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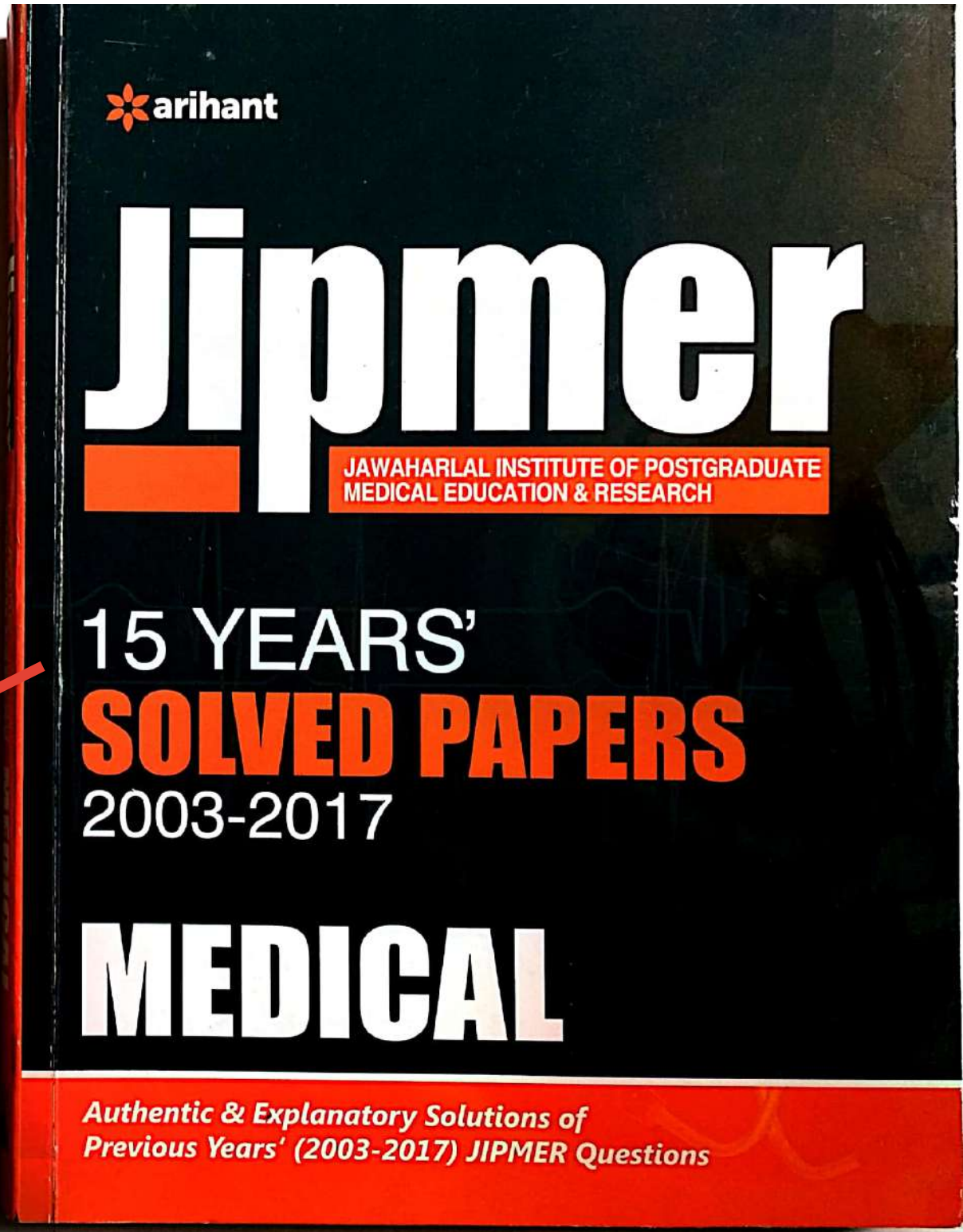
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FIRST & FOREMOST

Whenever a student decides to prepare for any examination his/her first and foremost curiosity is to know about the type of questions that are expected in the exams. This becomes more important in the context of competitive examinations where they have to face is neck-to-neck competition.

We feel great pleasure in presenting before you this book containing Error Free Solutions of previous years' (2003-2017) **JIPMER (Medical) Entrance Exam** questions specifically designed according to latest exam pattern. Going through this book, you will get an exact idea of the questions generally asked in JIPMER.

We have made maximum efforts to provide correct solutions to the best of our knowledge and opinion. Detailed explanatory discussions follow the answers. Discussions are not just sketchy–rather, have been drafted in a manner that the students will surely be able to solve some other related problems too. In this way, the students shall be able to judge the extent upto which they have been able to comprehend the methods.

We hope, these sets of papers along with error free solutions would be highly beneficial to the students. We would be grateful if any discrepancy or mistake in the questions or answers is brought to our notice so that these could be rectified in subsequent editions.

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CONTENTS

Solved Paper 2003 ——— 1-23
Solved Papers (English) 2003-2000 ——— 1-8
Solved Paper 2004 ——— 1-28
Solved Paper 2005 ——— 1-30
Solved Paper 2006 ——— 1-23
Solved Paper 2007 ——— 1-36
Solved Paper 2008 ——— 1-26
Solved Paper 2009 ——— 1-32
Solved Paper 2010 ——— 1-28
Solved Paper 2011 ——— 1-23
Solved Paper 2012 ——— 1-31
Solved Paper 2013 ——— 1-28
Solved Paper 2014 ——— 1-28
Solved Paper 2015 ——— 1-36
Solved Paper 2016 ——— 1-39
Solved Paper 2017 ——— 1-38

EXAMINATION PATTERN OF Jipmer

JAWAHARLAL INSTITUTE OF POSTGRADUATE MEDICAL EDUCATION & RESEARCH

MBBS entrance examination for JIPMER is an objective type test of 2 hours & 30 minutes duration. The paper consist of 200 MCQs from Physics, Chemistry, Botany, Zoology & English, evenly distributed. Each of the questions is provided with 4 options, one of which is being the correct answer. For every correct response 1 mark is awarded. More than one answer indicated against a question is deemed as incorrect response and no mark is given. However, there is NO NEGATIVE marking in JIPMER test.

The questions of the JIPMER test are based on the syllabus for XI & XII Standard as prescribed by State Board Hr. Sec. and CBSE. And the examination is conducted in English medium only. Candidates have to mark their response in an OMR answer sheet that is given inside the Test Booklet. They are required to enter correctly the Test Booklet code in the Answer Sheet. Candidates are needed to use only BLACK BALL-POINT PEN for answering, which will be provided in the hall by the Invigilator. Answers marked with pencil would not be evaluated/summarily rejected.

Note Candidates must fully satisfy themselves about the accuracy of the answer before darkening the appropriate circle as no change in answer once marked is possible. Use of eraser or white fluid on the Answer Sheet is NOT permissible as the Answer Sheets are machine gradable and it may lead to wrong evaluation.

The result of the test will be published within a week and the marks obtained by the candidates will be placed in the official Website: www.jipmer.edu

Distribution of Questions & Marks

Subject	No. of Q.	Marks Per Q.	Negative Marks	Duration	Medium
Physics	60	1@ per Que.	Nil	2hrs 30min (150 min)	English
Chemistry	60				
Biology	60				
Q.R. & English	20				
Total	200	1 x 200 = 200			



MERIT LIST

A combined merit list of all the categories of candidates will be drawn on the basis of their performance in the Entrance Examination. In the case of two or more candidates securing equal marks in the entrance examination their inter se merit shall be determined as follows :

1. Eliminating first English marks.
2. If there is still a tie by eliminating Physics marks.
3. If there is still a tie by eliminating Chemistry marks.
4. If there is still a tie by eliminating Botany marks.
5. If the tie is still not broken, seniority of age the candidates will be taken into consideration.

Individual letters will be sent to the selected candidates and to those who are placed in the waiting list. They will be required to attend Counseling and Medical Examination at the Institute at their own cost on the notified date. Before entry to the counseling hall, candidates will be subjected to biometric authentication of finger print and image. They have to produce the original Mark Sheet of the qualifying examination and other original documents.

HOW TO PREPARE FOR

Different Subjects in Stipulated Time

- Start preparation in sufficient advance. JIPMER entrance is not something that you can crack simply by cramming just before exam.
- Concentrate on being conceptually extremely sound. For that matter you should thoroughly study NCERT and ISC text books + various resource books.
- Meticulously go through each and every topic of all the subjects.
- Revise the theory portion as much as you can. You need to be real quick in your thought process, for cracking the exam.
- Recollect important points and frame questions of your own. You require more power of recollection to tackle biology.
- Work on improving your basics on English grammer.
- Answer direct questions without looking at the options, because options confuse a lot.
- Once the subject-wise basic preparation is over, you should solve the question papers of past few years repeatedly, to get well-versed with the examination process and trend.
- Practice as many MCQs as you can. While doing so, make sure NOT about the quantity of questions you are solving, but the quality of MCQs.
- On final leg, you should take full length Mock Tests. This will help you learn time management tactics, also induce you with necessary confidence level, required to crack the exam.

JIPMER

MEDICAL ENTRANCE EXAM 2002

Physics

1. A car of mass 1000 kg moves on a circular track of radius 20 m. If the coefficient of friction of 0.64. The maximum velocity with which the car can be moved, is:
   (a) 11.2 m/s (b) 112 m/s
   (c) $\frac{0.64 \times 20}{1000 \times 100}$ m/s (d) $\frac{1000}{64 \times 20}$ m/s

2. The angle through which a cyclist bends when he covers a circular path of 34.3 m circumference in $\sqrt{22}$ sec is ($g = 9.8\ m/s^2$)
   (a) 15° (b) 30° (c) 60° (d) 45°

3. The radius of earth is 6400 km and $g = 10\ m/s^2$. In order that a body of 5 kg weight is zero at the equator, the angular speed is
   (a) $\frac{1}{800}$ rad/sec (b) $\frac{1}{1600}$ rad/sec
   (c) $\frac{1}{400}$ rad/sec (d) $\frac{1}{80}$ rad/sec

4. The escape velocity for the earth is 11.2 km/sec. The mass of another planet 100 times mass of earth and its radius is 4 times radius of the earth. The escape velocity for the planet is:
   (a) 56.0 km/sec (b) 280 km/sec
   (c) 112 km/sec (d) 56 km/sec

5. A wheel rotates with constant acceleration of 2.0 radian/sec^2. If the wheel starts from rest the number of revolution it makes in the first ten second, will be approximately:
   (a) 32 (b) 24 (c) 16 (d) 8

6. The moment of inertia of a body about a given axis 1.2 kg m^2. Initially the body is at rest. In order to produce a rotational kinetic energy of 1500 J and angular acceleration of 25 rad/s^2 must be applied about the axis for a duration of:
   (a) 10 s (b) 8 s (c) 2 s (d) 4 s

7. A girl is swinging on a swinging plate form in sitting position when the girl stands up then the period of swinging?
   (a) Will not change
   (b) Will depend on height of girl
   (c) Will be longer
   (d) Will be shorter

8. The displacement of the motion of a particle is represent by a equation
   $$y = A \sin \omega t + B \cos \omega t$$
   The motion of particle is
   (a) SHM with amplitude $\sqrt{A^2 + B^2}$
   (b) SHM with amplitude $A + B$
   (c) SHM with amplitude A
   (d) Oscillatory but not in SHM

9. A ball falling in a lake depth 200 m shows a decrease of 0.1% in its volume at the bottom then the bulk modulus of the material of the ball is:
   (a) 19.6×10^8 N/m^2 (b) 19.2×10^7 N/m^2
   (c) 2.4×10^9 N/m^2 (d) 2.4×10^5 N/m^2

10. A fixed volume of iron is drawn into a wire of length l. The extension x produced in this wire by a constant force F is proportional to :
    (a) l (b) $\frac{1}{l}$ (c) l^2 (d) $\frac{1}{l^2}$

11. Two bars A and B of circular cross-section and same volume made of same material are subjected under same tension. If the diameter of A is half that of B. The ratio of extension of A to B will be
(a) 16 (b) 2 (c) 1/4 (d) 4

12. Water rises in a capillary upto a extension height such that upward force of surface tension balances the force of 75×10^{-4} N due to weight of water. If surface tension of water is 6×10^{-2} N/m. The internal circumference of the capillary must be
(a) 12.5×10^{-2}m (b) 6.5×10^{-2}m
(c) 0.50×10^{-2}m (d) 1.25×10^{-2} m

13. A capillary tube of radius r can support a liquid of weight 6.28×10^{-4} N. If the surface tension of the liquid is 5×10^{-2}N/m. The radius of capillary must be
(a) 2.0×10^{-3} m (b) 2.0×10^{-4} m
(c) 1.5×10^{-3} m (d) 125×10^{-4} m

14. The soap bubbles have radii in the ratio 2 : 1 ratio of excess pressure in side there is:
(a) 1 : 4 (b) 4 : 1
(c) 2 : 1 (d) 1 : 2

15. Standing wave are produced in a 10 m long stretched string. If the string vibrates in 5 segments and the wave velocity is 20 m/s. The frequency is
(a) 10 Hz (b) 5 Hz
(c) 4 Hz (d) 2 Hz

16. A steel wire 0.5 m long has a total mass 0.01 kg and stretched with a tension of 800 N. The frequency with which it vibrates in its fundamental note will be
(a) 4 Hz (b) 2 Hz
(c) 200 Hz (d) 160 Hz

17. A cord attached to a vibrating tuning fork is divided into six segments under tension of 36 N. It will be divided into four segments, if the tension is
(a) 48 N (b) 81 N
(c) 24 N (d) 16 N

18. The equation of travelling wave is $y = 60 \cos(1800t - 6x)$ where y is in micron and t in second and x in metre. The ratio of maximum particle velocity to velocity of wave propagation is
(a) 3.6 (b) 3.6×10^{-4}
(c) 3.6×10^{-11} (d) 3.6×10^{-6}

19. In a sinusoidal wave, the time required for a particular point to move from maximum displacement to zero displacement is 0.170. The frequency of the wave will be :
(a) 2.94 Hz (b) 0.73 Hz
(c) 0.36 H (d) 1.47 Hz

20. The root mean square velocity of hydrogen molecules of an ideal hydrogen gas kept in a gas chamber at 0°C is 3180 m/s. Calculate the pressure of hydrogen gas: (Density of hydrogen gas $= 8.99 \times 10^{-2}$ kg/m^3, atmosphere $= 1.01 \times 10^5$ N/m^2)
(a) 3.0 atm (b) 2.0 atm
(c) 1.5 atm (d) 1.0 atm

21. 22 g of CO_2 at 27°C is mixed with 16 g of O_2 at 37°C. If both gases are considered as ideal, then temperature of mixture is:
(a) 30.5°C (b) 37°C
(c) 27°C (d) 29.3°C

22. At a given temperature the pressure of an ideal of density ρ is proportional to :
(a) ρ^2 (b) ρ (c) $\frac{1}{\rho^2}$ (d) $\frac{1}{\rho}$

23. Air is expended from 50 litres to 150 litres at 2 atmosphere the external work done is (1 atmospheric pressure $= 1 \times 10^5$ N/m^2)
(a) 2×10^{-8} J (b) 2×10^4 J
(c) 200 J (d) 2000 J

24. Helium at 27°C has a volume 8 litres. It is suddenly compressed to a volume of 1 litre. The temperature of the gas will be ($V = 5/3$)
(a) 9327°C (b) 1200°C
(c) 927°C (d) 108°C

25. Energy is being emitted from the surface of a black body at 127°C the rate of 1.0×10^6 J/sm^2. The temperature of black body at which the rate of energy emission is 16.0×10^6 J / sm^2 will be
(a) 754°C (b) 527°C
(c) 254°C (d) 508°C

26. A cup of tea cools from 80°C to 60°C in one minute. The ambient temperature is 30°C. In cooling from 60°C to 50°C. It will take:
(a) 50 sec (b) 90 sec (c) 60 sec (d) 48 sec

27. Light of wavelength 6000 Å is reflected at nearly normal incidence from a soap film of refractive index 1.4. The least thickness of the film that will appear black is:
(a) 200 Å (b) 2000 Å
(c) 1000 Å (d) infinity

28. Light travels faster in air than that in glass. This is accordance with:
(a) wave theory of light
(b) corpuscular theory of light
(c) Neither (a) nor (b)
(d) Both (a) and (b)

29. In Young's double slit experiment, light of wavelength 6000 Å is used to produced fringes of width 0.8 mm at a distance of 2.5 m. If the whole appart is dropped in liquid of refractive index 1.6, then the fringe width will be
(a) 0.2 mm (b) 0.4 mm
(c) 0.5 mm (d) 0.6 mm

30. The electric potential at the surface of an atomic nucleus ($Z = 50$) of radius 9.0×10^{-15} m is:
(a) 8×10^6 V (b) 80 V
(c) 9×10^5 V (d) 9 V

31. Two metal plates having a potential difference of 800 V and 2 cm apart. It is found that a particle of mass 1.96×10^{-15} kg remaining suspended in the region between the plates. The charge on the particle must be (e = elementry charge)
(a) $8e$ (b) $6e$ (c) $3e$ (d) $2e$

32. The working of dynamic is based on the principle of:
(a) electromagnetic induction
(b) chemical effect of current
(c) magnetic effect of current
(d) heating effect of current

33. When a voltmeter connected across the terminals of cell, measures 5 V and an ammeter connected measures 10 A. A resistance of 2 Ω is connected across the terminal of the cell. The current flowing through this resistance is :
(a) 7.5 amp (b) 5.0 amp
(c) 2.5 amp (d) 2.0 amp

34. In a neon discharge tube 2.9×10^{18} Ne^+ ions move to be the right per second while 1.2×10^{18} electron move to the left per second electric charge is 1.6×10^{-19} C. The current in discharge tube is :
(a) 0.66 A towards left
(b) 0.66 A towards right
(c) 1 A towards right
(d) zero

35. The capacity of a parallel plate capacitor with no dielectric substance but with a separation of 0.4 cm is 2 μF. The separation is reduced to half and it is filled with a dielectric substance of value of 2.8. The final capacity of capacitor is.
(a) 15.6 μF (b) 11.2 μF
(c) 19 μF (d) 22.4 μF

36. In forward biased if the p-n junctions diode is forward biased, then width of potential barrier in p-n junction diode:
(a) remains constant (b) increase
(c) decrease (d) None of these

37. If the energy released in the fission of one nucleus is 3.2×10^{-11} J, then number of nuclei required per second in a power plant of 16 kW is
(a) 0.5×10^{14}
(b) 0.5×10^{12}
(c) 5×10^{12}
(d) 5×10^{14}

38. *X*-rays are
(a) electromagnetic radiation
(b) stream of electron
(c) stream of proton
(d) stream of uncharged particle

39. The plates of a parallel plate capacitor of capacity of 50 μF are charged by a battery to a potential of 100 volt. The battery remains connected the plates are separated from each other so that the distance between them is doubled. Then, the energy spent by battery in doing so, will be :
(a) 12.5×10^{-2} J (b) 35×10^{-2} J
(c) 42.5×10^{-2} J (d) 25×10^{-2} J

40. A light of wavelength 2000 Å falls on a metallic surface of work function 5.01 eV then required potential difference to slope fastest photoelectron is ($h = 6.62 \times 10^{-34}$ J-s)
(a) 4.8 V (b) 3.6 V
(c) 2.4 V (d) 1.2 V

41. The distance between the poles of horse shoe magnet is 10 cm and its pole strength is 10^4 A. The magnetic field induction at point *P* mid-way between the poles is :
(a) 8×10^{-9} tesla (b) 4×10^{-19} tesla
(c) 2×10^{-9} tesla (d) zero

42. Two small magnets each of magnetic moment 10 Am^2 are placed in end on position 0.1 m apart from their centres. The force acting between them is :
(a) 0.6 N (b) 0.06 N
(c) 0.06×10^7 N (d) 0.6×10^7 N

43. Magnetic field of a short magnet at a distance 1m on axial line is 1 oersted at a distance 2 m on the same line the intensity in oersted is:
(a) 0.75 (b) 0.125
(c) 0.25 (d) 0.5

44. The ratio of magnetic moments of two short magnets which give null deflection in tan *B* position at 12 cm and 18 cm from the centre of a deflection magnetometer is :
(a) 4 : 9 (b) 27 : 8
(c) 2 : 3 (d) 8 : 27

45. If the flux associated with a coil varies at the rate of 1 wb/min the induced emf is:
(a) zero (b) 60 V (c) $\frac{1}{60}$ V (d) 1 V

46. An AC supply gives 30 V_{rms} which is fed on a pure resistance of 10 ohm. The power dissipated in this is:
(a) 90 watt (b) 45 watt
(c) 90: 2 watt (d) 180 watt

47. The energy of a photon corresponding to the visible light maximum wavelength is nearly:
(a) 7 eV (b) 3.2 eV (c) 1 eV (d) 1.6 eV

48. If an electron has orbital angular momentum quantum number $l = 7$ then it will have an orbital angular momentum equal to:
(a) $\sqrt{56}\left(\frac{h}{2\pi}\right)$ (b) $57\left(\frac{h}{2\pi}\right)$
(c) $42\left(\frac{h}{2\pi}\right)$ (d) $7\left(\frac{h}{2\pi}\right)$

49. The radius of electron second stationary orbit in Bohr's atom is *R*. The radius of third orbit will be :
(a) 2.25 *R* (b) 3 *R* (c) *R*/3 (d) 9 *R*

50. The slope of plate characteristic and mutual characteristic curves of a triode valve is 0.02 mA / V and 1 mA / V. The amplification factor of triode valve is:
(a) 2×10^8 (b) 20 (c) 50 (d) 40

51. Dimension of relative density is:
(a) kg m^{-3} (b) ML^{-3}
(c) dimensionless (d) M^2L^{-6}

52. A ball is thrown from height '*h*' and another from '2*h*'. The ratio of time taken by the two balls to reach ground is :
(a) $1:\sqrt{2}$ (b) $\sqrt{2}:1$ (c) 2 : 1 (d) 1: 2

53. A ball is thrown upwards, it takes 4 sec to reach back to the ground. Find its initial velocity :
(a) 30 ms^{-1} (b) 10 ms^{-1}
(c) 40 ms^{-1} (d) 20 ms^{-1}

54. A man is at a height of 100 m. He sees a car which makes an angle of $\pi/6$ with man's position. If the car moves to a point where angle is $\pi/3$ what is the distance moved by it?
(a) $\left(\frac{100}{\sqrt{3}}\right)$ m (b) $(200\sqrt{3})$ m
(c) $\left(\frac{200}{\sqrt{3}}\right)$ m (d) $\left(\frac{150}{\sqrt{3}}\right)$ m

55. A body of mass 0.1 kg attains a velocity of 10 ms^{-1} in 0.1 sec. The force acting on the body is:
(a) 10 N (b) 0.01 N (c) 0.1 N (d) 100 N

56. If force $\vec{F} = 5\hat{i} + 3\hat{j} + 4\hat{k}$ makes a displacement of $\vec{s} = 6\hat{i} - 5\hat{k}$ work done by the force is:
(a) 10 units (b) $122\sqrt{5}$ units
(c) $5\sqrt{122}$ units (d) 20 units

57. The angular velocity of second hand, of a clock is :
(a) $\left(\frac{\pi}{6}\right)$ rad s^{-1} (b) $\left(\frac{\pi}{60}\right)$ rad s^{-1}
(c) $\left(\frac{\pi}{30}\right)$ rad s^{-1} (d) $\left(\frac{\pi}{15}\right)$ rad s^{-1}

58. A body is moving in a circular path with acceleration '*a*'. If its velocity gets doubled, find the ratio of acceleration after and before the change:
(a) 1: 4
(b) $\frac{1}{4}$: 1
(c) 2 : 1
(d) 4 : 1

59. Acceleration due to gravity at earth's surface is '*g*' ms^{-2} . Find the effective value of gravity at a height of 32 km from sea level: ($R_e = 6400$ km)
(a) 0.5 *g* ms^{-2}
(b) 0.99 *g* ms^{-2}
(c) 1.01 *g* ms^{-2}
(d) 0.90 *g* ms^{-2}

60. Near earth's surface, time period of a satellite is 4 hrs. Find its time period at height' 4*R*' from the centre of earth :
(a) 32 hrs (b) $\left(\frac{1}{8\sqrt[3]{2}}\right)$ hrs
(c) $8\sqrt[3]{2}$ hrs (d) 16 hrs

Chemistry

61. In an isochoric process, the increase in internal energy is equal to:
(a) the sum of heat absorbed and work done
(b) the work done
(c) heat absorbed
(d) heat evolved

62. 75 c.c. of N/5 H_2SO_4, 10 c.c. of N/2 HCl and 30 c.c. of N/10 HNO_3 are mixed together. The strength of the resulting acid mixture is:
(a) 0.1 N (b) 0.2 N (c) 0.3 N (d) 0.4 N

63. What would be the freezing point of aqueous solution containing 17g of C_2H_5OH in 1000 g of water?
(a) 0.34°C (b) 0.0°C
(c) – 0.34°C (d) – 0.69°C

64. The pH of a solution is 5.0. If H^+ ion concentration is decreased 100 times. Then the solution will be :
(a) neutral
(b) more acidic
(c) basic
(d) of the same acidity

65. The molarity of pure water is:
(a) 100 (b) 55.6
(c) 18 (d) 5.56

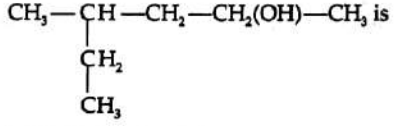
66. Azeotropic mixture of HCl and water has:
(a) 20.2% HCl (b) 22.2% HCl
(c) 63% HCl (d) 84% HCl

67. Percentage of silver in the alloy German silver is :
(a) 0% (b) 1.0%
(c) 2.5% (d) 1.5%

68. Which will have maximum ionization energy?
(a) Na (b) Mg
(c) K (d) Bi

69. Rusting of iron is a chemical reaction. The reaction is :
(a) double decomposition
(b) combination
(c) displacement
(d) analysis

70. The IUPAC name of



(a) 2-ethylpentanol-4
(b) 3-methylhexanol-3
(c) 4-methylhexanol-2
(d) 4-ethylpentanol-2

71. An asymmetric carbon atom is which
(a) attached three atoms or groups are different
(b) attached all the atoms or groups are different
(c) attached two atoms or groups are different
(d) attached all the atoms or groups are the same

72. The most reactive hydrocarbon is :
(a) methane (b) ethane
(c) ethylene (d) acetylene

73. Which one of the following molecules undergoes polymerisation to form natural rubber?
(a) Styrene
(b) 2-methyl-1, 3-butadiene
(c) Ethylene
(d) Iso-butene

74. Heat of a reaction at constant pressure is equal to :
(a) $H_P - H_R$ (b) $H_P + H_R$
(c) $H_P \times H_R$ (d) $\frac{H_P}{H_R}$

75. The density of SO_2 at STP is 2.86 kg m^{-3}. Its density at 819°C and 2 atmospheres is :
(a) 0.715 kg m^{-3} (b) 1.43 kgm^{-3}
(c) 2.86 kg m^{-3} (d) 4.26 kg m^{-3}

76. Quartz is an example of
(a) cyclic silicate
(b) chain silicate
(c) frame work silicate
(d) sheet silicate

77. Oxidation number of Cr in $K_2Cr_2O_7$ is
(a) 2 (b) 4
(c) 6 (d) 7

78. Which of the following is most powerful oxidising agent?
(a) I_2 (b) Cl_2
(c) Br_2 (d) F_2

79. Among the following compounds which is planar in shape is
(a) acetylene (b) benzene
(c) isobutene (d) methane

80. One gram of mass is equal to :
(a) 9×10^{20} ergs
(b) 7×10^{15} ergs
(c) 5×10^{10} ergs
(d) 3×10^{5} ergs

81. Vapour density of a volatile substance is 4 ($CH_4 = 1$). Its molecular weight would be:
(a) 2 (b) 8 (c) 64 (d) 128

82. The 3rd transitional series contain elements having atomic numbers from:
(a) 21 to 29 (b) 21 to 30
(c) 20 to 30 (d) 21 to 31

83. Which of the following ions is paramagnetic?
(a) Cu^{++} (b) Zn^{++}
(c) Ni^{++} (d) Both 'a' and 'c'

84. Which one of the following colloidal solution is positive sol?
(a) Gelatin in strongly acidic solution
(b) Smoke
(c) Dlay soil
(d) Blood

85. The pH of blood is :
(a) greater than 10
(b) less than 6
(c) greater than 7 and less than 8
(d) greater than 8 and less than 9

86. If K_b of HCN is 4.0×10^{-10}, then the pH of 2.5×10^{-1} molar aqueous HCN is
(a) 2.0 (b) 4.7 (c) 5.0 (d) 2×10^{-5}

87. How many grams of CaC_2O_4 will dissolve in distilled water to make one litre of saturated solution? Solubility product of CaC_2O_4 is 2.5×10^{-9} mol^2 $litre^{-2}$ and its molecular weight is 128
(a) 0.0640 g (b) 0.0032 g
(c) 0.0128 g (d) 0.0064 g

88. Deuterium oxide is used in nuclear reactor as
(a) source of α-particle (b) source of deuteron
(c) moderator (d) fuel

89. Lowest MP and BP is of
(a) Ar (b) Xe (c) He (d) Ne

90. Silicon is an important constituent of
(a) alloys (b) vegetables
(c) animals (d) rocks

91. H_3PO_3 is
(a) dibasic acid (b) basic
(c) tribasic acid (d) neutral

92. Which of the following is coinage metal?
(a) Cu (b) Sn
(c) Zn (d) Pb

93. Hexamethylenetetramine is used as
(a) urinary antiseptic (b) antipyretic
(c) analgesic (d) all of these

94. Vinegar contains
(a) 100% acetic acid (b) 10 – 20% acetic acid
(c) 7 – 8% acetic acid (d) 1% acetic acid

95. Which of following is the correct order of increasing reactivity?
(a) RCOOR' < RCOCl < $RCONH_2$
(b) RCOOR' < $RCONH_2$ < RCOCl
(c) RCOCl < $RCONH_2$ < RCOOR'
(d) $RCONH_2$ < RCOOR' < RCOCl

96. Enzymes are
(a) fatty acids (b) oils
(c) minerals (d) proteins

97. Gasoline is
(a) $C_{17}H_{36}$ to $C_{21}H_{50}$ (b) C_7H_{24} to $C_{14}H_{34}$
(c) C_7H_{16} to $C_{10}H_{22}$ (d) C_3H_8 to C_6H_{14}

98. What is the name of reaction when benzaldehyde changes in to benzyl alcohol?
(a) Cannizzaro's reaction
(b) Wurtz reaction
(c) Kolbe reaction
(d) Friedel-Craft's reaction

99. Gammexane is
(a) benzene hexachloride
(b) bromo benzene
(c) benzyl chloride
(d) chlorobenzene

100. Aniline on treatment with HCl and $NaNO_2$ gives
(a) diazo salt (b) nitroaniline
(c) chloroaniline (d) aminophenol

101. Saccharin contains
(a) carbon and hydrogen
(b) carbon, oxygen and hydrogen
(c) carbon, hydrogen, oxygen and nitrogen
(d) carbon, hydrogen, sulphur, nitrogen and oxygen

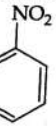
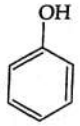
102. The digestion of fat in intestines is aided by
(a) emulsification (b) peptisation
(c) protection (d) diffusion

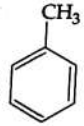
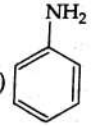
103. Dehydration of alcohol involves
(a) carbene (b) carbanion
(c) free radical (d) carbonium ion

104. Fenton's reagent is
(a) NaOH + $FeSO_4$ (b) H_2O_2 + $FeSO_4$
(c) H_2O_2 + $ZnSO_4$ (d) H_2O_2 + $MgSO_4$

105. A sample of $CHCl_3$ before using as an anaesthetic is tested by
(a) $AgNO_3$ solution after boiling with KOH
(b) Ammonical cuprous chloride
(c) Fehling solution
(d) $AgNO_3$

106. Which of the following compounds reacts slower than benzene in electrophilic bromination

(a)  (b) 

(c)  (d) 

107. Which of the following possesses highest melting point?
(a) *p*-dichlorobenzene
(b) *m*-dichlorobenzene
(c) *o*-dichlorobenzene
(d) chlorobenzene

108. In the complex $[Co(en)_2Cl_2]Br$, the co-ordination number and oxidation state of cobalt are
(a) 6 and +1 (b) 6 and +3
(c) 3 and +3 (d) 4 and +2

109. The transition metals mostly are
(a) paramagnetic
(b) diamagnetic
(c) both 'a' and 'b'
(d) neither diamagnetic nor paramagnetic

110. Strongest Bronsted base among the following anions is
(a) ClO_4^- (b) ClO_3^- (c) ClO_2^- (d) ClO^-

111. Cadmium rods are used for which purpose?
(a) emit electrons (b) absorb neutrons
(c) emit neutrons (d) absorb electrons

112. Propionic acid and KOH reacts to produce which one of the following?
(a) Potassium propionate
(b) Propyl alcohol
(c) Propionaldehyde
(d) Does not react

113. What is the effect of dilution on the equivalent conductance of strong electrolyte?
(a) Decrease on dilution
(b) Remains unchanged
(c) Increase on dilution
(d) None of the above

114. 35.4 mL of HCl is required for the neutralization of a solution containing 0.275 g of sodium hydroxide. The normality of hydrochloric acid is?
(a) 0.97 N (b) 0.142 N
(c) 0.194 N (d) 0.244 N

115. When H_2S gas is passed in a metal sulphate solution in presence of NH_4OH, a white precipitate is produced. The metal is identified as
(a) Zn (b) Fe
(c) Pb (d) Hg

116. The value of amu is which of the following?
(a) 1.57×10^{-24} kg
(b) 1.66×10^{-24} kg
(c) 1.99×10^{-23} kg
(d) 1.66×10^{-27} kg

117. The molecule having largest dipole moment among the following is
(a) CHI_3 (b) CH_4
(c) $CHCl_3$ (d) CCl_4

118. When calcium acetate is distilled, it will produce which of the following compound?
(a) CH_3COOH (b) CH_3CHO
(c) CH_3COCH_3 (d) all of these

119. Which of the following electronic configuration represents noble gas?
(a) ns^2np^6 (b) ns^2np^5
(c) ns^2np^4 (d) ns^2np^3

120. Sodium pyrophosphate is represented by which of the following formula?
(a) $Na_2P_2O_4$ (b) $Na_4P_2O_5$
(c) $Na_4P_2O_7$ (d) $Na_2P_2O_5$

Biology

121. Total number of bones in the hind limb of a man is
(a) 21 (b) 23
(c) 27 (d) 30

122. CO is a pollutant because
(a) it reacts with O_2
(b) it inhibits glycolysis
(c) it reacts with haemoglobin
(d) it makes nervous system inactive

123. Protein deficiency disease is
(a) eczema
(b) cirrhosis
(c) kwashiorkor
(d) night blindness

124. In living beings ammonia is converted into urea through
(a) ornithine cycle
(b) citrulline cycle
(c) fumarine cycle
(d) arginine cycle

125. The chemical knifes of DNA are
(a) polymerases
(b) ligases
(c) endonucleases
(d) amylases

126. A definite number of segments are found in
(a) slug
(b) earthworm
(c) leech
(d) tapeworm

127. Biologically most resistant plant material is
(a) sporopollenin
(b) cutin
(c) lignin
(d) suberin

128. Which of the following is an edible fungus
(a) *Agaricus* (b) *Albugo*
(c) *Rhizopus* (d) *Puccinia*

129. $2n-1$ condition is called
(a) trisomy (b) monosomy
(c) nullisomy (d) tetrasomy

130. Blue-green algae is found in
(a) *Cycas*
(b) Pinus
(c) Scales of *Marchantia*
(d) *Riccia*

131. Turpentine oil is obtained from
(a) *Pinus*
(b) *Cycas*
(c) *Cedrus*
(d) *Delbergia*

132. In gametophyte of fern
(a) prothallus is independent from sporophyte
(b) prothallus is attached with sporophyte
(c) it is main plant body
(d) a structure attached with rhizome

133. The lack of fruit formation in gymnosperm is due to
(a) absence of fertilization
(b) lack of seeds
(c) naked ovule
(d) sheding of immature seed

134. A secretion that digests both carbohydrates and proteins is
(a) ptyalin (b) pepsin
(c) pancreatic juice (d) saliva

135. Food is move along the alimentary canal by the contraction known as
(a) peristalisis
(b) epiglottis
(c) osmosis
(d) cyclosis

136. Villi are present in the
(a) large intestine
(b) small intestine
(c) colon
(d) stomach

137. Fatty acids are absorbed by the
(a) lacteals
(b) pylorous
(c) colon
(d) capillaries

138. Hydrochloric acid in the stomach is secreted by some special type of cells called
(a) peptic cells
(b) goblet cells
(c) oxyntic cells
(d) gastric cells

139. Enzyme and carbohydrates dominate in the digestive tract of
(a) carnivores
(b) omnivores
(c) parasites
(d) herbivores

140. In horses, rabbits, hares the cellulose gets digested in the
(a) caecum
(b) stomach
(c) appendix
(d) rumen

141. The pylorous is the constricted part of the alimentary canal which is situated between
(a) stomach and duodenum
(b) oesophagus and stomach
(c) duodenum and ileum
(d) ileum and rectum

142. The intestinal juice, succus entericus is secreted by
(a) Brunner's gland
(b) Kupffer cells
(c) crypts of Leiberkuhn
(d) goblet cells

143. Below freezing point, the pepsin
(a) becomes over activated
(b) gets destroyed
(c) remains unaffected
(d) gets inactivated

144. In *Pteridium* meiosis takes place at the timeof
(a) spore formation
(b) organ formation in pro thallus
(c) spore germination
(d) gamete formation

145. 'Club moss' is the common name of
(a) *Selaginella*
(b) *Funaria*
(c) *Potamogeton*
(d) *Lycopodium*

146. Pneumatophores (respiratory roots) are found in
(a) *Pistia* (b) *Calobranchia*
(c) *Rhizophora* (d) all of these

147. "All tissues consist of cells" sentence was said by
(a) Wallace
(b) Virchow
(c) Schleiden
(d) none of these

148. The part of mushroom comes out from soil is called
(a) basidiocarp (b) ascogonium
(c) ascocarp (d) pericarp

149. The red colour of 'red sea' is due to which of the following blue-green algae?
(a) *Chlamydomonas nivalis*
(b) *Anabaena*
(c) *Microcystis*
(d) *Trichodesmium*

150. Maximum absorption of light occurs in the region of
(a) 400-700 nm
(b) 700-900 nm
(c) 1000-1200 nm
(d) 1500-2000 nm

151. The first animal domesticated by primitive man was
(a) dog (b) horse
(c) cat (d) cow

152. Mycorrhiza is correctly described as
(a) symbiosis of algae and fungi
(b) relation of ants with the stem of some trees
(c) parasitic association between roots and some fungi
(d) symbiotic relationship between fungi and roots of some higher plants

153. Now-a-days cornea transplantation is very popular. The reason is that it
(a) is easy to preserve
(b) transplanted very easily
(c) can be easily obtained
(d) does not link with blood supply and immune system

154. In C_4 plants, CO_2 combines with
(a) phosphoglyceric acid
(b) ribulose diphosphate
(c) phosphoenol pyruvate
(d) phosphoglyceraldehyde

155. Which one of the following elements is almost non-essential for plants?
(a) Ca
(b) Mo
(c) Zn
(d) Na

156. Which is a typical example of 'feedback inhibition'?
(a) Allosteric inhibition of hexokinase by glucose-6-phosphate
(b) Reaction between succinic dehydrogenase and succinic acid
(c) Cyanide and cytochrome reaction
(d) Sulpha drugs and folic acid synthesizer bacteria

157. Photorespiration is favoured by
(a) high O_2 and low CO_2
(b) high CO_2 and low O_2
(c) high temperature and low O_2
(d) high humidity and temperature

158. The true statement about 'green-house effect' is that it is
(a) casued only by CO_2
(b) caused by CO_2, CFC's, CH_4 and NO_2 gases
(c) caused by combination of many gases
(d) none of the above

159. Cochineal insects have proved very useful for
(a) rodents control
(b) *Parthenium* control
(c) cactus prevention
(d) *Eicchornia* prevention

160. 'Gymnosperm' have how many species?
(a) 1000 (b) 900
(c) 640 (d) 300

161. If there are 4 microspore mother cells in an anther, what will be the number of pollen grains?
(a) 4 (b) 8
(c) 12 (d) 16

162. What are the sex organs provided in some bacteria?
(a) Circular DNA
(b) Gametes
(c) Sex pili
(d) Plasmid

163. The correct sequence for the formation of chemicals on the primitive earth is
(a) NH_3, protein, carbohydrate and nucleic acid
(b) NH_3, water, nucleic acids and protein
(c) NH_3, nucleic acids, protein and carbohydrate
(d) protein, carbohydrate, water and nucleic acids

164. 2, 4-D is an effective
(a) fungicide (b) weedicide
(c) rodenticide (d) wormicide

165. Which vertebrate orgen receives only oxygenated blood?
(a) Gill (b) Lung
(c) Spleen (d) Liver

166. Which typical stage is known for DNA replication?
(a) Metaphase
(b) G_1-phase
(c) S-phase
(d) G_2-phase

167. The formation of canal system in sponges is due to
(a) reproduction
(b) porous walls
(c) folding of inner walls
(d) gastro-vascular system

168. The term 'Meiosis' was given by
(a) Johansen
(b) Knoll and Ruska
(c) A. Flemming
(d) Farmer and Moore

169. Lampbrush chromosomes are seen in which typical stage
(a) mitotic anaphase (b) mitotic prophase
(c) mitotic metaphase (d) meiotic prophase

170. Benthoic animals are those, which
(a) are deep dweller in sea
(b) are floating (free) organisms
(c) are submerged in sea
(d) float on the sea surface

171. In C_4 plants, CO_2 fixation is done by
(a) mesophyll cells
(b) guard cells
(c) sclerenchyma
(d) chlorenchyma and hypodermis

172. Which country has the greatest contribution for the hole formation in ozone layer?
(a) USA (b) Germany
(c) Russia (d) Japan

173. Radio-tracer technique shows that DNA is in
(a) single-helix stage (b) double-helix stage
(c) multi-helix stage (d) none of these

174. When paternal and maternal chromosomes change their materials with each other in cell division this event is called
(a) synapsis
(b) crossing over
(c) bivalent-forming
(d) dyad-forming

175. AIDS disease was first reported in
(a) Russia
(b) Germany
(c) USA
(d) France

176. Which of the following products are obtained by anaerobic respiration from yeast?
(a) Alcohols
(b) CO_2
(c) Bear and wine
(d) All of the above

177. What will be the number of Calvin cycles to generate one molecule of hexose?
(a) 4 (b) 6
(c) 8 (d) 9

178. When a natural predator (living being) is applied on the other pathogen organism to control them, this process is called
(a) biological control
(b) genetic engineering
(c) artificial control
(d) confusion technique

179. The 10% energy transfer law of food chain was given by
(a) Stanley
(b) Weismann
(c) Lindemann
(d) Tansley

180. The ornithine cycle removes two waste products from the blood in liver. These products are
(a) CO_2 and urea
(b) ammonia and urea
(c) CO_2 and ammonia
(d) ammonia and uric acid

ANSWERS

Physics

1. (a)	2. (d)	3. (a)	4. (a)	5. (c)	6. (c)	7. (d)	8. (a)	9. (a)	10. (b)
11. (a)	12. (a)	13. (a)	14. (d)	15. (b)	16. (c)	17. (b)	18. (b)	19. (d)	20. (a)
21. (d)	22. (b)	23. (b)	24. (c)	25. (b)	26. (d)	27. (b)	28. (a)	29. (c)	30. (a)
31. (c)	32. (a)	33. (d)	34. (b)	35. (b)	36. (c)	37. (d)	38. (a)	39. (d)	40. (d)
41. (a)	42. (b)	43. (b)	44. (d)	45. (c)	46. (a)	47. (d)	48. (a)	49. (d)	50. (c)
51. (c)	52. (a)	53. (d)	54. (c)	55. (a)	56. (a)	57. (c)	58. (d)	59. (b)	60. (a)

Chemistry

61. (c)	62. (b)	63. (d)	64. (a)	65. (b)	66. (a)	67. (a)	68. (b)	69. (b)	70. (c)
71. (b)	72. (c)	73. (b)	74. (a)	75. (b)	76. (c)	77. (c)	78. (d)	79. (b)	80. (c)
81. (c)	82. (b)	83. (d)	84. (a)	85. (c)	86. (c)	87. (d)	88. (c)	89. (c)	90. (d)
91. (a)	92. (a)	93. (a)	94. (c)	95. (d)	96. (d)	97. (c)	98. (a)	99. (a)	100. (a)
101. (d)	102. (a)	103. (d)	104. (b)	105. (d)	106. (a)	107. (a)	108. (b)	109. (a)	110. (d)
111. (b)	112. (a)	113. (c)	114. (c)	115. (a)	116. (d)	117. (c)	118. (c)	119. (a)	120. (c)

Biology

121. (d)	122. (c)	123. (c)	124. (d)	125. (c)	126. (c)	127. (a)	128. (a)	129. (b)	130. (a)
131. (a)	132. (a)	133. (c)	134. (c)	135. (a)	136. (b)	137. (a)	138. (c)	139. (d)	140. (a)
141. (a)	142. (c)	143. (d)	144. (a)	145. (d)	146. (c)	147. (c)	148. (a)	149. (d)	150. (a)
151. (a)	152. (d)	153. (d)	154. (c)	155. (d)	156. (a)	157. (a)	158. (b)	159. (c)	160. (c)
161. (d)	162. (c)	163. (b)	164. (b)	165. (c)	166. (c)	167. (c)	168. (d)	169. (d)	170. (a)
171. (a)	172. (a)	173. (d)	174. (b)	175. (c)	176. (d)	177. (b)	178. (a)	179. (c)	180. (c)

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HINTS & SOLUTIONS

Physics

1. $v_{max} = \sqrt{\mu r g} = \sqrt{0.64 \times 20 \times 9.8}$

$= 11.2 \text{ m/s}$

2. Speed of particle

$$v = \frac{s}{t} = \frac{34.3}{\sqrt{22}} \text{ m/s}$$

$$r = \frac{s}{2\pi} = \frac{34.3}{2\pi} \text{ m}$$

Now, $\tan\theta = \frac{v^2}{rg} = \frac{\frac{(34.3)^2}{22}}{\frac{34.3}{2\pi} \times 9.8} = 1$

$= 45°$

3. $g' = 0$ and $g = R\omega^2$

$$\omega = \sqrt{\frac{g}{R}} = \sqrt{\frac{10}{6400 \times 10^3}}$$

$$= \frac{1}{800} \text{ rad/sec}$$

4. $v_{escape} = \sqrt{\frac{2GM}{R}} \propto \sqrt{\frac{M}{R}}$

Hence, $\frac{v_p}{v_e} = \sqrt{\frac{M_p}{R_p} \times \frac{R_e}{M_e}}$

or $\frac{v_p}{v_e} = \sqrt{100 \times \frac{1}{4}} = 5$

$v_p = 5 \times 11.2 = 56 \text{ km/sec}$

5. $\theta = \frac{\alpha t^2}{2} = \frac{2 \times 100}{2} = 100$

$n = \frac{\theta}{2\pi} = \frac{100}{2 \times 3.14} = 15.92 \approx 16$

6. Kinetic energy is given by

$E = \frac{1}{2} I\omega^2$, $\omega^2 = \frac{2E}{I}$

$\omega^2 = \frac{2 \times 1500}{1.2} = 2500$

$\omega = \sqrt{2500} = 50 \text{ rad/sec}$

$t = \frac{\omega}{\alpha} = \frac{50}{25} = 2 \text{ sec}$

7. When the girl stands up on a swinging the time period of swinging will be shorter.

8. $y = A\sin\omega t + B\cos\omega t$ ...(1)

let $A = a\cos\phi$ ...(2)

$B = a\sin\phi$ ...(3)

then equation (1) becomes

$y = a\cos\phi \sin\omega t + a\sin\phi \cos\omega t$

$y = a\sin(\omega t + \phi)$ ...(4)

It is clear that the equation number (2) in simple harmonic motion with amplitude a squaring and adding (2) and (3), we get

$A^2 + B^2 \le a^2(\cos^2\phi + \sin^2\phi)$

$a = \sqrt{A^2 + B^2}$

9. $K = \frac{\Delta p}{\text{Volume strain}} = \frac{hdg}{\text{Volume strain}}$

$= \frac{200 \times 10^3 \times 9.8}{0.1 \times 10^{-2}}$

$= 19.6 \times 10^8 \text{ N/m}^2$

10. Extension $x = \frac{Fl}{AY}$ $\left(\begin{matrix}\text{as } V = Al \\ \text{so } A = \frac{V}{l}\end{matrix}\right)$

$= \frac{Fl^2}{VY} \propto l^2$

11. $\Delta l = \frac{FL}{\pi r^2 Y}$,

but $V = \pi r^2 L$

so $L = \frac{V}{\pi r^2} = \frac{FV}{(\pi r^2)^2 Y} \propto \frac{1}{r^4}$

$\frac{\Delta l_A}{\Delta l_B} = \left(\frac{r_B}{r_A}\right)^4 = \left(\frac{r_B}{\frac{r_B}{2}}\right)^4 = 16$

12. $F = TL$

$L = \frac{F}{L} = \frac{75 \times 10^{-4}}{6 \times 10^{-2}}$

$= 12.5 \times 10^{-2} \text{ m}$

13. $W = T \cdot 2\pi r$

$r = \frac{W}{2\pi T} = \frac{6.28 \times 10^{-4}}{2 \times 3.14 \times 5 \times 10^{-2}}$

$= 2 \times 10^{-3} \text{ m}$

14. $P \propto \frac{1}{r}$

hence, $\frac{P_1}{P_2} = \frac{r_2}{r_1} = \frac{1}{2}$

$P_1 : P_2 = 1 : 2$

15. $n = \frac{p}{2l}\sqrt{\frac{T}{m}} = \frac{pv}{2l} = \frac{5 \times 20}{2 \times 10} = 5 \text{ Hz}$

16. Mass per unit length

$m = \frac{M}{L} = \frac{0.01}{0.5} \text{ kg/m}$

Fundamental frequency is

$n = \frac{1}{2L}\sqrt{\frac{T}{m}} = \frac{1}{2 \times 0.5}\sqrt{\frac{800 \times 0.5}{0.01}}$

$= 200 \text{ Hz}$

17. From Melde's law

$P\sqrt{T} = \text{constant}$

hence, $P_1\sqrt{T_1} = P_2\sqrt{T_2}$

$6 \times \sqrt{36} = 4\sqrt{T_2}$

$\sqrt{T_2} = 9$ so $T_2 = 81$

18. Velocity of wave is given by

$v = \frac{\omega}{k} = \frac{1800}{6} = 300 \text{ m/s}$

Maximum particle velocity is

$u_{max} = A\omega = 60 \times 10^{-6} \times 1800 \text{ m/s}$

The ratio is

$\frac{u_{max}}{v} = \frac{60 \times 10^{-6} \times 1800}{300} = 3.6 \times 10^{-4}$

19. $\frac{T}{4} = 0.17$ or $T = 0.68$

Frequency $n = \frac{1}{T} = \frac{1}{0.68} = 1.47 \text{ Hz}$

20. $P = \frac{1}{3}\rho e^2$

$= \frac{1}{3} \times 8.99 \times 10^{-2} \times (3180)^2 \text{ N/m}^2$

$= \frac{1}{3} \times \frac{8.99 \times 10^{-2} \times (3180)^2}{1.01 \times 10^5} \text{ atm} = 3 \text{ atm}$

21. $T = \frac{n_1 C_{v_1} T_1 + n_2 C_{v_2} T_2}{n_1 C_{v_1} + n_2 C_{v_2}}$

$= \frac{\frac{22}{14} \times 3R \times 300 + \frac{16}{32} \times \frac{5}{2} R \times 310}{\frac{22}{14} \times 3R + \frac{16}{31} \times \frac{5}{2} R}$

$= \frac{1414.3 + 387.5}{4.71 + 1.25} = 302.3 \text{ K} = 29.3°\text{C}$

22. $P = \frac{1}{3}\rho c^2 \propto \rho$

Therefore at given temperature the pressure of an ideal gas is proportional to ρ.

23. Work done is $W = P\Delta V$

$= 2 \times 10^5 \times (150 - 50) \times 10^{-3}$

$= 2 \times 10^4 \text{ J}$

24. $T_1 V_1^{\gamma-1} = T_2 V_2^{\gamma-1}$

$T_2 = \left(\frac{V_1}{V_2}\right)^{\gamma-1} T_1$

$T_2 = \left(\frac{V_1}{V_2}\right)^{\frac{5}{3}-1} \times 300$

$T_2 = \left(\frac{8}{1}\right)^{2/3} \times 300 = 4 \times 300$

$= 1200 \text{ K} = 927°\text{C}$

25. $\frac{E_2}{E_1} = \left(\frac{T_2}{T_1}\right)^4$

$\frac{T_2}{T_1} = \left(\frac{E_2}{E_1}\right)^{1/4} = \left[\frac{16.0 \times 10^6}{1.0 \times 10^6}\right]^{1/4} = 2$

$T_2 = 2T_1 = 2 \times T_1$

$= 2 \times 400 = 800 \text{ K} = 527°\text{C}$

26. Rate of cooling α excess of temperature

$\frac{80° - 60°}{60°} = K\left(\frac{80° + 60°}{2} - 30°\right)$

$\frac{1}{3} = K(4)$ ... (1)

$\frac{60° - 50°}{t} = K\left(\frac{60° + 50°}{2} - 30°\right)$

$$\frac{10}{t} = K(25) \qquad \ldots(2)$$

Dividing equation (1) by (2), we get

$$\frac{t}{30} = \frac{40}{25} \text{ or } t = \frac{40}{25} \times 30 = 48 \text{ sec}$$

27. For minimum in reflected light

$$2\mu t \cos r = n\lambda$$

$$t = \frac{n\lambda}{2\mu \cos r}$$

$$t_{min} = \frac{\lambda}{2\mu} = \frac{6000\,\text{Å}}{2 \times 1.4}$$

$$= 2142\,\text{Å} \approx 2000\,\text{Å}$$

28. Light travels faster in air than that in glass. This is accordance with wave theory of light.

29. In water λ is reduced to $\frac{\lambda}{\mu}$ so $\lambda' = \frac{\lambda}{1.6}$

As $\omega = \frac{D\lambda}{d} \propto \lambda$

$$\frac{\omega'}{\omega} = \frac{\lambda'}{\lambda} = \frac{\lambda/16}{\lambda}$$

or $\omega' = \frac{0.8}{1.6} = 0.5$ mm

30. $V = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q}{R} = \frac{1}{4\pi\varepsilon_0} \frac{(Ze)}{R}$

$$= 9 \times 10^9 \times \frac{50 \times 1.6 \times 10^{-19}}{9.0 \times 10^{-15}}$$

$$= 8 \times 10^6 \text{ V}$$

31. $E = \frac{V}{d} = \frac{800}{2 \times 10^{-2}} \text{ V/m} = 4 \times 10^4 \text{ V/m}$

again, $qE = mg$

$$q = \frac{mg}{E} = \frac{1.96 \times 10^{-15} \times 9.8}{4 \times 10^4} e$$

$$= 3e$$

32. The dynamo operates on the principle of the production of dynamically induced emf. Hence when ever flux is cut by the conductor, emf is produced in it according to the law of electromagnetic induction.

33. Internal resistance of the cell is

$$r = \frac{E}{i} = \frac{5}{10} = 0.5\ \Omega$$

Current $i = \frac{E}{R+r} = \frac{5}{2+0.5} = 2$ A

34. Current due to both types of ions is in the same direction towards right so

$$i = i_1 + i_2$$

$$i = 2.9 \times 10^{18} \times 1.6 \times 10^{-19} + 1.2 \times 10^{18} \times 1.6 \times 10^{-19}$$

$$i = 0.66 \text{ A}$$

35. $C = \frac{\varepsilon_0 A}{d} \propto \frac{1}{d}$

Hence, $\frac{C_1}{C_2} = \frac{d_2}{d_1}$ or $\frac{2}{C_2} = \frac{0.2}{0.4}$

or $C_2 = \frac{0.4 \times 2}{0.2} = 4\,\mu\text{F}$

Final capacity is

$$C = 4 \times k = 4 \times 2.8 = 11.2\,\mu\text{F}$$

36. In forward bias the terminal of the same polarity are connected between the diode and the supply. Hence by repulsion excess number of holes or electron come out and width of potential barrier can be decreased.

37. The number of nuclei required per second is

$$n = \frac{P}{E} = \frac{16 \times 10^3}{3.2 \times 10^{-11}} = 5 \times 10^{14}$$

38. X-rays consists of oscillating electric and magnetic field at right angles of each other and in the directions of propagation of the X-rays. Hence, X-rays are electromagnetic radiations.

39. When separation between the plates is doubled the capacitance becomes one half.

It means $C' = 25\,\mu\text{F}$

Now energy spent by the battery

$$= qV = (C'V)\,V$$

$$= C'V^2 = 25 \times 10^{-6} \times (100)^2$$

$$= 25 \times 10^{-2}\ \text{J}$$

41. $B = B_1 + B_2 = \frac{\mu_0}{4\pi}\left(\frac{m_1}{r_1^2} + \frac{m_2}{r_2^2}\right)$

as $m_1 = m_2$ and $r_1 = r_2$

so, $B = \frac{\mu_0}{4\pi}\frac{2m_1}{r_1^2} = 10^{-7}\frac{2 \times 10^{-4}}{(5 \times 10^{-2})^2}$

$$= 8 \times 10^{-9}\ \text{T}$$

42. $F = \frac{\mu_0}{4\pi}\frac{6M_1M_2}{r^4} = 10^{-7}\frac{6 \times 10 \times 10}{(0.1)^4}$

$$= 0.06\ \text{N}$$

43. $B \propto \frac{1}{r^3}$

hence, $\frac{B_2}{B_1} = \left(\frac{r_1}{r_2}\right)^3$

$$B_2 = \left(\frac{r_1}{r_2}\right)^3 \times B_1 = \left(\frac{1}{2}\right)^3 \times 1$$

$$= 0.125 \text{ oersted}$$

44. $\frac{M_1}{d_1^3} = \frac{M_2}{d_2^3}$ or $\frac{M_1}{M_2} = \left(\frac{d_1}{d_2}\right)^3 = \left(\frac{2}{3}\right)^3 = \frac{8}{27}$

$$M_1 : M_2 = 8 : 27$$

45. $E = -\frac{d\phi}{dt} = 1 \text{ wb/min} = 1 \text{ wb}/60 = \frac{1}{60}$ watt

46. $P = \frac{V^2}{R} = \frac{(30)^2}{10} = 90$ watt

47. In the visible light $\lambda_{max} = 7800$ Å

$$E = \frac{hc}{\lambda} = \frac{12375}{7800}\ \text{eV} = 1.6\ \text{eV}$$

48. $L = \sqrt{l(l+1)} \cdot \frac{h}{2\pi} = \sqrt{7 \times 8}\,\frac{h}{2\pi} = \sqrt{56}\,\frac{h}{2\pi}$

51. Relative density is ratio of densities of two substances, so it is dimensionless.

52. For first ball,

$$h = 0 \times t_1 + \frac{1}{2}gt_1^2$$

$$\Rightarrow \quad t_1 = \sqrt{\frac{2h}{g}} \qquad \ldots(i)$$

For second ball,

$$2h = 0 \times t_2 - \frac{1}{2}gt_2^2$$

$$\Rightarrow \quad t_2 = \sqrt{\frac{4h}{g}} \qquad \ldots(ii)$$

From equation (i) and (ii)

$$t_1 : t_2 = 1 : \sqrt{2}$$

53. Since the ball is thrown upwards and it reaches back, so time to reach maximum height is half of total time i.e.,

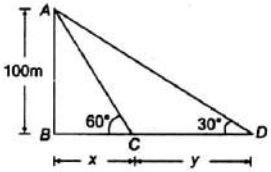
$$t_{maximum} = 2 \text{ sec}$$

Also speed at maximum height is zero, so

$$0 = u - gt_{max}$$

$$\Rightarrow \quad u = gt_{max} = 20\ \text{ms}^{-1} \qquad (\because g = 10\ \text{ms}^{-2})$$

54. In ΔABC



$$\tan 60° = \frac{100}{x}$$

$$\Rightarrow \quad x = \frac{100}{\sqrt{3}} \qquad \ldots(i)$$

In ΔABD

$$\tan 30° = \frac{100}{x + y}$$

$$\Rightarrow x + y = 100\sqrt{3}$$

$$\Rightarrow \quad y = 100\sqrt{3} - \frac{100}{\sqrt{3}} \text{ from (i)}$$

$$= \frac{200}{\sqrt{3}}\ \text{m}$$

55. $F = ma = m \times \frac{\Delta v}{\Delta t}$

$$= 0.1 \times \frac{10}{0.1} = 10\ \text{N}$$

56. Work done $= \vec{F}.\vec{s}$

$= (5\hat{i} + 3\hat{j} + 4\hat{k}).(6\hat{i} - 5\hat{k})$

$= (5\hat{i} + 3\hat{j} + 4\hat{k}).(6\hat{i} + 0\hat{j} - 5\hat{k})$

$= (30 + 0 - 20) = 10$ units

57. Angular velocity $= \frac{\Delta\theta}{\Delta t} = \frac{2\pi}{60}$ rad s^{-1}

$= \frac{\pi}{30}$ rad s^{-1}

Reason : A second hand makes an angle of 2π (*i.e.*, 360°) in one minute. (*i.e.*, 60 second)

58. In a circular motion

$$a = \frac{v^2}{r}$$

$$\therefore \quad \frac{a_2}{a_1} = \left(\frac{v_2}{v_1}\right)^2 = \left(\frac{2v_1}{v_1}\right)^2 = 4$$

$$\Rightarrow \quad a_2 : a_1 = 4 : 1$$

59. For height 'h' above the earth's surface

$$g' = g\left(1 - \frac{2h}{R_e}\right) = g\left(1 - \frac{64}{6400}\right)$$

$(\because R_e = 6400$ km$)$

$= g(1 - 0.01) = 0.99g$ ms^{-2}

60. We know, $T^2 \propto R^3$

$$\therefore \quad \left(\frac{T_2}{T_1}\right)^2 = \left(\frac{R_2}{R_1}\right)^3 \Rightarrow \frac{T_2}{4} = \left(\frac{4R}{R}\right)^{3/2}$$

$$\Rightarrow \quad T_2 = 4 \times 8 = 32 \text{ hrs}$$

Chemistry

61. In an isochoric process, $\Delta V = 0$, hence, work done $P\Delta V = W = 0$. So, $\Delta E = q + 0$. Hence, the increase in internal energy will be equal to heat absorbed by the system.

62. Normality of the resulting mixture

$$= \frac{N_1V_1 + N_2V_2 + N_3V_3}{V_1 + V_2 + V_3}$$

$$= \frac{75 \times \frac{1}{5} + 10 \times \frac{1}{2} + 30 \times \frac{1}{10}}{75 + 10 + 30}$$

$$= \frac{15 + 5 + 3}{115}$$

$$= \frac{23}{115} = \frac{N}{5} = 0.2\,N$$

63. Molality of C_2H_5OH (non-electrolyte) solution

$$= \frac{17g / 46 \times 1000\,g}{1000\,g \text{ water}}$$

$= 0.369$

$\Delta T_f = k_f \times m$

$= 1.86 \times 0.369 = 0.686$

Freezing point of the solution

$= 0°C - 0.686°C$

$= -0.69°C$

64. pH of the solution $= 5$

$[H^+] = 10^{-5}$ M

On decreasing the H^+ ion concentration 100 times the $[H^+]$ becomes

$$= \frac{10^{-5}}{100} = 10^{-7}\text{M}$$

Now pH=7, which signifies a neutral solution.

72. In ethylene $H_2C{=}CH_2$, the C—C bond distance is 1.34 Å, therefore, the π electrons of the double bond are easily exposed to the reactant (electrophiles) which readily react. In acetylene molecule $H-C \equiv C-H$, although there are two π bonds but these electrons arc not exposed to the attacking reagents due to small bond distance of $C \equiv C$ bond (1.20 Å). A catalyst mercuric ion is therefore needed in reactions with actylene.

73. Natural rubber is poly-*cis*-ispropene. It is polymer of 2-methyl-1, 3-butadiene (isoperene).

75. We have $d = \frac{PM}{RT}$

or $\quad \frac{d_1T_1}{P_1} = \frac{d_2T_2}{P_2}$

According to the equation,

$d_1 = 2.86$ kg m^{-3}, $d_2 = ?$

$T_1 = 273$K

$T_2 = 819 + 273 = 1092$ K

$P_1 = 1$ atm

$P_2 = 2$ atm

$$\therefore \quad \frac{2.86 \times 273}{1} = \frac{d_2 \times 1092}{2}$$

or $\quad d_2 = \frac{2 \times 2.86 \times 273}{1092}$

$= 1.43$ kg m^{-3}

77. $K_2Cr_2O_7$

$2(+1) + 2(x) + 7(-2) = 0$

$2 + 2x - 14 = 0$

$2x = 12$

$x = 6$

79. All the carbon atoms in benzene are in sp^2 state of hybridization, hence, all the six carbons and six hydrogen atoms attached with these carbon lie in a plane.

80. According to $E = mc^2$

$m = 1$ g,

$c = 3 \times 10^{10}$ cm sec^{-1}

$\therefore \quad E = 1\,g \times (3 \times 10^{10}\text{ cm sec}^{-1})^2$

$= 9 \times 10^{20}$ ergs

81. Actual vapour density of methane

$$= \frac{\text{mol. wt}}{2} = \frac{16}{2} = 8$$

$\therefore$ vapour density of volatile substance

$= 8 \times 4 = 32$

Molecular weight of the substance

$= 32 \times 2 = 64$

86. $[H^+]$ in a solution of weak acid of conc. "C" and dissociation constant K_a is given as

$$[H^+] = \sqrt{K_a \times C} = \sqrt{4.0 \times 10^{-10} \times 2.5 \times 10^{-1}}$$

$= \sqrt{1 \times 10^{-10}}$

$= 1 \times 10^{-5}$ M

$pH = -\log[H^+]$

$= -\log 10^{-5} = 5$

87. K_{sp} of CaC_2O_4 (a binary electrolyte)

$= 2.5 \times 10^{-9}$

Now we know,

$K_{sp} = S^2$ (S = molar solubility)

or $\quad S = \sqrt{K_{sp}} = \sqrt{2.5 \times 10^{-9}}$

$= 5 \times 10^{-5}$ mL^{-1}

Amount of CaC_2O_4 to make one litre saturated solution

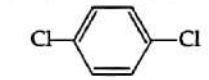
$= 5 \times 10^{-5}$ moles $\times 128$ g mol^{-1}

$= 0.0064$ g

105. A pure sample of $CHCl_3$ produces no. ppt. of AgCl with $AgNO_3$ because it does not contain Cl^- (chloride) ions. An impure sample. (Which has been oxidised by air) forms a white ppt. of AgCl with $AgNO_3$ because Ag^+ from $AgNO_3$ combine with the Cl^- ions of HCl formed by oxidation of $CHCl_3$.

106. Nitro group $\left(-N\begin{matrix}O\\O\end{matrix}\right)$ deactivates the benzene ring in nitrobenzene due to $-M$ effect.

107. *p*-dichlorobenzene molecule



has symmetrical structure. It can fit well in its crystal lattice. The intermolecular forces of attraction are strong. Hence, it possesses highest melting point among those given in the question.

108. Ethylene diamine (en) is a bidentate ligand, *i.e.*, it has two donor centres. In the complex $[CO(en)_2Cl_2]Br$, the total number of donor atoms is 6 (4 from two 'en' moles + 2 Cl^- ions). Let the oxidation state of 'Co' be x.

$x + (0 \times 2) + (-1 \times 2) + (-1) = 0$

$x + 0 - 2 - 1 = 0$

$x - 3 = 0$

$x = +3$

110. ClO^- (hypochlorite ion) is the strongest Bronsted base because its conjugate acid, HOCl is the weakest acid.

111. Cadmium rods are used to absorb neutrons in nuclear reactors, because cadmium is neutron absorber.

112. Propionic acid and KOH reacts to produce potassium propionate.

$$\underset{\text{Propionic acid}}{CH_3CH_2COOH} \xrightarrow{KOH} \underset{\text{Potassium propionate}}{CH_3CH_2COOK} + H_2O$$

113. The equivalent conductance of strong electrolyte is increased by dilution, because its value is equal to the multiple of K_v and the volume of solution. By making dilution the volume of solution increases which also increase the value of equivalent conductivity.

114. We know that 1 g equivalent weight of

$$NaOH = 40\text{ g}$$

$$\therefore \quad 40\text{ g of NaOH} = 1\text{ g eq. of NaOH}$$

$$\therefore 0.275\text{ g of NaOH} = \frac{1}{40} \times 0.275\text{ eq.}$$

$$= \frac{1}{40} \times 0.275 \times 1000$$

$$= 6.88\text{ meq}$$

$$\because \quad \underset{(HCl)}{N_1V_1} = \underset{(NaOH)}{N_2V_2}$$

$$N_1 \times 35.4 = 6.88 \qquad (\because \text{meq} = NV)$$

$$\therefore \quad N_1 = 0.194$$

115. Zinc is that metal, which gives white precipitate when H_2S gas is passed in the ammonical solution of its salt.

116. amu represents atomic mass unit. It is used in place of unified mass unit.

$$1\text{ amu} = 1\text{ Avogram} = 1\text{ Aston} = 1\text{ Dalton}$$

$$1\text{ amu} = \frac{1}{12} \times \text{mass of C-12 atm}$$

$$= \frac{1}{12} \times 1.9924 \times 10^{-23}\text{g}$$

$$= 1.66 \times 10^{-24}\text{g} = 1.66 \times 10^{-27}\text{kg}$$

117. $CHCl_3$ molecule is the molecule which have largest dipole moment.

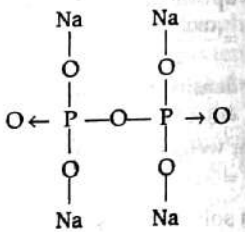
118. Calcium acetate on distillation produce acetone

$$\underset{\text{Calcium acetate}}{(CH_3COO)_2Ca} \xrightarrow{\text{Distillation}} \underset{\text{Acetone}}{CH_3COCH_3} + CaCO_3$$

119. Noble gases have fully filled valence shell electronic configuration. Therefore, it represents ns^2np^6.

120. Sodium pyrophosphate is represented by $Na_4P_2O_7$. It is sodium salt of pyrophosphoric acid ($H_4P_2O_7$), which may be considered to be made up by two molecules of orthro phosphoric acid (H_3PO_4), eleminating one molecule of H_2O.

$$2H_3PO_4 \xrightarrow{-H_2O} \underset{\text{Pyrophosphoric acid}}{H_4P_2O_7}$$



Sodium pyrophosphate

Biology

121. Hind limb of man contain 30 bones. Which are as follows

Femur-1	Tarsals-1
Fibula-1	Metatarsals-5
Tibia-1	Phalanges-14
Patella-1	

122. Carbon monoxide (CO) after inhalation combines with blood haemoglobin to form carboxy haemoglobin at a rate 200 times faster than the rate at which oxygen forms oxyhaemoglobin.

123. Kwashiorkor is a protein deficiency disease which is characterised by wasting of muscles, thining of limbs, failure of growth, brain development etc.

124. Ornithine combines with one molecule of NH_3 and CO_2 to produce citrulline. Citrulline combines with another molecule of NH_3 to form arginine. Arginine is broken down into urea and ornithine which repeat the cycle. This cycle known as ornithine cycle.

125. Restriction endonucleases work as knifes and are used to cut DNA at specific sites.

126. A definite number of segments (*i.e.*, 33 segments) are found in leech.

127. Sporopollenin is biologically most resistant plant material which is present in pollen exine and is contributed by the tapetum layer of the another wall.

128. *Agaricus* is an edible mushroom. It is a saprophytic fungus, which grows during rainy season in moisture grassy places and in richly manured unploughed fields.

129. $2n-1$ condition represents diploid set of chromosomes having loss of one chromosome, the presence of one unpaired chromosomes along with diploid set is called monosomy.

130. An algal zone containing blue-gree algae *Anabaena cycadeal* and *Nostoc punctiforme* is present in cortex of *Cycas* coralloid root.

131. Turpentine oil is obtained from *Pinus pinaster*.

132. Prothallus is independent from sporopyte in fern.

133. In gymnosperms, ovule lacks ovary and ovary wall which form fruit after maturation in angiosperms.

134. Pancreatic juices act upon both carbohydrates and proteins.

135. Peristalisis is a involuntary movements of gut by which food bolus is moved backward. It is least in rectum.

136. Villi present in small intestine increase surface area which is helpful in absorption.

137. Lacteals present in villus absorbed the fatty acids and glycerol molecules.

138. Oxyntic (parietal) cells secrets HCl.

139. Herbivores eat more carbohydrate food so enzyme carbohydrates dominates.

140. Caecum is a small, pouch-like structure which ends into a tubular structure called vermiform appendix.

141. Pylorous is constricted part of the alimentary canal present between stomach and duodenum.

142. Crypts of Leiberkuhn are multicellular, simple, tubular glands. The secretion of glands collectively called intestinal juices or succus entericus.

143. Below freezing point the enzyme pepsin gets inactivated.

144. Spore formed by meiotic division in spore mother cell is the first gametophytic structure in *Pteridium*.

145. *Lycopodium* a pteridophyte is commonly called as 'club moss'.

146. Aerotrophic respiratory roots called 'pneumatophores' are present in 'mangroves' plants grow in saline soil.
Example: *Rhizophora.*

147. Schleiden (1838) proposed cell theory and said, "all tissues consist of cell".

148. The part of mushroom comes out from soil is called basidiocarp.

149. Due to the presence of *Trichodesmium*, (a blue-green algal) in red sea, it gives specific red colour appearance.

150. Wavelengths shorter than 380 nm have too much energy which can disrupt the molecular organisation of cell; wavelength longer than 750 nm do not have energy to raise an electron to a higher orbital.

151. Dog was the first animal to be domesticated by man.

152. Mycorrhiza represents the symbiotic association between the fungi and the roots of higher plants.

153. Cornea transplantation is very popular these days because the cornea has no blood supply, so it is away from the immune system of the body.

154. In C_4 plants, CO_2 is picked up by a 3-carbon compound phosphoenol pyruvate (PEP) to form 4-carbon compound oxaloacetic acid. this reaction, catalysed by PEP carboxylase, takes place in the cytoplasm of mesophyll cells.

155. Sodium and iodine are not required by most of the plants. Of course, Na is essential for certain marshy plants.

156. Feedback inhibition of a biochemical path way is often achieved through allosteric inhibition of the first enzyme in the sequence (by the final product).

157. Oxygen is a competitive inhibitor of CO_2 fixation. Increase in O_2 concentration would favour the uptake of oxygen by Rubisco leading to increase in photorespiration.

158. Green-house effect is caused by CO_2, CFCs, CH_4 and NO_2.

159. In India and Australia, the overgrowth of cacti was checked by the introduction of cochineal insect (*Cactoblastis* cactorum).

160. About 70 genera and 730 species of gymnosperms exist (option '*c*' is nearest to 730 and may be considered correct).

161. Each microspore mother cell divides meiotically to form 4 pollen grains ($4 \times 4 = 16$).

162. Sex pili serve as portals of entry of genetic material from donor to recipient cell during conjugation.

163. As the earth cooled, free atoms in the atmosphere formed inorganic molecules (including H_2O and NH_3) which interacted to form sugars and then proteins and nucleic acids.

164. 2, 4-D is a selective weed killer. Kill broad-leaved plants (dicots) but do not affect mature monocot plants.

165. Lungs and gill receive deoxygenated blood for oxygenation. Liver also receives deoxygenated blood through hepatic portal system for extracting excess quantities of digested nutrients.

166. During S-phase of mitotic cycle, DNA is replicated and histones are synthesized so that each chromosomes becomes two chromatids.

167. Thick body wall is folded forming regularly arranged inpushings and outpushing leading to the formation of canals.

168. Farmer and Moore (1905) proposed the term meiosis.

169. Lampbrush chromosomes are found in the oocytes of certain animals and grow profusely during prophase of meiosis-I.

170. The term 'Benthoic' was originally used for those animals which live on sea bottom.

171. In C_4 plants, CO_2 is picked up by phosphoenol pyruvate (PEP) in the cytoplasm of mesophyll cells.

172. USA along release 37% of CFCs.

173. That DNA is a helical structures, could be show through X-ray diffraction patterns of DNA studied by Wilkins and Franklin.

174. Crossing over is the mutual exchange of segments of homologous chromatids during first meiotic prophase.

175. AIDS was first reported from USA in 1981.

176. During anaerobic respiration, pyruvic acid forms ethyl alcohol (C_2H_5OH) and CO_2. This is also called fermentation.

177. Six turns of the Calvin cycle result in the production of one molecule of glucose.

178. Biological control methods include using natural predators of pests, using resistant varieties, crop rotation etc.

179. Only about 10% of the energy is transferred from one trophic level to the next. This 10% law of energy transfer was proposed by Lindemann (1942).

180. During ornithine cycle in liver cell, ammonia and CO_2 are combined to form urea which is released into the blood.

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JIPMER

MEDICAL ENTRANCE EXAM

2002

Directions (Question 181 to 183): *Read the following passage carefully and answer the questions given below the passage.*

Our country is facing a severe environmental crisis. If it is not tackled on a war footing, it will certainly lead to socio-economic and ecological disaster, which will seriously affect the lives of millions of people, especially the poor. Government data usually understate the extent of environmental destruction. The recent satellite data have revealed that India is losing millions of hectares of forest every year which is many times more than the annual rate of deforestation put out by the forest department.

181. If India's environmental problem is not dealt with urgently, it will :
(a) create problems of poverty
(b) ruin the ecology of the country
(c) lead to war
(d) make people unemployed

182. The latest data regarding loss of forests have been collected by :
(a) environmentalists (b) satellites
(c) Indian farmers (d) state government

183. The amount of environmental damage as indicated by official figures is
(a) not very alarming
(b) much less than the actual one
(c) more than the actual damage
(d) as much as it really is

Directions (Question 184 to 187): *Choose the correct meaning of the given words.*

184. ADAMANT :
(a) tractable (b) flexible
(c) inflexible (d) soft

185. GOAD :
(a) features (b) complain
(c) urge (d) pertinent

186. FABULOUS :
(a) unbelievable (b) soft
(c) weaken (d) strong

187. ACME :
(a) surface layer (b) perfection
(c) bottom (d) depth

Directions (Question 188 to 191): *Choose the correct synonyms of the given words.*

188. IDOL :
(a) rough (b) normal
(c) favourite (d) bad

189. INFER :
(a) last (b) conclude
(c) enough (d) end

190. IMPRESS :
(a) hint
(b) inexpressible
(c) show
(d) force

191. ENTRY:
(a) come in
(b) penetration
(c) inside
(d) admittance

Directions (Question 192 to 195): *Choose the correct antonyms from the given set of words.*

192. INSERTION:
(a) displacement
(b) extraction
(c) withdrawl
(d) removal

Antonyms :—

193. PERMANENT:
(a) disheveled (b) improper
(c) indifferent (d) temporary

194. BLASE:
(a) cultured
(b) indifferent
(c) afraid
(d) worldly

195. FATUOUS:
(a) witty – Intelligent
(b) in one
(c) thin
(d) planned

○ ***Directions (Question 196 to 200):*** *Choose the incorrect word in the following sentences.*

196. Had I known you were coming I would stay at?
(a) coming I
(b) I would stay
(c) you were
(d) I known

197. The bus was hired by the ladies for its picnic:
(a) the bus
(b) was hired
(c) by the ladies
(d) for its picnic

198. I must find out some means of balancing my budget:
(a) my budget
(b) of balancing
(c) some means
(d) out

199. Listen carefully, he speaks :
(a) listen (b) carefully
(c) he (d) he speaks

200. The crowd at the stadium clapped jubilantly when the champion received his trophy:
(a) crowd at the stadium
(b) clapped jubilantly
(c) when the champion
(d) his

ANSWERS

181. (b)	182. (b)	183. (b)	184. (c)	185. (c)	186. (a)	187. (b)	188. (c)	189. (b)	190. (d)
191. (d)	192. (b)	193. (d)	194. (c)	195. (a)	196. (d)	197. (d)	198. (d)	199. (d)	200. (d)

(194) eg. She was becoming quite blase about danger.

(195) witty का Antonym = dull

ENGLISH (2002)

○ ***Directions (Question 181 to 185):*** *Select the word or phrase, which is nearest in meaning to the given word.*

181. NEXUS: (a link)
(a) a linked group (b) noxious
(c) shibboleth (d) a discrete group

182. DIABOLIC:
(a) having double meaning
(b) angelic
(c) fiendish
(d) authoritarian

183. CARICATURE:
(a) miniature (b) aberration
(c) consequential (d) cartoon likeness

184. COEVAL:
(a) contemporary (b) extol
(c) intrepid (d) subordinate

185. UPBRAID:
(a) extol (b) revile
(c) restrain (d) sanction

○ ***Directions (Question 186 to 190):*** *In the following questions, a proverb/idiom/phrase is followed by four alternative choices. Select from amongst the given alternatives which best explains the meaning of the proverb/idiom/phrae.*

186. One swallow does not always made a summer:
(a) one hot day does not mean that summer has set in
(b) one difficulty overcome does not mean that trouble is over
(c) one secret cannot save a person's life
(d) spring does not always follow a winter

187. Sent to coventry (to refuse)
(a) ostracised (b) sent to public school
(c) welcomed (d) none of these

188. To have a second string to one's bow:
(a) to have second alternative in case the first one fails
(b) to keep one's powder dry
(c) to deceive someone
(d) none of the above

189. To look a gift-horse in the mouth:
(a) to pick flaws in a gift or favour
(b) to be indifferent
(c) to appreciate a gift or favour
(d) none of the above

190. To make fish of one and flesh of another:
(a) to be impartial
(b) to be extra smart
(c) to become a non-vegetarian
(d) to be partial

○ ***Directions (Question 191 to 195):*** *In these questions a sentence is given which contains an idiom or an idiomatic expression which has been italicised. Below it, four alternative meanings of the idiom have been suggested. Choose the correct meaning*

191. It has been *raining cats and dogs*:
(a) raining lightly
(b) raining musically
(c) raining cruelly
(d) raining heavily

192. He was *cool as a cucumber:*
(a) fainted
(b) nervous
(c) dead
(d) cool and composed

193. The *long and the short of it* is that they decided to marry:
(a) staunchly
(b) stoutly
(c) all that need be left unsaid is
(d) all that can need and be said is

194. He refused *point-blank* to compromise on principles:
(a) in a soft voice (b) coldly
(c) flatly (d) hotly

195. As our army attacked, the enemy retreated *pell-mell*:
(a) in an orderly manner
(b) in a disorderly manner
(c) in a courageous manner
(d) in a heap

○ ***Directions (Question 196 to 200):*** *In these questions there are four words in each group.Out of these, one word is mis-spelt, put a cross in your answer-sheet in the circle under the letter (a), (b), (c), (d) against the mis-spelt word.*

196. (a) bemuse (b) benifit (c) benevolent (d) because

197. (a) venerable (b) vehical (c) veritable (d) fearful

198. (a) permenent (b) permissible (c) prevalent (d) perennial

199. (a) envelope (b) enquiry (c) employement (d) worried

200. (a) wearysome (b) worried (c) weird (d) wanded

ANSWERS

181. (a)	182. (c)	183. (d)	184. (a)	185. (b)	186. (a)	187. (a)	188. (a)	189. (a)	190. (d)
191. (d)	192. (d)	193. (d)	194. (c)	195. (b)	196. (b)	197. (c)	198. (a)	199. (c)	200. (d)

ENGLISH (2001)

○ ***Directions (Question 181 to 190):*** *Read the following passage carefully and answer the questions given below it. Certain words/phrases are given in bold to help you to locate them while answering some of the questions*

In terms of the total energy consumed by different sectors, the largest consumer is understandably the industrial sector, which accounts for nearly half the total energy used in the country today. This is followed by the transport sector which consumes about 25%, the household sector about 14% and the agricultural sector about 9%. The last sector has shown considerable increase in energy use over the last four decades. Among the primary fuels, the relative proportion of coal has decreased from the earlier 80% to 40% and that of oil has gone up from 17% to 44% over the same period.

Total energy consumption in India today is equivalent to 291 million tons of oil of which 26% comes from wood. On a per capita basis it works out to about 1 litre of oil per day, which is extremely low by international standards. The future energy demand depends upon the level of development and also on the people to be affected by it.

The energy disparity between the urban and the rural population is at present as wide as between nations on a world wide scale. There is apparently a great need to provide energy in the rural areas and to improve the national figures for energy consumption, limiting its use to those who are alredy getting the share in bulk.

With the projected rate of population growth, improving upon the per capita energy consumption is Herculean task as our coal reserves and the capacity to import oil cannot be increased beyond a point. There is clearly no escape from the utilization of renewable energy source in a big way if the gap between the desired levels of energy supply and available resources has to be kept at the minimum.

181. Which of the following correctly shows the different sectors consuming energy in ascending order?
(a) agriculture, transport, household, industrial
(b) agriculture, household, transport, industrial
(c) industrial, transport, household, agriculture
(d) industrial, household, agriculture, transport

182. The author is laying great emphasis on which of the following?
(i) Efficient use of energy.
(ii) Increasing national indices for energy consumption.
(iii) Controlling population growth.
(a) only 1
(b) only 2
(c) only 3
(d) all the three

183. The author feels that increasing per capita use of energy is :
(a) rather difficult but not impossible
(b) not easy but certainly achievable
(c) not at all desirable
(d) a matter of great difficulty

184. According to the passage, the energy requirement of the future will be decided on the basis of which of the following?
(i) total energy already consumed by us in the past.
(ii) level of development of oil industry.
(iii) Profile of the affected people.
(a) only (i)
(b) only (ii)
(c) only (iii)
(d) both (b) and (c)

185. "There is clearly no escape ... " means :
(a) There is a way out but it is ambiguous
(b) There is a problem but not without solution
(c) There is also no solution of this
(d) There is hardly any alternative

186. Which of the following styles has been adopted by the author?
(a) Unsubstantiated arguments and views
(b) Data-based but coloured by socialism
(c) Highly subjective with bias for rural people
(d) Data-based, objective, positive, solution-oriented

187. Which of the following has been suggested by the author as the best possible solution to overcome energy crisis?
(a) importing large quantities of coal
(b) exploration of oil reserves
(c) reducing share of bulk users
(d) maximization of renewable source

188. "The energy disparity ... as wide as ...word-wide scale" means :
(a) disparity in urban and rural areas is observed in all the nations
(b) in no other nation such disparity is observed
(c) developed countries consume more energy than developing countries
(d) worldwide scale is different for rural and urban areas

189. Which of the following statements is true?
(a) The household sector has shown considerable increase in energy use
(b) Use of oil has increased from 40% to 80%
(c) Industrial sector uses 50% of the total energy used in India
(d) Energy consumption in India is 26% of world consumption
(e) Import of oil to the extent of requirement is quite possible

190. Which of the following has been mentioned as a major hurdle in enhancing per capita consumption of energy in India?
(a) Present level of development in India
(b) Increased use of energy in agricultural sector
(c) Disparity in the use of energy in rural and urban areas
(d) none of the above

○ ***Directions (Questions 191 to 197):*** *In each question, a part of the sentence is italicized. Below each sentence four choices (a), (b), (c) and (d) are given. Find out the choice which can correctly substitute the italicized part of the sentence.*

191. The quality of food served in this hotel is so poor that no repectable person *would want to eat* over here:
(a) will want to eat
(b) will have wanted to eat
(c) will be wanting to eat
(d) no correction required

192. I am *absolute confident what* we are going to move forward strongly:
(a) absolutely confidence that
(b) absolutely confident what
(c) absolute confidential what
(d) absolutely confident that

193. *Leaving* aside little room for misinterpretation, the senior politician offered clarification about his role in the party elections:
(a) leaving little room for
(b) leaving for little room to
(c) leaving less room for
(d) having left less room for

194. The principal lamented that though a detailed report was submitted to the management a month ago no *action is being took* so far:
(a) no action had taken
(b) no action was being taken
(c) no action has been taken
(d) no correction required

195. We *must make for* our foreign policy on the basis of guarding national interest alone:
(a) have made for
(b) must be making to
(c) must make
(d) no correction required

196. One of the men gave first aid to Nitesh, *who is injured* in a road accident:
(a) which was injured
(b) who had injured
(c) as he was to injure
(d) who was injured

197. Shela was going to the temple *then Madhu came on* meet her:
(a) when Madhu was coming to
(b) when Madhu came to
(c) before Madhu was coming to
(d) after Madhu was coming to

○ ***Directions (Question 198 to 200):*** *Pick up the most effective word from the given words to fill in the blanks to make the sentence meaningfil*

198. There is no doubt that one has to keep ..... with the changing times:
(a) himself
(b) tuning
(c) pace
(d) oneself

199. The passengers and crew members of the aeroplane had a ... escape when it was taking off from the runway:
(a) little (b) narrow (c) brief (d) large

200. Eight scientists have ... the national awards for outstanding contribution and dedication to the profession :
(a) picked (b) conferred
(c) bagged (d) discovered

ANSWERS

181. (c)	182. (b)	183. (d)	184. (d)	185. (d)	186. (d)	187. (d)	188. (c)	189. (c)	190. (d)
191. (d)	192. (d)	193. (a)	194. (b)	195. (c)	196. (d)	197. (b)	198. (c)	199. (b)	200. (c)

ENGLISH (2000)

○ *Directions (Question 181 to 185): Find out the mis-spelt word ..*

181. (a) trauma (b) tinker
(c) takiturn (d) turpitude

182. (a) synchronize (b) simulate
(c) stimulate (d) scoul

183. (a) groupie (b) gurantee
(c) gubematorial (d) guard-rail

184. (a) loubrow (b) loutish
(c) luminosity (d) lumpen

185. (a) indefatigable (b) indentured
(c) indicative (d) intelligetsia

○ *Directions (Question 186 to 190): In each of the following questions six words are given which are denoted by (a), (b), (c), (d), (e) and (f). By using all the six words, once each, you have to frame a meaningful and grammatically correct sentence. Choose from the correct order of words and mark it as your answer on the answer sheet.*

186. (A) tree (B) the (C) fell (D) The (E) from (F) boy:
(a) DFCEBA (b) BACEDF
(c) BFCDAE (d) EDACBF

187. (A) grinded (B) to (C) the (D) a (E) train (F) halt:
(a) DEABCF (b) DFABCE
(c) CEABDF (d) FEACBD

188. (A) dejected (B) students (C) lot (D) the (E) a (F) were:
(a) ABFECD (b) EACFDB
(c) DBFEAC (d) ECFDAB

189. (A) convicted (B) court (C) of (D) murder (E) the (F) him :
(a) EDAFCB (b) CEDBAF
(c) FAEBCD (d) EBAFCD

190. (A)vehicle (B) accosted (C) the (D) speeding (E) sergeant (F) the :
(a) FEBCDA (b) FBACDE
(c) CDABFE (d) BFEDAC

○ *Directions (Question 191 to 200): In the passage below, there are blanks and each has been numbered. Below the passage there are four choices for each question. One out of these, suits to fill in the blanks. Find out the appropriate words.*

It is now well known that stress 11 up a 12 of body chemicals that eventually 13 your health. Now scientists 14 further findings. It 15 that every time one goes through 16 stress, the body's stress thermostat gets 17 to a greater 18 Researchers compare this to an allergy once the body is 19 to a substance. It reacts strongly even at a mere 20 of the stuff.

191. (a) generates (b) brings
(c) develops (d) stirs

192. (a) flow (b) storm
(c) plethora (d) array

193. (a) effect (b) destroy
(c) ruins (d) affect

194. (a) develop (b) report
(c) hypothesize (d) relate

195. (a) appears (b) signifies
(c) propagates (d) shows

196. (a) prolonged (b) serious
(c) any (d) proper

197. (a) alarmed (b) activated
(c) reset (d) ready

198. (a) level (b) program
(c) energy (d) sensitivity

199. (a) alert (b) allergetic
(c) sensitised (d)immune

200. (a) disturbance (b) whiff
(c) addition (d) smell

ANSWERS

181. (c)	182. (d)	183. (b)	184. (a)	185. (d)	186. (a)	187. (c)	188. (c)	189. (d)	190. (a)
191. (d)	192. (b)	193. (d)	194. (b)	195. (a)	196. (b)	197. (c)	198. (d)	199. (c)	200. (b)

JIPMER
MEDICAL ENTRANCE
Solved Paper 2004

PHYSICS

1. A particle of mass m moving with velocity v collides with a stationary particle of mass $2m$. The speed of the system, will be
(a) $3v$ (b) $\frac{v}{2}$ (c) $\frac{v}{3}$ (d) $2v$

2. The dimensions of gravitational constant are
(a) $[ML^3T^{-2}]$ (b) $[M^{-1}L^2T^{-2}]$
(c) $[ML^{-2}T^2]$ (d) $[M^{-1}L^3T^{-2}]$

3. A stone is thrown with an initial speed of 4.9 m/s from a bridge in vertically upward direction. It falls down in water after 2 sec. The height of bridge is
(a) 24.7 m (b) 19.8 m
(c) 9.8 m (d) 4.9 m

4. A ball of mass 10 g moving with acceleration of 20 m/s^2 is hit by a force which acts on it for 0.1 sec. The impulsive force is
(a) 1.2 Ns (b) 0.3 Ns
(c) 0.1 Ns (d) 0.5 Ns

5. The earth of mass = 6×10^{24} kg revolves around the sun with an angular velocity of 2×10^{-7} rad/s in a circular orbit of radius 1.5×10^8 km. The force exerted by the sun on earth is :
(a) 6×10^{19} N
(b) 18×10^{26} N
(c) 36×10^{21} N
(d) 27×10^{39} N

6. A particle moves from position $\vec{r}_1 = 3\hat{i} + 2\hat{j} - 6\hat{k}$ to position $\vec{r}_2 = 14\hat{i} + 13\hat{j} + 9\hat{k}$ under action of force $\mathbf{F} = 4\hat{i} + \hat{j} + 3\hat{k}$ N. The work done will be:
(a) 100 J (b) 50 J
(c) 200 J (d) 75 J

7. A cylinder contains 10 kg of gas at pressure of 10^7 N/m^2. The quantity of gas taken out of the cylinder, if final pressure is 2.5×10^6 N/m^2 will be (temperature of gas is constant)
(a) 15.2 kg (b) 3.7 kg
(c) zero (d) 7.5 kg

8. In junction diode, the holes are because of
(a) missing electrons
(b) extra electrons
(c) protons
(d) neutrons

9. The work done in pulling up a block of wood weighing 2 kN for a length of 10 m on a smooth plane inclined at an angle of 15° with the horizontal is
(a) 9.82 kJ (b) 89 kJ
(c) 4.35 kJ (d) 5.17 kJ

10. If the heat of 110 J is added to a gaseous system, whose internal energy is 40 J, then the amount of external work done is
(a) 180 J (b) 70 J
(c) 110 J (d) 30 J

11. A resonance air column of length 40 cm resonates with a tuning fork of frequency 450 Hz. Ignoring end correction, the velocity of sound in air will be
(a) 1020 m/s (b) 920 m/s
(c) 820 m/s (d) 720 m/s

12. If vibration of string is to be two times, then tension in the string must be made
(a) eight times (b) four times
(c) twice (d) half

13. A siren emitting sound of frequency 500 Hz is going away from a stationary listener with a speed of 50 m/s, the frequency of sound heard directly from the siren is
(a) 286.5 Hz (b) 481 Hz
(c) 434.2 Hz (d) 580 Hz

14. The half life of a radioactive substance is 3.6 days. How much of 20 mg of this radioactive substance will remain after 36 days?
(a) 0.0019 mg (b) 1.019 mg
(c) 1.109mg (d) 0.019 mg

15. The kinetic energy of an electron is 5 eV. Calculate the de-Broglie wavelength associated with it ($h = 6.6 \times 10^{-34}$ Js, $m_e = 9.1 \times 10^{-31}$ kg)
(a) 5.47 Å (b) 10.9 Å
(c) 2.7 Å (d) None of these

16. A charged particle is suspended in equilibrium in a uniform vertical electric field of intensity 20000V/m. If mass of the particle is 9.6×10^{-16} kg, the charge on it, and excess number of electrons on the particle respectively are ($g = 10 m/s^2$)
(a) 4.8×10^{-19}C, 3 (b) 5.8×10^{-19}C, 4
(c) 3.8×10^{-19}C, 2 (d) 2.8×10^{-19} C, 1

17. The energy in MeV is released due to transformation of 1 kg mass completely into energy, is ($c = 3 \times 10^8$ m/s)
(a) 7.625 × 10 MeV (b) 10.5×10^{29} MeV
(c) 2.8×10^{-28} MeV (d) 5.625×10^{29} MeV

18. 20 kV potential is applied across X-ray tube, the minimum wavelength of X-ray emitted will be
(a) 0.62 Å (b) 0.37 Å
(c) 1.62 Å (d) 1.31 Å

19. In the *CB* mode of a transistor, when the collector voltage is changed by 0.5 volt, the collector current changes by 0.05 mA. The output resistance will be
(a) 10 kΩ (b) 20 kΩ
(c) 5 kΩ (d) 2.5 kΩ

20. A transmitting station transmits radiowaves of wavelength 360 m. Calculate the inductance of coil required with a condenser of capacity 1.20 μF in the resonant circuit to receive them
(a) 3.07×10^{-8} H
(b) 2.07×10^{-8} H
(c) 4.07×10^{-8} H
(d) 6.07×10^{-8} H

21. A circular coil of mean radius of 7 cm and having 4000 turns is rotated at the rate of 1800 revolutions per minute in the earth's magnetic field (B = 0.5 gauss), the emf induced in coil will be
(a) 1.158 V (b) 0.58 V
(c) 0.29 V (d) 5.8 V

22. The peak value of alternating current is $5\sqrt{2}$ ampere. The mean square value of current will be
(a) 5A
(b) 2.5 A
(c) $5\sqrt{2}$
(d) None of the above

23. A lamp in which 10 amp current can flow at 15 V, is connected with an alternating source of potential 220 V. The frequency of source is 50 Hz. The impedance of choke coil required to light the bulb is
(a) 0.07 H
(b) 0.14 H
(c) 0.28 H
(d) 1.07H

24. If the current 30A flowing in the primary coil is made zero in 0.1 sec, the emf induced in the secondary coil is 1.5 volt. The mutual inductance between the coils is
(a) 0.05 H (b) 1.05 H
(c) 0.1 H (d) 0.2 H

25. Two equal resistances R are joined with voltage source V in (i) series (ii) parallel, the ratio of electrical power consumed in two cases wll be
(a) 1 : 4 (b) 4 : 1
(c) 2 : 1 (d) 1 : 2

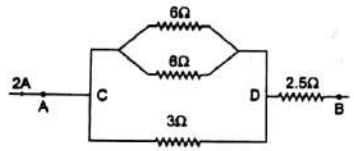
26. A proton enters a magnetic field of intensity 1.5 Wb/m^2 with a velocity 2×10^7 m/s in a direction at an angle 30° with the field. The force on the proton will be (charge on proton is 1.6×10^{-19} C)
(a) 2.4×10^{-12} N
(b) 4.8×10^{-12} N
(c) 1.2×10^{-12} N
(d) 7.2×10^{-12} N

27. 20 ampere current is flowing in a long straight wire. The intensity of magnetic field at a distance 10 cm from the wire will be
(a) 2×10^{-5} Wb/m^2
(b) 9×10^{-5} W/m^2
(c) 4×10^{-5} Wb/m^2
(d) 6×10^{-5} Wb/m^2

28. The resistance of a galvanometer is 50 Ω. When 0.01 A current flows in it, full scale deflection is obtained in galvanometer, the resistance of shunt connected to convert galvanometer into an ammeter of range 5A, will be
(a) 0.1 Ω (b) 0.2 Ω
(c) 0.3 Ω (d) 0.4 Ω

29. When a resistance of a Ω is connected at the ends of a battery, its potential difference decreases from 40 V to 30 V. The internal resistance of the battery is
(a) 3 Ω (b) 6 Ω
(c) 1.5 Ω (d) 4 Ω

30. The equilvalent resistance and potential difference between A and B for the circuit



respectively are
(a) 4 Ω, 8 V (b) 8 Ω, 4 V
(c) 2 Ω, 2 V (d) 16 Ω, 8 V

31. A wire of resistance R is divided in equal parts, then these parts are joined in parallel, the equivalent resistance of the combination will be
(a) nR (b) $\frac{R}{n}$
(c) $\frac{n}{R}$ (d) $\frac{R}{n^2}$

32. The capacity of an air condenser is 2.0 μF. If a medium is placed between its plates, the capacity becomes 12 μF. The dielectric constant of the medium will be
(a) 5 (b) 4
(c) 3 (d) 6

33. Taking the earth to be a spherical conductor of diameter 12.8×10^3 km. Its capacity will be
(a) 711 μF (b) 611 μF
(c) 811 μF (d) 511 μF

34. The ratio of electrostatic and gravitational forces acting between electron and proton separated by a distance 5×10^{11} m, will be
(Charge on electron = 1.6×10^{-19}C, mass of electron = 9.1×10^{-31} kg, mass of proton = 1.6×10^{-27} kg, $G = 6.7 \times 10^{-11}$ Nm^2/kg^2)
(a) 2.36×10^{39}
(b) 2.36×10^{40}
(c) 2.34×10^{41}
(d) 2.34×10^{42}

35. A student can distinctly see the object upto a distance 15 cm. He wants to see the black board at a distance of 3m. Focal length and power of lens used respectively will be :
(a) – 4.8 cm, – 3.3 D (b) – 5.8 cm, – 4.3 D
(c) – 7.5 cm, – 6.3 D (d) – 15.8 cm, – 6.33 D

36. A this glass prism ($\mu = 1.5$) in the position of minimum deviation deviates the monochromatic light ray by 10°, the refracting angle of prism is
(a) 20° (b) 10° (c) 30° (d) 45°

37. Two thin lenses of powers 12 D and –2D respectively are placed in contact, the power, focal length and nature respectively will be
(a) 8 D, 0.8 m, convex
(b) 14 D, 0.5 m convex
(c) 5 D, 0.2 m, convex
(d) 10 D, 0.1 m, convex

38. Amount of work which can be obtained from 200 cal heat, will be
(a) 280 J (b) 800 J
(c) 420 J (d) 840 J

39. The spring extends by x on loading, then energy stored by the spring is
(if T is the tension in spring and k is spring constant)
(a) $\frac{T^2}{2k}$ (b) $\frac{T^2}{2k^2}$
(c) $\frac{2k}{T^2}$ (d) $\frac{2T^2}{k}$

40. The kinetic energy of one molecule of a gas at normal temperature and pressure will be (k = 8.31 J/mole K)
(a) 1.7×10^3 J
(b) 10.2×10^3 J
(c) 3.4×10^3 J
(d) 6.8×10^3 J

CHEMISTRY

41. The significant figures in 1.0024, 1.240 and 0.0020 are respectively
(a) 5, 4, 2 (b) 3, 3, 1
(c) 5, 3, 4 (d) 5, 3, 2

42. Bauxite is an ore of
(a) boron (b) barium
(c) aluminium (d) bismuth

43. A golf-ball weigh 40.0g. If it is moving with a velocity of 20.0 ms^{-1}, it's de-Broglie wavelength is
(a) 1.66×10^{-34} nm (b) 8.28×10^{-32} nm
(c) 8.28×10^{-25} nm (d) 1.66×10^{-24} nm

44. Which one of the following elements, is a component of a compound essential for photosynthesis ?
(a) Iron (b) Calcium
(c) Barium (d) Magnesium

45. Which of the following, is a mordant dye?
(a) Aniline black (b) Congo-red
(c) Alizarin (d) Indigo

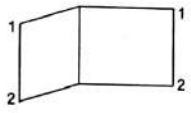
46. Which is the shortest wavelength line in the Lyman series of the hydrogen spectrum?
($R = 1.097 \times 10^{-2} nm^{-1}$)
(a) 94.21 nm (b) 91.16 nm
(c) 911.6 nm (d) 933.6 nm

47. Which of the following order of ionisation energy is correct ?
(a) B < Be < N < C
(b) Be > B > C > N
(c) B < Be < C < N
(d) Be < B < C < N

48. Which of the following turns potassium dichromate paper green?
(a) NO_2 (b) HCl (c) NH_3 (d) SO_2

49. The correct order of stability of carbocations, is :
(a) $1° < 2° < 3° < \overset{+}{C}H_3$
(b) $\overset{+}{C}H_3 < 1° < 2° < 3°$
(c) $3° < 2° < 1° < \overset{+}{C}H_3$
(d) $2° < 3° < 1° < \overset{+}{C}H_3$

50. The IUPAC name of the following compound is



(a) bicyclo [2, 2, 0] octane
(b) bicyclo [0, 2, 2] hexane
(c) bicyclo [2, 1, 1] hexane
(d) bicyclo [2, 2, 0] hexane

51. The following compound can not exhibit
$CH_3CH{=}CH{-}CH(OH).COOH$
(a) geometrical isomerism
(b) optical isomerism
(c) metamerism
(d) position isomerism

52. Volume of CO_2 obtained from complete decomposition of 20 g $CaCO_3$ at STP is
(a) 2.24 litre (b) 4.48 litre
(c) 20 litre (d) 22.4 litre

53. The shape of an orbital is determined by
(a) n (b) l
(c) m (d) s

54. Oxidation number Fe in $K_3[FeCN)_6]$ is
(a) +1 (b) +2
(c) +3 (d) +4

55. The enthalpies of all elements in their standard states are
(a) zero (b) > 0
(c) < 0 (d) unity

56. Which of the following, is not a unit of pressure?
(a) Atmosphere (b) Torr
(c) Pascal (d) Newton

57. The Ka of an acid is 3.2×10^{-5}. The degree of dissociation of the acid at concentration of 0.2 M is
(a) 6.0×10^{-2}
(b) 1.26×10^{-2}
(c) 40×10^{-4}
(d) 0.04×10^{-3}

58. Which of the following ions, has smallest size?
(a) Ca^{2+} (b) Cl^-
(c) S^{2-} (d) K^+

59. Which of the following acids is monobasic?
(a) H_3PO_3 (b) H_3PO_2
(c) H_2SO_3 (d) H_3PO_4

60. Which of the following is paramagnetic?
(a) CO (b) N_2
(c) O_2 (d) H_2O_2

61. Yellow phosphorus is kept in
(a) water (b) kerosene
(c) ether (d) alcohol

62. The oxide that gives H_2O_2 on treatment with dilute acid is
(a) PbO_2 (b) MnO_2
(c) Na_2O_2 (d) TiO_2

63. Which of the following dissolves in hot conc. NaOH solution?
(a) Fe (b) Zn
(c) Cu (d) Ag

64. CH_3CHCl_2, on hydrolysis, will give
(a) CH_3CHO (b) CH_3COOH
(c) $CHCl_3$ (d) CH_3CH_2OH

65. The compound which reacts faster with Lucas reagent is
(a) butan-1-ol
(b) butan-2-ol
(c) 2-methyl-propan-1-ol
(d) 2-methyl propan-2-ol

66. What is obtained, when potassium succinate soluton is electrolysed ?
(a) Ethane (b) Ethene
(c) Ethyne (d) All of these

67. Which of the following has the maximum acidic strength ?
(a) *p*-nitrophenol
(b) *p*-nitrobenzoic acid
(c) *o*-nitrobenzoic acid
(d) *m*-nitrobenzoic acid

68. Which of the following statement is not correct?
(a) Adsorption energy for chemical adsorption is generally greater than that of physical adsorption
(b) Physical adsorption is due to van der Waal forces
(c) Physical adsorption decreases at high temperature and low pressure
(d) Physical adsorption is irreversible

69. An element '*Y*' emits one α-and two β-particles to give '*X*'. *X* and *Y* are
(a) isotones
(b) isobars
(c) isotopes
(d) isoelectronics

70. For a reaction, the half-life is independent of initial concentration. What is the order of that reaction ?
(a) Zero (b) One
(c) Two (d) Three

71. Addition of a non-volatile solute causes lowering in vapour pressure of a solvent from 0.8 atm. to 0.2 atm. What is the mole fraction of solvent?
(a) 0.25
(b) 0.75
(c) 0.50
(d) Cannot be predicted

72. Which of the following has sp^3-hybridisation?
(a) BCl_3
(b) PCl_3
(c) $BeCl_2$
(d) None of these

73. The pH of 10^{-8}M NaOH is
(a) 8.0
(b) 6.0
(c) 6.96
(d) 7.04

74. For the reaction, $2NO_2$ $2NO + O_2$, the value of K_p is equal to K. What will the value of K_p for reaction,

$$NO + \frac{1}{2}O_2 \longrightarrow NO_2$$

(a) $\sqrt{K}$ (b) $\frac{1}{K}$
(c) $\sqrt{\frac{1}{K}}$ (d) $\frac{1}{K^2}$

75. Two metals 'A' and 'B' have E°_{red} value equal to 0.36 V and 1.23 V. What will be the correct cell equation ?
(a) $A + B^{2+} \longrightarrow A^{2+} + B$
(b) $A^{2+} + B \longrightarrow A + B^{2+}$
(c) Both (a) and (b)
(d) None of the above

76. Lunar caustic is
(a) AgCl (b) $AgNO_3$
(c) NaOH (d) KNO_3

77. Which of the following forms molecular solid?
(a) SO_2 (b) SiO_2
(c) SiC (d) Diamond

78. $CH_3COOH \xrightarrow{P/Br_2} CH_2BrCOOH$
This reaction is called
(a) Schotton-Bauman reaction
(b) Finkelstin reaction
(c) Hell-Volhard-Zelinsky reaction
(d) none of the above

79. What is 'X' in the following sequence ?

$$Ar.N_2Cl \xrightarrow[KCN]{CuCN} Z \xrightarrow{H.OH} Y \xrightarrow[\Delta]{soda\text{-}lime} X$$

(a) Benzoic acid
(b) Sodium benzoate
(c) Benzaldehyde
(d) Benzene

80. Solvent loving colloids are known as
(a) hydrophobic (b) lyophilic
(c) hydrophilic (d) none of these

ZOOLOGY

81. ADH controls water permeability of
(a) collecting tube
(b) proximal convoluted tubules
(c) distal convoluted tubules
(d) all of the above

82. At high altitude, RBC's of human blood will
(a) increase in number
(b) decrease in number
(c) decrease in size
(d) increase in size

83. A person who is trisomic for twenty first pair of chromosome suffers from
(a) Klinefelter's syndrome
(b) Down's syndrome
(c) Turner's syndrome
(d) None of the above

84. Enzymes are absent in
(a) algae (b) plants (c) virus (d) bacteria

85. The basic unit of chitin is
(a) *N*-acetyl glucosamine
(b) glucose
(c) galactose
(d) fructose

86. Striped muscles are
(a) anucleate (b) binucleate
(c) uninucleate (d) syncytial

87. Ventricles are related to
(a) heart only (b) brain only
(c) both 'a' and 'b' (d) none of these

88. Incomplete division of egg during cleavage is known as
(a) meroblastic (b) holoblastic
(c) meridional (d) spiral

89. In which blood group antigens are absent ?
(a) O (b) B (c) AB (d) A

90. Arachidonic acid is
(a) non-essential fatty acid
(b) essential fatty acid
(c) poly unsaturated fatty acid
(d) both 'b' and 'c'

91. The immediate cause of induction of ovulation in female is the large plasma surge of
(a) progesterone (b) estradiol
(c) LH (d) FSH

92. Which type of enzyme is present in lysosome?
(a) ATPase (b) Hydrolytic
(c) Lyase (d) None of these

93. The true stomach in ruminants where most of digestion takes place is
(a) rumen (b) omasum
(c) reticulum (d) abomasum

94. The effect of intraspecific competition on niches is to make them
(a) smaller (b) larger
(c) change location (d) more triangular

95. The larvicidial fish used in biocontrol of mosquitoes
(a) *Gambusia* (b) Hilsa
(c) *Scatophagus* (d) Gold fish

96. The joint of radio-ulna with the upper arm is
(a) hinge joint (b) pivot joint
(c) socket joint (d) none of these

97. Which of the following amino acids are present in ornithine cycle ?
(a) Valine and cystine
(b) Arginine and citrulline
(c) Glycine and methionine
(d) None of these

98. Third cleavage of frog's development is
(a) equatorial (b) vertical
(c) latitudinal (d) none of these

99. Which of the following is both exocrine and endocrine gland ?
(a) Liver (b) Pancreas
(c) Thyroid (d) Adrenal

100. Which of the following is the part of mid brain of rabbit?
(a) Diencephalon
(b) Cerebrum
(c) Corpora quadrigemina
(d) None of the above

101. Phospholipids are
(a) amphipathic (b) amphibolic
(c) hydrophobic (d) none of these

102. Which of the following assists in the locomotion of the organism stated?
(a) Epithelium of *Pheretima*
(b) Trichocysts of *Paramecium*
(c) Pedicellaria of Star fish
(d) Posterior sucker of *Hirudinaria*

103. Dinosaurs become extinct in
(a) Permian age
(b) Triassic period
(c) Jurassic period
(d) Cretaceous period

104. Blood calcium level can be increased by the administration of
(a) glucagon (b) parathormone
(c) thyroxine (d) calcitonin

105. The first heart sound is produced when
(a) diastole begins
(b) semilunar valve close quickly
(c) interventricular pressure decreases
(d) bicuspid and tricuspid valve close quickly

106. The epithelial lining in the alveoli of the frogs facing lung cavity is
(a) squamous ciliated
(b) columnar ciliated
(c) columnar nonciliated
(d) squamous nonciliated

107. The infective stage of *Plasmodium* is
(a) sporozoite (b) trophozoite
(c) merozoite (d) schizont

108. A man of blood group 'A', marries a woman of blood group 'B', both of them are heterozygous for blood group, chances of their first child having blood group AB will be
(a) 25% (b) 50% (c) 75% (d) 100%

109. The scientist, who described the birds as glorified reptiles, was
(a) Romer (b) Huxley
(c) Mendel (d) Robert Hooke

110. Which one of the following is vestigeal organ of human?
(a) Hair (b) Intestine
(c) Wisdom teeth (d) Muscle of glottis

111. Organ of Corti is found in
(a) heart (b) kidneys
(c) inner ear (d) nasal chamber

112. Which of the following is a transparent tissue?
(a) Tendon (b) Hyaline cartilage
(c) Fibrous cartilage (d) All of these

113. In frog, the vertebra with an anterior convex surface (*i.e.*, double convexties) is
(a) atlas (b) urostyle
(c) 8th vertebra (d) 9th vertebra

114. Peyer's patches produce
(a) mucus (b) trypsin
(c) lymphocytes (d) enterokinase

115. The vital capacity of lungs is equal to
(a) 4000 ml (b) 5000 ml
(c) 6000 ml (d) 7000 ml

116. What is left when bath sponges dries up?
(a) Spicules (b) Spongin fibres
(c) Tentacles (d) Holdfast

117. RBC's are nucleated in
(a) man (b) rat (c) frog (d) rabbit

118. Which of the following pairs is correctly matched?
(a) Central dogma – Codon
(b) Okazaki fragments – Splicing
(c) RNA polymerase –RNA primer
(d) Restriction enzymes – Genetic engineering

119. A nucleoside is
(a) base + sugar
(b) base + phosphate
(c) sugar + phosphate
(d) base + sugar + phosphate

120. Stanley Miller performed an experiment to prove the origin of life. They took gases NH_3 and H_2 along with
(a) N_2 and H_2O (b) H_2O and CH_4
(c) CH_4 and N_2 (d) CO_2 and NH_3

BOTANY

121. Mannitol is reserve food in
(a) Rhodophyceae
(b) Chlorophyceae
(c) Phaeophyceae
(d) Xanthophyceae

122. Plants growing on sand and gravel are called
(a) eremophytes
(b) psammophytes
(c) psilophytes
(d) oxylophytes

123. The inflorescence in *Ocimum* is :
(a) cyathium
(b) verticillaster
(c) hypanthodium
(d) raceme

124. If the pollen tube enters the ovule through funiculus, the phenomenon is known as
(a) porogamy
(b) chalazogamy
(c) mesogamy
(d) heterogamy

125. The first phylogenetic system of plant classification was proposed by
(a) Engler
(b) Engler and Prantl
(c) Eichler
(d) Wetlstein

126. Cellulose fibre is obtained from *Gossypium*.
(a) stem surface
(b) seed hair
(c) leaf surface
(d) root hair

127. In split genes the coding sequences are called
(a) introns
(b) exons
(c) cistrons
(d) operons

128. The real forces responsible for the movement of water from one cell to another cell is mainly
(a) Osmotic Pressure (OP)
(b) Turgor Pressure (TP)
(c) Diffusion Pressure Deficit (DPD)
(d) imbibition

129. Which of the following is the most resistant material in pollen grain ?
(a) Sporopollenin (b) Intine
(c) Exine (d) Certicle

130. The amphibians of plant kingdom are
(a) multicellular non motile algae
(b) bryophytes with simple internal organisation
(c) unicellular motile algae
(d) pteridophytes with complex internal organisation

131. Black rust of wheat is a fungal disease caused by
(a) *Melampsora lini*
(b) *Claviceps Purpurea*
(c) *Albugo candida*
(d) *Puccinia graemzinis tritici*

132. Which of the following statement is correct about DDT ?
(a) It is a biomagnifying biodegradable pollutant
(b) It is non biomagnifying biodegradable pollutant
(c) It is biomagnifying non biodegradable pollutant
(d) It is not a pollutant

133. In Chlorophyceae the mode of sexual reproduction is
(a) anisogamy (b) oogamy
(c) isogamy (d) all of these

134. Restriction enzymes are used in genetic engineering, because they
(a) can degrade harmful proteins
(b) can join different DNA fragments
(c) can cut DNA at specific base sequence
(d) are nucleases that cut DNA at variable sites

135. In which genera endospores are formed for reproduction?
(a) *Monococcus* and *Clostridium*
(b) *Bacillus* and *Clostridium*
(c) *Mucor* and *Bacillus*
(d) None of the above

136. Agricultural chemicals include
(a) growth regulators (b) fertilizers
(c) pesticides (d) all of these

137. $2n-1$ condition represent
(a) tetrasomy (b) trisomy
(c) monosomy (d) multisomy

138. CO is harmful to human being because
(a) it decreases CO_2 concentration
(b) it competes O_2 to combine with haemoglobin
(c) it is carcinogenic
(d) it depletes O_3 layer

139. Which of the following is a day neutral plant?
(a) *Helianthus annuus*
(b) *Euphorbia pulcherrima*
(c) *Avena sativa*
(d) *Beta vulgaris*

140. Which of the following is an antigibberellin?
(a) Auxin (b) ABA
(c) Ethylene (d) Cytokinin

141. Heterospory is the production of
(a) sexual and asexual spores
(b) large and small spores
(c) haploid and diploid spores
(d) diploid and tetraploid spores

142. Algal zone is present in
(a) normal root of *Cycas*
(b) coralloid root of *Cycas*
(c) normal root of *Pinus*
(d) stem of *Cycas*

143. Double fertilization means
(a) fusion of nucleus of male gamete with the egg nucleus
(b) fusion of two polar nuclei
(c) fusion of sperm nucleus with secondary nucleus
(d) fusion of one sperm nucleus with nucleus and fusion of other sperm nucleus with secondary nucleus

144. The magnitude of root pressure ranges from:
(a) 2-5 atm (b) 1-5 atm
(c) 0.1-0.2 atm (d) 4-6 arm

145. Which of the following element plays an important role in nitrogen fixation?
(a) Zinc (b) Molybdenum
(c) Manganese (d) Copper

146. The terminal electron acceptor during electron transport system is
(a) oxygen (b) cyto a_3
(c) cyto c (d) plasto quinone

147. The *Orobanche* plant is
(a) partial stem parasite
(b) total root parasite
(c) symbiont
(d) total stem parasite

148. Glycolysis occurs in
(a) cytosol
(b) mitochondria
(c) Golgi complex
(d) ribosomes

149. 'Reindeer moss' is common name for
(a) *Funaria hygrometrica*
(b) *Marchantia* sp
(c) *Cladonia rangifera*
(d) *Polytrichum sp*

150. Micro-organism which act as a vehicle for foreign gene transfer in higher plants:
(a) *Agrobacterium*
(b) *E. coli*
(c) T.M.V.
(d) *Bacillus anihracis*

151. DNA polymerase enzyme is required for synthesis of :
(a) DNA from RNA
(b) RNA from DNA
(c) DNA from DNA
(d) RNA from RNA

152. In terrestrial ecosystem such as forest, maximum energy is found in which trophic level?
(a) T_1 (b) T_2 (c) T_3 (d) T_4

153. The part of earth in which life exist is known as ?
(a) Lithosphere
(b) Biosphere
(c) Atmosphere
(d) Hydrosphere

154. Periderm includes :
(a) cork cambium only
(b) cork cambium and cork
(c) cork and secondary cortex
(d) cork cambium, cork and secondary cortex

155. Yeast belongs to which class?
(a) Basidiomycetes (b) Ascomycetes
(c) Eumycetes (d) None of these

156. In *Spirogyra* sometimes a ladder like structure is present due to :
(a) vegetative reproduction
(b) asexual reproduction
(c) lateral conjugation
(d) scalariform conjugation

157. In Hatch and Slack type plants CO_2 acceptor is
(a) malate
(b) pyruvate
(c) phosphoenol pyruvate
(d) aspartate

158. In CAM plants
(a) stomata open in day and close at night
(b) stomata remain open in day and night both
(c) stomata remain closed in day and night both
(d) stomata open at night and close in day

159. Which type of DNA is found in bacteria?
(a) Helical DNA
(b) Membrane bound DNA
(c) Straight DNA
(d) Circular free DNA

160. Which is social foresting species?
(a) *Leucaena leucocephala*
(b) *Tectona grandis*
(c) *Mangifera indica*
(d) *Rosa indica*

GENERAL ENGLISH

Directions : In the following passage there are blanks each of which has been numbered. Fill up the blank spaces choosing the appropriate word from the given alternatives.
For generations man has 1 against the wilds to create a world where only he 2 whether animals and plants survive or are 3 out. Earlier we accepted as self-evident that any 4 in our environment brought about by science and technology must be improvements 5 the world of our 6 However, many people all over the world have begun to feel that 7 are going too far and that we should try to 8 some of the world's original life before we find it 9 too late. The same science which had led us away from nature is now 10 the miracle of creation.

161. (a) faced (b) stood
(c) struggled (d) challenged

162. (a) decides (b) thinks
(c) advises (d) observes

163. (a) taken (b) wiped
(c) put (d) thrown

164. (a) differences (b) increments
(c) changes (d) replacements

165. (a) in (b) at (c) over (d) for

166. (a) aborigins (b) ancients
(c) successors (d) ancestors

167. (a) ourselves (b) we
(c) us (d) some

168. (a) demolish (b) cherish
(c) save (d) renovate

169. (a) occurs (b) sounds
(c) seems (d) gets

170. (a) unfolding (b) discussing
(c) arguing (d) narrating

Directions : Pick up the synonyms for each of the following words given in capitals.

171. WEIRD
(a) frightening (b) unpleasant
(c) unnatural (d) beastly

172. TYRANNY
(a) miserly (b) madness
(c) cruelty (d) strength

173. RESILIENCE
(a) diversity (b) elasticity
(c) strength (d) adjustment

174. SYCOPHANT
(a) admirer (b) suppliant
(c) follower (d) flatterer

175. FACADE
(a) front (b) top
(c) floor (d) basement

176. SHAM
(a) blunt (b) unnatural
(c) unfair (d) pretender

Directions : Pick up the antonyms for each of the following words given in capitals.

177. HOARD
(a) deposit (b) store
(c) supply (d) exit

178. RANCOUR
(a) harmony (b) enmity
(c) devotion (d) animosity

179. BIZARRE
(a) strange (b) usual
(c) same (d) gentle

180. DEARTH
(a) abundance (b) extravagance
(c) scarcity (d) sufficiency

181. SLOVENLY
(a) neat (b) decent
(c) proper (d) correct

182. IMPENITENT
(a) sorrowful
(b) pertinent
(c) repentant
(d) disgraceful

Directions : In each of the following sentences a part of the sentence is italicised. Select the better substitution' than the italicised part, from the given alternatives.

183. The document is *concerning* your health and that of your family.
(a) concerns with (b) is concerned with
(c) concerns (d) may concern

184. I'll write to you *after I shall arrive.*
(a) after I shall have arrived
(b) after I have arrived
(c) after I arrive
(d) after I will arrive

185. I did nothing but *laughed.*
(a) laughing (b) laugh
(c) laughed aloud (d) went on laughing

186. He learnt it sitting *under the feet* of many great teachers.
(a) before the feet (b) at the feet
(c) on the feet (d) over the feet

187. The Minister asked me to *carry on* his orders immediately.
(a) carry out (b) carry in
(c) carry with (d) carry forward

188. You don't know the mechanism of computer properly, *isn't it ?*
(a) don't you (b) haven't you
(c) do you (d) were you

189. *Until* the sky is overcast, I take my raincoat with me.
(a) whenever (b) even if
(c) when (d) unless

190. He does not like *me coming so late.*
(a) me come so late (b) I coming so late
(c) my coming so late (d) mine coming so late

Directions : Read the following passages and answer the questions that follow :

PASSAGE – I

At low tide he walked over the sands to the headland and round the corner to the little bay facing the open sea. It was inaccessible by boat because seams of rock jutted out and currents swirled round them treacherously. But you could walk there if you chose one of the lowest ebb tides that receded a very long way. You could not linger on the expedition, for once the tide was on the turn, it came in rapidly. For this reason very few people cared to explore the little bay and the cave at the back of it. But the unknown always drew this man like a magnet. He found the bay fresh and unlittered, as it was completely covered by the sea at high tide. The cave looked mysteriously dark, cool and inviting, and he penetrated to the farthest corner where he discovered a wide crack, rather like a chimney. He peered up and thought he could see a patch of daylight.

191. According to the writer the bay could not be reached by boat, because
(a) it had numerous layers of rock
(b) there were too many eddies
(c) it was facing the open sea
(d) there were seams of rock and treacherously swirling currents

192. One could visit the bay
(a) at any time one chose
(b) on certain specified occasions
(c) when there was a low tide
(d) during the evening walk

193. It was not possible to "linger on the expedition" because
(a) the water rose rapidly
(b) the tide turned quickly
(c) the tide turned sprightly
(d) the water rushed in with a great force

194. He found the bay "fresh and unlittered" because
(a) the sea water had receded
(b) he was the first visitor there
(c) the high tide had just washed the litter away
(d) it was not frequented by people who would pollute it

195. While passing through the cave, the writer discovered a
(a) cool and secluded corner
(b) large opening
(c) chimney-shaped rock
(d) big crack through which light came in

PASSAGE – II

Recent research indicates that proper diet may help to reduce the risk of cancer. Since cancer develops over a long time–typically decades–one has time to hinder or promote it. Certain foods can block the chemicals that initiate cancer. Anti- oxidants found in some vitamins and minerals can snuff out oxygen free radicals, which are thought to make cells susceptible to cancer. They can even repair some of the cellular damage that has been done.

Wheat bran, for example has been shown to shrink precancerous cells. One of the most studied anti-oxidants in vegetables and fruits is beta-carotene concentrated in deep green, yellow and orange vegetables such as carrots, sweet potatoes and spinach, fruits such as apricots and muskmelons. Beta-carotene has a direct toxic effect on cells from malignant tumours. Inside the body it changes to retinoic acid used in the treatment of cancer. A simple rule is, darker the vegetable more is the anti-oxidant within. Vegetables such as cabbage, cauliflower and broccoli reduce the risk of breast cancer. Soyabeans contain at least five compounds believed to inhibit cancer. Wheat bran lowers the risk of colon cancer. The ideal diet is low in fat and calories, high in fibre and includes a variety of nutrients–rich foods like fruits, vegetables, beans, seeds and nuts.

196. The idea that what one eats has an effect on one's susceptibility to a disease like cancer is
(a) an age-old belife
(b) the result of modern experimental evidence
(c) an accidental discovery
(d) a myth

197. Human cells becomes more susceptible to cancer because of
(a) oxygen-free radicals
(b) anti-oxidants
(c) vitamins and minerals
(d) cellular malfunctioning

198. The virulence of malignant tumours can be reduced with the help of
(a) deep red and pale green vegetables
(b) retinoic acid directly taken from fruits
(c) beta-carotene
(d) high calorie foods

199. Cells which subsequently become cancerous can be inhibited by
(a) fatty acids
(b) unsieved wheat flour
(c) regular intake of retinoic acid
(d) highly cooked food

200. Fibre needed to reduce the risk of cancer is present in
(a) foods rich in fat
(b) linen and jute
(c) vegetarian food
(d) meat and fish

Answers

PHYSICS

1. (c)	2. (d)	3. (c)	4. (b)	5. (c)	6. (a)	7. (d)	8. (a)	9. (d)	10. (b)
11. (d)	12. (b)	13. (c)	14. (d)	15. (a)	16. (a)	17. (d)	18. (a)	19. (a)	20. (a)
21. (b)	22. (a)	23. (a)	24. (a)	25. (a)	26. (a)	27. (c)	28. (a)	29. (a)	30. (a)
31. (d)	32. (d)	33. (a)	34. (a)	35. (d)	36. (a)	37. (d)	38. (d)	39. (a)	40. (c)

CHEMISTRY

41. (a)	42. (c)	43. (c)	44. (d)	45. (c)	46. (b)	47. (c)	48. (d)	49. (b)	50. (d)
51. (c)	52. (b)	53. (b)	54. (c)	55. (a)	56. (d)	57. (b)	58. (a)	59. (b)	60. (c)
61. (a)	62. (c)	63. (b)	64. (a)	65. (d)	66. (b)	67. (c)	68. (d)	69. (c)	70. (b)
71. (a)	72. (b)	73. (d)	74. (c)	75. (a)	76. (b)	77. (a)	78. (c)	79. (d)	80. (b)

ZOOLOGY

81. (c)	82. (a)	83. (b)	84. (c)	85. (a)	86. (d)	87. (c)	88. (a)	89. (a)	90. (d)
91. (c)	92. (b)	93. (d)	94. (a)	95. (a)	96. (a)	97. (b)	98. (c)	99. (b)	100. (c)
101. (a)	102. (d)	103. (d)	104. (b)	105. (d)	106. (b)	107. (a)	108. (a)	109. (b)	110. (c)
111. (c)	112. (b)	113. (d)	114. (c)	115. (b)	116. (b)	117. (c)	118. (d)	119. (a)	120. (d)

BOTANY

121. (c)	122. (b)	123. (b)	124. (c)	125. (c)	126. (b)	127. (b)	128. (c)	129. (a)	130. (b)
131. (d)	132. (c)	133. (d)	134. (c)	135. (b)	136. (d)	137. (c)	138. (b)	139. (a)	140. (b)
141. (b)	142. (b)	143. (d)	144. (b)	145. (b)	146. (a)	147. (b)	148. (a)	149. (c)	150. (a)
151. (c)	152. (a)	153. (b)	154. (d)	155. (b)	156. (d)	157. (c)	158. (d)	159. (d)	160. (a)

GENERAL ENGLISH

161. (c)	162. (a)	163. (b)	164. (c)	165. (a)	166. (d)	167. (b)	168. (c)	169. (d)	170. (a)
171. (c)	172. (c)	173. (b)	174. (d)	175. (a)	176. (d)	177. (c)	178. (a)	179. (b)	180. (a)
181. (a)	182. (c)	183. (b)	184. (b)	185. (b)	186. (b)	187. (a)	188. (c)	189. (a)	190. (c)
191. (a)	192. (c)	193. (b)	194. (c)	195. (d)	196. (b)	197. (a)	198. (c)	199. (c)	200. (c)

Hints & Solution

PHYSICS

1. According to conservation of momentum

$$m_1 v_1 + m_2 v_2 = (m_1 + m_2)\, v'$$

$$mv + 2m \times 0 = (m + 2m)\, v'$$

So, $$v' = \frac{v}{3}$$

2. From the formula $G = \dfrac{FR^2}{m_1 m_2}$

Dimensions of

$$G = \frac{\text{dimensions of force } F \times \text{dimension of } (R)^2}{\text{dimensions of mass } M \times \text{dimension of mass } M}$$

$$= \frac{[MLT^{-2}][L^2]}{[M][M]} = [M^{-1}L^3T^{-2}]$$

3. Here: Initial velocity $u = -4.9$ m/s (–ve is due to vertically upward motion)

Total time $t = 2$ sec

The height of the bridge is given by

$$s = ut + \frac{1}{2}gt^2$$

$$= -4.9 \times 2 + \frac{1}{2} \times 9.8 \times (2)^2$$

$$= -9.8 + 19.6 = 9.8 \text{ m}$$

4. Here: Mass of the ball $m = 150$ g

time = 0.15 kg

Acceleration of the ball = 20 m/s^2

dt 0.1 s

Force, $F = ma = 0.15 \times 20 = 3$ N

Now impulsive force

$$= F \times dt = 3 \times 0.1 = 0.3 \text{ Ns}$$

5. Here: Mass of earth $M_e = 6 \times 10^{24}$ kg

Angular velocity of earth $\omega = 2 \times 10^{-7}$ rad/s

Radius of circular orbit

$$R = 1.5 \times 10^8 \text{ km}$$

$$= 1.5 \times 10^{11} \text{ m}$$

Force exerted on the earth by the sun is given by $F = M_e R\omega^2$

$$= 6 \times 10^{24} \times 1.5 \times 10^{11} \times (2 \times 10^{-7})^2$$

$$= 36 \times 10^{21} \text{ N}$$

6. Using the formula for work done

$$W = \vec{F} \cdot \vec{r} = \vec{F} \cdot (\vec{r_2} - \vec{r_1})$$

$$W = (4\hat{i} + \hat{j} + 3\hat{k}) \cdot (14\hat{i} + 13\hat{j} + 9\hat{k}) - 3\hat{i} - 2\hat{j} + 6\hat{k})$$

$$W = (4\hat{i} + \hat{j} + 3\hat{k}) \cdot (11\hat{i} + 11\hat{j} + 15\hat{k})$$

$$W = 44 + 11 + 45 = 100 \text{ joule}$$

7. Intital mass of the gas $m_1 = 10$ kg

Initial pressure $P_1 = 10$ N/m^2

Final pressure $P_2 = 2.5 \times 10^6$ N / m^2

According to kinetic theory of gases

$$PV = \frac{1}{3}mc^{-2}$$

or $$P \propto m$$

Hence, $$\frac{P_1}{P_2} = \frac{m_1}{m_2}$$

or $$\frac{10^7}{2.5 \times 1^6} = \frac{10}{m_2}$$

or $$m_2 = 2.5 \text{ kg}$$

Hence, quantity of gas taken out from the cylinder is 10 – 2.5 = 7.5 kg

8. In semiconductor, when an electron leaves its place, a positive charge is left behind and it is known as hole. Hence, holes are created becauase of missing electrons.

9. Here : Weight of block $w = 2$ kN,

Distance $d = 10$ m

Angle of inclination on the plane $\alpha = 15°$

The block will be pulled up on a smooth plane

Hence, force of resistance due to inclination

$$F = w \sin \alpha = 2 \times 10^3 \sin 15°$$

$$= 2 \times 10^3 \times 0.2588$$

$$= 0.5176 \text{ kN}$$

Now work done,

$$W = Fd = 0.5176 \times 10^3 \times 10$$
$$= 5.17 \text{ kJ}$$

10. Heat added to the system $\Delta Q = 110$ J

Internal energy $\Delta u = 40$ J

External work done is given by

$$\Delta W = \Delta Q - \Delta u = 110 - 40 = 70 \text{ J}$$

11. Here : Length of column = 40 cm = 0.4 m

Frequency of tuning fork = 450 Hz

Using the formula $n = \frac{v}{4l}$

or $v = 450 \times 4 \times 0.4$

$= 720$ m/s

12. Here: Initial vibration $n_1 = n$, final vibration $n_2 = 2n$

Initial tension $T_1 = T$

Vibration of frequency of string

$$n = \frac{1}{2l}\sqrt{\frac{T}{m}}$$

$$\Rightarrow \quad n \propto \sqrt{T}$$

Hence, $\frac{n_1}{n_2} = \sqrt{\frac{T_1}{T_2}}$

or $\frac{T_1}{T_2} = \left(\frac{n_1}{n_2}\right)^2 = \left(\frac{n}{2n}\right)^2 = \frac{1}{2}$

or $T_2 = 4T_1$

13. Here: Frequency of siren = 500 Hz

The speed of siren $v_s = 50$ m/s

Using Doppler's principle

$$n' = \frac{v}{v + v_s} n$$

or $n' = \left(\frac{330}{330 + 50}\right) \times 500$

or $n' = \frac{330 \times 500}{380} = 434.2$ Hz

14. Half life $T_{1/2} = 3.6$ days

Initial quantity $N_0 = 20$ mg

Total time = 36 days

The number of half lives

$$n = \frac{t}{T_{1/2}} = \frac{36}{3.6} = 10$$

Hence, mass of radioactive substance left after 10 half lives

$$N = N_0 \times \left(\frac{1}{2}\right)^n = 20 \times \frac{1}{1024} = 0.019 \text{ mg}$$

15. Wavelength associated with an electron

$$\lambda = \frac{h}{\sqrt{2mE}}$$

$$= \frac{6.6 \times 10^{-34}}{\sqrt{2 \times 9.1 \times 10^{-31} \times 5 \times 1.6 \times 10^{-19}}}$$

$$= 5.47 \times 10^{-10} \text{m} = 5.47 \text{ Å}$$

16. Charge on the particle is given by

$$qE = mg \text{ or } q = \frac{mg}{E}$$

$$= \frac{9.6 \times 10^{-16} \times 10}{20000} = 4.8 \times 10^{-19}$$

When there is an excess of n electrons on the particle, then

$$q = ne$$

So, $n = \frac{q}{e} = \frac{4.8 \times 10^{-19}}{1.6 \times 10^{-19}} = 3$

17. According to Einstein's mass energy equivalence

$$E = mc^2 = 1 \times (3 \times 10^8)^2 = 9 \times 10^{16} \text{ J}$$

$$= \frac{9 \times 10^{16}}{1.6 \times 10^{-13}} \text{ MeV}$$

(since 1 MeV = 1.6×10^{-13} J)

$$= 5.625 \times 10^{29} \text{ MeV}$$

18. From relation, $\frac{hc}{\lambda_{min}} = eV$

or $\lambda_{min} = \frac{hc}{eV}$

or $\lambda_{min} = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{1.6 \times 10^{-19} \times 20 \times 10^3}$

$$= 0.62 \times 10^{-10} \text{m} = 0.62 \text{ Å}$$

19. Here: $\Delta V_c = 0.5$ volt,

$$\Delta I_c = 0.05 \text{ mA} = 0.05 \times 10^{-3} \text{A}$$

Output resistance is given by

$$R_{out} = \frac{\Delta V_c}{\Delta I_c}$$

$$= \frac{0.5}{0.05 \times 10^{-3}} = 10^4 \ \Omega = 10 \ K\Omega$$

20. The frequency of radiowaves (speed $c = 3 \times 10^8$ m/s) transmitted

$$f = \frac{c}{\lambda} = \frac{3 \times 10^8}{360} = 8.3 \times 10^5 \text{ Hz}$$

Frequency of series resonant circuit

$$f = \frac{1}{2\pi\sqrt{LC}}$$

or $L = \frac{1}{(2\pi f)^2 C}$

$$= \frac{1}{(2 \times 3.14 \times 8.3 \times 10^5)^2 \times 1.20 \times 10^{-6}}$$

$$= 3.07 \times 10^{-8} \text{ H}$$

21. Here: $n = 4000$, $B = 0.5 \times 10^{-4}$ Wb/m^2

Rate of rotation of coil = 1800 rev/min

$$= \frac{1800}{60} = 30 \text{ rev/sec}$$

$\omega = 2\pi f = 2\pi \times 30 = 60\ \pi$ rad/s,

$r = 7$ cm $= 0.07$ m

Now area of coil

$$A = \pi r^2 = \pi \times (0.07)^2 = 49\pi \times 10^{-4} \text{ m}^2$$

Now the maximum energy induced is

$$e = BA\ n\omega$$
$$= 0.5 \times 10^{-4} \times 49\ \pi \times 10^{-4} \times 4000 \times 60\pi$$
$$= 0.58 \text{ V}$$

22. Here: $I_0 = 5\sqrt{2}$ A

Root mean square value of current

$$I_{rms} = \frac{I_0}{\sqrt{2}} \ \frac{5\sqrt{2}}{\sqrt{2}} = 5 \text{ A}$$

23. The resistance of lamp

$$R = \frac{V}{I} = \frac{15}{10} = 1.5\ \Omega$$

The impedance of circuit

$$Z = \frac{V}{I} = \frac{220}{10} = 22 \text{ ohm}$$

Again impedance $Z = \sqrt{R^2 + \omega^2 L^2}$

or $22 = \sqrt{(1.5)^2 + (2 \times \pi \times 50)^2 L^2}$

or $(22)^2 = (1.5)^2 + 4\pi^2 \times 50^2 \times L^2$

or $L = 0.07$ Henry

24. Here: $e = 1.5$ volt

$\Delta i = 0 - 3 = -3$ A, $\Delta t = 0.1$ sec

Now the emf induced in secondary coil

$$e = \frac{M\Delta i}{\Delta t} \quad \text{(numerically)}$$

or $1.5 = \frac{M \times 3}{0.1}$

or $M = \frac{1.5 \times 0.1}{3} = 0.05$ H

25. (i) In series: total resistance $= R + R = 2R$

Power consumed $P_1 = \frac{V^2}{2R}$ ...(i)

(ii) In parallel : potential difference across each resistance will be V

So, power consumed in each resistance is

$$P = \frac{V^2}{R}$$

So total power consumed in two resistance is

$$P_2 = \frac{V^2}{R} + \frac{V^2}{R} = \frac{2V^2}{R} \quad \text{...(ii)}$$

Hence, required ratio $= \frac{P_1}{P_2}$

$$= \frac{V^2 \times R}{2R \times 2V^2} = \frac{1}{4}$$

26. Here: $q = 1.6 \times 10^{-19}$ C, $B = 1.5$ Wb/m^2,

$v = 2 \times 10^7$ m/s, $\theta = 30°$ or $\sin 30° = \frac{1}{2}$

Force on proton is given by

$$F = qvB \sin\theta$$

$$= 1.6 \times 10^{-19} \times 2 \times 10^7 \times 1.5 \times \frac{1}{2}$$

$$= 2.4 \times 10^{-12} \text{ N}$$

27. Here: $i = 20$ A, $r = 10$ cm $= 0.1$ m

Intensity of magnetic field produced due to straight current carrying wire is

$$B = \frac{\mu_0}{4\pi} \times \frac{2i}{r}$$

$$= 10^{-7} \times \frac{2 \times 20}{0.1}$$

$$= 4 \times 10^{-5} \text{ Wb/m}^2$$

28. Here: $I_g = 0.01$ A, $G = 50\,\Omega$

To convert the galvanometer in to an ammeter of range 5A, a low resistance is to be connected in parallel with coil of galvanometer.

$$S = \frac{ig \times G}{i - i_g}$$

$$= \frac{0.01 \times 50}{5 - 0.01} = \frac{0.5}{4.99} = 0.1\,\Omega$$

29. $E = 40$ V, $V = 30$ V, $r = \alpha\,\Omega$

Internal resistance

$$r = \left(\frac{E}{V} - 1\right) R = \left(\frac{40}{30} - 1\right) 9$$

$$= \frac{1}{3} \times 9 = 3\Omega$$

30. The equivalent resistance between A and B is

$$\frac{1}{R'} = \frac{1}{6} + \frac{1}{6} + \frac{1}{3} = \frac{2}{3}$$

or $\quad R' = \frac{3}{2} = 1.5\,\Omega$

Now the equivalent resistance between A and B is

$$R'' = 1.5 + 2.5 = 4\Omega$$

Now by Ohm's law, potential difference between A and B is given by

$$V_A - V_B = iR = 2 \times 4.0$$

$$= 8 \text{ volt}$$

31. Resistance of one part $\frac{R}{n}$

Now equivalent resistance of n parts each of resistance $\frac{R}{n}$ in parallel is given by

$$R' = \frac{R/n}{n} = \frac{R}{n^2}$$

32. Dielectric constant of medium

$$K = \frac{\text{capacity of condenser with medium}}{\text{capacity of condenser without medium}}$$

$$= \frac{12}{2.0} = 6$$

33. Here : Diameter of earth

$$= 12.8 \times 10^3 \text{ km}$$

So, radius $\quad R = \frac{12.8}{2} \times 10^3$

$$= 6.4 \times 10^3 \text{ km} = 6.4 \times 10^6 \text{ m}$$

Capacity $\quad C = 4\pi\varepsilon_0 R$

$$= \frac{1}{9 \times 10^9} \times 6.4 \times 10^6$$

$$= 711 \times 10^{-6} \text{ F} = 711\,\mu\text{F}$$

34. Gravitational force $F = \frac{GM_1M_2}{r^2}$

$$F_G = \frac{6.7 \times 10^{-11} \times 9.1 \times 10^{-31} \times 1.6 \times 10^{-27}}{(5 \times 10^{-11})^2}$$

$$= 3.9 \times 10^{-47} \text{ N}$$

Electrostatic force $F_E = \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_2}{r^2}$

$$F_e = \frac{9 \times 10^9 \times 1.6 \times 10^{-19} \times 1.6 \times 10^{-19}}{(5 \times 10^{-11})^2}$$

$$= 9.22 \times 10^{-8} \text{ N}$$

$$\therefore \quad \frac{\text{Electrostatic force}}{\text{Gravitational force}} = \frac{F_E}{F_G}$$

$$= \frac{9.22 \times 10^{-8}}{3.9 \times 10^{-47}}$$

$$= 2.36 \times 10^{39}$$

35. The student should use a lens which forms image at distance of 15 cm of the object placed at 3m *i.e.*, object distance $u = -3$ m $= -300$ cm, image distance $v = -15$ cm

From lens formula $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

we get $\quad \frac{1}{-15} - \frac{1}{-300} = \frac{1}{f}$

or $\quad \frac{1}{f} = \frac{1}{300} - \frac{1}{15} = -\frac{19}{300}$

or $\quad f = \frac{-300}{19} = -15.8\,\text{cm}$ (concave lens)

Now power of the lens is

$$P = \frac{100}{f(\text{cm})} = \frac{100}{-015.8} = -6.33\text{ D}$$

36. Given : $\delta_m = 10°$, $\mu = 1.5$

For a thin prism of minimum deviation

$$\delta_m = (\mu - 1)\,A$$

$$10° = (1.5 - 1)\,A \text{ or } A = \frac{10}{0.5} = 20°$$

37. Given : $P_1 = 12$ D, $P_2 = -2$ D

Power of combination

$$P = P_1 + P_2 = 12 - 2 = 10\text{ D}$$

Focal length $f = \frac{1}{P} = \frac{1}{10}\text{ m} = 0.1\text{ m}$

The combined lens will be convex (convergent)

38. Amount of work done is given by

$$W = 200\text{ cal} = 200 \times 4.2\text{ J} = 840\text{ J}$$

39. The energy stored in the spring is

$$E = \frac{1}{2}kx^2 \qquad \ldots(1)$$

and expansion in the spring is

$$x = \frac{T}{k} \qquad \ldots(2)$$

From equations (1) and (2), we get

$$E = \frac{1}{2}k\frac{T^2}{k^2} = \frac{1}{2}\frac{T^2}{k} = \frac{T^2}{2k}$$

40. According to kinetic theory, K.E. of 1g-mole of an ideal gas, $E = \frac{3}{2}RT$

Hence, K.E. at normal temperature 0°C

$$= 273\text{ K}$$

or $\quad E = \frac{3}{2} \times 8.31 \times 273 = 3.4 \times 10^3\text{ J}$

CHEMISTRY

41. In 1.0024, all figures are significant. In 1.240,the significant figures are four (zero tells about precision). Zero before a number are not significant, hence 0.0020 has only two significant numbers (2 and 0 after 2).

42. Bauxite (Al203·2H20) is the most important ore of aluminium.

43. From de-Broglie equation,

$$\lambda = \frac{h}{mv}$$

$$\therefore \quad \lambda = \frac{6.626 \times 10^{-34}\text{ j.s}}{40 \times 10^{-3}\text{ kg} \times 20.0\text{ ms}^{-1}}$$

$$= 8.28 \times 10^{-34}\text{ m}$$

$$= 8.28 \times 10^{-34} \times 10^9\text{ nm}$$

$$= 8.28 \times 10^{-25}\text{ nm}$$

44. Magnesium is found in chlorophyll, the green pigment, essential for photosynthesis.

45. Mordant dyes are those dyes, which cannot be fixed directly on fabric but require some fixating agents (like Cr salts) *e.g.*, Alizarin.

46. For Lyman series, $\frac{1}{\lambda} = R\left(\frac{1}{(1)^2} - \frac{1}{n^2}\right)$ hence, for λ to be smallest, n should be greatest (*i.e.*, ∞)

$$\therefore \quad \frac{1}{\lambda_{\min}} = 1.097 \times 10^{-2}\left(1 - \frac{1}{\infty^2}\right)$$

$$= 1.097 \times 10^{-2}$$

or $\quad \lambda_{\min} = \frac{1}{1.097 \times 10^{-2}} = 91.16\text{ nm}$

47. Ionisation energy generally increase in a period from left to right. But due to comparatively stabler configuration of Be ($1s^2, 2s^2$), it has more ionisation energy than Boron ($1s^2, 2s^2, 2p^1$). Hence, the correct order is :

$$B < Be < C < N$$

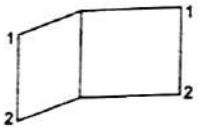
48. SO_2 gas is a reducing agent, hence turns dichromate paper green due to formation of chromium sulphate. Sulphite radical (SO_3^{2-}) is identified by this:

$$K_2Cr_2O_7 + 3SO_2 + H_2SO_4 \longrightarrow \underset{\text{green}}{Cr_2(SO_4)_2} + K_2SO_4 + H_2O$$

49. More the +I alkyl groups on electron deficient carbon, more stable will be the cabocation. Hence, 3° carbocations are more stable.

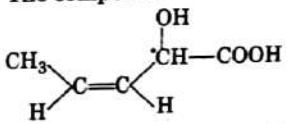
The correct order is $3^\circ > 2^\circ > 1^\circ > \overset{-}{C}H_3$

50.



Hence, correct IUPAC name is = bicyclo [2, 2, 0] hexane.

51. The compound



can show optical isomerism, geometrical isomerism and position isomerism. But it cannot exhibit metamerism as it has no functional group which is polyvalent.

52. $\underset{(40+12+3\times16)\atop=100}{CaCO_3} \xrightarrow{\Delta} CaO + \underset{22.4\text{litre}}{CO_2}$

$\because$ 100 g $CaCO_3$, on decomposition, gives

$= 22.4$ litre CO_2 at STP

$\therefore$ 20 g $CaCO_3$, on decomposition, will give

$$= \frac{22.4 \times 20}{100}$$

$= 4.48$ litre CO_2 at STP

53. The azimuthal quantum number (l) determines the shape of an orbital. For,

$l = 0$ (sperical, s)

$l = 1$ (dumb-bell, p) etc.

54. Let, oxidation number of Fe be 'x'

$\therefore \quad 3(+1) + x + 6(-1) = 0$

$3 + x - 6 = 0$

$x = +3$

55. The enthalphy of elements are zero in their standard state.

56. Newton is not the unit of pressure. It is the unit of force. Atmosphere, torr and pascal (Pa) are the units of pressure.

1 atm. $= 1.01 \times 10^5$ Pa

1 torr $= 133.3$ Pa

57. From Ostwald's dilution law

$$\alpha = \sqrt{\frac{Ka}{c}}$$

$$= \sqrt{\frac{3.2 \times 10^{-5}}{0.2}}$$

$$= 1.26 \times 10^{-2}$$

58. Ca^{2+}, Cl^-, S^{2-} and K^+ are isoelctronic species. In isoelectronic ions, size decrease with increasing nuclear charge. Hence, Ca^{2+} ion is the smallest among these.

59. H_3PO_2 (hypophosphorus acid) is a monobasic acid. It gives only one type of salt *e.g.*, NaH_2PO_2.

60. Oxygen (O_2) contains 2 unpaired electron, hence it is paramagnetic

$O_2 = \sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_x^2$

$\pi 2p_y^2 \pi 2p_z^2 \pi^* 2p_y^1 \pi^* 2p_z^1$

61. Phosphorus (white or yellow) is kept preserved in water as it catches fire in air at normal temperature.

62. Peroxides give hydrogen peroxide, on treatment with dilute acids. Hence, only sodium peroxide (Na_2O_2) will give H_2O_2.

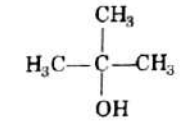
63. Zinc is quite reactive metal. It dissolves in excess of hot NaOH to give sodium zincate.

$$Zn + 2NaOH \longrightarrow \underset{\text{sodium zincate}}{Na_2ZnO_2} + H_2\uparrow$$

64. gem dihalides, on hydrolysis, give carbonyl compounds

$$CH_3CHCl_2 \xrightarrow[-2HCl]{2H.OH} CH_3—CH\langle \begin{matrix} O\boxed{H} \\ \boxed{OH} \end{matrix} \xrightarrow[-H_2O]{} \underset{\text{acetaldehyde}}{CH_3CHO}$$

65. Tertiary alcohols react faster with Lucas reagent. They give turbidity with Lucas reagent (cone. HCl + anhyd. $ZnCl_2$) at once. Hence, 2-methyl propan-2-ol will react with Lucas reagent faster.



66. This is an example of Kolbe's electrolysis. Ethylene is obtained on electrolysis of potassium succinate.

$$\begin{matrix} CH_2COOK \\ | \\ CH_2COOK \end{matrix} \xrightarrow{\text{electrolysis}} \begin{matrix} CH_2COO^- \\ | \\ CH_2COO^- \end{matrix} + 2K^+$$

At anode $\begin{matrix} CH_2COO^- \\ | \\ CH_2COO^- \end{matrix} \xrightarrow{-2e^-} \begin{matrix} CH_2COO^\bullet \\ | \\ CH_2COO^\bullet \end{matrix}$

$$\xrightarrow{-2CO_2} \begin{matrix} CH_2^\bullet \\ | \\ CH_2^\bullet \end{matrix} \longrightarrow \begin{matrix} CH_2 \\ \| \\ CH_2 \end{matrix}$$

Ethene

67. *o*-nitrobenzoic acid is the strongest acid among these. —NO_2 group is a powerful electron withdrawing group and it has most effect when present at *o*-position. It is also known as *o*-effect. Due to its electron withdrawing nature electron density on H-atom in — COOH group becomes very less, hence it can be easily donated.

68. Physical adsorption is due to van der Waal's forces which are weak forces, hence this type of adsorption is reversible and not irreversible. All other statements are correct.

69. Let atomic mass and atomic number of Y are 'a' and 'b' respectively. Hence,

$${}_bY^a \xrightarrow{-\alpha} {}_{b-2}M^{a-4} \xrightarrow{-\beta} {}_{b-1}N^{a-4} \xrightarrow{-\beta} {}_bX^{a-4}$$

Hence, X and Y are isotopes (*i.e.*, having equal atomic number but differing in mass number)

70. For an n^{th} order reaction,

$$t_{1/2} \propto \frac{1}{C^{n-1}} \qquad (C = \text{initial conc.})$$

Hence, for Ist order reaction ($n = 1$), we have

$$t_{1/2} \propto \frac{1}{C^{1-1}}$$

$\therefore \quad t_{1/2} \propto C^0$

Thus half life of Ist order reaction is independent of the initial concentration of reactant.

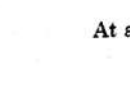
71. From Raoult's law, $\frac{P - P_s}{P}$ = mole fraction of solute (x_A)

$\therefore \quad x_A = \frac{0.8 - 0.2}{0.8} = \frac{0.6}{0.8} = 0.75$

Hence, mole-fraction of solvent

$= 1 - 0.75 = 0.25$

72.



($lps + \sigma - bps = 1 + 3 = 4$)

hence, hybridisation = sp^3

PCl_3 has sp^3 hybridisation but due to presence of one lone pair, it is pyramidal in geometry. (Inspite of being tetrahedral)

73. For 10^{-8}M NaOH,

$[OH^-] = 10^{-8} + 10^{-7}$ (from water)

$= 11 \times 10^{-8}$

$\therefore \quad pOH = -\log [OH^-] = -\log 11 \times 10^{-8}$

$= 8 - 1.04 = 6.96$

$\therefore \quad pH = 14 - 6.96 = 7.04$

74. $2NO_2 \quad 2NO + O_2$

$$K_p = \frac{P_{NO}^2 \cdot P_{O_2}}{P_{NO_2}} = K \qquad \ldots(i)$$

For reaction, $NO + \frac{1}{2}O_2 \rightleftharpoons NO_2$

$$K_p' = \frac{P_{NO_2}}{P_{NO} \cdot P_{O_2}^{1/2}} \qquad \ldots(ii)$$

From equation (i) and (ii)

$$K_p' = \sqrt{\frac{1}{K}}$$

75. From E°_{red}. values, it is clear that A is more electropositive than B (as it has lesser E°_{red}), hence it can replace B from its salt solution and act as anode in galvanic cell. Hence, correct cell equation will be:

$$A + B^{2+} \longrightarrow A^{2+} + B$$

76. $AgNO_3$ is also called lunar caustic as it leaves white scar on skin due to reduction to silver by skin.

77. SO_2, on cooling comes into solid form, which is due to weak van der Waal's forces. Such type of solids are called molecular solids. All other are covalent solids.

78. The substitution of α-hydrogen atom by halogens in acids, is called Hell-Volhard-Zelinsky (HVZ) reaction

79. The reaction sequence is as follows:

$$ArN_2Cl \xrightarrow[\text{Sandmeyer's reaction}]{CuCN/KCN} ArCN \xrightarrow{H.OH} \underset{\text{benzoic acid}}{C_6H_5COOH} \xrightarrow[\text{decarboxylation}]{\Delta,\ \text{sodalime}} \underset{\text{benzene}}{C_6H_6}$$

80. Solvent loving colloids are called lyophilic colloids. These are natural, reversible colloids which easily form colloidal solution *e.g.*, albumin, gelatin, gum-arabic etc

ZOOLOGY

81. The vasopressin hormone, secreted by neurohypophysis of pituitary gland promotes the reabsorption of water from the distal convoluted tubules of nephrons, reducing excretion of water in urine (= diuresis). Hence, it is called antidiuretic Hormone (ADH). Its release in blood is controlled by an 'osmoregulatory centre" located in hypothalamus. Hyposecretion of ADH causes diabetes incipidus.

82. At height above 8000 m from sea level, the partial pressure of O_2 in air is decreased. As a result less haemoglobin is formed and the person suffers from dizziness, breathlessness etc. This is called mountain sickness. A continuous exposure to this height increases ventilation to about 3 to 7 times normal then there is significant increase in RBC count and haemoglobin content in blood and breathing becomes normal.

83. Down's syndrome (45 + XX or 45 + XY) is the case when there is one extra chromosome in 21st pair of autosome. It is also called trisomy 21 or trisomy-*G*. It is most common in children of over aged mothers (above 41 years). It is also called Mongolian syndrome.

84. Virus is without necessary metabolic enzymes, hence, free virus are inert particles incapable of any vital activities and uses host machinery. Virus is regarded as obligate parasite and have characteristic of both living and non-livings.

85. The chitin (= polyglycosamine) is an acetate of mucopolysaccharide called glycosamine which is formed by the combination of polysaccharide with small peptide molecules. The basic unit (monomer) of chitin is *N*-acetylglucosamine, monomers are joined by 1 – 4 β linkages.

86. Striped (striated or skeletal or voluntary) muscles are syncytial. Nuclei are spindle shaped, peripheral in position and lie near the sarcolemma. They are multi nucleate because each fibre is formed by the fusion of a number of embryonic stem cells (myoblasts), hence, regarded multicellular syncytial body.

87. Ventricles are related to both heart and brain. Mammalian heart is four chambered. The upper two chambers known as right and left auricle and the lower as right and left ventricles. In brain there are four ventricles. Ventricle Ist and II (lateral ventricles) are cavities of two cerebral hemispheres. IIIrd ventricle (diocoel) is cavity of diencephalon and IV ventricle (metacoel) is cavity of medulla oblongata.

88. In meroblastic cleavage, division occurs only in small amount of metabolically active cytoplasm, confined to the animal pole or peripheral region of egg. The yolk remains undivided. It is found in macrolecithal eggs. *e.g.* birds

89. Person with blood group 'O' has no antigen on his RBC but has both the antibodies (*i.e.*, a and b) in his plasma. Whereas a person with blood group '*AB*' has both antigens but no antibody. Due to this blood group 'O' is universal donor and blood group '*AB*' is universal acceptor.

90. Arachidonic acid is polyunsaturated (*i.e.*, have more than one double bond) and essential fatty acids. Essential fatty acids cannot be synthesised by the body of animal and has to be taken from outside to fulfil the body requirement. Linoleic acid and linolenic acid are also essential fatty acids.

91. Ovulation takes place on 14th day of cycle, concentration of LH is highest on 14th day because it has to break the Graafian follicle so as to release the ovum later if the concentration of estrogen and progesterone decrease there is lose of internal lining of uterus and menstural bleeding start.

92. Lysosomes or suicidal bags are bounded by single unit membrane. It contains hydrolytic enzymes which help to digest the nucleic acids, proteins and polysaccharide etc. (*i.e.*, extracellular material). It also helps in autolysis.

93. In ruminants (*e.g.*, cow, goat and camel) the stomach is 4 chambered as follows

(a) Rumen (cellulose is digested)
(b) Reticulum (cellulose is digested)
(c) Omasum (absorb water)
(d) Abomasum (true stomach)

94. The intraspecific competition makes the size of niche smaller due to keen competition among the members.

95. *Gambusia* is an exotic fish feeds on the larvae of mosquito. Now-a-days it is widely used to eradicate mosquito.

96. In hinge joint a condyle at the end of one bone fits in the depression of other bone in such a manner that the bone with condyle can swung like a loop on its hinge only in one direction *e.g.* leg elbow joint, ankle joint and knee joint etc.

97. Ornithine cycle takes place in liver. The amino acid arginine and citrulline are formed during this cycle. Therefore it is referred as ornithine, arginine cycle and also Kreb-Henseleit cycle. The products of this cycle are urea and ornithine. The substances excreted through this cycle are CO_2 and NH_3

98. First and second cleavage in frog are holoblastic, complete, equal, vertical, whereas third cleavage is holoblastic, complete, unequal, latitudinal or horizontal and near the animal pole. It results in the formation of 8 cells of three are black micromeres which have less or no yolk, so divide faster and 4 are colourless macromeres.

99. Pancreas are partially exocrine and partially endocrine glands.

Exocrine = Acini cells = Pancreatic enzyme
Endocrine = Islets of Langerhans

α cells	β cells	δ cells	polypeptide cells
(Glucagon)	(Insulin)	(Somatostain)	(Polypeptide)

100. The dorsal part of mid brain (mesencephalon) is in the form of two pairs (*i.e.*, four) of spherical optic lobes (corpora quadrigemina) located behind the pineal body optic lobes are reduced merely as reflex centres of visual and auditory.

101. The phospholipid is a bipolar molecule having long fatty acid called hydrophobic tail (water hating) or non-polar end. Another is hydrophillic (water loving) or polar end, hence, it is amphipathic in nature.

102. *Hirudinaria* belongs to class Hirudinea of phylum–Annelida. It has definite number of body segments (26 + 7 = 33) It feeds on blood (sanguivorous) and has anticoagulant hirudin in its saliva. *Hirudinaria* have a posterior sucker for locomotion. Leech creep by looping and swim by undulations of body.

103. Dinosaurs become extinct in cretaceous period.

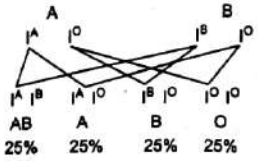
104. Blood calcium level is regulated by Parathormone.

105. During working of heart two sounds are produced lub and dub. First sound (*i.e.*, lub) is produced when auriculoventricular (tricuspid and bicuspid) valves are closed or at the end of diastole. The second sound (*i.e.*, dub) is produced when semilunar valves at the base of dorsal aorta are closed or at the end of systole.

106. Alveoli is highly vascularised with an internal lining of very thin squamous epithelium, which always remain moist by mucus. The epithelial cells at the linar most margins of septa facing lung cavity are columnar and ciliated.

107. Infective stage of *Plasmodium* is a sporozoite inoculated into human blood by female *Anopheles*. Sporozoite are produced due to gamogony (sexual cycle in the stomach of mosquito) followed by sporogony (asexual cycle in the stomach wall of mosquito) sporozoites are sickle or spindle–shaped.

108. Man Blood group Women Blood group



There is 25% chances of first offspring having blood group AB.

109. Huxley stated that birds are glorified reptiles. The missing link *Archaeopteryx* is a fossil lizard bird. It was founded by Andreas Wagner (1861) from upper Jurassic limestone rocks of Solenbofen in Bowaria, Germany.

110. Vestigeal organs are present in reduced form and are of no use to the animal in which they are present. Man has, 180 vestigeal organs. e.g., nictitating membrane, vermiform appendix, wisdom tooth, muscle of pinna and forhead, mammary glands in male etc.

111. Organ of Corti are found in cochlear channel (internal ear) and are responsible for hearing. Ear is concerned both with hearing and balance, semicircular canals are responsible for balance when body is in motion.

112. Hyaline cartilage has a clear, homogenous, transparent bluish–green matrix. It gives glass like appearance. A few bundles of small white fibres are imbedded in the matrix. It is present in the end of limb bones (called hyaline caps).

113. The 9th or sacral vertebra is acoelous and highly specialised the anterior face is convex for this give greater strength them, it would be given if its anterior end

are hollowed out the transverse process are stout and downwardly directed. The ileum of the pelvic girdle articulates with the transverse process of 9th vertibrae.

114. Peyer's patches are found in ileum and made up of lymph nodes. These are aggregates of lymphocytes where B cells form a central follicle and are surrounded by T-cells and macrophages which help the T-cells to recognise Antigen Mucosa Associated Lymphoid Tissue (MALT) is made up of Peyer's patches.

115. The vital capacity is the maximum amount of air that can be expelled from lungs by forced exhalation after a forced inhalation. It is equal to the sum of tidal volume (TV), inspiratory reserve volume (IRV) and expiratory reserve volume (ERV).

$$VC = TV + IRV + ERV$$
$$= 500 + 3000 + 1100$$
$$= 4600 \text{ ml}$$

116. *Euspongia* is called bath spongia. The sponge are classified on the basis of skeleton which is made up of spongin fibere. After the bath sponge dries only the skeleton is left.

117. RBC in man is anucleated. Nucleated RBCs are found in camel and amphibians (e.g. frog). In frog, RBCs are typically flattened and more or less eliptical in shape but it appears biconvex when seen along its edge. They filled with cytoplasm of faint straw colour and contains a definite round nucleus in centre

118. Restriction enzyme recognises specific nucleotide sequences in DNA and then makes a double–stranded cleavage of DNA molecule. Restriction enzymes are called genetic scissors as they slice off genes and is recently being used in gene therapy technique. They are key tool of genetic engineering. Central dogma is related with protein synthesis. Okazaki fragments are found during DNA synthesis and RNA polymerase is used in synthesis of RNA.

119. Base + sugar form a nucleoside and base + sugar + phosphate group combine together to give a nucleotide.

120. Stanley Miller using $CH_4 : NH_3 : H_2$ gases in the ratio of 2 : 2 : 1 and water vapours synthesised many simple organic compounds including amino acids, glycine, alanine and aspartic acid. According to him life originated from NH_3, CH_4, H_2 and H_2O.

BOTANY

121. Class Phaeophyceae includes brown algae Brown algae are marine plants. Chief pigments found in the members of this class are chloropyll *a* and *c* β-carotene, violaxanthin, fucoxanthin, lutein, diatoxanthin. Reserve food is laminarin, mannitol and oils.

122. Psammophytes grow in sand and gravel, eremophytes grow in desert and gravel, psilophytes grow in savanna and oxylophytes grow on acidic soil.

123. Verticillaster consists of biparous cymes ending in uniparous scorpioid cymes on either side e.g. *Ocimum* and several members of family Labiatae.

124. In porogamy the pollen tube enters the ovule through micropyle, in chalazogamy pollen tube enters through chalaza and in mesogamy pollen tube enters through funiculus.

125. The first phylogenetic system was proposed by Eichler who is famous for his work entittled "Bluthen Diagramme" published in two volumes.

126. Cotton is the seed surface fibre of *Gossypium*. Its processing involves ginning, bailing, picking, lapping, carding and twisting. It is used in textile industry.

127. Split genes were discovered by Phillip Sharp and Robert Richard. The part of DNA which express itself by making *m* RNA is called exon. One exon is separated from other by inactive part of DNA called intron. This is called split DNA.

128. The net force with which water is drawn into a cell is equal to difference of OP and TP, known as diffusion pressure deficit or suction pressure. DPD of pure water is maximum (≈ 1236 atm) solvent moves from cell of low DPD to high DPD. DPD, or SP = OP – TP.

129. Sporopollenin is most resistant chemical substance in pollen grains wall.

130. In bryophytes water is essential for fertilization. It provides a medium of transport for antherozoids to reach archegonia. Hence, they are called amphibians of plant kingdom.

131. *Puccinia graminis tritici* belongs to class Basidiomycetes. It causes black rust of wheat.

132. DDT has been recently banned because it is non-biodegradable and biomagnifying pollutant. Biomagnification means the increase in amount of DDT in the body of organism along with the increase in trophic level. Hence, the amount of DDT in 1st trophic level will be minimum and in top consumer will be maximum.

133. In isogamy, gametes are morphologically and physiologically same, in anisogamy gametes are morphologically different but physiologically same and in oogamy, gametes are both morphologically and physiologically different e.g., *Ulothrix* and *Spirogyra* members of Chlorophyceae.

134. Restriction enzyme are also known as molecular knifes or molecular scissors. They are isolated from bacteria. They recognize specific base sequence in DNA and cleave both strands of it

135. Some species of bacteria reproduce sexually with the help of endospores. Endospores are thick–walled spores, formed singly in a bacterial cell. These are commonly seen in the species of *Bacillus* and *Clostridium*.

136. As growth regulators control the growth of plants, pesticides control the pests and fertilizers enhance productivity of the soil, hence all of these are regarded as agricultural chemicals

137. When changes involve only a few chromosome say one or two and not the entire genome, the phenomenon is called aneuploidy. Monosomy is a case of aneuploidy, when there is loss of one chromosome from a pair of homologue.

138. Haemoglobin forms a stable compound with CO. The affinity of haemoglobin for CO is 200 times more than for O_2 so even 0.1% CO blocks 50% haemoglobin of the body due to which oxygen carrying capacity of blood is decreased. This is called hypoxia.

139. Day neutral plants do not need a specific photoperiod to produce flowers. They are also called intermediates or photoneutrals. Their photoperiod varies from a few hours to 24 hours of uninterrupted light e.g. tomato, cucumber, sunflower, Helianthus annuus, maize and cotton etc.

140. The ABA inhibits gibberellin induced growth activities on account of this antagonistic behaviour, it is also called antigibberellin.

141. In some pteridophytes two types of spores are formed which differ significantly in their size and also in function. This phenomenon is called heterospory *e.g.*, *Selaginella* and *Marsilea* etc.

142. The cortex in coralloid roots of *Cycas* is divided into inner and outer regions by algal zone. The cells of this zone contain endophytic algal forms particularly *Anabaena cycadeae* and *Nostoc punctiforme*.

143. Double fertilization was first observed by Nawaschin (1892) in *Lilium* and *Fritillaria* and confermed by Grignard. It is characteristic of angiosperms. In double fertilization first fertilization is normal and second, as it involves three nuclei is known as triple fusion.

144. The term root pressure was coined by Stephen Hales (1727). The evidences that support the existence of this phenomenon are bleeding and guttation. The magnitude of root pressure is 1 – 2 atm and very rarely 5 atm.

145. Molybdenum is a component of nitrogenase and thus brings about fixation of gaseous nitrogen. It also act as enzyme activator of nitrate reductase.

146. Oxygen is the terminal acceptor of electron in electron transport system, which in the presence of proton forms a water molecule

$$\frac{1}{2}O_2 + 2e \longrightarrow O^{2-}$$

$$2H^+ + O^{2-} \longrightarrow H_2O$$

147. Total root parasites have no chlorophyll. These are common on the roots of Cruciferae and Solanaceae *e.g.*, *Balanophora* and *Orobanche* etc.

148. Glycolysis or Embden Myerhof Parna spathway takes place in cytoplasm. It is a common phase between aerobic and anaerobic respiration. The enzymes occur in cytosol.

149. The bitter substance present in lichens are removed before being used as fodder. Lichens form favourite food for reindeers, cattles etc. *Cladonia rangifera* is the commonly used food for reindeer in tundra regions.

150. The bacterium—*Agrobacterium* acts as a vehicle for transfer of DNA or genes from one organism to another organism because it infects all dicot plants.

151. The enzyme needed for replication of DNA *i.e.* formation of DNA from DNA is DNA polymerase III. DNA replication is initiated by RNA primer which is later removed by DNA polymerase I.

152. In all ecosystem the maximum amount of energy is found in trophic level 1-r t_1 (*i.e.* the producers) which keeps on decreasing along the higher trophic level.

153. Biosphere is the part of earth where life exists.

154. Periderm formation occurs in the root and stems of dicots and gymnosperm in extra stelar region with the help of cork cambium. Periderm is external secondary protective tissue and compreses of cork, cork cambium and secondary cortex.

155. The yeast (*Saccharomyces*) is a saprophytic fungus which belongs to class Ascomycetes.

156. Sexual reproduction in *Spirogyra* takes place by conjugation. Scalariform conjugation occurs between the cells belonging to different filaments. Hence, these species are heterothallic. Lateral conjugation is primitive than scalariform conjugation.

157. In Hatch and Slack cycle CO_2 acceptor is phosphoenol pyruvic acid and first product is oxaloacetic acid, (a 4-C compound). Therefore it is popularly termed as C_4 cycle.

158. CAM is found in members of the family Crassulaceae (*e.g.*, *Kalanchoe*), family Cactaceae (*e.g.*, *Opuntia*, *Cereus*), and some members of Liliaceae, Orchidaceae, Bromeliaceae, *Euphorbia* sp. All CAM plants are not succulent and stomata open at night.

159. Bacteria are prokaryotic in nature, in which typical chromosomes are lacking. DNA is circular and naked as it is not surrounded by his tones (basic proteins).

160. *Leucaena leucocephala* is commonly known as subabool. It is a very fast growing leguminous plant and therefore is commonly used as social foresting species.

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JIPMER

MEDICAL ENTRANCE

SOLVED PAPER 2005

PHYSICS

1. A simple pendulum of length l has a maximum angular displacement θ. The maximum kinetic energy of the bob is
(a) $mgl(1-\cos\theta)$ (b) $0.5\,mgl$
(c) mgl (d) $0.5\,mgl$

2. Radius of orbit of satellite of earth is R. Its kinetic energy is proportional to
(a) $\frac{1}{R}$ (b) $\frac{1}{\sqrt{R}}$ (c) R (d) $\frac{1}{R^{3/2}}$

3. The radius R of the soap bubble is doubled under isothermal condition. If T be the surface tension of soap bubble. The work done in doing so is given by
(a) $32\pi R^2T$ (b) $24\pi R^2T$
(c) $8\pi R^2T$ (d) $4\pi R^2T$

4. A body of specific heat 0.2 kcal/kg°C is heated through 100°C. The percentage increase in its mass is
(a) 9% (b) 9.3×10^{-11}%
(c) 10% (d) None of these

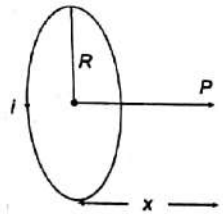
5. Two similar coils are kept mutually perpendicular such that their centres coincide. At the centre, find the ratio of the magnetic field due to one coil and the resultant magnetic field through both coils, if the same current is flown.
(a) $1:\sqrt{2}$ (b) 1 : 3
(c) 1 : 2 (d) $\sqrt{3}$: 1

6. A prism of refractive index $\sqrt{2}$ has a refracting angle of 60°. At what angle a ray must be incident on it so that it suffers a minimum deviation.
(a) 45° (b) 60° (c) 90° (d) 180°

7. A cone filled with water is revolved in a vertical circle of radius 4 m and the water does not fall down. What must be the maximum period of revolution?
(a) 2 s (b) 4 s
(c) 1 s (d) 6 s

8. A conducting sphere of radius $R=20$ cm is given a charge $Q=16\mu$C. What is $\vec{E}$ at centre?
(a) 3.6×10^6 N/C
(b) 1.8×10^6 N/C
(c) Zero
(d) 0.9×10^6 N/C

9. A coil having N turns carry a current as shown in the figure. The magnetic field intensity at point P is



(a) $\frac{\mu_0 NiR^2}{2(R^2+x^2)^{3/2}}$ (b) $\frac{\mu_0 Ni}{2R}$
(c) $\frac{\mu_0 NiR^2}{(R+x)^2}$ (d) zero

10. The maximum range of a gun on horizontal terrain is 16 km, if $g=10\,m/s^2$. What must be the muzzle velocity of the shell ?
(a) 200 m/s (b) 100 m/s
(c) 400 m/s (d) 300 m/s

11. The length, breadth and thickness of a block are given by $l = 12$ cm, $b = 6$ cm and $t = 2.45$ cm. The volume of the block according to the idea of significant figures should be
(a) 1×10^2 cm^3
(b) 2×10^2 cm^3
(c) 1.763×10^2 cm^3
(d) None of the above

12. Five particles of mass 2 kg are attached to the rim of a circular disc of radius 0.1 m and negligible mass. Moment of inertia of the system about the axis passing through the centre of the disc and perpendicular to its plane is
(a) 1 kg m^2 (b) 0.1 kg m^2
(c) 2 kg m^2 (d) 0.2 kg m^2

13. The radius of the convex surface of planoconvex lens is 20 cm and the refractive index of the material of the lens is 1.5. The focal length is
(a) 30 cm (b) 50 cm
(c) 20 cm (d) 40 cm

14. An ice-cube of density 900 kg / m^3 is floating in water of density 1000 kg / m^3. The percentage of volume of ice-cube outside the water is
(a) 20% (b) 35%
(c) 10% (d) 25%

15. A sphere of diameter 0.2 m and mass 2 kg is rolling on an inclined plane with velocity $v = 0.5$ m/s. The kinetic energy of the sphere is
(a) 0.1 J (b) 0.3 J
(c) 0.5 J (d) 0.42 J

16. An electron moves at right angle to a magnetic field of 1.5×10^{-2} T with a speed of 6×10^7 m / s. If the specific charge of the electron is 1.7×10^{11} C / kg. The radius of the circular path will be
(a) 2.9 cm (b) 3.9 cm
(c) 2.35 cm (d) 2 cm

17. If work function of a metal is 4.2 eV, the cut off wavelength is
(a) 8000 Å (b) 7000 Å
(c) 1472 Å (d) 2950 Å

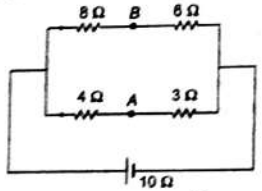
18. A particle is executing the motion $x = a\cos(\omega t - \theta)$. The velocity of the particle is
(a) $a\omega\cos\theta$
(b) $a\omega$
(c) $a\omega\sin\theta$
(d) None of the above

19. A particle is executing two different simple harmonic motions, mutually perpendicular, of different amplitudes and having phase difference of $\frac{\pi}{2}$. The path of the particle will be
(a) circular
(b) straight line
(c) parabolic
(d) elliptical

20. Equations of motion in the same direction are given by
$$y_1 = 2a\sin(\omega t - kx)$$
$$y_2 = 2a\sin(\omega t - kx - \theta)$$
The amplitude of the medium particle will be
(a) $2a\cos\theta$
(b) $\sqrt{2}\,a\cos\theta$
(c) $4a\cos\frac{\theta}{2}$
(d) $\sqrt{2}\,a\cos\frac{\theta}{2}$

21. The work function of sodium is 2.3 eV. The threshold wavelength of sodium will be
(a) 2900 Å (b) 2500 Å
(c) 5380 Å (d) 1200 Å

22. The potential difference between points A and B is

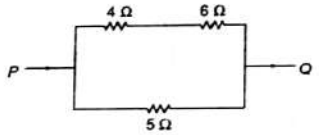


(a) $\frac{20}{7}$ V (b) $\frac{40}{7}$ V
(c) $\frac{10}{7}$ V (d) zero

23. A short linear object of length b lies along the axis of a concave mirror of focal length f at a distance u from the pole of the mirror, what is the size of image?
(a) $\left(\frac{f}{u-f}\right)b$ (b) $\left(\frac{f}{u-f}\right)^2 b$
(c) $\left(\frac{f}{u-f}\right)b^2$ (d) $\left(\frac{f}{u-f}\right)$

24. A closed argon pipe and an open argon pipe are tuned to the same fundamental frequency. What is the ratio of their lengths?
(a) 1 : 2 (c) 2 : 1
(b) 2 : 3 (d) 4 : 3

25. When a certain current is passed in the circuit as shown in figure, 10 kcal of heat is produced in 5 Ω resistance. How much heat is produced in 4 Ω resistance?



(a) 4 kcal (b) 2 kcal
(c) 5 kcal (d) 3 kcal

26. A steel scale measures the length of a copper wire as 80.0 cm, when both are at 20°C, the calibration temperature for the scale. What would the scale read for the length of the rod when both are at 40°C?
Given: α for steel $= 11 \times 10^{-6}$ per °C and α for Cu $= 11 \times 10^{-6}$ per° C
(a) 80.0096 cm
(b) 80.0272 cm
(c) 1 cm
(d) 25.2 cm

27. A tank is filled with water upto height H. When a hole is made at a distance h below the level of water. What will be the horizontal range of water jet?
(a) $2\sqrt{h(H-h)}$
(b) $4\sqrt{h(H+h)}$
(c) $4\sqrt{h(H-h)}$
(d) $2\sqrt{h(H+h)}$

28. A raft of wood of mass 120 kg floats in water. The weight that can be put on the raft to make it just sink, should be ($d_{raft} = 600$ kg / m^3)
(a) 80 kg (b) 50 kg
(c) 60 kg (d) 30 kg

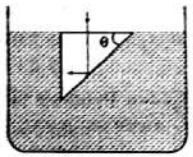
29. A particle is kept at rest at the top of a sphere of diameter 42 m. When disturbed slightly, it slides down. At what height h from the bottom, the particle will leave the sphere?
(a) 14 m (b) 28 m
(c) 35 m (d) 7 m

30. If an insulated non-conducting sphere of radius R has charge density ρ. The electric field at a distance r from the centre of sphere ($r > R$) will be
(a) $\frac{\rho R}{3\varepsilon_0}$ (b) $\frac{\rho r}{\varepsilon_0}$
(c) $\frac{\rho r}{3\varepsilon_0}$ (d) $\frac{3\rho R}{\varepsilon_0}$

31. The minimum wavelength of X-ray emitted by X-ray tube is 0.4125Å. The accelerating voltage is
(a) 30 kV (b) 50 kV
(c) 80 kV (d) 60 kV

32. A monoatomic gas supplied the heat Q very slowly keeping the pressure constant. The work done by the gas will be
(a) $\frac{2}{3}Q$ (b) $\frac{3}{5}Q$
(c) $\frac{2}{5}Q$ (d) $\frac{1}{5}Q$

33. The refractive index of the material of the prism and liquid are 1.56 and 1.32 respectively. What will be the value of θ for the following refraction?

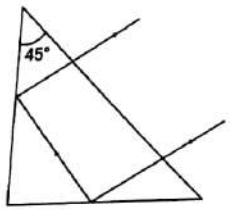


(a) $\sin\theta \geq \frac{13}{11}$ (b) $\sin\theta \geq \frac{11}{13}$
(c) $\sin\theta \geq \frac{\sqrt{3}}{2}$ (d) $\sin\theta \geq \frac{1}{\sqrt{2}}$

34. The temperature of the black body increases from T to $2T$. The factor by which the rate of emission will increase, is?
(a) 4 (b) 2
(c) 16 (d) 8

35. A police jeep is chasing with velocity of 45 km/h. A thief in another jeep moving with velocity 153 km/h. Police fires a bullet with muzzle velocity of 180 m/s. The velocity it will strike the car of the thief is
(a) 150 m/s (b) 27 m/s
(c) 450 m/s (d) 250 m/s

36. What should be the minimum value of refractive index of the material of the prism for the reflections to take place as shown in the figure?



(a) 1.7 (b) 1.4
(c) 1.2 (d) 2.7

37. An L.C. circuit is in the state of resonance. If $C = 0.1\mu F$ and $L = 0.25$ Henry. Neglecting ohmic resistance of circuit. What is the frequency of oscillations?
(a) 1007 Hz (b) 100 Hz
(c) 109 Hz (d) 500 Hz

38. A person who can see things most clearly at a distance of 10 cm, requires spectacles to enable to see clearly things at a distance of 30 cm. What should be the focal length of the spectacles?
(a) 15 cm (Concave)
(b) 15 cm (Convex)
(c) 10 cm
(d) 0

39. The dimensional formula for Young's modulus is
(a) $ML^{-1}T^{-2}$ (b) $M^0 LT^{-2}$
(c) MLT^{-2} (d) $ML^2 T^{-2}$

40. When temperature of an ideal gas is increased from 27°C to 227°C, its rms speed is changed from 400 m/s to v_s. Then, v_s is
(a) 516 m/s
(b) 450 m/s
(c) 310 m/s
(d) 746 m/s

CHEMISTRY

1. Graphite is soft while diamond is hard because
(a) graphite is in powder form
(b) diamond has sp^2 hybridisation but graphite has sp^3 hybridisation
(c) graphite is in planar form while diamond is in tetrahedral form
(d) graphite is covalent and diamond is ionic

2. The pH of a 10^{-10}M – NaOH solution is
(a) 10 (b) 7.01
(c) 6.99 (d) 4

3. $Na_2S_2O_3 + I_2 \longrightarrow$ Product is
(a) Na_2S (b) Na_2SO_4
(c) $Na_2S_4O_6$ (d) S_2

4. Phenol and benzoic acid are distinguished by
(a) NaOH (b) $NaHCO_3$
(c) Na_2CO_3 (d) H_2SO_4

5. H_2O is liquid while H_2S is a gas due to
(a) covalent bonding
(b) molecular attraction
(c) H-bonding
(d) both H-bonding and molecular attraction

6. Phenol reacts with chloroform in presence of
(a) H_2SO_4
(b) KOH
(c) $NaNO_2$ / HCl
(d) G.R

7. Frenkel and Schottky defects are
(a) nucleus defects
(b) non-crystal defects
(c) crystal defects
(d) nuclear defects

8. $CH_3CH_2C \equiv CH \xrightarrow{R}$ butanone -2. R is
(a) Hg^{++} / dil· H_2SO_4
(b) $KMnO_4$
(c) $KClO_3$
(d) $K_2Cr_2O_7$

9. Which has minimum solubility?
(a) Bi_2S_3 (b) Ag_2S
(c) CoS (d) PbS

10. Ratio of molecular weights of A and B is $\frac{4}{25}$ then ratio of rates of diffusion will be
(a) 5 : 1 (b) 5 : 2
(c) 25 : 3 (d) 25 : 4

11. H-bond is strongest in
(a) C_2H_5OH
(b) H — F
(c) H_2O
(d) CH_3COCH_3

12. Strongest nucleophile is
(a) RNH_2 (b) ROH
(c) $C_6H_5O^-$ (d) CH_3O^-

13. a/V^2 given in van der Waal's equation is for
(a) internal pressure
(b) inter molecular attraction
(c) both (1) and (2)
(d) temperature correction

14. The hardest substance is
(a) iron (b) steel
(c) diamond (d) graphite

15. Which of the following is wrong statement?
(a) $Ni(CO)_4$ has oxidation number +4 for Ni
(b) $Ni(CO)_4$ has zero oxidation number for Ni
(c) Ni is metal
(d) CO is gas

16. Hybridization of 1 and 2 carbon atom in $\overset{1}{C}H_2 = \overset{2}{C} = CH_2$ are
(a) sp, sp (b) sp^2, sp^2
(c) sp^2, sp (d) sp^3, sp^2

17. In $[NiCl_4]^{2-}$, the number of unpaired electrons, are
(a) 4 (b) 2
(c) 3 (d) 5

18. Which carbocation is most stable ?
(a) $CH_3\overset{+}{C}H_2$
(b) $\overset{+}{C}H_3$
(c) $C_6H_5\overset{+}{C}H_2$
(d) $CH_3CH_2\overset{+}{C}H_2$

19. $CH_3-\overset{CH_2CH_3}{\overset{|}{C}}=\overset{}{\underset{CH_3}{\overset{|}{CH}}} \xrightarrow[H_2]{\text{catalyst}} X$. No of optical isomer possible will be
(a) 2 (b) 4
(c) 0 (d) 3

20. $C_{(dia)} + O_2 \longrightarrow CO_2$; $\Delta H = -395.4$ kJ / mole
$C_{(gr)} + O_2 \longrightarrow CO_2$ $\Delta H = -393.5$ kJ / mole
$C_{(gr)} \longrightarrow C_{(dia)}$; $\Delta H = ?$
(a) –3.8 (b) –1.9
(c) +3.8 (d) +1.9

21. The internal energy of a substance
(a) decrease with increase in temperature
(b) increase with increase in temperature
(c) remains unaffected with change in temperature
(d) calculated by $E = mc^2$

22. The rate constant of a reaction depends on
(a) the temperature of a reaction
(b) the time of a reaction
(c) the extent of reaction
(d) the initial conc. of the reactant

23. The half life of a radioactive element is 40 days. Calculate the average life
(a) 5.76 days
(b) 57.6 days
(c) 646 days
(d) 4.56 days

24. In an isothermal process
(a) $\Delta H = \Delta E + P\Delta V$
(b) $\Delta H = W$
(c) $\Delta H = \Delta E$
(d) $\Delta H = S\Delta T$

25. Number of orbitals in L energy level
(a) 1 (b) 2
(c) 3 (d) 4

26. How much chlorine will be liberated on passing one ampere current for 30 min. through NaCl solution ?
(a) 0.66 mole (b) 0.33 mole
(c) 0.66 g (d) 0.33 g

27. $H_2C_2O_4 + KMnO_4$ in acidic medium reacts to have change in oxidation number of Mn from
(a) 7 to 5 (b) 2 to 7
(c) 5 to 7 (d) 7 to 2

28. When the temperature of an ideal gas is increased from 27°C to 927°C, the kinetic energy will be
(a) same (b) eight times
(c) four times (d) twice

29. Ratio of radii of second and first Bohr orbits of H atom is
(a) 2 (b) 4
(c) 3 (d) 5

30. India conducted an underground nuclear test at
(a) Narora (b) Tarapur
(c) Pushkar (d) Pokharan

31. Which is used as medicine?
(a) PVC (b) Terylene
(c) Glyptal (d) Urotropine

32. NaOH / H^+ reacts with
(a) $C_6H_5OCH_3$ (b) CH_3OH
(c) $CH_3-\overset{\overset{O}{\|}}{C}-CH_3$ (d) C_2H_5OH

33. Butyne-1 and butyne-2 can be distinguished by
(a) H_2SO_4 (b) $AgNO_3 + NH_4OH$
(c) $K_2Cr_2O_7$ (d) NH_4OH

34. The incorrect configuration is
(a) K = [Ar] $4s^1$
(b) Cr = [Ar] $3d^5, 4s^1$
(c) Cr = [Ar] $3d^4, 4s^1$
(d) Cu = [Ar] $3d^{10}, 4s^1$

35. Which of the following compound gives iodoform test?
(a) CH_3CN (c) CH_3OH
(b) CH_3COCH_3 (d) C_6H_5OH

36. Dual nature of particle was-given by
(a) Bohr theory
(b) Thomson model
(c) Heisenberg principle
(d) de-Broglie equation

37. NaOH(aq), HCl(aq), and NaCl(aq) concentration of each is 10^{-3} M. Their pH will be respectively
(a) 10, 6, 2 (b) 11, 3, 7
(c) 10, 3, 7 (d) 10, 4, 7

38. Most acidic is
(a) CH_3COOH
(b) $C_6H_5CH_2COOH$
(c) HCOOH
(d) CH_3CH_2COOH

39. Substance having ester linkage is
(a) bakelite (b) polythene
(c) PVC (d) terylene

40. Carborandum is
(a) Al_2O_3 (b) $AlCl_3$ (c) $CuCO_3$ (d) SiC

ZOOLOGY

1. Secretion of gastric juice is stimulated by
(a) pepsin (b) gastrin
(c) renin (d) secretin

2. Which one is not correct?
(a) Humans – Ureotelic
(b) Birds – Uricotelic
(c) Lizards – Uricotelic
(d) Whale – Ammonotelic

3. Which one shows bio-luminescence?
(a) *Noctiluca* (b) *Polystomella*
(c) *Entamoeba* (d) *Suctoria*

4. Mantle, foot and shell are the characteristics of
(a) *Nautilus*
(b) *Echinus*
(c) *Limulus*
(d) *Euplectella*

5. Protists are
(i) unicellular and prokaryote
(ii) unicellular and eukaryote
(iii) multicellular and eukaryote
(iv) autotroph or heterotroph
(a) (i), (ii) and (iii)
(b) (ii), (iii) and (iv)
(c) (iii), (iv)
(d) (ii), (iv)

6. Pepsin is inactivated at pH
(a) below 3 (b) below 2
(c) above 5 (d) above 3

7. Which one is not produced by aquaculture?
(a) oyster (b) silkworn
(c) singhara (d) frog

8. Progesterone is secreted by
(a) Corpus luteum
(b) Utreus
(c) Placenta
(d) Graafian follicle

9. Which one affects liver, muscle and adipose tissue?
(a) Androgen (b) Insulin
(c) Progesterone (d) Glucagon

10. Inner lining of blood vessels is formed by
(a) ciliated epithelium
(b) squamous epithelium
(c) cubical epithelium
(d) columnar epithelium

11. Nucleated RBC is present in
(a) man (b) rat
(c) frog (d) rabbit

12. Pellagra is caused by deficiency of vitamin
(a) B_1 (b) B_2
(c) B_5 (d) B_6

13. The main excretory organ of prawn is
(a) green gland
(b) flame cell
(c) Malpighian tubule
(d) nephridia

14. Moulting hormone is secreted by
(a) corpora cardiacum
(b) prothoracic gland
(c) corpora allata
(d) neurosecretory hormone

15. Deoxyribonuclease and ribonuclease are secreted by
(a) liver (b) stomach
(c) pancreas (d) kidney

16. Haemodialysis helps in patient having
(a) uremia (b) anaemia
(c) diabetes (d) goitre

17. X-rays are used in
(a) ECG
(b) EEG
(c) CT-scan
(d) Endoscopy

18. Disease caused by deficiency of protein in children is
(a) Obesity
(b) Marasmus
(c) Diabetes
(d) Kwashiorkor

19. The thin filaments of a muscle fibre are made up of
(a) actin, troponin, tropomyosin
(b) actin, troponin
(c) myosin, troponin
(d) actin, tropomyosin

20. The species, which is going to become extinct due to lack of proper care would be called
(a) rare
(b) endangered
(c) vulnerable
(d) extinct

21. In which part of mitochondria does ATP synthesis occur?
(a) F_1
(b) F_0
(c) Cristae
(d) Inner membrane of mitochondria

22. Abnormal growth of the tumor in cancer is due to
(a) abnormal mitotic division
(b) accumulation of body fluid
(c) abnormal meiotic division
(d) metastasis

23. Fat, prior to its oxidation associate with
(a) cyclic AMP (b) Co-A
(c) GMP (d) ATP

24. Schwann cell is found around
(a) axon
(b) cyton
(c) dendrite
(d) dendron

25. Which part of retina consists of only cones?
(a) Fovea centralis
(b) Optic nerve
(c) Blind spot
(d) Orasmata

26. Heparin is secreted by
(a) mast cell
(b) alveolar cell
(c) plasma cell
(d) goblet cell

27. Antibody is produced by
(a) *B*-Lymphocyte
(b) Heparin
(c) *T*-Lymphocyte
(d) Both (a) and (b)

28. Reflex action involves
(a) spinal cord
(b) cerbellum
(c) medulla oblongata
(d) optic lobe

29. Which one has no intermediate host?
(a) *Taenia*
(b) *Ascaris*
(c) *Fasciola*
(d) *Plasmodium*

30. In the wall of alimentary canal, what is the actual sequence from outer to inner
(a) serosa, longitudinal muscle, mucosa, submucosa
(b) mucosa, serosa, long muscle
(c) serosa, long muscle, circular, submucosa, mucosa
(d) serosa, long muscle, submucosa, mucosa

31. Which one of the following can help in the diagnosis of a genetical disorder?
(a) ELISA
(b) ABO blood group
(c) PCR
(d) NMR

32. Bile helps in the digestion of fat through
(a) emulsification (b) alkalinity
(c) forming micelles (d) All of these

33. In frog chromosome number is reduced to half
(a) when 2nd polar body is separated
(b) when 2nd polar body is divided
(c) when 3rd polar body is separated
(d) when 1st polar body is separated

34. Ischihara chart is used to detect
(a) TB
(b) eye sight
(c) colourblindness
(d) diabetes

35. In diastole, heart is filled by
(a) mixed blood
(b) venous blood
(c) oxygenated blood
(d) deoxygenated blood

36. Periyar sanctuary is located in
(a) Madhya Pradesh
(b) Kerala
(c) Uttar Pradesh
(d) Assam

37. Which of the following is not an insect?
(a) Locust (b) Lepisma
(c) Termites (d) Spider

38. Which of the following represents the dental formula of man?
(a) $\frac{0.0.3.3}{3.1.3.3}$ (b) $\frac{2.0.3.3}{1.0.2.3}$
(c) $\frac{2.1.2.3}{2.1.2.3}$ (d) $\frac{1.0.0.3}{1.0.0.3}$

39. The children of a haemophilic man and a normal woman are
(a) all haemophilic
(b) only daughters are haemophilic
(c) only sons are haemophilic
(d) neither sons nor daughters are haemophilic

40. Which cells are found only in sponges?
(a) Amoeboid cells (b) Choanocytes
(c) Pigment cells (d) Gland cells

BOTANY

1. Double fertilisation was discovered by
(a) Nawaschin
(b) Starsburger
(c) Emerson
(d) None of the above

2. In photosythesis action and absorption spectrum were related by
(a) Von Helmont
(b) Engelmann
(c) Emerson
(d) Lavosier

3. Which one of the following does'nt help in molecule transport?
(a) Diffusion
(b) Osmosis
(c) Surface tension
(d) Active transport

4. Stomatal opening in plants occurs due to influx of
(a) Na
(b) K
(c) ABA
(d) Auxins

5. Energy transfer in photosynthesis occurs as
(a) Phycoerythrin → Phycocyanin → Carotenoid → Chlorophyll *a*
(b) Chlorophyll *b* → Carotenoid → Phycoerythrin → Chlorophyll *a*
(c) Phycocyanin → Phycoerythrin → Carotenoid → Chlorophyll *a*
(d) Chlorophyll *b* → Carotenoid → Phycocyanin → Chlorophyll *a*

6. Litmus is obtained from
(a) *Rocella montagnei*
(b) *Lasallia postulata*
(c) Both (a) and (b)
(d) *Cladonia crispata*

7. If a plant having yellow or round seeds was crossed with another plant having green and wrinkled seeds then F_1 progeny are in the ratio
(a) 15 : 1
(b) 1 : 15
(c) 1 : 13
(d) all yellow and round seeds

8. Commercial cork is obtained from
(a) Flax
(b) *Juglans regia*
(c) *Hevea brassiliansis*
(d) *Quercus suber*

9. Tea and coffee are affected by
(a) *Phytophthora*
(b) *Cephaleuros*
(c) *Herviella*
(d) *Albugo candida*

10. If decomposers are removed what will happen to the ecosystem?
(a) Energy cycle is stopped
(b) Mineral cycle is stopped
(c) Consumers cannot absorb solar energy
(d) Rate of decompostion of mineral increases

11. In photosynthesis what occurs in PS-II?
(a) It takes longer wavelength of light and e^- from H_2O
(b) It takes shorter wavelength of light and e^- from H_2O
(c) It takes longer wavelength of light and e^- from NADP
(d) It takes shorter wavelength of light and e^- from NADP

12. Which are sensitive to SO_2 pollution?
(a) Mosses (b) Algae
(c) Lichen (d) Ferns

13. Though *Cycas* has 2 cotyledons, this is not included in dicot because
(a) naked ovule
(b) they have megaspore
(c) appears as palm tree
(d) has compound leaves

14. In meiosis division is
(a) Ist reductional and IInd equational
(b) Ist equational and IInd reductional
(c) both reductional
(d) both equational

15. Auxin in plant means for
(a) cell elongation
(b) fruit ripening
(c) cell division
(d) inhibit the root growth

16. The thylakoid in chloroplast are arranged as
(a) interconnected disc
(b) interconnected sacs
(c) stacked discs
(d) None of the above

17. The given formula belong to

$$Br \oplus ♀ Epi_3K_{(5)} \overset{\curvearrowleft}{C_5} A(\infty)G_{(5)}$$

(a) Solanaceae (b) Malvaceae
(c) Graminae (d) Compositae

18. Which of the following is used as green manure?
(a) *Azolla*
(b) *Azadirachta indica*
(c) *Crotolaria juncea*
(d) *Hevea brassiliansis*

19. The non-photosynthetic, non-symbiotic N_2 fixing bacteria are
(a) *Rhodobacter* (b) *Spirillum*
(c) *Azotobacter* (d) All of these

20. In monocot roots which types of vascular bundles are found?
(a) Collateral, conjoint and closed
(b) Radial with exarch xylem
(c) Bicollateral, conjoint and closed
(d) Radial with endarch xylem

21. The modified stem of *Opuntia* is
(a) phyllode (b) phylloclade
(c) cladode (d) stamroinode

22. Among plants "pheromones" are secreted by the cells of the following plants for given function
(a) all plants for growth and development
(b) Yeast for facilitating mating
(c) all fungi for sexual reproduction
(d) *Rhizopus* for formation of zygospore

23. The gases that produce green house effect are
(a) CH_4, CFC_S, CO_2
(b) CO_2, N_2O, H_2
(c) CFCs, NO_2, O_2
(d) CO_2, N_2, water vapour

24. What's the difference between RNA and DNA?
(a) Base
(b) Sugar
(c) Sugar and base
(d) Phosphate

25. Increase in toxic concentration from one trophic level to another trophic level is called
(a) ecological toxification
(b) bio-magnification
(c) bioconcentration
(d) cytological effect

26. Potometer is used to measure
(a) ascent of sap
(b) root pressure
(c) transpiration
(d) photosynthesis

27. Which one is antioxidant vitamin?
(a) Vitamin-D
(b) Vitamin-E
(c) Vitamin-B
(d) Vitamin-K

28. The net gain ATP from complete oxidation of 1 molecule of glucose in eukaryote is
(a) 2 (b) 4
(c) 24 (d) 36

29. Which of the following workers are related as ecologist, palaeobotanist and embryologist respectively?
(a) B. Sahni, R. Mishra, P. Maheshwari
(b) R Mishra, B. Sahni, P. Maheshwari
(c) B. Sahni, P. Maheshwari, R Mishra
(d) P. Maheshwari, R Mishra, B. Sahni

30. In bacteria respiration occurs in
(a) cytoplasmic membrane
(b) mitochondria
(c) nuclear membrane
(d) endoplasmic reticulum

31. R.Q. is always less than one in
(a) wheat
(b) millets
(c) bean
(d) castor

32. Pencils are prepared from the wood of
(a) *Pinus vinaster*
(b) *Juniperus virginiana*
(c) *Chamaecyparis piscifera*
(d) *Abies pindrow*

33. Ageing is retarted by
(a) ABA (b) CKN
(c) GA (d) C_2H_4

34. The form of pigment which inhibits germination is
(a) P_{760} (b) P_{730}
(c) P_{650} (d) All of these

35. In Hatch and Slack pathway
(a) chloroplast are of same type
(b) occurs in Kranz anatomy where mesophyll have small chloroplast whereas bundle sheath have granal chloroplast
(c) occurs in Kranz anatomy when mesophyll have small chloroplast where as bundle sheath have larger, agranal chloroplast
(d) Kranz anatomy where mesophyll cell are diffused

GENERAL ENGLISH

Directions (for Q. 1 to 4) : *Choose synonym for the word given in capital letters from each set.*

1. LET.
(a) To permit (b) Documents
(c) Pupil (d) Smooth

2. DIGNITY
(a) Character (b) Level
(c) Class (d) Nobleness

3. FEIGN
(a) Pretend (b) Sympathy
(c) Gross (d) Wicked

4. REPUTE
(a) Humiliated
(b) Esteem
(c) Ridiculous
(d) Discredit

Directions (for Q. 5 to 8) : *Choose the correct antonym for the word given in capital letters from each set.*

5. BLUNT
(a) Rude (b) Sharp
(c) Dull (d) Frank

6. EMBRACE
(a) Hug (b) Adopt
(c) Accept (d) Ban

7. JOLLY
(a) Fun (b) Cheerful
(c) Serious (d) Blissful

8. BE-LIKE
(a) Impossible (b) Underrate
(c) Dwarf (d) Disparage

Directions (for Q. 9 to 15) : *Choose the incorrect word in the given sentences.*

9. I shall be drowned and nobody shall save me .
(a) shall be (b) and
(c) save (d) shall

36. The *Triticale* is an intergeneric hybrid between
(a) wheat and maize
(b) maize and rye
(c) wheat and rye
(d) bajra and wheat

37. The dormancy of seed is regulated by
(a) ABA (b) Ethylene
(c) GA-3 (d) Dihydrozeatin

38. Colchicine prevents the mitosis of the cells at which of the following stage?
(a) Anaphase
(b) Metaphase
(c) Prophase
(d) Interphase

39. For the formation of tetrasporic embryosac, how many megaspore mother cells are required?
(a) 1 (b) 2
(c) 3 (d) 4

40. DNA replication generally proceeds in a
(a) 5 → 3 direction (b) 3 → 5 direction
(c) 3 → 3 direction (d) 5 → 5 direction

10. He has passed the Secondary Examination in 1968.
(a) the (b) has
(c) he (d) passed

11. He replied that he will come.
(a) he (b) come
(c) replied (d) will

12. She comes to me each day.
(a) to (b) she
(c) comes (d) each

13. I haven't some spare pen.
(a) spare (b) I
(c) some (d) haven't

14. There is a little milk in the jug.
(a) in (b) a
(c) there (d) milk

15. There are much flowers in this garden.
(a) this (b) much
(c) there (d) in

Directions (for Q. 16 to 20) : *Read the following passage carefully and answer the questions given below it. Certain words/phrases in the passage are given in bold to locate them while answering some of the questions.*

The world of today has achieved much, but for all its **declared love for humanity** it has based itself far more on hatred and violence than on the virtues that make man human. War is the negation of truth and humanity. War may be unavoidable sometimes but its progeny are terrible to contemplate. Not mere killing, for man must die, but the deliberate and persistent propagation of hatred and falsehood, which gradually become the normal habits of the people. It is dangerous and harmful to be guided in our life's course by hatreds and aversions, for they are wasteful of energy and limit and twist the mind, and prevent it from perceiving the truth.

16. War is the negation of truth means
(a) wars kill human beings
(b) wars do not exist
(c) wars are evil
(d) wars spread and advertise falsehood

17. According to the author the achievements of the world are not impressive because
(a) the world has not made any achievement
(b) there is nothing much to boast of
(c) its love of humanity is a pretence
(d) they are mostly in the field of violence

18. Hatred and aversions are unwholesome as they are
(a) dangerous
(b) narrow
(c) harmful
(d) barriers in seeing the truth

19. According to the author the word 'declared love of humanity' is
(a) non-existent
(b) false
(c) true
(d) not to be taken seriously

20. Man should be guided by
(a) materialism
(b) scientific discoveries
(c) generous human feelings
(d) practical wisdom

Directions (for Q. 21 to 25) : *Choose the most appropriate preposition in the following sentences.*

21. Ashish jumped ..... the well.
(a) down (b) into
(c) to (d) onto

22. Students are laughing ..... monkeys.
(a) in (b) for
(c) at (d) of

23. Rajesh Budakoti was the class monitor ..... IX to X.
(a) between (b) to
(c) from (d) in

24. The valley was ..... the hill.
(a) along
(b) under
(c) between
(d) below

25. Navneet is better in study ..... his friend.
(a) with (b) along with
(c) from (d) than

Directions (for Q. 26 to 30) : *In each of the following questions, an idiomatic expression/ proverb has been given which is followed by some alternatives. Choose the one which expresses the meaning of the given idiom/proverb.*

26. The backbone of the team
(a) on whom one can rely
(b) to be selfish
(c) to divulge a secret
(d) before doing something

27. Set free
(a) enfeebled (b) released
(c) rubbish (d) disparages

28. Sets in
(a) reserved (b) removed
(c) attacked by (d) begins

29. Stand by
(a) interrupted (b) support
(c) started (d) attached

30. Run across
(a) strange person (b) incited him to
(c) meet by chance (d) pretended to be

Directions (for Q. 31 to 35) : *In the following questions, the first and the last parts of the sentence are numbered 1 and 6. The rest of the sentence is split into four parts and named P, Q, R and S. These four parts are not given in their proper order. Find out the correct combinations.*

31. 1. Many people
P : that the government can always pay out money quite easily
Q : that the government can only pay out money
R : seem to think
S : but they forget
6. that it has received in taxes
(a) RPSQ (b) PRQS
(c) QPRS (d) SQRP

32. 1. The next stop
P : lying in the centre
Q: of a day
R: was a port
S : that our ship halted at
6. in South Wales
(a) SRQP (b) PQRS
(c) QSRP (d) RSQP

33. 1. Inspite of repeated attempts
P : in the dictionary
Q : and finally had to ask his teacher
R : he could not locate
S : the strange-looking word
6. what it meant
(a) QRSP (b) PQRS
(c) SPQR (d) RSPQ

34. 1. Above all,
P : in the present age of light reading
Q: it is well if something heavier is cast now and then
R : of reading hastily and thoughtlessly
S : that is,
6. into the midst of the reading public
(a) QSRP (b) PQRS
(c) PSRQ (d) PRQS

35. 1. Though the exact dimensions
P : involved in the rocket
Q : and the precise amounts
R : it is clear that such an operation
S : are yet to be ascertained
6. could not have been possible without the connivance of officials at various levels
(a) SPRQ (b) QPSR
(c) PSRQ (d) RQPS

Directions (for Q. 36 to 40) : *Choose the correct form of verb from the given choices.*

36. Hari and Ram ..... here.
(a) was (b) are (c) were (d) is

37. I shall ..... you tomorrow.
(a) seen (b) saw
(c) seeing (d) see

38. I ..... taken my camera.
(a) have (b) shall (c) were (d) will

39. The Governor with his aide-de-camp, ... arrived.
(a) are (b) were (c) has (d) have

40. Each of the sisters ..... cleaver.
(a) is (b) are (c) has (d) were

Answers

PHYSICS

1. (a)	2. (a)	3. (a)	4. (b)	5. (a)	6. (a)	7. (b)	8. (c)	9. (a)	10. (c)
11. (b)	12. (b)	13. (d)	14. (c)	15. (d)	16. (c)	17. (d)	18. (b)	19. (d)	20. (c)
21. (c)	22. (d)	23. (c)	24. (a)	25. (b)	26. (a)	27. (a)	28. (a)	29. (c)	30. (c)
31. (a)	32. (a)	33. (b)	34. (c)	35. (a)	36. (b)	37. (a)	38. (a)	39. (a)	40. (a)

CHEMISTRY

1. (c)	2. (b)	3. (c)	4. (b)	5. (c)	6. (b)	7. (c)	8. (a)	9. (b)	10. (b)
11. (b)	12. (d)	13. (b)	14. (c)	15. (a)	16. (c)	17. (b)	18. (c)	19. (a)	20. (d)
21. (b)	22. (a)	23. (b)	24. (b)	25. (d)	26. (c)	27. (d)	28. (c)	29. (b)	30. (d)
31. (d)	32. (a)	33. (b)	34. (c)	35. (c)	36. (d)	37. (b)	38. (c)	39. (d)	40. (d)

ZOOLOGY

1. (b)	2. (d)	3. (a)	4. (a)	5. (d)	6. (c)	7. (b)	8. (a)	9. (b)	10. (b)
11. (c)	12. (c)	13. (a)	14. (b)	15. (c)	16. (a)	17. (c)	18. (d)	19. (a)	20. (b)
21. (a)	22. (a)	23. (b)	24. (a)	25. (a)	26. (a)	27. (a)	28. (a)	29. (b)	30. (c)
31. (c)	32. (d)	33. (d)	34. (c)	35. (b)	36. (b)	37. (d)	38. (c)	39. (d)	40. (b)

BOTANY

1. (a)	2. (b)	3. (c)	4. (b)	5. (a)	6. (c)	7. (d)	8. (d)	9. (b)	10. (b)
11. (b)	12. (c)	13. (a)	14. (a)	15. (a)	16. (c)	17. (b)	18. (c)	19. (c)	20. (b)
21. (b)	22. (b)	23. (a)	24. (c)	25. (b)	26. (c)	27. (b)	28. (d)	29. (b)	30. (a)
31. (d)	32. (b)	33. (b)	34. (c)	35. (c)	36. (c)	37. (a)	38. (b)	39. (d)	40. (a)

GENERAL ENGLISH

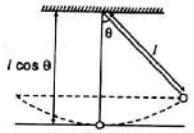
1. (a)	2. (d)	3. (a)	4. (b)	5. (b)	6. (d)	7. (c)	8. (a)	9. (a)	10. (b)
11. (d)	12. (d)	13. (c)	14. (b)	15. (b)	16. (d)	17. (c)	18. (d)	19. (d)	20. (c)
21. (b)	22. (c)	23. (c)	24. (d)	25. (d)	26. (a)	27. (b)	28. (d)	29. (b)	30. (c)
31. (a)	32. (c)	33. (d)	34. (c)	35. (b)	36. (b)	37. (d)	38. (a)	39. (c)	40. (a)

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Hints & Solutions

PHYSICS

1. Here : length of pendulum = l



maximum angular displacement = θ

mass of the bob = m

Now height of the bob at maximum angular displacement is

$$h = l - l\cos\theta = l(1 - \cos\theta)$$

Also at the end of the displacement kinetic energy of the bob = potential energy of the bob

$$= mgh = mgl(1 - \cos\theta)$$

2. Kinetic energy of the satellite

$$KE = \frac{1}{2}mv_0^2 \qquad ...(1)$$

where $v_0 = \sqrt{\frac{GM}{R}}$

Now putting the value of v_0 is eq. (1), we get

$$KE = \frac{1}{2}m\left(\sqrt{\frac{GM}{R}}\right)^2 = \frac{1}{2}\frac{mGM}{R}$$

Hence, $KE \propto \frac{1}{R}$

3. Initial surface energy

$$w_1 = 2 \times 4\pi R^2 T = 8\pi R^2 T$$

Final surface energy

$$w_2 = 2 \times 4\pi (2R)^2 T = 32\pi R^2 T$$

4. Heat taken by the given body = $mc\,\Delta\theta$

{specific heat of body = 0.2 kcal/kg°C, final temperature of the body = 100° C}

$$\Delta E = m \times 0.2 \times 100 = 20m \text{ kcal}$$

$$= 20m \times 4.2 \times 10^3 \text{ J}$$

Now gain in mass is given by

$$\Delta m = \frac{\Delta E}{C^2} \qquad (\because E = mc^2)$$

$$= \frac{20m \times 4.2 \times 10^3}{(3 \times 10^8)^2}$$

Therefore, percentage increase in mass is given by

$$= \frac{\Delta m}{m} \times 100$$

$$= \frac{20m \times 4.2 \times 10^3}{(3 \times 10^8)^2 \times m} \times 100$$

$$= 9.3 \times 10^{-11}\%$$

5. Suppose the magnetic field produced due to each coil is B.

The two coils are kept perpendicular hence, the angle between these is 90° therefore, the resultant magnetic field is given by

$$= \sqrt{B^2 + B^2 + 2B.B.\cos 90°}$$

$$= \sqrt{2B^2 + 2B^2 \times 0}$$

$$= \sqrt{2B^2} = B\sqrt{2}$$

Hence, the ratio of magnetic field due to one coil and the resultant magnetic field is given by

$$= \frac{B}{\sqrt{2}B} = 1 : \sqrt{2}$$

6. The relation for refractive index of prism is

$$\mu = \frac{\sin i}{\sin r} \qquad ...(1)$$

The condition for minimum deviation is

$$r = \frac{A}{2} = \frac{60°}{2} = 30°$$

Putting the given value of $\mu = \sqrt{2}$ and $r = 30°$ in eq (1), we get

$$\sqrt{2} = \frac{\sin i}{\sin 30°}$$

So, $\sin i = \sqrt{2} \times \frac{1}{2} = \frac{1}{\sqrt{2}}$

$$\sin i = \sin 45°$$

$$i = 45°$$

7. When a cone filled with water is revolved in a vertical circle, then the velocity at the highest point is given by

$$v \geq \sqrt{gr}$$

Also $v = r\omega = r\frac{2\pi}{T}$

Hence, $\frac{2r\pi}{T} \geq \sqrt{rg}$

$$T \leq \frac{2\pi r}{\sqrt{rg}} = 2\pi\sqrt{\frac{r}{g}} = 2\pi\sqrt{\frac{4}{9.8}}$$

$$= 2 \times 3.14 \times 0.6389 = 4.0 \text{ sec}$$

So, $T_{max} = 4$ sec

8. The value of E at the centre of sphere is zero. Since, the centre of sphere is placed with in the Gaussian surface. Hence $E = 0$.

9. From the formula, magnetic field intensity at point P, shown in given figure while coil carry current i and having N turns is given by

$$\frac{\mu_0 NiR^2}{2(R^2 + x^2)^{3/2}}$$

10. We know that in projection of the particle, for maximum range, $\theta = 45°$

Now maximum range

$$R = \frac{u^2 \sin 2\theta}{g} = \frac{u^2 \sin 90°}{g}$$

$$u = \sqrt{Rg} \quad ...(1)$$

Here : $R_{max} = 16 \text{ km} = 16 \times 10^3$ m,

$g = 10 \text{ m/s}^2$

Now from eq. (1), we get

$$u = \sqrt{16 \times 10^3 \times 10} = 400 \text{ m/s}$$

11. Using the relation for volume

V = length × breadth × thickness

$= 12 \times 6 \times 2.45 = 176.4$

$= 1.764 \times 10^2 \text{ cm}^3$

The minimum number of significant figures is 1 in thickness, hence the volume will contain only one significant figure.

Therefore, $V = 2 \times 10^2 \text{ cm}^3$

12. The moment of inertia of the given system that contains 5 particles each of mass = 2 kg on the rim of circular disc of radius 0.1 m and of negligible mass is given by

= MI of disc + MI of particle

Since the mass of the disc is negligible therefore, MI of the system = MI of particle

$= 5 \times 2 \times (0.1)^2 = 0.1 \text{ kg m}^2$

13. Using the relation for focal length of planoconvex lens

$$= \frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

(Refractive index of material of lens $\mu = 1.5$, $R_1 = 20$ cm, $R_2 = \infty$)

$$\frac{1}{f} = (1.5 - 1)\left(\frac{1}{20} - \frac{1}{\infty}\right)$$

$$\frac{1}{f} = \frac{1}{40}$$

or $f = 40$ cm

14. The percentage of volume of ice cube outside the water is

$$= \frac{\rho_{water} - \rho_{ice}}{\rho_{water}} \times 100$$

$$= \frac{1000 - 900}{1000} \times 100 = 10\%$$

15. The kinetic energy of sphere while rolling on an inclined plane is given by

E_K = Translational kinetic energy + Rotational kinetic energy

$$= \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$$

$$E_K = \frac{1}{2} \times 2 \times (0.5)^2 + \frac{1}{2} \times \frac{2}{3} \times 2 \times (0.1)^2 \times \left(\frac{0.5}{0.1}\right)^2$$

$$= 0.25 + 0.17 = 0.42 \text{ J}$$

16. The formula for radius of circular path is

$$r = \frac{mv}{eB} = \frac{v}{\left(\frac{e}{m}\right)B} \quad ...(1)$$

Given : e/m of electron

$= 1.7 \times 10^{11}$ C/kg and $v = 6 \times 10^7$ m/s

$B = 1.5 \times 10^{-2}$ T

So, $r = \frac{6 \times 10^7}{1.7 \times 10^{11} \times 1.5 \times 10^{-2}}$

$= 2.35 \times 10^{-2} \text{ m} = 2.35 \text{ cm}$

17. Suppose the cut off wavelength is represented by λ_0

So, $\frac{hc}{\lambda_0}$ = work function = W_0

$$\frac{hc}{\lambda_0} = 4.2 \times 1.6 \times 10^{-19}$$

$$\lambda_0 = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{4.2 \times 1.6 \times 10^{-19}}$$

$$= 2946 \times 10^{-10} \text{ m}$$

$$\approx 2950 \text{ Å}$$

18. Given equation is $x = a\cos(\omega t - \theta)$

So, velocity $\left|\frac{dx}{dt}\right| = a\omega\sin(\omega t - \theta)$

At $(\omega t - \theta) = 90°$, the velocity will be maximum, therefore the maximum velocity is

$v = a\omega$

19. As the different amplitudes are mutually perpendicular which have phase difference of $\frac{\pi}{2}$. Therefore, particle will follow elliptical path.

20. The given equations of motion are

$y_1 = 2a\sin(\omega t - kx)$

$y_2 = 2a\sin(\omega t - kx - \theta)$

Now the resultant equation of wave is given by

$$y = y_1 + y_2$$

$$= 2a\sin(\omega t - kx) + 2a\sin(\omega t - kx - \theta)$$

$$y = 2a\left[2\sin\frac{(\omega t - kx + \omega t - kx - \theta)}{2} \times \cos\frac{\omega t - kx - (\omega t - kx - \theta)}{2}\right]$$

$$y = 4a\cos\frac{\theta}{2}\sin\left(\omega t - kx - \frac{\theta}{2}\right) \quad ...(1)$$

Now comparing equation (1) with $y = A\sin(\omega t - kx)$, we have

Resultant amplitude $A = 4a\cos\frac{\theta}{2}$

21. Here : work function

$$W_0 = 2.3 \text{ eV} = 2.3 \times 1.6 \times 10^{-19} \text{ J}$$

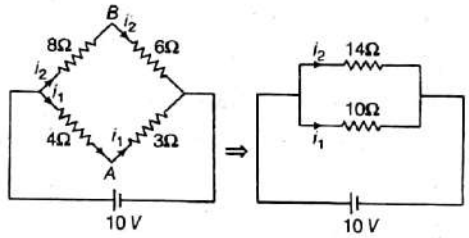
where λ_0 is the threshold wavelength for sodium

Then, $W_0 = \frac{hc}{\lambda_0}$ or $\lambda_0 = \frac{hc}{W_0}$

$$\lambda_0 = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{2.3 \times 1.6 \times 10^{-19}}$$

$$= 5380 \times 10^{-10} \text{ m} = 5380 \text{ Å}$$

22. From the given figure, current through lower branch of resistances which are joined in series is $i_1 = \frac{10}{4+3} = \frac{10}{7}$ amp



Again current through upper branch of resistances which are also connected in series, is

$$i_2 = \frac{10}{8+6} = \frac{10}{14} \text{ amp}$$

Now according to the Kirchhoff's voltage law

$$V_B - V_A = 8 \times i_2 - 4 \times i_1$$

$$= 8 \times \frac{10}{14} - 4 \times \frac{10}{7} = 0$$

23. Using the relation for the focal length of concave mirror

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u} \quad ...(1)$$

Differentiating equation (1), we obtain

$$0 = -\frac{1}{v^2}dv - \frac{1}{u^2}du$$

So, $dv = -\frac{v^2}{u^2} \times b$ ...(2)

(Here : $du = b$)

From equation (1)

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{u-f}{fu}$$

or $$\frac{u}{v} = \frac{u-f}{f}$$

$$\frac{v}{u} = \frac{f}{u-f} \quad ...(3)$$

Now, from equations (2) and (3), we get

$$dv = -\left(\frac{f}{u-f}\right)^2 b$$

Therefore, size or image is $= \left(\frac{f}{u-f}\right)^2 b$

24. Avoiding end correction, the length of the closed organ pipe is

$$l_1 = \frac{\lambda_1}{4} \text{ or } l_1 = 4l_1$$

The length of open organ pipe is

$$l_2 = \frac{\lambda_2}{2} \text{ or } \lambda_2 = 2l_2$$

Here, $n_1 = n_2$

So, $\frac{v}{\lambda_1} = \frac{v}{\lambda_2}$ or $\frac{v}{4l_1} = \frac{v}{2l_2}$

Therefore, $l_1 : l_2 = 1:2$

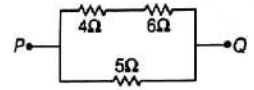
25. Heat produced in $5\Omega = 10$ kcal

Now from the relation

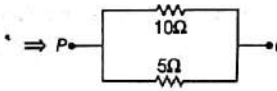
$$H_1 = i_1^2 R_1 t \text{ or } i_1^2 = \frac{H_1}{R_1 t}$$

or $$i_1^2 = \frac{H_1}{5t} \quad ...(1)$$

Again, $5 \times i_1 = 10 \times i_2$ or $i_2 = \frac{i_1}{2}$



$\Rightarrow$



Now heat produced in 4Ω resistance is

$$H_2 = i_2^2 R_2 t$$

$$i_2^2 = \frac{H_2}{R_2 t}$$

or $$\frac{i_1^2}{4} = \frac{H_2}{4t} \text{ or } i^2 = \frac{H_2}{t} \quad ...(2)$$

From eqs. (1) and (2)

$$\frac{H_2}{t} = \frac{H_1}{5t}$$

or $$H_2 = \frac{H_1}{5} = \frac{10}{2} = 2 \text{ kcal}$$

26. Using the relation $l_t = l_0(1 + \alpha t)$

$$= 1 \times [1 + 11 \times 10^{-6} \times (40° - 20°)]$$

$$= 1.00022 \text{ cm}$$

Now length of copper rod at 40°C

$$R_t' = l_0'(1 + \alpha' t)$$

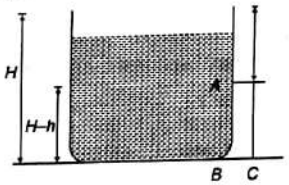
$$= 80[1 + 17 \times 10^{-6}(40° - 20°)]$$

$$= 80.0272 \text{ cm}$$

Now number of cms observed on the scale

$$= \frac{80.0272}{1.00022} = 80.0096$$

27. Applying Bernoullis' theorem,



the velocity of water at point

$$v = \sqrt{2gh}$$

Time take on to reach point C is t

So, $$H - h = \frac{1}{2} g t^2$$

$$t = \sqrt{\frac{2(H-h)}{g}} \quad ...(1)$$

Now horizontal range

$$R = vt$$

$$= \sqrt{2gh} \times \sqrt{\frac{2(H-h)}{g}} = 2\sqrt{(H-h)h}$$

28. Volume of raft is given by

$$V = \frac{m}{d} = \frac{120}{600} = 0.2 \text{ m}^3$$

If the raft is immersed fully in water.

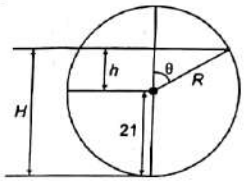
Then weight of water displaced is $= Vd_{water}$

$$= 0.2 \times 10^3 = 200 \text{ kg}$$

Hence, the additional weight which is supported by raft

$$= 200 \text{ kg} - 120 \text{ kg} = 80 \text{ kg}$$

29. The condition of slipping by particle from top is given by



$$\cos\theta = 2/3$$

From the figure,

$$h = r\cos\theta = 21 \times \frac{2}{3} = 14 \text{ m}$$

Therefore, the required height at which the particle will leave the sphere is

$$= 21 + h = 21 + 14 = 35 \text{ m}$$

30. Charge which is enclosed in the surface is given by $\sigma = \frac{4}{3}\pi r^3 \rho$

Now according to Gaussian law

$$\varepsilon \phi E\, ds = \sigma,\ \varepsilon_0 E\, 4\pi r^2 = \frac{4}{3}\pi r^3 \rho$$

$$E = \frac{\rho r}{3\varepsilon_0}$$

31. From the formula

$$eV = h\frac{c}{\lambda}$$

$$V = \frac{hc}{e\lambda} = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{1.6 \times 10^{-19} \times 0.4125 \times 10^{-10}}$$

$$= 30 \times 10^3 \text{ volt} = 30 \text{ kvolt}$$

32. For monoatomic gas at constant pressure

$$\frac{\Delta U}{Q} = \frac{1}{3}$$

or $$\Delta U = \frac{Q}{3}$$

Now applying first law of thermodynamics

$$W = \Delta Q - \Delta U$$

$$= Q - \frac{Q}{3} = \frac{2Q}{3}$$

33. Using the formula

$$\mu_{prism} = \frac{\mu_{liquid}}{\mu_{prism}} = \frac{1.32}{1.56} = \frac{11}{13} \quad ...(1)$$

Now the condition for total internal reflection, occur when $\sin\theta \geq \mu$

So, $$\sin\theta \geq \frac{11}{13}$$

34. According to Stefan's law for radiated energy

$$E \propto T^4$$

Hence, $$\frac{E_1}{E_2} = \frac{T_1^4}{T_2^4} = \left(\frac{T}{2T}\right)^4 = \frac{1}{16}$$

$\therefore$ $$E_2 = 16\, E_1$$

35. Here we calculate the relative velocity of Jeep

$$= 153 - 45 = 108 \text{ km/h}$$

$$= 108 \times \frac{5}{18} = 30 \text{ m/s}$$

Therefore, striking speed = relative speed of bullet with respect to thief's car

$$= 180 - 30 = 150 \text{ m/s}$$

36. From the formula, the minimum refractive index is

$$\mu_m = \frac{\sin i}{\sin r} = \frac{\sin 90°}{\sin 45°}$$

$$= \frac{1}{1/\sqrt{2}} = \sqrt{2} = 1.414$$

$$\approx 1.4$$

37. From the formula, the frequency of oscillation is

$$f = \frac{1}{2\pi\sqrt{LC}}$$

$$= \frac{1}{2\pi\sqrt{0.25 \times 0.1 \times 10^{-6}}}$$

$$= 1007 \text{ Hz}$$

38. A concave lens is required by the person so that the lens forms the image of object distant 30 cm, at 10 cm it means

$$u = -30\text{ cm},\ v = -10\text{ cm}$$

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$= \frac{1}{-10} - \frac{1}{-30} = -\frac{2}{30}$$

or $$\frac{1}{f} = \frac{-1}{15}$$

So $$f = -15\text{ cm}$$

Minus sign singnifies that lens used is concave

39. The formula for the Young's modulus

$$Y = \frac{\text{stress}}{\text{strain}}$$

Dimensions of $$Y = \frac{ML^{-1}T^{-2}}{M^0L^0T^0}$$

$$= ML^{-1}T^{-2}$$

40. We know that rms speed is directly proportional to square root of temperature

$$v_{rms} \propto \sqrt{T}$$

Hence, $$\frac{v_{rms\,(1)}}{v_{rms\,(2)}} = \sqrt{\frac{T_1}{T_2}}$$

$$\frac{400}{v_{rms\,(2)}} = \frac{\sqrt{27+273}}{\sqrt{227+273}} = \sqrt{\frac{300}{500}}$$

$$V_{rms\,(2)} = \sqrt{\frac{500}{300}} \times 400$$

$$= 1.29 \times 400 = 516.39\text{ m/s}$$

$$\approx 516\text{ m/s}$$

CHEMISTRY

1. In diamond each carbon atom is sp^3 hybridised and is joined to each other by strong covalent bond to form a tetrahedral structure. While in graphite carbon atoms form planar, hexagonal rings to give it a sheet like structure. Each sheet is joined to each other by weak van der Waal force. Hence diamond is harder than graphite.

2. When the solution is very dilute, the concentration of OH^- produced from water cannot be neglected. Hence,

$$[OH^-] = 10^{-10} + 10^{-7}$$

(obtained from water)

$$= 10^{-7}(0.001 + 1) = 1.001 \times 10^{-7}$$

$$\therefore \quad pOH = -\log[OH^-]$$

$$= -\log(1.001 \times 10^{-7})$$

$$= 7 - 0.01 = 6.99$$

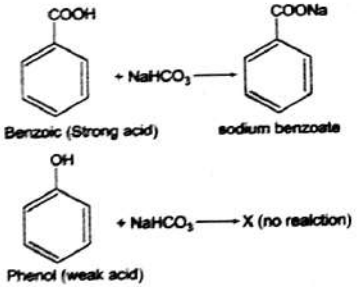
$$\therefore \quad pH = 14 - pOH$$

$$= 14 - 6.99 = 7.01$$

3. The product of sodium thiosulphate and iodine is sodium tetra thionate.

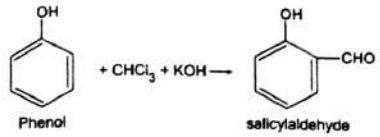
$$2Na_2S_2O_3 + I_2 \longrightarrow \underset{\text{sodium tetrathionate}}{Na_2S_4O_6} + 2NaI$$

4. Phenol and benzoic acid can be distinguished by $NaHCO_3$ because only stronger acid reacts with sodium bi carbonate.



5. Due to stronger hydrogen bonding, water is a liquid while hydrogen sulphide is a gas.

6. Phenol reacts with chloroform in presence of potassium hydroxide to form salicylaldehyde.



7. Frenkel and Schottky defects are called the Crystal Defects.

8. Alkyne change to ketone upon hydrolysis in presence of mercury salt.

$$CH_3CH_2C \equiv CH \xrightarrow[Hg^{2+}/H_2SO_4]{H.OH} \underset{\text{butanone-2}}{CH_3CH_2COCH_3}$$

9. Solubilities of salts are as follows :

$$Bi_2S_3 = \sqrt[5]{\frac{K_{sp}}{108}}$$

$$= \sqrt[5]{\frac{1.6 \times 10^{-72}}{108}} = 1.7 \times 10^{-15}$$

$$Ag_2S = \sqrt[3]{\frac{K_{sop}}{4}} = \sqrt[3]{\frac{1.6 \times 10^{-49}}{4}}$$

$$= 3.4 \times 10^{-17}$$

$$PbS = \sqrt{K_{sp}} = \sqrt{1.1 \times 10^{-29}}$$

$$= 3.3 \times 10^{-15}$$

$$CoS = \sqrt{K_{sp}} = \sqrt{2 \times 10^{-27}} = 4.5 \times 10^{-14}$$

Hence, Ag_2S is least soluble.

So minimum solubility is of CoS as its force of attraction is greatest.

10. According to Graham's rule

$$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$$

or $$\frac{r_1}{r_2} = \sqrt{\frac{25}{4}}$$

$$\Rightarrow \quad = \frac{5}{2}$$

Hence ratio of diffusion is 5 : 2

11. All compound which have hydrogen atom attached to F, O or N atom (i.e. highly electronegative atoms) exhibit H bonding. In the question Hf exhibit strongest H bonding because F is most electronegative element.

12. CH_3O^- is stronger nucleophilic reagent because methyl group increase the electron density on oxygen, since it show +I effect.

13. For the explaination of real gas behaviour van der Waal gave an equation. The gas pressure is changed due to intermolecular attraction. By adding $\frac{a}{V^2}$ the pressure value is made correct.

14. The hardest substance in the nature is diamond due to complex tetrahedral structure.

15. In $Ni(CO)_4$, carbonyl group is a neutral species. So oxidation number of Ni is zero.

$$Ni(CO)_4$$

$$x + 4 \times 0 = 0$$

$$x = 0$$

16. In this compound carbon atoms have following hybridization :

$$\overset{1}{C}H_2 = \underset{sp}{\overset{2}{C}} = CH_2$$
$$sp^2$$

Carbon one contains one π bond and carbon two contains two π bonds and hence show sp^2 and sp hybridization respectively.

17. In $[NiCl_4]^{2-}$ the oxidation number of Ni is +2.

Electronic configuration of Ni

(at no. = 28)

$$Ni = [Ar]\,3d^8 4s^2$$

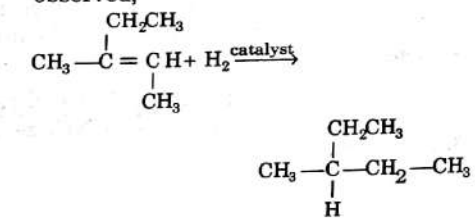
$$Ni^{+2} = [Ar]\,3d^8$$

or [Ar] | ↑↓ | ↑↓ | ↑↓ | ↑ | ↑ |

It is evident that in $[NiCl_4]^{2-}$ the number of unpaired electrons are two.

18. A phenyl group, in which there is a flow of electron due to resonance of the benzene ring, generally causes -I effect, but truely speaking it can act as both electron donating as well as electron withdrawing groups, depending upon the nature of group with which it is attached. In $C_6H_5CH_2^+$, phenyl group is attached to electron deficient group, hence it will donate electron due to resonance in benzene ring and thus stabilise the cation.

19. When *A* react with hydrogen in presence of a catalyst then following reaction is observed,



products is found in *d* and 1 from So two optical isomers are possible.

20. $C(dia) + O_2 \rightarrow CO_2$

$(\Delta H = -395.4\ kJ/mole)$ ...(1)

$C(gr) + O_2 \longrightarrow CO_2$

$(\Delta H = -393.5\ kJ/mole)$ ...(2)

subtracting eq. (1) from (2), we have

$C(gr) \longrightarrow C_{(dia)}$;

$(\Delta H = +1.9\ kJ/mole)$

$[\because \Delta H = -393.5 - (-395.4)$

$= +1.9\ kJ\ mol^{-1}]$

21. The internal energy of a substance always increases with increase in temperature.

22. The rate constant of a reaction depends upon the temperature of the reaction, i.e., rate constant (k) is constant for a particular reaction at fixed temperature.

23. We know

Average life $(T) = 1.44 \times$ half life $(t_{1/2})$

Hence $T = 1.44 \times 40$

or $T = 57.6$ days

So, average life of that radioactive element is 57.6 days.

24. In an isothermal process, the temperature is constant.

So, $\Delta E = 0$

Hence $\Delta H = P\Delta V$ $(As, \Delta H = \Delta E + P\Delta V)$

$\Delta H = W$ $(\because W = P\Delta V)$

25. It is second energy level. Second energy level contains one *s*-orbital and three *p* orbitals. Therefore total number of orbital in *L* level is four.

26. According to Faraday's law

$$\frac{w}{E} = \frac{it}{96500}$$

or $$\frac{w}{35.5} = \frac{1 \times 30 \times 60}{96500}$$

$$= 0.662\ g$$

so, 0.662 g chlorine is liberated.

27. In this reaction change in oxidation number is from +7 to +2.

$$\underset{+7}{KMnO_4} \longrightarrow \underset{+2}{Mn^{2+}}$$

28. Increase in temperature of ideal gas from 27° C to 927° C

$\therefore$ Increase in $KE = \frac{3}{2}RT$

$T_1 = 27 + 273$

$= 300\ K$

$T_2 = 927 + 273 = 1200\ K$

$\therefore \quad KE_1 = \frac{3}{2} \times R \times 300\ K$

$KE_2 = \frac{3}{2} \times R \times 1200\ K$

So, $$\frac{KE_2}{KE_1} = \frac{\frac{3}{2} \times R \times 1200\ K}{\frac{3}{3} \times R \times 300\ K} = 4$$

Hence kinetic energy is increased four times.

29. According to Bohr rule, $r \propto n^2$

where *r* is radii and *n* is the number of orbit

So, $$\frac{r_1}{r_2} = \frac{(2)^2}{(1)^2} = 4$$

Hence, ratio of radii is 4

30. India conducted underground nuclear test at Pokharan.

31. Urotropine is a medicine, which is used for the treatment of Athritis.

32. Dil. sodium hydroxide is used for the hydrolysis of ether.

$$\underset{\text{Ether}}{C_6H_5OCH_3} + H.OH \xrightarrow[H^+]{NaOH} \underset{\text{Phenol}}{C_6H_5OH} + CH_3OH$$

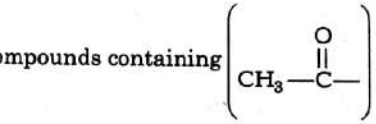
33. Butyne-1 has the terminal hydrogen atom which reacts with ammonical silver nitrate easily and liberate hydrogen.

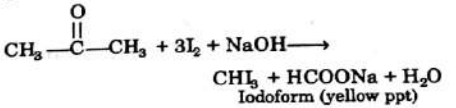
$2CH_3CH_2C \equiv CH + Ag_2O \longrightarrow$

$\underset{\text{white ppt}}{CH_3CH_2C \equiv CAg} + H_2O$

Hence butyne-1 and butyne-2 are distinguished by $AgNO_3 + NH_4OH$

34. The correct configurations of K, Cu and Cr are [Ar] $4s^1$, [Ar] $3d^{10}4s^1$, [Ar] $3d^5\ 4s^1$ respectively. As half filled and completely filled d orbitals are more stable, hence in case of Cr and Cu one electron shifts from 4*s* orbital to 3*d* orbital to give them stable electronic configuration.

35. Compounds containing  group give the iodoform test.



Hence only acetone gives the iodoform test.

36. Dual nature of particle was given by de-Broglie.

37. Given OH^- ion conc. is 10^{-3} M

we know $[H^+][OH^-] = 10^{-14}$

or $$[H^+] = \frac{10^{-14}}{10^{-3}}$$

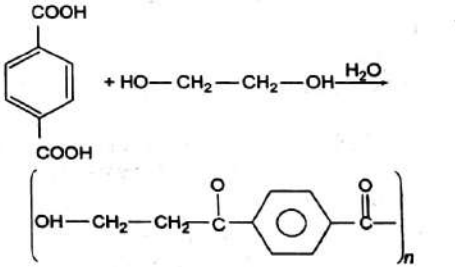
or $$[H^+] = 10^{-11}$$

$\because \quad PH = -\log[H^+] = -\log[10^{-11}]$

Similarly pH of HCl is 3 and pH of NaCl is 7.

38. Due to +I effect methyl group has lesser acidic property. So formic acid is more acidic in comparision to other given acids.

39. Terylene is a form of polyester.



so, terylene having ester linkage.

40. When silicon reacts with carbon, it forms carborandum. Its formula is SiC.

ZOOLOGY

1. The flow of gastric juice is regulated partly by a nervous mechanism and partly by the action of the hormone gastrin, which is produced in the mucosa cells of the stomach. It induces the secretion of gastric juice by gastric glands.

2. The animals that excrete nitrogen in the form of urea are called ureotelic. Ureotelic animals include man and all other mammals and aquatic mammals like whales. So, whale is ureotelic and not ammonotelic.

3. *Noctiluca* is a marine and pelagic dinoflagellate which shows bio-lumine scence. At night, it produces the effect of burning of sea. The luminescence is caused by a bio-luminescent luciferin,which under the influence of an enzymeluciferase emits light.

4. Mantle, foot and shell are characteristics of a mollusc. Out of the given options *Nautilus* is a mollusc, it is a tetrabranch cephalopod. The shell is .external and coiled over the head. *Nauctilus* is always active at night and rests on bottom during day.

5. A five kingdom division of organisms was proposed by Whittaker. Protista is one of that division. It is a kingdom of unicellular, eukaryotic organism. Many of them are photosynthetic autotrophs, unicellular algae and diatoms. Some protists are heterotrophic, e.g. Protozoa.

6. Pepsin is inactivated at pH above 5. Pepsin is a proteolytic or protein splitting enzyme. The pH optimum of pepsin is about 2 and the enzyme, therefore, works well in the acidic gastric juice while it is inactivated in the basic medium.

7. Silkworm is an insect. The rearing of silk worm on large scale is called sericulture not aquaculture. The other three being found in water their rearing can be grouped under aquaculture.

8. Progesterone is a principle female sex hormone. It is a steroid. It is secreted during the later half of the menstrual cycle in human females by temporary endocrine tissue, the corpus luteum. The luteinizing hormone (LH) of anterior pituitary brings about a rupture of the Graafian folllicle to release the ovum and changes the ruptured follicle into a yellow structure called corpus luteum, which secrets progesterone.

9. Insulin affects liver, muscle and adipose tissue. In the muscular tissue it acts to promote carbohydrate metabolism and storage of glycogen. In liver cells, it favours glycongenesis, glycolysis and increases lipogenesis. In adipose tissue in enhances the membrane transfer of glucose and promotes lipogenesis.

10. Inner lining of blood vessels is formed by squamous epithelium. Spuamous epithelium consists of a layer of thin, flat scale-like cells with prominent nuclei. The cell have irregular boundaries that fit closely into those of neighbouring cells.

11. Nucleated RBCs are present in frog. In fishes, amphibians, reptiles and birds erythrocytes are usually nucleated, oval and biconvex, but in mammals they are non-nucleated and biconcave.

12. Pellagra is caused by deficiency of vitamin-B_5. Therefore, vitamin-B_5 is also known as antipellagra factor. The symptoms of this disease are swollen lips, thick pigmented skin of hands and legs and patient feels irritable.

13. The main excretory organs of prawn are paired green glands. They are located within the second antennae, which are the second pair of appendages, attached to the anterior part of the body. Each green gland consists of on endsac, labyrinth and a bladder.

14. Moulting hormone (ecdysone) is secreted by prothoracic gland. These glands are paired, bilateral sheet of cells in the thorax. In *Periplaneta*, this endocrine gland is *X*-shaped. This gland is stimulated by prothoracicotropic hormone. Ecdysone, by causing transformation from larval to pupal stage, initiates post embryonic growth in insects.

15. Deoxyribonuclease and ribonuclease are secreted by pancreas. These enzymes act on DNA and RNA and convert them to deoxyribonucleotides and ribonucleotides, respectively. The optimum pH required by pancreatic juice to secrete these enzymes is 7-8 (alkaline).

16. Haemodialysis helps the patient suffering from uremia. In this condition, the excretory products (*i.e.*, urea) go on accumulating in blood. This happens due to kidney, failure. In haemodialysis the patients blood is passed through disposable dialyser and is then returned to body by the intravenous route.

17. *X*-rays are used in CT-scan (computed tomographic scanning). It uses *X*-rays but employs a computer for reconstructing the image instead of directly recording it on a photographic film. This technique is used in the diagnosis of diseases of brain, spinal cord, chest, etc. It is also useful in detecting tumors.

18. Kwashiorkor is caused by the deficiency of proteins in diet. This disease occurs in children of age group 1 to 5 years. Its symptoms are oedema (swelling of abdomen), thining of limbs, diarrhoea and retarded brain.

19. The thin filaments of a muscle fibre are made up of actin, troponin and tropomyosin. One thin filament probably contains 300-400 actin molecules, about 50 tropomyosin and 50 troponin. It is said that tropomyosin plays a vital role in sensitizing the contractile proteins (actin and myosin) to calcium ions.

20. Taxa whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction are called endangered animals. e.g. Lion tailed macaque, Crocodile, Musk deer, Rhino, etc.

21. During the oxidation process (occurs in inner mitochondrial membrane during electron transport system). enormous amount of free energy is released, some of which is utilixed by inner membrane sub units or F_1 particles containing three coupling factors and ATP enzyme, in the synthesis of ATP molecules.

22. Sometimes certain cells, which have differentiated and stopped dividing, suddenly start multiplying in an uncontrolled way to form a malignant growth called tumor. All cells carry certain cancer producing oncogenes. Under certain conditions these oncogenes are triggered to form masses of cells (tumor).

23. The respiratory decomposition of fatty acids is known as beta oxidation, which occurs in liver and adipose tissue. First of all, there is activation of fatty acid, then dehydrogenation of activated fatty acid takes place. This is followed by hydration. The β-hydroxyl acyl derivative is converted to β-keto derivative, which then reacts with Co-A. Finally there is oxidation.

24. All multicellular animals contain elongated nerve cells, called neurons. Each neuron has a cell body, axon and smaller processes called dendrites. An axon is the process of a nerve cell that carries impulses away from it. Axons run parallel to one another and each is surrounded along its whole length by series of Schwann cells. They may have myelin sheath.

25. Lateral to the blind spot, there is a dipressed area of the retina, called fovea centralis, which contains only cones. Ability for vision is highest in the fovea.

26. Heparin is released from mast-cells. It is an anticoagulant which prevents activation of prothrombin.

27. Antibody is produced by B-lymphocyte. Lymphocytes are critical for immune reactions and of two types B-lymphocytes and T-lymphocytes. B-lymphocytes, upon contact with appropriate antigens, are transformed into plasma cells, which are responsible for the production of antibody. They produce, 20 trillion antibodies per day.

28. Reflexes are classified as the spinal reflexes and the cranial reflexes. The former are so called because their basic neural path leads through spinal nerves and spinal cord. Reflexes at the spinal level have the purpose of removing the animal from harmful stimuli.

29. *Ascaris lumbricoides* (the common roundworm) has no intermediate host. Man acquires infection by directly ingesting *Ascaris* eggs having the infective second stage-rhabditoid larva, with contaminated food or water.

30. The wall of alimentary canal is made up of four basic layers. Ist of all there is serosa which is a thin membranous covering around oesophagus. Then there is muscle layer-outer layer of longitudinal muscles and inner layer of circular muscles. Last there is submucosa, which contains a few oesophageal glands. Then comes mucosa, which have several layers of flattened cells.

31. PCR is a technique in which a small fragment of DNA is rapidly cloned or duplicated to produce multiple DNA copies. Thus, it helps in the diagnosis of a genetical disorder. This technique was conceived by American biochemist Kary B. Mullis.

32. Bile contains no digestive enzymes, yet it plays an important role in fat digestion. It intensifies the 'mixing contractions' of intestinal wall. The organic salts by bile reduce the surface tension of fats globules and suspend them in water of digestive juice. It is emulsification of fats. It facilitates easy action of pancreatic juice on fats. They also help in formation of micelles which help to transport of all and products of fat digestion from intestinal lumen to absorptive cells. The inorganic bile salts import alkalinity to chyme and inactivate gastric pepsin.

33. Each primary oocyte undergo two maturation divisions, first meiotic and the second meiotic division. In the I-meiotic division, the primary oocyte divides into two unequal haploid daughter cells-a large secondary oocyte and very small first polar body. In II-maturation division, the first polar body may divide to form two second polar bodies. The secondary oocyte again divides into two unequal daughter cells, a large ootid and a very small second polar body. The ootid grows into a functional haploid ovum. The I meiotic division is reductional and II meiotic division is equational division.

34. Ischihara chart is used to detect colourblindness.

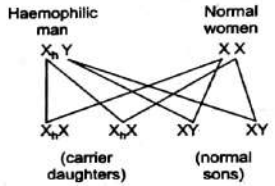
35. During joint diastole, blood continues to flow into auricle through the great viens (superior and inferior venae cavae), which bring venous blood from all parts of the body. During atrial diastole, venous blood again passes from the great veins to the auricle.

36. Periyar sanctuary is located in Kerala. Important animals found here are elephant, tiger, wild bear, sloth bear, grey hornbill etc.

37. Spider is not an insect. It belongs to the order Araneae of the class—Arachnida. It bears four pairs of walking legs unlike insects (have three pairs of walking legs) Loust, Lepisma and Termites are come in the category of insects.

38. The number and kinds of teeth in a species of mammals can be represented by a sort of equation, which is called dental formula. The dental formula of man is $\frac{2.1.2.3}{2.1.2.3} = 32$.

39. The children of a haemophilic man and normal woman will be all normal. Neither sons nor daughters (only carrier) will be haemophilic.



40. Choanocytes are found only in sponges. The choanocyte is an ovoid cell with free ends bearing a transparent contractile collar. The collar surrounds a single, long flagellum. Choanocytes are used in feeding and for ensuring flow of water within the animal's body.

BOTANY

1. The two gametes released by the pollen tube move in opposite direction most probably the streaming currents of cytoplasm. One gamete fuses with egg called fertilisation and second fuses with two polar nuclei called triple fusion *i.e.* fertilisation and triple fusion jointly called double fertilisation. It was first observed by Nawaschin (1848) in *Lilium* and *Fritillaria*. This phenomenon is unique to angiosperm.

2. Engelmann studied the effect of different region of the visible spectrum on the rate of photosynthesis of different algae. The amount of oxygen (O_2) released was found to be maximum in blue and red absorption bands of chlorophyll.

3. Surface tension does'nt help in molecule transport. The process of diffusion and osmosis transport molecules is without using energy but in case of active transport energy (ATP) is used.

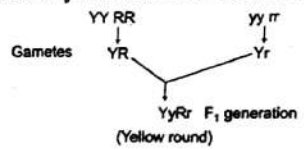
4. It has been now experimentally proved that opening of stomata is an energy consuming process and not closing. The turgidity of guard cells is usually controalled by K^+, Cl^- and H^+. The opening of stomata is initiated by excretion of H^+ by guard cells, intake of K^+ and Cl^- and closing is controlled by abscisic acid.

5. Chlorophyll is the principal pigment involved in photosynthesis. Chlorophyll '*a*' is the major pigment involved in trapping light energy and converting it into electrical and chemical energy. Chlorophyll '*b*' molecules also acts as accessory pigment. Other accessory pigments are phycoerythrin, phycocyanin, carotenoids etc. The accessory pigment and reaction centre together form photo-system.

6. Litmus is used as acid-base indicator is obtained from *Rocella moniagnei* and *Lasallia postulata*

7. Mendel crossed a dominant homozygous yellow, round seeded plant with a recessive homozygous green and wrinkled seeded plant. The F_1 offsprings produced are heterozygous yellow, round seeded plants

parents : yellow round × Green wrinkled.



8. The 'cork' of commerce is obtained from *Quercus suber*. The first formed periderm, called virgin cork is removed when the tree is just 20 years old.

9. The green algae *Cephaleuros virescens* causes red rust of tea. Thus, destroying the tea leaves. Similar disease is caused by the species of *Cephaleuros* to coffee plant, piper and *Citrus* species.

10. Decomposers are heterotropic organisms mostly bacteria and fungi which live on dead organic matter or detritus. They release different enzymes from their bodies into the dead and decaying plant and animal remains. The extra cellular digestion of the dead remains, lead to the release of simple inorganic substances.

11. Green plants and algae use two type of photo-system called PS-I and PS -II. In PS-I chlorophyll absorb maximum at 700 nm wavelength of light thus reaction centre is P_{700} and PS-II absorb maximum 680 nm wavelength of light thus reaction centre is P_{680}. P_{680} (PS-II) extracts an electron from water, returning to its unexcited state because hydrolysis of H_2O occurs in PS-II. So, O_2 evolved in PS-II come from water.

12. Lichens are sensitive to SO_2 environment. They can not grow in sulphur dioxide pollutated area. So, lichens are called pollution indicating plants.

13. In *Cycas* ovules are found without ovary, this condition is called naked ovule. *Cycas* produces largest ovules in the plant kingdom. The ovules are orthotropous and unitegmic.

14. The term 'Meiosis' was given by Farmer and Moore (1905). The best plant part for studing meiosis is the anther. Meiosis takes places in reproductive cells and maintain constant number of chromosomes from generation to generation in a species.

15. Auxins induce cell elongation. IAA is true auxin hormone. Auxins are generally acidic in nature.

16. Most of the lamellae (folding forms a series of parallel membranous sheets) in the chloroplasts are organised to form sac like structures called thylakoids. These thylakoids may be stacked like a pile of coins, this formation has been termed as grana. Chlorophyll found in grana and light reaction of photosynthesis occur in grana.

17. The family Malvaceae includes 75 genera and 1000 species they are chiefly distributed in tropical and subtropical region of the world. The floral fomula is of malva plant.

18. *Crotolaria juncea*, common name sunn hemp. A quick growing crop, is cultivated and ploughed under, to incorporate it into the soil. A green manure crop supplies organic matter and additional nitrogen and also exercises a protective action against erosion and leaching.

19. *Azotobacter, Beijerinkia* are non photosynthetic, non symbiotic and aerobic nitrogen fixing bacteria.

20. When xylem and phloem groups are located on different radii, the bundles are said to be radial *e.g.* root. The protoxylem element lie at the periphery and metaxylem in the centre, this condition is called exarch *e.g.* root.

21. When the stem is flattened and functions as leaf is called phylloclade or cladophyll.

22. Pheromone is a substance secreted to outside by an indivisual and received by a second indivisual of the same specic in which it induce a specific reaction *e.g.* fusion of two yeast cells during sexual reproduction.

23. Green house effect is the CO_2 effect. It is due to CO_2 layer in atmosphere and also by CFC_s, SO_2, NO_2, CH_4. These gases come from factories, automobile, agriculture, refrigerators, deforestation. These gases entrap the solar heat and prevents the escape of heat from earth to outer space, thus increasing the temperature of earth which further lead to global warming.

24. DNA has deoxy ribose pentose sugar and four nitrogenous bases *i.e.* adenine [A], guanine [G], both are purines and cytosine [C], thymine [T] are pyrimidines. While RNA has ribose pentose sugar and four nitrogenous bases as in DNA except uracil [U] in place of thymine.

25. The phenomenon through which certain pollutants (toxic substances) get accumulated in trophic level in increasing concentrations along the different trophic level is called biological magnification or ecological magnification.

26. Potometer is used to measure transpiration rate. Potometers are of four types simple, Ganong's, Bose's and Farmer's potometer.

27. Three vitamins C, E and β-carotene (provitamin) are called antioxidant vitamin. Because they inactivate oxygen free radicals. Free radicals are highly reactive particles that carry an unpaired electron [e^-], they damage cell membranes, DNA, other cellular structures and contribute to formation of artery narrowings and atherosclerosis.

28. There is a total gain of 38 ATP molecules during aerobic respiration of one molecules of glucose. Out of these two molecules of ATP are required for transporting the NADH produced in

glycolysis (in cytoplasm) into the mitochondria for further oxidation, hence the net gain of ATP is 36 molecules.

29. Prof. Ramdeo Misra is known as the "father of Ecology in India". Prof. R. Misra obtained Ph.D in Ecology 1937 under Prof. W.H. Pearsall. Prof Misra formulated the first post graduate course in India. Prof. Birbal Sahni is called "father of Indian Palaeobotany". Prof. P. Maheshwari called "father of Indian embryology". In India for the Ist time he did haploid plant culture (anther and pollen culture). Guha and Maheshwari 1964 successfully cultured the Anther of *Datura innoxia* on basal medium supplimented with kinetin, coconut milk and fruit juices.

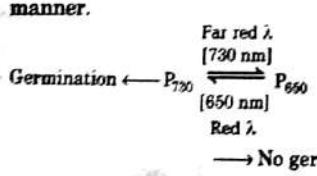
30. In bacteria, respiration occurs in cytoplasmic membrane because bacteria is a prokaryotic cell (true nucleus and membrane bounded organalle are absent).

31. When the fats respire, the value of R.Q. is less than one.

32. *Juniperus virginiana* wood is used for making pencils.

33. Richmond and Lang 1967 observed that degradation of protein and chlorophyll was delayed in the detached leaves of *Xanthium*, if there was cytokinin in the medium.

34. The seed germination is promoted by red wavelength (650 nm) and inhibited by far red (730 nm), this is due to the pigment phytochrome behaving in the following manner.



35. C_4 plants have "Kranz type" anatomy. Vascular bundles are surrounded by bundle sheath cells. The chloroplasts are dimorphic. The cells of bundle sheath have very large chloroplasts. They lack grana and contain starch grains. They are centripetally arranged and mesophyll cells have small and granal chloroplast.

36. The *Triticale* is the first man made cereal. It is formed by a cross between wheat (*Triticum*) and rye (*Secale cerale*) followed by allopolyploidy (multiplication of none homologous chromosomes).

Triticum sp × *Secale cerale*
↓
Diploid
↓ Allopolyploidy
Triticale

37. Dormancy is the condition of a seed when it fails to germinate even when the environmental conditions usually considered necessary for germination are available. It is regulated by ABA (Absicsic acid)

38. Colchicine, an alkaloid obtained from *Colchincum autumnale* (Liliaceae), prevents mitosis by inhibiting spindle formation through disruption of microtubules. It is a mitotic poison.

39. When all the four megaspore nuclei take part in the formation of the female gametophyte (embryo sac). This type of development is called as tetrasporic. In tetrasporic embryo sacs, meiosis is not accompanied by wall formation.

40. DNA synthesis or replication always proceeds in $C_5 \rightarrow C_3$ direction. Both the strands replicate by the addition of nucleotide monomer in $C_5 \rightarrow C_3$ direction.

JIPMER
SOLVED PAPER 2006

Physics

1. Which is true for rolling friction (μ_r), static friction (μ_s) and kinetic friction (μ_k):
(a) $\mu_s > \mu_k > \mu_r$ (b) $\mu_s < \mu_k < \mu_r$
(c) $\mu_s < \mu_k > \mu_r$ (d) $\mu_s > \mu_r > \mu_k$

2. Two weights w_1 and w_2 are suspended to the two strings on a frictionless pulley. When the pulley is pulled up with an acceleration g, then the tension in the string is :
(a) $\frac{4w_1w_2}{w_1 + w_2}$ (b) $\frac{w_1w_2}{w_1 + w_2}$
(c) $\frac{2w_1w_2}{w_1 + w_2}$ (d) $\frac{w_1 + w_2}{2}$

3. Two similar charges having mass m and $2m$ are placed in an electric field. The ratio of their kinetic energy is :
(a) 4 : 1 (b) 1 : 1
(c) 2 : 1 (d) 1 : 2

4. In a system of units if force (F), acceleration (A), and time (T) are taken as fundamental units, then the dimensional formula of energy is :
(a) FA^2T (b) FAT^2
(c) F^2AT (d) FAT

5. If the length of a pendulum is made 9 times and mass of the bob is made 4 times, then the value of time period becomes :
(a) $3T$ (b) $3/2T$
(c) $4T$ (d) $2T$

6. There are 26 tuning forks arranged in the decreasing order of their frequencies. Each tuning fork gives 3 beats with the next. The first one is octave of the last. What is the frequency of 18th tuning fork ?
(a) 100 Hz (b) 99 Hz
(c) 96 Hz (d) 103 Hz

7. Who discovered X-rays ?
(a) Roentgen
(b) Madam Curie
(c) Rutherford
(d) All of these

8. The light rays having photons of energy 1·8 eV are falling on a metal surface having a work function 1·2 eV. What is the stopping potential to be applied to stop the emitting electrons ?
(a) 3 eV (b) 1.2 eV
(c) 0.6 eV (d) 1.4 eV

9. A car starts from rest, moves with an acceleration a and then decelerates at a constant rate b for sometimes to come to rest. If the total time taken is t. The maximum velocity of car is given by :
(a) $\frac{abt}{(a+b)}$ (b) $\frac{a^2t}{a+b}$
(c) $\frac{at}{(a+b)}$ (d) $\frac{b^2t}{a+b}$

10. A pendulum is undergoing SHM with frequency f. What is the frequency of its kinetic energy ?
(a) $f/2$ (b) $2f$
(c) $3f$ (d) $4f$

11. Two planets are revolving around the earth with velocities v_1 and v_2 and in radii r_1 and r_2 ($r_1 > r_2$) respectively. Then :
(a) $v_1 = v_2$ (b) $v_1 > v_2$
(c) $v_1 < v_2$ (d) $\frac{v_1}{r_1} = \frac{v_2}{r_2}$

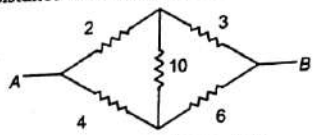
12. The angular momentum of a rotating body changes from A_0 to $4A_0$ in 4 minutes. The torque acting on the body is :
(a) $3/4A_0$ (b) $4A_0$
(c) $3A_0$ (d) $3/2A_0$

13. A charge Q is distributed uniformly in a sphere (solid). Then, the electric field at any point r, where, $r < R$ (r is the radius of sphere) varies as :
(a) $r^{1/2}$ (b) r^{-1}
(c) r (d) r^{-2}

14. A person is observing two trains one coming towards him and other leaving with the same velocity 4 m/s. If their whistling frequencies are 240 Hz each, then the number of beats per

second heard by the person will be : (if velocity of sound is 320 m/s)
(a) 3 (b) 6
(c) 9 (d) zero

15. In the given circuit, what will be the equivalent resistance between the points A and B ?



(a) 10/3 Ω (b) 20 / 3 Ω
(c) 10 / 5 Ω (d) 5 Ω

16. If the focal length of a lens of a camera is $5f$ and that of another is $2.5f$, what is the time of exposure for the second, if for the first one is $\frac{1}{200}$ s ?
(where f is focal length/unit aperture)
(a) $\frac{1}{200}$ (b) $\frac{1}{800}$
(c) $\frac{1}{6400}$ (d) $\frac{1}{3200}$

17. If a charge particle enters perpendicularly in the uniform magnetic field, then :
(a) energy and momentum both remains constant
(b) energy remains constant but momentum changes
(c) both energy and momentum changes
(d) energy changes but momentum remains constant

18. Earth is revolving around the sun. If the distance of the earth from the sun is reduced to 1/4th of the present distance then the length of present day will be reduced by :
(a) $\frac{1}{4}$ (b) $\frac{1}{2}$
(c) $\frac{1}{8}$ (d) $\frac{1}{6}$

19. Two rods of same material have same length and area. The heat ΔQ flows through them for 12 minutes when they are joint side by side. If now both the rods are joined in parallel, then the same amount of heat ΔQ will flow in :
(a) 24 min (b) 3 min
(c) 12 min (d) 6 min

20. There are two planets and the ratio of radius of the two planets is K but ratio of acceleration due to gravity of both planets is g. What will be the ratio of their escape velocity ?
(a) $(Kg)^{1/2}$ (b) $(Kg)^{-1/2}$
(c) $(Kg)^2$ (d) $(Kg)^{-2}$

21. In the reaction given below
$${}_{86}A^{222} \longrightarrow {}_{84}B^{210}$$
how many α and β-particles are emitted ?
(a) 6α, 3β (b) 3α, 4β
(c) 4α, 3β (d) 3α, 6β

22. If a spherical ball rolls on a table without slipping the friction of its total energy associated with rotational energy is :
(a) 3/5 (b) 2/7
(c) 2/5 (d) 3/7

23. The equation of stationary wave along a stretched string is given by $y = 5 \sin \frac{\pi x}{3} \cos 40 \pi t$, where, x and y are in cm and t in second. The separation between two adjacent nodes is :
(a) 1.5 cm (b) 3 cm
(c) 6 cm (d) 4 cm

24. Which of the following is not an inelastic collision ?
(a) A man jump on a cart
(b) A bullet embedded in a block
(c) Collision of two glass ball
(d) none of the above

25. If a convex lens of focal length 80 cm and a concave lens of focal length 50 cm are combined together, what will be their resultant power ?
(a) + 0.65 D (b) – 0.65 D
(c) + 0.75 D (d) – 0.75 D

26. The phenomenon of radioactivity is :
(a) exothermic change which increases or decreases with temperature
(b) increases on applied pressure
(c) nuclear process does not depend on external factors
(d) none of the above

27. A perfect gas is found to obey the relation $PV^{3/2}$ = constant during an adiabatic process. If such a gas initially at a temperature T, is compressed to half of its initial volume, then its final temperature will be :
(a) $2T$ (b) $4T$
(c) $(2)^{1/2} T$ (d) $2(2)^{1/2} T$

28. The amplification factor of a triode valve is 15. If the grid voltage is changed by 0·3 V, the change in plate voltage in order to keep the current constant (in volt) is :
(a) 0.02 (b) 0.002
(c) 4.5 (d) 5.0

29. A uniform wire of length l and having resistance R is cut into n equal parts and all parts are connected in parallel, then the equivalent resistance will be :
(a) R (b) R/n
(c) R/n^2 (d) n^2R

30. In isothermal process, which of the following is not true ?
(a) Temperature remains constant
(b) Internal energy does not change
(c) No heat enters or leaves the system
(d) none of the above

31. A force F is given by $F = at + bt^2$, where, t is time. What are the dimensions of a and b ?
(a) $[MLT^{-1}]$ and $[MLT^0]$
(b) $[MLT^{-3}]$ and $[ML^2T^4]$
(c) $[MLT^{-4}]$ and $[MLT^1]$
(d) $[MLT^{-3}]$ and $[MLT^{-4}]$

32. In a L-C-R circuit, the capacitance is made one-fourth, then what should be change in inductance, so that the circuit remains in resonance ?
(a) 8 times (b) 1/4 times
(c) 2 times (d) 4 times

33. A plane glass slab is kept over various colour letters, the letter which appears least raised is :
(a) red (b) violet
(c) green (d) blue

34. A convex lens forms a full image of the object on a screen. If half of the lens is covered with an opaque object, then :
(a) the image disappears
(b) half of the image is seen
(c) full image is seen and of same intensity
(d) full image is seen and of decreased intensity

35. A river is flowing from west to east with a speed of 5 m/min. A man can swim in still water with a velocity 10 m/min. In which direction should the man swim so, as to take the shortest possible path to go to the south ?
(a) 30° east of south (b) 60° east of south
(c) 60° west of south (d) 30° west of north

36. The time taken by light to pass through 4 mm thick glass slab of refractive index 1.5 will be : (velocity of light in air = 3×10^8 m/s)
(a) 8×10^{-11} s (b) 2×10^{-11} s
(c) 8×10^{-8} s (d) 2×10^{-8} s

37. A lens acts as converging in air and diverging when immersed in water. Then, refractive index of lens is :
(a) equal to unity (b) below 1.33
(c) greater than 1.33 (d) less than unity

38. A light passing through air has wavelength 6000 Å. The wavelength when same ray passes through a glass slab of refractive index 1.5 will be :
(a) 2000 Å (b) 4000 Å
(c) 8000 Å (d) 1200 Å

39. Radius of first Bohr orbit is r. What is the radius of 2nd Bohr orbit ?
(a) $8r$ (b) $2r$
(c) $4r$ (d) $2\sqrt{2}r$

40. Two equal –ve charges $-q$ are fixed at the point $(0, a)$ and $(0, a)$ on the y-axis. A positive charge Q is released from rest at the poin $(2a, 0)$ on the x-axis. The charge will :
(a) execute SHM about the origin
(b) move to the origin and remain at rest
(c) move to infinity
(d) execute oscillatory but not SHM

Chemistry

1. What is the formula of bleaching powder ?
(a) CaO(OCl) (b) Ca(OCl)Cl
(c) $Ca(OCl)_2$ (d) $Ca(OCl)_2Cl$

2. By which one of the following compounds both CH_4 and $CH_3 - CH_3$ can be prepared in one step ?
(a) CH_3I (b) CH_3OH
(c) CH_3CH_2I (d) C_2H_5OH

3. $R - NH - COH \xrightarrow[\text{Pyridine}]{POCl_3}$ product
In the given reaction, what will be the product ?
(a) $R - N{=}C{=}O$ (b) $R - \overset{+}{N} \equiv C^-$
(c) $R - C \equiv N$ (d) None of these

4. $A + B \rightleftharpoons C + D$. If initially the concentration of A and B are both equal but at equilibrium, concentration of D will be twice of that of A,

then what will be the equilibrium constant of reaction ?
(a) 4/9 (b) 9/4
(c) 1/9 (d) 4

5. Which of the following is secondary pollutant ?
(a) CO_2 (b) N_2O
(c) PAN (d) SO_2

6. The geometry of $Ni(CO)_4$ and $Ni(PPh_3)_2Cl_2$ are :
(a) both square planar
(b) tetrahedral and square planar respectively
(c) both tetrahedral
(d) square planar and tetrahedral respectively

7. Cr is member of 3d transition series of atomic number 24. What will be its electronic configuration ?
(a) $3d^6 4s^2$ (b) $3d^5 4s^2$
(c) $3d^4 4s^2$ (d) $3d^5 4s^1$

8. Which of the following compounds is carborundum ?
(a) Al_2O_3 (b) SiO_2
(c) SiC (d) SnO_2

9. What amount of Cl_2 gas liberated at anode, if 1 ampere current is passed for 30 minute from NaCl solution ?
(a) 0.66 mol (b) 0.33 mol
(c) 0.66 g (d) 0.33 g

10. Certain crystals produce electric signals on application of perssure. This phenomenon is called :
(a) pyroelectricity (b) ferroelectricity
(c) piezoelectricity (d) ferrielectricity

11. Aspirin is :
(a) antipyretic (b) tranquilizer
(c) narcotic (d) anaesthetic

12. Which of the following is not a property of liquid state ?
(a) Intermolecular force of attraction in a liquid is quite large
(b) All liquids accompanied by cooling on evaporation
(c) Lower the boiling point of a liquid, greater is its vapour pressure at room temperature
(d) A liquid boils at high temperature at the top of a mountain than at the sea level

13. In Williamson's synthesis, ethoxyethane is prepared by :
(a) passing ethanol over heated alumina
(b) heating sodium ethoxide with ethyl bromide
(c) treating ethyl alcohol with excess of H_2SO_4 at 430-440 K
(d) heating ethanol with dry Ag_2O

14. If for a sucrose solution, elevation in boiling point is 0.1°C, then what will be the boiling point of NaCl solution for same molal concentration ?
(a) 0.1°C (b) 0.2°C
(c) 0.08°C (d) 0.01°C

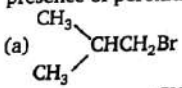
15. Which of the following have maximum number of unpaired electrons ?
(a) Fe^{3+} (b) Fe^{2+}
(c) Co^{2+} (d) Co^{3+}

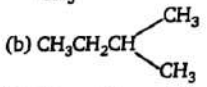
16. Which of the following statements is false ?
(a) $CaOCl_2$ gives OH^-, Cl^- and OCl^- in aqueous solution
(b) Diamond and graphite are allotropes of carbon
(c) Bleaching action of Cl_2 in moist condition is not permanent
(d) Calomel is Hg_2Cl_2

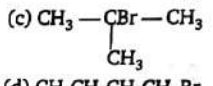
17. What will be the order of Ist ionisation energy ?
(a) Li > Na > K (b) K > Li > Na
(c) Na > Li > K (d) Li > K > Na

18. The element $_{90}Th^{232}$ belongs to thorium series. Which of the following will act as the end product of the series ?
(a) $_{82}Pb^{208}$ (b) $_{82}Bi^{209}$
(c) $_{82}Pb^{206}$ (d) $_{82}Pb^{207}$

19. The reaction of HBr with  in the presence of peroxide will give :

(a) 

(b) 

(c) 

(d) $CH_3CH_2CH_2CH_2Br$

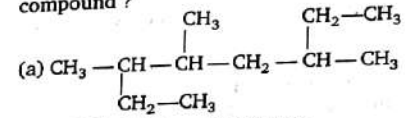
20. Given pH of a solution *A* is 3 and it is mixed with another solution *B* having pH 2. If both mixed, then resultant pH of the solution will be :
(a) 3.2 (b) 1.9
(c) 3.4 (d) 3.5

21. With which of the given pairs CO_2 resembles ?
(a) $HgCl_2$, C_2H_2
(b) $HgCl_2$, $SnCl_4$
(c) C_2H_2, NO_2
(d) N_2O and NO_2

22. If magnetic quantum number of a given atom represented by –3, then what will be its principal quantum number ?
(a) 2 (b) 3
(c) 4 (d) 5

23. Which of the following will show geometrical isomerism ?
(a) but-1-ene
(b) but-2-ene
(c) 2, 3-dichlorobutane
(d) ethene

24. What will be the IUPAC name of given compound ?

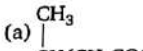
(a) 

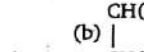
(a) 2, 5-diethyl-4-methylhexane
(b) 3, 4, 6-trimethyloctane
(c) 2, 5, 6-trimethyloctane
(d) 3, 5-dimethyl-6-ethylheptane

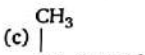
25. A mixture of camphor and benzoic acid can be separated by :
(a) chemical method
(b) sublimation
(c) fractional distillation
(d) extraction with a solvent

26. HCHO reacts with CH_3MgI to give :
(a) CH_3CH_2OH (b) CH_3OH
(c) CH_3CH_2I (d) CH_3I

27. reacts with acetic acid in presence of Hg^{2+} to give :

(a) 

(b) 

(c) 

(d) none of these

28. Which of the following have highest electron affinity ?
(a) F (b) Cl
(c) N (d) O

29. Which among the following is strongest acid ?
(a) $H(ClO)O_2$ (b) $H(ClO)O_3$
(c) H(ClO)O (d) H(ClO)

30. Which of the following amino acid is optically inactive ?
(a) Phenyl alanine (b) Glycine
(c) Glutamic acid (d) Asparagine

31. Glucose has difference from fructose in that it :
(a) does not undergo hydrolysis
(b) gives silver mirror with Tollen's reagent
(c) monosaccharide
(d) none of the above

32. Which of the following gives correct arrangement of compounds involved based on their bond strength ?
(a) HF > HCl > HBr > HI
(b) HI > HBr > HCl > HF
(c) HF > HBr > HCl > HI
(d) HCl > HF > HBr > HI

33. The enthalpy of combustion at 25°C of H_2, cyclohexane (C_6H_{12}) and cyclohexene (C_6H_{10}) are – 241, – 3920 and – 3800 kJ/mol respectively. The heat of hydrogenation of cyclohexene is :
(a) – 121 kJ/mol (b) + 121 kJ/mol
(c) – 242 kJ/mol (d) + 242 kJ/mol

34. The entropy values (in $JK^{-1}mol^{-1}$) of $H_2(g) = 130.6$, $Cl_2(g) = 223.0$ and $HCl(g) = 186.7$ at 298 K and 1 atm pressure. Then entropy change for the reaction :
$H_2(g) + Cl_2(g) \longrightarrow 2HCl(g)$ is :
(a) + 540.3 (b) + 727.3
(c) – 166.9 (d) + 19.8

35. A certain sample of gas has a volume of 0.2 L measured at 1 atm pressure and 0°C. At the same pressure but 273°C, its volume will be :
(a) 0.4 L (b) 0.8 L
(c) 27.8 L (d) 55.6 L

36. Hardness of water is due to presence of salts of :
(a) Na^+ and K^+ (b) Ca^{2+} and Mg^{2+}
(c) Ca^{2+} and K^+ (d) Ca^{2+} and Na^+

37. Total number of atoms represented by the compound $CuSO_4 \cdot 5H_2O$ is :
(a) 27 (b) 21
(c) 5 (d) 8

38. The half-life of a first order reaction having rate constant $k = 1.7 \times 10^{-5}\ s^{-1}$ is :
(a) 12.1 h (b) 9.7 h
(c) 11.3 h (d) 1.8 h

39. Which one of the following contain isopropyl group ?
(a) 2, 2, 3, 3-tetramethylpentane
(b) 2-methylpentane
(c) 2, 2, 3-trimethylpentane
(d) 3, 3-dimethylpentane

40. When electrons are trapped into the crystal in anion vacancy, the defect is known as :
(a) Schottky defect
(b) Frenkel defect
(c) stoichiometric defect
(d) F-centres

Zoology

1. Acrosome is formed by :
(a) nucleus (b) Golgi apparatus
(c) mitochondria (d) none of these

2. Cell membrane in animals is composed mainly of the molecule of :
(a) lipids (b) proteins
(c) lipids and proteins (d) carbohydrates

3. Which one is single membrane cell organelle ?
(a) Endoplasmic reticulum
(b) Mitochondria
(c) Lysosomes
(d) Chloroplast

4. Chloragogen cells help in :
(a) respiration (b) reproduction
(c) circulation (d) nutrition

5. Which is gonadotropin hormone ?
(a) GH (b) MSH
(c) ADH (d) FSH and LH

6. Which have not left any evidences of organic evolution ?
(a) *Archaeopteryx* (b) Cow
(c) *Peripatus* (d) *Neopilina*

7. Which leaves the liver and moves towards kidney ?
(a) Ammonia (b) Urea
(c) Glycogen (d) Bile

8. Major nitrogenous waste product in ureotelic animals like rabbit and other mammals is :
(a) uric acid (b) urea
(c) ammonia (d) amino acids

9. Urine is concentrated in :
(a) kidney (b) deamination
(c) arginine (d) Ornithine

10. 'Sea fan' belongs to :
(a) Coelenterata (b) Porifera
(c) Echinodermata (d) Mollusca

11. Trochophore is the larva of :
(a) *Neopilina* (b) *Chiton*
(c) *Pila* (d) All of these

12. Food storage in *Leucosolenia* occur by :
(a) ostia (b) osculum
(c) thesocyte (d) spongocoel

13. Organs which differ in origin but perform similar functions :
(a) analogous (b) homologous
(c) vestigial (d) all of these

14. Blood leaving liver and going towards heart is rich in :
(a) bile (b) urea
(c) ammonia (d) oxygen

15. Sequence of DNA (non-coding) is known as :
(a) exon (b) intron
(c) cistron (d) none of these

16. How many sperms are formed by four primary spermatocytes ?
(a) 1 (b) 4
(c) 16 (d) 32

17. 'Digestion' word means :
(a) burning of food (b) oxidation of food
(c) hydrolysis of food (d) breakdown of food

18. Maximum absorption of water occurs in :
(a) colon (b) rectum
(c) large intestine (d) small intestine

19. Set which includes only analogous organs is :
(a) wings of butterfly, housefly and bat
(b) hindlegs of horse, grasshopper and bat
(c) wings of butterfly and wingspread of bat and birds
(d) mandibles of cockroach, mosquito and honey bee

20. 'Convergent Evolution' is shown by :
(a) homologous organs
(b) analogous organs
(c) vestigial organs
(d) all of the above

21. Chloragogen cells of earthworms are analogous to vertebrate :
(a) lungs (b) liver
(c) gut (d) kidneys

22. Class Crustacea differs from Insecta in having :
(a) two pairs of antennae
(b) jointed foot
(c) chitinous cuticle
(d) none of the above

23. In DNA, which is absent ?
(a) Adenine (b) Thymine
(c) Guanine (d) Uracil

24. Neural canal is present in :
(a) humerus
(b) tibia-fibula
(c) vertebral column
(d) cranial bones

25. Sigmoid notch is formed by :
(a) cavity formed by humerus
(b) cavity formed by radius-ulna
(c) cavity formed by tibia-fibula
(d) cavity formed by femur

26. Lymphocytes are formed by :
(a) plasma cells (b) mast cells
(c) liver cells (d) none of these

27. On high mountains, difficulty in breathing is due to :
(a) decrease in partial pressure of O_2
(b) decrease in amount of O_2
(c) increase in CO_2 concentration
(d) all of the above

28. Which of the following character is present essentialy in chordates ?
(a) Ventral spinal chord
(b) Dorsal heart
(c) Pharyngeal gill slits
(d) Blood flow in forward direction in ventral blood vessels

29. If dorsal nerve of spinal cord is broken down then its effect is :
(a) no impulse is transmitted
(b) impulse is transmitted but slowly
(c) impulse is transmitted fast
(d) no effect on impulse

30. Striped muscles are characterized by :
(a) syncytial (b) spindle shape
(c) uninucleate (d) none of these

31. Bowman's capsule is found in :
(a) glomerulus (b) uriniferous tubule
(c) nephron (d) Malpighian capsule

32. Which of the following hormone stimulates the gastric secretion ?
(a) Enterogastrone (b) Gastrin
(c) CCK–PZ (d) Villikinin

33. Example of analogous organs is :
(a) wings of bird and insect
(b) forelimbs of horse and man
(c) teeth of elephant and man
(d) none of the above

34. During starvation what will be sequence of ending of food stuffs ?
(a) Carbohydrates – Fat – Protein
(b) Carbohydrate – Protein – Fat
(c) Fat – Protein – Carbohydrate
(d) Fat – Carbohydrate – Protein

35. Number of cranial nerves in frog :
(a) 10 pairs (b) 9 pairs
(c) 12 pairs (d) none of these

36. How many ATP are formed by oxidation of one glucose molecule in liver cells ?
(a) 36 (b) 38
(c) 2 (d) 8

37. A haemophilic woman marries a normal man then :
(a) all the children will be normal
(b) all the sons will be haemophilic
(c) all the girls will be haemophilic
(d) half girls will be haemophilic

38. Husband has blood group A and wife has blood group B. What is the blood group of children ?
(a) A (b) B
(c) AB (d) A, B, AB or O

39. Which insect is useful for us ?
(a) *Periplaneta*
(b) *Musca*
(c) *Bombyx*
(d) Mosquitoes

40. Which is called soluble RNA ?
(a) *r*-RNA (b) *t*-RNA
(c) *m*-RNA (d) *hn*-RNA

Botany

1. The protein rich alga is :
(a) *Ulothrix* (b) *Spirogyra*
(c) *Nostoc* (d) *Chlorella*

2. Floral formula of $\oplus\ \varphi\ \overset{\frown}{\sigma}\ K_5C_5A_{5+5}\ \underline{G_1}$ is characteristic of the family :
(a) Papilionaceae (b) Caesalpinoideae
(c) Cruciferae (d) Mimosoideae

3. Biotic factors are :
(a) chemical factors of soil which affect life
(b) physical factors of soil which affect life
(c) all living organisms which influence other organisms
(d) factors of atmosphere which affect life

4. Which of the following as a living fossil ?
(a) *Pinus* (b) *Gnetum*
(c) *Ginkgo* (d) *Riccia*

5. The alga used for quick sewage disposal is :
(a) *Ulothrix* (b) *Cladophora*
(c) *Volvox* (d) *Chlorella*

6. Lactic acid is produced by *Rhizopus* species :
(a) *R. oryzae* (b) *R. stolonifer*
(c) *R. nodosus* (d) *R. sexualis*

7. The number of female flowers found in a cyanthium is :
(a) one (b) three
(c) two (d) many

8. In turnip, 2/3 part of swollen area is derived from :
(a) hypophysis (b) hypocotyl
(c) epicotyl (d) radicle

9. The amphibians of plant kingdom are :
(a) algae (b) bryophytes
(c) thallophytes (d) floating plants

10. The law of limiting factors for photosynthesis was enunciated by :
(a) R. Hill (b) Calvin
(c) Krebs (d) Blackman

11. Who said that "transpiration is a necessary evil" ?
(a) Curtis (b) Steward
(c) Andersen (d) J.C. Bose

12. Transpiration would be lowest when :
(a) wind velocity is high
(b) enough water is in the soil
(c) atmospheric RH is high
(d) high temperature and light

13. Which of the following exhibits a direct porportionality to transpiration?
(a) Light and RH
(b) Temperature and RH
(c) Temperature and wind
(d) RH and wind

14. Water in plants is transported by :
(a) cambium (b) phloem
(c) xylem (d) epidermis

15. The most important force which pulls water up in tall trees is :
(a) imbibition force
(b) osmotic force
(c) cohesive force
(d) electromagnetic force

16. The light phase of photosynthesis is called :
(a) Hill reaction
(b) photo action
(c) pigment action
(d) chlorophyllous process

17. The plant *Cuscuta* shows maximum photosynthesis in :
(a) red light
(b) blue light
(c) green light
(d) no photosynthesis at all

18. The incomplete breakdown of sugars in anaerobic respiration results in the formation of :
(a) fructose and water
(b) glucose and CO_2
(c) alcohol and CO_2
(d) water and CO_2

19. During anaerobic conditions, the rate of glycolysis increases, is called :
(a) compensation point
(b) extinction point
(c) Warburg effect
(d) Pasteur effect

20. Micro-nutrients are :
(a) less important in nutrition than macro-nutrients
(b) as important in nutrition as macro-nutrients
(c) may be omitted from culture media without any detrimental effect on the plant
(d) called micro because they play only minor role in nutrition

21. Hydroponics is a :
(a) soilless culture (b) waterless culture
(c) airless culture (d) none of these

22. Green plants constitute :
(a) first trophic level (b) second trophic level
(c) third trophic level (d) complete food chain

23. The plant that is characteristics component of mangrove vegetation :
(a) *Rhizophora mangel*
(b) *Ficus religiosa*
(c) *Mangifera indica*
(d) *Prosopis specigera*

24. Carrier of fluorosis is :
(a) CO_2 (b) chlorine
(c) nitrogen (d) water

25. Non-genetic RNA is of :
(a) two types (b) three types
(c) only one type (d) none of these

26. Kappa particles indicate :
(a) nuclear inheritance
(b) cytoplasmic inheritance
(c) mutation
(d) nucleo-cytoplasmic inheritance

27. A nucleotide is a molecule consisting of a :
(a) hexose sugar, phosphorus and albumen
(b) phosphorus, iron and calcium
(c) phosphate, 5-carbon sugar and nitrogen base
(d) RNA and glucose

28. Quiescent centre is the zone of :
(a) least mitotic activity in the root apex
(b) least mitotic activity in the shoot apex
(c) maximum mitotic activity in the root apex
(d) maximum mitotic activity in the shoot apex

29. Perisperm is :
(a) degenerate part of synergids
(b) peripheral part of endosperm
(c) degenerate part of secondary nucleus
(d) remnant of nucellus

30. An orthotropus ovule is one in which micropyle and chalaza are :
(a) in straight line of funiculus
(b) parallel of funiculus
(c) at right angles to funiculus
(d) oblique to funiculus

31. Which of the following is non symbiotic bio-fertilizer ?
(a) VAM (b) *Azotobacter*
(c) *Anabaena* (d) *Rhizobium*

32. Transformation in bacteria was discovered by :
(a) Lederberg (b) Griffith
(c) Avery *et. al.*, (d) Tatum

33. Lathyrism is caused by :
(a) dal (b) moth dal
(c) khesari dal (d) *Glycine*

34. The arrangement of genes on chromosomes in :
(a) linear (b) ovoid
(c) diffused (d) spiral

35. Pigment anthocyanin is located in :
(a) chloroplast (b) chromoplast
(c) cytoplasm (d) vacuole

36. Cell theory was propounded in 1838–39 by :
(a) Schleiden
(b) Schwann
(c) Schleiden and Schwann
(d) Virchow

37. Non-protein part of enzyme is known as :
(a) holoenzyme (b) apoenzyme
(c) prothetic group (d) none of these

38. The enzyme responsible for atmospheric nitrogen fixation is :
(a) nitrogenase (b) hydrogenase
(c) oxygenase (d) carboxylase

39. Insects captured by insectivorous plants fulfil their requirements of :
(a) enzymes (b) oxygen
(c) nitrogen (d) water

40. Gibberellin was first extracted from :
(a) *Gibberella fujikuroi*
(b) algae
(c) bacteria
(d) roots of higher plants

General English

Directions (Q.1–5) : Choose the word opposite in meaning to the given word.

1. ENMITY :
(a) Friendship (b) Agreement
(c) Amity (d) Co-operation

2. FRUGAL :
(a) Charitable (b) Extravagant
(c) Generous (d) Gaudy

3. PERILOUS :
(a) Innocuous (b) Healthy
(c) Safe (d) Fine

4. VIVACIOUS :
(a) Languid (b) Open
(c) Strong (d) Bright

5. OBVIOUS :
(a) Isolated (b) Celebration
(c) Ancient (d) Illusion

Directions (Q. 6–10) : Select the word which is most nearly the same in meaning to the word in capital letters.

6. DEMISE :
(a) Result (b) Default
(c) Death (d) Apprehension

7. DISPARITY :
(a) Distaste (b) Dissimilarity
(c) Criticism (d) Distinction

8. FORUM :
(a) An assembly
(b) Place of public discussion
(c) An application
(d) Recesses

9. DISMANTLE :
(a) Take apart (b) Destroy
(c) Shatter (d) Upset

10. CURTAIL :
(a) Decorate (b) Celebrate
(c) Cut short (d) Deprive

Directions (Q.11–15) : The following sentences contain errors in grammar, usage, diction (choice of words) and idioms. Some sentences may be correct. No sentence has more than one error. Select the numbered part that according to you contains the error. If there is no error, the answer is (d), i.e., No error.

11. Being a very cold day (a) I would not go out (b) for a morning walk. (c) No error. (d)

12. Such an act of cruelty (a) had never (b) be committed before. (c) No error. (d)

13. If you will (a) insist upon challenging me (b) I will fight it out alone. (c) No error. (d)

14. Of all the other teachers the (a) students respected the history (b) teacher the most. (c) No error. (d)

15. He is one of those persons (a) who listen (b) to all advice but keep his own counsel. (c) No error. (d)

Directions (Q.16–20) : In each question below a part of the sentence is printed in **bold** type. The part printed in **bold** type may or may not contain an error. Below each sentence four phrases are given. One of these can substitute the part of the sentence in bold type to correct it. If the part of the sentence which is printed in **bold** type is correct as it is mark (d) *i.e.*, no correction required, as your answer.

16. It is nice if everyone **can have a own car.**
(a) can has a own car
(b) can has his own car
(c) can have his own car
(d) no correction required

17. In ancient time **one believes in witches.**
(a) people believes in witches
(b) people believed in witches
(c) one believed in witches
(d) no correction required

18. He said that he **has forgotten** his umbrella at home.
(a) had forgotten
(b) had left
(c) has left
(d) no correction required

19. I **am not having seen** her anywhere.
(a) have not seeing
(b) have not being seen
(c) have not seen
(d) no correction required

20. **Having been** there before, he knew what to expect.
(a) have been
(b) has been
(c) had been
(d) no correction required

Directions (Q.21–25) : Choose the alternative which best expresses the meaning of idiom/phrase printed in **bold** type in the sentence.

21. Napoleon **won his laurels** in the Battle of Waterloo.
(a) acquired distinction
(b) defeated the enemies
(c) adopted aggressive attitude
(d) surrendered to his opponents

22. He is regarded as manager's **right hand man.**
(a) good follower
(b) close relative
(c) most efficient assistant
(d) psycophant

23. We shall be formidable if we **stand by** one another.
(a) support (b) oppose
(c) understand (d) encourage

24. Pannikar is one of the few officers who are **above board.**
(a) friendly
(b) able to face difficulties
(c) honest
(d) hard-working

25. When I refused his request for a loan, he was **put out.**
(a) collapsed
(b) started to cry
(c) threatened to use force
(d) was annoyed

Directions (Q.26-30) : Put the given sentences in proper order.

26. P. He recognised it and streamlined the management.
Q. The process started at the top.
R. He undoubtedly had the force of personality to impose painful measures.
S. Within four years he had rescued the company.
(a) Q R S P (b) R Q P S
(c) R S P Q (d) Q P S R

27. P. His mother was dead.
Q. They had not sent him the sand information.
R. Probably they knew his deep love for her.
S. When Gandhi returned to India his son Harilal was four.
(a) S R P Q (b) S P Q R
(c) S Q P R (d) S R Q P

28. P. It results from a carefully devised plan.
Q. Men work together for a cause or purpose.
R. Team work does not just happen.
S. It must be clearly known to them.
(a) Q R P S (b) R S Q P
(c) Q R S P (d) R P Q S

29. P. I will give you a copy of it.
Q. The book was published in New York.
R. It is very interesting book.
S. It deals with mankind's political future.
(a) S R Q P (b) R S Q P
(c) Q S R P (d) S Q R P

30. P. He had inherited that money from an uncle.
Q. Mr. Maini was an innocent man.
R. It was regarding investing ten thousand rupees in my firm.
S. He agreed to my proposal.
(a) S R P Q (b) Q P S R
(c) R S P Q (d) Q S R P

Directions (Q.31–35) : Choose the correct pair of words out of the alternatives given to fill in the blanks in each sentence.

31. He went ..... here ..... five-days ago.
(a) from, about (b) in, into
(c) into, by (d) out, of

32. This college is affiliated ..... Kanpur University ..... Uttar Pradesh.
(a) by, of
(b) with, by
(c) to, in
(d) in, into

33. He belongs ..... an ancient family ..... Hyderabad.
(a) upon, by
(b) into, of
(c) to, of
(d) of, of

34. He insists ..... going ..... train.
(a) on, by (b) in, with
(c) by, in (d) to, in

35. He called ..... me ..... Tuesday.
(a) on, by (b) upon, on
(c) by, before (d) to, on

Directions (Q. 36-40) : Choose the one suitable word for each of the sentences out of the four responses.

36. Mania for stealing articles :
(a) Logamania
(b) Kleptomania
(c) Hymphomania
(d) Lypomania

37. A person living permanently in a certain place :
(a) Native
(b) Resident
(c) Domicile
(d) Subject

38. Witty clever retort :
(a) Repartee
(b) Sarcasm
(c) Platitude
(d) Invective

39. A person who actively opposes somebody of something :
(a) Antagonist
(b) Activist
(c) Incendiary
(d) Terrorist

40. A story in which ideas are symbolised as people :
(a) Fable
(b) Allegory
(c) Legend
(d) Parable

ANSWERS

PHYSICS

1.	(a)	2.	(a)	3.	(c)	4.	(b)	5.	(a)	6.	(b)	7.	(a)	8.	(c)
9.	(a)	10.	(b)	11.	(b)	12.	(a)	13.	(c)	14.	(b)	15.	(a)	16.	(b)
17.	(b)	18.	(c)	19.	(b)	20.	(a)	21.	(b)	22.	(b)	23.	(b)	24.	(c)
25.	(d)	26.	(c)	27.	(c)	28.	(c)	29.	(c)	30.	(c)	31.	(d)	32.	(d)
33.	(a)	34.	(d)	35.	(a)	36.	(b)	37.	(b)	38.	(b)	39.	(c)	40.	(d)

CHEMISTRY

1.	(b)	2.	(a)	3.	(b)	4.	(d)	5.	(c)	6.	(c)	7.	(d)	8.	(c)
9.	(c)	10.	(c)	11.	(a)	12.	(d)	13.	(b)	14.	(b)	15.	(a)	16.	(c)
17.	(a)	18.	(a)	19.	(a)	20.	(b)	21.	(a)	22.	(c)	23.	(b)	24.	(b)
25.	(a)	26.	(a)	27.	(a)	28.	(b)	29.	(b)	30.	(b)	31.	(b)	32.	(a)
33.	(a)	34.	(d)	35.	(a)	36.	(b)	37.	(b)	38.	(c)	39.	(b)	40.	(d)

ZOOLOGY

1.	(b)	2.	(c)	3.	(c)	4.	(d)	5.	(d)	6.	(b)	7.	(b)	8.	(b)
9.	(a)	10.	(a)	11.	(d)	12.	(c)	13.	(a)	14.	(b)	15.	(b)	16.	(c)
17.	(c)	18.	(a)	19.	(c)	20.	(b)	21.	(b)	22.	(a)	23.	(d)	24.	(c)
25.	(b)	26.	(a)	27.	(a)	28.	(c)	29.	(a)	30.	(a)	31.	(d)	32.	(b)
33.	(a)	34.	(a)	35.	(a)	36.	(b)	37.	(b)	38.	(d)	39.	(c)	40.	(b)

BOTANY

1.	(d)	2.	(b)	3.	(c)	4.	(c)	5.	(d)	6.	(c)	7.	(d)	8.	(b)
9.	(b)	10.	(d)	11.	(a)	12.	(c)	13.	(c)	14.	(c)	15.	(c)	16.	(a)
17.	(d)	18.	(c)	19.	(d)	20.	(b)	21.	(a)	22.	(a)	23.	(a)	24.	(d)
25.	(b)	26.	(b)	27.	( )	28.	(a)	29.	(d)	30.	(a)	31.	(c)	32.	(b)
33.	(c)	34.	(a)	35.	(d)	36.	(c)	37.	(c)	38.	(a)	39.	(c)	40.	(a)

GENERAL ENGLISH

1.	(a)	2.	(b)	3.	(c)	4.	(a)	5.	(d)	6.	(c)	7.	(b)	8.	(b)
9.	(a)	10.	(c)	11.	(a)	12.	(c)	13.	(a)	14.	(c)	15.	(c)	16.	(c)
17.	(b)	18.	(b)	19.	(c)	20.	(d)	21.	(a)	22.	(c)	23.	(a)	24.	(c)
25.	(d)	26.	(b)	27.	(b)	28.	(d)	29.	(b)	30.	(d)	31.	(a)	32.	(c)
33.	(c)	34.	(a)	35.	(b)	36.	(b)	37.	(c)	38.	(a)	39.	(a)	40.	(b)

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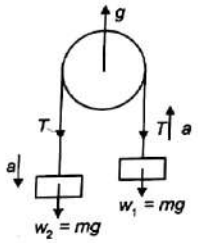
HINTS & SOLUTIONS

Physics

1. Static friction is always greater than kinetic friction, and rolling friction is less than kinetic friction, so

$$\mu_s > \mu_k > \mu_r$$

2. Equation of motion for first weight



$$T - m_1 g = m_1 (g + a)$$

$$\Rightarrow \quad T - 2m_1 g = m_1 a \qquad \ldots(1)$$

For second weight

$$m_2 g - T = m_2 (a - g)$$

$$2m_2 g - T = m_2 a \qquad \ldots(2)$$

On solving Eqs. (1) and (2)

$$T = \frac{4m_1 m_2 g}{(m_1 + m_2)} = \frac{4w_1 w_2}{(w_1 + w_2)}$$

3. Force on charged particle is electric field

$$F = qE$$

$$\therefore \text{ Acceleration } a = \frac{F}{m} = \frac{qE}{m}$$

$$\therefore \text{ Velocity } \quad v = u + at = 0 + \frac{qE}{m} t$$

So, kinetic energy $K = \frac{1}{2} mv^2$

$$= \frac{1}{2} m \left(\frac{qE}{m} t\right)^2$$

Ratio of kinetic energies

$$= \frac{\frac{1}{2} m_1 \left(\frac{qE}{m_1} t\right)^2}{\frac{1}{2} m_2 \left(\frac{qE}{m_2} t\right)^2} = \frac{m_2}{m_1} = \frac{2m}{m} = \frac{2}{1} = 2:1$$

4. Let energy $E = F^x A^y T^3$

Writing the dimensions on both sides

$$[ML^2T^{-2}] = [MLT^{-2}]^x [LT^{-2}]^y [T]^2$$

$$[ML^2T^{-2}] = [M^x L^{x+y} T^{-2x-2y+z}]$$

On comparing both sides

$$x = 1$$

$$x + y = 2$$

$$\Rightarrow \quad y = 2 - x = 2 - 1 = 1$$

and $\quad -2x - 2y + z = -2$

$$\Rightarrow \quad -2 \times 1 - 2 \times 1 + z = -2$$

$$\Rightarrow \quad z = -2 + 2 + 2 = 2$$

$\therefore$ Dimensional formula of energy $= FAT^{-2}$

5. Time period $T = 2\pi \sqrt{\frac{l}{g}}$

i.e., time period does not depend on the mass of the bob.

$$\therefore \quad T \propto \sqrt{l}$$

$$\frac{T_1}{T_2} = \sqrt{\frac{l_1}{l_2}}$$

$$\Rightarrow \quad \frac{T}{T_2} = \sqrt{\frac{l}{9l}}$$

$$\therefore \quad T_2 = 3T$$

6. Each tuning forck gives 3 beats with the next, so the difference in the frequencies of two consecutive forks is 3.

$$\therefore \quad f_{26} = f_1 + (n-1) \times -3$$

$$f = 2f + (26 - 1) \times -3$$

$$f = 75 \text{ Hz}.$$

$\therefore$ Frequency of 18th tuning fork

$$f_{18} = f_1 + (18 - 1) \times -3$$

$$= 2 \times 75 + 17 \times -3$$

$$= 150 - 51 = 99 \text{ Hz}.$$

8. Maximum kinetic energy of photoelectron

$$(KE)_{max} = E - \phi$$

$$= 1.8 - 1.2$$

$$= 0.6 \text{ eV}$$

i.e., $\quad eV_0 = (KE)_{max}$

or $\quad eV_0 = 0.6 \text{ eV}$

$\therefore$ Stopping potential $V_0 = 0.6$ eV.

9. Let car acceleates for time t_1 and decelerates for time t_2 then

$$t_1 + t_2 = t \qquad \ldots(1)$$

From $\quad v = u + at$

$$v = u + at_1$$

$$\Rightarrow \quad v = at_1$$

For deceleration

$$v = u - at \qquad (\because u = v)$$

$$0 = at_1 - bt_2$$

$$at_1 = bt_2$$

$$\Rightarrow \quad t_2 = \frac{at_1}{b}$$

$$\therefore \quad t_1 + \frac{at_1}{b} = 1 \qquad \text{[From Eq. (1)]}$$

$$\Rightarrow \quad t_1\left(1 + \frac{a}{b}\right) = t$$

$$\Rightarrow \quad t_1 = \frac{bt}{a+b}$$

∴ Maximum velocity of car

$$v = at_1 = \frac{abt}{a+b}$$

11. Orbital velocity $v = \sqrt{gr}$

$$\frac{v_1}{v_2} = \sqrt{\frac{r_1}{r_2}}$$

As, $r_1 > r_2$ so, $v_1 > v_2$.

12. Torque $\tau = \frac{dL}{dt} = \frac{(4A_0 - A_0)}{4}$

$$= \frac{3A_0}{4}.$$

13. Electric field intensity at a point inside the sphere $E = \frac{Q}{4\pi\varepsilon_0 R} r$

$$\therefore \quad E \propto r$$

14. Observed frequency of first train

$$n_1 = \frac{v}{v - v_s} \times n$$

$$= \frac{320}{320 - 4} \times 240$$

$$= \frac{320}{316} \times 240$$

$$= 243 \text{ Hz}.$$

Observed frequency of second train

$$n_2 = \frac{v}{v + v_s} n$$

$$= \frac{320}{320 + 4} \times 240$$

$$= 237 \text{ Hz}.$$

∴ Number of beats = 243 – 237 = 6

15. $\because \quad \frac{2}{3} = \frac{4}{6}$

∴ Given, circuit is a balanced Wheatstone's Bridge.

So, 10 Ω resistance will be ineffective.

Equivalent resistance of upper arms

$$R_1 = 2 + 3 = 5\ \Omega$$

∴ Equivalent resistance of lower arms

$$R_2 = 4 + 6 = 10\ \Omega$$

$$R_{AB} = \frac{R_1 R_2}{R_1 + R_2}$$

$$= \frac{5 \times 10}{5 + 10}$$

$$= \frac{50}{10} = \frac{10}{3}\ \Omega$$

16. Ratio of time of expoiusers

$$\frac{t_1}{t_2} = \left(\frac{f_1}{f_2}\right)^2 = \left(\frac{5f}{2.5f}\right)^2$$

$$\Rightarrow \quad \frac{1/200}{t_2} = (2)^2$$

$$\Rightarrow \quad t_2 = \frac{1}{800}\ s$$

17. When charge particle enters in a magnetic field perpendicularly, then the magnitude of its velocity remains constant, but direction changes, so its energy (scalar quantity) remains constant, but its momentum (vector quantity) changes.

18. From Kepler's law

$$T^2 \propto R^3$$

$$\therefore \quad \left(\frac{T_1}{T_2}\right)^2 = \left(\frac{R_1}{R_2}\right)^3$$

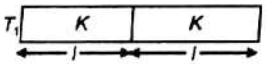
$$\frac{T_1}{T_2} = \left(\frac{R_1}{R_2}\right)^{3/2} = \left(\frac{R}{R/4}\right)^{3/2}$$

$$= (4)^{3/2} = (2)^3 = 8$$

$$\therefore \quad T_2 = \frac{T_1}{8}.$$

Hence, the length of the day is reduced by $\frac{1}{8}$.

19. When rods are joined in series then heat flow



$$\Delta Q_1 = \frac{A(T_1 - T_2)t_1}{\frac{l}{K_1} + \frac{l}{K_2}}$$

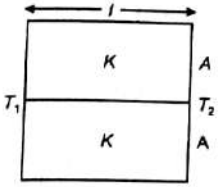
$$= \frac{A(T_1 - T_2)t_1}{\frac{l}{K_1} + \frac{l}{K_2}} = \frac{A(T_1 - T_2)t_1}{l} \frac{K}{2}$$

When rods are joined in parallel

$$\Delta Q_2 = (K_1 A + K_2 A)\frac{(T_1 - T_2)t_2}{l}$$

$$= \frac{2KA(T_1 - T_2)t_2}{l}$$

$\because \quad \Delta Q_1 = \Delta Q_2$ (given)



$$\therefore \quad t_2 = \frac{t_1}{4} = \frac{12}{4} = 3 \text{ min}$$

20.

$$v_e = \sqrt{Rg}$$

$$\frac{v_1}{v_2} = \sqrt{\frac{R_1}{R_2} \cdot \frac{g_1}{g_2}}$$

$$= \sqrt{Kg}$$

$$= (Kg)^{1/2}$$

21. ${}_{86}A^{222} \longrightarrow {}_{84}B^{210}$

Decrease in mass number = 222 – 210 = 12

∴ Number of α-particles emitted

$$= \frac{12}{4} = 3$$

${}_{86}A^{222} \longrightarrow {}_{80}X^{210} \longrightarrow {}_{84}B^{210}$

Increase in atomic number = 84 – 80 = 4

∴ Number of β-particles emitted = 4

22. Rotational energy of sphere

$$E_R = \frac{1}{2} I\omega^2$$

For sphere, moment of inertia

$$I = \frac{2}{5} mR^2$$

$$\therefore \quad E_R = \frac{1}{2}\left(\frac{2}{5} mR^2\right)\left(\frac{v}{R}\right)^2$$

$$= \frac{1}{5} mv^2$$

Translational kinetic energy $E_r = \frac{1}{2} mv^2$

∴ Total energy $= \frac{1}{5} mv^2 + \frac{1}{2} mv^2$

$$= \frac{7}{10} mv^2$$

∴ Required fraction $= \frac{\frac{1}{5} mv^2}{\frac{7}{10} mv^2}$

$$= \frac{2}{7}$$

23. Given, equation

$$y = 5 \sin \frac{\pi x}{3} \cos 40\pi t$$

Comparing with standard equation

$$y = A \sin kx \cos \omega t$$

$$\therefore \quad k = \frac{\pi}{3}$$

$$\Rightarrow \quad \frac{2\pi}{\lambda} = \frac{\pi}{3}$$

$$\lambda = 6 \text{ cm}$$

Separation between two consecutive nodes

$$= \frac{\lambda}{2} = \frac{6}{2} = 3 \text{ cm}.$$

25. $f_1 = +80$ cm, $f_2 = -50$ cm.

Resultant focal length

$$F = \frac{f_1 f_2}{f_1 + f_2}$$

$$= \frac{80 \times -50}{80 - 50} = \frac{-4000}{30}$$

$$= -\frac{4000}{3} \text{ cm}.$$

$$\text{Resultant power } P = \frac{100}{F} = \frac{100}{-400/3}$$

$$= -\frac{3}{4}$$

$$= -0.75 \text{ D}.$$

26. Radioactivity is a natural process which does not depend upon external factors.

27. Gas obeys the equation

$$PV^{3/2} = \text{constant}$$

Comparing with $PV^{\gamma} = \text{constant}$

$$\gamma = \frac{3}{2}$$

For adiabatic process

$$T_1 V_1^{\gamma - 1} = T_2 V_2^{\gamma - 1}$$

$$T\,(V)^{3/2 - 1} = T_2 \left(\frac{V}{2}\right)^{3/2 - 1}$$

$$T_2 = T\,(2)^{3/2 - 1}$$

$$= (2)^{1/2} T$$

28. $\mu = 15$, $\Delta V_g = 0.3$

$$\therefore \quad \mu = \frac{\Delta V_p}{\Delta V_g} \Rightarrow \Delta V_p = \mu \Delta V_g$$

$$= 15 \times 0.3$$

$$= 4.5 \text{ V}.$$

29. Resistance of each part $R' = \frac{R}{n}$

When, these parts are connected in parallel.

Then, $\frac{1}{R''} = \frac{1}{R'} + \frac{1}{R'} \ldots . n$ time

$$= \frac{n}{R'}$$

$$\therefore \quad R'' = \frac{R'}{n} = \frac{R}{n^2}$$

30. In isothermal process, heat enters or leaves the system, to keep the temperature constant, so statement (c) is wrong.

31. Force $F = at + bt^2$

From principle of homogeneity,

Dimensions of at = dimensions of F

$$\therefore \text{Dimensions of } a = \frac{[F]}{[t]} = \frac{[MLT^{-2}]}{[T]} = [MLT^{-3}]$$

Similarly, dimensions of

$$b = \frac{[F]}{[t^2]} = \frac{[MLT^{-2}]}{[T^2]} = [MLT^{-4}]$$

32. Resonance frequency $f = \frac{1}{2\pi\sqrt{LC}}$

For the circuit to remain in resonance, $\sqrt{LC}$ = constant

or $L_1C_1 = L_2C_2$

or $LC = L_2\frac{C}{4}$

$\therefore$ $L_2 = 4L$

$\therefore$ Inductance should be change to four times.

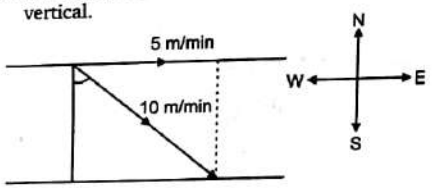
33. Refractive index

$$\mu = \frac{\text{real depth}}{\text{apparent depth}}$$

For red colour, refractive index is minimum, *i.e.*, it will have maximum apparent depth and hence, appears least raised.

34. If half of the lens is covered with an opaque object, then, full image is seen but intensity of image decreases.

35. Let the swimmer swims at an angle θ with the vertical.



$$\therefore \quad \sin\theta = \frac{v_r}{v_s} = \frac{5}{10} = \frac{1}{2} = \sin 30°$$

$$\theta = 30°$$

The swimmer should swim 30° east of south to take the shortest possible path to go to the south.

36. Time taken by light

$$t = \frac{\mu d}{c}$$

$$= \frac{1.5 \times 4 \times 10^{-3}}{3 \times 10^8} = 2 \times 10^{-11}\ s$$

37. When lens is immersed in water then its nature changes. The refractive index of lens is less than that of water *i. e.*, less than 1.33.

38. When light ray passes through a glass slab, then new wavelength

$$\lambda' = \frac{\lambda}{\mu} = \frac{6000}{1.5}$$

$$= 4000\ \text{Å}$$

39. Radius of Bohr orbit

$$r \propto n^2$$

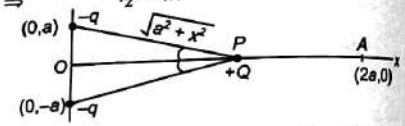
$$\frac{r_1}{r_2} = \left(\frac{n_1}{n_2}\right)^2$$

$$\Rightarrow \quad \frac{r}{r_2} = \left(\frac{1}{2}\right)^2$$

$$\Rightarrow \quad \frac{r}{r_2} = \frac{1}{4}$$

$$\Rightarrow \quad r_2 = 4r.$$

40.



Component of force on charge $+Q$ at P, along x-axis,

$$F_x = \frac{2Qq}{4\pi\varepsilon_0 (a^2 + x^2)} \cos\theta$$

$$= \frac{2Qq}{4\pi\varepsilon_0 (a^2 + x^2)} \times \frac{x}{\sqrt{a^2 + x^2}}$$

$$= \frac{2Qqx}{4\pi\varepsilon_0 (a^2 + x^2)^{3/2}}$$

Which is not directly proportional to x. So, motion is oscillatory but not SHM.

Chemistry

1. Bleaching powder is represented by the formula $Ca(OCl)Cl$.

2. $CH_3I + 2H \xrightarrow[\text{or Zn–Cu/}C_2H_5OH]{\text{Zn + HCl}} \underset{\text{Methane}}{CH_4} + HI$

$$CH_3I + 2Na + ICH_3 \xrightarrow[\text{dry ether}]{} \underset{\text{Ethane}}{CH_3 - CH_3} + 2NaI$$

3. $R - NH - COH \xrightarrow[\text{Pyridine}]{POCl_3} R - N^+ \equiv C^-$

4. $\underset{x}{A} + \underset{x}{B} \rightleftharpoons \underset{0\ \text{(Initial)}}{\underset{2x\ \text{(At equilibrium)}}{C}} + \underset{0\ \text{(Initial)}}{\underset{2x\ \text{(At equilibrium)}}{D}}$

$$K_c = \frac{[C][D]}{[A][B]} = \frac{2x \times 2x}{x \times x} = 4$$

5. Pollutants which are formed by reaction amongst the primary pollutants (persist in the environment in the form they are passed into it) are called as secondary pollutants *e.g.*, peroxyacyl nitrates (PAN) are formed through reaction between nitrogen oxides and hydrocarbons in the presence of sunlight.

6. $Ni(CO)_4$ and $Ni(PPh_3)_2Cl_2$ are tetrahedral in geometrical shape, because co-ordination number of Ni is 4 in both cases.

7. $_{24}Cr \longrightarrow [Ar]\ 3d^5\ 4s^1$

8. Reason being SiC is also used as carborundum.

9. $2Cl^- \rightarrow \underset{1\ \text{mole}}{Cl_2} + \underset{2 \times 96500\ \text{coulomb}}{2e^-}\ \text{(At anode)}$

$$Q = it = 1 \times 30 \times 60$$

$$= 1800\ \text{coulomb}$$

The amount of chlorine liberated by passing 1800 coulomb of electric charge

$$= \frac{1 \times 1800 \times 71}{2 \times 96500} = 0.66g$$

10. Certain crystals produce electric signals on application of pressure. This phenomenon is called piezoelectricity.

11. Aspirin is used as antipyretic as well as analgesic.

12. We know that boiling point falls on decreasing the pressure. At mountain air pressure is low so liquid boils at lower temperature at the top of mountain than at the sea level.

13. $\underset{\text{Sodium ethoxide}}{CH_3CH_2ONa} + \underset{\text{Bromo ethane}}{C_2H_5Br} \xrightarrow[\text{synthesis}]{\text{Williamson's}} \underset{\text{Ethoxyethane}}{CH_3CH_2OCH_2CH_3} + NaBr$

14. Elevation in boiling point is a colligative property as it depends upon the number of particles.

$$\Delta T_b \propto n$$

For sucrose, $n = 1$, $\Delta T_b = 0.1°C$

For NaCl, $n = 2$, $\Delta T_b = 0.2°C$

15. $Fe^{3+} \longrightarrow [Ar]\ 3d^5\ 4s^0$

Number of unpaired electrons = 5.

16. Reason being bleaching action of Cl_2 in moist condition is permanent.

17. In a sub-group ionisation energy decreases from top to bottom because atomic size increases. So, the Ist IE of Li, Na and K are in the order Li > Na > K.

18. The end product of thorium series is Pb–208.

19. $\begin{matrix}CH_3\\CH_3\end{matrix}\!\!>\!C = CH_2 + HBr \xrightarrow{\text{Peroxide}}$

$$\begin{matrix}CH_3\\CH_3\end{matrix}\!\!>\!CH - CH_2Br$$

Addition of HBr according to Anti-Markownikoff's rule.

20. pH of $A = 3$ pH of $B = 2$

$\therefore$ $[H^+] = 10^{-3}$ M, $[H^+] = 10^{-2}$ M

Total $[H^+]$

$$= 10^{-3} + 10^{-2} = 10^{-3} + 10 \times 10^{-3}$$

$$= 11 \times 10^{-3}$$

$$\therefore \quad pH = -\log_{10}[H^+] = -\log(11 \times 10^{-3})$$

$$= 3 - \log 11$$

$$= 3 - 1.04 = 1.96$$

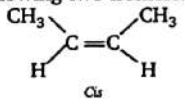
21. CO_2, $HgCl_2$ and C_2H_2 all are linear in shape. O=C=O, Cl—Hg—Cl, HC≡CH.

22. If $m = -3$

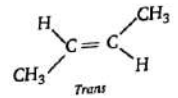
$\therefore$ $l = 3$

$n = 4$

23. But-2-ene will show geometrical isomerism. It has following two isomers.

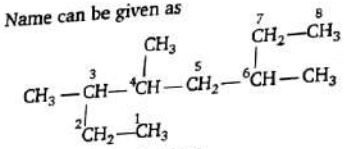


Cis



Trans

24. Name can be given as

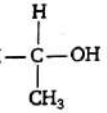


3, 4, 6-trimethyloctane

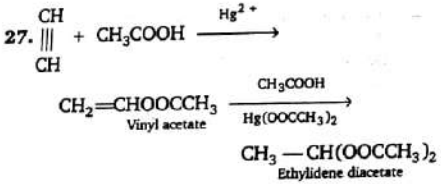
25. Aqueous solution of $NaHCO_3$ is used to separate benzoic acid from its mixture with camphor. Benzoic acid form water soluble sodium benzoate with $NaHCO_3$.

26. $HCHO + CH_3MgI \rightarrow$

$\xrightarrow{H^+}$



27.



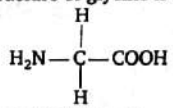
28. Electron affinity of halogens is maximum in a period and it decreases in a group from top to bottom but the EA of chlorine is greater than fluorine due to smaller atomic size of fluorine.

29. We know that acidic strength $\propto$ Oxidation number

$\therefore$ Correct order is

$$\overset{+1}{HClO} < \overset{+3}{HClO_2} < \overset{+5}{HClO_3} < \overset{+7}{HClO_4}$$

30. The structure of glycine is as



So, it is optically inactive.

31. Glucose gives silver mirror with Tollen's reagent while fructose does not.

32. Reason being,

$$\text{Bond strength} \propto \frac{1}{\text{size of halogen}}$$

33. $H_2 + \frac{1}{2} O_2 \longrightarrow H_2O$

$\Delta H = -241$ kJ ...(i)

$C_6H_{10} + \frac{17}{2} O_2 \longrightarrow 6CO_2 + 5H_2O$

$\Delta H = -3800$ kJ ...(ii)

$C_6H_{12} + 9O_2 \longrightarrow 6CO_2 + 6H_2O$

$\Delta H = -3920$ kJ ...(iii)

hydrogenation of cyclohexene–

$C_6H_{10} + H_2 \longrightarrow C_6H_{12}$

Eq (i) + Eq (ii) – Eq (iii)

$\Delta H = -241 - 3800 - (-3920)$

$= -4041 + 3920$

$= -121$ kJ

34. $\Delta S° = 2S°_{HCl} - (S°_{H_2} + S°_{Cl_2})$

$= 2 \times 186.7 - (130.6 + 223.0)$

$= 19.8\ JK^{-1}\ mol^{-1}$

35. According to Charles' law

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{0.2}{273} = \frac{V_2}{476}$$

$\therefore \quad V_2 = 0.4$ L

36. Hardness of H_2O is due to the presence of bicarbonates, chlorides, and sulphates of Ca and Mg ions.

37. Total number of atoms in $CuSO_4 \cdot 5H_2O$ is 21.

38. $k = 1.7 \times 10^{-5}\ s^{-1}$

$$t_{1/2} = \frac{0.693}{k} = \frac{0.693}{1.7 \times 10^{-5}} = 11.3\ h$$

39. Structure of 2-methyl pentane has isopropyl group



2-methyl pentane

40. F-centres are the sites where anions are missing and instead electrons are present. They are responsible for colour.

Zoology

1. Acrosome is the penetrating tip of spermatozoan which is formed of Golgi apparatus. It contains hyaluronidase and several lytic enzymes.

2. Chemically, the plasma membrane or cell membrane is made up of 60% proteins and 40% lipids. The percentage of carbohydrates ranges from 1-10 which are in the form of glycoproteins or glycolipids. Proteins may be extrinsic (peripheral) and intrinsic (integral) while lipids may be phospholipids, glycolipids and sterols.

3. Endoplasmic reticulum, mitochondria and chloroplast are double membraned cell organelles whereas lysosome is a single membraned cell organelle.

4. Chloragogen cells or yellow cells are present in the region of intestine in *Pheretima*. The exact function of these cells is not fully known but it is believed that they are concerned with storage of reserve food and also excretory in function. Chloragogen cells are analogous to liver of vertebrates.

5. Gonadotropins or gonadotropic hormones are as follows.

(a) Follicle Stimulating Hormone (FSH) : It stimulates growth of ovarian follicles and their secretion of oestrogen in the female and spermatogenesis in the male.

(b) Interstitial Cell Stimulating Hormone (ICSH) : It activates the Leydig's cells of the testis to secrete androgens. In female it stimulates the corpus luteum of the ovary to secrete progesterone. In female ICSH is termed as LH (Luteinizing Hormone).

6. The organisms which possess the characters of two different groups are called **connecting links.** They provide the evidence of organic evolution. Examples :

(1) *Archaeopteryx* is connecting link between reptiles and birds.

(2) *Neopilina* is connecting link between Annelida and Mollusca.

(3) *Peripatus* is connecting link between Annelida and Arthropoda.

7. Urea is the main nitrogenous excretory product of ureotelic animals. It is produced by liver cells from deaminated excess amino acid via urea cycle or Ornithine cycle. Urea is released outside the body in the form of urine through the kidneys.

8. Major nitrogenous waste product in ureotelic animals like rabbit and other mammals is, urea.

9. Urine formation takes place in kidney. It includes glomerular filtration (ultrafiltration), selective reabsorption and tubular secretion. Urine is stored temporarily in urinary bladder.

10. Sea fan is common name of *Gorgonia*. It belongs to phylum–Coelenterata, class–Anthozoa and order–Gorgonacea.

11. Trochophore is cilliated, larval stage of polychaetes, mollsucs and rotifers. *Neopilina, Chiton* and *Pila* belong to phylum—Molusca. Molluscan development is either direct or with metamorphosis through the trochophore stage.

12. Food storage in *Leucosolenia* occurs by thesocyte. Thesocytes have lobose pseudopodia and are filled with food reserves, thus, acting as storage cells.

13. The oragns which have similar function but are different in their structure and origin are called **analogous organs.**

The organs which have same fundamental structure and origin but function may be similar or different, are called **homologous organs.**

The organs which are present in reduced form and do not correspond to the fully developed functional organs to related animals are called **vestigial organs.**

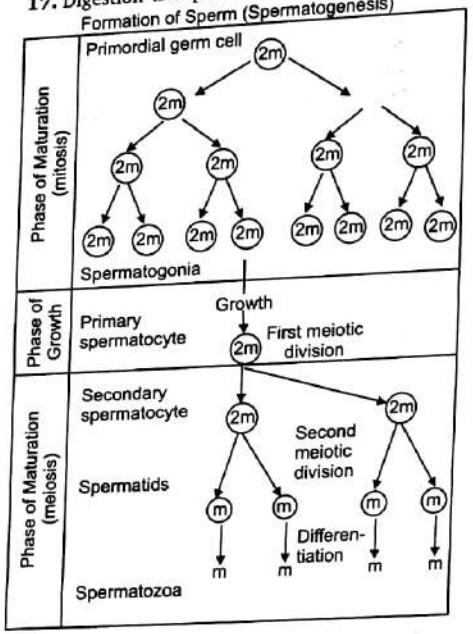
14. As urea formation takes place in liver through Ornithine cycle, the blood leaving liver and going towards heart has high amount of urea.

15. Introns are DNA sequence lying within a coding sequence (exons) but not usually encoding cell product and resulting so called split genes. **Cistron** is a segment of linear DNA encoding a specific and functional product, usually protein.

16. Spermatogenesis is the formation of sperm from a germ cell. Four spermatozoa are produced from a primary spermatocyte, therefore, 16

spermatozoa will be formed from four primary spermatocytes.

17. Digestion is a process in which non-diffusible



foods are converted into diffusible foods with the help of digestive enzymes. Digestion is mostly carried out by the process of hydrolysis using water molecules for the cleavage. The enzymes which bring about digestion are called hydrolases.

18. The chief functions of the large intestine are the absorption of water and the elimination of solid wastes. Large intestine is divided into three parts *i.e.,* caecum, colon and rectum. In mammals, colon has essential water absorbing role in preparation of faeces.

19. Analogous organs have similar functions but are different in their structure and origin.

Examples :

(1) Wings of butterfly, birds and bat have similar functions.

(2) Stings of honey bee and scorpion are analogous structures.

(3) Fins of fishes and flippers of whales are analogous organs.

20. **Convergent evolution** or adaptive convergence or parallel evolution is shown by analogous organs, whereas **divergent evolution** or evolutionary divergence or adaptive radiation are shown by homologous organs.

21. Chloragogen cells of earthworm are analogous to liver of vertebrates.

22. The main characteristics of class Crustacea and Insecta are as follows :

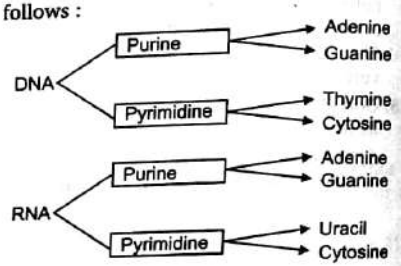
(1) Class Crustacea : Mostly aquatic with gills, two pairs of antennae and atleast three pairs of jaws, appendages mostly biramous and always more than four in the trunk region.

Example : prawn, crab, lobster etc.

(2) Class Insecta : Hexapod arthropods with a pair of antennae and three pairs of Jaws.

Example : cockroach, grasshopper, bees, housefly etc.

23. Uracil remains absent in DNA. It is present in RNA. The nitrogen bases of DNA and RNA are as follows :



24. A typical vertebra has a centrum or body and neural arch. The hole formed by the neural arch is the vertebral foramen. The vertebral foramina of all vertebrat form the vertebral canal or neural canal.

25. Radius and ulna are the bones of the forearm which are closely held together. The ulna is the long bone and bears a deep sigmoid notch for articulation with the trochlea of the humerus.

26. Lymphocyte is a type of agranular leucocytes found in lymph nodes.

27. On high mountains, difficulty in breathing is due to decrease in partial pressure.

28. Chordate animals, at some time in their life history, exhibit the following three diagnostic charcters :

(1) Presence of notochord.

(2) Presence of dorsal tubular nerve cord.

(3) Presence of gill clefts during development.

Beside these, some other characters are :

(4) Ventral heart.

(5) Hepatic portal system.

29. Spinal nerve is a mixed nerve which arises from grey matter of spinal cord. Spinal nerves have two roots. The dorsal root is sensory and the ventral root is motor. If dorsal nerve of spinal cord is broken down, the pathway of nerve will break, so, no impulse will transmitted.

30. Striated muscle or skeletal muscle or voluntary muscle or striped muscle fibre is an elongated cell surrounded externally by sarcolemma. Just beneath the sarcolemma in each fibre, many nuclei occur at irregular intervals. Thus, these fibres are multinucleated or syncytial in nature.

31. Human kidney possesses about one million nephrons. Each nephron in made up of two main parts *i.e.,* Malpighian body and renal tubule.

Malpighian body comprises a cup shaped Bowman's capsule and a meshwork of blood capillaries, the glomerulus.

32. **Gastrin** hormone is secreted by the the gastric glands to release the gastric juice. **Enterogasterone** is secreted by the duodenal epithelium. It inhibits the secretion of gastric juice and slows gastric contraction.

Cholecystokinin pancreozymin (CCK–PZ) is secreted by entire small intestine. It stimulates the gall bladder to release bile and the pancreas to release enzymes in the pancreatic juice.

Villikinin accelerates the movement of intestinal villi.

33. Wings of bird and insects are analogous organs.

34. During starvation reserve carbohydrate is used up firstly by the body and after carbohydrates, fat is used as energy source and at last, when both carbohydrate and fat are absent, proteins are used as energy source. Therefore, the sequence is

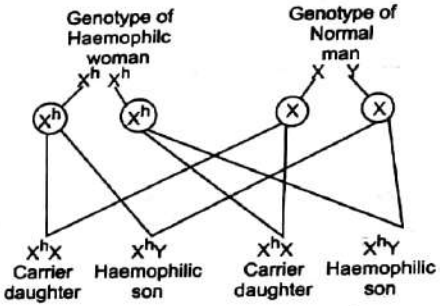
Carbohydrate → Fat → Protein

35. Ten pairs of cranial nerves are present in anamniotes such as fishes and amphibians (*e.g.,* Frog). Twelve pairs of cranial nerves are present in amniotes, reptiles, birds and mammals including rabbit and humans.

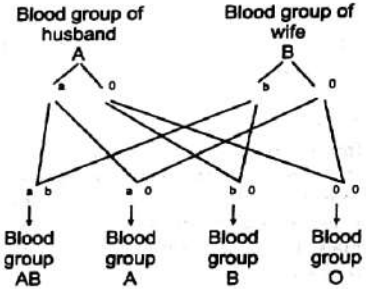
36. In liver cells and prokaryotic cells, 38 ATP are produced by the complete oxidation of one molecule of glucose.

Glycolysis 2 ATP directly	= 2 ATP
2 mol. of NADH	= 6 ATP
Pyruvic acid to **Acetyl Co-A** 2 mol. of NADH	= 6 ATP
Citric acid cycle 6 mol. of NADH	= 18 ATP
2 mol. of FADH	= 4 ATP
2 mol. of GTP	= 2 ATP
Total	= 38 ATP

37.



38.



Thus, if husband has blood group A and wife has blood group B, the blood group of children may be A, B, AB or O.

39. *Bombyx mori* is a silk producing insect, which is reared on mulberry leaves for commercial production of silk whereas mosquito, *Musca* and *Periplanata* are harmful arthropodes.

40. There are following three types of cellular RNA.

(1) Transfer RNA or soluble RNA

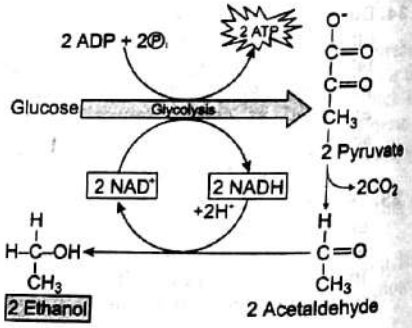
(2) Messenger RNA or template RNA

(3) Ribosomal RNA

Transfer RNA (*t*-RNA) and messenger RNA (*m*-RNA) are synthesized on DNA template of chromosomes while ribosomal RNA (*r*-RNA) is derived from nucleolar DNA.

Botany

1. *Chlorella*, commonly known as space alga is a protein rich alga, containing about 50% protein, 20% lipids, 20% carbohydrates and a little percentage of vitamin– B_2, B_{12}, C, H, K etc.
2. The member of sub-family Caesal pinieae have bracteate, zygomorphic, bisexual, hypogynous, pentamerous flowers with 5-sepals (polysepalous) 5-petals (polypeptalous), 5 +5 stamens (polyandrous) and monocarpellary, superior ovary with marginal placentation.
3. Biotic factors include all the living organisms which influence the other organisms.
4. *Linkgo*, a member of order linkgoales, is called living fossil because all the others except *Ginko biloba* are now extinct.
5. Certain algae such as *Chlorella, Chlamydomonas, Scenedesmus, Oscillatoria* etc., are used for the quick disposal of sewage, domestic and some industrial wastes.
6. *Rhizopus* species causing fermentation are :
   (i) *R. oryzae* – Alcoholic fermentation
   (ii) *R. nodosus* – Lactic acid fermentation
   (iii) *R. stolonifer (R. nigricans)* – Fumaric acid fermentation.
7. Cyanthium is a special type of inflorescence (found in *Euphorbia* sp.) with a cup shaped involucre having nector secreting glands, a centrally placed single large female flower which is reduced to pistil surrounded by many male flowers present in the form of stamens.
8. In turnip, napiform root is found, the swollen part of which is derived from the hypocotyl.
9. The bryophytes are terrestrial plants, generally growing in moist and shady places but always need water for fertilization. Hence, these are called amphibians of the plant kingdom.
10. Blackman (1905) proposed the law of limiting factor according to which, "when a biological process is controlled as to its rapidity by a number of separate factors, the rate of the process is limited by the pace of the slowest factor.
11. Curtis (1926) called transpiration as necessary evil because it provides some beneficial aspects but on the other hand, many functioning and energy gets wasted from absorption of water upto the stage of transpiration.
12. When atmospheric RH is high, the temperature of atmosphere will be low. This will reduce the rate of evaporation and also reduces the rate of transpiration.
13. Temperature and wind have the direct proportional to the transpiration. When the winds faster and dry and temperature is high, the rate of water evaporation will also high, increasing the rate of transpiration.
14. The water absorbed by root hairs is transported to other parts of the plant through xylem. Phloem transfers food prepared in leaves to the other parts. Cambium is responsible for secondary growth while epidermis is the outermost protective layer of cells.
15. The most important force which pulls water up in the tall trees is the cohesive (inter-molecular) force between H_2O molecules. It also helps in maintaining the continuity of water column in tall trees.
16. Hill reaction, also called as light reaction is a photochemical reaction. In this, reduced enzymes and phosphate bond energy (ATP) are produced.
17. *Cuscuta* is a parasitic plant which gets prepared food from other plants through the haustoria. At this plant lacks chlorophyll, it is unable to perform photosynthesis or to make its own food itself.
18. The anaerobic respiration occurs in many bacteria, some fungi, germinating seeds and some fruits. It involves the incomplete breakdown of sugars forming C_2H_5OH and CO_2 as end products and 27 kcal energy is released.



19. Pasteur's effect refers to the increase of rate of glycolysis in absence of O_2 due to the non-availability of those enzymes which are easily available in the presence of O_2.
20. Micro-nutrients are the minerals/elements which are required in less amount by the plants and thus are present in less quantity in the plants but these are as important as the macro-nutrients. Examples of micro-nutrients iron (Fe), manganese (Mn), copper (Cu), zinc (Zn), molybdenum (Mo), boron (B) and chlorine (Cl).
21. Hydroponics refers to soil-less cultures of plants and growing them on mineral solution.
22. Green plants constiture the first trophic level at these store energy by trapping the light and forming the food through photosynthesis and then passed to other organisms from the plants.
23. *Rhizophora mangel* is the component of mangrove vegetation and grows in marshes or nitrogen and air deficient soil. These plants possess vivipary and pneumatophores or respiratory roots.
24. Fluorosis is a disease caused by the consumption of water with excess fluoride or fluorine.
25. Non-genetic RNA is found in all eukaryotic and prokaryotic organisms. It is of three types *i.e.*,
   (i) Ribosomal RNA (*r*-RNA)
   (ii) Transfer RNA (*t*-RNA)
   (iii) Messenger RNA (*m*-RNA)
26. Kappa particles are found in *Paramecium* and possess cytoplasmic inheritance, also called extra-chromosomal inheritance.
27. A nucleotide is a nucleoside (sugar + nitorgen base) with phosphate group.
   Thus, nucleoside = sugar + nitrogenous base
   nucleotide = nucleoside + phosphate group
28. Quiescent centre is an area at the top of the root apical meristem where the cells have least mitotic activity *i.e.*, the rate of cell division is lower than in surrounding tissue.
29. Perisperm is the remnant of nucellus. It is found in Piperaceae and Scitaminaceae. It is formed when the nucellus is not completely used up and is present in the form of a thin layer in the seed enclosing the embryo and the endosperm.
30. Orthotropous ovule is also called atropous. In this type of ovule the micropyle, chalaza and funicle lie in one straight line, *e.g.*, Polygonaceae, Piperaceae etc.
31. *Anabaena, Nostoc, Aulosira* etc., are agriculturally very important as non-symbiotic bacteria also called free living nitrogen fixing bacteria. VAM, *Azotobacter* and *Rhizobium* are symbiotic organisms.
32. Griffiths (1928), for the first time, reported transformation in bacteria and later on Avery, Mcleod and McCarthy (1944) studied it in detail.
33. Lathyrism is caused due to consumption of khesari dal *(Lathyrus odoratus)*.
34. According to chromosome theory, proposed by Morgan and Castle (1912), the genes showing linkage are situated on the same pair of chromosome and are arranged in a linear fashion.
35. Vacuoles are the storage depots of cells, surrounded by a single membrane. They contain excess water, waste products, mineral elements, cell sap and sometimes a soluble pigment anthocyanin also.
36. The cell theory or cell doctrine is credited to Matthias Schleiden (1838) a botanist of Germany and Theodor Schwann (1839), a zoologist also of Germany.
37. The enzyme complex (holoenzyme) is made up of two parts *i.e.*, protein part (apoenzyme) and non-protein part (cofactor). Cofactor is of three types —
   (i) prosthetic group
   (ii) coenzymes
   (iii) metal ions
   Holoenzymes = Apoenzyme + Prosthetic group
   (Enzyme complex) (Protein part) (Non-protein part).
38. Enzyme nitrogenase plays a key role in N_2 fixations and remains active only during anaerobic condition. It is made up of two protein subunits :
   (i) non-heme iron protein or Fe-protein or dinitrogen reductase.
   (ii) Iron molybdenum protein or Mo-Fe protein or dinitrogenase.
39. The insectivorous plants grow in nitrogen deficient soil and their nitrogen requirement is fulfilled by capturing and digesting the insects.
40. Yabuta and Hayashi (1939) isolated an active substance from a fungus, *Gibberella fujikuroi* and called it gibberellin–A. It causes backane disease in rice seedlings.

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MEDICAL ENTRANCE
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Physics

1. A coil in the shape of an equilateral triangle of side l is suspended between the pole pieces of a permanent magnet such that $\vec{B}$ is in plane of the coil. If due to a current i in the triangle a torque τ acts on it, the side l of the triangle is

(a) $\frac{2}{\sqrt{3}}\left(\frac{\tau}{Bi}\right)^{1/2}$ (b) $\frac{2}{\sqrt{3}}\left(\frac{\tau}{Bi}\right)$

(c) $2\left(\frac{\tau}{\sqrt{3}\,Bi}\right)^{1/2}$ (d) $\frac{1}{\sqrt{3}}\frac{\tau}{Bi}$

2. A point source emits sound equally in all directions in a non-absorbing medium. Two points P and Q are at distance of 2m and 3m respectively from the source. The ratio of the intensities of the waves at P and Q is

(a) 9: 4 (b) 2: 3
(c) 3: 2 (d) 4: 9

3. A bomb of mass 30 kg at rest explodes into two pieces of masses 18 kg and 12 kg. The velocity of 18 kg mass is 6 ms^{-1}. The kinetic energy of the other mass is

(a) 256 J (b) 486 J (c) 524 J (d) 324 J

4. A drum of radius R and mass M, rolls down without slipping along an inclined plane of angle θ. The frictional force

(a) converts translational energy to rotational energy
(b) dissipates energy as heat
(c) decreases the rotational motion
(d) decreases the rotational and translational motion

5. Imagine a new planet having the same density as that of earth but it is 3 times bigger than the earth in size. If the acceleration due to gravity on the surface of earth is g and that on the surface of the new planet is g', then

(a) $g' = 3g$ (b) $g' = \frac{g}{9}$
(c) $g' = 9g$ (d) $g' = 27g$

6. Which of the following circular rods, (given radius r and length l) each made of the same material and whose ends are maintained at the same temperature will conduct most heat?

(a) $r = 2r_0, l = 2l_0$ (b) $r = 2r_0, l = l_0$
(c) $r = r_0, l = l_0$ (d) $r = r_0, l = 2l_0$

7. In the reaction ${}_1^2H + {}_1^3H \longrightarrow {}_2^4He + {}_0^1n$, if the binding energies of ${}_1^2H$, ${}_1^3H$ and ${}_2^4He$ are respectively a, b and c (in MeV), then the energy (in MeV) released in this reaction is

(a) $c + a - b$ (b) $c - a - b$
(c) $a + b + c$ (d) $a + b - c$

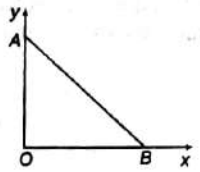
8. The work functions for metals A, B and C are respectively 1.92 eV, 2.0 eV and 5 eV. According to Einstein's equation, the metals which will emit photoelectrons for a radiation of wavelength 4100 Å is/are

(a) none (b) A only
(c) A and B only (d) all the three metals

9. The nuclei of which one of the following pairs of nuclei are isotones ?

(a) ${}_{34}Se^{74}$, ${}_{31}Ga^{71}$ (b) ${}_{42}Mo^{92}$, ${}_{40}Zr^{92}$
(c) ${}_{38}Sr^{84}$, ${}_{38}Sr^{86}$ (d) ${}_{20}Ca^{40}$, ${}_{16}S^{32}$

10. As per this diagram a point charge + q is placed at the origin O. Work done in taking another point charge – Q from the point A [coordinates $(0, a)$]

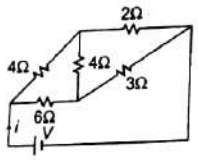


to another point B [coordinates $(a, 0)$] along the straight path AB is

(a) zero (b) $\left(\frac{-qQ}{4\pi\varepsilon_0}\frac{1}{a^2}\right)\sqrt{2}a$

(c) $\left(\frac{qQ}{4\pi\varepsilon_0}\frac{1}{a^2}\right)$ (d) $\left(\frac{qQ}{4\pi\varepsilon_0}\frac{1}{a^2}\right)\sqrt{2}a$

11. For the network shown in the figure, the value of the current i is



(a) $\frac{9V}{35}$ (b) $\frac{5V}{18}$ (c) $\frac{5V}{9}$ (d) $\frac{18V}{5}$

12. The circular motion of a particle with constant speed is

(a) simple harmonic but not periodic
(b) periodic and simple harmonic
(c) neither periodic nor simple harmonic
(d) periodic but not simple harmonic

13. A particle executing simple harmonic motion of amplitude 5 cm has maximum speed of 31.4 cm/s. The frequency of its oscillation is

(a) 3 Hz (b) 2 Hz
(c) 4 Hz (d) 1 Hz

14. The ratio of the dimensions of Planck's constant and that of the moment of inertia is the dimension of

(a) frequency
(b) velocity
(c) angular momentum
(d) time

15. Which of the following processes is reversible?

(a) Transfer of heat by radiation
(b) Electrical heating of a nichrome wire
(c) Transfer of heat by conduction
(d) Isothermal compression

16. The temperature of inversion of a thermocouple is 620°C and the neutral temperature is 300°C, what is the temperature of cold junction?

(a) 20°C (b) 320°C
(c) – 20°C (d) 40°C

17. A photosensitive metallic surface has work function, $h\nu_0$. If photons of energy $2h\nu_0$ fall on this surface, the electrons come out with a maximum velocity of 4×10^6 m/s. When the photon energy is increased to $5h\nu_0$, then maximum velocity of photoelectrons will be

(a) 2×10^6 m/s (b) 2×10^7 m/s
(c) 8×10^5 m/s (d) 8×10^6 m/s

18. Fission of nuclei is possible because the binding energy per nucleon in them

(a) increases with mass number at high mass numbers
(b) decreases with mass number at high mass numbers
(c) increases with mass number at low mass numbers
(d) decreases with mass number at low mass numbers

19. The displacement x of a particle varies with time t as $x = ae^{-\alpha t} + be^{\beta t}$, where a, b, α and β are positive constants. The velocity of the particle will

(a) go on decreasing with time
(b) be independent of α and β
(c) drop to zero when $\alpha = \beta$
(d) go on increasing with time

20. In any fission process the ratio $\frac{\text{mass of fission products}}{\text{mass of parent nucleus}}$ is

(a) less than 1
(b) greater than 1
(c) equal to 1
(d) depends on the mass of parent nucleus

21. An ideal gas heat engine operates in Carnot cycle between 227°C and 127°C. It absorbs 6×10^4 cal of heat at higher temperature. Amount of heat converted to work is

(a) 2.4×10^4 cal
(b) 6×10^4 cal
(c) 1.2×10^4 cal
(d) 4.8×10^4 cal

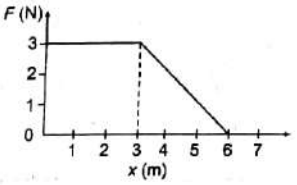
22. If a vector $2\hat{i} + 3\hat{j} + 8\hat{k}$ is perpendicular to the vector $4\hat{j} - 4\hat{i} + \alpha\hat{k}$, then the value of α is

(a) -1 (b) $\frac{1}{2}$
(c) $-\frac{1}{2}$ (d) 1

23. Zener diode is used for

(a) producing oscillations in an oscillator
(b) amplification
(c) stabilisation
(d) rectification

24. A force F acting on an object varies with distance x as shown here. The force is in newton and distance is in metre. The work done by the force in moving the object from $x = 0$ to $x = 6$ m is



(a) 4.5 J (b) 13.5 J (c) 9.0 J (d) 18.0 J

25. If the magnetic dipole moment of an atom of diamagnetic material, paramagnetic material and ferromagnetic material are denoted by μ_d, μ_p and μ_f respectively, then

(a) $\mu_d \neq 0$ and $\mu_f \neq 0$ (b) $\mu_p = 0$ and $\mu_f \neq 0$
(c) $\mu_d = 0$ and $\mu_p \neq 0$ (d) $\mu_d \neq 0$ and $\mu_p = 0$

26. In a circuit, L, C and R are connected in series with an alternating voltage source of frequency f. The current leads the voltage by 45°. The value of C is

(a) $\frac{1}{2\pi f(2\pi fL + R)}$ (b) $\frac{1}{\pi f(2\pi fL + R)}$
(c) $\frac{1}{2\pi f(2\pi fL - R)}$ (d) $\frac{1}{\pi f(2\pi fL - R)}$

27. The angular resolution of a 10 cm diameter telescope at a wavelength of 5000 Å is of the order of

(a) 10^6 rad (b) 10^{-2} rad (c) 10^{-4} rad (d) 10^{-6} rad

28. Two vibrating tuning forks produce progressive waves given by $y_1 = 4 \sin 500\pi t$ and $y_2 = 2 \sin 506\pi t$. Number of beats produced per minute is

(a) 360 (b) 180 (c) 3 (d) 60

29. When a wire of uniform cross-section a, length l and resistance R is bent into a complete circle, resistance between two of diametrically opposite points will be

(a) $\frac{R}{4}$ (b) $\frac{R}{8}$ (c) $4R$ (d) $\frac{R}{2}$

30. Carbon, silicon and germanium atoms have four valence electrons each. Their valence and conduction bands are separated by energy band gaps represented by $(E_g)_C$, $(E_g)_{Si}$ and $(E_g)_{Ge}$ respectively. Which one of the following relationships is true in their case?

(a) $(E_g)_C > (E_g)_{Si}$
(b) $(E_g)_C = (E_g)_{Si}$
(c) $(E_g)_C < (E_g)_{Ge}$
(d) $(E_g)_C > (E_g)_{Si}$

31. If λ_v, λ_x and λ_m represent the wavelengths of visible light, X-rays and microwaves respectively, then

(a) $\lambda_m > \lambda_x > \lambda_v$
(b) $\lambda_v > \lambda_m > \lambda_x$
(c) $\lambda_m > \lambda_v > \lambda_x$
(d) $\lambda_v > \lambda_x > \lambda_m$

32. Two boys are standing at the ends A and B of a ground, where $AB = a$. The boy at B starts running in a direction perpendicular to AB with velocity v_1. The boy at A starts running simultaneously with velocity v and catches the other boy in a time t, where t is

(a) $\frac{a}{\sqrt{v^2 + v_1^2}}$ (b) $\sqrt{\frac{a^2}{v^2 - v_1^2}}$
(c) $\frac{a}{(v - v_1)}$ (d) $\frac{a}{(v + v_1)}$

33. A 5 A fuse wire can withstand a maximum power of 1 W in circuit. The resistance of the fuse wire is

(a) 0.2 Ω (b) 5 Ω (c) 0.4 Ω (d) 0.04 Ω

34. An electron moves in a circular orbit with a uniform speed v. It produces a magnetic field B at the centre of the circle. The radius of the circle is proportional to

(a) $\frac{B}{v}$ (b) $\frac{v}{B}$ (c) $\sqrt{\frac{v}{B}}$ (d) $\sqrt{\frac{B}{v}}$

35. Choose the only false statement from the following

(a) Substances with energy gap of the order of 10 eV are insulators
(b) The conductivity of a semiconductor increases with increases in temperature
(c) In conductors the valence and conduction bands may overlap
(d) The resistivity of a semiconductor increases with increase in temperature

36. If the angle between the vectors $\vec{A}$ and $\vec{B}$ is θ, the value of the product $(\vec{B} \times \vec{A}) \cdot \vec{A}$ is equal to

(a) $BA^2 \cos\theta$
(b) $BA^2 \sin\theta$
(c) $BA^2 \sin\theta \cos\theta$
(d) zero

37. The moment of inertia of a uniform circular disc of radius R and mass M about an axis passing from the edge of the disc and normal to the disc is

(a) $\frac{1}{2}MR^2$ (b) MR^2
(c) $\frac{7}{2}MR^2$ (d) $\frac{3}{2}MR^2$

38. Copper has face-centered cubic (fcc) lattice with interatomic spacing equal to 2.54 Å. The value of lattice constant for this lattice is

(a) 1.27 Å (b) 5.08 Å (c) 2.54 Å (d) 3.59 Å

39. The total energy of an electron in the first excited state of hydrogen is about – 3.4 eV. Its kinetic energy in this state is

(a) – 3.4 eV (b) – 6.8 eV (c) 6.8 eV (d) 3.4 eV

40. A ball is thrown vertically upward. It has a speed of 10 m/s when it has reached one-half of its maximum height. How high does the ball rise? (Take, $g = 10\ m/s^2$)

(a) 15 m (b) 10 m (c) 20 m (d) 5 m

Chemistry

1. Which amongst the following is the most stable carbocation?

(a) $CH_3-\overset{+}{C}(CH_3)-H$ (b) $CH_3-\overset{+}{C}(CH_3)-CH_3$
(c) $\overset{+}{C}H_3$ (d) $CH_3\overset{+}{C}H_2$

2. Products of the following reaction

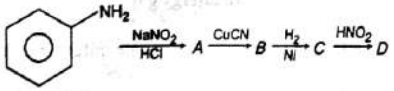
$CH_3C \equiv C \cdot CH_2CH_3 \xrightarrow[(2)\ Hydrolysis]{(1)\ O_3}$ ... are

(a) $CH_3CHO + CH_3CH_2CHO$
(b) $CH_3COOH + CH_3COCH_3$
(c) $CH_3COOH + HOOC \cdot CH_2CH_3$
(d) $CH_3COOH + CO_2$

3. At 25°C, the dissociation constant of a base, BOH, is 1.0×10^{-12}. The concentration of hydroxyl ions in 0.01 M aqueous solution of the base would be

(a) 2.0×10^{-6} mol L^{-1} (b) 1.0×10^{-5} mol L^{-1}
(c) 1.0×10^{-6} mol L^{-1} (d) 1.0×10^{-7} mol L^{-1}

4. Aniline in a set of reactions yielded a product *D*.



The structure of the product *D* would be

(a) $C_6H_5CH_2NH_2$ (b) $C_6H_5NHCH_2CH_3$
(c) C_6H_5NHOH (d) $C_6H_5CH_2OH$

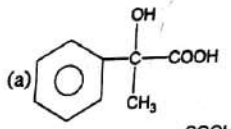
5. The mass of carbon anode consumed (giving only carbondioxide) in the production of 270 kg of aluminium metal from bauxite by the Hall process is
(Atomic mass Al = 27)

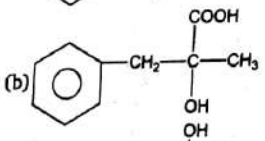
(a) 180 kg (b) 270 kg (c) 540 kg (d) 90 kg

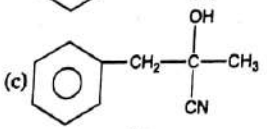
6. In a set of reactions, acetic acid yielded a product *D*.

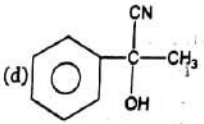
$CH_3COOH \xrightarrow{SOCl_2} A \xrightarrow[anhyd.\ AlCl_3]{Benzene} B \xrightarrow{HCN} C \xrightarrow{HOH} D$

The structure of *D* would be

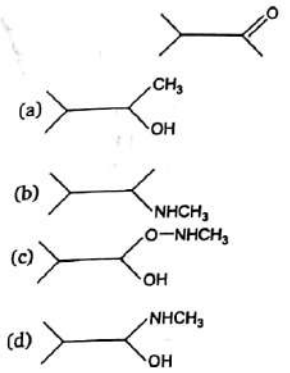
(a) 

(b) 

(c) 

(d) 

7. The major organic product formed from the following reaction $\xrightarrow[(ii)\ LiAlH_4\ (iii)\ H_2O]{(i)\ CH_3NH_2}$ ... is



8. The number of moles of $KMnO_4$ reduced by one mole of KI in alkaline medium is

(a) one-fifth (b) five
(c) one (d) two

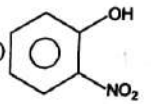
9. Which of the following molecules has trigonal planar geometry?

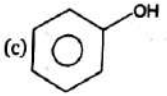
(a) IF_3 (b) PCl_3
(c) NH_3 (d) BF_3

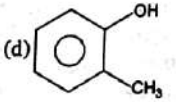
10. The aqueous solution containing which one of the following ions will be colourless ?
(Atomic no. Sc = 21, Fe = 26, Ti = 22, Mn = 25)

(a) Sc^{3+} (b) Fe^{2+}
(c) Ti^{3+} (d) Mn^{2+}

11. Which one of the following compounds is most acidic?

(a) Cl—CH_2—CH_2—OH (b) 

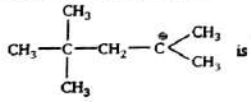
(c) 

(d) 

12. A reaction occurs spontaneously if

(a) $T\Delta S < \Delta H$ and both ΔH and ΔS are + ve
(b) $T\Delta S > \Delta H$ and both ΔH and ΔS are + ve
(c) $T\Delta S = \Delta H$ and both ΔH and ΔS are + ve
(d) $T\Delta S > \Delta H$ and ΔH is + ve and ΔS is – ve

13. The monomer of the polymer



is

(a) $H_2C{=}C(CH_3)(CH_3)$
(b) $(CH_3)_2C{=}C(CH_3)_2$
(c) $CH_3CH{=}CH \cdot CH_3$
(d) $CH_3CH{=}CH_2$

14. The correct sequence of increasing covalent character is represented by

(a) LiCl < NaCl < $BeCl_2$
(b) $BeCl_2$ < NaCl < LiCl
(c) NaCl < LiCl < $BeCl_2$
(d) $BeCl_2$ < LiCl < NaCl

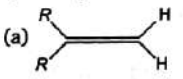
15. What is the correct relationship between the pHs of isomolar solutions of sodium oxide (pH_1), sodium sulphide (pH_2), sodium selenide (pH_3) and sodium telluride (pH_4)?

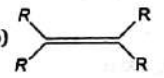
(a) $pH_1 > pH_2 \approx pH_3 > pH_4$
(b) $pH_1 < pH_2 < pH_3 < pH_4$
(c) $pH_1 < pH_2 < pH_3 \approx pH_4$
(d) $pH_1 > pH_2 > pH_3 > pH_4$

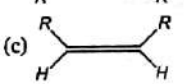
16. Which of the following pairs of a chemical reaction is certain to result in a spontaneous reaction?

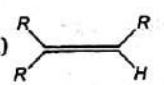
(a) Exothermic and decreasing disorder
(b) Endothermic and increasing disorder
(c) Exothermic and increasing disorder
(d) Endothermic and decreasing disorder

17. Which one of the following alkenes will react faster with H_2 under catalytic hydrogenation conditions?
(*R* = Alkyl substituent)

(a) 

(b) 

(c) 

(d) 

18. For a first order reaction $A \longrightarrow B$, the reaction rate at reactant concentration of 0.01 M is found to be 2.0×10^{-5} mol $L^{-1}s^{-1}$. The half-life period of the reaction is
(a) 220 s (b) 30 s
(c) 300 s (d) 347 s

19. Which of the following is the electron deficient molecule?
(a) B_2H_6 (b) C_2H_6
(c) PH_3 (d) SiH_4

20. A nuclide of an alkaline earth metal undergoes radioactive decay by emission of three α-particles in succession. The group of the periodic table to which the resulting daughter element would belong to
(a) Group 14 (b) Group 16
(c) Group 4 (d) Group 6

21. The absolute enthalpy of neutralisation of the reaction
$MgO(s) + 2HCl(aq) \longrightarrow MgCl_2(aq) + H_2O(l)$
will be
(a) less than – 57.33 kJ mol^{-1}
(b) – 57.33 kJ mol^{-1}
(c) greater than– 57.33 kJ mol^{-1}
(d) 57.33 kJ mol^{-1}

22. Which one of the following forms micelles in aqueous solution above certain concentration?
(a) Urea
(b) Dodecyl trimethyl ammonium chloride
(c) Pyridinium chloride
(d) Glucose

23. Electrolytic reduction of nitrobenzene in weakly acidic medium gives
(a) aniline
(b) nitrosobenzene
(c) N-phenylhydroxylamine
(d) p-hydroxyaniline

24. Equilibrium constants K_1 and K_2 for the following equilibria
$NO(g) + \frac{1}{2}O_2 \overset{K_1}{\rightleftharpoons} NO_2(g)$ and
$2NO_2(g) \overset{K_2}{\rightleftharpoons} 2NO(g) + O_2(g)$
are related as
(a) $K_2 = \frac{1}{K_1}$ (b) $K_2 = K_1^2$
(c) $K_2 = \frac{K_1}{2}$ (d) $K_2 = \frac{1}{K_1^2}$

25. Which of the following would have a permanent dipole moment?
(a) BF_3 (b) SiF_4 (c) SF_4 (d) XeF_4

26. Which of the following undergoes nucleophilic substitution exclusively by S_N 1 mechanism?
(a) Benzyl chloride
(b) Ethyl chloride
(c) Chlorobenzene
(d) Isopropyl chloride

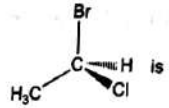
27. The rate of reaction between two reactants A and B decreases by a factor of 4, if the concentration of reactant B is doubled. The order of this reaction with respect to reactant B is
(a) – 1 (b) – 2
(c) 1 (d) 2

28. In a face-centered cubic lattice, a unit cell is shared equally by how many unit cells?
(a) 8 (b) 4 (c) 2 (d) 6

29. A solution of urea (mol. mass 56g mol^{-1}) boils at 100.18°C at the atmospheric pressure. If k_f and k_b for water are 1.86 and 0.512 K kg mol^{-1} respectively, the above solution will freeze at
(a) – 6.54° C (b) 6.54° C
(c) 0.654° C (d) – 0.654° C

30. Which functional group participates in disulphide bond formation in proteins?
(a) Thiolactone (b) Thiol
(c) Thioether (d) Thioester

31. The chirality of the compound



(a) *R* (b) *S* (c) *Z* (d) *E*

32. H_2S gas when passed through a solution of cations containing HCl precipitates the cations of second group of qualitative analysis but not those belonging to the fourth group. It is because :
(a) presence of HCl decreases the sulphide ion concentration
(b) presence of HCl increases the sulphide ion concentration
(c) solubility product of group II sulphides is more than that of group IV sulphides
(d) sulphides of group IV cations are unstable in HCl

33. Which one of the following oxides is expected to exhibit paramagnetic behaviour?
(a) CO_2
(b) SO_2
(c) ClO_2
(d) SiO_2

34. Which one of the following is expected to exhibit optical isomerism?
(en = ethylenediamine)
(a) *cis*-$[Pt(NH_3)_2Cl_2]$
(b) *trans*-$[Co(en)_2Cl_2]$
(c) *trans*-$[Pt(NH_3)_2Cl_2]$
(d) *cis*-$[Co(en)_2Cl_2]$

35. The correct order of acid strength is
(a) $HClO < HClO_2 < HClO_3 < HClO_4$
(b) $HClO_4 < HClO < HClO_2 < HClO_3$
(c) $HClO_2 < HClO_3 < HClO_4 < HClO$
(d) $HClO_4 < HClO_3 < HClO_2 < HClO$

36. The main reason for larger number of oxidation states exhibited by the actinides than the corresponding lanthanides, is
(a) lesser energy difference between 5*f* and 6*d* orbitals than between 4*f* and 5*d* orbitals
(b) larger atomic size of actinides than the lanthanide
(c) more energy difference between 5*f* and 6*d* orbitals than between 4*f* and 5*d* orbitals
(d) greater reactive nature of the actinides than the lanthanides

37. Names of some compounds are given. Which one is not correct in IUPAC system?
(a) $CH_3-\underset{OH}{CH}-\underset{CH_3}{CH}-CH_3$
3-methyl-2-butanol
(b) $CH_3-C\equiv C-CH(CH_3)_2$
4-methyl-2-pentyne
(c) $CH_3-CH_2-\underset{CH_2}{C}-\underset{CH_3}{CH}-CH_3$
2-ethyl-3-methyl-but-1-ene
(d) $CH_3-CH_2-CH_2-\underset{CH_2CH_3}{CH}-\underset{CH_3}{CH}-CH_2CH_3$
3-methyl-4-ethyl heptane

38. A solution has a 1 : 4 mole ratio of pentane to hexane. The vapour pressure of the pure hydrocarbons at 20°C are 440 mm of Hg for pentane and 120 mm of Hg for hexane. The mole fraction of pentane in the vapour phase would be
(a) 0.549 (b) 0.200 (c) 0.786 (d) 0.478

39. 4.5 g of aluminium (Atomic mass 27 amu) is deposited at cathode from Al^{3+} solution by a certain quantity of electric charge. The volume of hydrogen produced at STP from H^+ ions in solution by the same quantity of electric charge will be
(a) 22.4 L (b) 44.8 L (c) 5.6 L (d) 11.2 L

40. The best method for the separation of naphthalene and benzoic acid from their mixture is
(a) chromatography (b) crystallisation
(c) distillation (d) sublimation

Zoology

1. There are two opposing views about origin of modern man. According to one view *Homo erectus* in Asia were the ancestors of modern man. A study of variations of DNA however suggested African origin of modern man. What kind of observation on DNA variation could suggest this?
(a) Greater variation in Africa than in Asia
(b) Variation only in Asia and no variation in Africa
(c) Greater variation in Asia than in Africa
(d) Similar variation in Africa and Asia

2. The world's highly prized wool yielding 'Pashmina' breed is
(a) sheep
(b) goat
(c) goat-sheep cross
(d) Kashmir sheep-Afghan sheep cross

3. Grey crescent is the area
(a) at the point of entry of sperm into ovum
(b) just opposite to the site of entry of sperm into ovum
(c) at the animal poles
(d) at the vegetal pole

4. A student wishes to study the cell structure under a light microscope having 10X eyepiece and 45X objective. He should illuminate the object by which one of the following colours of light so as to get the best possible resolution?
(a) Yellow (b) Green (c) Blue (d) Red

5. The net pressure gradient that causes the fluid to filter out of the glomeruli into the capsule is
(a) 20 mm Hg (b) 75 mm Hg
(c) 30 mm Hg (d) 50 mm Hg

6. A man and a woman, who do not show any apparent signs of a certain inherited disease, have seven children (2 daughters and 5 sons). Three of the sons suffer from the given disease but none of the daughters are affected. Which of the following mode of inheritance do you suggest for this disease?
(a) Autosomal dominant (b) Sex-linked dominant
(c) Sex-limited recessive (d) Sex-linked recessive

7. In Ornithine cycle, which of the following wastes are removed from the blood?
(a) Urea and urine (b) Ammonia and urea
(c) CO_2 and ammonia (d) CO_2 and urea

8. Centromere is required for
(a) transcription
(b) crossing over
(c) cytoplasmic cleavage
(d) movement of chromosomes towards poles

9. Damage to thymus in a child may lead to
(a) a reduction in haemoglobin content of blood
(b) a reduction in stem cell production
(c) loss of antibody mediated immunity
(d) loss of cell mediated immunity

10. G-6-P dehydrogenase deficiency is associated with haemolysis of
(a) lymphocytes (b) RBCs
(c) platelets (d) leucocytes

11. According to IUCN red list what is the status of red Panda *(Athurus fulgens)*?
(a) Vulnerable species
(b) Critically endangered species
(c) Extinct species
(d) Endangered species

12. Which of the following substances, if introduce in the blood stream, would cause coagulation, at the site of its introduction?
(a) Fibrinogen
(b) Prothrombin
(c) Heparin
(d) Thromboplastin

13. Nucleotide are building blocks of nucleic acids, nucleotide is a composite molecule formed by
(a) (base-sugar-phosphate)*n*
(b) base-sugar-OH
(c) base-sugar-phosphate
(d) sugar-phosphate

14. Which of the following is the simplest amino acid?
(a) Tyrosine
(b) Asparagine
(c) Glycine
(d) Alanine

15. Enzymes, vitamins and hormones can be classified into a single category of biological chemicals, because all of these
(a) enhance oxidative metabolism
(b) are conjugated proteins
(c) are exclusively synthesized in the body of a living organism as at present
(d) help in regulating metabolism

16. Which one of the following phenomena supports Darwin's concept of natural selection in organic evolution?
(a) Development of transgenic animals
(b) Production of 'Dolly' the sheep by cloning
(c) Prevalence of pesticide resistant insects
(d) Development of organs from 'stem cells' for organ transplantation

17. In a man, abducens nerve is injured. Which one of the following functions will be affected?
(a) Movement of the eye ball
(b) Swallowing
(c) Movement of the tongue
(d) Movement of the neck

18. Protein synthesis in an animal cell occurs
(a) only on the ribosomes present in cytosol
(b) on ribosomes present in cytoplasm as well as in mitochondria
(c) only on ribosomes attached to the nuclear envelope and endoplasmic reticulum
(d) on ribosomes present in the nucleolus as well as in cytoplasm

19. The ability of the venus flytrap to capture insects is due to
(a) chemical stimulation by the prey
(b) a passive process requiring no special ability on the part of the plant
(c) specialized "muscle-like" cells
(d) rapid turgor pressure changes

20. Animals have the innate ability to escape from predation. Examples for the same are given below. Select the incorrect example
(a) enlargement of body size by swallowing air in puffer fish
(b) melanism in moths
(c) poison fangs in snakes
(d) colour change in chameleon

21. Which one of the following experiments suggests that simplest living organisms could not have originated spontaneously from non-living matter?
(a) Microbes did not appear in stored meat
(b) Larvae could appear in decaying organic matter
(c) Microbes appeared from unsterilized organic matter
(d) Meat was not spoiled, when heated and kept sealed in a vessel

22. A woman with normal vision, but whose father was colourblind, marries a colourblind man. Suppose that the fourth child of this couple was a boy. This boy
(a) must have normal colour vision
(b) will be partially colourblind since he is heterozygous for the colourblind mutant allele
(c) must be colourblind
(d) may be colourblind or may be of normal vision

23. Which of the following is not a hereditary disease?
(a) Cretinism (b) Cystic fibrosis
(c) Thalassaemia (d) Haemophilia

24. de Vries gave his mutation theory on organic evolution while working on
(a) *Althea rosea*
(b) *Drosophila melanogaster*
(c) *Oenothera lamarckiana*
(d) *Pisum sativum*

25. One of the examples of the action of the autonomous nervous system is
(a) knee-jerk response
(b) pupillary reflex
(c) swallowing of food
(d) peristalsis of the intestines

26. Parkinson's disease (characterized by tremors and progressive rigidity of limbs) is caused by degeneration of brain neurons that are involved in movement control and make use of neurotransmitter
(a) acetylcholine (b) norepinephrine
(c) dopamine (d) GABA

27. An acromian process is characteristically found in the
(a) pelvic girdle of mammals
(b) skull of frog
(c) pectoral girdle of mammals
(d) sperm of mammals

28. Epithelial cells of the intestine involved in food absorption have on their surface
(a) pinocytic vesicles (b) phagocytic vesicles
(c) zymogen granules (d) micro-villi

29. A patient is generally advised to specially, consume more meat, lentils, milk and eggs in diet only when he suffers from
(a) kwashiorkor (b) rickets
(c) anaemia (d) scurvy

30. Which one of the following makes use of RNA as a template to synthesize DNA?
(a) Reverse transcriptase
(b) DNA dependant RNA polymerase
(c) DNA polymerase
(d) RNA polymerase

31. In contrast to annelids the platyhelminthes show
(a) radial symmetry
(b) presence of pseudocoel
(c) bilateral symmetry
(d) absence of body cavity

32. Which of the following pairs is correctly matched?
(a) Cartilaginous joint – Skull bones
(b) Hinge joint – Between vertebrae
(c) Fibrous joint – Between phalanges
(d) Gliding joint – Between zygapophyses of the successive vertebrae

33. Haemophilia is more commonly seen in human males than in human females because
(a) this disease is due to an X-linked dominant mutation
(b) a greater proportion of girls die in infancy
(c) this disease is due to an X-linked recessive mutation
(d) this disease is due to a Y-linked recessive mutation

34. A woman with 47 chromosomes due to three copies of chromosome 21 is characterized by
(a) Down syndrome (b) triploidy
(c) Turner syndrome (d) super femaleness

35. Secretin and cholecystokinin are digestive hormones. They are secreted in
(a) oesophagus (b) ileum
(c) duodenum (d) pyloric stomach

36. AIDS is caused by HIV that principally infects
(a) all lymphocytes (b) activator B cells
(c) T_4 lymphocytes (d) cytotoxic T cells

37. If mammalian ovum fails to get fertilized, which one of the following is unlikely?
(a) Corpus luteum will disintegrate
(b) Estrogen secretion further decreases
(c) Primary follicle starts developing
(d) Progesterone secretion rapidly declines

38. A person is undergoing prolonged fasting. His urine will be found to contain abnormal quantities of
(a) fats (b) ketones
(c) amino acids (d) glucose

39. Which group of three of the following five statements (A–E) contain is all three correct statements regarding beri-beri?
A. A crippling disease prevalent among the native population of sub-Sahara Africa.
B. A deficiency disease caused by lack of thiamine (vitamin-B_1).
C. A nutritional disorder in infants and young children when the diet is persistently deficient in essential protein.
D. Occurs in those countries where the staple diet is polished rice.
E. The symptoms are pain from neuritis, paralysis, muscle wasting, progressive oedema, mental deterioration and finally heart failure.
(a) A, B and D (b) B, C and E
(c) A, C and E (d) B, D and E

40. Which one of the following depresses brain activity and produces feelings of calmness, relaxation and drowsiness?
(a) Valium (b) Morphine
(c) Hashish (d) Amphetamines

Botany

1. The main organelle involved in modification and routing of newly synthesized proteins to their destinations is
(a) mitochondria
(b) endoplasmic reticulum
(c) lysosome
(d) chloroplast

2. Photosynthesis in C_4 plants is relatively less limited by atmospheric CO_2 levels because
(a) four carbon acids are the primary initial CO_2 fixation products
(b) the primary fixation of CO_2 is mediated *via* PEP carboxylase
(c) effective pumping of CO_2 into bundle sheath cells
(d) RUBISCO in CO_4 plants has higher affinity for CO_2

3. At what stage of the cell cycle are histone proteins synthesized in a eukaryotic cell ?
(a) During entire prophase
(b) During telophase
(c) During S-phase
(d) During G_2 stage of prophase

4. There exists a close association between the alga and the fungus within a lichen. The fungus
(a) fixes the atmospheric nitrogen for the alga
(b) provides protection, anchorage and absorption for the alga
(c) provides food for the alga
(d) releases oxygen for the alga

5. At which latitude, heat gain through insolation approximately equals heat loss. through terrestrial radiation?
(a) 66° North and South
(b) $22\frac{1}{2}$° North and South
(c) 40° North and South
(d) $42\frac{1}{2}$° North and South

6. During transcription holoenzyme RNA polymerase binds to a DNA sequence and the DNA assumes a saddle like structure at that point. What is that sequence called?
(a) CAAT box (b) GGTT box
(c) AAAT box (d) TATA box

7. Chlorophyll in chloroplasts is located in
(a) grana (b) pyrenoid
(c) stroma (d) both (a) and (c)

8. Three crops that contribute maximum to global food grain production are
(a) wheat, rice and maize
(b) wheat, maize and sorghum
(c) rice, maize and sorghum
(d) wheat, rice and barley

9. Genes for cytoplasmic male sterility in plants are generally located in
(a) mitochondrial genome (b) cytosol
(c) chloroplast genome (d) nuclear genome

10. Which one of the following hydrolysis internal phosphodiester bonds in a polynucleotide chain?
(a) Lipase (b) Exonuclease
(c) Endonuclease (d) Protease

11. Match items in column-I with those in Column-II

Column - I	Column - II
A. Peritrichous flagellation	1. *Ginkgo*
B. Living fossil	2. *Macrocystes*
C. Rhizophore	3. *Escherichia coli*
D. Smallest flowering plant	4. *Selaginella*
E. Largest perennial alga	5. *Wolffia*

Select the correct answer from the following

	A	B	C	D	E		A	B	C	D	E
(a)	2	1	3	4	5	(b)	5	3	2	5	1
(c)	1	2	5	3	2	(d)	3	1	4	5	2

12. The name of Norman Borlaug is associated with
(a) green revolution (b) yellow revolution
(c) white revolution (d) blue revolution

13. In which one pair both the plants can be vegetatively propagated by leaf pieces?
(a) *Bryophyllum and Kalanchoe*
(b) *Chrysanthemum and Agave*
(c) *Agave and Kalanchoe*
(d) *Asparagus and Bryophyllum*

14. *E. coli* cells with a mutated Z gene of the lac operon cannot grow in medium containing only lactose as the source of energy because
(a) in the presence of glucose, *E. coli* cells do not utilize lactose
(b) they cannot transport lactose from the medium into the cell
(c) the lac operon is constitutively active in these cells
(d) they cannot synthesize functional β-galactosidase

15. Top-shaped multiciliate male gametes and the mature seed which bears only one embryo with two cotyledons, are characteristic features of
(a) polypetalous angiosperms
(b) gamopetalous angiosperms
(c) conifers
(d) cycads

16. More than 70% of world's freshwater is contained in
(a) Antarctica
(b) Glaciers and Mountains
(c) Greenland
(d) Polar ice

17. Which one of the following pairs is mismatched?
(a) Biomass burning — Release of CO_2
(b) Fossil fuel burning — Release of CO_2
(c) Nuclear power — Radioactive wastes
(d) Solar energy — Green house effect

18. Which of the following is not true for a species?
(a) Members of a species can interbreed
(b) Variations occurs among members of a species
(c) Each species is reproductively isolated from every other species
(d) Gene flow does not occur between the populations of a species

19. One of the most important functions of botanical gardens is that
(a) one can observe tropical plants there
(b) they allow *ex situ* conservation of germplasm
(c) they provide the natural habitat for wild life
(d) they provide a beautiful area for recreation

20. Biodiversity act of India was passed by the Parliament in the year
(a) 1996
(b) 1992
(c) 2002
(d) 2000

21. During which stage in the complete oxidation of glucose are the greatest number of ATP molecules formed from ADP?
(a) Conversion of pyruvic acid to acetyl Co-A
(b) Electron transport chain
(c) Glycolysis
(d) Krebs cycle

22. Ectophloic siphonostele is found in
(a) *Adiantum* and *Cucurbitaceae*
(b) *Osmunda* and *Equisetum*
(c) *Marsilea* and *Botrychium*
(d) *Dicksonia* and maiden hair fern

23. Which of the following represents the edible part of the fruit of litchi?
(a) Pericarp (b) Mesocarp
(c) Juicy aril (d) Endocarp

24. Carbohydrates, the most abundant biomolecules on earth, are produced by:
(a) all bacteria, fungi and algae
(b) fungi, algae and green plant cells
(c) some bacteria, algae and green plant cells
(d) viruses, fungi and bacteria

25. Identify the correctly matched pair
(a) Montreal protocol — Global warming
(b) Kyoto protocol — Climatic change
(c) Ramsar convention — Ground water pollution
(d) Basal convention — Biodiversity conservation

26. The deficiencies of micro-nutrients, not only affects growth of plants but also vital functions such as photosynthetic and mitochondrial electron flow. Among the list given below, which group of three elements shall affect most, both photosynthetic and mitochondrial electron transport ?
(a) Cu, Mn, Fe (b) Co, Ni, Mo
(c) Mn, Co, Ca (d) Ca, K, Na

27. Chemiosmotic theory of ATP synthesis in the chloroplasts and mitochondria is based on
(a) proton gradient
(b) accumulation of K ions
(c) accumulation of Na ions
(d) membrane potential

28. In a type of apomixis known as adventive embryony, embryos develop directly from the
(a) nucellus or integuments
(b) synergids or antipodals in an embryo sac
(c) accessory embryo sacs in the ovule
(d) zygote

29. Through which cell of the embryo sac, does the pollen tube enter the embryo sac?
(a) Egg cell (b) Central cell
(c) Persistant synergid (d) Degenerated synergid

30. Which one of the following pairs is mismatched?
(a) Savanna — *Acacia trees*
(b) Prairie — Epiphytes
(c) Tundra — Permafrost
(d) Coniferous forest — Evergreen trees

31. Which one of the following represents an ovule, where the embryo sac becomes horse-shoe shaped and the funiculus and micropyle are close to each other?
(a) Circinotropous (b) Anatropous
(c) Amphitropous (d) Atropous

32. Potometer works on the principle of
(a) amount of water absorbed equals the amount transpired
(b) osmotic pressure
(c) root pressure
(d) potential difference between the tip of the tube and that of the plant

33. In a woody dicotyledonous tree, which of the following parts will mainly consist of primary tissues?
(a) Stem and root
(b) All parts
(c) Shoot tips and root tips
(d) Flowers, fruits and leaves

34. Using imprints from a plate with complete medium and carrying bacterial colonies, you can select streptomycin resistant mutants and prove that such mutations do not originate as adaptation. These imprints need to be used
(a) only on plates with streptomycin
(b) on plates with minimal medium
(c) only on plates without streptomycin
(d) on plates with and without streptomycin

35. Which of the following is generally used for induced mutagenesis in crop plants?
(a) Alpha particles
(b) X-rays
(c) UV (260 nm)
(d) Gamma rays (from cobalt 60)

36. In order to find out the different types of gametes produced by a pea plant having the genotype AaBb, it should be crossed to a plant with the genotype
(a) aaBB (b) AaBb (c) AABB (d) aabb

37. Why is vivipary an undesirable character for annual crop plants ?
(a) It reduces the vigour of plant
(b) The seeds cannot be stored under normal conditions for the next season
(c) The seeds exhibit long dormancy
(d) It adversely affects the fertility of the plant

38. *Bacillus thuringiensis* (Bt) strains have been used for designing novel
(a) bio-metallurgical technique
(b) bio-mineralization processes
(c) bio-insecticidal plants
(d) bio-fertilizers

39. Photosynthetic Active Radiation (PAR) has the following range of wavelengths
(a) 400 - 700 nm
(b) 450 - 950 nm
(c) 340 - 450 nm
(d) 500 - 600 nm

40. Golden rice is a transgenic crop of the future with the following improved trait
(a) high lysine (essential amino acid) content
(b) insect resistance
(c) high protein content
(d) high vitamin A content

General English

➡ **Directions (Q. 1-5) :** *In each of the following questions, choose the alternative which is opposite in meaning to the word given in italics in the sentence.*

1. People know him for his vanity.
(a) humanity (b) honesty
(c) courtesy (d) modesty

2. Let us not *aggravate* the sufferings of the poor.
(a) abbreviate (b) alleviate
(c) advocate (d) appreciate

3. It was a mystery as to where the young girl had acquired such a *cynical* attitude.
(a) mature (b) naive
(c) eccentric (d) crazy

4. Avogadro's *hypothesis* has proved significant till the present day.
(a) fact (b) theory
(c) conclusion (d) experiment

5. He stood gazing at the *serene* expanse of the sea.
(a) scenic (b) clear (c) tranquil (d) ruffled

➡ **Directions (Q. 6-10) :** *In each of the following questions, choose the alternative which is most nearly the same in meaning to the word given in italics in the sentence.*

6. Sporadic rise in his temperature has caused us much worry.
(a) frequent (b) irksome
(c) irregular (d) scattered

7. Ant is believed to be the most *industrious* creature.
(a) sensible (b) diligent
(c) successful (d) punctual

8. The tour was cancelled on account of *incessant* rain.
(a) constant
(b) heavy
(c) intermittent
(d) unexpected

9. I *Disdain* those who tell lies.
(a) condemn (b) scold
(c) hate (d) despise

10. The *benevolence* of the God of Rain has seen a very successful monsoon this year too.
(a) vision
(b) morbidity
(c) kindness
(d) ill-will

➡ **Directions (Q. 11-15) :** *In each of the following questions, a part of the sentence is italicised. Below each sentence, three possible substitutions for the italicised part are given. Choose the one which improves the italicised part. If none of the substitutions improves the italicised part, your answer is (d) .*

11. No *sooner* I saw the tiger than I ran away.
(a) No sooner I had seen (b) No sooner did I see
(c) As soon as I saw (d) No improvement

12. The teacher has instructed all of us to finish the work by tomorrow, *isn't it?*
(a) has she (b) didn't she
(c) hasn't she (d) No improvement

13. He *has eaten* his food.
(a) has had (b) has taken
(c) has swallowed (d) No improvement

14. Please *blow up* the candle.
(a) turn off (b) blow out
(c) put off (d) No improvement

15. Practically *every part* of the banana tree is used by man.
(a) most part (b) any part
(c) each part (d) No improvement

Directions (Q. 16-20) : *Choose the correct alternative to fill in the blank.*

16. ..... work is more enjoyable than compulsory work.
(a) Temporary (b) Voluntary
(c) Slavish (d) Mechanical

17. He has shown both by his hard work and by his conduct that he ..... a special award.
(a) aspires (b) needs
(c) merits (d) dislikes

18. As a witness of the court, you have to be ..... in your statement.
(a) short (b) accurate
(c) pointed (d) prompt

19. The organisers of the conference have ..... the allegations made against them.
(a) retorted (b) repulsed
(c) rebuked (d) repudiated

20. Hamlet wanted to ..... the death of his father who was treacherously killed by his mother's lover.
(a) revenge (b) avenge (c) forgive (d) vindicate

Directions (Q. 21-25) : *In each of the following questions, choose the alternative which best expresses the meaning of the given idiom /phrase.*

21. To push somebody to the wall
(a) To defeat him (b) To humiliate him
(c) To heckle him (d) To knock him down

22. To be in two minds
(a) To be dominated by someone else
(b) To be uncertain
(c) To work on somebody else's advice
(d) To be in a critical state

23. A square peg in a round hole
(a) An impossible task
(b) A scheme that never works
(c) A person unsuited to the position he fills
(d) None of the above

24. To keep the wolf away from the door
(a) To keep away from extreme poverty
(b) To keep off an unwanted and undesirable person
(c) To be agile
(d) To hold the difficulties and dangers in check

25. To see eye to eye with
(a) To agree (b) To stare fixedly
(c) To be angry (d) To take revenge

Directions (Q. 26-30) : *In each of the following questions, choose the alternative which can be substituted for the given words/sentence.*

26. A person with a beautiful and elegant handwriting
(a) Calligrapher (b) Collier
(c) Choroegrapher (d) Cartographer

27. A person who is always dissatisfied
(a) Heretic (b) Felon
(c) Malcontent (d) Surrogate

28. Loss of power to move in any or every part of the body
(a) Rheumatism (b) Paralysis
(c) Eczema (d) Leprosy

29. One who does not care for literature or art
(a) Barbarian (b) Philistine
(c) Illiterate (d) Primitive

30. A group of three novels or plays, each complete in itself
(a) Triplet (b) Triumvir
(c) Trilogy (d) Trivet

Directions (Q. 31-35) : *In each of the following questions, re-arrange the parts P, Q, R and S to make a proper sentence.*

31. Why do people
(P) despite a desire
(Q) to quit and despite
(R) continue smoking
(S) the known health hazards
(a) PQRS (b) RPQS
(c) RQPS (d) RSPQ

32. As lightning accompanies thunder,
(P) was mingled with
(Q) so in my character
(R) the mutterings of my wrath
(S) a flash of humour
(a) PRSQ (b) QPRS
(c) QRPS (d) QSPR

33. During hibernation
(P) they have lost a good deal of weight
(Q) of course the animals consume
(R) and when they awake again
(S) the fats accumulated in the summer
(a) PQRS (b) QSRP
(c) RQSP (d) SQPR

34. The exhibition committee
(P) attractive and useful
(Q) to make the exhibition
(R) making efforts
(S) has been
(a) QPRS (b) QPSR
(c) SRPQ (d) SRQP

35. The house,
(P) about half a mile distant
(Q) that stands in front of us
(R) was built of stones
(S) which were dug out of its own site
(a) QPRS (b) QRPS
(c) QRSP (d) QSPR

Directions (Q. 36-40) : *Read the following passage carefully and answer the questions given below it.*

Speech is a great blessing but it can also be a great curse, for while it helps us to make our intentions and desires known to our fellows, it can also, if we use it carelessly, make our attitude completely misunderstood. A slip of the tongue, use of an unusual word, or of an the ambiguous word, and so on, may create an enemy where we had hoped to win a friend. Again, different classes of people use different vocabularies, and the ordinary speech of an educated man may strike an uneducated listener as pompous. Unwittingly, we may use a word which bears a different meaning to our listener from what It does to men of our own class. Thus speech is not a gift to use lightly without thought, but one which demands careful handling. Only a fool will express himself alike to all kinds and conditions of men.

36. Speech can be a curse, because it can
(a) reveal our intentions
(b) lead to carelessness
(c) hurt others
(d) create misunderstanding

37. A 'slip of the tongue' means something said
(a) unintentionally
(b) wrongly by chance
(c) without giving proper thought
(d) to hurt another person

38. The best way to win a friend is to avoid in speech.
(a) ambiguity (b) verbosity
(c) pomposity (d) irony

39. While talking to an uneducated person, we should use
(a) polite language
(b) ordinary speech
(c) his vocabulary
(d) simple words

40. If one used the same style of language with everyone, one would sound
(a) democratic (b) foolish
(c) boring (d) flat

ANSWERS

Physics

1. (c)	2. (a)	3. (b)	4. (a)	5. (a)	6. (b)	7. (b)	8. (c)	9. (a)	10. (a)
11. (b)	12. (d)	13. (d)	14. (a)	15. (d)	16. (c)	17. (d)	18. (b)	19. (d)	20. (a)
21. (c)	22. (c)	23. (c)	24. (b)	25. (c)	26. (c)	27. (d)	28. (b)	29. (a)	30. (a)
31. (c)	32. (b)	33. (d)	34. (c)	35. (d)	36. (d)	37. (d)	38. (d)	39. (d)	40. (b)

Chemistry

1. (b)	2. (c)	3. (d)	4. (d)	5. (d)	6. (a)	7. (b)	8. (d)	9. (d)	10. (a)
11. (b)	12. (b)	13. (a)	14. (c)	15. (d)	16. (c)	17. (a)	18. (d)	19. (a)	20. (a)
21. (a)	22. (b)	23. (c)	24. (d)	25. (c)	26. (a)	27. (b)	28. (d)	29. (d)	30. (b)
31. (a)	32. (a)	33. (c)	34. (b)	35. (a)	36. (a)	37. (d)	38. (d)	39. (c)	40. (d)

Zoology

1. (c)	2. (b)	3. (b)	4. (c)	5. (a)	6. (d)	7. (c)	8. (d)	9. (d)	10. (b)
11. (d)	12. (d)	13. (c)	14. (c)	15. (d)	16. (c)	17. (a)	18. (b)	19. (d)	20. (c)
21. (d)	22. (d)	23. (a)	24. (c)	25. (d)	26. (c)	27. (c)	28. (d)	29. (a)	30. (a)
31. (d)	32. (d)	33. (c)	34. (a)	35. (c)	36. (c)	37. (b)	38. (b)	39. (d)	40. (a)

Botany

1. (b)	2. (b)	3. (c)	4. (b)	5. (c)	6. (d)	7. (a)	8. (a)	9. (a)	10. (c)
11. (d)	12. (a)	13. (a)	14. (d)	15. (d)	16. (d)	17. (d)	18. (d)	19. (b)	20. (c)
21. (b)	22. (b)	23. (c)	24. (c)	25. (b)	26. (a)	27. (a)	28. (a)	29. (d)	30. (b)
31. (c)	32. (a)	33. (c)	34. (a)	35. (d)	36. (d)	37. (b)	38. (c)	39. (a)	40. (d)

General English

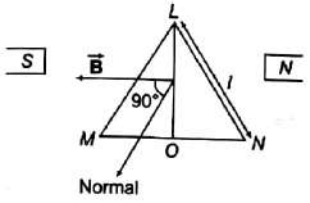
1. (d)	2. (b)	3. (b)	4. (a)	5. (d)	6. (c)	7. (b)	8. (a)	9. (c)	10. (c)
11. (b)	12. (c)	13. (b)	14. (c)	15. (d)	16. (b)	17. (c)	18. (b)	19. (d)	20. (b)
21. (a)	22. (b)	23. (c)	24. (a)	25. (a)	26. (a)	27. (c)	28. (b)	29. (b)	30. (c)
31. (b)	32. (d)	33. (b)	34. (d)	35. (a)	36. (d)	37. (c)	38. (a)	39. (c)	40. (b)

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HINTS & SOLUTIONS

Physics

1. Torque acting on equilateral triangle in a magnetic field $\vec{B}$ is



$$\tau = i\,AB\sin\theta$$

Area of triangle LMN

$$A = \frac{\sqrt{3}}{4}l^2 \text{ and } \theta = 90°$$

Substituting the given values in the expression for torque, we have

$$\tau = i \times \frac{\sqrt{3}}{4} l^2\, B \sin 90°$$

$$= \frac{\sqrt{3}}{4} il^2\, B \ (\because \sin 90° = 1)$$

Hence, $$l = 2\left(\frac{\tau}{\sqrt{3}\,Bi}\right)^{1/2}$$

2. Key Idea : *The average power per unit area that is incident perpendicular to the direction of propagation is called the intensity.*

Intensity of sound

$$I = \frac{P}{4\pi r^2}$$

or $$I \propto \frac{1}{r^2}$$

or $$\frac{I_1}{I_2} = \left(\frac{r_2}{r_1}\right)^2$$

Here, $r_1 = 2\,\text{m}, r_2 = 3\,\text{m}$

Substituting the values, we have

$$\frac{I_1}{I_2} = \left(\frac{3}{2}\right)^2 = \frac{9}{4}$$

3. Key Idea : *The linear momentum of exploding part will remain conserved.*

Applying conservation of linear momentum, we write,

$$m_1u_1 = m_2u_2$$

Here, $m_1 = 18\,\text{kg}, m_2 = 12\,\text{kg}$

$u_1 = 6\,\text{ms}^{-1}, u_2 = ?$

$$\therefore \quad 18 \times 6 = 12\,u_2$$

$$\Rightarrow \quad u_2 = \frac{18 \times 6}{12}\ 9\ \text{ms}^{-1}$$

Thus, kinetic energy of 12 kg mass

$$K_2 = \frac{1}{2} m_1 u_2^2$$

$$= \frac{1}{2} \times 12 \times (9)^2$$

$$= 6 \times 81$$

$$= 486\,\text{J}$$

4. When a body rolls down without slipping along an inclined plane of inclination θ, it rotates about a horizontal axis through its centre of mass and also its centre of mass moves. Therefore, rolling motion may be regarded as a rotational motion about an axis through its centre of mass plus a translational motion of the centre of mass. As it rolls down, it suffers loss in gravitational potential energy provided translational energy due to frictional force is converted into rotational energy.

5. The acceleration due to gravity on the new planet can be found using the relation

$$g = \frac{GM}{R^2} \qquad \ldots(i)$$

but $M = \frac{4}{3}\pi R^3\rho$, ρ being density.

Thus, Eq. (i) becomes

$$\therefore \quad g = \frac{G \times \frac{4}{3}\pi R^3\rho}{R^2}$$

$$= G \times \frac{4}{3}\pi R\rho$$

$$\Rightarrow \quad g \propto R$$

$$\therefore \quad \frac{g'}{g} = \frac{R'}{R}$$

$$\Rightarrow \quad \frac{g'}{g} = \frac{3R}{R} = 3$$

$$\Rightarrow \quad g' = 3g$$

6. Key Idea : *Heat conduction through a rod is rate of change of heat* $\left(\frac{\Delta Q}{\Delta t}\right)$.

$$\therefore \quad H = \frac{\Delta Q}{\Delta t} = KA\left(\frac{T_1 - T_2}{l}\right)$$

$$\Rightarrow \quad H \propto \frac{r^2}{l} \qquad \ldots(i)$$

(a) When $r = 2r_0, l = 2l_0$

$$H \propto \frac{(2r_0)^2}{l_0} \Rightarrow H \propto \frac{2r_0^2}{l_0}$$

(b) When $r = 2r_0, l = l_0$

$$H \propto \frac{(2r_0)^2}{2l_0} \Rightarrow H \propto \frac{4r_0^2}{l_0}$$

(c) When $r = r_0, l = l_0$

$$H \propto \frac{r_0^2}{l_0}$$

(d) When $r = r_0, l = 2l_0$

$$H \propto \frac{r_0^2}{2l_0}$$

It is obvious that heat conduction will be more in case (b).

7. Key Idea: *The energy released per nuclear reaction is the resultant binding energy.*

Binding energy of $({}_1^2\text{H} + {}_1^3\text{H}) = a + b$

Binding energy of ${}_2^4\text{He} = c$

In a nuclear reaction the resultant nucleus is more stable than the reactants. Hence, binding energy of ${}_2^4\text{He}$ will be more than that of $({}_1^2\text{H} + {}_1^3\text{H})$

Thus, energy released per nucleon

= resultant binding energy

$= c - (a + b) = c - a - b$

8. Key Idea: *That metal will emit photoelectrons which has work function lower than that obtained with the radiation of* 4100 Å.

Work function for wavelength of 4100 Å is

$$W = \frac{hc}{\lambda}$$

$$= \frac{6.62 \times 10^{-34} \times 3 \times 10^8}{4100 \times 10^{-10}}$$

$$= 4.8 \times 10^{-19}\ \text{J}$$

$$= \frac{48 \times 10^{-19}}{1.6 \times 10^{-19}}\ \text{eV} = 3\ \text{eV}$$

Now, we have

$W_A = 1.92$ eV.

$W_B = 2.0$ eV,

$W_C = 5$ eV

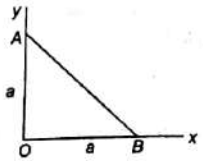
Since, $W_A < W$

and $W_B < W$, hence, A and B will emit photoelectrons.

9. The nuclei which have same number of neutrons but different atomic number and mass number are known as isotones. In choice (a) nuclei of ${}_{34}\text{Se}^{74}$ and ${}_{31}\text{Ga}^{71}$ are isotones as

$$A - Z = 74 - 34 = 71 - 31 = 40$$

10. Key Idea : *The work done in carrying a test charge consists in product of difference of potentials at points A and B and value of test charge.*



Potential at A

$$V_A = \frac{1}{4\pi\varepsilon_0}\frac{q}{a}$$

Potential at B

$$V_B = \frac{1}{4\pi\varepsilon_0}\frac{q}{a}$$

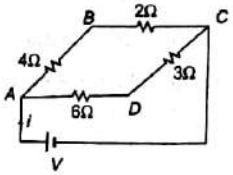
Thus, work done in carrying a test charge $-Q$ from A to B

$$W = (V_A - V_B)(-Q) = 0$$

11. The circuit given resembles the balanced Wheatstone Bridge as $\frac{4}{6} = \frac{2}{3}$.

Thus, middle arm containing 4 Ω resistance will be ineffective and no current flows through it.

The equivalent circuit is shown as below :



Net resistance of AB and BC

$$R' = 4 + 2 = 6\ \Omega$$

Net resistance of AD and DC

$$R'' = 6 + 3 = 9\Omega$$

Thus, parallel combination of R' and R'' gives

$$R = \frac{R' \times R''}{R' + R''}$$

$$= \frac{6 \times 9}{6 + 9} = \frac{54}{15} = \frac{18}{5}\ \Omega$$

Hence, current $i = \frac{V}{R} = \frac{V}{18/5} = \frac{5V}{18}$

12. In a circular motion particle repeats after equal intervals of time. So, particle motion on a circular path is periodic but not simple harmonic as it does not execute to and fro motion about a fixed point.

13. Maximum speed of a particle executing SHM is

$$u_{max} = a\omega = a(2\pi n)$$

$$\Rightarrow \quad n = \frac{u_{max}}{2\pi a}$$

Here, $u_{max} = 31.4$ cm/s, $a = 5$ cm

Substituting the given values, we have

$$n = \frac{31.4}{2 \times 3.14 \times 5} = 1\ \text{Hz}$$

14. $E = h\nu$

$$\Rightarrow \quad h = \text{Planck's constant} = \frac{E}{\nu}$$

$$\therefore \quad [h] = \frac{[E]}{[\nu]} = \frac{[ML^2T^{-2}]}{[T^{-1}]}$$

$$= [ML^2T^{-1}]$$

and I = moment of inertia $= MR^2$

$$\Rightarrow \quad [I] = [M]\,[L^2] = [ML^2]$$

Hence, $\frac{[h]}{[I]} = \frac{[ML^2T^{-1}]}{[ML^2]} = [T^{-1}]$

$$= \frac{1}{[T]} = \text{dimensions of frequency}$$

Alternative: $\frac{h}{I} = \frac{E/\nu}{I}$

$$= \frac{E \times T}{I} = \frac{(\text{kg-m}^2/\text{s}^2) \times \text{s}}{(\text{kg-m}^2)}$$

$$= \frac{1}{s} = \frac{1}{\text{time}} = \text{frequency}$$

Thus, dimensions of $\frac{h}{I}$ is same as of frequency.

15.(a) It is the process by which heat is transmitted from one place to another without heating the intervening medium.

Hence, it is not a reversible process.

(b) Nichrome wire is made of alloys and has high resistance. When current is passed through it, heat is produced. So, here electrical energy is converted into heat energy. Hence, it is not a reversible process.

(c) It is the process by which heat is transmitted from one point to another through a substance in the direction of fall of temperature without the actual movement of the particles of the substances themselves. Hence, it cannot be reversible.

(d) Isothermal compression is reversible, for example-Carnot cycle, Heat engine.

Thus, choice (d) is correct.

16. Key Idea : *The temperature of inversion is higher than the neutral temperature by the same amount as the neutral temperature is higher than the temperature of cold junction.*

As per Key Idea

$$t_n - t_0 = t_i - t_n$$

$$\Rightarrow \quad t_0 = 2t_n - t_i$$

Given, $t_i = 620°$ C, $t_n = 300°$C

Hence, t_0 = temperature of cold junction

$= 2 \times 300 - 620$

$= 600 - 620 = -20°$C

NOTE: Neutral temperature does not change for a metal whether the temperature of cold junction and inversion temperature change by any value.

17. Key Idea: *The solution to our problem consists in Einstein's photoelectric equation.*

Einstein's photoelectric equation can be written as

$$\frac{1}{2}mv^2 = h\nu - \phi$$

$$\Rightarrow \quad \frac{1}{2}m \times (4 \times 10^6)^2 = 2h\nu_0 - h\nu_0 \qquad \ldots(i)$$

and $\frac{1}{2}m \times v^2 = 5h\nu_0 - h\nu_0 \qquad \ldots(ii)$

Dividing Eq. (ii) by Eq. (i), we get

$$\frac{v^2}{(4 \times 10^6)^2} = \frac{4h\nu_0}{h\nu_0}$$

$$\Rightarrow \quad v^2 = 4 \times 16 \times 10^{12}$$

$$\Rightarrow \quad v^2 = 64 \times 10^{12}$$

$$\therefore \quad v = 8 \times 10^6\ \text{m/s}$$

NOTE: The efficiency of photoelectric effect is less than 1% .*ie*, number of photons less than 1% are capable of ejecting photoelectrons.

18. The binding energy per nucleon for the middle nuclides (from $A = 20$ to $A = 56$) is maximum. Hence, these are more stable.

As the mass number increases, the binding energy per nucleon gradually decreases and ultimately binding energy per nucleon of heavy nuclides (such as uranium etc.) is comparatively low. Hence, these nuclides are relatively unstable. So, they can be fissioned easily.

19. Given,

$$x = ae^{-\alpha t} + be^{\beta t}$$

So, velocity $$v = \frac{dx}{dt}$$

$$= -a\alpha e^{-\alpha t} + b\beta e^{\beta t}$$

$$= A + B$$

Where, $$A = -a\alpha e^{-\alpha t},\ B = b\beta e^{\beta t}$$

The value of term $A = -a\alpha e^{-\alpha t}$ decreases and of term $B = b\beta e^{\beta t}$ increases with increase in time.

As a result, velocity goes on increasing with time.

20. In fission process, when a parent nucleus breaks into daughter products, then some mass is lost in the form of energy. Thus, mass of fission products < mass of parent nucleus

$$\Rightarrow \quad \frac{\text{Mass of fission Products}}{\text{Mass of parent nucleus}} < 1$$

21. **Key Idea :** *The heat converted to work is the amount of heat that remains after going through sink.*

From the relation

$$\frac{Q_2}{Q_1} = \frac{T_2}{T_1}$$

Given, $Q_1 = 6 \times 10^4$ cal,

$T_1 = 227 + 273 = 500$ K

$T_2 = 127 + 273 = 400$ K

$$\therefore \quad \frac{Q_2}{6 \times 10^4} = \frac{400}{500}$$

$$\Rightarrow \quad Q_2 = \frac{4}{5} \times 6 \times 10^4 = 4.8 \times 10^4 \text{ cal}$$

Now, heat converted to work

$$= Q_1 - Q_2$$

$$= 6.0 \times 10^4 - 4.8 \times 10^4$$

$$= 1.2 \times 10^4 \text{ cal}$$

22. **Key Idea:** *Two vectors must be perpendicular if their dot product is zero.*

Let $$\vec{a} = 2\hat{i} + 3\hat{j} + 8\hat{k}$$

$$\vec{b} = 4\hat{j} - 4\hat{i} + \alpha\hat{k}$$

$$= -4\hat{i} + 4\hat{j} + \alpha\hat{k}$$

According to the above hypothesis

$$\vec{a} \perp \vec{b}$$

$$\Rightarrow \quad \vec{a} \cdot \vec{b} = 0$$

$$\Rightarrow \quad (2\hat{i} + 3\hat{j} + 8\hat{k}) \cdot (-4\hat{i} + 4\hat{j} + \alpha\hat{k}) = 0$$

$$\Rightarrow \quad -8 + 12 + 8\alpha = 0$$

$$\Rightarrow \quad 8\alpha = -4$$

$$\therefore \quad \alpha = -\frac{4}{8} = -\frac{1}{2}$$

NOTE: $\vec{a} \cdot \vec{b} = ab\cos\theta$. Here, a and b are always positive as they are the magnitudes a $\vec{a}$ and $\vec{b}$.

23. Zener diode is a silicon crystal diode having an unusual reverse current characteristic which is particularly suitable for voltage regulating purposes. Due to this characteristic, it is used as voltage stabilizer in many applications in electronics.

24. **Key Idea :** *The work done will be the area of the F-x graph.*

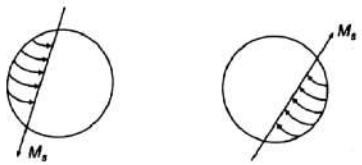
Work done in moving the object from $x = 0$ to $x = 6$ m is given by

W = area of rectangle + area of triangle

$$= 3 \times 3 + \frac{1}{2} \times 3 \times 3$$

$$= 9 + 4.5 = 13.5 \text{ J}$$

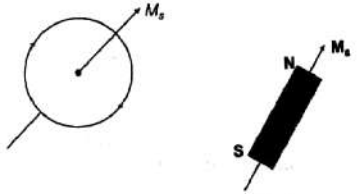
25. In diamagnetic substances in each pair of electrons, the spin of both the electrons are in opposite directions. Hence, the electrons of each pair completely cancel the magnetic moment of each other. Thus, the net magnetic moment of each atom of such substances is zero *i.e.*, $\mu_d = 0$.



The property of paramagnetism is found in those substances whose atoms, or molecules have an excess of electrons spinning in same direction.

Hence, atoms of paramagnetic substances have permanent magnetic moment *ie*, $\mu_p \neq 0$.

The property of ferromagnetism is found in substances which acquire very strong magnetism when placed in an external magnetic field. Like the paramagnetic substances each atom of ferromagnetic substances also has a permanent magnetic moment *i.e*, $\mu_f \neq 0$.



26. $$\tan\phi = \frac{\omega L - \frac{1}{\omega C}}{R}$$

ϕ being the angle by which the current leads the voltage.

Given, $\phi = 45°$

$$\therefore \quad \tan 45° = \frac{\omega L - \frac{1}{\omega C}}{R} \Rightarrow 1 = \frac{\omega L - \frac{1}{\omega C}}{R}$$

$$\Rightarrow \quad R = \omega L - \frac{1}{\omega C} \Rightarrow \omega C = \frac{1}{(\omega L - R)}$$

$$\Rightarrow \quad C = \frac{1}{\omega(\omega L - R)} = \frac{1}{2\pi f(2\pi f L - R)}$$

NOTE: *In series resonance L-C-R circuit,* $\frac{1}{\omega CR}$ *is greater than unity.*

27. Angular resolution $$= \frac{1.22\lambda}{d}$$

$$= \frac{1.22 \times 5000 \times 10^{-10}}{10 \times 10^{-2}}$$

$$= 6.1 \times 10^{-6}$$

$$\approx 10^{-6} \text{ rad}$$

28. **Key Idea :** *To reach the solution the given wave equations must be compared with standard equation of progressive wave.*

So,

$$y_1 = 4\sin 500\,\pi t \quad \ldots(i)$$

$$y_2 = 2\sin 506\,\pi t \quad \ldots(ii)$$

Comparing Eqs. (i) and (ii) with

$$y = a\sin\omega t \quad \ldots(iii)$$

We have,

$$\omega_1 = 500\,\pi$$

$$\Rightarrow \quad f_1 = \frac{500\,\pi}{2\pi} = 250 \text{ beats/s}$$

and $$\omega_2 = 506\,\pi$$

$$\Rightarrow \quad f_2 = \frac{506\pi}{2\pi} = 253 \text{ beats/s}$$

Thus, number of beats produced

$$= f_2 - f_1 = 253 - 250$$

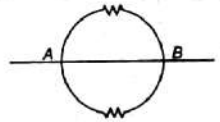
$$= 3 \text{ beats/s}$$

$$= 3 \times 60 \text{ beats/min}$$

$$= 180 \text{ beats/min}$$

29. When wire is bent to form a complete circle then

$$2\pi r = R \Rightarrow r = \frac{R}{2\pi}$$



Resistance of each semicircle

$$= \pi r = \frac{\pi R}{2\pi} = \frac{R}{2}$$

Thus, net resistance in parallel combination of two semicircular resistance

$$R' = \frac{\frac{R}{2} \times \frac{R}{2}}{\frac{R}{2} + \frac{R}{2}} = \frac{\frac{R^2}{4}}{R} = \frac{R}{4}$$

30. Carbon, silicon and germanium are semiconductors.

$(E_g)_C = 5.2$ eV

$(E_g)_{Si} = 1.21$ eV

$(E_g)_{Ge} = 0.75$ eV

Thus, $(E_g)_C > (E_g)_{Si}$ and $(E_g)_C > (E_g)_{Ge}$

NOTE : Elements carbon, silicon and germanium are found in IVA group of periodic table.]

31. Wavelength order of given rays are listed below:

Rays	Wavelength (Å)
Visible light	4000 – 7900
X-rays	1 –100
Microwaves	10^7–10^9

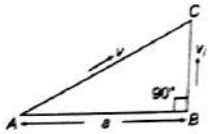
Obviously, $\lambda_x < \lambda_v < \lambda_m$

or $\lambda_m > \lambda_v > \lambda_x$

NOTE : Visible light, X-rays and microwaves are all electromagnetic waves.

32. Distance covered by boy A in time t

$$AC = vt \quad ...(i)$$



Distance covered by boy B in time t

$$BC = v_1 t \quad ...(ii)$$

Using Pythagorus theorem

$$AC^2 = AB^2 + BC^2$$

or $(vt)^2 = a^2 + (v_1 t)^2$

or $v^2t^2 - v_1^2t^2 = a^2$

or $t^2(v^2 - v_1^2) = a^2$

$$\therefore \quad t = \sqrt{\frac{a^2}{(v^2 - v_1^2)}}$$

33. Power $P = i^2R$

$$\Rightarrow \quad R = \frac{P}{i^2}$$

Given, $P = 1\,W, i = 5\,A$

$$\therefore \quad R = \frac{1}{(5)^2} = 0.04\,\Omega$$

34. The time period of electron moving in a circular orbit

$$T = \frac{\text{circumference of circular path}}{\text{speed}} = \frac{2\pi r}{v}$$

and equivalent current due to electron flow

$$I = \frac{e}{T} = \frac{e}{(2\pi r / v)} = \frac{ev}{2\pi r}$$

Magnetic field at centre of circle

$$B = \frac{\mu_0 I}{2r} = \frac{\mu_0 ev}{4\pi r^2}$$

$$\Rightarrow \quad r \propto \sqrt{\frac{v}{B}}$$

35.(a) In insulators energy gap is of the order of 5 to 10 eV and it is practically impossible to impart this much amount of energy to the electrons in valence band.

So, as to jump to conduction band.

So, choice (a) is correct.

(b) In semiconductors with the rise in temperature more electrons from valence band jump to conduction band and this results is increase in conductivity. So, choice (b) is correct.

(c) In conductors, the conduction band is either partially filled or the conduction band overlaps on the valence band. So, choice (c) is correct.

(d) In semiconductor, resistivity decreases with increase in temperature.

So, choice (d) is wrong.

36. $(\vec{B} \times \vec{A}) . \vec{A}$

$$= B\,A \cos\theta\, \hat{n} . \vec{A}$$

$$= 0$$

Here $\hat{n}$ is perpendicular to both $\vec{A}$ and $\vec{B}$.

Alternative : $(\vec{B} \times \vec{A}) \cdot \vec{A}$

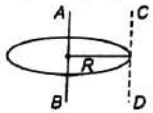
Interchange the cross and dot, we have,

$(\vec{B} \times \vec{A}) \cdot \vec{A} = \vec{B} \cdot (\vec{A} \times \vec{A}) = 0 \quad (\because \vec{A} \times \vec{A} = 0)$

NOTE: The volume of a parallelopiped bounded by vectors $\vec{A}$, $\vec{A}$ and $\vec{A}$ can be obtained by giving formula $(\vec{A} \times \vec{A}) \cdot \vec{A}$

37. Key Idea : *We should use parallel axis theorem.*

Moment of inertia of disc passing through its centre of gravity and perpendicular to its plane



is $I_{AB} = \frac{1}{2}MR^2$

Using theorem of parallel axes, we have

$$I_{CD} = I_{AB} + MR^2$$

$$= \frac{1}{2}MR^2 + MR^2$$

$$= \frac{3}{2}MR^2$$

NOTE · The role of moment of inertia in the study of rotational motion is analogous to that of mass in study of linear motion.

38. Interatomic spacing for a fcc lattice

$$r = \left[\left(\frac{a}{2}\right)^2 + \left(\frac{a}{2}\right)^2 + (0)^2\right]^{1/2} = \frac{a}{\sqrt{2}}$$

a being lattice constant.

$$\therefore \quad a = \sqrt{2}r = \sqrt{2} \times 2.54 = 3.59\,\text{Å}$$

NOTE : Interatomic spacing is just the nearest neighbours distance.

39. Key Idea : *The kinetic energy is equal to the negative of total energy.*

Kinetic energy of electron

$$K = \frac{Ze^2}{8\pi\varepsilon_0 r}$$

Potential energy of electron

$$U = -\frac{1}{4\pi\varepsilon_0}\frac{Ze^2}{r}$$

∴ Total energy

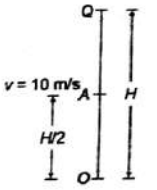
$$E = K + U = \frac{Ze^2}{8\pi\varepsilon_0 r} - \frac{Ze^2}{4\pi\varepsilon_0 r}$$

or $E = -\frac{Ze^2}{8\pi\varepsilon_0 r}$

or $E = -K$

or $K = -E = -(-3.4) = 3.4$ eV

40. Key Idea : *The problem can be solved using third equation of motion at A and O'.*



Let maximum height attained by the ball be H.Third equation of motion gives

$$v^2 = u^2 - 2gh$$

At A, $(10)^2 = u^2 - 2 \times 10 \times \frac{H}{2}$

$$\Rightarrow \quad u^2 = 100 + 10H \quad ...(i)$$

At O', $(0)^2 = u^2 - 2 \times 10 \times H$

$$\Rightarrow \quad u^2 = 20H \quad ...(ii)$$

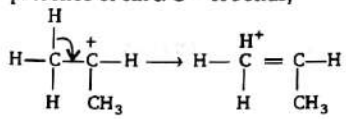
Thus, from Eqs. (i) and (ii), we get

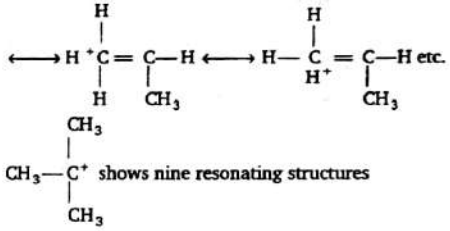
$$20H = 100 + 10H$$

$$\Rightarrow \quad 10H = 100 \quad \therefore H = 10\,\text{m}$$

Chemistry

1. The most stable carbocation is *t*-alkyl carbocation because the order of stability of alkyl carbocation is *t*-alkyl>*s*-alkyl> *p*-alkyl > CH_3^+ carbocation. This stability order is described with the help of hyperconjugation and inductive effect. On the basis of hyper conjugation, $(CH_3)_2\overset{+}{C}H$ shows six resonating structures due to presence of six α C—H bonds,





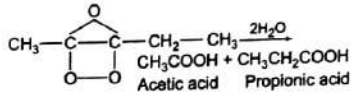
$CH_3—\overset{+}{C}(CH_3)—CH_3$ shows nine resonating structures

due to presence of nine α C—H bonds

$\overset{+}{C}H_3$ does not show the property of resonance while $CH_3—\overset{+}{C}H_2$ shows three resonating structures due to presence of three α C—H bonds. Hence, larger number of

resonating structures are possible in (2), so it is most stable. The above order of stability is also explained with the help of (+) *I*-effect of $-CH_3$ group. More the number of $-CH_3$ group. more will be tendency to displace the electrons towards positive charged carbon of carbocation. Thus (+)charge is decreased or compensated *i.e*, positive charge is decreased and stability of carbocation is increased.

2. $CH_3-C\equiv C-CH_2-CH_3 \xrightarrow{O_3}$



3. Base *BOH* is dissociated as follows

$BOH \rightleftharpoons B^+ + OH^-$

So, the dissociation constant of *BOH* base

$$K_b = \frac{[B^+][OH^-]}{[BOH]} \quad \ldots (i)$$

At equilibrium $[B^+] = [OH^-]$

$$\therefore \quad K_b = \frac{[OH^-]^2}{[BOH]}$$

Given that $K_b = 1.0 \times 10^{-12}$ and

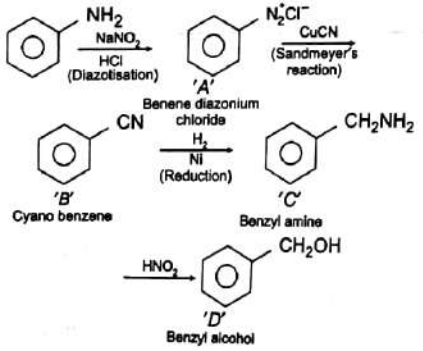
$[BOH] = 0.01$ M

Thus $1.0 \times 10^{-12} = \frac{[OH^-]^2}{0.01}$

$[OH^-]^2 = 1 \times 10^{-14}$

$[OH^-] = 1.0 \times 10^{-7}$ mol L^{-1}

4.



5. In Hall and Heroult process

$2Al_2O_3 \longrightarrow 4Al + 3O_2$

$4C + 3O_2 \longrightarrow 2CO_2 + 2CO\uparrow$

$2Al_2O_3 + 4C \longrightarrow 4Al + 2CO_2 + 2CO$

Only for removal of CO_2, following equation is possible

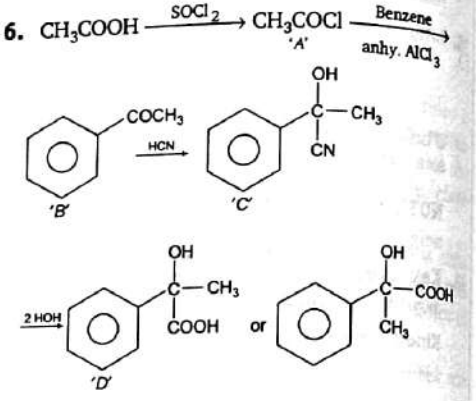
$$2Al_2O_3 + \underset{3\times12=36}{3C} \longrightarrow \underset{4\times27=108}{4Al} + 3CO_2$$

∵ For 108 g of Al, 36 g of C is required in above reaction

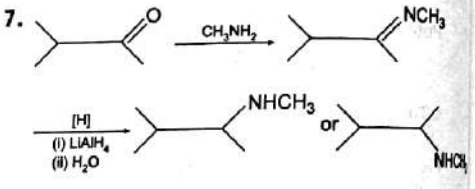
∴For 270 g of Al require amount of C

$$= \frac{36}{108} \times 270 = 90 \text{ g}$$

6.



7.



8. In alkaline solution, $KMnO_4$ is reduced to MnO_2 (colourless).

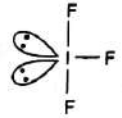
$2KMnO_4 + 2H_2O \longrightarrow 2MnO_2 + 2KOH$

$+ 3[O]\ KI + 3[O] \longrightarrow KIO_3$

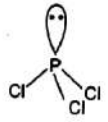
$2KMnO_4 + 2H_2O + KI \longrightarrow 2MnO_2 + 2KOH + KIO_3$

Hence, two moles of $KMnO_4$ are reduced by one mole of KI.

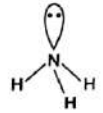
9. IF_3 has bent-T geometery



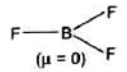
PCl_3 has pyramidal geometery.



NH_3 has pyramidal geometry.



BF_3 has trigonal planar geometry.



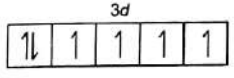
10. $_{21}Sc = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^1, 4s^2$

So, $Sc^{3+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6$

(It is colourless due to absence of unpaired electrons in *d*-stubshell)

$_{26}Fe = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^6, 4s^2$

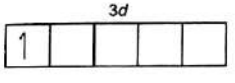
$Fe^{2+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^6$



(It is coloured due to presence of four unpaired electrons in *d*-subshell.)

$_{22}Ti = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^2, 4s^2$

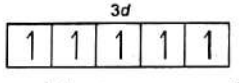
$Ti^{3+} = 1s^2, 2s^2 2p^6, 3s^2, 3s^6 3d^1$



(It is coloured due to presence of one unpaired electron in *d*-subshell).

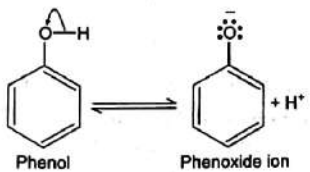
$_{25}Mn = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^5, 4s^2$

$Mn^{2+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^5$

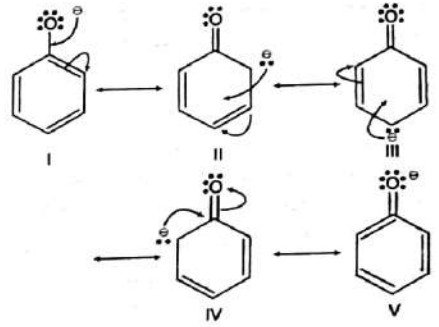


(It is coloured due to presence of five unpaired electrons in *d*-subshell)

11. Phenols are much more acidic than alcohols, due to the stabilisation of phenoxide ion by resonance.



Phenoxide ion is stabilized due to following resonating structures :



While in alcohols

$R-\ddot{O}: \rightleftharpoons R-\ddot{O}:^{\ominus} + H^+$

Alcohol — Not stabillsed due to assence of resonance

Ortho nitrophenol is most acidic because in it $-NO_2$ electron attracting group is attached on *ortho* position which helps in stabilising of negative charge on the oxygen of phenoxide ion.Hence, due to this reason acidic character of phenol is increased, while on attachment of $-CH_3$ group (electron donating group) acidic strength of phenol is decreased in cresol due to destabilisation of phenoxide ion.

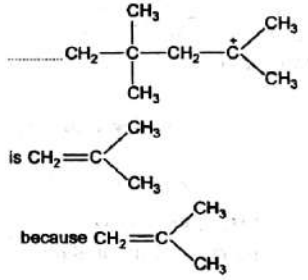
12. The spontaneity of reaction is based upon the negative value of ΔG, ΔG is based upon T, ΔS and ΔH according to following equation (Gibbs-Helmholtz equation)

$$\Delta G = \Delta H - T\Delta S$$

If the magnitude of $\Delta H - T\Delta S$ is negative, then the reaction is spontaneous.

when $T\Delta S > \Delta H$ and ΔH and ΔS are + ve, then ΔG is negative.

13. The monomer of polymer



shows cationic polymerisation.

14. On the basis of Fajan's rule, lower the size of cation higher will be its polarising power and higher will be covalent character.

$\therefore$ Polarising power $\propto \frac{1}{\text{size of cation}}$

Covalent character $\propto$ Polarising power

So the correct order is

$NaCl < LiCl < BeCl_2$

(The order of size of cation $Na^+ > Li^+ > Be^{2+}$)

15. The correct order of pH of isomolar solution in sodium oxide (pH_1), sodium sulphide (pH_2), sodium selenide (pH_3) and sodium telluride (pH_4) is $pH_1 > pH_2 > pH_3 > pH_4$ because in aqueous solution, they are hydrolysed as follows.

$Na_2O + 2H_2O \longrightarrow \underset{\text{Base}}{2NaOH} + H_2O$

$Na_2S + 2H_2O \longrightarrow \underset{\text{Strong base}}{2NaOH} + \underset{\text{Weak acid}}{H_2S}$

$Na_2Se + 2H_2O \longrightarrow \underset{\text{Strong base}}{2NaOH} + \underset{\text{Weak acid}}{H_2Se}$

$Na_2Te + 2H_2O \longrightarrow \underset{\text{Strong base}}{2NaOH} + \underset{\text{Weak acid}}{H_2Te}$

Order of acidic strength

$H_2Te > H_2Se > H_2S > H_2O$

Order of neutralisation of NaOH

$H_2Te > H_2Se > H_2S > H_2O$

Hence, their aqueous solutions have the following order of basic character due to neutralisation of NaOH with H_2O, H_2S. H_2Se and H_2Te

$Na_2O > Na_2S > Na_2Se > Na_2Te$

($\because$ pH of basic solution is higher than acidic or least basic solution.)

16. If reaction is exothermic, therefore, ΔH is – ve and on increasing disorder, ΔS is + ve thus, at these condition, ΔG is negative according to following equation.

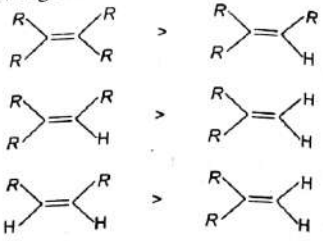
$\Delta G = \Delta H - T\Delta S$

ΔG = – ve. Hence, for spontaneous reaction ΔG must be – ve.

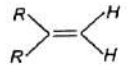
17. Stability of alkene

$\propto \frac{1}{\text{Heat of hydrogenation of alkene}}$

Greater the number of alkyl groups attached to the doubly bonded carbon atoms, more stable is the alkene. Hence, given alkene follow the following order of stability.



Hence, faster hydrogenation in



18. For first order reaction

$A \longrightarrow B$

Given that rate = $k \times [A]$

Rate $= 2.0 \times 10^{-5}$ mol L^{-1} s^{-1}

$[A]$ = Conc. of A = 0.01 M

So, $2.0 \times 10^{-5} = k \times 0.01$

$$k = \frac{2.0 \times 10^{-5}}{0.01}\ s^{-1}$$

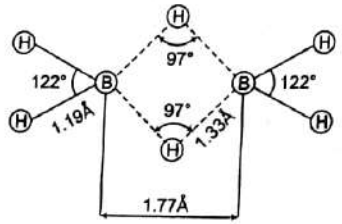
$$= 2.0 \times 10^{-3} s^{-1}$$

For first order reaction

$$T_{1/2} = \frac{0.693}{k} = \frac{0.693}{2.0 \times 10^{-3}}$$

$$= 346.5 \approx 347\ s$$

19. B_2H_6 is electron deficient molecule because boron atom has three half filled orbitals in excited state. The structure of B_2H_6 is represented as follows:

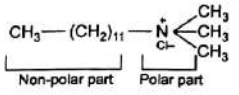


In it two electrons of a B — H bond are involved in formation of three centre bond, these bonds are represented as dotted lines.

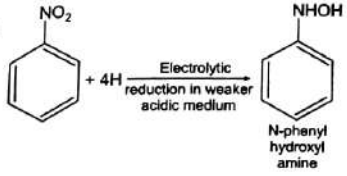
20. After decay of radioactive element, the last element (stable) Pb is obtained which belongs to group 14 of periodic table.

21. Heat of neutralisation of strong acid and strong base is – 57.33 kJ. MgO is weak base while HCl is strong acid, so the heat of neutralisation of MgO and HCl is lower to – 57.33 kJ because MgO requires some heat in ionisation, then net released amount of heat is decreased.

22. Surfactants detergents form micelles in aqueous solution above to their C.M.C (critical micelle concentration). Dodecyl trimethyl ammonium chloride is an example of surfactant (cationic surfactant), so it shows a following phenomena.



23.



24. (i) $NO(g) + \frac{1}{2}O_2(g) \overset{K_1}{\rightleftharpoons} NO_2(g)$

So $$K_1 = \frac{[NO_2]}{[NO]\,[O_2]^{\frac{1}{2}}} \quad \text{... (i)}$$

(ii) $2NO_2(g) \overset{K_2}{\rightleftharpoons} 2NO + O_2(g)$

So $$K_2 = \frac{[NO]^2\,[O_2]}{[NO_2]^2} \quad \text{... (ii)}$$

From Eq. (i)

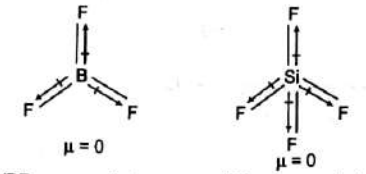
$$K_1^2 = \frac{[NO_2]^2}{[NO]^2[O_2]}$$

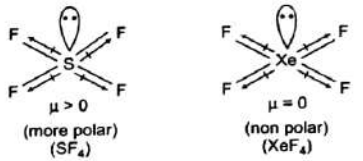
or $$\frac{1}{K_1^2} = \frac{[NO]^2[O_2]}{[NO_2]^2} \quad \text{... (iii)}$$

From Eqs. (ii) and (iii)

$$K_2 = \frac{1}{K_1^2}$$

25.





26. Aliphatic S_N1 reaction is carried out in two steps. In form of slow step

Step (i) carbonium (carbocation) ion is formed and its formation is based upon the stability Stability order of carbocation

$C_6H_5\overset{+}{C}H_2 > CH_3—\overset{+}{C}H—CH_3 > CH_3—\overset{+}{C}H_2$

and in step (ii) nucleophile is attracted towards the carbonium ion in form of fast step to give final product.

Hence, in benzyl chloride, ethyl chloride and isopropyl chloride order of S_N1 reaction is benzyl chloride > isopropyl chloride > ethyl chloride

In chlorobenzene, mechanism of S_N1 reaction is differ to aliphatic alkyl halide. The aryl halides are much less reactive as compared to alkyl halides, towards nucleophilic reagents in either S_N1 or S_N2 reaction.

The carbon-halogen bond in the aryl halide is quite strong and only forcing conditions can break up this bond.

Hence,

Step (i)

$$C_6H_5CH_2—Cl \xrightarrow{\text{Slow}} C_6H_5\overset{+}{C}H_2 + Cl^-$$

Rate $\propto [C_6H_5CH_2Cl]$

Step (ii) $C_6H_5—\overset{+}{C}H_2 + Nu^- \xrightarrow{\text{Fast}} C_6H_5CH_2Nu$

27. $A + B \longrightarrow$ Product

Rate $\propto [A][B]^{-2}$ ... (i)

The rate decreases by factor 4 if the concentration of reactant 'B' is doubled.

So, Rate $\propto [A][2B]^{-2}$

$$\propto \frac{[A][B]^{-2}}{4} \quad \text{...(ii)}$$

Hence, order of reaction wrt reactant B is – 2.

28. In a face centered cubic lattice a unit cell is shared equally by six unit cells.

29. $\because \Delta T_f = k_f \times$ Molality of solution

$\Delta T_b = k_b \times$ Molality of solution

or $\frac{\Delta T_f}{\Delta T_b} = \frac{k_f}{k_b}$

Given that

$\Delta T_b = T_2 - T_1 = 100.18 - 100 = 0.18$

k_f for water = 1.86 K kg mol^{-1}

k_b for water = 0.512 K kg mol^{-1}

$\therefore \quad \frac{\Delta T_f}{0.18} = \frac{1.86}{0.512}$

$\Delta T_f = \frac{1.86 \times 0.18}{0.512}$

$= 0.6539 \sim 0.654$

$\Delta T_f = T_1 - T_2$

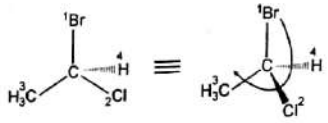
$0.654 = 0°C - T_2$

$\therefore \quad T_2 = -0.654°C$

($T_2 \rightarrow$ Freezing point of aqueous urea solution)

30. Disulphide bond may be reduced to thiol by means of reagents ie, $NaBH_4$, which shows the presence of thiol group in disulphide bond formation,

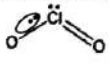
31.



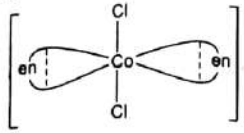
Lowest priority atom is always away from the viewer. Priority is seen on the basis of atomic number and if atomic numbers are same then on the basis of second or third bond in above figure priority order group or atom is —Br > —Cl > —CH_3 > H and in it rotation is clockwise. So it shows *R*-configuration.

32. In qualitative analysis of cation of second group H_2S gas is passed in presence of HCl, therefore due to common ion effect, lower concentration of sulphide ions is obtained which is sufficient for the precipitation of second group cations in form of their sulphides due to lower value of their solubility product (K_{sp}). Here, fourth group cations are not precipitated because they require for exceeding their ionic product to their solubility products and higher sulphide ions concentration due to their higher K_{sp} which is not obtained here due to common ion effect.

33. ClO_2 shows paramagnetic character due to presence of unpaired electron in its structure.



34. *Trans* $[CO(en)_2Cl_2]$ is able to exhibit the phenomena of optical isomerism because it can form a superimposable mirror image.



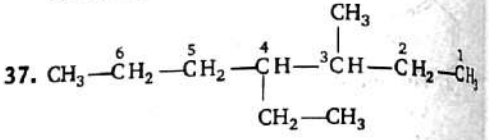
35. Correct order of acid strength

$\underset{+1}{HClO} < \underset{+3}{HClO_2} < \underset{+5}{HClO_3} < \underset{+7}{HClO_4}$

Acid strength $\propto$ oxidation number.

36. The main reason for larger number of oxidation states exhibited by actinides than corresponding lanthanides is lesser energy difference between 5*f* and 6*d* orbitals than between 4*f* and 5*d*-orbitals.

37.



Correct IUPAC name is 4-ethyl-3-methyl heptane because substituents are written in alphabetical order.

38. Total vapour pressure of mixture

= (Mole fraction of pentane × VP of pentane) + (Mole fraction of hexane × VP of hexane)

= VP of pentane in mixture + VP of hexane in mixture

$= \left(\frac{1}{5} \times 440 + \frac{4}{5} \times 120\right) = 184$ mm

∵ VP of Pentane in mixture.

= VP of mixture × mole fraction of pentane in vapour phase

88 = 184 × mole fraction of pentane in vapour phase

∴ Mole fraction of pentane in vapour phase

$= \frac{88}{184} = 0.478$

39. From second law of Faraday

$\frac{m_{Al}}{m_H} = \frac{E_{Al}}{E_H}$

$\therefore \quad \frac{4.5}{m_H} = \frac{27/3}{1}$

or $\quad m_H = 0.5$ g

∵ 2 g H_2 volume at STP = 22.4 L

∴ 0.5 g H_2 volume at STP

$= \frac{22.4 \times 0.5}{2}$ L = 5.6 L

40. The best method for the separation of naphthalene and benzoic acid from their mixture is sublimation because it is applicable for those organic compounds which pass directly from solid to vapour state on heating and *vice-versa* on cooling. In these compounds naphthalene is volatile and benzoic acid is non-volatile due to the formation of dimer *Via* hydrogen bonding (intermolecular).

Zoology

1. There are two models about origin of modern man (*Homo sapiens sapiens*) *i.e.*

(i) **Multiregional model :** According to this view, Modern humans evolved in many parts of the world from regional descendants of *Homo erectus* who dispersed from Africa between 1 and 2 million years ago.

(ii) **Monogenesis model:** According to this view only African descendents of *Homo erectus* gave rise to modern humans. In late 1980s Rebecca Cann and other geneticists supported this view on the basis of DNA of living humans. They compared the mitochondrial DNA (*mt*DNA) of a multiathenic sample of more than 100 people representing four continents. The greater the difference between the *mt*DNAs of two peoples, the longer ago that *mt*DNAs diverged from a common source. By using bioinformatics, they concluded that the divergence of *mt*DNA of Africans from common source began just 200,000 years ago, much to late to represent the dispersal of *Homo erectus*. Thus there are greater variation in Asia than in Africa.

2. The world's highly prized wool yielding 'Pashmina' breed is goat.

3. The grey crescent area is the area of just opposite to the entry of sperm into ovum.

4. Resolving power or resolution is the ability of the lens to distinguish fine details and structure. Specifically it refers to the ability of the lenses to distinguish between two points at a specified distance apart. Resolving power depends on two factors :

(i) Wavelength of light used for illumination

(ii) Power of objective lenses

$\text{Resolving power} = \frac{\text{Wavelength of light}}{2 \times \text{NA}}$

Since the limit of resolving power of a microscope is fixed by the structure of light, the shortest wavelength of visible light will give the maximum resolution. Among yellow, green, red and blue light colour. Blue (500 nm) have shortest wavelength so, it will give best resolution.

5. Kidneys help in the formation of urine, from the blood flowing through glomerular capillaries. About 20% of plasma fluid filters out into the Bowman's capsule through a thin glomerular-capsular membrane due to a net or effective filtration of about 10 to 15 mm Hg.

So, the nearest option is (a).

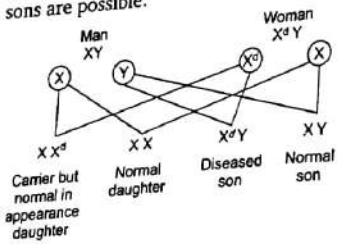
6. A genetic characteristic that is determined by genes located on the sex chromosomes (X or Y) are called sex linked characteristic and the condition where expression of sex linked genes is limited to one sex is called sex limited characteristics. In given problem, disease is the result of sex-linked recessive genes. As neither man nor woman shows signs of disease it means woman would be carrier for disease causing gene. In their children none of the daughter is suffering from disease, while the sons are suffering, it means daughters are also carrier, *i.e*, X-linked recessive.

Suppose, genotype of man = X Y

Genotype of woman = X^dX

(d-disease causing gene)

For each delivery the probability for each combination is 25%. So, among seven children 2 normal daughter, 3 diseased sons and 2 normal sons are possible.



7. Mammals are ureotelic organisms. In these organisms the ammonia deposited in the mitochondria of liver cells is converted into urea in the Ornithine cycle or urea cycle. Hans Kreb discovered this cycle in 1932 (who later also discovered citric acid cycle). Urea production is occurred almost exclusively in liver and it passes into blood stream and then to kidneys. During excretion of this urea through kidneys, CO_2 is also excreted.

8. Chromosomes are responsible for the transmission of the hereditary information from one generation to the next. The arms of chromosome is known as chromatids. These arms are held together at a point called the centromere (or primary constriction). Centromere occurs any where along the length of chromosome. During cell division spindle fibres are attached to centromere and help in the movement of chromosomes towards the poles.

9. Thymus gland is found in the upper part of thorax near the heart. It is a bilobed pinkish gland. At the time of birth, it is a prominent gland but in the adult it gradually atrophies. This gland secretes thymosin hormone, thymic humoral factor, thymic factor and thymopoietin. Proliferation of lymphocytes and differentiation of these lymphocytes into a variety of clones are induced by these factors. These clones are differentially specialized to destroy different specific category of antigens and pathogens. Thus thymus gland brings fourth T-Lymphocytes for cell mediated immunity.

10. G-6-P dehydrogenase deficiency is associated with haemolysis of RBCs.

11. Approximately 300 species and sub species of mammals are considered as endangered by the International Union for the Conservation of Nature and Natural Resources (IUCN). Red Panda is an endangered species because it is facing a very high risk of extinction in near future.

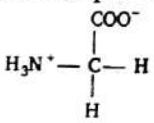
12. Lipoproteinaceous, thromboplastin is released by the injured tissue. This reacts with Ca^{2+} ions present in blood and forms a proteinaceous enzyme called prothrombinase. **Later** in the presence of Ca^{2+} inactivates heparin (anticoagulant) and catalyses prothrombin (inactive plasma protein) into an active thrombin protein. Thrombin acts as an enzyme and catalyses fibrinogen (a soluble plasma protein) into an insoluble fibre like polymer, fibrin. These fibres form a dense network upon the wound and trap blood corpuscles (WBCs, RBCs and platelets) and thus form a clot. This clot seals the wound and stop bleeding. In blood vessels, thromboplastin do not release due to which blood does not clot. But external thromboplastin to blood will cause blood clotting at the site of its introduction due to formation of prothrombinase.

13. Nucleotides are the building blocks of nucleic acids (DNA and RNA). A single nucleotide is composed of a phosphate molecule, a five carbon sugar (either ribose or deoxyribose) and a purine (adenine or guanine) or a pyrimidine (thymine or cytosine or uracil) nitrogenous base.

Nucleoside = Base + Sugar

Nucleotide = Base + Sugar + Phosphate

14. Proteins are polymers of amino acids in which amino acids are joined by peptide bonds. Glycine has the simplest structure.



Glycine amino acid

15. Enzymes, vitamins and hormones are classified into a single category of biological chemical because all these help in regulation of metabolism. Enzyme is a proteinaceous catalyst produced by a cell and responsible for the high rate and specificity of one or more intercellular or intracellular biochemical reactions. Vitamin is an organic substance which generally synthesized by plants (exception vitamin-D). Absence of a vitamin from the diet for sufficient time gives symptoms of a resulting deficiency disease. Hormones are chemical messengers which on secretion bring about a specific and adaptive physiological response.

16. According to Darwin's concept of natural selection, the organisms which are provided with favourable variations would survive because, they are the fittest to face their surrounding while the organisms, which are unfit for surrounding variations are destroyed. Prevalence of pesticide resistant insects is due to adaptability of these insects for the changes in environment (due to use of pesticides).

17. Abducens (abducent) nerve is a cranial nerve, which originated from the ventral surface of medulla oblongata. It innervates the lateral rectus muscle of eye ball. It is a motor nerve and controls the movements of the eye ball. Hence, if abducens nerve is injured in a man, movement of eye ball will be affected.

18. Protein synthesis takes place on ribosomes. In an eukaryotic cell ribosomes are present in cytoplasm, mitochondria and chloroplasts. So, in these places protein synthesis take place.

19. Insectivorous plants grow in water logged swampy soils, deficient in nitrogenous compounds. These plants obtain their nitrogen compounds from the insects. Due to this reason, these plants are called as semi-autotrophic or semi-heterotrophic. *Dionea* (an insectivorous plant) is commonly called as venus fly trap. Leaves of this plant have winged petiole and lamina modified into two toothed jaws. Each jaw bears several teeth. Upper surface of each jaw bears triangularly arranged long sensitive hairs or bristles and many glands, which are irregularly scattered. These hairs are very sensitive to touch stimulus. When an insect touches these hairs, this stimulus causes rapid turgor pressure changes which closes the leaf.

20. Animals resist predation by cryptic colouration, deceptive marking, behavioural defenses and the possession of mechanical or chemical defenses.

Example : A. enlargement of body size by swallowing air in puffer fish.

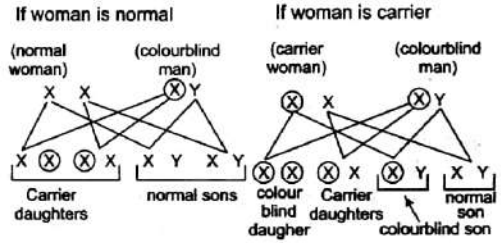
B. Melanism in moths.

C. Colour change in chameleon.

21. Pasteur performed experiments in which he took sterilized (by boiling) yeast and sugar solution in a long necked, then he bent the neck of the flask like a neck of swan. After one month he observed that no life appeared in flask solution because the curved flask neck acts as a filter. He later on broken down the neck and observed the solution. He found that many micro-organisms were originated in solution.

22. Colourblindness is a sex linked (X-linked) trait. It always transfers from mother to son.

A woman, whose father was colourblind, will cross be carrier for colourblind trait. Marriage of this woman with a colourblind man will result of the following possibilities.



23. Cretinism is a disorder which is caused by deficiency of thyroid hormones in infants. Symptoms of this disorder are slow body growth and mental development, slow heart beat, low blood pressure, stunted growth, retarded sexual development etc. This disease can be treated by an early administration of thyroid hormones.

24. Hugo de Vries (1848-1935) proposed mutation theory for the formation of new species. According to him, new species are not formed by

continuous variations but by sudden appearance of variations which he assigned as mutations. He stated that these mutations are heritable and persist in successive generations. For proposing this theory he performed experiments on *Oenothera lamarckiana (evening primrose)*.

25. Peristalsis of intestine is related with autonomous nervous system whereas knee-jerk response, pupillary reflex and swallowing of food are related to reflex action.

26. Deficiency of dopamine in the human produces symptoms of Parkinson's disease.

27. An acromian process is found in pectoral girdle of mammals.

28. The mucosa and sub-mucosa of small intestine are thrown into folds. Surfaces of these folds is covered by fine, fingerlike projections of the epithelium. These projections are called villi. In addition, the epithelial cells of the villi are covered on their exposed surface by cytoplasmic projections called microvilli.

29. The deficiency of proteins within the body is responsible for a disease, known as kwashiorkor. So, a kwashiorkor diseased patient is generally advised to specially, consume more meat, lentils, milk and eggs because these are rich sources of protein.

30. In 1970 H. Temin and D. Baltimore independently discovered the enzyme reverse transcriptase. This enzyme uses RNA as template for the synthesis of C-DNA (Complementary DNA).

RNA
↓ Reverse transcriptase used RNA as
C - DNA template

31. Platyhelminths do not have a coelomic or pseudocoelomic cavity for digestion of food as found in higher organisms. Because these organisms obtain digested food directly.

32. Gliding joint is present between zygapophyses of the successive vertebrae. ,

33. Haemophilia, a hereditary (recessive X-linked) disease is caused due to fault in genes, which controlling the factor VIII and IX, located on X-chromosome. The male carries only one X-chromosome, his other sex chromosome which carries no genes for blood clotting, so the condition is usually seen only in males where only one faulty chromosome is needed.

While a female with one faulty X-chromosome will be carrier. So, in females two faulty X-chromosomes are needed to cause the disease.

34. Down's syndrome is due to an extra chromosome, which combines to the chromosome pair 21. Down syndrome is caused due to trisomy, in which the fusion of a normal n gamete (haploid) takes place with an $n + 1$ gamete (diploid). J. Langdon Down first described the developmental defect produced by trisomy in 1866. For this reason it is called Down's syndrome. Persons having Down's syndrome generally have a short, stocky build, short hands, flattened facial features and poor muscle tone. In addition they are mentally retarded.

35. Secretin and Cholecystokinin (CCK) are two main Gastrointestinal (GI) hormones secretes in duodenum of alimentary canal. CCK stimulates gall bladder contraction and thus increases the flow of bile salts into the intestine. Secretin stimulates the release of an alkaline pancreatic fluid that neutralizes stomach acid as it enters the intestine.

36. AIDS (Acquired Immuno Deficiency Syndrome) was described first time in 1981 (Africa). It is the result of an infection by the Human Immuno Deficiency Virus (HIV). It is a lentivirus within the family of Retroviride. Principal target cells for HIV are T_4 lymphocytes because these cells have CD_4 receptor protein for interaction of HIV.

37. If mammalian ovum fails to get fertilized, the oestrogen secretion does not decrease further while corpus luteum will disintegrate. Primary follicle starts developing and progesterone secretion rapidly declines.

38. If a person is undergoing prolonged fasting, his urine will be found to contain abnormal quantities of ketones. During fasting energy is obtained by the oxidation of reserved fats. As a result of fatty acid oxidation large amount of ketone bodies are produced such as acetoacetate, β-hydroxybutyrate and acetone.

39. The deficiency of vitamin-B_1 or thiamine is responsible for the disease beri-beri. This disease occurs in those countries where the staple diet is polished rice. The symptoms of this disease are pain from neuritis, paralysis, muscle wasting, progressive oedema, mental deterioration and finally heart failure.

40. Valium depresses brain activity and produces feeling of calmness, relaxation and drowsiness.

Botany

1. Porter coined the name Endoplasmic Reticulum (ER). It is a network of tubules, vesicles and cisternae within an eukaryotic cell (absent in prokaryotic cells). Two types of ER are recognised on the basis of presence/absence of ribosomes on the wall of the ER.

(i) **Smooth ER**—Wall of this ER does not has ribosomes. Smooth ER helps in the synthesis of lipid and glycogen.

(ii) **Rough ER**—Wall of this ER contains ribosomes. Rough ER is involved in protein synthesis and transfer.

Protein synthesis takes place in ribosomes attached on wall of ER. Newly formed protein enters within the cavity of rough ER and follows following path:

Protein → Cavity of rough ER → Cavity of smooth ER → Golgi membrane → Lysosomes or transport vesicles or secretory granules.

2. The fixation of CO_2 in C_4 plants takes place in two places and by two different organic compounds. Phosphoenol pyruvate (PEP) is found in mesophyll cells which primarily fixes atmospheric CO_2 into oxaloacetic acid (4C).

RUBISCO is present in bundle sheath cells where final fixation of CO_2 in hexose sugars takes place. CO_2 is primarily fixed by PEP carboxylase because this enzyme has greater affinity to CO_2 than RUBISCO.

3. Histone proteins are basic proteins and are used in packing of eukaryotic (absent in prokaryotes) DNA. DNA and histones together comprise chromatin, forming bulk of the eukaryotic chromosomes. Histones are of five major kinds H_1, H_{2A}, H_{2B}, H_3 and H_4. H_1 histones link neighbouring nucleosomes (fundamental packing units of an eukaryotic chromosome), while other are elements of nucleosome structure. During S-phase of cell cycle synthesis of histone proteins take place because at this stage number of chromosomes become double to that of somatic number.

4. Lichen is a symbiotic association between a fungus and an algae (green alga or blue green alga). The algal partner of lichen is called as phycobiont while fungal partner is termed as mycobiont. Lichen develops into a unique morphological form which is quite distinct from either partner. The fungal partner of lichen helps in the absorption of water and mineral to algal partner additionally it also provides protection and anchorage to algal partner of lichen. In exchange of this, the fungal partner absorbs prepared food material from algal partner. This food material is prepared by the algal partner of lichen through the process of photosynthesis.

5. At 40° North and South the heat gain through insolation approximately equal to the heat loss through terrestrial radiation.

6. TATA box is present in eukaryotic promoter region. It has a resemblance with pribnow box of prokaryotes. TATA box was identified by Dr. Hogness and so, it is also called as Hogness box. It is a 7 bp long region located 20 bp upstream to the start point. During the process of transcription the RNA polymerase (a holoenzyme which has a core unit and a sigma factor for proper initiation of transcription) binds to TATA box due to which DNA assumes a saddle like structure at this place.

7. Chloroplast, which is a cytoplasmic cell organelle finds only in eukaryotic plant cells. These structures help in the manufacture of food through, photosynthesis. Chlorophyll is a specialized light absorbing pigment which is found in the inner wall of granum. Each granum is a flat, sac like structure in which light reaction of photosynthesis takes place.

8. Wheat, rice and maize belongs to family Poaceae or Graminae. The main fruit type of these crops is caryopsis in which fruit wall is fused with seed coat. These crops are cultivated in all over the world and are contributed maximum to global food grain production.

9. Mitochondria are the eukaryotic cell organelles (do not present in prokaryotic cells). These originate from pre-existing mitochondria only. Mitochondria are also known as semi autonomous organelles because they contain a circular, double stranded DNA molecule, RNA and 70 S type of ribosomes. The genes, located outside of nucleus (*i.e.*, within the cytoplasm) also governes some traits, are referred to as plasmogenes or cytoplasmic genes.

Cytoplasmic male sterility (*i.e.*, dominance of female cytoplasmic genes over male) is due to plasmogenes located in mitochondrial DNA (*mt* DNA).

10. DNA ase (or deoxyribonuclease) or simply nuclease is an enzyme which breaks down DNA by hydrolysis of the phosphodiester bonds of its sugar-phosphate back-bone. Depending on the position of hydrolysing phosphodiester bonds, nucleases are of two types:

(i) Endonucleases (ii) Exonucleases.

Endonucleases hydrolyse internal phosphodiester bonds in a polynucleotide chain (*i.e.*, DNA). While exonucleases hydrolyse terminal phosphodiester bonds in a polynucleotide chain (*i.e.*, DNA).

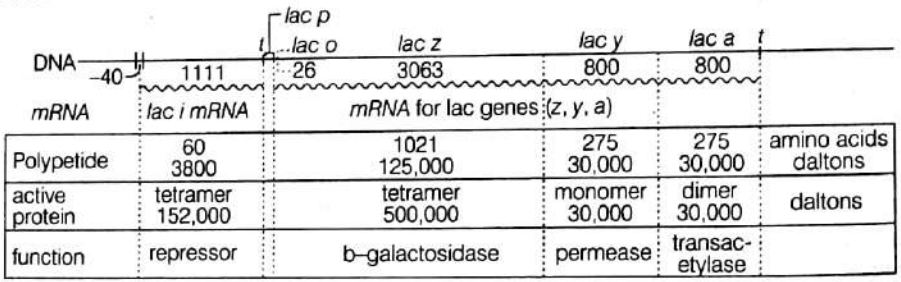
11.

	Column I	Column II
A.	Peritrichous flagella (flagella all over the body)	*Escherichia coli* (a bacterium)
B.	Living fossil	*Ginkgo biloba* (maidan hair tree)
C.	Rhizophore (a form of aerial adventitious roots)	*Selaginella* (a pteridophyte)
D.	Smallest flowering plant	Wolffia
E.	Largest perennial algae	*Macrocystes*

12. Norman Borlaug is associated with green revolution. The green revolution means an increase in the production of crops particularly cereal crops. Such as wheat, rice and maize.

13. Marginal notches in *Kalanchoe* and *Bryophyllum* possess adventitious buds in their leaves for vegetative propagation.

14. Lac operon is a cluster of genes encoding three proteins that bacteria use to obtain energy from the sugar lactose. There are three structural genes in lac operon.



Polypetide	60 3800	1021 125,000	275 30,000	275 30,000	amino acids daltons
active protein	tetramer 152,000	tetramer 500,000	monomer 30,000	dimer 30,000	daltons
function	repressor	b–galactosidase	permease	transac-etylase	

(i) **Lac Z** (3063 bp) : This gene codes for the enzyme β galactosidase which breaks lactose into glucose and galactose to be utilized in the cell. Therefore, *E.coli* cells with a mutated Z genes of the lac operon can not grow in medium containing only lactose as the source of energy because they cannot synthesize functional β-galactosidase.

(ii) **Lac Y** (800 bp) : It codes for β galactose permease enzyme which is a membrane bound protein and helps in transport of metabolites.

(iii) **Lac A** (800 bp) : It codes for β galactose transacetylase an enzyme that transfers an acetyl group from acetyl Co-A to β-galactosidase.

15. Cycads is a group of gymnosperms, which have top shaped multiciliated male gametes (largest male gamete) and the each mature seed of these plants contain one embryo and two cotyledons (dicotyledonous) eg, *Cycas*.

16. Three fourth surface of earth (about 71% of total) is occupied by oceans which contain 97.5% of total water. This is marine water with about 3.5% salt contents. Rest water *i.e.*, 2.5% is freshwater, which occurs on land. Most amount of this water (about 1.97%) occurs as frozen ice caps and glaciers and 0.5% freshwater occurs as ground water.

17. Solar energy is not responsible for green house effect instead it is a source of energy for the plants and animals. Green plants prepare their food by the use of this solar energy. CO_2 gas is mainly responsible for green house effect. Excess of this gas forms a thick layer around the earth and prevents re-radiation of entering sun rays to atmosphere. Thus functions like the glass panels of a green house (or the glass windows of a motor car). This is so called green house effect.

18. Gene flow means the spread of genes through populations as affected by movements of individual and their propagules *e.g.*, spores, seeds etc. Gene flow ensures that all populations of a given species share a common gene pool *i.e.*, it reduces difference between populations. The interruption of gene flow between populations is a pre-requisite for the formation of new species.

19. A Botanical garden is a collection of various types of living plants. *Ex situ* conservation means conservation of plants or animals in the artificial habitats, which are quite similar to the normal habitats of these organisms. In this way botanical gardens provide *ex situ* conservation of germplasm.

20. According to the US office of technology assessment (1987) "biological diversity is the variety among living organisms and the ecological complexes in which they occur". Biodiversity act of India was passed by the Parliament in the year of 2002.

21. In glycolysis 4 ATP and 2 $NADH_2$ molecules are formed. These 2 $NADH_2$ molecules go to electron transport chain.

In oxidative decarboxylation no ATP molecule is formed but two molecules of $NADH_2$ are formed from two molecules of pyruvate. These two $NADH_2$ go to electron transport chain. In Krebs cycle 2 ATP, 6 $NADH_2$ and 2 $FADH_2$ molecules are formed from two molecule of acetyl *Co*-A. These $NADH_2$ and $FADH_2$ go to electron transport chain. In electron transport chain all $NADH_2$ and $FADH_2$ pass to electron carriers and yield 3 ATP and 2 ATP molecules per $NADH_2$ and $FADH_2$ respectively.

Thus,

4 ATP are formed in glycolysis

2 ATP in Krebs cycle and

34 ATP from electron transport chain

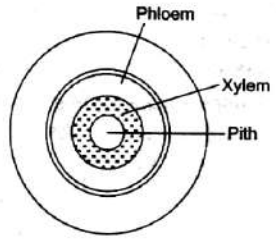
40 ATP

2 ATP molecules are used during glycolysis.

So, net gain of ATP molecules during one complete oxidation of a glucose molecule is 38 ATP.

22. In the ectophloic siphonostele the xylem surrounds pith and this xylem is surrounded by phloem, pericycle and endoderm is respectively.

e.g., *Osmunda* and *Equisetum*.



Ectophloic Siphonostele

23. The edible part of the fruit of litchi is juicy aril. Aril is an accessory seed covering formed by an outgrowth at the base of the ovule.

24. Some photosynthetic bacteria such as *Rhodopseudomonas* can prepare carbohydrates. But during this type of food synthesis O_2 does not evolved because in this case hydrogen donor is other than H_2O. Algae (green and blue green) and all green plant cells prepare their food (carbohydrate) through photosynthesis.

Here, hydrogen ions are donated by water molecules by the process of photolysis of water *i.e.*, O_2 is released during this type of food synthesis.

25. In Kyoto protocol (Dec. 1997), it was determined that the climatic changes due to green house gases will be lower down till 2012.

26. Micronutrients are minerals obtained from the soil and present in plant tissues at concentrations usually less than 3μ mol g^{-1} dry matter. Cu (copper), Mn (manganese) and Fe (iron) are those micronutrients, which affect both photosynthesis and mitochondrial electron transport because they are the main constituents of various electron carriers.

27. Chemiosmotic hypothesis for oxidative phosphorylation (ATP synthesis) was proposed by Peter Mitchell in 1961 for this he was awarded Noble Prize in 1978. This theory is based on proton gradient.

28. Apomixis does not involve gamete formation and fertilization as found in amphimixis. Adventive embryo formation is a type of apomixis in which embryos are formed from diploid integumental or nucellar cells.

29. Egg apparatus is present towards the micropylar end of an ovule. Egg apparatus has two lateral synergid cells and one centrally located egg cell. During entry of pollen tube within the ovule synergid cells become disintegrate and provide path for entry of pollen tube within the chamber of embryo sac.

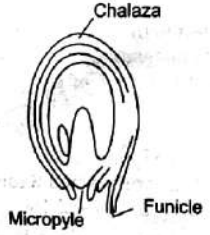
30. Prairies contain tall grasses and shrubs:

Savanna—*Acacia* trees

Tundra—Permafrost

Coniferous forest—Evergreen trees.

31. In an amphitropous ovule, the embryo sac becomes horse-shoe shaped and the funiculus and micropyle are close to each other. This type of ovule is found in Alismaceae, Butamaceae families.



32. Evaporation of water in the form of vapours from aerial parts of a living plant is known as transpiration. Measurement of transpiration can be done with the help of potometer. It works on the principle of amount of water absorbed equals the amount of water transpired.

33. Primary tissues are those meristematic tissues, which are derived directly from embryonal tissues.

e.g., shoot apex and root apex:

34. Plates having streptomycin allow to propagate only those bacteria, which are resistant to the antibiotic.

35. Gamma rays (from cobalt 60) is generally used for induced mutation in crop plants.

36. Scientists perform test cross to find out the different types of gametes or the genotype of an unknown individual. Test cross is performed always between the F_1 heterozygous plants and pure recessive (homozygous) parent plant. So, in the given case AaBb should be crossed with aabb.

37. Vivipary is the condition when seeds germinate on the plant. It is an undesirable character for annual crop plants because germinated seeds cannot be stored under normal conditions for the next season.

38. Bioinsecticides are those biological agents, which are used to control harmful insects. A bacterium, *Bacillus thuringiensis* is used for this purpose. Spores of this bacterium produce the insecticidal cry-protein. Therefore, spores, of this bacterium kill larvae of certain insects. The commercial preparations of *B. thuringiensis* contain a mixture of spores, cry-protein and an inert carrier.

39. The cosmic rays, X-rays, UV-rays, the visible spectrum, infra red rays, radio waves, coming from sun are constituted electromagnetic spectrum. The waves of each of these types have a characteristic range of wavelengths. The visible spectrum, which is also known as Photosynthetic Active Radiation (PAR), has a range of wavelength of 380 nm to 760 nm. This part of electromagnetic spectrum is responsible for photosynthesis.

40. Generally seeds of rice do not have vitamin-A, but golden rice, which is developed through genetic engineering has the high vitamin-A content.

Solved Paper 2008

JIPMER
Medical Entrance Exam

Physics

1. For inelastic collision between two spherical rigid bodies
(a) the total kinetic energy is conserved
(b) the total mechanical energy is not conserved
(c) the linear momentum is not conserved
(d) the linear momentum is conserved

2. We consider a thermodynamic system. If ΔU represents the increase in its internal energy and W the work done by the system, which of the following statements is true ?
(a) $\Delta U = -W$ in an adiabatic process
(b) $\Delta U = W$ in an isothermal process
(c) $\Delta U = -W$ in an isothermal process
(d) $\Delta U = W$ in an adiabaitc process

3. Aerofils are so designed that the speed of air
(a) on top side is more than on lower side
(b) on top side is less than on lower side
(c) is same on both sides
(d) is turbulent

4. The time of reverberation of a room A is one second. What will be the time (in seconds) of reverberation of a room, having all the dimensions double of those of room A?
(a) 2 (b) 4
(c) $\frac{1}{2}$ (d) 1

5. In refraction, light waves are bent on passing from one medium to the second medium, because, in the second medium
(a) the frequency is different
(b) the coefficient of elasticity is different
(c) the speed is different
(d) the amplitude is smaller

6. Which of the following circular rods, (given radius r and length l) each made of the same material and whose ends are maintained at the same temperature will conduct most heat?
(a) $r = 2r_0; l = 2l_0$ (b) $r = 2r_0; l = l_0$
(c) $r = r_0; l = l_0$ (d) $r = r_0; l = 2l_0$

7. For a satellite moving in an orbit around the earth, the ratio of kinetic energy to potential energy is
(a) 2 (b) $\frac{1}{2}$
(c) $\frac{1}{\sqrt{2}}$ (d) $\sqrt{2}$

8. 300 J of work is done in sliding a 2 kg block up an inclined plane of height 10 m. Taking $g = 10\ m/s^2$, work done against friction is
(a) 200 J (b) 100 J
(c) zero (d) 1000 J

9. Interference was observed in an interference chamber when air was present. Now, the chamber is evacuated and if the same light is used, a careful observation will show
(a) no interference
(b) interference with bright band
(c) interference with dark bands
(d) interference in which breadth of the fringe will be slightly increased

10. When a charged particle moving with velocity $\vec{v}$ is subjected to a magnetic field of induction $\vec{B}$, the force on it is non-zero. This implies that
(a) angle between $\vec{v}$ and $\vec{B}$ is necessarily 90°
(b) angle between $\vec{v}$ and $\vec{B}$ can have any value other than 90°
(c) angle between $\vec{v}$ and $\vec{B}$ can have any value other than zero and 180°
(d) angle between $\vec{v}$ and $\vec{B}$ is either zero or 180°

11. A particle moves along a straight line OX. At a time t (in second) the distance x (in metre) of the particle from O is given by

$$x = 40 + 12t - t^3$$

How long would the particle travel before coming to rest?

(a) 24 m (b) 40 m
(c) 56 m (d) 16 m

12. Which one of the following statements is true?

(a) Both light and sound waves in air are transverse
(b) The sound waves in air are longitudinal while the light waves are transverse
(c) Both light and sound waves in air are longitudinal
(d) Both light and sound waves can travel in vacuum

13. When power is drawn from the secondary coil of the transformer, the dynamic resistance

(a) increases
(b) decreases
(c) remains unchanged
(d) changes erratically

14. Pressure of an ideal gas is increased by keeping temperature constant. What is the effect on kinetic energy of molecules?

(a) Increase (b) Decrease
(c) No change (d) Can't be determined

15. What maximum frequency can be reflected from ionosphere?

(a) 5 MHz (b) 6 GHz
(c) 5 kHz (d) 500 MHz

16. A telescope has focal length of objective and eye-piece as 200 cm and 5 cm respectively. What is magnification of telescope?

(a) 40 (b) 80
(c) 50 (d) 0.01

17. A small disc of radius 2 cm is cut from a disc of radius 6 cm. If the distance between their centres is 3.2 cm, what is the shift in the centre of mass of the disc?

(a) 0.4 cm (b) 2.4 cm
(c) 1.8 cm (d) 1.2 cm

18. Hydrogen bomb is based upon

(a) fission
(b) fusion
(c) chemical reaction
(d) transmutation

19. What is not true for equipotential surface for uniform electric field?

(a) Equipotential surface is flat
(b) Equipotential surface is spherical
(c) Electric lines are perpendicular to equipotential surface
(d) Work done is zero

20. A closed organ pipe of length 20 cm is sounded with tuning fork in resonance. What is the frequency of tuning fork? ($v = 332$ m/s)

(a) 300 Hz (b) 350 Hz
(c) 375 Hz (d) 415 Hz

21. The displacement of particle is given by

$$x = a_0 + \frac{a_1 t}{2} - \frac{a_2 t^2}{3}$$

What is its acceleration?

(a) $\frac{2a_2}{3}$ (b) $-\frac{2a_2}{3}$
(c) a_2 (d) Zero

22. The area of the acceleration-displacement curve of a body gives

(a) impulse
(b) change in momentum per unit mass
(c) change in KE per unit mass
(d) total change in energy

23. The speed of earth's rotation about its axis is ω. Its speed is increased to x times to make the effective acceleration due to gravity equal to zero at the equator. Then x is

(a) 1 (b) 8.5
(c) 17 (d) 34

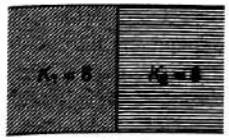
24. Hard X-rays for the study of fractures in bones should have a minimum wavelength of 10^{-11} m. The accelerating voltage for electrons in X-ray machine should be

(a) < 124 kV
(b) > 124 kV
(c) between 60 kV and 70 kV
(d) = 100 kV

25. In photoelectric effect, the electrons are ejected from metals if the incident light has a certain minimum

(a) wavelength (b) frequency
(c) amplitude (d) angle of incidence

26. A capacitor having capacitance 1 μF with air, is filled with two dielectrics as shown. How many times capacitance will increase?



(a) 12 (b) 6
(c) 8/3 (d) 3

26. A leaf which contains only green pigments, is illuminated by a laser light of wavelength 0.6328 μm. It would appear to be

(a) brown (b) black
(c) red (d) green

28. The operation of a nuclear reactor is said to be critical, if the multiplication factor (k) has a value

(a) 1 (b) 1.5
(c) 2.1 (d) 2.5

29. A galvanometer having a resistance of 8 Ω is shunted by a wire of resistance 2 Ω. If the total current is 1 A, the part of it passing through the shunt will be

(a) 0.25 A (b) 0.8 A
(c) 0.2 A (d) 0.5 A

30. Flash light equipped with a new set of batteries, produces bright white light. As the batteries wear out

(a) the light intensity gets reduced with no change in its colour
(b) light colour changes first to yellow and then red with no change in intensity
(c) it stops working suddenly while giving white light
(d) colour changes to red and also intensity gets reduced

31. If alpha, beta and gamma rays carry same momentum, which has the longest wavelength?

(a) Alpha rays
(b) Beta rays
(c) Gamma rays
(d) None, all have same wavelength

32. When you make ice cubes, the entropy of water

(a) does not change
(b) increases
(c) decreases
(d) may either increase or decrease depending on the process used

33. Half-lives of two radioactive substances A and B are respectively 20 min and 40 min. Initially the samples of A and B have equal number of nuclei. After 80 min the ratio of remaining number of A and B nuclei is

(a) 1 : 16 (b) 4 : 1
(c) 1 : 4 (d) 1 : 1

34. Given that $y = A \sin\left[\left(\frac{2\pi}{\lambda}(ct - x)\right)\right]$, where y and x are measured in metre. Which of the following statements is true?

(a) The unit of λ is same as that of x and A
(b) The unit of λ is same as that of x but not of A
(c) The unit of c is same as that of $\frac{2\pi}{\lambda}$
(d) The unit of $(ct - x)$ is same as that of $\frac{2\pi}{\lambda}$

35. A projectile is thrown in the upward direction making an angle of 60° with the horizontal direction with a velocity of 147 ms^{-1}. Then the time after which its inclination with the horizontal is 45°, is

(a) 15 s (b) 10.98 s
(c) 5.49 s (d) 2.745 s

36. A motor cycle is going on an overbridge of radius R. The driver maintains a constant speed. As the motor cycle is ascending on the overbridge, the normal force on it

(a) increases
(b) decreases
(c) remains the same
(d) fluctuates erratically

37. If we throw a body upwards with velocity of 4 m/s, at what height does its kinetic energy reduce to half of the initial value? (Take $g = 10$ ms^{-2})

(a) 4 m (b) 2 m
(c) 1 m (d) 0.4 m

38. Two glass plates are separated by water. If surface tension of water is 75 dyne/cm and area of each plate wetted by water is 8 cm^2 and the distance between the plates is 0.12 mm, then the force applied to separate the two plates is

(a) 10^2 dyne (b) 10^4 dyne
(c) 10^5 dyne (d) 10^6 dyne

39. Which of the following is true for rays coming from infinity?



(a) Two images are formed
(b) Continuous image is formed between focal points of upper and lower lens
(c) One image is formed
(d) None of the above

40. The north pole of a long horizontal bar magnet is being brought closer to a vertical conducting plane along the perpendicular direction. The direction of the induced current in the conducting plane will be
(a) horizontal (b) vertical
(c) clockwise (d) anticlockwise

Chemistry

1. Plaster of paris is
(a) $CaSO_4 \cdot \frac{1}{2} H_2O$ (b) $CaSO_4 \cdot 2H_2O$
(c) $CaSO_4 \cdot H_2O$ (d) $CaSO_4 \cdot 4H_2O$

2. The most stable compound is
(a) LiF (b) LiCl
(c) LiBr (d) LiI

3. Heavy water is
(a) $CaSO_4$
(b) water contain $CaSO_4$, $MgSO_4$
(c) D_2O
(d) water contain $CaCO_3$

4. When copper reacts with hot and conc. H_2SO_4, gives
(a) H_2 (b) N_2
(c) O_2 (d) SO_2

5. BaO_2 and ozone reacts to produce
(a) Ba (b) Ba_2O_3
(c) BaO (d) $Ba(OH)_3$

6. Heisenberg uncertainty principle can be explained as
(a) $\Delta x \geq \frac{\Delta P \times h}{4\pi}$ (b) $\Delta x \times \Delta P \geq \frac{h}{4\pi}$
(c) $\Delta x \times \Delta P \geq \frac{h}{\pi}$ (d) $\Delta P \geq \frac{\pi h}{\Delta x}$

7. A gas mixture contains O_2 and N_2 in the ratio of 1 : 4 by weight. The ratio of their number of molecules is
(a) 1 : 8 (b) 1 : 4
(c) 3 : 16 (d) 7 : 32

8. Bleaching powder is obtained by treating Cl_2 with
(a) $Ca(OH)_2$ (b) CaO
(c) $CaCO_3$ (d) $CaCl_2$

9. The de-Broglie wavelenght of a particle with mass 1 kg and velocity 100 m/s is
(a) 6.6×10^{-33} m (b) 6.6×10^{-36} m
(c) $3.3 \times 10^{+33}$ m (d) 3.3×10^{-36} m

10. The volume of a gas measured at 27°C and 1 atm pressure is 10 L. To reduce the volume to 2 L at 1 atm pressure, the temperature required is
(a) 60 K (b) 75 K
(c) 150 K (d) 225 K

11. The number of moles of oxygen obtained by the electrolytic decomposition of 108 g water is
(a) 2.5 (b) 3
(c) 5 (d) 7.5

12. The change in entropy for the fusion of 1 mole of ice is [mp of ice = 273 K, molar enthalpy of fusion for ice = 6.0 kJ mol^{-1}]
(a) 11.73 JK^{-1} mol^{-1}
(b) 18.84 JK^{-1} mol^{-1}
(c) 21.97 JK^{-1} mol^{-1}
(d) 24.47 JK^{-1} mol^{-1}

13. Which does not give a precipitate with $AgNO_3$ solution ?
(a) $[Co(NH_3)_6]Cl_3$ (b) $[Co(NH_3)_5Cl]Cl_2$
(c) $[Co(NH_3)_4Cl_2]Cl$ (d) $[Co(NH_3)_3Cl_3]$

14. Total volume of atoms present in a face centred cubic unit cell of a metal is (r is atomic radius)
(a) $\frac{16}{3}\pi r^3$ (b) $\frac{20}{3}\pi r^3$
(c) $\frac{24}{3}\pi r^3$ (d) $\frac{12}{3}\pi r^3$

15. Pure silicon doped with phosphorus is a
(a) metallic conductor
(b) insulator
(c) n-type semiconductor
(d) p-type semiconductor

16. Neutron is discovered by
(a) Chadwick (b) Rutherford
(c) Yukawa (d) Dalton

17. What is X in the following nuclear reaction ?
$${}_7N^{14} + {}_1H^1 \longrightarrow {}_8O^{15} + X$$
(a) ${}_0n^1$ (b) ${}_{-1}e^0$
(c) ${}_{+1}e^0$ (d) γ

18. Solubility product of $PbCl_2$ at 298 K is 1×10^{-6}. At this temperature solubility of $PbCl_2$ in mol/L is
(a) $(1 \times 10^{-6})^{1/2}$ (b) $(1 \times 10^{-6})^{1/3}$
(c) $(0.25 \times 10^{-6})^{1/3}$ (d) $(2.5 \times 10^{-6})^{1/2}$

19. The pH of a 0.001 M solution of HCl is
(a) 0 (b) 3
(c) 5 (d) 10

20. Gold number is associated with
(a) amount of gold (b) protective colloids
(c) purple of cassius (d) electrophoresis

21. Noble gases are used in discharge tubes to give different colours. Reddish-orange glow is due to
(a) Ar (b) Ne
(c) Xe (d) Kr

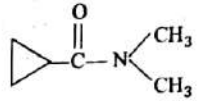
22. The set representing the correct order for first ionisation potential is
(a) K > Na > Li (b) Be > Mg > Ca
(c) B > C > N (d) Ge > Si > C

23. Dry ice is
(a) solid CO_2 (b) solid camphor
(c) solid SO_2 (d) solid NO_2

24. Methanol and ethanol are miscible in water due to
(a) covalent character
(b) hydrogen bonding character
(c) oxygen bonding character
(d) None of the above

25. Stereoisomers differ in
(a) configuration
(b) conformation
(c) they do not differ
(d) None of the above

26. IUPAC name of the following compound



(a) N, N-dimethylcyclopropane carboxamide
(b) N-methylcyclopropanamide
(c) cyclopropionamide
(d) None of the above

27. The product of following reaction is
$$2CH_3MgBr + CH_2O \longrightarrow$$
(a) CH_3OH (b) C_2H_5OH
(c) CH_4 (d) C_2H_6

28. Freon used as refrigerant is
(a) $CF_2 = CF_2$ (b) CH_2F_2
(c) CCl_2F_2 (d) CF_4

29. Lucas reagent is
(a) anhy. $ZnCl_2$ and NH_3
(b) anhy. $ZnCl_2$ and $CaCl_2$
(c) anhy. $ZnCl_2$ and conc. HCl
(d) anhy. $ZnCl_2$ and HCl gas

30. The enzyme which can catalyse the conversion of glucose to ethanol is
(a) zymase (b) invertase
(c) maltase (d) diastase

31. When dihydroxy acetone reacts with HIO_4, the product is/are
(a) HCHO
(b) HCOOH
(c) HCHO and HCOOH
(d) HCHO and CO_2

32. Which of the following does not reduce Fehling's solution?
(a) Benzaldehyde (b) Formic acid
(c) Glucose (d) Fructose

33. Sodium formate on heating gives
(a) oxalic acid and H_2
(b) sodium oxalate and H_2
(c) sodium oxalate
(d) CO_2 and caustic soda

34. Reaction of ethyl formate with excess of CH_3MgI followed by hydrolysis gives
(a) n-propyl alcohol
(b) isopropyl alcohol
(c) acetaldehyde
(d) acetone

35. Hydrolysis of phenyl isocyanide forms
(a) benzoic acid (b) formic acid
(c) acetic acid (d) None of these

36. Styrene can be purified by
(a) simple distillation
(b) fractional distillation
(c) steam distillation
(d) vacuum distillation

37. Which of the following is not reducing sugar ?
(a) Glucose (b) Fructose
(c) Lactose (d) Sucrose

38. The monomer of teflon is
(a) $CHF = CH_2$ (b) $CF_2 = CF_2$
(c) $CHCl = CHCl$ (d) $CHF = CHCl$

39. The hybridisation state of carbon in fullerene is
(a) sp (b) sp^2
(c) sp^3 (d) sp^3d

40. A fruity smell is produced by the reaction of C_2H_5OH with
(a) CH_3COCH_3 (b) CH_3COOH
(c) PCl_5 (d) CH_3CHO

Zoology

1. Moulting hormone is secreted by
(a) corpora cardiacum
(b) corpora allata
(c) neurosecretory hormone
(d) prothoracic gland

2. Movements by pseudopodia of *Amoeba* are due to change in
(a) pressure (b) atmosphere
(c) temperature (d) viscosity

3. From outer to inside the sequence of three bones present in the middle ear of mammals is
(a) malleus, stapes and incus
(b) stapes, malleus and incus
(c) malleus, incus and stapes
(d) incus, malleus and stapes

4. The reabsorption of water in the kidney is under the control of
(a) LH (b) ADH
(c) STH (d) ACTH

5. *Yersinia pestis* is responsible for
(a) syphilis (b) whooping cough
(c) plague (d) leprosy

6. Protein present in silk fibre is
(a) casein (b) keratin
(c) elastin (d) fibroin

7. Ovulation takes place in a month between
(a) 11-14 day (b) 14-16 day
(c) 15-28 day (d) 21-26 day

8. In sea anemone, the symmetry is
(a) radial (b) bilateral
(c) spherical (d) absent

9. Compound squamous epithelium is found in
(a) stomach (b) intestine
(c) trachea (d) pharynx

10. Solenocytes are associated with
(a) respiration (b) digestion
(c) excretion (d) nutrition

11. The cavity of diencephalon is known as
(a) I ventricle (b) II ventricle
(c) III ventricle (d) iter

12. Which vitamin should not be stored ?
(a) Calciferol (b) Retinol
(c) Niacin (d) Ascorbic acid

13. Connecting link between annelids and molluscs is
(a) *Neopilina* (b) *Peripatus*
(c) *Periplaneta* (d) *Limulus*

14. Shell of molluscs is derived from
(a) foot (b) mantle
(c) ctenidia (d) placoid

15. Pneumatic bones are expected to be found in
(a) house lizard (b) flying fish
(c) pigeon (d) tadpole of frog

16. A man of 'A' blood group marries a woman of 'AB' blood group. Which type of progeny would indicate that man is heterozygous ?
(a) O (b) B
(c) A (d) AB

17. Balbiani rings are the structural features of
(a) allosomes
(b) polytene chromosomes
(c) autosomes
(d) Lampbrush chromosomes

18. Presence of tail in a child is an example of
(a) atavism
(b) divergent evolution
(c) convergent evolution
(d) mutation

19. Action potential is generated by
(a) Na^+ (b) K^+
(c) Ca^+ (d) Cl^-

20. Aqueous and vitreous humour are divided by
(a) lens (b) iris
(c) retina (d) optic nerve

21. Indian rhinoceros are protected in
(a) Gir Forest
(b) Kaziranga National Park
(c) Bandipur National Park
(d) Ranthambore National Park

22. Mitotic spindle have main protein
(a) tubulin (b) myosin
(c) tropomyocin (d) dynein

23. Accessory sexual character in female is promoted by
(a) androgen (b) progesterone
(c) estrogen (d) testosterone

24. X-linked recessive gene is
(a) always expressed in male
(b) always expressed in female
(c) lethal
(d) sub lethal

25. Ligament is mainly made up of
(a) reticulin (b) elastin
(c) myosin (d) collagen

26. Secretion of pancreatic juice is stimulated by
(a) gastrin (b) secretin
(c) enterogasteron (d) enterokinase

27. Crossing over occurs in
(a) zygotene (b) leptotene
(c) pachytene (d) diplotene

28. Mesozoic era is Golden period of
(a) reptiles (b) Mollusca
(c) fishes (d) amphibians

29. Hamburger shift is also known as
(a) bicarbonate shift
(b) chloride shift
(c) potassium shift
(d) All of the above

30. "Bundle of His" are
(a) nervous tissue supplied to ventricles
(b) nervous tissue supplied to heart
(c) muscular tissue supplied to ventricle
(d) muscular tissue supplied to heart

31. Cell theory was proposed by
(a) Virchow
(b) Schleiden and Schwann
(c) Robert Hooke
(d) B McClintock

32. Who for the first time developed electron microscope ?
(a) Knoll and Ruska
(b) Rudolf and Kolliker
(c) Robert Hooke
(d) Swanson

33. Repressor protein is produced by
(a) regulator gene (b) operator gene
(c) structural gene (d) promotor gene

34. Autonomic nervous system affects
(a) reflex actions
(b) sensory organs
(c) internal organ
(d) None of these

35. Schizogony occurs in
(a) RBC of human
(b) intestine of parasite
(c) liver of human
(d) liver of parasite

36. Gases found in primitive atmosphere are
(a) CH_4, NH_3, H_2, H_2O (vapour form)
(b) CH_4, NH_3, CO_2, H_2O
(c) CH_4, H_2O, CO_2
(d) CH_4, O_2, CO_2

37. Sertoli cells are found in testis. These cells are
(a) nurse cell
(b) reproductive cell
(c) receptor cell
(d) None of the above

38. After a deep inspiration and maximum expiration, the capacity of lungs is known as
(a) vital capacity (b) tidal volume
(c) IRV (d) ERV

39. Which one is the sweetest sugar ?
(a) Glucose (b) Fructose
(c) Sucrose (d) Maltose

40. Species can be identified on the basis of
(a) interbreed
(b) species diversity
(c) reproductive isolation
(d) None of the above

Botany

1. In Whittaker's system of classification, prokaryotes belong to the kingdom
(a) Monera (b) Protista
(c) Animalia (d) Fungi

2. Water bloom is generally caused by
(a) green algae (b) blue-green algae
(c) bacteria (d) *Hydrilla*

3. Which one of the following is a saprophytic bryophyte ?
(a) *Riccia fluitans*
(b) *Buxbaumia aphylla*
(c) *Funaria hygrometrica*
(d) *Sphagnum*

4. A genophore is made up of
(a) a single double stranded DNA
(b) a single stranded DNA
(c) RNA and histones
(d) histones and non-histones

5. Iodine is obtained from
(a) *Laminaria* (b) *Chlorella*
(c) *Polysiphonia* (d) *Porphyra*

6. Covered smut of barley is caused by
(a) *Ustilago hordei*
(b) *Tilletia caries*
(c) *Ustilago nuda*
(d) *Colletotrichum falcatum*

7. Root hair absorbs water from soil through
(a) turgor pressure (b) ion exchange
(c) osmosis (d) DPD

8. In CAM plants, CO_2 acceptor is
(a) RuBP (b) PEP
(c) OAA (d) PGA

9. Which one of the following is a natural growth inhibitor ?
(a) NAA (b) ABA
(c) IAA (d) GA

10. Apical dominance is caused by
(a) auxin (b) gibberellin
(c) kinetin (d) ABA

11. Growth of pollen tube towards embryo sac is
(a) geotropism
(b) thigmotaxis
(c) chemotaxis
(d) All of these

12. Ozone depletion in stratosphere would result in
(a) forest fires
(b) global warming
(c) skin cancer incidence
(d) None of the above

13. Which of the following is a test cross ?
(a) Tt × tt (b) TT × tt
(c) Tt × Tt (d) tt × tt

14. 1 : 2 : 1 phenotypic and genotypic ratio is found in
(a) complementary genes
(b) blending inheritance
(c) multiple alleles
(d) pseudo alleles

15. The back bone of RNA consists of which of the following sugar ?
(a) Deoxyribose (b) Ribose
(c) Sucrose (d) Maltose

16. Stop codons are
(a) AUG, GUG (b) UAA, UGA, UAG
(c) UAC, UGG (d) AGU, AGA, UAC

17. A lake with nutrients is called
(a) trophic (b) euphotic
(c) oligotrophic (d) eutrophic

18. Which of the following is not caused by deficiency of mineral ?
(a) Chlorosis
(b) Etiolation
(c) Shortening of internodes
(d) Necrosis

19. Retrovirus have genetic material
(a) DNA only
(b) RNA only
(c) DNA or RNA only
(d) either DNA or RNA only

20. DCMU
(a) inhibits PS-I
(b) inhibits PS-II
(c) destroy chloroplast
(d) inhibits oxidative phosphorylation

21. According to Kyoto protocol the major nations abide to reduce concentration of green house gases by
(a) 2008 (b) 2010
(c) 2012 (d) 2018

22. Ginger is an underground stem. It is distinguished from root because
(a) it lacks chlorophyll
(b) it stores food
(c) it has nodes and internodes
(d) it has xylem and vessels

23. During DNA replication in prokaryotes DNA is anchored to
(a) chromosome (b) mesosome
(c) nucleolus (d) ribosome

24. The mineral present in cell wall is
(a) Na (b) Ca
(c) K (d) Mg

25. Male gamete in angiosperm is produced by
(a) generative cell
(b) microspore cell
(c) vegetative cell
(d) tube cell

26. Meristematic tissue in vascular bundle is
(a) phellem
(b) procambium
(c) interfascicular cambium
(d) fascicular cambium

27. Study of Ecology of population is called
(a) Autecology (b) Synecology
(c) Ecotype (d) Demecology

28. Which of the following plant is LDP ?
(a) *Xanthium* (b) Soybean
(c) Wheat (d) Tobacco

29. Which of the following is used as a best genetic vector in plants ?
(a) *Bacillus thurengiensis*
(b) *Agrobacterium tumifaciens*
(c) *Pseudomonas putida*
(d) All of the above

30. One gene-one enzyme hypothesis of Beadle and Tatum was experimentally proved on
(a) *Saccharomyces*
(b) *Neurospora crassa*
(c) *Lathyrus odoratus*
(d) *Claviceps*

31. Which of the following is not a pyrimidine ?
(a) Thymine (b) Uracil
(c) Guanine (d) Cytosine

32. Which organelle is present in higher number in secretory cells ?
(a) Dictyosome (b) ER
(c) Lysosome (d) Vacuole

33. Bio-indicators are used for
(a) oxygen demand
(b) air pollution
(c) mineral present
(d) All of the above

34. What happened when we inoculated *Rhizobium* in wheat field ?
(a) No increase in production (nitrogen content of soil remains same)
(b) A lot of increase in production (nitrogen content of soil increases)
(c) Fertility of soil decreases
(d) Fertility of soil increases

35. Nitrifying bacteria are able to
(a) convert atmospheric nitrogen into soluble forms
(b) convert ammonia to nitrate
(c) ammonia to nitrogen
(d) nitrate to nitrogen

36. RNA is not found in
(a) chromosome (b) plasmalemma
(c) nucleolus (d) ribosome

37. Systema Naturae was written by
(a) Linnaeus (b) Aristotle
(c) Hippocrates (d) Darwin

38. Number of chromosomes in an angiospermic plant is 14, then the number of chromosomes in synergid cells will be
(a) 14 (b) 7
(c) 28 (d) 21

39. Phytochrome is present in
(a) vascular cryptogam
(b) prokaryotes
(c) flowering plants
(d) algae

40. Vessels and companion cells are found in
(a) angiosperm
(b) pteridophytes
(c) bryophytes
(d) thallophytes

General English

Directions (Q. 1-5) : *In each of the following questions, choose the alternative which best expresses the meaning of the given idiom/phrase.*

1. To throw dust in one's eyes
   (a) To show false things
   (b) To make blind
   (c) To harm someone
   (d) To deceive

2. To be rolling in money
   (a) Wasting a lot of money
   (b) Very rich
   (c) Borrowing money liberally
   (d) Spending more than his income

3. To get into hot waters
   (a) To be impatient
   (b) To suffer a huge financial loss
   (c) To get into trouble
   (d) To be in a confused state of mind

4. To save one's face
   (a) To hide oneself
   (b) To oppose
   (c) To evade disgrace
   (d) To say plainly

5. To wash one's dirty linen in public
   (a) To criticise one's nature in public
   (b) To quarrel in the open
   (c) To do some ugly work in public
   (d) To discuss dirty and scandalous matters of personal nature in the presence of strangers

Directions (Q. 6-10) : *Choose the correct alternative to fill in the blank.*

6. There was so much.....material in the speech that it was difficult to know what the speaker wanted to say.
   (a) banal (b) extraneous
   (c) superficial (d) variegated

7. Our flight was ..... from Jaipur to Agra airport.
   (a) deflected (b) shifted
   (c) diverted (d) reverted

8. His..... handling resulted in all that destruction and damage.
   (a) inept (b) skilful
   (c) sophisticated (d) uncouth

9. Rabindranath Tagore was a ..... writer of his times.
   (a) true (b) fantastic
   (c) profound (d) prolific

10. The manager tried hard to.....his men to return to work before declaring a lockout.
    (a) motivate (b) persuade
    (c) encourage (d) permit

Directions (Q. 11-15) : *In each of the following questions, rearrange the parts P, Q, R and S to make a proper sentence.*

11. Little
    (P) that he had been let down
    (Q) stood by all these years
    (R) did he realise
    (S) by a colleague whom he had
    (a) QSPR (b) QPSR
    (c) RPSQ (d) RSQP

12. It has been established that
    (P) Einstein was
    (Q) although a great scientist
    (R) weak in arithmetic
    (S) right from his school days
    (a) QPRS (b) QPSR
    (c) RQPS (d) SRPQ

13. The statement
    (P) therefore you must listen carefully
    (Q) what the speaker has said
    (R) in order to understand
    (S) will be made just once
    (a) RSPQ (b) SPQR
    (c) SPRQ (d) SRQP

14. Towards midnight
    (P) so that the sky was lighted with
    (Q) and the clouds drifted away
    (R) the rain ceased
    (S) the incredible lamp of stars
    (a) RPQS (b) RQPS
    (c) SPQR (d) SQPR

15. Without books
    (P) no cultured society is possible
    (Q) no fresh ideas are possible
    (R) and
    (S) without fresh ideas
    (a) PRSQ (b) QRSP
    (c) RSPQ (d) RSQP

Directions (Q. 16-20) : *In each of the following questions, a part of the sentence is italicised. Below each sentence, three possible substitutions for the italicised part are given. Choose the one which improves the italicised part. If none of the substitutions improves the italicised part, your answer is (d).*

16. Tell your leader that I grant him permission *of stay* in my kingdom.
    (a) for stay (b) about staying
    (c) to stay (d) No improvement

17. I was delighted to see *him fully recover*.
    (a) he full recovered
    (b) him fully recovered
    (c) his full recovery
    (d) No improvement

18. While we would like *that all Indian children* to go to school, we need to ponder why they do not.
    (a) all Indian children
    (b) that all the Indian children
    (c) if all the children of India
    (d) No improvement

19. *Scarcely had he left* when his friend came.
    (a) He had scarcely left
    (b) He had left scarcely
    (c) He scarcely had left
    (d) No improvement

20. Mr. Dewan has driven almost thrice *so far as* Mr. Gupta has.
    (a) as far (b) as far as
    (c) as much as (d) No improvement

Directions (Q. 21-25) : *In each of the following questions, choose the alternative which is most nearly the same in meaning to the word given in italics in the sentence.*

21. The prisoner has been *languishing* in the jail for the last many years.
    (a) enjoying (b) avoiding
    (c) suffering (d) convicted

22. Some people adopt excellent manners only to *camouflage* their real character.
    (a) project (b) hide
    (c) misrepresent (d) reveal

23. They *venerated* the old teacher.
    (a) humiliated (b) teased
    (c) respected (d) let go

24. Nobody has yet seen the *peregrination* of heavenly beings on earth.
    (a) visit (b) arrival
    (c) travelling (d) casting glance on

25. He did not make any attempt to *placate* her.
    (a) please (b) pacify
    (c) serve (d) satisfy

Directions (Q. 26-30) : *In each of the following questions, choose the alternative which is opposite in meaning to the word given in italics in the sentence.*

26. My uncle is very wealthy, but rather *parsimonious* in his habits.
    (a) extravagant (b) generous
    (c) careless (d) strict

27. I am somewhat *sceptical* about his claim.
    (a) optimistic (b) convinced
    (c) credulous (d) hopeful

28. His writings have been much *eulogised* by Indian scholars.
    (a) condemned (b) flouted
    (c) disapproved (d) disparaged

29. The boy was *accused* of theft.
    (a) liberated (b) impeached
    (c) exonerated (d) sentenced

30. This is not ideology but *pragmatic* language teaching.
    (a) impractical (b) improper
    (c) imperfect (d) impossible

Directions (Q. 31-35) : *In each of the following questions, choose the alternative which can be substituted for the given words/sentence.*

31. A man who is having the qualities of woman
    (a) Loquacious (b) Celibate
    (c) Effeminate (d) Epicurean

32. A word no longer in use
    (a) Exotic (b) Primitive
    (c) Obsolete (d) Ancient

33. A person who enters without any invitation
    (a) Burglar (b) Intruder
    (c) Thief (d) Vandal

34. The period between two reigns
    (a) Lapse (b) Interregnum
    (c) Anachronism (d) Intermission

35. Poem in short stanzas narrating a popular story
    (a) Ballet (b) Epic
    (c) Ballad (d) Sonnet

Directions (Q. 36-40) : *Read the following passage carefully and answer the questions given below it.*

Journalism combines writing with news gathering and interpretation. While the journalist's work obviously varies from newspaper to newspaper and from magazine to magazine, all journalists are as much research workers, as they are writers. They cannot write their news or feature stories, unless they locate it and research them first. They must be able to read the in-between lines of the main source-news and interpret that. A great many stories hunt the journalist, who rejects most of them. He carefully sorts and sifts those, taking only a relatively very small proportion of news, may be, coming from an unexpected source. A successful journalist may gather news to the tune of 100 percent but he can use them for his profession only 3-5 percent. He must be able to see or forecast to himself, the news of tomorrow or the day after, from the news of today; because newspapers want advance news or advance warning to give a good, exclusive and exhaustive coverage to anything of interest. But a real 'scoop' is a very rare event. And bogus scoops also bring disrepute to the newspaper.

36. According to the passage, a journalist's work includes
(a) writing
(b) news gathering
(c) sorting out the news
(d) All of the above

37. What, according to the passage, is the common characteristic of all journalists?
(a) They all write for the newspapers
(b) They all have to first probe into the news they gather
(c) They all make an adventure to find a worthy news
(d) They all can forecast future news

38. What is most important for a journalist?
(a) He must be able to interpret the news correctly
(b) He must know how to sort out the news
(c) He must be able to write effectively
(d) He must know how to gather the right news

39. What does the passage say about successful journalists?
(a) They reject a major portion of the gathered news
(b) They can use a relatively small portion of the news
(c) Their news come from unexpected sources
(d) They present advance news

40. What is the basic requisite for exclusive and exhaustive coverage of newspapers?
(a) Forecast of tomorrow's news from today's news
(b) Collecting the news of a 'real scoop'
(c) Selection of a small portion of the gathered news
(d) Effective style of writing

Answers

PHYSICS

1. (d)	2. (a)	3. (a)	4. (a)	5. (c)	6. (b)	7. (b)	8. (b)	9. (d)	10. (c)
11. (c)	12. (b)	13. (a)	14. (c)	15. (a)	16. (a)	17. (a)	18. (b)	19. (b)	20. (d)
21. (b)	22. (c)	23. (c)	24. (a)	25. (b)	26. (b)	27. (b)	28. (a)	29. (b)	30. (d)
31. (d)	32. (c)	33. (c)	34. (a)	35. (c)	36. (a)	37. (d)	38. (c)	39. (a)	40. (c)

CHEMISTRY

1. (a)	2. (a)	3. (c)	4. (d)	5. (c)	6. (b)	7. (d)	8. (a)	9. (b)	10. (a)
11. (b)	12. (c)	13. (d)	14. (a)	15. (c)	16. (a)	17. (d)	18. (c)	19. (b)	20. (b)
21. (b)	22. (b)	23. (a)	24. (b)	25. (a)	26. (a)	27. (b)	28. (c)	29. (c)	30. (a)
31. (d)	32. (d)	33. (b)	34. (c)	35. (b)	36. (d)	37. (d)	38. (b)	39. (b)	40. (b)

ZOOLOGY

1. (d)	2. (d)	3. (c)	4. (b)	5. (c)	6. (d)	7. (b)	8. (a)	9. (d)	10. (c)
11. (c)	12. (d)	13. (a)	14. (b)	15. (c)	16. (b)	17. (b)	18. (a)	19. (a)	20. (a)
21. (b)	22. (a)	23. (c)	24. (a)	25. (d)	26. (b)	27. (c)	28. (a)	29. (b)	30. (c)
31. (b)	32. (a)	33. (a)	34. (c)	35. (c)	36. (a)	37. (a)	38. (a)	39. (b)	40. (c)

BOTANY

1. (a)	2. (b)	3. (b)	4. (a)	5. (a)	6. (a)	7. (c)	8. (b)	9. (b)	10. (a)
11. (c)	12. (c)	13. (a)	14. (b)	15. (b)	16. (b)	17. (d)	18. (b)	19. (b)	20. (b)
21. (c)	22. (c)	23. (b)	24. (b)	25. (a)	26. (d)	27. (d)	28. (c)	29. (b)	30. (b)
31. (c)	32. (a)	33. (d)	34. (a)	35. (b)	36. (b)	37. (a)	38. (b)	39. (c)	40. (a)

GENERAL ENGLISH

1. (d)	2. (b)	3. (c)	4. (c)	5. (d)	6. (c)	7. (c)	8. (a)	9. (c)	10. (b)
11. (c)	12. (a)	13. (c)	14. (b)	15. (b)	16. (c)	17. (b)	18. (a)	19. (d)	20. (b)
21. (c)	22. (b)	23. (c)	24. (c)	25. (b)	26. (a)	27. (b)	28. (a)	29. (c)	30. (a)
31. (c)	32. (c)	33. (b)	34. (b)	35. (c)	36. (d)	37. (b)	38. (a)	39. (b)	40. (a)

Hints & Solutions

Physics

1. In an inelastic collision, the particles do not regain their shape and size completely after collision. Some fraction of mechanical energy is retained by the colliding particles in the form of deformation potential energy. Thus, the kinetic energy of particles no longer remains conserved. However in the absence of external forces, law of conservation of linear momentum still holds good.

2. An isothermal process is a constant temperature process. In this process,

$$T = \text{constant or } \Delta T = 0.$$

$$\therefore \quad \Delta U = nC_V \Delta T = 0$$

An adiabatic process is defined as one with no heat transfer into or out of a system. Therefore,

$$Q = 0$$

From first law of thermodynamics

$$W = -\Delta U$$

or $$\Delta U = -W$$

3. The aerofils are so designed that

$$P_{\text{upper side}} < P_{\text{lower side}}$$

so that the aerofils get a lifting force in upward direction.

According to Bernoulli's theorem, where the pressure is large, the velocity will be minimum or *vice-versa*.

Thus, $v_{\text{upper side}} > v_{\text{lower side}}$

4. Sabine formula for reverberation time is

$$T = \frac{0.16\,V}{\Sigma aS}$$

where V is volume of hall in m^3.

$\Sigma aS = a_1S_1 + a_2S_2 + \ldots$

= total absorption of the hall (room)

Here, S_1, S_2, S_3 ..... are surface areas of the absorbers and a_1, a_2, a_3 ..... are their respective absorption coefficients.

$$\therefore \quad \frac{T'}{T} = \frac{V'}{S'} \times \frac{S}{V} = \frac{(2)^3}{(2)^2} = \frac{8}{4} = 2$$

Hence, $T' = 2T = 2 \times 1 = 2$ s

5. When a ray of light travels from one medium to second medium, it bends. If first medium is rarer and second medium is denser, it bends towards the normal while if first medium is denser and second medium is rarer, it bends away from the normal. This bending is due to refractive index of second medium with respect to first.

The refractive index is related to the speed of light in the two media as below :

$$_1\mu_2 = \frac{\text{speed of light in first medium}}{\text{speed of light in second medium}}$$

or speed of light in second medium

$$= \frac{\text{speed of light in first medium}}{{}_1\mu_2}$$

where $_1\mu_2$ is refractive index of second medium relative to the first medium.

Hence, we see that on passing through another medium speed of light changes.

6. Heat conduction through a rod is given by

$$H = \frac{\Delta Q}{\Delta t} = KA\left(\frac{T_1 - T_2}{l}\right)$$

$$\Rightarrow \quad H \propto \frac{r^2}{l} \qquad \ldots(i)$$

(a) When $r = 2r_0; l = 2l_0$

$$H \propto \frac{(2r_0)^2}{2l_0}$$

$$\Rightarrow \quad H \propto \frac{2r_0^2}{l_0}$$

(b) When $r = 2r_0; l = l_0$

$$H \propto \frac{(2r_0)^2}{l_0}$$

$$\Rightarrow \quad H \propto \frac{4r_0^2}{l_0}$$

(c) When $r = r_0; l = l_0$

$$H \propto \frac{r_0^2}{l_0}$$

(d) When $r = r_0; l = 2l_0$

$$H \propto \frac{r_0^2}{2l_0}$$

It is obvious that heat conduction will be more in case (b).

7. **Key Idea** *Kinetic energy of satellite is half of its potential energy.*

Potential energy of satellite

$$U = -\frac{GM_em}{R_e}$$

where R_e is radius of earth, M_e the mass of earth, m the mass of satellite and G the gravitational constant.

$$|U| = \frac{GM_em}{R_e}$$

Kinetic energy of satellite

$$K = \frac{1}{2}\frac{GM_em}{R_e}$$

Thus, $$\frac{K}{|U|} = \frac{1}{2}\frac{GM_em}{R_e} \times \frac{R_e}{GM_em} = \frac{1}{2}$$

8. Net work done in sliding a body up to a height h on inclined plane

= Work done against gravitational force + Work done against frictional force

$$\Rightarrow \quad W = W_g + W_f \qquad \ldots(i)$$

but $$W = 300 \text{ J}$$

$$W_g = mgh = 2 \times 10 \times 10 = 200 \text{ J}$$

Putting in Eq. (i), we get

$$300 = 200 + W_f$$

$$\Rightarrow \quad W_f = 300 - 200 = 100 \text{ J}$$

9. When chamber is evacuated, the refractive index (μ) decreases. Therefore, wavelength $\left(\lambda \propto \frac{1}{\mu}\right)$ increases.

Now, fringe width is given by

$$\beta = \frac{\lambda D}{d}$$

$$\Rightarrow \quad \beta \propto \lambda$$

Therefore, as wavelength increases, the fringe width will increase.

10. When a charged particle q is moving in a uniform magnetic field $\vec{B}$ with velocity $\vec{v}$ such that angle between $\vec{v}$ and $\vec{B}$ be θ, then due to interaction between the magnetic field produced due to moving charge and magnetic force applied, the charge q experiences a force which is given by

$$F = qvB \sin\theta$$

If $\theta = 0°$ or $180°$, then $\sin\theta = 0$

$$\therefore \quad F = qvB \sin\theta = 0$$

Since, force on charged particle is non-zero, so angle between $\vec{v}$ and $\vec{B}$ can have any value other than zero and 180°.

Note : Force experienced by the charged particle is Lorentz force.

11. **Key Idea** *Speed is rate of change of distance.*

Distance travelled by the particle is

$$x = 40 + 12t - t^3$$

We know that, speed is rate of change of distance *i.e*, $v = \frac{dx}{dt}$

$$\therefore \quad v = \frac{d}{dt}(40 + 12t - t^3)$$

$$= 0 + 12 - 3t^2$$

but final velocity $v = 0$

$$\therefore \quad 12 - 3t^2 = 0$$

or $$t^2 = \frac{12}{3} = 4$$

or $$t = 2\text{s}$$

Hence, distance travelled by the particle before coming to rest is given by

$$x = 40 + 12(2) - (2)^3$$

$$= 40 + 24 - 8 = 64 - 8$$

$$= 56 \text{ m}$$

12. In a longitudinal wave, the particles of the medium oscillate about their mean or equilibrium position along the direction of propagation of the wave itself. Sound waves are longitudinal in nature. In transverse wave, the particles of the medium oscillate about their mean or equilibrium position at right angles to the direction of propagation of wave itself. Light waves being electromagnetic are transverse waves.

13. When the secondary coil circuit is open, the magnetic flux in the core is produced by the primary current only. When the secondary circuit is closed, the currents in the secondary coil also produce magnetic flux in the core but in opposite direction. This decreases the core flux and hence reduces the back emf produced in the primary coil. The source emf is now in excess of the back emf, more current is drawn in the primary coil. Hence, power factor is no longer zero. The power factor has increased or the phase difference is no longer 90°, *ie*, phase

difference has decreased. Thus, dynamic resistance has increased.

14. Kinetic energy of ideal gas depends only on its temperature. Hence, it remains constant whether its pressure is increased on decreased.

15. The ionosphere extends from a height of 80 km to 300 km. The refractive index of ionosphere is less than its free space value. That is, it behaves as a rarer medium. As we go deep into the ionosphere, the refractive index keeps on decreasing. The bending of beam (away from the normal) will continue till it reaches critical angle after which it will be reflected back. The different points on earth receive signals reflected from different depths of the ionosphere. There is a critical frequency f_c (5 to 100 MHz) beyond which the waves cross the ionosphere and do not return back to earth.

16. In relaxed eye state of telescope or when final image is formed at infinity, the magnification of telescope is given by

$$|M| = \frac{f_o}{f_e}$$

where f_o = focal length of objective = 200 cm

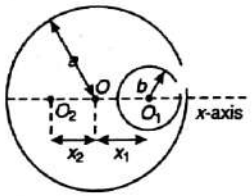
f_e = focal length of eye-piece = 5 cm

Hence, $|M| = \frac{200}{5} = 40$

Note : The aperture of the objective lens is kept large so that more and more rays coming from the heavenly body may enter the telescope and a bright image is formed by the objective lens. The aperture of the eye lens is kept comparatively small so that all the rays may enter the eye.

17. The situation can be shown as :

Let radius of complete disc is a and that of small disc is b. Also let centre of mass now shifts to O_2 at a distance x_2 from original centre.



The position of new centre of mass is given by

$$X_{CM} = \frac{-\sigma \cdot \pi b^2 \cdot x_1}{\sigma \cdot \pi a^2 - \sigma \cdot \pi b^2}$$

Here, $a = 6$ cm, $b = 2$ cm, $x_1 = 3.2$ cm

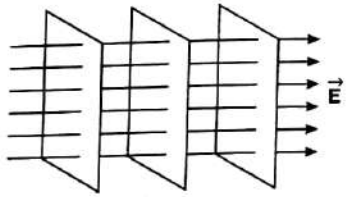
Hence, $X_{CM} = \frac{-\sigma \times \pi (2)^2 \times 3.2}{\sigma \times \pi \times (6)^2 - \sigma \times \pi \times (2)^2}$

$= \frac{12.8\pi}{32\pi}$

$= -0.4$ cm

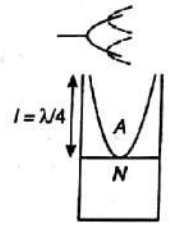
18. The working of hydrogen bomb is based on nuclear fusion. But for the process of nuclear fusion, a very high temperature ($\approx 10^7$ K) and a very high pressure is required, hence to construct a hydrogen bomb, first atom bomb is constructed. The atom bomb is then covered from all sides by an enclosure of a compound of heavy hydrogen (deuteron) such as lithium hydride. First the atom bomb is exploded which produces such a high temperature and pressure that deuteron nuclei get fused and a huge amount of energy is released.

19. An equipotential surface is a surface with a constant value of potential at all points on the surface. For a uniform electric field, say, along the x-axis, the equipotential surfaces are planes normal to the x-axis, *i.e*, plane parallel to the y-z plane. Equipotential surfaces for a dipole and its electric field lines are shown in figure.



As said above that on equipotential surface, potential at all points is constant, this means that on equipotential surface work done in moving a test charge from one point to other point is zero.

20. **Key Idea** *When length of air column is* $\frac{\lambda}{4}$, *then first resonance occurs.*



If we adjust the length of air-column in closed organ pipe as such its any natural frequency equals to the frequency of tuning fork, then the amplitude of forced vibrations of air-column increases very much. This is the state of resonance. At first resonance

$$l = \frac{\lambda}{4}$$

So, frequency of tuning fork

$$f = \frac{v}{\lambda} = \frac{v}{4l}$$

Given, $l = 20$ cm $= 0.2$ m, $v = 332$ m/s

Hence, $f = \frac{332}{4 \times 0.2} = 415$ Hz

21. **Key Idea** *Acceleration is the rate of change of velocity and velocity is the rate of change of displacement.*

The displacement equation is given by

$$x = a_0 + \frac{a_1 t}{2} - \frac{a_2 t^2}{3}$$

Velocity = rate of change of displacement

i.e, $v = \frac{dx}{dt}$

$= \frac{d}{dt}\left(a_0 + \frac{a_1 t}{2} - \frac{a_2 t^2}{3}\right)$

$= 0 + \frac{a_1}{2} - \frac{2a_2 t}{3}$

$= \frac{a_1}{2} - \frac{2a_2 t}{3}$

Acceleration = rate of change of velocity

i.e, $a = \frac{dv}{dt}$

$= \frac{d}{dt}\left(\frac{a_1}{2} - \frac{2a_2}{3} t\right)$

$= 0 - \frac{2a_2}{3}$

$= -\frac{2a_2}{3}$

22. Area of acceleration-displacement curve gives change in KE per unit mass.

$$\frac{1}{2} m(v^2 - u^2) = Fs = \frac{mdv}{dt} \times s$$

$\therefore$ $\frac{\text{Change in KE}}{\text{Mass}} = \frac{dv}{dt} \times s$

23. Earth rotates about its own axis in 24 h.

So, $T = 24 \times 60 \times 60$ s

So, angular speed of earth about its own axis

$$\omega = \frac{2\pi}{T} = \frac{2\pi}{24 \times 60 \times 60} \text{ rad/s}$$

At equator, $g' = g - R_e \omega'^2$

or $0 = g - R_e \omega'^2$

or $\omega' = \sqrt{\frac{g}{R_e}} = \frac{2\pi}{84.6 \times 60}$

$\therefore$ $\frac{\omega'}{\omega} = \frac{24 \times 60 \times 60}{84.6 \times 60} \approx 17$

$\Rightarrow$ $\omega' = 17\,\omega$

So, value of x is 17.

24. From conservation of energy the kinetic energy of electron equals the maximum photon energy (we neglect the work function ϕ because it is normally so small compared to eV_0).

$\therefore$ $eV_0 = h\nu_{max}$

or $eV_0 = \frac{hc}{\lambda_{min}}$

$\therefore$ $V_0 = \frac{hc}{e\lambda_{min}}$

or $V_0 = \frac{12400 \times 10^{-10}}{10^{-11}}$

$= 124$ kV

Hence, accelerating voltage for electrons in X-ray machine should be less than 124 kV.

25. In photoelectric effect for a given photosensitive material, there exists a certain minimum cut-off frequency, called the threshold frequency, below which no emission of photoelectrons takes place no matter how intense the light is.

26. **Key Idea** *After filling with dielectrics the two capacitors will be in parallel order.*

As shown, the two capacitors are connected in parallel. Initially the capacitance of capacitor



$$C = \frac{\varepsilon_0 A}{d}$$

where A is area of each plate and d is the separation between the plates.

After filling with dielectrics, we have two capacitors of capacitance.

$$C_1 = \frac{K_1 \varepsilon_0 (A/2)}{d} = \frac{8}{2}\frac{\varepsilon_0 A}{d} = \frac{4\varepsilon_0 A}{d} = 4C$$

and $C_2 = \frac{K_2\varepsilon_0(A/2)}{d} = \frac{4}{2}\frac{\varepsilon_0 A}{d} = \frac{2\varepsilon_0 A}{d} = 2C$

Hence, their equivalent capacitance

$$C_{eq} = C_1 + C_2$$
$$= 4C + 2C = 6C$$

ie, new capacitance will be six times of the original.

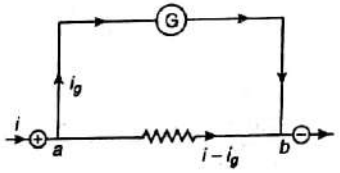
27. If an object reflects the colour of light incident on it, it will appear with that colour but if object absorbs the colour of light, it will appear to be black. Since, the given wavelength does not belong to green, so it will be absorbed by the leaf and hence, it would appear to be black.

28. The multiplication factor (k) is an important reactor parameter and is the ratio of number of neutrons present at the beginning of a particular generation to the number present at the beginning of the next generation. It is a measure of the growth rate of the neutrons in the reactor. For $k = 1$, the operation of the reactor is said to be critical.

Note : If k becomes greater than one, the reaction rate and the reactor power increase exponentially. Unless the factor k is brought down very close to unity, the reactor will become supercritical and can even explode.

29. **Key Idea** *Potential difference across galvanometer should be equal to potential difference across shunt.*

The shunt and galvanometer are connected as shown figure.



Let total current through the parallel combination is i, the current through the galvanometer is i_g and the current through the shunt is $i - i_g$.

The potential difference V_{ab} $(= V_a - V_b)$ is the same for both paths, so

$$i_g G = (i - i_g) S$$

or $$i_g (G + S) = i S$$

or $$\frac{i_g}{i} = \frac{S}{S+G}$$

The fraction of current passing through shunt

$$= \frac{i - i_g}{i} = 1 - \frac{i_g}{i}$$
$$= 1 - \frac{S}{S+G} = \frac{G}{S+G}$$
$$= \frac{8}{2+8} = \frac{8}{10}$$
$$= 0.8 \text{ A}$$

30. As batteries wear out, temperature of filament of flash light attains lesser value, therefore intensity of radiation reduces. Also dominating wavelength (λ_m) in spectrum, which is the red colour, increases.

31. On the basis of dual nature of light, Lious de-Broglie suggested that the dual nature is not only of light, but each moving material particle has the dual nature. He assumed a wave to be associated with each moving material particle which is called the matter wave. The wavelength of this wave is determined by the momentum of the particle. If p is the momentum of the particle, the wavelength of the wave associated with it is

$$\lambda = \frac{h}{p}$$

where h is Planck's constant.

Since, it is given that, alpha, beta and gamma rays carry same momentum, so they will have same wavelength.

32. The entropy function gives us a numerical measure of the irreversibility of a given process, *i.e,* it is a measure of disorder of a system. During formation of ice cubes orderedness increases, *i.e,* disorderness decreases, hence entropy decreases.

33. **Key Idea** *Total number of nuclei remained after n half-lives is* $N = N_0\left(\frac{1}{2}\right)^n$.

Total time given = 80 min

Number of half-lives of A, $n_A = \frac{80 \text{ min}}{20 \text{ min}} = 4$

Number of half-lives of B, $n_B = \frac{80 \text{ min}}{40 \text{ min}} = 2$

Number of nuclei remains undecayed

$$N = N_0\left(\frac{1}{2}\right)^n$$

where N_0 is initial number of nuclei.

$$\therefore \quad \frac{N_A}{N_B} = \frac{\left(\frac{1}{2}\right)^{n_A}}{\left(\frac{1}{2}\right)^{n_B}}$$

or $$\frac{N_A}{N_B} = \frac{\left(\frac{1}{2}\right)^4}{\left(\frac{1}{2}\right)^2} = \frac{\left(\frac{1}{16}\right)}{\left(\frac{1}{4}\right)}$$

or $$\frac{N_A}{N_B} = \frac{1}{4}$$

34. Here $\frac{2\pi}{\lambda}(ct - x)$ is dimensionless.

Hence, $\frac{ct}{\lambda}$ is also dimensionless and unit of ct is same as that of x. Therefore, unit of λ is same as that of x. Also unit of y is same as that of A, which is also the unit of x.

35. **Key Idea** *At the two points of the trajectory during projection, the horizontal component of the velocity is the same.*

Horizontal component of velocity at angle 60°

= Horizontal component of velocity at 45°

ie, $$u \cos 60° = v \sin 45°$$

or $$147 \times \frac{1}{2} = v \times \frac{1}{\sqrt{2}}$$

or $$v = \frac{147}{\sqrt{2}} \text{ m/s}$$

Vertical component of $u = u \sin 60°$

$$= \frac{147\sqrt{3}}{2} \text{ m}$$

Vertical component of $v = v \sin 45°$

$$= \frac{147}{\sqrt{2}} \times \frac{1}{\sqrt{2}} = \frac{147}{2} \text{ m}$$

but $$v_y = u_y + at$$

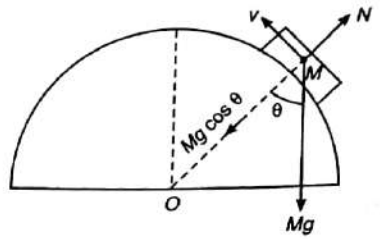
$$\therefore \quad \frac{147}{2} = \frac{147\sqrt{3}}{2} - 9.8t$$

or $$9.8t = \frac{147}{2}(\sqrt{3} - 1)$$

$$\therefore \quad t = 5.49 \text{ s}$$

36. Reaction of normal force on the motor cyclist

$$Mg \cos\theta - N = \frac{mv^2}{R}$$



or $$N = Mg \cos\theta - \frac{Mv^2}{R}$$

As the motor cyclist moves upward on the bridge, θ decreases and therefore, N increases and becomes maximum at the highest point.

37. **Key Idea** *At a given height the half of the kinetic energy of the body is equal to its potential energy.*

Initial kinetic energy of the body

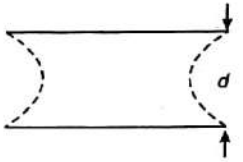
$$= \frac{1}{2}mv^2$$
$$= \frac{1}{2}m(4)^2 = 8m$$

Let at height h, the kinetic energy reduces to half, *ie,* it becomes 4 m. It is also equal to potential energy. Hence,

$$mgh = 4 \text{ m}$$

or $$h = \frac{4}{g} = \frac{4}{10} = 0.4 \text{ m}$$

38. The shape of water layer between the two plates is shown in the figure.



Thickness d of the film = 0.12 mm

= 0.012 cm

Radius R of the cylindrical face $= \frac{d}{2}$

Pressure difference across the surface

$$= \frac{T}{R} = \frac{2T}{d}$$

Area of each plate wetted by water = A

Force F required to separate the two plates is given by

F = pressure difference × area

$$= \frac{2T}{d} A$$

Putting the given values, we get

$$F = \frac{2 \times 75 \times 8}{0.012} = 10^5 \text{ dyne}$$

39. Since, lens is made of two layers of different refractive indices, for a given wavelength of light it will have two focal lengths or will form two images at two different points as there are μ's as

$$\frac{1}{f} \propto (\mu - 1)$$

40. The induced emf will oppose the motion of the magnet. Applying the right hand rule, the direction of induced current will be clockwise.

Chemistry

1. Calcium sulphate hemihydrate $\left(CaSO_4 \cdot \frac{1}{2} H_2O\right)$ is called plaster of paris.

2. The electronegativity of halogen is as :

$$F > Cl > Br > I$$

Among alkali metals the electropositive character increases as :

$$Li < Na < K < Rb < Cs$$

Hence, LiF is the most stable compound.

3. D_2O is called heavy water. It is used as moderator in nuclear reactor.

4. When copper reacts with hot and conc. H_2SO_4 SO_2 is produced.

$$Cu + 2H_2SO_4 \longrightarrow CuSO_4 + SO_2 + 4H_2O$$

5. BaO_2 and ozone reacts to produce BaO and oxygen.

$$BaO_2 + O_3 \longrightarrow BaO + 2O_2$$

6. According to Heisenberg uncertainty principle, the product of uncertainty in momentum (ΔP) and in position (Δx) remains constant.

$$\Delta x \times \Delta P \geq \frac{h}{4\pi}$$

7. ∵ The ratio of O_2 and N_2 by weight is 1 : 4.

∴ the ratio of O_2 and N_2 by moles $= \frac{1}{32} : \frac{4}{28}$

$= 7 : 32$

8. Bleaching powder is obtained by treating Cl_2 with lime water.

$$Ca(OH)_2 + Cl_2 \longrightarrow CaOCl_2 + H_2O$$

9. ∵ $\lambda = \frac{h}{mv} = \frac{6.6 \times 10^{-34}}{1 \times 100}$

$= 6.6 \times 10^{-36}$ m

10. Here $V_1 = 10$ L, $V_2 = 2$ L

$p_1 = 1$ atm, $p_2 = 1$ atm

$T_1 = 300$ K, $T_2 = ?$

$$\frac{p_1 V_1}{T_1} = \frac{p_2 V_2}{T_2}$$

$$\frac{1 \times 10}{300} = \frac{1 \times 2}{T_2}$$

$$T_2 = \frac{300 \times 2}{10} = 60 \text{ K}$$

11. $2H_2O \xrightarrow{\text{Electrolysis}} 2H_2 + O_2$

2 mol — 1 mol

2×18

= 36 g

∵ 36 g of H_2O produce 1 mole of oxygen

∴ 108 g of water will produce oxygen

$$= \frac{108}{36} = 3 \text{ mol}$$

12. Entropy change of fusion

$$\Delta S_f = \frac{\Delta H_f}{T}$$

$\Delta H_f = 60 \times 10^3$ J, mol^{-1}, $T = 273$ K

$$\Delta S_f = \frac{60 \times 10^3}{273}$$

$= 21.97$ J K^{-1} mol^{-1}

13. $[Co(NH_3)_3Cl_3]$ does not give a precipitate with $AgNO_3$ solution because in it all the chlorine atoms are attached by secondary valencies.

14. In fcc unic cell $z = 4$

Hence, occupied volume by sphere $= 4 \times \frac{4}{3} \pi r^3$

$$= \frac{16}{3} \pi r^3$$

15. Excess of one valence electron in P atom (5 valence electron) over Si (4 valence electron) will form *n*-type semiconductor.

16. Neutron is discovered by Chadwick.

17. $_7N^{14} + {}_1H^1 \longrightarrow {}_8O^{15} + g$

18. $PbCl_2 \rightleftharpoons \underset{s}{Pb^{2+}} + \underset{2s}{2Cl^-}$

$$K_{SP} = (S)(2S)^2$$

$$1 \times 10^{-6} = 4S^3$$

$$S = \left(\frac{1}{4} \times 10^{-6}\right)^{1/3}$$

$$= (0.25 \times 10^{-6})^{1/3}$$

19. $[H^+] = 0.001$

$$pH = -\log [H^+]$$

$$= -\log [10^{-3}]$$

$$= 3$$

20. The protective power of a colloid is expressed as gold number.

21. Noble gases are used in discharge tubes to give different colours. Reddish orange glow is due to Ne.

22. The IP decreases in a group on moving downward because atomic radius increases hence the correct order is :

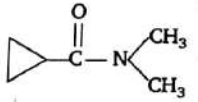
$$Be > Mg > Ca$$

23. Solid CO_2 is called ice because it changes to vapour state directly without changing to liquid state.

24. Methanol and ethanol are miscible in water due to hydrogen bonding character.

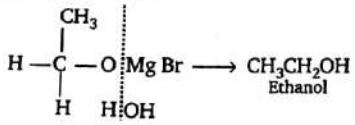
25. Stereoisomers are differ in configuration.

26.



N,N-dimethyl cyclopropane carboxamide.

27. $CH_3MgBr + HCHO \longrightarrow$



Ethanol

28. Freon is CCl_2F_2. It is used as refrigerant.

29. Anhy. $ZnCl_2$ and conc. HCl is called Lucas reagent. It is used to distinguish the primary, secondary and tertiary alcohol.

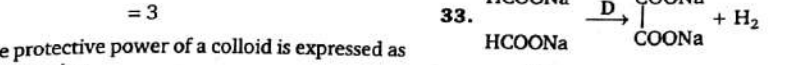
30. $C_6H_{12}O_6 \xrightarrow{\text{Zymase}} 2C_2H_5OH + CO_2$

31.

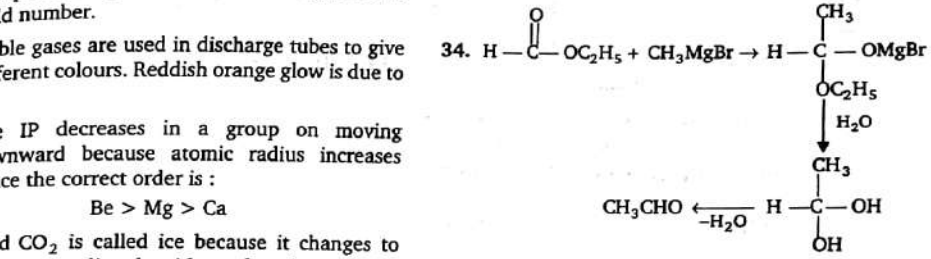


32. Fructose does not reduce Fehling's solution because it contains ketonic group.

33.



34.



35. Hydrolysis of phenyl isocyanide forms formic acid.

36. Styrene can be purified by vacuum distillation.

37. Sucrose is not a reducing sugar.

38. Tetrafluoroethene is the monomer of teflon.

$$nCF_2 \equiv CF_2 \xrightarrow{\text{Polymerisation}} \underset{\text{Teflon}}{\left(CF_2 - CF_2\right)_n}$$

39. The hybridisation state of carbon in fullerene is sp^2.

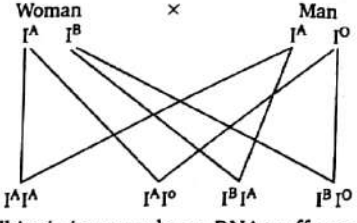
40. C_2H_5OH reacts with CH_3COOH and gives ethylethanoate. Which is an ester and it has fruity smell.

$$C_2H_5OH + CH_3COOH \xrightarrow{\text{conc. } H_2SO_4}$$

$$\underset{\substack{\text{Ester} \\ \text{(Fruity smell)}}}{CH_3COOC_2H_5} + H_2O$$

1. Prothoracic gland is also known as **moult gland** in some arthropods and Y organ or ventral gland in crustaceans. The prothoracic gland secretes moulting hormone called **ecdysone** or **ecdysome**, which is steroid and stimulates moulting or ecdysis during metamorphosis in insects.
2. Sol-gel theory of amoeboid movement was first given by **Hyman**, supported by **Pantin** (1923) and **Mast** (1926). According to this theory, amoeboid locomotion is due to change in the viscosity of cytoplasm.
3. The middle ear cavity in mammals characteristically contains a chain of three little bones or **ear ossicles** extending between the tympanic membrane and the fenestra ovalis. These are called from outside as the **malleus** (hammer), **incus** (anvil) and **stapes** (stirrup), so named because of their characteristic shapes.
4. **Antidiuretic hormone** (ADH) controls the tubular permeability and concentration of sodium in the extracellular fluid. It associates with the **renal pressure system** and then regulates the fluid volume of body through the agency of **hypothalamic osmoreceptors**.
5. Bubonic plague (black death) is caused by *Yersinia pestis* (formerly *Pasteurella pestis*) bacteria.
6. Silk fibre is formed of two proteins namely **fibroin** and **sericin**.
7. Ovulation is the release of the secondary oocyte from the ovary. In humans, ovulation occurs about 14 days before the onset of the next menstruation.
8. In radial symmetry, body can be divided into similar halves by more than two planes passing through the main axis.

   Cnidarians or coelenterates (like *Hydra*, sea anemone, *Aurelia*, *Obelia*) are radially symmetrical animals with cell-tissue grade of body organization.
9. In the structure of compound squamous epithelium, several layers of cells, deep layers are cuboidal to columnar, surface layers flat and scale-like. This epithelium founds in mouth, oesophagus, part of epiglottis (pharynx) and vagina. The main function of this epithelium is protection.
10. **Solenocytes** or flame cells are the excretory organs of phylum-Platyhelminthes.
11. Diencephalon is situated between the cerebral hemispheres above and midbrain below. Its cavity known as the **third ventricle** or diocoel is connected to each lateral ventricle of cerebral hemisphere by **foramen of Monro**, separately.
12. Vitamin-C (ascorbic acid) has virucidal property and its excess amount is excreted in urine.
13. *Neopilina* (mollusc) is considered connecting link between Annelida and Mollusca.
14. Molluscs are the soft bodied, unsegmented animals covered by a shell. In between the shell and body wall is a covering called **mantle**, which secretes the shell.
15. Bones of Aves (*eg*, pigeon) are pneumatic. Pneumatic bones contain air cavities to reduce weight. Pneumatic bones help in aerial mode of life.



17. Balbiani rings are large RNA puffs reported in the salivary gland chromosomes (polytene chromosome) of *Chironomus* insect during larval development.
18. Atavism is the phenomenon of appearance of ancestral character (not parental) in young ones after many generations, *eg*, presence of tail in a child.
19. Action potential refers to the electrical potential difference across an axon membrane, that is stimulated (action). Action potential is generated by Na^+.
20. Lens is a transparent, biconvex, elastic structure that bends light waves as they pass through its surfaces. The lens separates the aqueous and vitreous humours.

21. Rhino (*Rhinoceros unicomis*) are protected in Kaziranga National park. This park is situated in Assam.
22. Microtubules are unbranched, hollow, submicroscopic tubules, which form the structural material of cilia, flagella, basal bodies, **centrioles** and **spindle apparatus**. Microtubules are built up of protofilaments formed of two related proteins, α and β-tubulins.
23. **Estrogens** are secreted by cells of Graafian follicles. Estradiol is the principal feminizing estrogen. It stimulates the development of female secondary sex characteristics during puberty and maintains them through the reproductive years of adult life.
24. X-linked genes are represented twice in female and once in male. The recessive X-linked genes have characteristic criss-cross inheritance, *ie*, **male** transmits his X-linked recessive genes to his grandson through his daughter.
25. **Ligament** is tough cord or fibrous band of dense regular connective tissue that contains numerous parallel arrangements of **collagen fibres**. It connects bones or cartilages and serves to strengthen joints.
26. The secretion of pancreatic juice is stimulated by both **secretin** and **cholecystokinin** (CCK). These two hormones, however, are secreted in response to different stimuli and they have different effects on the composition of pancreatic juice.
27. Crossing over *ie*, exchange of segments between non-sister chromatids of homologous chromosome occurs in **pachytene** stage of prophase-I (meiosis-I).
28. The Mesozoic era is known as "Golden age of reptiles".
29. To maintain electrostatic neutrality of plasma, many chloride ions diffuse from plasma into RBCs and bicarbonate ions pass out. The chloride content of RBCs increases when oxygenated blood becomes deoxygenated. This is termed as **chloride shift** or **Hamburger shift**.
30. Bundle of His is a network of muscle fibres found in between two ventricles.
31. **M J Schleiden** and **T Schwann** (1838-1839) proposed cell theory.
32. **Knoll** and **Ruska** discovered electron microscope in 1932.
33. The regulator gene is responsible for the synthesis of a protein called **repressor**. The repressor may be active or inactive (aporepressor). The active repressor is normally seen in inducible systems while aporepressor is seen in repressible system. The repressor has an affinity for operator gene.
34. Autonomic nervous system controls and coordinates the involuntary activites of various internal organs. This system is divisible into two parts :

    (a) Sympathetic nervous system

    (b) Para-sympathetic nervous system.
35. **Schizogony** is stage in asexual reproduction of *Plasmodium* (malarial parasite) in which schizont is formed. From the human blood sporozoites enter the **liver cells**. The sporozoite grows in size to become a rounded schizont called cryptozoite. The latter divides to form cryptomerozoites (= merozoites). The merozoites are asexual haploid forms. The host liver cells rupture to liberate the cryptomerozoites into the liver sinusoids.
36. The primitive atmosphere was chiefly consisting of methane, ammonia, water vapour, hydrogen gas, nitrogen gas and some carbon monoxide and carbon dioxide.
37. Sertoli cells are found in testis. These cells nourish the developing sperms.
38. **Vital capacity** is the amount of air which one can inhale and exhale with maximum effort. It is the sum of tidal volume, inspiratory reserve volume and expiratory reserve volume.

$$VC = TV + IRV + ERV$$
$$= 500 + 3100 + 1200$$
$$= 4800 \text{ mL}$$

39. Fructose is the sweetest sugar. It is found in sweet fruits and in honey.
40. The prevention of inbreeding between the populations of two different species is known as **reproductive isolation**. Reproductive isolation leads to the origin of new species.

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Botany

1. In order to develop phylogenetic classification, R H Whittaker (1969), an American taxonomist, divided all the organisms into five kingdoms. Whittaker's five kingdoms are Monera, Protista, Fungi, Plantae and Animalia. Monera includes all prokaryotes mycoplasma, bacteria, Actinomycetes and cyanobacteria or blue-green algae.

2. Water blooms are formed by the growth of some microscopic or semi-microscopic algae such as *Anabaena, Arthrospira, Nodularia, Nostoc* etc. Water blooms may be harmful because they are indirectly responsible for fish mortality due to depletion of oxygen.

3. Bryophytes usually grow in moist and shady places. Some bryophytes grow in diverse habitats such as **aquatic** (*eg, Riccia fluitans*), **epiphytic** (*eg, Dendroceros* and many mosses) **saprophytic** (*eg, Buxbaumia aphylla*) and in **dry habitats** such as dry heaths (*eg, Polytrichum juniperinum*) deserts (*eg, Tortula desertorum*) and dry rocks (*eg, Porella platyphylla*).

4. Bacteria being prokaryotes, lack organized nucleus. Instead of a ring-shaped, double helical, double stranded, single DNA molecule is present. The incipient nucleus or primitive nucleus is named as nucleoid or genophore.

5. Brown algae such as *Laminaria, Macrocystis, Fucus* etc are the main source of iodine.

6. Covered smut of barley is caused by *Ustilago hordei.*

7. Root hair absorbs water from soil through osmosis. Osmosis is a special type of diffusion of a liquid, when solvent moves through a semipermeable membrane from a place of higher diffusion pressure to a place of lower diffusion pressure.

8. The process of photosynthesis in C_4-plants and CAM (Crassulacean Acid Metabolism) is same. But instead of spatial separation of initial PEP case fixation and final Rubisco fixation of CO_2, the two steps occur in same cell but at different times, night and day, *eg, Opuntia*, pineapple, *Vanilla*. PEP (Phosphoenol Pyruvate) is the first acceptor of CO_2 in CAM plants like C_4-plants.

9. ABA (Abscisic Acid) is a naturally occurring growth inhibitor in plants.

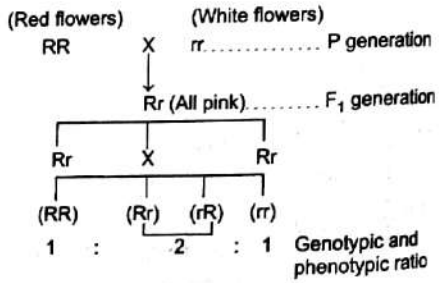
10. In many plants, as the apical bud grows, the growth of lower axillary buds is suppressed. Removal of apical bud results in the growth of lower buds. The auxin (IAA) of the terminal bud inhibits the growth of lateral buds. This phenomenon is known as **apical dominance**.

11. Chemotaxis is locomotory movement in response to presence of chemicals, *eg*, growth of pollen tube towards egg.

12. In the atmosphere (stratosphere), about 30 km above the surface of the earth, the ozone molecules (O_3) form an umbrella. It prevents the penetration of harmful ultra violet radiation from the sun and thus protects the life on earth. It is now feared that there is danger of depletion of the ozone layer. The prime suspects of ozone thining or depletion are chlorofluoro carbons (CFCs). Because it is odourless, invisible, that is why it is widely used in domestic refrigerators and cold storage facilities. It is calculated that the depletion of ozone layer by 1% results in an increase in the incidence of skin cancer by 5% to 7%.

13. A test cross is a cross between heterozygous F_1 hybrid and double recessive homozygous *eg*, Tt × tt to show whether F_1 is homozygous or heterozygous.

14. Incomplete dominance or blending inheritance was first seen in *Mirabilis jalapa* (4'O clock plant). Here, when red flowers are crossed with white flowers variety, the F_1 hybrid is pink and F_2 ratio is 1 red : 2 pink : 1 white.



15. The back bone of RNA is made up of ribose sugar (5-carbon) whereas DNA consists of deoxyribose sugar.

16. Three codons UAG, UAA and UGA are stop codons or non-sense codons. They do not code for any amino acid.

    AUG works as initiation codon in eukaryotes and prokaryotes. In rare case GUG also serves as initiation codon in bacterial protein synthesis.

    UAC coded for tyrosine, UGG coded for tryptophan, AGU coded for serine, AGA coded for argenine.

17. A lake with nutrients is called eutrophic.

18. **Etiolation** is the symptom developed by plants when grown in the dark. Examples include pale yellow or white colour due to lack of chlorophyll, long internodes, small and rudimentary leaves, poor development of lignified tissue.

19. Retrovirus is an RNA virus that infects animal cells and replicates by first being converted to double stranded DNA, with the enzyme reverse transcriptase. Retroviruses are enveloped Viruses. The HIV III (Human Immunodeficiency virus), which causes AIDS, is a retrovirus.

20. DCMU (Dichlorophenyl Dimethyl Urea) is a herbicide, which inhibits O_2 evolution and non-cyclic photophosphorylation, O_2 evolution and non-cyclic photophosphorylation both involve in PS-II.

21. International conference held in Kyoto, Japan obtained commitments from different, countries for reducing overall green house gas emissions at a level 5% below 1990 level by 2008-2012.

22. Underground stems can be differentiated from roots by (i) Absence of root cap (ii) Absence of root hair (iii) Presence of terminal bud (iv) Presence of nodes and internodes (v) Occurrence of foliage or scale leaves on the nodes.

23. On the plasma membrane of bacteria generally at mid point, there are present some circular coiled bodies called mesosomes. Mesosomes are more prominent in Gram +ve bacteria. Mesosomes receive DNA during conjugation and DNA replicaton enzyme.

24. Chemical composition of the cell wall is the following :
    (a) **Matrix** water—60%, hemicellulose—5-15%, pectic substance—2-8%, Lipids—0.5-3.0%, proteins—1-2%.
    (b) **Microfibrils** Cellulose/fungus cellulose—10-15%.
    (c) **Other Ingredients** lignin, cutin, suberin, silica, minerals (*eg*, iron, calcium, carbonate) waxes, tannins, resins, gum etc

25. In angiosperms, male gametophyte consists of a tube cell and generative cell which divides to form two male gametes.

26. The cambium present between the xylem and phloem of vascular bundle is called vascular cambium. It is a lateral meristem that gives rise to secondary xylem and phloem and occurs in the form of a thin strip. Vascular cambium is also called fascicular cambium.

27. The study of ecology of population is called Demecology.

28. Long Day Plants (LDP) require a photoperiod of more than a critical length, which may vary from 4 to 18 hours. The best flowering of long day plants usually occurs in continuous light. For flowering they require either no dark period or a very short dark period. Example of long day plants are wheat, maize, oats, spinach etc.

29. *Agrobacterium tumifaciens* is used as a best genetic vector in plants.

30. One gene-one enzyme theory was given by **Beadle** and **Tatum** in 1958, while they were working on red mould or *Neurospora crassa* (Ascomycetes fungus), which is also called *Drosophila* of plant kindgom.

31. The nitrogenous bases are of two types :
    (a) Pyrimidine base—cytosine, thymine
    (b) Purine base—adenine, guanine.
    These nitrogenous bases are found in DNA/RNA. Uracil is found in RNA in place of thymine.

32. Dictyosome or Golgi complex is present in higher number in secretory cells. All glandular cells depend upon Golgi complex for concentrating and pouring their secretion to outside.

33. Any organism, which can be used to characterize particular environmental properties is called **biological indicator**, *eg*, pollution oxygenation.

34. *Rhizobium* species is symbiotic nitrogen-fixing bacteria, which occurs in root nodules of legumes. When we inoculated *Rhizobium* in wheat field, there is no increase in production. Because wheat has no root nodules for fixing nitrogen content. Therefore, nitrogen content of soil will remain same.

35. Most of the ammonia produced in the soil is acted upon by nitrifying bacteria. Ammonia is changed to nitrate. The reaction occurs in two steps nitrite formation (*eg*, *Nitrosomonas*) and nitrate formation (*eg*, *Nitrobacter*).

36. RNA is not found in plasmalemma. Plasmalemma is the cell membrane which also lines the connecting plasmodesmata.

37. 'Systema Naturae' was written by Carolus Linnaeus. Linnaeus is called father of taxonomy.

38. 7, the number of chromosomes in root cells is $2n$ while it is n in synergids because it develops by reductional division.

39. Phytochrome is chromoprotein (photosensitive photoreceptor, blue pigment protein complex. Found in almost all flowering plants (angiosperms).

40. Angiosperms are those seed plants in which seeds are formed inside fruits and the sporophylls are organized into flower. In angiosperms, xylem contains vessels and phloem possesses sieve tubes and companion cells.

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PHYSICS

1. In radioactive decay process, the negatively charged emitted β-particles are
   (a) the electrons present inside the nucleus
   (b) the electrons produced as a result of the decay of neutrons inside the nucleus
   (c) the electrons produced as a result of collisions between atoms
   (d) the electrons orbiting around the nucleus

2. The maximum number of possible interference maxima for slit-separation equal to twice the wavelength in Young's double-slit experiment, is
   (a) infinite (b) five
   (c) three (d) zero

3. Two spherical conductors B and C having equal radii and carrying equal charges in them repel each other with a force F when kept apart at some distance. A third spherical conductor having same radius as that of B but uncharged, is brought in contact with B, then brought in contact with C and finally removed away from both. The new force of repulsion between B and C is
   (a) $\frac{F}{4}$ (b) $\frac{3F}{4}$
   (c) $\frac{F}{8}$ (d) $\frac{3F}{8}$

4. In gamma ray emission from a nucleus
   (a) both the neutron number and the proton number change
   (b) there is no change in the proton number and the neutron number
   (c) only the neutron number changes
   (d) only the proton number changes

5. A particle starting from the origin (0, 0) moves in a straight line in the (x, y) plane. Its coordinates at a later time are $(\sqrt{3}, 3)$. The path of the particle makes with the x-axis an angle of
   (a) 30° (b) 45°
   (c) 60° (d) 0°

6. A wheel has angular acceleration of 3.0 rad/s^2 and an initial angular speed of 2.00 rad/s. In a time of 2 s it has rotated through an angle (in radian) of
   (a) 6 (b) 10
   (c) 12 (d) 4

7. The resistance of an ammeter is 13 Ω and its scale is graduated for a current upto 100 A. After an additional shunt has been connected to this ammeter it becomes possible to measure currents upto 750 A by this meter. The value of shunt resistance is
   (a) 20 Ω (b) 2 Ω
   (c) 0.2 Ω (d) 2 kΩ

8. Under the influence of a uniform magnetic field a charged particle is moving in a circle of radius R with constant speed v. The time period of the motion
   (a) depends on v and not on R
   (b) depends on both R and v
   (c) is independent of both R and v
   (d) depends on R and not on v

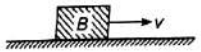
9. The primary and secondary coils of a transformer have 50 and 1500 turns respectively. If the magnetic flux ϕ linked with the primary coil is given by $\phi = \phi_0 + 4t$, where ϕ is in weber, t is time in second and ϕ_0 is a constant, the output voltage across the secondary coil is
   (a) 90 V (b) 120 V
   (c) 220 V (d) 30 V

10. The frequency of a light wave in a material is 2×10^{14} Hz and wavelength is 5000 Å. The refractive index of material will be
   (a) 1.40 (b) 1.50
   (c) 3.00 (d) 1.33

11. A car moves from X to Y with a uniform speed v_u and returns to Y with a uniform speed v_d. The average speed for this round trip is
(a) $\frac{2v_dv_u}{v_d+v_u}$ (b) $\sqrt{v_uv_d}$
(c) $\frac{v_dv_u}{v_d+v_u}$ (d) $\frac{v_u+v_d}{2}$

12. A particle executes simple harmonic oscillation with an amplitude a. The period of oscillation is T. The minimum time taken by the particle to travel half of the amplitude from the equilibrium position is
(a) $\frac{T}{4}$ (b) $\frac{T}{8}$
(c) $\frac{T}{12}$ (d) $\frac{T}{2}$

13. A block B is pushed momentarily along a horizontal surface with an initial velocity v. If μ is the coefficient of sliding friction between B and the surface, block B will come to rest after a time



(a) $\frac{v}{g\mu}$ (b) $\frac{g\mu}{v}$
(c) $\frac{g}{v}$ (d) $\frac{v}{g}$

14. Two radioactive substances A and B have decay constants 5λ and λ respectively. At $t = 0$ they have the same number of nuclei. The ratio of number of nuclei of A to those of B will be $\left(\frac{1}{e}\right)^2$ after a time interval
(a) $\frac{1}{4\lambda}$ (b) 4λ
(c) 2λ (d) $\frac{1}{2\lambda}$

15. A transformer is used to light a 100 W and 110 V lamp from a 220 V mains. If the main current is 0.5 A, the efficiency of the transformer is approximately
(a) 30% (b) 50%
(c) 90% (d) 10%

16. A charged particle (charge q) is moving in a circle of radius R with uniform speed v. The associated magnetic moment μ is given by
(a) $\frac{qvR}{2}$ (b) qvR^2
(c) $\frac{qvR^2}{2}$ (d) qvR

17. A steady current of 1.5 A flows through a copper voltameter for 10 min. If the electrochemical equivalent of copper is 30×10^{-5} g C^{-1}, the mass of copper deposited on the electrode will be
(a) 0.40 g (b) 0.50 g
(c) 0.67 g (d) 0.27 g

18. In a mass spectrometer used for measuring the masses of ions, the ions are initially accelerated by an electric potential V and then made to describe semicircular paths of radius R using a magnetic field B. If V and B are kept constant, the ratio $\left(\frac{\text{charge on the ion}}{\text{mass of the ion}}\right)$ will be proportional to
(a) $\frac{1}{R}$ (b) $\frac{1}{R^2}$
(c) R^2 (d) R

19. Three resistances P, Q, R each of 2Ω and an unknown resistance S form the four arms of a Wheatstone's bridge circuit. When a resistance of 6Ω is connected in parallel to S the bridge gets balanced. What is the value of S?
(a) 2Ω (b) 3Ω
(c) 6Ω (d) 1Ω

20. Two satellites of earth, S_1 and S_2, are moving in the same orbit. The mass of S_1 is four times the mass of S_2. Which one of the following statements is true?
(a) The time period of S_1 is four times that of S_2
(b) The potential energies of earth and satellite in the two cases are equal
(c) S_1 and S_2 are moving with the same speed
(d) The kinetic energies of the two satellites are equal

21. An observer moves towards a stationary source of sound, with a velocity one-fifth of the velocity of sound. What is the percentage increase in the apparent frequency?
(a) Zero (b) 0.5%
(c) 5% (d) 20%

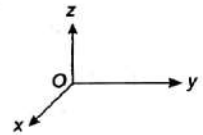
22. A coil of inductance 300 mH and resistance 2Ω is connected to a source of voltage 2 V. The current reaches half of its steady state value in
(a) 0.05 s (b) 0.1 s
(c) 0.15 s (d) 0.3 s

23. The refractive index of glass is 1.520 for red light and 1.525 for blue light. Let D_1 and D_2 be angles of minimum deviation for red and blue light respectively in a prism of this glass. then,
(a) $D_1 < D_2$
(b) $D_1 = D_2$
(c) D_1 can be less than or greater than D_2 depending upon the angle of prism
(d) $D_1 > D_2$

24. A particle of mass 100 g is thrown vertically upwards with a speed of 5 m/s. The work done by the force of gravity during the time the particle goes up is
(a) – 0.5 J (b) –1.25 J
(c) 1.25 J (d) 0.5 J

25. A mass of M kg is suspended by a weightless string. The horizontal force that is required to displace it until the string makes an angle of 45° with the initial vertical direction is
(a) $Mg(\sqrt{2}+1)$ (b) $Mg\sqrt{2}$
(c) $\frac{Mg}{\sqrt{2}}$ (d) $Mg(\sqrt{2}-1)$

26. A force of $-F\hat{\mathbf{k}}$ acts on O, the origin of the coordinate system. The torque about the point $(1, -1)$ is



(a) $F(\hat{\mathbf{i}}-\hat{\mathbf{j}})$ (b) $-F(\hat{\mathbf{i}}+\hat{\mathbf{j}})$
(c) $F(\hat{\mathbf{i}}+\hat{\mathbf{j}})$ (d) $-F(\hat{\mathbf{i}}-\hat{\mathbf{j}})$

27. If M_O is the mass of an oxygen isotope ${}_8O^{17}$, M_p and M_n are the masses of a proton and a neutron, respectively, the nuclear binding energy of the isotope is
(a) $(M_O - 8M_p)c^2$
(b) $(M_O - 8M_p - 9M_n)c^2$
(c) M_Oc^2
(d) $(M_O - 17M_n)c^2$

28. A sound absorber attenuates the sound level by 20 dB. The intensity decreases by a factor of
(a) 1000 (b) 10000
(c) 10 (d) 100

29. Which of the following parameters does not characterise the thermodynamic state of matter?
(a) Temperature (b) Pressure
(c) Work (d) Volume

30. A charged oil drop is suspended in unifor m field of 3×10^4 V/m so that it neither falls nor rises. The charge on the drop will be (Take the mass of the charge = 9.9×10^{-15} kg and $g = 10$ m/s^2)
(a) 3.3×10^{-18} C (b) 3.2×10^{-18} C
(c) 1.6×10^{-18} C (d) 4.8×10^{-18} C

31. Dimensions of resistance in an electrical circuit, in terms of dimension of mass M, of length L, of time T and of current I, would be
(a) $[ML^2T^{-3}I^{-1}]$ (b) $[ML^2T^{-2}]$
(c) $[ML^2T^{-1}I^{-1}]$ (d) $[ML^2T^{-3}I^{-2}]$

32. An alpha nucleus of energy $\frac{1}{2}mv^2$ bombards a heavy nuclear target of charge Ze. Then the distance of closest approach for the alpha nucleus will be proportional to
(a) v^2 (b) $1/m$
(c) $1/v^4$ (d) $1/Ze$

33. The work of 146 kJ is performed in order to compress one kilo mole of a gas adiabatically and in this process the temperature of the gas increases by 7°C. The gas is ($R = 8.3$ J mol^{-1} K^{-1})
(a) diatomic
(b) triatomic
(c) a mixture of monoatomic and diatomic
(d) monoatomic

34. Diwali rocket is ejecting 50 g of gases/s at a velocity of 400 m/s. The accelerating force on the rocket will be
(a) 22 dyne (b) 20 N
(c) 20 dyne (d) 100 N

35. A frame made of metallic wire enclosing a surface area A is covered with a soap film. If the area of the frame of metallic wire is reduced by 50%, the energy of the soap film will be changed by
(a) 100% (b) 75%
(c) 50% (d) 25%

36. Mercury boils at 367°C. However, mercury thermometers are made such that they can measure temperature upto 500°C. This is done by
(a) maintaining vacuum above mercury column in the stem of the thermometer
(b) filling nitrogen gas at high pressure above the mercury column

(c) filling oxygen gas at high pressure above the mercury column
(d) filling nitrogen gas at low pressure above the mercury column

37. In a laboratory four convex lenses L_1, L_2, L_3 and L_4 of focal lengths 2, 4, 6 and 8 cm, respectively are available. Two of these lenses form a telescope of length 10 cm and magnifying power 4. The objective and eye lenses are respectively
(a) L_2, L_3 (b) L_1, L_4
(c) L_1, L_2 (d) L_4, L_1

38. A symmetric double convex lens is cut in two equal parts by a plane perpendicular to the principal axis. If the power of the original lens is 4D, the power of a cut lens will be
(a) 2D (b) 3D
(c) 4D (d) 5D

39. For a metallic wire, the ratio $\frac{V}{i}$ (V = applied potential difference and i = current flowing) is
(a) independent of temperature
(b) increases as the temperature rises
(c) decreases as the temperature rises
(d) increases or decreases as temperature rises depending upon the metal

40. The potential energy of a molecule on the surface of a liquid compared to one inside the liquid is
(a) zero (b) lesser
(c) equal (d) greater

CHEMISTRY

1. Which of the following is not correct ?
(a) Hydrolysis of NCl_3 gives NH_3 and HOCl
(b) NH_3 is less stable than PH_3
(c) NH_3 is a weak reducing reagent compared to PH_3
(d) Nitric oxide in solid state exhibits diamagnetic property

2. SiO_2 is reacted with sodium carbonate. What is the gas liberated ?
(a) CO (b) O_2
(c) CO_2 (d) O_3

3. The compounds formed at anode in the electrolysis of an aqueous solution of potassium acetate, are
(a) C_2H_6 and CO_2 (b) C_2H_4 and CO_2
(c) CH_4 and H_2 (d) CH_4 and CO_2

4. Which of the following is not correct regarding the elecolytic preparation of H_2O_2 ?
(a) Lead is used as cathode
(b) 50% H_2SO_4 is used
(c) Hydrogen is liberated at anode
(d) Sulphuric acid undergoes oxidation

5. Which of the following is correct?
(a) The pH of one litre solution containing 0.49 g of H_2SO_4 is 2.0
(b) The conjugate base of H_2S is S^{2-}
(c) BF_3 is a Lewis base
(d) Phenolphthalein is colourless in basic medium

6. Which of the following is correct ?
(a) Catalyst undergoes permanent chemical change
(b) Particle size of solute in true solution is 10^{-3} m
(c) Starch solution is a hydrosol
(d) Hydrolysis of liquid ester in the presence of mineral acid is an example of heterogeneous catalysis reactions

7. In an oxidation-reduction reaction, MnO_4^- ion is converted to Mn^{2+}. What is the number of equivalents of $KMnO_4$ (mol. wt. = 158) present in 250 mL of 0.04 M $KMnO_4$ solution ?
(a) 0.02 (b) 0.05
(c) 0.04 (d) 0.07

8. Which of the following reagents converts both acetaldehyde and acetone to alkanes ?
(a) Ni/H_2 (b) $LiAlH_4$
(c) I_2/NaOH (d) Zn-Hg/conc. HCl

9. The heat of formation of $CO(g)$ and $CO_2(g)$ are $\Delta H = -110$ and $\Delta H = -393$ kJ mol^{-1} respectively. What is the heat of reaction (ΔH) (in kJ mol^{-1}) for the following reaction ?

$$CO(g) + \frac{1}{2}O_2(g) \longrightarrow CO_2(g)$$

(a) -504 (b) -142.5
(c) -283 (d) 504

10. What is the wavelength (in m) of a particle of mass 6.62×10^{-29} g moving with a velocity of 10^3 ms^{-1} ?
(a) 6.62×10^{-4} (b) 6.62×10^{-3}
(c) 10^{-5} (d) 10^5

11. What is the electrode potential (in V) of the following electrode at 25°C ?
Ni^{2+} (0.1 M) | Ni(s)
(Standard reaction potential of Ni^{2+} | Ni is -0.25V, $\frac{2.303RT}{F} = 0.06$)
(a) -0.28 V (b) -0.34 V
(c) -0.82 V (d) -0.22 V

12. What is the equation for the equilibrium constant (K_c) for the following reaction?

$$\frac{1}{2}A(g) + \frac{1}{3}B(g) \overset{T(K)}{\rightleftharpoons} \frac{2}{3}C(g)$$

(a) $K_c = \frac{[A]^{1/2}[B]^{1/3}}{[C]^{3/2}}$ (b) $K_c = \frac{[C]^{3/2}}{[A]^2[B]^3}$
(c) $K_c = \frac{[C]^{2/3}}{[A]^{1/2}[B]^{1/3}}$ (d) $K_c = \frac{[C]^{2/3}}{[A]^{1/2} + [B]^{1/3}}$

13. Which of the following can give a Grignard reagent when reacted with magnesium in dry ether ?
(a) C_2H_6 (b) C_2H_5Cl
(c) C_2H_5OH (d) C_2H_5CN

14. Which of the following is not correct?
(a) Al reacts with NaOH and liberate H_2
(b) $AlCl_3$ is a Lewis acid
(c) Al is used in the manufacture of electrical cables
(d) NaOH is used during Hall's process of purification of bauxite

15. A 0.5 g/L solution of glucose is found to be isotonic with a 2.5 g/L solution of an organic compound. What will be the molecular weight of that organic compound ?
(a) 300 (b) 600
(c) 900 (d) 200

16. *t*-butyl chloride preferably undergo hydrolysis by
(a) S_N1 mechanism
(b) S_N2 mechanism
(c) Any of (a) and (b)
(d) None of these

17. Oxidation state of oxygen in F_2O is
(a) +1 (b) -1
(c) +2 (d) -2

18. To dissolve argentite ore which of the following is used ?
(a) $Na[Ag(CN)_2]$ (b) NaCN
(c) NaCl (d) HCl

19. If 50% of a radioactive substance dissociates in 15 min, then the time taken by substance to dissociate 99% will be
(a) 50 min (b) 100 min
(c) 99 min (d) 150 min

20. H—O—H bond angle in H_2O is 104.5° and not 109° 28' because of
(a) lone pair-lone pair repulsion
(b) lone pair-bond pair repulsion
(c) bond pair-bond pair repulsion
(d) high electronegativity of oxygen

21. The reaction,
$C_6H_5CHO + CH_3COOC_2H_5 \longrightarrow C_6H_5CH{=}CHCOOC_2H_5$, is called
(a) Benzoin condensation
(b) Claisen condensation
(c) Cannizaro's reaction
(d) Perkin reaction

22. The best method to separate the mixture of *ortho* and *para* nitrophenol (1 :1) is
(a) vaporisation (b) colour spectrum
(c) distillation (d) crystallisation

23. Iodoform gives a precipitate with $AgNO_3$ on heating but chloroform does not because
(a) C — I bond in iodoform is weak and C — Cl bond in chloroform is strong
(b) chloroform is covalent
(c) iodoform is ionic
(d) None of the above

24. What are the values of n_1 and n_2 respectively for H_β line in the Lyman series of hydrogen atomic spectrum 44 ?
(a) 3 and 5 (b) 2 and 3
(c) 1 and 3 (d) 2 and 4

25. The homologue of ethyne is
(a) C_2H_2 (b) C_2H_6
(c) C_3H_8 (d) C_3H_4

26. A 0.1 aqueous solution of a weak acid is 2% ionised. If the ionic product of water is 1×10^{-4}, the $[OH^-]$ is
(a) 5×10^{-12} M (b) 2×10^{-3} M
(c) 1×10^{-14} M (d) None of these

27. Which of the following does not have coordinate bond?
(a) SO_2 (b) HNO_3
(c) H_2SO_3 (d) HNO_2

28. The total number of orbitals in the fifth energy level is

(a) 5 (b) 10
(c) 18 (d) 25

29. The most probable velocity (in cm/s) of hydrogen molecule at 27°C will be
(a) 19.3×10^4 (b) 17.8×10^4
(c) 24.93×10^9 (d) 17.8×10^8

30. In III group precipitation, NH_4Cl is added before adding NH_4OH to
(a) decrease conc. of OH^-
(b) prevent interference of PO_4^{3-}
(c) increase conc. of Cl^-
(d) increase conc. of OH^- ion

31. Steel is heated to below red heat and then, cooled slowly. The process refers to
(a) hardening (b) annealing
(c) tempering (d) nitriding

32. What is the wave number of 4th line in Balmer series of hydrogen spectrum ?
($R = 1,09,677\ cm^{-1}$)
(a) 24,630 cm^{-1} (b) 24,360 cm^{-1}
(c) 24,730 cm^{-1} (d) 24, 372 cm^{-1}

33. 9.2 g N_2O_4 is heated in a 1 L vessel till equilibrium state is established
$N_2O_4(g) \rightleftharpoons 2NO_2(g)$
In equilibrium state 50% N_2O_4 was dissociated, equilibrium constant will be
(mol. wt. of $N_2O_4 = 92$)
(a) 0.1 (b) 0.4
(c) 0.3 (d) 0.2

34. Disperse phase and dispersion medium in butter are respectively
(a) solid and liquid (b) liquid and solid
(c) liquid and liquid (d) solid and solid

35. Which of the following carbonates decomposes readily at low temperatures ?
(a) Na_2CO_3 (b) K_2CO_3
(c) Li_2CO_3 (d) Rb_2CO_3

36. The atomic number of an element '*M*' is 25. How many electrons are present in the *M*-shell of the element in its M^{3+} state ?
(a) 11 (b) 15 (c) 14 (d) 13

37. In which of the following pairs, both molecules possess dipole moment ?
(a) CO_2, SO_2 (b) BCl_3, PCl_3
(c) H_2O, SO_2 (d) CO_2, CS_2

38. Which one of the following reactions is called Rosenmund reaction ?
(a) Aldehydes are reduced to alcohols
(b) Acids are converted to acid chlorides
(c) Alcohols are reduced to hydrocarbons
(d) Acid chlorides are reduced to aldehydes

39. During, acetylation of amines, what is replaced by acetyl group ?
(a) Hydrogen atom attached to nitrogen atom
(b) One or more hydrogen atoms attached to carbon atom
(c) One or more hydrogen atoms attached to nitrogen atom
(d) Hydrogen atoms attached to either carbon atom or nitrogen atom

40. Which is used in alcoholic beverages ?
(a) Methanol (b) Ethanol
(c) Phenol (d) Glycerol

ZOOLOGY

1. The trisomy for 21st chromosome is called
(a) Down's syndrome
(b) Turner's syndrome
(c) Sickle cell anaemia
(d) Klinefelter's syndrome

2. Which of the following is the largest gland in an adult man ?
(a) Thymus (b) Liver
(c) Thyroid (d) Pancreas

3. In *Pheretima*, septa are absent between which segments ?
(a) 3/4 and 9/10 (b) 4/5 and 8/9
(c) 5/6 and 7/8 (d) 7/8 and 6/7

4. During emergency which of the following hormone is secreted?
(a) Aldosterone (b) Thyroxine
(c) Adrenalin (d) Calcitonin

5. In cockroach, larval and nymphal characters are maintained by
(a) ecdysone (b) salivary glands
(c) parotid gland (d) juvenile hormone

6. Which of the following is a transparent tissue?
(a) Tendon (b) Fibrous cartilage
(c) Hyaline cartilage (d) All of these

7. Rh factor is present in
(a) all vertebrates
(b) all mammals
(c) all reptiles
(d) man and rhesus monkey only

8. In rabbit, end of a long bone is connected in another by
(a) tendon (b) ligaments
(c) muscle (d) cartilage

9. Which of the following cell type is capable of giving rise to other cell types in sponges ?
(a) Thesocytes (b) Pinacocytes
(c) Cnidocytes (d) Archaeocytes

10. Thigmotaxis is not shown by
(a) *Paramecium* (b) *Amoeba*
(c) *Ascaris* (d) *Hydra*

11. Which is correctly matched?
(a) Apiculture — Honey bee
(b) Pisciculture — Silk moth
(c) Sericulture — Fish
(d) Aquaculture — Mosquito

12. Animals having a built in thermostat to maintain constant body temperature are known as
(a) biothermic (b) poikilothermic
(c) oligothermic (d) homeothermic

13. The intermediate host of *Schistosoma* is
(a) snail (b) mosquito
(c) housefly (d) sheep

14. The vitamin which is essential for blood clotting is
(a) vitamin-A (b) vitamin-B
(c) vitamin-C (d) vitamin-K

15. The female genital pore of *Pheretima posthuma* located upon the segment
(a) 14th (b) 16th
(c) 18th (d) 15th

16. Polyp phase is absent in
(a) *Hydra* (b) *Aurelia*
(c) *Physalia* (d) *Obelia*

17. In frog heart, there are cardiac muscles which consists of fibres called
(a) Purkinje fibres (b) myonemes
(c) telodendria (d) columnae carnae

18. Malpighian tubules are
(a) excretory organs of insects
(b) excretory organs of frog
(c) respiratory organs of insects
(d) endocrine glands of insects

19. LH and FSH are collectively called
(a) oxytocin (b) somatotropins
(c) luteotropic (d) gonadotropins

20. Which of the following provides most evident proof of evolution?
(a) Fossils (b) Morphology
(c) Embryo (d) Vestigial organs

21. In Mollusca, eye is present over a stalk, called
(a) ostracum (b) operculum
(c) ommatophores (d) osphradium

22. Turbellarians are free living
(a) nematodes (b) cestodes
(c) flat worms (d) trematodes

23. The characteristic larva of phylum—'Coelenterata' is
(a) planula (b) cysticercus
(c) rhabdiform (d) wriggler

24. In rabbit, head of epididymis present at the head of the testis is called
(a) vas deferens (b) cauda epididymis
(c) gubernaculum (d) caput epididymis

25. In blood, CO_2 in transported majorly as
(a) sodium carbonate
(b) carboxyhaemoglobin
(c) bicarbonate
(d) CO_2 as such

26. Animals undergoes inactive stage during winter, is known as
(a) aestivation (b) hibernation
(c) adaptation (d) acclimatization

27. Kupffer cells are present in
(a) liver (b) small intestine
(c) pancreas (d) thyroid gland

28. The embryo at 16 celled stage is known as
(a) morula (b) gastrula
(c) blastula (d) blastomere

29. Contractile vacuole in protozoan *Amoeba* is meant for
(a) respiration (b) excretion
(c) locomotion (d) osmoregulation

30. Which of the following is important for muscle contraction and nerve impulse transmission?
(a) Ca^{2+} ions (b) Mg^{2+} ions
(c) Both (a) and (b) (d) Fe^{2+} ions

31. Which one is component of Ornithine cycle?
(a) Ornithine, citrulline and alanine
(b) Ornithine, citrulline and arginine
(c) Amino acid are not used
(d) Ornithine, citrulline and fumaric acid

32. Chromosome complement with $2n - 1$ is called
(a) monosomy (b) nullisomy
(c) trisomy (d) tetrasomy

33. Which of the following is not vestigial in man?
(a) Tail vertebrae
(b) Nails
(c) Nictitating membrane
(d) Vermiform appendix

34. Small fish get stuck near the bottom of a shark and derives its nutrition from it. This kind of association is called as
(a) antibiosis (b) commensalism
(c) predation (d) parasitism

35. The group of Anamniota includes
(a) reptiles and birds
(b) birds and mammals
(c) fishes an amphibians
(d) reptiles and mammals

36. The excretory material of bony fish is
(a) urea (b) protein
(c) ammonia (d) amino acid

37. The leucocytes contain which of the following in large quantity?
(a) Basophils (b) Neutrophils
(c) Eosinophils (d) Monocytes

38. During inspiration, the diaphragm
(a) expands
(b) shows no change
(c) contracts and flattens
(d) relaxes to become dome-shaped

39. The function of pineal body is to
(a) lighten the skin colours
(b) control sexual behaviour
(c) regulates the period of puberty
(d) All of the above

40. Synsacrum of fowl consists of about
(a) 29 vertebrae (b) 3 vertebrae
(c) 16 vertebrae (d) single vertebrae

» BOTANY

1. Jumping genes in maize were discovered by
(a) Hugo de Vries (b) Barbara McClintock
(c) T H Morgan (d) Mendel

2. Streptomycin is obtained from
(a) *Streptomyces griseus* (b) *S. aureofaciens*
(c) *S. venezuelae* (d) *S. ramosus*

3. Indusium is found in
(a) algae (b) ferns
(c) moss (d) *Cycas*

4. The vacuole is lined by a membrane called
(a) tonoplast (b) jacket
(c) cell membrane (d) tonoplasm

5. Agar-agar is obtained from
(a) *Chlorella* (b) *Spirogyra*
(c) *Ulothrix* (d) *Gelidium*

6. DNA element with ability to change position is called
(a) cistron (b) transposon
(c) intron (d) recon

7. Initiation codon is
(a) UUU (b) UGA
(c) AUG (d) UAG

8. DNA multiplication is called
(a) translation (b) replication
(c) transduction (d) transcription

9. Duramen is present in
(a) inner region of secondary wood
(b) part of sap wood
(c) outer region of secondary wood
(d) region of pericycle

10. In plants, water supply is due to
(a) osmosis (b) imbibition
(c) guttation (d) adhesion force

11. Most of the economically important fibre yielding plants belong to family
(a) Malvaceae (b) Solanaceae
(c) Cruciferae (d) Poaceae

12. Paraffin wax is
(a) ester
(b) acid
(c) monohydric alcohol
(d) cholesterol

13. Which is always present in photochemical smog?
(a) O_3 (b) CO_2 (c) SO_2 (d) CH_4

14. In cell cycle, during which phase, chromosomes are arranged in equatorial plate?
(a) Metaphase (b) Anaphase
(c) Telophase (d) Prophase

15. The soil which is transported by wind is known as
(a) colluvial (b) eolian
(c) aluvial (d) glacial soil

16. Spindle fibre is made up of
(a) tubulin
(b) humulin
(c) intermediate filament
(d) flagellin

17. Lichen is the pioneer vegetation on which succession?
(a) Hydrosere (b) Lithosere
(c) Psammosere (d) Xerosere

18. In *Pinus*, male cone bears a large number of
(a) ligules
(b) anthers
(c) micro-sporophylls
(d) mega-sporophylls

19. Induction of flowering by low temperature treatment is
(a) vernalization (b) cryobiology
(c) photoperiodism (d) prunning

20. Decomposers are
(a) autotrophs (b) autoheterotrophs
(c) organotrophs (d) heterotrophs

21. Cleavage polyembryony occurs in
(a) *Pinus* (b) Mini *Cycas*
(c) *Cycas* (d) *Ephedra*

22. Edible part of mushroom is
(a) basidiocarp
(b) secondary mycelium
(c) primary mycelium
(d) tertiary mycelium

23. Calyptra is derived from
(a) archegonia (b) capsule
(c) antheridia (d) columella

24. 'Clamp connections' are observed in
(a) Basidiomycetes (b) Zygomycetes
(c) Ascomycetes (d) Oomycetes

25. What is the main cause for the extinction of some species in tropical forest ?
(a) Deforestation (b) Afforestation
(c) Pollution (d) Soil erosin

26. Most accepted theory for ascent of sap is
(a) capillarity theory (b) root pressure theory
(c) pulsation theory (d) transpiration pull

27. Which of the following is not the feature of gymnosperms ?
(a) Parallel venation
(b) Perennial plants
(c) Distinct branches (long and short branches)
(d) Xylem with vessels

28. The presence of diversity at the junction of territories of two different habitats is known as
(a) bottle neck effect (b) edge effect
(c) junction effect (d) Pasteur effect

29. In which form does the food transported in plants?
(a) Sucrose (b) Fructose
(c) Glucose (d) Lactose

30. In *Cycas*, pollination takes place in
(a) 3 celled stage (b) 4 celled stage
(c) 2 celled stage (d) 1 celled stage

31. The bioassay of auxin is
(a) avena curvature test
(b) callus formation
(c) culture of fungus
(d) seed dormancy

32. A eukaryotic gene contains two kinds of base sequences. Which of these plays an important role in protein synthesis?
(a) Introns (b) Exons
(c) Both (a) and (b) (d) None of these

33. L-shaped chromosomes are also called
(a) acrocentric (b) telocentric
(c) sub-metacentric (d) None of these

34. Which of the following is/are grouped under phanerogams?
(a) Angiosperms (b) Gymnosperms
(c) Pteridophytes (d) Both (a) and (b)

35. A bacterium divides after every 35 min., if a culture containing 10^5 cells per mL is grown, then cell concentration per mL after 175 min. will be
(a) 175×10^5 (b) 125×10^5
(c) 48×10^5 (d) 32×10^5

36. Which of the following theory gives the latest explanation for the closure of stomata?
(a) ABA theory
(b) Munch theory
(c) Starch glucose theory
(d) Active K^+ transport theory

37. Biological concept of species is mainly based on
(a) reproductive isolation
(b) morphological features only
(c) methods of reproduction only
(d) morphology and methods of reproduction

38. In the treatment of waste water discharge, which treatment stage involves biological treatment ?
(a) Primary treatment
(b) Secondary treatment
(c) Tertiary treatment
(d) Reverse osmosis stage

39. Nucellus forms which of the following part of fruit ?
(a) Seed coat (b) Perisperm
(c) Seed (d) Raphe

40. If root of a flowering plant has 24 chromosomes, then its gamete has how many chromosomes ?
(a) 24 (b) 12
(c) 4 (d) 8

GENERAL ENGLISH

Directions (Q. 1-5) : *In each of the following questions, choose the alternative which best expreses the meaning of the given idiom/phrase.*

1. A pipe dream
   (a) A pleasant dream
   (b) A bad dream
   (c) An impracticable plan
   (d) A foolish idea
2. To give up the ghost
   (a) To die
   (b) To make false appearance
   (c) To terrify others by acting in suspicious manner
   (d) To leave useless pursuits
3. To disabuse one's mind
   (a) To conceal something
   (b) To remove a misapprehension
   (c) To banish from one's mind a thought
   (d) To proceed cautiously so as to avoid risks and dangers
4. To wrangle over an ass's shadow
   (a) To act in a foolish way
   (b) To quarrel over trifles
   (c) To waste time fron petty things
   (d) To do something funny
5. To be at daggers drawn
   (a) To be frightened
   (b) To be ready to face danger
   (c) To threaten one
   (d) To be bitter enemy

Directions (Q. 6-10) : *Choose the correct alternative to fill in the blank.*

6. According to corporate circles, Datta is pushing through the merger to create a financially ____ company in the processed foods business, the group's thrust area for the 1990s.
   (a) straight (b) powerful
   (c) leading (d) acceptable
7. A man who is well-bred and honourable in-variably shows ____ for the feelings of other people.
   (a) complacence
   (b) concern
   (c) consideration
   (d) contempt
8. You will have to face some practical problems when you start ____ this plan.
   (a) prosecuting (b) projecting
   (c) prescribing (d) proscribing
9. Speeding and blocking are traffic offences which lead to ___ accidents.
   (a) winsome (b) urban
   (c) gruesome (d) minor
10. The more your action and thought are allied and ___, the happier you grow.
    (a) invincible (b) divergent
    (c) integrated (d) unravelled

Directions (Q. 11-15) : *In each of the following questions, rearrange the parts P, Q, R and S to make a proper sentence.*

11. Around the world, painful terminal diseases/(P), the question of human death/(Q), people are wrestling with /(R), especially in the face of/(S)
    (a) R S Q P (b) P Q R S
    (c) R Q S P (d) P S Q R
12. The specific, ability requirements of the job/(P), depend on the/(Q), required for adequate job performance/(R), intellectual or physical abilities/(S)
    (a) P Q R S (b) S R Q P
    (c) P R Q S (d) S Q R P
13. Freedom, is the restricted kind in the sense/(P), the rich and the poor woman/(Q), that a wide gulf separates/(R), which a modern woman enjoys/(S)
    (a) P S R Q (b) S R Q P
    (c) R Q P S (d) S P R Q
14. In life, some rules are/ (P), as in business/(Q), they seem almost instinctive/(R), learnt so early that/(S)
    (a) R S P Q (b) Q P S R
    (c) R P S Q (d) Q S P R
15. Kapil, left in an aeroplane/(P), after reading a sailing magazine/(Q), had decided/(R), to build his own boat nine years earlier/(S)
    (a) P R Q S (b) R S Q P
    (c) R Q P S (d) P S R Q

Directions (Q. 16-20) : *In each of the following questions, a part of the sentence is italicised. Below each sentence, three possible substitutions for the italicised part are given. Choose the one which iproves the italicised part. If none of the substitutions improves the italicised part, your answer is (d).*

16. I *would gladly accompany* your sister if you had asked me.
    (a) would have gladly accompanied
    (b) was to have gladly accompanied
    (c) will gladly accompany
    (d) No improvement
17. The indecisive man *was readily persuaded* to change his mind again.
    (a) was persuaded ready
    (b) was ready to persuade
    (c) was ready persuaded
    (d) No improvement
18. He enjoys *to tell stories* to children.
    (a) how to tell stories
    (b) telling stories
    (c) to narrate stories
    (d) No improvement
19. It is unreasonable to *distort* the statement of a man simply because he does not agree with your opinions.
    (a) discourage (b) denounce
    (c) bend (d) No improvement
20. *Would* you find me absent, please don't forget to leave a message behind.
    (a) As
    (b) Should
    (c) Unless
    (d) No improvement

Directions (Q. 21-25) : *In each of the following questions, choose the alternative which is most nearly the same in meaning to the word given in italics in the sentence.*

21. The *rancous* shouts of the audience forced the management to call off the show.
    (a) unpleasant (b) loud
    (c) harsh (d) harmful
22. At the Hardy house there was great *consternation* when Aunt Gertrude saw Joe helping Frank up the stairs.
    (a) surprise (b) panic
    (c) gaity (d) anxiety
23. Methods of spreading the family planning message have been as *fecund* as they have been abortive.
    (a) fruitful (b) failing
    (c) peculiar (d) false
24. Now the *fury* of the demonstrators turned against the machines.
    (a) asperity (b) passion
    (c) rage (d) acrimony
25. Everyone who has worked for him *hammers* home that point because they feel that it is widely unappreciated.
    (a) hints (b) stresses
    (c) strikes (d) directs

Directions (Q. 26-30) : *In each of the following questions, choose the alternative which is opposite in meaning to the word given in italics in the sentence.*

26. Here *debonair* manners were noticed by everyone present in the city.
    (a) stiff (b) cheerless
    (c) courteous (d) pleasant
27. Like poverty, *affluence* can sometimes create its own problems.
    (a) sorrow (b) indigence
    (c) exuberance (d) opulence
28. It is surprising to find her *condoning* such an act.
    (a) disparaging (b) condemning
    (c) disliking (d) forbidding
29. He proved utterly *capricious* in his dealings with his friends.
    (a) helpful (b) steadfast
    (c) understanding (d) obstinate
30. As long as he remained in that office, he maintained his *hegemony*.
    (a) predominance (b) poverty
    (c) subordination (d) chaos

Directions (Q. 31-35) : *In each of the following questions, choose the alternative which can be substituted for the given words/sentence.*

31. Medical study of the skin and its diseases
    (a) Dermatology (b) Orthopaedics
    (c) Venereology (d) Homeopathy
32. Code of diplomatic etiquette and precedence
    (a) Formalism (b) Statesmanship
    (c) Protocol (d) Hierachy

33. The branch of medical science which deals with the problems of the old
(a) Oncology (b) Geriatric
(c) Obstetrics (d) Endocrinol

34. One who promotes the idea of absence of government of any kind, when every man should be a law unto himself
(a) Anarchist (b) Belligerent
(c) Iconoclast (d) Agnostic

35. Design made by putting together coloured pieces of glass or stones
(a) Oleograph (b) Mosaic
(c) Tracery (d) Relief

Directions (Q. 36-40) : *Read the following passage carefully and answer the questions given below it.*

Most of us use the products of science—railways, aeroplanes, electricity, wireless and thousands of others—without thinking how they came into existence. We take them for granted, as if we were entitled to them as a matter of right. And we are very proud of the fact that we live in an advanced age and are ourselves so very 'advanced'. Now, there is no doubt that our age is a very different one from previous ages and I think it is perfectly correct to say that it is far more advanced. But that is a different thing from saying that we as individuals or groups are more advanced. It would be the height of absurdity to say that because an engine-driver can run an engine and Plato or Socrates could not, the engine-driver is more advanced than, or is superior to Plato or Socrates. But it would be perfectly correct to say that the engine itself is a more advanced method of locomotion than Plato's chariot was.

36. Which one of the following statements is true?
(a) An engine-driver is cleverer than Plato or Socrates.
(b) Plato or Socrates is in no way inferior to the engine-driver.
(c) Plato and Socrates surpassed the engine-driver in every respect.
(d) The engine-driver cannot be compared to Plato or Aristotle.

37. In this passage the author mentions Plato and/or Socrates to emphasise that
(a) they are/were men of great scholarship.
(b) people as individuals in the modern age are not more advanced than their predecessors.
(c) the engine is a better mode of locomotion than Plato's chariot.
(d) Plato and Aristotle had greater respect for learning.

38. According to the author, the present age is far more advanced than
(a) all the previous ages in some respect.
(b) the age of Socrates and Aristotle in some respects.
(c) some of the previous ages in all respects.
(d) all the previous ages in all respects.

39. Many of us make use of machines
(a) with very little knowledge of their mechanism
(b) without any knowledge of their historical significance.
(c) with full knowing of their genesis.
(d) without knowing how they were invented.

40. People today are very proud because they live
(a) in a philosophically advanced age.
(b) in a materially advanced age.
(c) in a scientifically advanced age.
(d) in a spiritually advanced age.

Answers

PHYSICS

1. (b)	2. (b)	3. (d)	4. (b)	5. (c)	6. (b)	7. (b)	8. (c)	9. (b)	10. (c)
11. (a)	12. (c)	13. (a)	14. (d)	15. (c)	16. (a)	17. (d)	18. (b)	19. (b)	20. (c)
21. (a)	22. (b)	23. (a)	24. (b)	25. (d)	26. (c)	27. (b)	28. (d)	29. (c)	30. (a)
31. (d)	32. (b)	33. (a)	34. (b)	35. (c)	36. (b)	37. (d)	38. (a)	39. (b)	40. (d)

CHEMISTRY

1. (b)	2. (c)	3. (a)	4. (c)	5. (a)	6. (c)	7. (b)	8. (d)	9. (c)	10. (c)
11. (a)	12. (c)	13. (b)	14. (d)	15. (c)	16. (a)	17. (c)	18. (b)	19. (c)	20. (a)
21. (b)	22. (c)	23. (a)	24. (c)	25. (d)	26. (a)	27. (c)	28. (d)	29. (b)	30. (a)
31. (b)	32. (d)	33. (d)	34. (b)	35. (c)	36. (d)	37. (c)	38. (d)	39. (c)	40. (b)

ZOOLOGY

1. (a)	2. (b)	3. (a)	4. (c)	5. (d)	6. (c)	7. (d)	8. (b)	9. (d)	10. (c)
11. (a)	12. (d)	13. (a)	14. (d)	15. (a)	16. (b)	17. (a)	18. (a)	19. (d)	20. (a)
21. (c)	22. (c)	23. (a)	24. (d)	25. (c)	26. (b)	27. (a)	28. (a)	29. (d)	30. (a)
31. (b)	32. (a)	33. (b)	34. (b)	35. (c)	36. (a)	37. (b)	38. (c)	39. (d)	40. (c)

BOTANY

1. (b)	2. (a)	3. (b)	4. (a)	5. (d)	6. (b)	7. (c)	8. (b)	9. (a)	10. (d)
11. (a)	12. (a)	13. (a)	14. (a)	15. (b)	16. (a)	17. (b)	18. (c)	19. (a)	20. (c)
21. (a)	22. (a)	23. (a)	24. (a)	25. (a)	26. (d)	27. (d)	28. (b)	29. (a)	30. (a)
31. (a)	32. (b)	33. (c)	34. (d)	35. (d)	36. (d)	37. (a)	38. (b)	39. (b)	40. (b)

GENERAL ENGLISH

1. (c)	2. (a)	3. (b)	4. (b)	5. (d)	6. (b)	7. (c)	8. (b)	9. (c)	10. (c)
11. (c)	12. (b)	13. (d)	14. (b)	15. (b)	16. (a)	17. (d)	18. (b)	19. (d)	20. (b)
21. (c)	22. (a)	23. (a)	24. (c)	25. (b)	26. (b)	27. (b)	28. (b)	29. (b)	30. (c)
31. (a)	32. (c)	33. (b)	34. (a)	35. (b)	36. (b)	37. (b)	38. (a)	39. (d)	40. (c)

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Solutions

PHYSICS

1. Beta decay can involve the emission of either electrons or positrons. The electrons or positrons emitted in a β-decay do not exist inside the nucleus. They are only created at the time of emission, just as photons are created when an atom makes a transition from higher to a lower energy state.

   In negative β-decay a neutron in the nucleus is transformed into a proton, an electron and an antineutrino. Hence, in radioactive decay process, the negatively charged emitted β-particles are the electrons produced as a result of the decay of neutrons present inside the nucleus.

2. For possible interference maxima on the screen, the condition is

$$d \sin\theta = n\lambda \quad \ldots(i)$$

Given : d = slit - width $= 2\lambda$

$\therefore \quad 2\lambda \sin\theta = n\lambda$

$\Rightarrow \quad 2\sin\theta = n$

The maximum value of $\sin\theta$ is 1, hence,

$$n = 2\times 1 = 2$$

Thus, Eq. (i) must be satisfied by 5 integer values *ie*, $-2, -1, 0, 1, 2$. Hence, the maximum number of possible interference maxima is 5.

3. Let the spherical conductors B and C have same charge as q. The electric force between them is

$$F = \frac{1}{4\pi\varepsilon_0}\frac{q^2}{r^2}$$

r, being the distance between them.

When third uncharged conductor A is brought in contact with B, then charge on each conductor

$$q_A = q_B = \frac{q_A + q_B}{2} = \frac{0+q}{2} = \frac{q}{2}$$

When this conductor A is now brought in contact with C, then charge on each conductor

$$q_A = q_C = \frac{q_A + q_C}{2} = \frac{(q/2)+q}{2} = \frac{3q}{4}$$

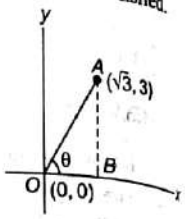
Hence, electric force acting between B and C is

$$F' = \frac{1}{4\pi\varepsilon_0}\frac{q_B q_C}{r^2} = \frac{1}{4\pi\varepsilon_0}\frac{(q/2)(3q/4)}{r^2}$$

$$= \frac{3}{8}\left[\frac{1}{4\pi\varepsilon_0}\frac{q^2}{r^2}\right] = \frac{3F}{8}$$

4. In gamma ray emission the energy is released from nucleus, so that nucleus get stablished.

5. Draw the situation as shown. OA represents the path of the particle starting from origin $O(0, 0)$. Draw a perpendicular from point A to x-axis. Let path of the particle makes an angle θ with the x-axis, then



$$\tan\theta = \text{slope of line } OA = \frac{AB}{OB} = \frac{3}{\sqrt{3}} = \sqrt{3}$$

or $\quad \theta = 60°$

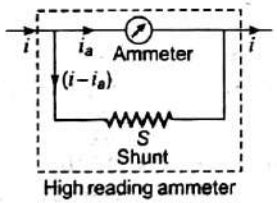
6. $\theta = \omega_0 t + \frac{1}{2}\alpha t^2$

Given, $\alpha = 3.0$ rad/s^2, $\omega_0 = 2.0$ rad/s, $t = 2$ s

Hence, $\quad \theta = 2\times 2 + \frac{1}{2}\times 3\times (2)^2$

or $\quad \theta = 4 + 6 = 10$ rad

7. Let i_a is the current flowing through ammeter and i is the total current. So, a current $i - i_a$ will flow through shunt resistance.



Potential difference across ammeter and shunt resistance is same.

ie, $\quad i_a \times R = (i - i_a)\times S$

or $\quad S = \frac{i_a R}{i - i_a} \quad \ldots(i)$

Given, $\quad i_a = 100$ A, $i = 750$ A, $R = 13\,\Omega$

Hence, $\quad S = \frac{100\times 13}{750 - 100} = 2\,\Omega$

8. When magnetic field is perpendicular to motion of charged particle, then

Centripetal force = magnetic force

ie, $\quad \frac{mv^2}{R} = Bqv$

or $\quad R = \frac{mv}{Bq}$

Further, time period of the motion

$$T = \frac{2\pi R}{v} = \frac{2\pi\left(\frac{mv}{Bq}\right)}{v}$$

or $\quad T = \frac{2\pi m}{Bq}$

It is independent of both R and v.

9. The magnetic flux linked with the primary coil is given by

$$\phi = \phi_0 + 4t$$

So, voltage across primary

$$V_p = \frac{d\phi}{dt} = \frac{d}{dt}(\phi_0 + 4t)$$

$$= 4 \text{ volt} \quad (\text{as } \phi_0 = \text{constant})$$

Also, we have

$N_p = 50$ and $N_s = 1500$

From relation,

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

or $\quad V_s = V_p\frac{N_s}{N_p}$

$$= 4\left(\frac{1500}{50}\right)$$

$$= 120 \text{ V}$$

10. Velocity of light waves in material is

$$v = \nu\lambda \quad \ldots(i)$$

Refractive index of material is

$$\mu = \frac{c}{v} \quad \ldots(ii)$$

where c is speed of light in vacuum or air.

or $\quad \mu = \frac{c}{\nu\lambda} \quad \ldots(iii)$

Given, $\quad \nu = 2\times 10^{14}$ Hz,

$\lambda = 5000$ Å $= 5000\times 10^{-10}$ m,

$c = 3\times 10^8$ m/s

Hence, from Eq. (iii), we get

$$\mu = \frac{3\times 10^8}{2\times 10^{14}\times 5000\times 10^{-10}} = 3.00$$

11. Let t_1 and t_2 be times taken by the car to go from X to Y and then from Y to X respectively.

Then, $t_1 + t_2 = \frac{XY}{v_u} + \frac{XY}{v_d} = XY\left(\frac{v_u + v_d}{v_u v_d}\right)$

Total distance travelled

$$= XY + XY = 2XY$$

Therefore, average speed of the car for this round trip is

$$v_{av} = \frac{2XY}{XY\left(\frac{v_u + v_d}{v_u v_d}\right)}$$

or $\quad v_{av} = \frac{2v_u v_d}{v_u + v_d}$

12. Let displacement equation of particle executing SHM is

$$y = a\sin\omega t$$

As particle travels half of the amplitude from the equilibrium position, so

$$y = \frac{a}{2}$$

Therefore, $\quad \frac{a}{2} = a\sin\omega t$

or $\quad \sin\omega t = \frac{1}{2} = \sin\frac{\pi}{6}$

or $\quad \omega t = \frac{\pi}{6}$

or $\quad t = \frac{\pi}{6\omega}$

or $\quad t = \frac{\pi}{6\left(\frac{2\pi}{T}\right)} \quad \left(\text{as } \omega = \frac{2\pi}{T}\right)$

or $\quad t = \frac{T}{12}$

Hence, the particle travels half of the amplitude from the equilibrium in $\frac{T}{12}$ s.

13. Block B will come to rest, if force applied to it will vanish due to frictional force acting between block B and surface, *ie*,

force applied = frictional force

ie, $\quad \mu mg = ma$

or $\quad \mu mg = m\left(\frac{v}{t}\right)$

or $\quad t = \frac{v}{\mu g}$

14. Number of nuclei remained after time t can be written as

$$N = N_0 e^{-\lambda t}$$

where N_0 is initial number of nuclei of both the substances.

$$N_1 = N_0 e^{-5\lambda t} \quad \ldots(i)$$

and $\quad N_2 = N_0 e^{-\lambda t} \quad \ldots(ii)$

Dividing Eq. (i) by Eq. (ii), we obtain

$$\frac{N_1}{N_2} = e^{(-5\lambda + \lambda)t} = e^{-4\lambda t} = \frac{1}{e^{4\lambda t}}$$

But, we have given

$$\frac{N_1}{N_2} = \left(\frac{1}{e}\right)^2 = \frac{1}{e^2}$$

Hence, $\frac{1}{e^2} = \frac{1}{e^{4\lambda t}}$

Comparing the powers, we get

$2 = 4\lambda t$

or $t = \frac{2}{4\lambda} = \frac{1}{2\lambda}$

15. The efficiency of transformer $= \frac{\text{Energy obtained from the secondary coil}}{\text{Energy given to the primary coil}}$

or $\eta = \frac{\text{Output power}}{\text{Input power}}$

or $\eta = \frac{V_s I_s}{V_p I_p}$

Given, $V_s I_s = 100$ W, $V_p = 220$ V, $I_p = 0.5$ A

Hence, $\eta = \frac{100}{220 \times 0.5} = 0.90 = 90\%$

16. As revolving charge is equivalent to a current, so

$$I = q f = q \times \frac{\omega}{2\pi}$$

But $\omega = \frac{v}{R}$

where R is radius of circle and v is uniform speed of charged particle.

Therefore, $I = \frac{qv}{2\pi R}$

Now, magnetic moment associated with charged particle is given by

$$\mu = IA = I \times \pi R^2$$

or $\mu = \frac{qv}{2\pi R} \times \pi R^2$

$$= \frac{1}{2} qvR$$

17. If m is the mass of a substance deposited or liberated at an electrode during electrolysis when a charge q passes through electrolyte, then according to Faraday's first law of electrolysis,

$m \propto q$

or $m = zq$

where z is a constant of proportionality and is called electrochemical equivalent (ECE) of the the substance.

If an electric current I flows through the electrolyte, then

$q = It$

$\therefore m = zit$

Here, $i = 1.5$ A, $t = 10$ min $= 10 \times 60$ s, $z = 30 \times 10^{-5}$ gC^{-1}

Hence, mass of copper deposited on the electrode

$$m = 30 \times 10^{-5} \times 1.5 \times 10 \times 60$$
$$= 27 \times 10^{-2} = 0.27 \text{ g}$$

18. The radius of the orbit in which ions moving is determined by the relation as given below

$$\frac{mv^2}{R} = qvB$$

where m is the mass, v is velocity, q is charge on ion and B is the flux density of the magnetic field, so that qvB is the magnetic force acting on the ion, and $\frac{mv^2}{R}$ is the centripetal force on the ion moving in a curved path of radius R.

The angular frequency of rotation of the ion about the vertical field B is given by

$$\omega = \frac{v}{R} = \frac{qB}{m} = 2\pi\nu$$

where ν is frequency.

Energy of ion is given by

$$E = \frac{1}{2} mv^2$$
$$= \frac{1}{2} m(R\omega)^2$$
$$= \frac{1}{2} mR^2 B^2 \frac{q^2}{m^2}$$

or $E = \frac{1}{2} \frac{R^2 B^2 q^2}{m}$ ...(i)

If ions are accelerated by electric potential V, then energy attained by ions

$E = qV$ ...(ii)

From Eqs. (i) and (ii), we get

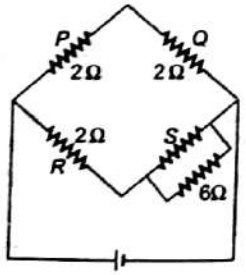
$$qV = \frac{1}{2} \frac{R^2 B^2 q^2}{m}$$

or $\frac{q}{m} = \frac{2V}{R^2 B^2}$

If V and B are kept constant, then

$$\frac{q}{m} \propto \frac{1}{R^2}$$

19. The situation can be depicted as shown in figure.



As resistances S and 6 Ω are in parallel their effective resistance is

$$\frac{6S}{6+S} \Omega$$

As the bridge is balanced, hence it is balanced Wheatstone's bridge.

For balancing condition,

$$\frac{P}{Q} = \frac{R}{\left(\frac{6S}{6+S}\right)}$$

or $\frac{2}{2} = \frac{2(6+S)}{6S}$

or $3S = 6 + S$

or $S = 3\,\Omega$

20. When two satellites of earth are moving in same orbit, then time period of both are equal. From Kepler's third law,

$T^2 \propto r^3$

Time period is independent of mass, hence their time periods will be equal.

The potential energy and kinetic energy are mass dependent, hence the PE and KE of satellites are not equal.

But, if they are orbiting in a same orbit, then they have equal orbital speed.

21. Given : $v_o = \frac{v}{5} \Rightarrow v_o = \frac{320}{5} = 64$ m/s

When observer moves towards the stationary source, then

$$n' = \left(\frac{v + v_o}{v}\right) n$$

$$n' = \left(\frac{320 + 64}{320}\right) n$$

$$n' = \left(\frac{384}{320}\right) n$$

$$\frac{n'}{n} = \frac{384}{320}$$

Hence, percentage increase

$$\left(\frac{n' - n}{n}\right) = \left(\frac{384 - 320}{320} \times 100\right) \%$$

$$= \left(\frac{64}{320} \times 100\right) \% = 20\,\%$$

22. The current at any instant is given by

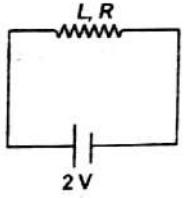
$I = I_0 (1 - e^{-Rt/L})$

$\frac{I_0}{2} = I_0 (1 - e^{-Rt/L})$

$\frac{1}{2} = (1 - e^{-Rt/L})$

$e^{-Rt/L} = 1/2$

$\frac{Rt}{L} = \ln 2$



$\therefore t = \frac{L}{R} \ln 2 = \frac{300 \times 10^{-3}}{2} \times 0.693$

$= 150 \times 0.693 \times 10^{-3}$

$= 0.10395$ s $= 0.1$ s

23. $D = (\mu - 1)$ A

For blue light μ is greater than that for red light, so $D_2 > D_1$.

24. The height (h) traversed by particle while going up is

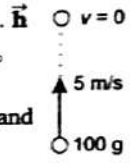
$$h = \frac{u^2}{2g} = \frac{25}{2 \times 9.8}$$

Work done by gravity force $= m\vec{g} \cdot \vec{h}$

$$= 0.1 \times g \times \frac{25}{2 \times 9.8} \cos 180°$$

[Angle between force and displacement is 180°]

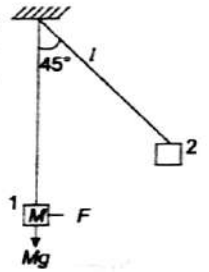
$\therefore W = -0.1 \times \frac{25}{2} = -1.25$ J



25. Here, the constant horizontal force required to take the body from position 1 to position 2 can be calculated by using work-energy theorem. Let us assume that body is taken slowly so that its speed doesn't change, then

$\Delta K = 0$

$= W_F + W_{Mg} + W_{\text{tension}}$



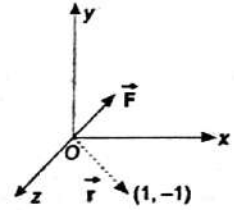
[symbols have their usual meanings]

$W_F = F \times l \sin 45°$,

$W_{Mg} = M_g(l - l\cos 45°)$, $W_{\text{tension}} = 0$

$\therefore F = Mg(\sqrt{2} - 1)$

26. $\vec{\tau} = \vec{r} \times \vec{F}$



$\vec{\tau} = (\hat{i} - \hat{j}) \times (-F\hat{k})$

$= F[(-\hat{i} \times \hat{k}) + (\hat{j} \times \hat{k})]$

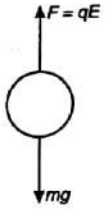
$= F[\hat{j} + \hat{i}] = F[\hat{i} + \hat{j}]$

27. Binding energy
$$BE = (M_{nucleus} - M_{nucleons})c^2$$
$$= (M_O - 8M_p - 9M_n)c^2$$

28. Let intensity of sound be I and I'
Loudness of sound initially
$$\beta_1 = 10 \log\left(\frac{I}{I_0}\right)$$
Later, $$\beta_2 = 10 \log\left(\frac{I'}{I_0}\right)$$
Given, $$\beta_2 - \beta_1 = 20$$
$$\therefore \quad 20 = 10 \log\left(\frac{I'}{I}\right)$$
$$\therefore \quad I' = 100I$$

29. Work does not characterise the thermodynamic state of matter, it is a path function giving only relationship between two quantities.

30. In steady state,
electric force on drop
= weight of drop
$$\therefore \quad qE = mg$$
$$\Rightarrow \quad q = \frac{mg}{E}$$
$$= \frac{9.9 \times 10^{-15} \times 10}{3 \times 10^4}$$
$$= 3.3 \times 10^{-18} \text{ C}$$



31. Resistance
$$R = \frac{\text{potential difference}}{\text{current}} = \frac{V}{i} = \frac{W}{qi}$$
(∵ Potential difference is equal to work done per unit charge)
So, Dimensions of R
$$= \frac{\text{[Dimensions of work]}}{\text{[Dimensions of charge][Dimensions of current]}}$$
$$= \frac{[ML^2T^{-2}]}{[IT][I]} = [ML^2T^{-3}I^{-2}]$$

32. Since, here nuclear target is heavy it can be assumed safely that it will remain stationary and will not move due to the Coulombic interaction force.
At distance of closest approach relative velocity of two particles is v. Here target is considered as stationary, so α-particle comes to rest instantaneously at distance of closest approach. Let required distance is r, then from work energy-theorem.
$$0 - \frac{mv^2}{2} = -\frac{1}{4\pi\varepsilon_0}\frac{Ze \times 2e}{r}$$
$$\Rightarrow \quad r \propto \frac{1}{m}$$
$$\propto \frac{1}{v^2}$$
$$\propto Ze^2$$

33. For adiabatic process,
$$dQ = 0$$
So, $$dU = -\Delta W$$
$$\Rightarrow \quad nC_V dT = +146 \times 10^3 \text{ J}$$
$$\Rightarrow \quad \frac{nfR}{2} \times 7 = 146 \times 10^3$$
[$f \rightarrow$ Degree of freedom]
$$\Rightarrow \quad \frac{10^3 \times f \times 8.3 \times 7}{2} = 146 \times 10^3$$
$$f = 5.02 \approx 5$$
So, it is a diatomic gas.

34. The accelerating force on the rocket
$$= \text{upward thrust} = \frac{\Delta m}{\Delta t} \cdot u$$
Given, $\frac{\Delta m}{\Delta t} = 50 \times 10^{-3}$ kg/s, $v = 400$ m/s
So, accelerating force $= 50 \times 10^{-3} \times 400$
$$= 20 \text{ N}$$

35. Surface energy = surface tension × surface area
$$E = T \times 2A$$
New surface energy,
$$E_1 = T \times 2\left(\frac{A}{2}\right) = T \times A$$
% decrease in surface energy
$$= \frac{E - E_1}{E} \times 100$$
$$= \frac{2TA - TA}{2TA} \times 100 = 50\%$$

36. If we fill nitrogen gas at high pressure above mercury level, the boiling point of mercury is increased which can extend the range upto 500°C.

37. Length of tube = 10 cm
$$f_o + f_e = 10 \text{ cm}$$
Magnification $m = \frac{f_o}{f_e} = 4$
$$f_o = 4f_e$$
Putting in Eq. (i),
$$5f_e = 10 \text{ cm}$$
or $$f_e = 2 \text{ cm}$$
and $$f_o = 8 \text{ cm}$$
$$f_o = 8 \text{ cm}, f_e = 2 \text{ cm}$$

Hence, L_4 and L_1 will be used.

38. Biconvex lens is cut perpendicularly to the principal axis, it will become a plano-convex lens.



Focal length of biconvex lens
$$\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$
$$\frac{1}{f} = (n-1)\frac{2}{R} \quad (\because R_1 = R, R_2 = -R)$$
$$\Rightarrow \quad f = \frac{R}{2(n-1)} \qquad \ldots(i)$$
For plano-convex lens
$$\frac{1}{f_1} = (n-1)\left(\frac{1}{R} - \frac{1}{\infty}\right)$$
$$f_1 = \frac{R}{(n-1)} \qquad \ldots(ii)$$
Comparing Eqs. (i) and (ii), we see that focal length becomes double.
As power of lens $P \propto \frac{1}{\text{focal length}}$
Hence, power will become half.
$$\text{New power} = \frac{4}{2} = 2 \text{ D}$$

39. The resistance of a metallic wire at temperature t°C is given by
$$R_t = R_0(1 + \alpha t)$$
where α is coefficient of expansion.
Hence, resistance of wire increases on increasing the temperature. Also, from Ohm's law, ratio of $\frac{V}{i}$ is equal to R *ie*,
$$\frac{V}{i} = R$$
Hence, on increasing the temperature the ratio $\frac{V}{i}$ increases.

40. When the surface area of a liquid is increased, molecules from the interior of the liquid rise to the surface. As these molecules reach the surface work is done against the cohesive force. This work is stored in the molecules in the form of potential energy. Thus, the potential energy of the molecules lying in the surface is greater than that of the molecules in the interior of the liquid.

CHEMISTRY

1. Among V A group hydrides, the stability decreases in going down the group *ie*,
$NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$
It is due to the increasing bond length down the group.

2. When silica is heated with metal carbonate, it form silicates.
$$SiO_2 + Na_2CO_3 \xrightarrow{\Delta} Na_2SiO_3 + CO_2 \uparrow$$

3. This is an example of Kolbe's electrolysis.
$$2CH_3COOK \xrightarrow{\text{electrolysis}} 2CH_3COO^- + 2K^+$$
At cathode :
$$2K^+ + 2e^- \longrightarrow 2K$$
$$2K + 2H_2O \longrightarrow 2KOH + H_2 \uparrow$$
At anode :
$$2CH_3COO^- \longrightarrow 2CH_3C\dot{O}O + 2e^-$$
$$\downarrow -2CO_2$$
$$2\dot{C}H_3$$
$$\downarrow$$
$$C_2H_6$$

4. H_2O_2 can be prepared by electrolysis of 50% H_2SO_4. In this method, hydrogen is liberated at cathode.
$$H_2SO_4 \rightleftharpoons 2H^+ + 2HSO_4^-$$
At anode : $2HSO_4^- \longrightarrow H_2S_2O_8 + 2e^-$
$$H_2S_2O_8 + 2H_2O \longrightarrow 2H_2SO_4 + H_2O_2$$
At cathode : $2H^+ + 2e^- \longrightarrow H_2 \uparrow$

5. $w = 0.49$ g
$E = 49$
$V = 1000$ mL
$$\therefore \quad N = \frac{w \times 1000}{E \cdot V} = \frac{0.49 \times 1000}{49 \times 1000} = 0.01 \text{ N}$$
$$\therefore \quad [H^+] = 0.01$$
$$\therefore \quad pH = -\log[H^+]$$
$$= -\log(1 \times 10^{-2}) = 2$$

6. Starch solution is a hydrosol as it forms colloidal solution with water.

7. Change in oxidation number = (+7) − (+2) = 5
∴ Normality of solution = 5 × 0.04 = 0.20 N
Volume = 250 mL
∴ Number of equivalents of $KMnO_4$
$$= 0.20 \times \frac{250}{1000} = 0.05$$

8. Clemmensen's reduction (conc. HCl/Zn-Hg) or Wolf-Kishner reduction (C_2H_5ONa / NH_2NH_2) can be used to convert $>C=O$ group into $>CH_2$ group.

$$\underset{\text{aldehyde or ketone}}{R_2C=O} \xrightarrow[\text{conc.HCl}]{\text{Zn-Hg}} \underset{\text{hydrocarbon}}{R_2CH_2}$$

9. $C + \frac{1}{2}O_2 \longrightarrow CO, \quad \Delta H = -110 \text{ kJ mol}^{-1}$ ...(i)

$C + O_2 \longrightarrow CO_2, \quad \Delta H = -393 \text{ kJ mol}^{-1}$ ...(ii)

On subtracting Eq. (i) from Eq. (ii), we get

$CO + \frac{1}{2}O_2 \longrightarrow CO_2$

$\Delta H = 393 - (-110)$

$= -283 \text{ kJ mol}^{-1}$

10. According to de-Broglie equation

$$\lambda = \frac{h}{mv}$$

$$= \frac{6.62 \times 10^{-34}}{6.62 \times 10^{-29} \times 10^{-3} \times 10^{3}}$$

$$= 10^{-5} \text{ m}$$

11. $E^\circ_{cell} = E^\circ_{cell} - \frac{2.303RT}{nF} \log\left[\frac{[Ni]}{[Ni^{2+}]}\right]$

$$= -0.25 - \frac{0.06}{2} \log\left(\frac{1}{0.1}\right) \quad (\because n = 2)$$

$$= -0.25 - 0.03 \times 1$$

$E_{cell} = -0.28 \text{ V}$

12. $\frac{1}{2}A(g) + \frac{1}{3}B(g) \overset{T(K)}{\rightleftharpoons} \frac{2}{3}C(g)$

Equilibrium constant, $K_c = \frac{\text{Rate product}}{\text{Rate of reactant}}$

$$K_c = \frac{[C]^{2/3}}{[A]^{1/2}[B]^{1/3}}$$

13. C_2H_5Cl can give Grignard reagent when reacted with Mg in dry ether.

$RX + Mg \text{ (dry)} \xrightarrow{\text{Dry ether}} RMgX$

$C_2H_5Cl + Mg \xrightarrow{\text{Dry ether}} \underset{\text{ethyl magnesium chloride}}{C_2H_5MgCl}$

14. NaOH is used in the Baeyer's process. Hence, NaOH is used during Hall's process of purification of bauxite is not the correct statement.

15. Molarity of glucose solution

$$= \frac{0.5g}{180 \times 1L} = 0.00277 \text{ M}$$

Isotonic solution have equal molar concentrations, hence molarity of organic compound solution = 0.00277 M

∴Molecular weight of compound

$$= \frac{2.5}{0.00277 \times 1} = 900$$

16. Tertiary halide preferentially undergo S_N1 substitution as they can give stable carbocation.

$$\underset{\substack{t\text{-butyl chloride}}}{(CH_3)_3C-Cl} \xrightarrow[-Cl]{\text{slow}} \underset{\substack{3^\circ \text{ carbocation} \\ \text{(most stable)}}}{(CH_3)_3C^+} \xrightarrow[\text{fast}]{+OH^-} \underset{t\text{-butyl alcohol}}{(CH_3)_3COH}$$

17. Let the oxidation state of oxygen in F_2O is x.

F_2O

$2(-1) + x = 0 \quad (\because F \text{ is more electronegative})$

$-2 + x = 0$

$x = +2$

18. Argentite is Ag_2S.

$Ag_2S + 4NaCN \longrightarrow 2Na[Ag(CN)_2] + Na_2S$

$AgCl + 2NaCN \longrightarrow Na[Ag(CN)_2] + NaCl$

19. Radioactive disintegration is a Ist order reaction, hence

$$k = \frac{2.303}{t} \log \frac{a}{a-x}$$

$$\therefore \quad k = \frac{2.303}{15} \log \frac{100}{100-50}$$

also $$k = \frac{2.303}{t} \log \frac{100}{100-99}$$

$$\therefore \frac{2.303}{15} \log \frac{100}{50} = \frac{2.303}{t} \log \frac{100}{1}$$

$$\frac{1}{15} \log 2 = \frac{1}{t} \log 100$$

$$\frac{0.3010}{15} = \frac{2}{t}$$

$$t = \frac{2 \times 15}{0.3010} = 99 \text{ min}$$

20. The hybridisation of oxygen in water molecule is sp^3. So, water molecule must be tetrahedral and have bond angle 109°28'. But due to the presence of two lone pair of electrons on oxygen atom (repulsion between lone pair-lone pair) the bond angle decreases about 104.5° and the geometry becomes distorted tertrahedral or V-shaped.

21. **Claisen condensation :** Aromatic aldehyde condenses with esters having α-hydrogen atoms like ethyl acetate, in the presence of metallic Na and C_2H_5OH to form esters of α, β-unsaturated acids.

$$\underset{\text{benzaldehyde}}{C_6H_5CHO} + \underset{\text{ethyl acetate}}{H_2CH-COOC_2H_5} \xrightarrow[C_2H_5OH]{Na} \underset{\text{ethyl cinnamate}}{C_6H_5CH=CHCOOC_2H_5} + H_2O$$

22. *Ortho* and *para* nitrophenol is separated by distillation because *p*-nitrophenol has higher boiling point than *o*-nitrophenol due to H-bonding.

23. On heating C—I bond in CHI_3 breaks, but C—Cl bond in $CHCl_3$ does not break. Thus, $AgNO_3$ gives precipitate AgI with iodoform.

24. H_β line is formed when electron jumps from 3*rd* orbit to Ist orbit in Lyman series.

$\therefore \quad n_1 = 1, n_2 = 3$

25. Ethyne is nothing but C_2H_2 *ie*, acetylene which can be represented by general molecular formula C_nH_{2n-2}. Only C_3H_4 tallies with the formula. Hence, C_3H_4 is the homologue of C_2H_2.

26. Since, it is a weak acid, the equation to calculate $[H^+]$ is

$= C \times \alpha$ (α = % of ionisation)

$= 0.1 \times 0.02 = 2 \times 10^{-3}$ M

$K_w = [H^+][OH^-]$

$$[OH^-] = \frac{K_w}{[H^+]} = \frac{1 \times 10^{-14}}{2 \times 10^{-3}}$$

$$= 5 \times 10^{-12} \text{ M}$$

27. H_2SO_3 has the structure $\begin{matrix} H-O \\ H-O \end{matrix}\!\!>\!S=O$

HNO_2 is a tautometric mixture of its nitrile and nitro forms.

$$\begin{matrix} O \\ \\ O \end{matrix}\!\!>\!N-H, \quad O=N-O-H$$

Hence, it contains coordinate bond.

28. The total number of atomic orbitals (total m) in nth shell is equal to n^2.

So, in the fifth shell = $5^2 = 25$

29. Most probable velocity = $\sqrt{\frac{8RT}{\pi m}}$

$T = (27 + 273) = 300$ K

Molecular mass of $H_2 = 2g \text{ mol}^{-1}$

$$= \sqrt{\frac{8 \times 8.314 \times 10^7 \times 300}{3.14 \times 2}}$$

$= 17.8 \times 10^4$ cm/s.

30. In III group precipitation, NH_4Cl is added before adding NH_4OH to decrease the conc. of OH^-, as NH_4Cl and NH_4OH dissociates as follows.

$NH_4Cl \rightleftharpoons NH_4^+ + Cl^-$

$NH_4OH \rightleftharpoons \underset{\text{common ion}}{NH_4^+} + OH^-$

Due to presence of common ion, conc. of OH^- decreases and for III group precipitation lesser conc. of OH^- is required.

31. The process of heating the steel to a temperature much below to redness and cooling it slowly, is called annealing.

32. $\bar{v} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

For Balmer series $n_1 = 2$ and for 4th line in Balmer series $n_2 = 6$

$\because \quad R = 109677 \text{ cm}^{-1}$

$$\bar{v} = 109677\left(\frac{1}{2^2} - \frac{1}{6^2}\right)$$

$$= 109677\left(\frac{1}{4} - \frac{1}{36}\right)$$

$\bar{v} = 24{,}372 \text{ cm}^{-1}$

33. $N_2O_4(g) \rightleftharpoons 2NO_2(g)$

Molar concentration of

$$[N_2O_4] = \frac{9.2}{92} = 0.1 \text{ mol/L}$$

In equilibrium state when it 50% dissociates,

$[N_2O_4] = 0.05$ M

$[NO_2] = 0.1$ M

$$K_c = \frac{[NO_2]^2}{[N_2O_4]}$$

$$= \frac{0.1 \times 0.1}{0.05} = 0.2$$

34. Disperse phase and dispersion medium in butter are liquid and solid respectively.

35. Lithium carbonate decomposes readily at low temperature.

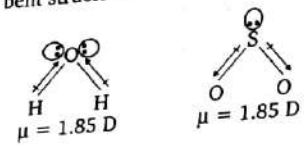
$$Li_2CO_3 \xrightarrow{\Delta} Li_2O + CO_2$$

36.

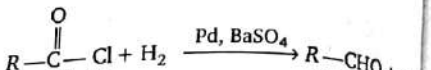
	K	L	M	N
M (26)	$1s^2$,	$2s^2\,2p^6$,	$3s^2 3p^6 3d^6$	$4s^2$
M^{3+}.	$1s^2$,	$2s^2\,2p^6$,	$3s^2\,3p^6\,3d^5$,	$4s^0$

Hence, 13 electrons are present in the *M*-shell of M^{3+} state.

37. H_2O and SO_2 both possess dipole moment due to bent structure.



38. In the Rosenmund's reaction acid chlorides are converted to corresponding aldehydes by catalytic reduction.



39. $R-NH_2 \xrightarrow[-HCl]{CH_3COCl} R-NH-\underset{\underset{O}{\|}}{C}-CH_3$

$\xrightarrow[-HCl]{CH_3COCl} R-N(COCH_3)-COCH_3$

40. Ethanol is used in alcoholic beverages.

1.

Abnormality	Cause	Characteristic
Down's syndrome	Trisomy of 21st autosome (45 A + XX/XY)	Mental retardation, prominent head, flattened nasal bridge, habitually open mouth and projecting lower lips
Turner's syndrome	Non-disjunction of sex chromosome (2n = 45, 44A + XO)	Sterile female, webbed neck, no breast development, no menstruation or egg production
Klinefelter's syndrome	Non-disjunction of sex chromosome (2n = 47, 44A + XXY)	Gynecomastia in males, mentally defective, testes underdeveloped
Sickle cell anaemia	Molecular gene mutation of gene Hb^A	Sickle-shaped RBCs, do not transport O_2 efficiently

2. **Liver is endodermal** in origin and is the largest gland in human body. It is the busiest and largest chemical factory in the body.

Liver cells secrete bile directly into bile capillaries, which is used in the emulsification and absorption of fats. Besides, it also functions in manufacture of anticoagulant heparin, plasma protein like albumin, fibrinogen and prothrombin and in deamination of proteins.

Thyroid gland (measures 3-7 cm in length and 25 gm in weight in adults) a median endocrine gland located below larynx is the largest endocrine gland in the body. Thyroxine (T_4), produced by thyroid gland, function mainly in controlling metabolism, *ie*, basal metabolic rate of the body.

Pancreas is a mixed gland (heterocrine gland) with both exocrine and endocrine portions. The average length of pancreas is 12-15 cm and weight is 50-70 gm. Insulin, glucagon, somatostatin are the hormones secreted by different cells of endocrine portion of pancreas.

Thymus gland (at birth weights 10-12 gm, at puberty 20-30 gm and at old age it weighs 3-6 gm) is mainly concerned with immunological functions but becomes inconspicuous after puberty.

3. In *Pheretima posthuma* (earthworm) septa are absent between 3/4 and 9/10 segments.

4. **Adrenalin** (epinephrine) is secreted by Chromaffin cells of adrenal medulla. The secretion of adrenalin is directly controlled by the autonomic nervous system, but not under the control of pituitary.

Adrenalin is also called 'emergency hormone' because it contributes the fright, fight or flight reactions' which occur in condition of emergency. Increase in emotional disturbance increases the secretion of adrenalin, accelerating the rate of respiration, dilating respiratory passage, increasing blood pressure, heart beat, sugar level and stimulating cellular metabolism.

Aldosterone, is a mineralocorticoid or salt retaining hormone secreted by adrenal cortex. Its basic funtion is in conservation of sodium and water and dimination of potassium.

Thyroxine (tri-iodothyronine) is manufactured in thyroid gland and is synthesized from iodine. Its main function is to control metabolism, regulating tissue growth and development.

Calcitonin or **Thyrocalcitonin** (TCT) is a non-iodized hormone, secreted by parafollicular cells of thyroid. Its main role is to lower the amount of calcium and phosphate in the blood.

5. **Juvenile hormone** is produced by corpora allata in insects, it favours the development of juvenile characteristics. During larval life, this hormone predominates and each moult yields another larger juvenile and keeps the larva in immature condition or maintains juvenility.

Ecdysone is a steroidal, moulting hormone of the prothoracic glands, named "ecdysone" in insects that triggers metamorphosis.

Salivary glands are the merocrine or epicrine type of gland. Their secretion diffuses out through the cell surface, causing no damage to the cell. In man, 3 pairs of salivary glands are present and in rabbit, they are 4 pairs. Salivary glands are absent in frog.

Parotid glands are compound tubulo-acinar glands and are the type of salivary glands with a flask-like secretory portion. **Poison gland** of a toad is modified **parotid gland**. In rabbit, parotid glands are the **largest** salivary gland, present beneath the ears. Duct of parotid gland is known as **Stenson's duct** in man.

6. **Hyaline cartilage** is the most abundant kind of cartilage with **no fibres** and transparent matrix. It is found upon articular surfaces at joints of long bones from articular cartilage, coastal cartilages at the ventral ends of the ribs. It helps to from the nose, larynx, trachea, bronchi and bronchial tubes leading to the lungs.

Fibrocartilage (fibrous cartilage) carries thick dense bundles of white collagen fibres in matrix. They are the strongest cartilage. They occur in joints between vertebrae and also pubic symphysis.

Tendon is a very dense, strong fibrous connective tissue made of collagen fibres. Tendon connects a skeletal muscle to a bone.

7. Rh factor was discovered by K Landsteiner and A S Wiener (1940) from rabbits immunized with the blood of monkey *Macaca rhesus*. It is found is man and rhesus monkey only.

8. **Ligaments** consist of mainly collagen fibres and some elastic fibres. It connects end of a long bone to another.

Tendon is a very dense, strong fibrous connective tissue made of collagen fibres. Tendon connects a skeletal muscle to a bone.

Cartilage is a solid but semi-rigid and flexible connective tissue. Cartilage like the fibrous tissues, is a vascular and nutrients must diffuse into it from nearby tissues.

Muscles are composed of muscle tissue, that contracts to affect a particular movement.

9. **Archaeocytes** are the totipotent cells, which provide great regenerating power to sponges. Sex cells (sperm and ova arise from undifferentiated archaeocytes.

Thesocytes are the amoebocytes with reserve food granules.

Pinacocytes are the polygonal flat cells present as outer layer of cells, called pinacoderm lining the spongocoel or body cavity in *Leucosolenia*.

Cnidocytes occur in entire epidermis except that of basal disc and are found only in cnidarians. Cnidocytes are spherical or oval cells.

10. *Ascaris* do not show thigmotaxis.

Amoeba shows thigmotaxis. On coming in contact with a solid object *Amoeba* generally avoid it by moving in a different direction by forming pseudopodia.

Hydra is known to respond to a variety of stimuli, both external and internal. On contact with a solid object other than a prey, the whole body usually contracts rather rapidly.

On contact with a hard solid object *Paramecium* induces avoiding response.

11. **Apiculture** is the rearing of bee or bee keeping for the production of honey and wax. **Pisciculture** (fish culture) is the rearing and breeding of fishes in ponds, artificial water reservoirs.

Sericulture is the rearing of silkworm or mulberry silkworm (*Bombyx mori*) for commercial production of silk. Caterpillar feeds on mulberry leaves, its salivary gland secretes liquid silk.

12. **Homeothermic** are the animals having a nearly uniform or constant body temperature.

These animals are known as warm blooded animals, *eg*, birds, man.

Poikilothermic are those, having a variable temperature which fluctuates with that of environment. They are called the cold blooded animals, *eg*, reptiles, amphibians.

13. *Schistosoma mansoni* is the common human **blood fluke.** It belongs to class-Trematoda of Platyhelminthes. Blood fluke is digenetic, primary host is man and secondary host is snail.

Sheep is the primary host of *Fasciola hepatica* (sheep liver fluke), causing 'liver rot'. Its secondary host is also the snail.

Mosquito and housefly do not found to be the intermediate host of any animal.

14. **Vitamin-K** is essential for clotting of blood. It is necessary for the synthesis of various blood clotting factors like prothrombin (II), proconvertin (VII), Stuart power factor (X) times Christmas factor. It is obtained from cabbage, spinach and other green leafy vegetables.

Vitamin-A is necessary for synthesis of rhodopsin of rod cells and iodopsin of cone cells of the retina of eye.

Vitamin-D promotes absorption of calcium and phosphorus by the intestine. It maintains the normal functioning of parathormone.

Vitamin-B (B_1) serves as a co-enzyme in the conversion of pyruvate into acetyl Co-A and α-ketoglutarate.

15. In *Pheretima posthuma*, common Indian earthworm, female genital pores present upon segment 14th, while one pair ovary on segment 13th.

Genital papillae occurs in segments 17 and 19 and male genital apertures upon segment 18. Segments 15-26 are the pretyphlosolar region of the intestine.

16. Polyp and medusa are the asexual and sexual phase present respectively in coelenterates. The members of different classes can be differentiated by the presence or absence of these stages.

Aurelia (jelly fish) belongs to class—Scyphozoa, in which medusoid phase is dominant and polypoid phase absent.

Hydra, Obelia, Physalia are the members of class- Hydrozoa in which, both medusoid and polypoid stages are present.

Metridium, Tubipora etc., belong to class Anthozoa, with all polyps but no medusae.

17. The heart wall of frog composed of epicardium, myocardium and endocardium. The myocardium is composed of branched and striated yet involuntary cardiac muscles which contracts and relax rhythmically at a fixed rate. The fibres of the self excitatory and conducting muscle of the heart are of three types-nodal fibres, transitional fibres and Purkinje fibres.

In frog heart, a number of muscular ridges called columnae carnae projected from the wall of ventricle into its cavity, dividing the peripheral part of the cavity into a number of pockets.

18. **Malpighian tubules** are the excretory organs of insects. It opens at the junction of midgut and hindgut (ileum) in cockroach. Malpighian tubules absorb excretory substances from haemolymph and fat bodies and pass into the proctodaeum. The excretory product of insects is uric acid related with water conservation. These tubules are concerned with homeostasis, osmoregulation and excretion,

Respiratory organ of insects is **tracheae**, which opens outside by ten pairs of spiracles, present in thoracic (2 pairs) and abdominal (8 pairs) parts.

Endocrine glands of insects consist of corpora allata, corpora cardiaca and prothoracic gland, which regulate metamorphosis in insects through different hormonal secretion.

Excretory organ of frog is kidney (mesonephric), large urinary bladder, excretion ureotelic.

19. Trophe = nourishment. Most of the tropic hormones are secreted by anterior lobe of pituitary.

Gonadotropins or **gonadotropic hormones** are those which stimulate the gonads (testes and ovaries), **FSH** (Follicle Stimulating Hormone) stimulates growth of **ovarian follicles** and the secretion of **oestrogens** in the **female** and **spermatogenesis** (formation of sperms) in the **male.** Luteinizing Hormone **(LH)** stimulates **corpus luteum** of the ovary to secrete **progesterone** in the females. In male it activates the **Leydig's** (interstitial) **cells** of the testis to secrete **androgens.**

Somatotropins or somatotropic hormone or **growth hormone** stimulates growth directly and in conjugation with other hormones the target cells of these hormones are various body cells which undergo growth.

Luteotropic hormones stimulates the corpus luteum of the ovary to secrete progesterone hormone. It is also called Prolactin Hormone (PRL) or **Mammotropin Hormone** (MTH) because its main physiological effect is to activate growth of breast during pregnancy and secretion of mammary glands after child birth.

Oxytocin (OT; pitocin) is secreted by posterior lobe of pituitary. It promotes contraction of the uterine muscles and myoepithelial cells of the lactating breast, ejecting the milk after child birth. Oxytocin is called **birth hormone** and **milk ejecting hormone.**

20. **Fossils** provide the direct evidences of organic evolution. Fossils may be entire organisms buried in sediment or snow, small part of ancient organisms or impression of extinct organisms, ancient leaf or stem.

Morphology is the study of form and structure in organisms. Comparative study of homologous and analogous organs provide evidence of evolution under functional anatomy (tectology).

Comparative **embryology** (study of embryo) provides evidence of organic evolution which is based on basic laws or principles of embryonic development (the biogenetic law or recapitulation theory).

Vestigial organs are degenerate, non-functional and rudimentary organs correspond to fully developed and functional organs of related organisms. They also afford to provide evidences for organic evolution.

But, among them most evident and direct proof of evolution is provided by fossils.

21. In Mollusca, each eye is located upon a stumpy peduncle called **ommatophore.**

In Mollusca, a loose skin fold, called mantle, dorsally covers most of the body and encloses a large mantle cavity. The mantle cavity contains the rectum, genital duct, a penis in males and a small bipectinate chemoreceptor called osphradium.

In Mollusca, the large oval aperture or mouth of the shell can be tightly closed by a thick, plate-like operculum attached to the foot.

22. Turbellaria (*L. turbella* — a string) is a class of phylum—Platyhelminthes. Turbellarians are mostly free, living flat worms, majorly aquatic (marine), presence of cilia, body unsegmented, mouth ventral, suckers absent with tango, chemo and photoreceptors, *eg*, *Planaria* (*Dugesia*), *Bipalium* etc.

Trematoda (Gr. *trema* = hole; *eidos* = form), class of phylum—Platyhelminthes. Commonly called 'flukes', ecto or endoparasites, body without cilia, unsegmented with suckers and hooks, *eg*, *Fasciola, Schistosoma* etc.

Cestoda (Gr. *kestos* = girdle *eidos* = form) is also one of the class of phylum—Platyhelminthes. They are commonly called 'tapeworms' parasites without cilia and sense organs body segmented (pseudometamerism), digestive system absent, *eg*, *Taenia* and *Echinococcus.*

23. **Coelenterata** (coelom + enteron) or phylum Cnidaria shows both sexual and asexual reproduction. The larval stages are **planula** (*Obelia*) and **ephyra** (*Aurelia*).

Cysticercus (bladder worm) is the third larval stage seen in *Taenia* besides oncosphere, hexacanth (other two larval stages). Cysticercus is seen after the hexacanth released in the stomach of pig, which, goes through blood circulation and on reaching muscles get encysted in the form of bladderworm.

Rhabditiform is the first larval stage in *Ascaris* which is formed within 10-14 days. It is non-infective juvenile stage which rests for a week and completes first moult within egg and becomes second stage rhabditiform larva which is infective. The larva is called rhabditiform or rhabditoid because of its close resemblance with *Rhabditis.*

Wriggler is the larva of mosquito. It is free-swimming, active, aquatic larva performing wriggling movements. It has a life-span of 3-4 days.

24. A compact, some what flattened and whitish mass, called epididymis is closely abutted against the dorsal aspect of each testis. In rabbit head of epididymis present at the head of the testis is called caput epididymis.

Epididymis differentiated into smaller posterior enlarged part called **cauda epididymis.**

Testes of rabbits are about 15 to 20 mm long and 10 mm thick, oval and pinkish structures. Each is held in its position within its scrotal sac and is supported from posterior scrotal wall by means of a small cord of fibro-muscular mesodermal tissue called gubernaculum.

From the tip of cauda epididymis, the Wolffian duct continues forwards as an uncoiled and some what thicker male genital duct or **vas deferens.**

25. **In dissolved state** 7% of CO_2 gets dissolved in the blood plasma and is carried in solution to lungs or about 0.3 mL of CO_2 is transported per 100 mL of blood in dissolved state in blood plasma.

In the form of bicarbonate about 70% of CO_2 (about 2.5 mL per 100 mL of blood) received by blood from tissues, enters the RBCs where it reacts with water to form carbonic acid (H_2CO_3).

As carbaminohaemoglobin about 23% of CO_2 is transported in combination with haemoglobin and plasma proteins. CO_2 reacts directly with amine radicals (NH_2) of haemoglobin to form an unstable compound carbamino-haemoglobin (Hb. CO_2).

Sodium bicarbonate acts as buffer of blood.

26. **Hibernation** is the inactive stage during winter or the dormancy during winter. It is known as winter sleep.

Aestivation in zoology is the dormancy during summer or dry weather.

In botany, it is the arrangement of parts in flower bud.

Adaptation is the sum total of environmental condition achieved by the organisms in a habitat.

Acclimatization is gradual physiological adaptation in response to enviromental changes.

27. **Kupffer cells** are the phagocytic cells present over the lining of 'sinusoids' (spaces between the hepatic cords) in liver. These cells destroy wan-out white and red blood cells and bacteria.

Small intestine possess paneth cells and Argentaffin cells secreting digestive enzymes. These cells are present on simple tubular pits of intestinal glands known as 'crypts of Lieberkuhn'.

Pancreas possess groups of cells, islets of Langerhans which contain four type of cells : Alpha cells (32-38%), Beta cells (60-70%), Delta and F-cells (2%-8%)

Thyroid gland possess spherical sacs called thyroid follicles. Wall of follicle is made of two types of cells, **Principal cells** and **Parafollicular cells.**

28. The embryo at the 16-celled stage is called the **morula.** It is the mass of cells resulting from the cleavage of the ovum before the formation of a blastula.

Blastomere is any cells produced during cleavage.

Blastula is the early development stage of a metazoan, following the morula stage and consisting of a single, spherical layer of cells that encloses a hollow, central cavity.

29. Contractile vacuole is the clear rounded, pulsating body present in the posterior part of endoplasm of *Amoeba.* It is found only in fresh water forms and is mainly concerned with osmoregulation, *ie,* removal of excess of water.

Plasmalemma, a trilaminar and selectively permeable membrane covering the body, functions both in excretion (ammonia) and respiration in *Amoeba.*

Pseudopodia (false feet) are finger—like and blunt-extensions of cell body in protozoans. In *Amoeba,* the type of pseudopodium found in lobopodium, composed of both ectoplasm and endoplasm. It is temporary locomotory structure which is also meant for feeding in *Amoeba.* Locomotion of *Amoeba* is known as **'amoeboid movement'** (Sol-gel theory).

30. Ca^{2+} is essential of muscle contraction, neutro-muscular functions and nerve impulse transmission. During nerve impulse transmission, as an impulse arrives at a synaptic knob, calcium ions (Ca^{2+}) diffuse into the knobs from surrounding tissue fluid. Ca^{2+} trigger a process in which numerous synaptic vesicles fuse with the membrane of the knob and the areas of fusion break down; releasing the contents of vesicles into the fluid of synaptic clefts.

31. Ornithine cycle or urea cycle or Krebs-Henseleit cycle was discovered by Hans Krebs and Kurt Henseleit. It takes place in liver cells. The main component of ornithine cycle are arginine, ornithine and citrulline.

32. When a change in the chromosome number does not involve entire sets of chromosome and restrict to only a few of chromosome, the situation is called aneuploidy. Aneuploidy may be of following types
(a) Monosomic ($2n - 1$)
(b) Trisomic ($2n + 1$)
(c) Nullisomic ($2n - 2$)
(d) Tetrasomic ($2n + 2$)
(e) Double momosomic ($2n - 1 - 1$)
(f) Double trisomic ($2n + 1 + 1$)

33. Vestigial organs are imperfectly developed, non-functional organs which were fully developed and functional in related and ancestral forms

Example : Nictitating membrane, tail vertebrae, vermiform appendix.

34. In commensalism, association between members of different species is made in the way that one is benefitted and neither is harmed, *eg,* small fish (sucker fish) gets stuck near the bottom of a shark with the help of its hold fast (modified dorsal fin) and is dispersed to distant areas. It also gets protection (due to association with shark) and derive its nutrition also. However, the shark does not get any benefit or harm form the sucker fish.

Antibiosis refers to the complete or partial inhibition of one organism by another through the production of some substance or environmental conditions as a result of metabolic pathways.

In parasitism the parasite organisms derives food and sometimes shelter also, from the host without killing it.

In predation, predatory organisms are free living which catch and kill another species for food.

35. Amnion is an extraembryonic membrane that surrounds embryo in reptiles, birds and mammals. The vertebrate animals which lack amnion are known as anamniotes, *eg,* fishes and amphibians.

36. The excretory and osmoregulatory organs of fishes are the gills and kidney. Excretion in bony fishes is ureotelic (*ie,* they excrete urea) but some fresh water bony fishes are ammonotelic (*ie,* excrete ammonia).

37. White blood cells are also known as leucocytes. There are two main groups of WBCs
(a) Agranulocytes (30%)
(b) Granulocytes (70%)

Granulocytes are made in the bone marrow but by the cells different from those that make red blood cells. These can be further subdivided into
(i) Neutrophils
(ii) Eosinophils
(iii) Basophils.

Neutrophils (phagocytes) make up about 70% of the total number of granular WBCs. They commonly squeeze between the cells of the capillary walls and wander through the intercellular spaces. They are actively phagocytic which engulf and digest disease causing bacteria.

38. Periodically filling the lung with atmospheric air and then emptying these is called breathing or ventilation of the lungs. Breathing in is called inspiration or inhalation and breathing out is called expiration or exhalations. During inhalation or inspiration the diaphragm contracts putting backwards by partial flattening and increase the thoracic cavity lengthwise.

39. The pineal body (gland) is small mass of tissues near the centre of the mammalian brain. The pineal secretes the hormone melatonin, a modified amino acid. The pineal contains light sensitive cells and has nervous connections from the eyes and melatonin regulates function related to light. It also regulates sexual behaviour and regulating the period of puberty.

40. Synsacrum is the thoracic region of vertebral column in fowl. It consists of about 16 fused vertebrae and provide support to ilia bones of immense pelvic girdle.

BOTANY

1. **'Jumping genes'** or **movable genetic elements** were discovered by 'Barbara McClintock' (1902-92) in maize. These 'controlling elements' could move from one location to another on the chromosome.

Barbara McClintock got the Nobel Prize for these genetic elements (Ds=Dissociation gene, Ac=Association gene) which can jump to any chromosome from their original location on chromosome.

The term **'transposon'** was introduced by R W Hedges and A E Jacob (1974) to these genetic element (jumping gene).

Hugo de Vries introduced the term **'mutation'**, in connection with the studies on *Oenothera lamarckiana* (evening primrose). His theory is known as mutation theory.

T H Morgan proposed the 'gene theory' (linkage of genes) and crossing over.

Gregor Johann Mendel (1822-1884) is known as the 'father of genetics'. The first scientific study leading to formulation of laws of inheritance was carried out by Mendel.

2. Streptomycin is obtained from *Streptomyces griseus.*
   Auromycin (tetracyclin) is obtained from *Streptomyces aureofaciens.*
   Chloromycetin is obtained from *Streptomyces venezuelae.*
   Terramycin is obtained from *Streptomyces ramosus.*

3. Indusium is a membranous structure which covers a group of sporangia below it. It is differentiated, into a kidney-shaped dorsal plate called hood and a short stalk through which it remains attached with the undersurface of the pinnule at a swollen base called placenta. The sporangia attached with a placenta form group called sorus (pl. sori). Different types of **sorus** (simple, gradate, mixed) are seen to be present in a box like structure called sporocarp formed on the vegetative leaf, *ie,* frond of ferns.

   Such spore producing structure, sorus, covered by a membranous structure is not found in any group of plants (Algae, Bryophyta, Gymnosperms) except, ferns of Pteridophyta.

4. The vacuole is lined by a membrane called **tonoplast.**

   Jacket layer is present around archegonia and antheredia in bryophytes.

   Tonoplasm is the content or liquid present inside the vacuole enclosed by a tonoplast membrane.

   Cell membrane is the semi-permeable membrane enclosing the protoplasmic material of a cell.

5. *Gelidium, Gracilaria, Pterocladia* are red algae having industrial importance. They produce a jelly like substance agar-agar, used as culture medium with a number of different uses.

   Chlorella, a green alga contains 50% protein, vitamins. Antibiotic chlorellin has been extracted from *Chlorella,* found to be more effective against bacteria.

   Spirogyra, a green alga is also known as water-silk.

6. **Transposon** is a **DNA segment** or genetic element moving from one chromosome to another. The 'term', was introduced by R W Hedges and A E Jacob in 1974, to **'controlling elements'** or **jumping genes'**, discovered by Barbara McClintock (1950) in maize.

   Cistron is the functional unit of DNA molecules, it codes for a particular gene product.

   Recon is the cross-over unit or it is segment of DNA which participates in crossing over.

   'Introns are the interrupted genes or those regions of a gene which do not form the part of *mRNA* and are removed from primary *mRNA* during gene expression in eukaryotes. These are non-coding sequences which get removed during splicing and processing.

7. AUG which codes for methionine (Met) is used as start signal in protein synthesis. It is the most common chain **initiation codon.**

   In prokaryotes, the codons GUG and UUG are also employed in instances as start codons.

   Three triplets, **UAA** (ochre), **UAG** (amber) and **UGA** (opal) do not code for any amino acid and are called **non-sense codons.** Their function is to terminate the message for gene controlling protein synthesis. Non-sense codons are also called **chain termination codons.**

   UUU (uracil) codes for phenylalanine.

8. **DNA multiplication** or duplication of DNA takes place by replication. It takes place during S-phase of interphase during cell-cycle. DNA replication is semi-conservative was strongly evidenced by **Mathew Meselson** and **Frankli Stahl** in 1958 in *E. coli.*

   Transcription is the mode by which DNA passes its genetic information to *mRNA.* It is the first step in protein synthesis which takes place in nucleus of eukaryotic cells.

   Translation is the synthesis of a chain of polypeptide by *mRNA.* It is the process when protein synthesis takes place at the site of ribosomes. It involves 3 steps initiation, elongation and termination.

   Transduction is the transfer of genes from one bacterial cell to another by means of a virus. Transduction was discovered by **Zinder** and **Lederberg** in 1952.

9. After certain years of growth, the xylem elements of the stems of a number of trees develop dark brown colouration, especially in the central or innermost layers. This region comprises dead element with highly lignified walls and is called heart wood or duramen. It is present in inner region of secondary wood.

10. The force between walls and water called **adhesion force.**

    Diffusion of water from its pure or dilute solution into a stronger solution when the two are separated by a semi-permeable membrane is termed as **osmosis.** In plants water supply is due to **osmosis.**

    The absorption of water by the solid particles of an adsorbant without forming a solution is called **imbibition.**

    The loss of water in the form of liquid droplets from the leaves and other parts of an uninjured or intact plant is called guttation.

11. The fibre yielding plants fulfil the second requirement of human beings, *ie,* clothing. Such plants are known to mankind since time immemorial. The flax was cultivated in Europe even in stone age. Botanically fibres are sclerenchymatous occurring in different parts of the plant. The longest fibre of *Boehmeria nivea* measures 55 cm in length. Most of the economically important fibre yielding plants belong to family-Malvaceae (*eg, Gossypium, Hibiscus, Cannabinus, Abutilon theophrasti, Abelmoschus esculentus, Hibiscus subdariffa, Urena lobata* etc).

12. Waxes are esters formed between a long chain alcohol and saturated fatty acids. This material is typically pliable and soft when warm but hard and water resistant when cold, *eg,* **paraffin wax.**

    Steroids are complex compounds commonly found in cell membranes and animal hormones. The best known of these is the sterol called **cholesterol** which reinforces the structure of cell membrane in animal cells.

13. Photochemical smog occurs at high temperature over cities and towns due to stull air, emission of nitrogen oxides and hydrocarbons from automobile exhausts and solar energy. Nitrogen dioxide splits into nitric oxide and **nascent oxygen.** Nascent oxygen combines with molecular oxygen to form ozone. **Ozone** reacts with hydrocarbons to form aldehydes and ketones. **Nitrogen oxide, oxygen** and **ketones** combines to form **Peroxy Acyl Nitrates** (PAN) which is responsible for the eye irritation. This smog was first observed in Los Angeles, so called as **Los Angeles smog.**

    Classical (London) Smog was reported in 1952 in London. It occurs at low temperaure, contains **sulphur gases** (hydrogen sulphide, sulphur dioxide), smoke and dust particles.

14. **Metaphase** in both mitosis and meiosis is characterized by the orientation of chromosomes themselves on the spindle fibres at the equatorial plate.

    Prophase is the first phage and the longest of all phages. Chromatin of the nucleus become condensed forming chromosomes.

    Anaphase is characterized by the separation of chromatids. Chromatids move in opposite direction towards the pole. Contraction of spindle fibre occurs. It is the shortest of four phases in duration.

    Telophase in a sense is reversible process of prophase. Chromatin network are reformed from chromosomes. The nuclear membrane and nucleolus (which disappeared at late prophase) reappears.

15. Soil transportation by wind is common in dry regions where soil is chiefly sandy and the vegetation is very poor. Transported soils are those where the weathered material is taken away at other places. Depending on the nature of these transporting agents the transported soil may be
    (i) **Glacial** transportation by glaciers (large mass of snow ice)
    (ii) **Eolian** Transportation by wind
    (iii) **Alluvial** Transportation by running water
    (iv) **Colluvial** Transportation by gravity.

16. **'Tubulin'** is a cytoskeletal globular protein that polymerizes to form **microtubules.** It plays a

motile and contractile role in cell structure and cell division. During cell division, the microtubules radiate from each end of the cell form a basket like arrangement (the spindle) which helps in the movement of chromosomes to poles.

The principal protein of cilia and flagella is also tubulin. Microtubules play a key role in the movement of cilia and flagella.

Intermediate filaments are tough rope-like bundles or protein (keratin, desmin, peripherin, vimentin etc). Intermediate filaments provide mechanical stability to cells. They interact with microfilaments (made of protein, actin) and microtubules to form cytoskeleton.

17. The occurrence of relatively definite sequence of communities over a period of time in the same area is known as ecological succession.

Lithosere is a type of xerosere originating on bare rock surfaces. The original substratum is deficient in water and lacks any organic matter having only minerals in disintegrated unweathered state. The pioneer vetegation is, therefore, lichens.

Hydrosere originating in a pond starts with the colonization of some phytoplanktons which form the pioneer plant community.

18. **Microsporophylls** and **megasporophylls** are the leaf-like structures on which microsporangia (pollen sacs) and magasporangia are borne on the same plant of *Pinus*. The sporophylls are aggregated in form of cones.
   (a) Male cones are smaller, also known as microstrobili (staminate strobili).
   (b) Female cones are larger, known as macrostrobili (ovulate strobili).

Each male cone consists of an elongated axis, bearing a number of spirally arranged **microsporophylls.** On the underside of which two microsporangia develop and get filled with microspores (pollen grains).

Anther or **microsporangium** is the male reproductive structures of **angiosperms.** Microsporangium forms microspores (pollens), through microsporogenesis.

Ligule is a tongue-like membranous outgrowth, present on upper surface, near the base of the microphyllous leaf in pteridophytes (*eg, Selaginella*). The ligule shrinks and becomes inconspicuous in mature leaves.

19. **Vernalization** is chilling or cold treatment of the young plants or seeds to induce flowering. It is a process of shortening of the juvenile or vegetative phase and fastening the flowering by a process of cold treatment. It was first reported by a Russion worker, Lysenko (1928) while working on cold requiring biennial plants. Common examples of plants requiring vernalization are winter rye, winter wheat, winter barley, pea, *Chrysanthemum* etc.

Cryobiology is the study of life at low temperature, usually at liquid nitrogen (i.e. –196°C) and preservation of organisms in liquid by chemical methods.

Photoperiodism is the effect of photoperiods or daily duration of light hours (and dark periods) on the growth and development mainly flowering in plants. It was first studied by 'Garner and Allard' (1920) on 'Maryland Mammoth' variety of tobacco.

20. **Decomposers** are organotrophs, which feed on dead bodies of organisms and organic wastes of living organisms.

Producers are photosynthetic or autotrophic plants which are able to synthesize organic food from inorganic raw materials with the help of solar radiations.

Heterotrophs are some times referred as organotrophs.

21. Polyembryony is of common occurrence among the gymnosperms. This is possible because more than one archegonia are fertilized and more than one zygotes are formed. These develops into embryos, but only one of them succeeds in developing into a complete embryo. In the conifers there is a cleavage polyembryony. In this case all the four cells of the young embryo separate and develop into 4 embryos, but only one completely develop and others abort, *eg Pinus*.

22. The cap and the stalk together constitute the fruiting body called the **basidiocarp** or **sporocarp.** Because of the presence of characteristic gills the members of Agaricaceae family are generally called the gill or gilled fungi. They are generally fleshy and are also known as fleshy fungi. Some of these gilled or fleshy fungi are edible, ordinarily the edible fleshy (or filled) fungi are called the mushrooms.

23. **Calyptra** is a small sheath of cells, derived from the archegonia, which covers top of the capsule.

Capsule is a sporophytic region of mosses.

Antheridia is a small structure that produces sperms in bryophytes or pteridophytes.

In fungi the young sporangium is a white spherical structure situated at the free end of the sporangiophore. At maturity it turns black. The black colour is due to the presence of sooty spores. The centre of the sporangium is a large dome-shaped structure called the columella.

24. 'Clamp connections' are observed in Basidiomycetes (club fungi). During nuclear divisions of the dikaryotic cell, special structures called the **clamp connections** are formed. These **clamp connections** ensure that the sister nuclei of the dikaryon, at each division, separate into daughter cells.

Torula stage of fungus is observed in **Zygomycetes.** In Zygomycetes the zygospore germinates to produce a hypha, the promycelium with terminal sporangium.

In Oomycetes one of the flagellum is of tinsel type and the other of whiplash type. The hyphal wall chiefly consists of β glucans and cellulose and not chitin. The mycelium is extensive and coenocyt c.

In Ascomycetes the spore of sexual stage (meiospores) which are known as the ascospores are endogenous in origin. They are produced within sac-like structures called asci which very in shape.

25. **Deforestation** is the depletion of forest resources. Its main cause is the explosion of human and livestock population with the increased demand of the basic needs. Ideally one third (33%) of land of a country must be covered by forest. In India forest cover is only 19.43% out of which only 13% are thick forest. India is losing about 1.5 million hectare of forest covers each year. The major effect of deforestation is the loss of precious wild life, rare species of flora and fauna. Directly or indirectly, deforestation caused intensified soil erosion, accentuated flood, drought and the worst pollution.

Afforestation or reforestation is the only major way to conserve the natural resources and the previous rare species.

26. **Transpiration pull** is the tension which develops due to transpiration. It has been demonstrated and evidenced, that rate of water absorption and hence, ascent of sap closely follows the rate of transpiration and hence, ascent of sap closely follows the rate of transpiration. **Cohesion** and **transpiration** pull theory, given by Dixon and Jolly (1894) is the most accepted theory for ascent of sap.

Root Pressure theory (Priestley; 1916) is a manifestation of active water absorption. It was objected, as it has not been applicable to all plants (*eg*, gymnospermous tallest trees). Moreover, this pressure is low to raise the sap to the top of trees and also many reasons which this theory was unable to proove.

Pulsation theory or **vital force theory** (J C Bose; 1923) was also discarded because living cells do not seen to be involved in the ascent of sap as water continuous to rise upward in the plant in which roots have been cut or living cells of stem are killed by poison and heat (Strassburger; 1891).

Capillarity theory (Bohm; 1863), laid stress on capillarity movement of water due to adhesion and cohesion forces balanced by downward pull of gravity. It was also discarded, as the value of capillary is too small and applicable only to small sized plants and tall plants with narrow vessels.

27. Gymnosperms (*Gymno* = naked + *sperma* = seed) are naked seeded plants in which ovule is not covered by ovary. In gymnosperms, xylem contains only tracheids and xylem parenchyma; vessels are absent (exceptionally present in Gnetales).

28. The presence of diversity at the junction of terretories of two different habitats is known as edge effect. In other words, the potential for the ecotone to act as habitat for species found in neither major community is called edge effect. In actual, the transition zone between two or more diverse communities is called the ecotone, the population of which becomes more adapted than both the major communities (communities of neighbouring habitats) which are too simple. In addition to this, in this region the density of most of the species is higher than that in the neighbouring.

29. In plants food produced by photosynthesis is transported in the form of sucrose through phloem. It is estimated that 90% of the total solute carried in the phloem is the carbohydrate sucrose, a disaccharide which is relatively inactive and highly soluble sugar with little direct role in metabolism.

30. In *Cycas*, pollination takes place in 3-celled stage, *ie*, pollen grain divides to form three cells, which are
(i) Prothallial cell
(ii) Generative cell
(iii) Tube cell.

31. A bioassay is a measurement of the effect of a known or suspected biologically active substance on living material. Went used *Avena sativa* (oat) coleoptiles in a technique called the *Avena* coleoptile curvature test for auxin.

32. In eukaryotic genes some non-coding parts are interspersed between coding parts. These non-coding parts are called introns and coding sequence are known as exons, *ie*, exons play significant role in protein synthesis.

33. The shape of the chromosome is determined by the position of centromere on the chromosome. Chromosomes may be of following five types on the basis of their shape.
(i) **Acentric**—Centromere remains absent.
(ii) **Telocentric**—Centromere present at one end of chromosome.
(iii) **Acrocentric**—When chromosome is divided into a very small segment at one end and a very large segment on the other end.
(iv) **Submetacentric**—When chromosome have two unequal segments, one of which is slightly larger than other and forms L-shaped chromosome.
(v) **Metacentric**—When two segments are equal and forming V-shaped structure.

34. **Eichler** (1883) divided plant kingdom into two sub-kingdoms.
(i) **Cryptogamae**— Plants having no flowers such as algae, fungi, bryophytes and pteridophytes
(ii) **Phanerogamae**—Plants having evident reproductive organs like flowers and seeds such as angiosperms and gymnosperms.

35. As we know that bacterium divided after every 35 minutes through simple mitotic division therefore, number of divisions are $\frac{175}{35} = 5$

Since, one bacterium on division produces two cells so, cell concentration after 175 minutes will be

$$= 10^5 \times (2)^5$$
$$= 32 \times 10^5$$

36. As per 'Active K^+ transport mechanism' accumulation of K^+ ions occurs in the guard cell during the day in response to light. It increases the turgidity of guard cells, consequently stomata open.

During night, ions move out of the guard cells into surrounding epidermal cells consequently guard cells become flaccid and stomata close.

37. A species can be defined as a group of closely related organisms which are capable of inbreeding to produce fertile offspring. Thus biological concept of species is mainly based on reproductive isolation, which preserve the integrity of the species by checking hybridization.

38. During waste water treatment :
(a) Primary treatment involves physical process of removing the suspended matters.
(b) Secondary treatment involves biological treatment.
(c) Tertiary treatment involves the removal of phosphate, nitrate and sulphate.

39. The post fertilization changes in the seeds are as follows—
Ovule—Seed
Ovary—Fruit
Nucellus—Perisperm (a nutritive tissue)
Integument—Seed coat.

40. The root cell of flowering plant is diploid ($2n = 24$) while the gamete is haploid therefore, the number of chromosomes becomes 12 in the gamete.

The cells of stem, leaf and somatic cells of flower are diploid, therefore, they contain the chromosome number $2n = 24$.

JIPMER
Medical Entrance Exam
Solved Paper 2010

Physics

1. The potential energy of a particle varies with distance x from fixed a origin as $v = \left(\frac{A\sqrt{x}}{x+B}\right)$; where, A and B are constants. The dimensions of AB are
(a) $[ML^{5/2}T^{-2}]$
(b) $[ML^2T^{-2}]$
(c) $[M^{3/2}L^{3/2}T^{-2}]$
(d) $[ML^{7/2}T^{-2}]$

2. A weightless thread can bear tension upto 37 N. A stone of mass 500 g is tied to it and revolved in a circular path of radius 4 m in a vertical plane. If $g = 10\ ms^{-2}$, then the maximum angular velocity of the stone will be
(a) 2 rad s^{-1} (b) 4 rad s^{-1}
(c) 8 rad s^{-1} (d) 16 rad s^{-1}

3. Two spherical bodies of masses M and $5M$ and radii R and $2R$ respectively are released in free space with initial separation between their centres equal to 12 R. If they attract each other due to gravitational force only,then the distance covered by the smaller body just before collision, is
(a) 1.5R (b) 2.5 R
(c) 4.5 R (d) 7.5 R

4. The moment of inertia of a uniform circular disc of radius R and mass M about an axis passing from the edge of the disc and normal to the disc is
(a) MR^2 (b) $\frac{1}{2}MR^2$
(c) $\frac{3}{2}MR^2$ (d) $\frac{7}{2}MR^2$

5. A satellite orbiting the earth in a circular orbit of radius R completes one revolution in 3h. If orbital radius of geostationary satellite is 36000 km, orbital radius of earth is
(a) 6000 km (b) 9000 km
(c) 12000 km (d) 15000 km

6. A wire can be broken by applying load of 200 N. The force required to break another wire of the same length and same material, but double in diameter is
(a) 200 N (b) 400 N
(c) 600 N (d) 800 N

7. A cube of side 40 mm has its upper face displaced by 0.1 mm by a tangential force of 8 kN. The shearing modulus of cube is
(a) $2 \times 10^9\ Nm^{-2}$
(b) $4 \times 10^9\ Nm^{-2}$
(c) $8 \times 10^9\ Nm^{-2}$
(d) $16 \times 10^9\ Nm^{-2}$

8. The neck and bottom of a bottle are 3 cm and 15 cm in radius respectively. If the cork is pressed with a force 12 N in the neck of the bottle, then force exerted on the bottom of the bottle is
(a) 30 N (b) 150 N
(c) 300 N (d) 600 N

9. A square wire frame of size L is dipped in a liquid. On taking out a membrane is formed. If the surface tension of liquid is T, then force acting on a frame will be
(a) $2TL$ (b) $4TL$
(c) $8TL$ (d) $16TL$

10. 64 spherical rain drops of equal size are falling vertically through air with a terminal velocity 1.5 ms^{-1}. If these drops coalesce to form a big spherical drop, then terminal velocity of big drop is
(a) 8 ms^{-1} (b) 16 ms^{-1}
(c) 24 ms^{-1} (d) 32 ms^{-1}

11. The equation of a wave is $y = 5\sin\left(\frac{t}{0.04} - \frac{x}{4}\right)$; where, x is in cm and t is in second. The maximum velocity of the wave will be
(a) 1 ms^{-1} (b) 2 ms^{-1}
(c) 1.5 ms^{-1} (d) 1.25 ms^{-1}

12. Two vibrating strings of the same material but lengths L and $2L$ have radii $2r$ and r respectively. They are stretched under the same tension. Both the strings vibrate in their fundamental modes, the one of length L with frequency ν_1 and the other with frequency ν_2. The ratio ν_1/ν_2 is
(a) 2 (b) 4
(c) 8 (d) 1

13. 1 mole of an ideal gas at an initial temperature of T K does $6R$ joule of work adiabatically. If the ratio of specific heats of this gas at constant pressure and at constant volume is 5/3, then final temperature of the gas will be
(a) $(T-4)$K (b) $(T+4)$K
(c) $(T-2.4)$K (d) $(T+2.4)$K

14. Consider a compound slab consisting of two different materials having equal lengths, thicknesses and thermal conductivities K and $2K$ respectively. The equivalent thermal conductivity of the slab is
(a) $\sqrt{2}K$ (b) $3K$
(c) $\frac{4}{3}K$ (d) $\frac{2}{3}K$

15. A black body has a wavelength of λ at temperature 2000 K. Its corresponding wavelength at temperature 3000 K will be
(a) $\frac{2\lambda}{3}$ (b) $\frac{3\lambda}{2}$
(c) $\frac{4\lambda}{9}$ (d) $\frac{9\lambda}{4}$

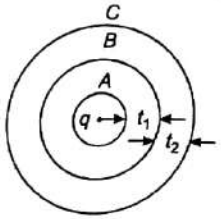
16. A plane mirror produces a magnification of
(a) zero (b) −1
(c) +1 (d) between 0 and +1

17. Two coherent light beams of intensities I and $4I$ are superposed. The maximum and minimum possible intensities in the resulting beam are
(a) $5I$ and I
(b) $5I$ and $3I$
(c) $9I$ and I
(d) $9I$ and $3I$

18. If Young's double slit experiment is performed in water instead of air, then
(a) no fringes would be seen
(b) fringe width would decrease
(c) fringe width would increase
(d) fringe width would remain unchanged

19. A charge q is located at the centre of a cube. The electric flux through any face is
(a) $\frac{4\pi q}{6(4\pi\varepsilon_0)}$ (b) $\frac{\pi q}{6(4\pi\varepsilon_0)}$
(c) $\frac{q}{6(4\pi\varepsilon_0)}$ (d) $\frac{2\pi q}{6(4\pi\varepsilon_0)}$

20. Figure shows three spherical and equipotential surfaces A, B and C round a point charge q. The potential difference $V_A - V_B = V_B - V_C$. If t_1 and t_2 be the distances between them, then



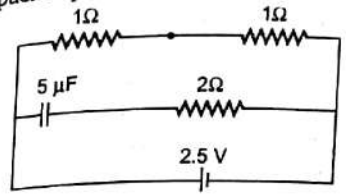
(a) $t_1 = t_2$ (b) $t_1 > t_2$
(c) $t_1 < t_2$ (d) $t_1 \le t_2$

21. Three capacitors of capacitances 1 μF, 2μF and 4μF are connected first in a series combination, and then in a parallel combination. The ratio of their equivalent capacitances will be
(a) 2 : 49 (b) 49 : 2
(c) 4 : 49 (d) 49 : 4

22. At room temperature, copper has free electron density of $8.4 \times 10^{28} m^{-3}$. The electron drift velocity in a copper conductor of cross-sectional area of $10^{-6} m^2$ and carrying a current of 5.4 A, will be
(a) 4 ms^{-1} (b) 0.4 ms^{-1}
(c) 4 cm s^{-1} (d) 0.4 mm s^{-1}

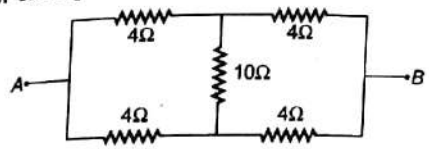
23. A uniform wire of resistance R and length L is cut into four equal parts, each of length $L/4$, which are then connected in parallel combination. The effective resistance of the combination will be
(a) R (b) $4R$
(c) $\frac{R}{4}$ (d) $\frac{R}{16}$

24. A capacitor of capacitance 5μF is connected as shown in the figure. The internal resistance of the cell is 0.5 Ω. The amount of charge on the capacitor plates is



(a) 80 μC (b) 40 μC
(c) 20 μC (d) 10 μC

25. The equivalent resistance across A and B is



(a) 2Ω (b) 3Ω
(c) 4Ω (d) 5Ω

26. An electric current passes through a long straight copper wire. At a distance 5 cm from the straight wire, the magnetic field is B. The magnetic field at 20 cm from the straight wire would be
(a) $\frac{B}{6}$ (b) $\frac{B}{4}$
(c) $\frac{B}{3}$ (d) $\frac{B}{2}$

27. An electron of mass m and charge q is travelling with a speed v along a circular path of radius r at right angles to a uniform magnetic field B. If speed of the electron is doubled and the magnetic field is halved. then resulting path would have a radius of
(a) $\frac{r}{4}$ (b) $\frac{r}{2}$
(c) $2r$ (d) $4r$

28. A galvanometer acting as a voltmeter should have
(a) low resistance in series with its coil
(b) low resistance in parallel with its coil
(c) high resistance in series with its coil
(d) high resistance in parallel with its coil

29. A frog can be levitated in magnetic field produced by a current in a vertical solenoid placed below the frog. This is possible because the body of the frog behaves as
(a) paramagnetic
(b) diamagnetic
(c) ferromagnetic
(d) anti-ferromagnetic

30. The magnetic flux linked with a coil at any instant t is given by the equation $\phi = 5t^3 - 100t + 300$. The magnitude of emf induced in the coil after 3 s is
(a) 10 V (b) 20 V
(c) 35 V (d) 70 V

31. In 0.1 s, the current in a coil increases from 1 A to 1.5A. If inductance of coil is 60 mH, then induced current in external resistance of 3Ω will be
(a) 1 A (b) 0.5 A
(c) 0.2 A (d) 0.1 A

32. The impedance of a circuit, when a resistance R and an inductor of inductance L are connected in series in an AC circuit of frequency f, is
(a) $\sqrt{R + 2\pi^2 f^2 L^2}$ (b) $\sqrt{R + 4\pi^2 f^2 L^2}$
(c) $\sqrt{R^2 + 4\pi^2 f^2 L^2}$ (d) $\sqrt{R^2 + 2\pi^2 f^2 L^2}$

33. In a series L-C-R circuit, resistance $R = 10\,\Omega$ and the impedance $Z = 10\,\Omega$. The phase difference between the current and the voltage is
(a) 0° (b) 30°
(c) 45° (d) 60°

34. Which of the following electromagnetic waves have the smallest wavelength?
(a) γ-rays (b) X-rays
(c) UV waves (d) Infrared rays

35. The kinetic energy of an electron, which is accelerated in the potential difference of 100 V, is
(a) 1.6×10^{-17} J (b) 1.6×10^{-14} J
(c) 1.6×10^{-10} J (d) 1.6×10^{-8} J

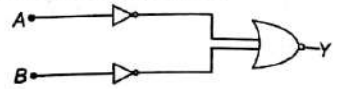
36. J.J. Thomson's cathode ray tube experiment demonstrated that
(a) cathode rays are streams of negatively charged ions
(b) all the mass of an atom is essentially in the nucleus
(c) the e/m of electrons is much greater than the e/m of protons
(d) the e/m ratio of the cathode ray particles changes when a different gas is placed in the discharged tube

37. Wavelength of light emitted from second orbit to first orbit in a hydrogen atom is
(a) 6563 Å
(b) 4102 Å
(c) 4861 Å
(d) 1215 Å

38. The half-life of a radio-isotope is 4h. If initial mass of the isotope was 200g, then mass remaining after 24 h will be
(a) 1.042 g (b) 2.084 g
(c) 3.125 g (d) 4.167 g

39. If $_{92}U^{238}$ emits 8 α-particles and 6 β-particles, then the resulting nucleus is
(a) $_{82}U^{206}$ (b) $_{82}Pb^{206}$
(c) $_{82}U^{210}$ (d) $_{82}U^{214}$

40. Which logic gate is represented by the following combination of logic gates?



(a) OR (b) NOR
(c) AND (d) NAND

Chemistry

1. In the electronic structure of H_2SO_4, the total number of unshared electrons is
(a) 20 (b) 16
(c) 12 (d) 8

2. The general molecular formula for disaccharide is
(a) $C_{12}H_{22}O_{11}$ (b) $C_{10}H_{20}O_{10}$
(c) $C_{12}H_{20}O_{10}$ (d) $C_{12}H_{22}O_{10}$

3. The correct order towards bond angle is
(a) $sp^3 < sp^2 < sp$ (b) $sp < sp^2 < sp^3$
(c) $sp < sp^3 < sp^2$ (d) $sp^2 < sp^3 < sp$

4. The vapour pressure of 100g water reduces from 3000 Nm^{-2} to 2985 Nm^{-2} when 5g of substance 'X' is dissolved in it. Substance 'X' is
(a) methanol (b) glucose
(c) carbon dioxide (d) Cannot predict

5. Which of the following relation is correct ?
(a) Ist IE of C > Ist IE of B
(b) Ist IE of C < Ist IE of B
(c) IInd IE of C > IInd IE of B
(d) Both (b) and (c)

6. The complex ion which has no d-electrons in the central metal atom is
(a) $[MnO_4]^-$ (b) $[Co(NH_3)_6]^{3+}$
(c) $[Fe(CN)_6]^{3-}$ (d) $[Cr(H_2O)_6]^{3+}$

7. Which of the following configurations corresponds to element of highest ionisation energy?
(a) $1s^2, 2s^1$ (b) $1s^2, 2s^2, 2p^3$
(c) $1s^2, 2s^2, 2p^2$ (d) $1s^2, 2s^2, 2p^6, 3s^1$

8. White P reacts with caustic soda, the products are PH_3 and NaH_2PO_2. This reaction is an example of
(a) hydrolysis
(b) reduction
(c) disproportionation
(d) neutralisation

9. The solubility of saturated solution of Ag_2CrO_4 is s mol L^{-1}. What is its solubility product?
(a) $4s^3$ (b) s^3
(c) $2s^3$ (d) $16s^2$

10. Which of the following has a bond formed by overlap of $sp - sp^3$ hybrid orbitals?
(a) $CH_3—C\equiv C—H$
(b) $CH_3—CH=CH—CH_3$
(c) $CH_2=CH—CH=CH_2$
(d) $HC\equiv CH$

11. Which one of the following proteins transports oxygen in the blood stream?
(a) Myoglobin (b) Insulin
(c) Albumin (d) Haemoglobin

12. The only o p-directing group which is deactivating in nature is
(a) $—NH_2$ (b) —OH
(c) $—X$ (halogens) (d) $—R$ (alkyl groups)

13. Which of the organic compounds will give red colour in Lassaigne test ?
(a) $C_6H_5NH_2$ (b) $NH_2—\overset{\overset{S}{\|}}{C}—NH_2$
(c) $NH_2—\overset{\overset{O}{\|}}{C}—NH_2$ (d) None of these

14. For a reaction, $A + B \longrightarrow$ Product, the rate is given by,
$$r = k[A]^{1/2}[B]^2.$$
What is the order of the reaction ?
(a) 0.5 (b) 2
(c) 2.5 (d) 1

15. The density of a gas is found to be 1.56 g/L at 745 mm pressure and 65°C. What is the moleculer mass of the gas?
(a) 44.2 u (b) 4.42 u
(c) 2.24 u (d) 22.4 u

16. Considering H_2O as weak field ligand, the number of unpaired electrons in $[Mn(H_2O)_6]^{2+}$ will be (Atomic number of Mn = 25)
(a) five (b) two
(c) four (d) three

17. Ethyl alcohol reacts with thionyl chloride to give
(a) $CH_3CH_2Cl + HCl$
(b) $CH_3CH_2Cl + H_2O + SO_2$
(c) $CH_3CH_2Cl + HCl + SO_2$
(d) $CH_3CH_2Cl + SO_2 + Cl_2$

18. The quantum numbers $+\frac{1}{2}$ and $-\frac{1}{2}$ for the electron spin represent
(a) rotation of the electron in clockwise and anticlockwise direction respectively
(b) rotation of the electron in anticlockwise and clockwise direction respectively
(c) magnetic moment of the electron pointing up and down respectively
(d) two quantum mechanical spin states which have no classical analogues

19. How long it will take to deposit 1.0 g of chromium when a current of 1.25 A flows through a solution of chromium (III) sulphate ? (Molar mass of Cr = 52)
(a) 1.24 min (b) 1.24 h
(c) 1.24 s (d) None of these

20. Gabriel phthalimide reaction is used for the preparation of
(a) primary aromatic amines
(b) secondary amines
(c) primary aliphatic amines
(d) tertiary amines

21. The monomers of terylene are
(a) phenol and formaldehyde
(b) ethylene glycol and phthalic acid
(c) adipic acid and hexamethylenediamine
(d) ethylene glycol and terephthalic acid

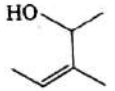
22. If a be the edge length of the unit cell and r be the radius of an atom then for fcc arrangement, the correct relation is
(a) $4a = \sqrt{3}r$ (b) $4r = \sqrt{3}a$
(c) $4r = \sqrt{2}a$ (d) $4r = \frac{a}{\sqrt{2}}$

23. CaC_2 and H_2O react to produce
(a) CH_4 (b) C_2H_4
(c) C_2H_2 (d) C_2H_6

24. Primary alcohols can be obtained from the reaction of R Mg X with
(a) CO_2 (b) HCHO
(c) CH_3CHO (d) H_2O

25. Proteins are composed of
(a) α-amino acids (b) carbohydrates
(c) vitamins (d) mineral salts

26. The IUPAC name of the following compound



, is
(a) 1, 2-dimethyl-2-butenol
(b) 3-methylpent-3-en-2-ol
(c) 3, 4-dimethyl-2-buten-4-ol
(d) None of the above

27. Ammonia gas can be dried over
(a) $CaCl_2$ (b) Conc. H_2SO_4
(c) P_2O_5 (d) quick lime

28. The number of phase in a colloidal system is
(a) 1 (b) 2
(c) 3 (d) 4

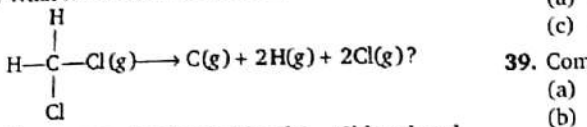
29. Which of the following has the highest bond order ?
(a) N_2 (b) O_2
(c) He_2 (d) H_2

30. Inorganic benzene is
(a) $B_3N_6H_3$ (b) $B_3N_3H_6$
(c) $Al_3N_3H_6$ (d) None of these

31. In long form of Periodic Table, the properties of the elements are a periodic function of their
(a) atomic size (b) ionisation energy
(c) atomic mass (d) atomic number

32. Which of the following is a wrong statement ? In a given period of the Periodic Table, the *s*-block element has, in general, a higher value of
(a) electronegativity (b) atomic radius
(c) ionisation energy (d) electron affinity

33. What is the ΔH of the reaction



$$H-C(Cl)-Cl(g) \longrightarrow C(g) + 2H(g) + 2Cl(g)?$$

The average bond energies of C—Cl bond and C—H bond are 416 kJ and 325 kJ mol^{-1} respectively.
(a) 1482 kJ (b) 1482 J
(c) 1492 kJ (d) 1492 J

34. Which of the following is a Lewis acid ?
(a) OH^- (b) H^+
(c) F^- (d) NH_3

35. Heating of rubber with sulphur is called
(a) vulcanisation
(b) galvanisation
(c) sulphonation
(d) bessemerisation

36. Which of the following statement is correct ?
(a) $+I$ group stabilises a carbocation
(b) $+I$ group stabilises a carbanion
(c) $-I$ group stabilises a carbocation
(d) $-I$ group stabilises a free radical

37. Dihedral angle between two methyl groups of *n*-butane in the *gauche* and *anti* forms are
(a) 60°, 0° (b) 0°, 60°
(c) 60°, 180° (d) 180°, 60°

38. A solid *AB* has the NaCl structure. If radius of cation A^+ is 120 pm, the maximum possible value of the radius of the anion B^- is
(a) 240 pm (b) 60 pm
(c) 49.6 pm (d) 290 pm

39. Common alum is
(a) $K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$
(b) $(NH_4)_2SO_4 \cdot FeSO_4 \cdot 6H_2O$
(c) $K_2SO_4 \cdot Cr_2(SO_4)_3 \cdot 24H_2O$
(d) $K_2SO_4 \cdot Fe_2(SO_4)_3 \cdot 24H_2O$

40. The bond length of HCl bond is 2.29×10^{-10} m. The percentage ionic character of HCl, if measured dipole moment is 6.226×10^{-30} C-m, is
(a) 8% (b) 20%
(c) 17% (d) 50%

Zoology

1. Which part of an animal virus is not reproduced in multiple copies?
(a) Capsid (b) Protein
(c) Envelope (d) Ribosome

2. The echinoderms are
(a) arborial insects
(b) marine animals
(c) terrestrial insects
(d) freshwater forms

3. The blood of cockroach contains no respiratory pigment. It means that
(a) respiration is anaerobic
(b) cockroach does not respire
(c) oxygen goes directly into tissues by diffusion
(d) oxygen goes into tissue by intracellular capillary system

4. Tube feet is the locomotory organ in
(a) starfish (b) jelly fish
(c) silver fish (d) *Scoliodon*

5. Follicle stimulating hormone is secreted by
(a) anterior lobe of pituitary
(b) hypothalamus
(c) gonads
(d) posterior lobe of pituitary

6. Which of the following amino acids is not optically active?
(a) Glycine (b) Valine
(c) Leucine (d) Isoleucine

7. Which of the following vitamins is water soluble as well as an antioxidant?
(a) Vitamin-B_1 (b) Vitamin-A
(c) Vitamin-D (d) Vitamin-C

8. Human ear ossicles are
(a) incus and stapes
(b) stapes
(c) incus, malleus and stapes
(d) incus and malleus

9. During strenuous exercise, glucose is converted into
(a) glycogen (b) pyruvic acid
(c) starch (d) lactic acid

10. 'Adaptation' of eyes in dark is due to
(a) depletion of vision pigment in rods
(b) depletion of vision pigment in cones
(c) repletion of vision pigment in rods
(d) repletion of vision pigment in cones

11. Human ancestors who left cave paintings were
(a) Neanderthal man
(b) Cro-magnon man
(c) Java ape man
(d) Peking man

12. *Entamoeba histolytica* differs from *Amoeba* in absence of
(a) pseudopodia (b) contractile vacuole
(c) nucleus (d) ectoplasm

13. Heparin is synthesised in
(a) liver (b) kidney
(c) saliva (d) pancreas

14. Sea gulls excrete excess of NaCl from
(a) liver (b) lungs
(c) nasal cavity (d) kidney

15. Which of the following is important for muscle contraction and nerve impulse transmission?
(a) Ca^{2+} ions (b) Ca^{2+} and Mg^{2+} ions
(c) Mg^{2+} ions (d) Fe^{2+} ions

16. Which one is component of Ornithine cycle?
(a) Ornithine, citrulline and alanine
(b) Ornithine, citrulline and arginine
(c) Amino acid are not used
(d) Ornithine, citrulline and fumaric acid

17. Bull semen is stored in
(a) liquid carbon dioxide
(b) liquid oxygen
(c) liquid nitrogen
(d) ice

18. In parasympathetic nervous system, which of the following is released?
(a) Epinephrine
(b) Norepinephrine
(c) Serotonin
(d) Acetylcholine

19. Pneumatic bones are expected to be found in
(a) house lizard (b) flying fish
(c) pigeon (d) tadpole of frog

20. Which compound has very important role in prebiotic evolution?
(a) Sulphur dioxide (b) Nitric oxide
(c) Methane (d) Sulphur trioxide

21. A man of blood group-A marries a woman of blood group-AB, which type of progeny would indicate that man is heterozygous?
(a) O (b) B
(c) A (d) AB

22. Balbiani rings are the structural features of
(a) allosomes
(b) polytene chromosomes
(c) autosomes
(d) lampbrush chromosomes

23. How many sperm cells are present in an average (3 mL) ejaculation?
(a) 200 million (b) 300 million
(c) 400 million (d) 500 million

24. The permanent decrease in population number occurs due to
(a) migration (b) natality
(c) emigration (d) mortality

25. Which one of the following is not a vestigial structural in *Homo sapiens*?
(a) Third molar
(b) Epiglottis
(c) Plica semilunaris
(d) Pyramidalis muscle

26. The velocity of conduction of nerve impulse in frog is
(a) 300 m/s
(b) same as of electricity
(c) faster than sound
(d) 30 m/s

27. Connecting link between annelids and molluscs is
(a) *Neopilina* (b) *Peripatus*
(c) *Periplaneta* (d) *Limulus*

28. The extra structure that provides nutrition to the embryo is
(a) umbilicus (b) amnion
(c) chorion (d) placenta

29. Ruminants belong to order
(a) Proboscida (b) Artiodactyla
(c) Marsupials (d) Edentata

30. Which of the following is a respiratory disease?
(a) Polio (b) Arthritis
(c) Asthma (d) Cancer

31. Sciatic vein of frog opens in
(a) heart (b) kidney
(c) pelvic region (d) liver

32. Aspirin is a/an
(a) antibiotic
(b) antipyretic
(c) antiseptic
(d) None of the above

33. Which of the following have notochord throughout life?
(a) Birds (b) Fish
(c) Snake (d) *Amphioxus*

34. First National Park developed in India is
(a) Gir (b) Kaziranga
(c) Jim Corbett (d) None of these

35. During unfavourable conditions, the sponges form
(a) cyst (b) encyst
(c) spicule (d) gemmule

36. Tree of life is
(a) arbor vitae (b) pons Varolii
(c) organ of Corti (d) diencephalon

37. Which is common between earthworm, leech and centipede?
(a) They have Malpighian tubules
(b) They are hermaphrodite
(c) They have ventral nerve cord
(d) None of the above

38. Eustachian canal connects
(a) middle ear with external ear
(b) middle ear with internal ear
(c) external ear with internal ear
(d) pharynx with middle ear

39. Shell of molluscs is derived from
(a) foot (b) mantle
(c) ctenidia (d) placoid

40. Sporogony of malarial parasite occurs in
(a) liver of man
(b) RBCs of man
(c) salivary glands of mosquito
(d) stomach wall of mosquito

Botany

41. Bacteria are considered plant because they
(a) are green in colour
(b) have rigid cell wall
(c) have chlorophyll
(d) have stomata

42. Solarisation is
(a) formation of chlorophyll
(b) destruction of chlorophyll
(c) utilisation of sunlight
(d) effects of solar light

43. Which is essential for root hair growth?
(a) Zinc (b) Calcium
(c) Molybdenum (d) Sulphur

44. A fern prothallus is bisexual. If fertilisation takes place between their gametes than it is known as
(a) cross-fertilisation (b) self-fertilisation
(c) isogamous (d) viviparous

45. In *Pisum sativum*, there are 14 chromosomes. How many types of homologous pairs can be prepared?
(a) 14 (b) 7
(c) 2^{14} (d) 2^{10}

46. Chicory powder which is mixed with coffee powder is obtained from
(a) root
(b) leaf
(c) stem
(d) seeds

47. Which of the following is not the feature of gymnosperms?
(a) Parallel venation
(b) Perennial plants
(c) Distinct branches (long and short branches)
(d) Xylem with vessels

48. In callus culture, roots can be induced by the supply of
(a) auxin (b) cytokinin
(c) gibberellin (d) ethylene

49. Stem cuttings are commonly used for the propagation of
(a) banana (b) rose
(c) mango (d) cotton

50. Pure tall plants are crossed with pure dwarf plants. In the F_1 generation, all plants were tall. These tall plants of F_1 generation were selfed and the ratio of tall to dwarf plants obtained was 3 : 1. This is called
(a) dominance (b) inheritance
(c) codominance (d) heredity

51. Edible part in 'sorosis', a composite fruit, is
(a) cotyledons
(b) endosperm
(c) perianth and peduncle
(d) fleshy thalamus

52. Which of the following is a true nut?
(a) Walnut (b) Cashewnut
(c) Groundnut (d) Pistachio

53. Most primitive member, in which roots are not present, is
(a) *Psilotum* (b) *Rhynia*
(c) *Lycopodium* (d) *Selaginella*

54. Botanical name of 'chana' is
(a) *Cicer arietinum*
(b) *Phaseolus aureus*
(c) *Lablab purpureus*
(d) *Dolichos*

55. The edible dry fruit 'chilgoza' is
(a) fruit of *Cycas*
(b) fruit of *Pinus gerardiana*
(c) seed of *Cycas*
(d) seed of *Pinus gerardiana*

56. Ubisch bodies are present in
(a) pollen tube (b) pollen gain
(c) microspore (d) tapetum

57. An obligate root parasite is
(a) *Rafflesia* (b) *Loranthus*
(c) *Viscum* (d) *Striga*

58. Lady finger belongs to family
(a) Malvaceae (b) Cucurbitaceae
(c) Liliaceae (d) Brassicaceae

59. What differentiates leaf of dicots from monocots?
(a) Parallel venation
(b) Differentiation of palisade and spongy parenchyma
(c) Stomata only on upper side
(d) Stomata both on upper and lower sides

60. The presence of diversity at the junction of territories to two different habitats is known as
(a) bottleneck effect
(b) edge effect
(c) junction effect
(d) Pasteur effect

61. Endoplasmic reticulum is in continuation with
(a) Golgi body (b) nuclear wall
(c) mitochondria (d) cell wall

62. In which form does the food transported in plants?
(a) Sucrose (b) Fructose
(c) Glucose (d) Lactose

63. Pappus is modified
(a) calyx (b) corolla
(c) bracts (d) gynoecium

64. Trimerous flower, superior ovary and axile placentation is characteristics of
(a) Liliaceae
(b) Cucurbitaceae
(c) Solanaceae
(d) Compositae

65. In *Cycas*, pollination takes place in
(a) 3-celled stage (b) 4-celled stage
(c) 2-celled stage (d) 1-celled stage

66. During the meiotic division, the
(a) homologous chromosomes are separated
(b) linkage is disturbed
(c) homologous chromosomes do not segregate
(d) All of the above

67. During the G_1-phase of cell division
(a) RNA and proteins are synthesised
(b) DNA and proteins are synthesised
(c) cell prepares for M-phase
(d) cell undergoes duplication

68. Chromosome complement with $2n - 1$ is called as
(a) monosomy (b) nullisomy
(c) trisomy (d) tetrasomy

69. The bioassay of auxin is
(a) avena curvature test
(b) callus formation
(c) culture of fungus
(d) seed dormancy

70. Clinging roots are found in
(a) orchids (b) *Trapa*
(c) *Podostemon* (d) screwpine

71. Benthic organisms are found in
(a) surface of marine water
(b) middle of water in sea
(c) bottom of sea
(d) on ground

72. Water bloom is generally caused by
(a) green algae
(b) blue-green algae
(c) bacteria
(d) *Hydrilla*

73. The process which can not take place in the absence of viruses is
(a) transformation (b) conjugation
(c) translocation (d) transduction

74. Molybdenum causes
(a) mottling (b) wilting
(c) reclamation (d) chlorosis

75. Ozone depletion in stratosphere would result in
(a) forest fires
(b) global warming
(c) skin cancer incidence
(d) None of the above

76. From which of the following plant is a medicine for respiratory disorders obtained?
(a) *Ephedra* (b) *Eucalyptus*
(c) *Cannabis* (d) *Saccharum*

77. Decarboxylation is involved in
(a) electron transport system
(b) glycolysis
(c) Krebs' cycle
(d) lactic acid fermentation

78. Osmotic pressure of a solution is
(a) greater than pure solvent
(b) less than pure solvent
(c) equal to pure solvent
(d) less than or greater than pure solvent

79. In Whittaker's system of classification, prokaryotes belong to the kingdom
(a) Monera (b) Protista
(c) Animalia (d) Fungi

80. Expanded green stem of *Opuntia* is called
(a) phylloclade (b) tendril
(c) bulb (d) cladode

General English

Direction (Q.1-5) *In each of the following questions, choose the alternative which is* ***opposite*** *in meaning to the word given in italics in the sentence.*

1. Guerillas *infiltrated* into the region during the severe winter of 1997.
(a) entered
(b) expelled
(c) penetrated
(d) filtered

2. He has always been *fastidious* while examining answer scripts.
(a) amiable (b) discriminating
(c) critical (d) judicious

3. The professor had to share a hotel room with a *garrulous* tax collector.
(a) dumb (b) speechless
(c) tongue-tied (d) silent

4. It was *fortuitous* that I met her in that party.
(a) unlucky (b) bad
(c) distressing (d) abominable

5. He is *zealous* only in the initial stages of a project.
(a) absent-minded (b) distraught
(c) inattentive (d) indifferent

Direction (Q. 6-10) *In each of the following questions, rearrange the parts* P, Q, R *and* S *to make a proper sentence.*

6. Various leading a productive (P) disabilities stand (Q) in and personally satisfying life the way of (R) millions of Indians. (S)

Which one of the following sequences is correct?
(a) Q R P S (b) P S Q R
(c) Q S P R (d) P R Q S

7. Farmers whether or not water will be available (P) land use plans only can prepare alternative (Q) (R) if they know in advance. (S)

Which one of the following sequences is correct?
(a) R S Q P (b) P Q S R
(c) R Q S P (d) P S Q R

8. No amount poor countries if they do (P) of direct aid will help not develop the capacity to (Q) (R) generate wealth for themselves (S)

Which one of the following sequences is correct?
(a) Q P R S (b) R S Q P
(c) Q S R P (d) R P Q S

9. Having achieved success to ride the next big (P) outsourcing wave in software exports and (Q) information technology areas, this time in (R) manufacturing from the U.S. Indian manufactures-exporters are well equipped. (S)

Which one of the following sequences is correct?
(a) P S Q R (b) Q R P S
(c) P R Q S (d) Q S P R

10. The majority of Britons believe that there (P) if the increasing problem (Q) must be restrictions on (R) cheap air travel of global warming is going to be (S) tackeled.

Which one of the following sequences is correct?
(a) S R Q P (b) P Q R S
(c) S Q R P (d) P R Q S

Direction (Q. 11-15) *In each of the following questions, choose the alternative which is most nearly the* ***same*** *in meaning to the word given in italics in sentence.*

11. He ended his speech on a *supercilious* note which was quite unexpected of a person of balanced and stable temperament.
(a) defamatory (b) contemptuous
(c) superfluous (d) irrelevant

12. Graduation day is *momentous* day for most students.
(a) memorable (b) melancholy
(c) important (d) hectic

13. The two opposing parties have reached a *stalemate*.
(a) dilemma (b) deadlock
(c) exhaustion (d) settlement

14. The Prime Minister delivered an *impromptu* speech to the students.
(a) important (b) impressive
(c) inspiring (d) off hand

15. This is a *lucrative* business.
(a) profitable (b) dangerous
(c) challenging (d) questionable

Direction (Q. 16-20) *In each of the following questions, choose the alternative which best expresses the meaning of the given idiom/phrase.*

16. Made a clean breast of
(a) confessed (b) took off his shirt
(c) suffered (d) spoke ill

17. A man of letters
(a) a man who wrote many letters
(b) a leader who received more letters
(c) a scholar with literary taste
(d) a good reader of letters

18. Reading between the lines
(a) reading slowly and haltingly
(b) understanding the sense rather than the actual words
(c) understanding the meaning of words and not the sense
(d) reading superficially

19. Cheek by jowl
(a) very near (b) tongue tied
(c) very far (d) irritated

20. Talking through one's hat
(a) talking nonsense
(b) talking ignorantly
(c) talking irresponsibly
(d) talking insultingly

Direction (Q. 21-25) *Read the following passage carefully and answer the questions given below it.*

Goldfish can be kept easily in small ponds and and aquariums, they make good pets, but like many other pets, they must have proper care and the right kind of place to live.

A two inch fish requires a minimum of two gallons of water containing sufficient oxygen to support life. Some oxygen will make its way into the water of an aquarium from the air that touches the surface. Plants in an aquarium also help to furnish oxygen. Snails help to keep an aquarium clean. Thus, with plenty of plants and snail, the water in an aquarium does not have to be changed frequently. A large lake may prove to be a quite unsuitable abode for goldfish.

It is important that goldfish should not be overfed. They can be fed such things as dried insects in addition to commercially prepared goldfish food, but they should never be fed more than once a day. Even then, they should not be given more food than can be consumed in about five minutes. This ensures prolonged life.

21. Which of the following statements is true?
(a) Goldfish should be given food only once a day
(b) Snails eat up the goldfish in an aquarium.
(c) Plants provide food to the snails
(d) Goldfish comes above the surface of water to get oxygen from air

22. Which of the following statements is not true?
(a) Snails make the aquarium clean by eating up goldfish
(b) Two gallons of water with sufficient oxygen is enough for two inch fish
(c) Goldfish can be made good pets
(d) Plants in an aquarium provide oxygen to goldfish

23. Which of the following helps supply goldfish with oxygen?
(a) Snails (b) Plants
(c) Dried insects (d) Aquarium

24. Water in an aquarium needs to be changed if
(a) there are plenty of snails and plants in it
(b) there is no sufficient oxygen in it
(c) it is very clean and contains sufficient oxygen
(d) it does not contain goldfish food and dried insects

25. What is important to remember when feeding goldfish?
(a) They should be fed more than once a day
(b) They should be fed at five-minute intervals
(c) They should be fed with plants and snails
(d) They should be fed only once a day

Direction (Q. 26-30) *In each of the following questions, choose the alternative which can be substituted for the given sentence.*

26. The study of sound.
(a) Aeronautics (b) Aesthetics
(c) Acoustic (d) Astrology

27. Murder of one's parents.
(a) Parricide (b) Patricide
(c) Uxoricide (d) Matricide

28. Government by the Gods.
(a) Theocracy (b) Thearchy
(c) Neocracy (d) Monarchy

29. A place for bees.
(a) Hive (b) Hutch
(c) Lair (d) Den

30. One who studies the evolution of mankind.
(a) Somnambulist (b) Cartographer
(c) Prephologist (d) Anthropologist

Direction (Q.31-35) *In each of the following questions, a part of the sentence is italicised. Below each sentence, three possible substitutions for the italicised part are given. Choose the one which proves the italicised part. If none of the substitutions improves the italicised part, your answer is* (d).

31. *All his answers* were correct.
(a) His all answers (b) His every answers
(c) All of his answers (d) No improvement

32. It was quite clear that the runner *could be able to* improve upon his own record.
(a) should be able (b) would be able
(c) will be able (d) No improvement

33. Within last few years most of the fertile land *had undergone* Indigo cultivation.
(a) had underwent (b) has undergone
(c) was undergone (d) No improvement

34. His *powerful desire* brought about his downfall.
(a) his intense desire (b) his desire for power
(c) his fatal desire (d) No improvement

35. If he *had time* he will call you.
(a) would have (b) would have had
(c) has (d) No improvement

Direction (Q.36-40) *Four alternatives* (a), (b), (c) *and* (d) *are given under each sentence, you are required to select the most suitable alternative to fill in the blank in the sentence to make it meaningful.*

36. He is too ..... to be deceived easily.
(a) strong (b) modern
(c) intelligent (d) kind

37. There has been a ..... lack of efficiency in all the crucial areas of the working of Public Sector Undertakings.
(a) positive (b) surprising
(c) conspicuous (d) stimulative

38. The shepherd was looking after the ..... of sheep.
(a) crew (b) gang
(c) fleet (d) flock

39. The Managing Director treated the employees to a ..... lunch at an expensive hotel.
(a) precious (b) thriving
(c) stupendous (d) sumptuous

40. Satish was ..... with a natural talent for music.
(a) given (b) found
(c) endowed (d) entrusted

Answers

Physics

1. (d)	2. (b)	3. (d)	4. (c)	5. (b)	6. (d)	7. (a)	8. (c)	9. (c)	10. (c)
11. (d)	12. (d)	13. (a)	14. (c)	15. (a)	16. (c)	17. (c)	18. (b)	19. (a)	20. (c)
21. (c)	22. (d)	23. (d)	24. (d)	25. (c)	26. (b)	27. (d)	28. (c)	29. (b)	30. (c)
31. (d)	32. (c)	33. (a)	34. (a)	35. (a)	36. (c)	37. (d)	38. (c)	39. (b)	40. (c)

Chemistry

1. (a)	2. (a)	3. (a)	4. (b)	5. (a)	6. (a)	7. (b)	8. (c)	9. (a)	10. (a)
11. (d)	12. (c)	13. (b)	14. (c)	15. (a)	16. (a)	17. (c)	18. (a)	19. (b)	20. (c)
21. (d)	22. (c)	23. (c)	24. (b)	25. (a)	26. (b)	27. (d)	28. (b)	29. (a)	30. (b)
31. (d)	32. (b)	33. (a)	34. (b)	35. (a)	36. (a)	37. (c)	38. (d)	39. (a)	40. (c)

Zoology

1. (d)	2. (b)	3. (c)	4. (a)	5. (a)	6. (a)	7. (d)	8. (c)	9. (d)	10. (c)
11. (b)	12. (b)	13. (a)	14. (c)	15. (b)	16. (b)	17. (c)	18. (d)	19. (c)	20. (c)
21. (b)	22. (b)	23. (b)	24. (d)	25. (b)	26. (d)	27. (a)	28. (d)	29. (b)	30. (c)
31. (b)	32. (b)	33. (d)	34. (c)	35. (d)	36. (a)	37. (c)	38. (a)	39. (b)	40. (d)

Botany

41. (b)	42. (b)	43. (b)	44. (b)	45. (b)	46. (a)	47. (d)	48. (a)	49. (b)	50. (a)
51. (c)	52. (b)	53. (b)	54. (a)	55. (d)	56. (d)	57. (a)	58. (a)	59. (b)	60. (b)
61. (b)	62. (a)	63. (a)	64. (a)	65. (a)	66. (a)	67. (a)	68. (a)	69. (a)	70. (a)
71. (c)	72. (b)	73. (d)	74. (a)	75. (c)	76. (a)	77. (c)	78. (a)	79. (a)	80. (a)

General English

1. (b)	2. (a)	3. (c)	4. (a)	5. (d)	6. (c)	7. (c)	8. (a)	9. (d)	10. (d)
11. (b)	12. (c)	13. (b)	14. (d)	15. (a)	16. (a)	17. (c)	18. (b)	19. (a)	20. (a)
21. (a)	22. (a)	23. (b)	24. (b)	25. (d)	26. (c)	27. (b)	28. (b)	29. (a)	30. (d)
31.)	32. (b)	33. (d)	34. (b)	35. (c)	36. (c)	37. (c)	38. (d)	39. (d)	40. (c)

Hints and Solutions

Physics

1. Given, $v = \frac{A\sqrt{x}}{x+B}$

Dimensions of v = dimensions of potential energy
$= [ML^2T^{-2}]$

From Eq. (i)
Dimensions of B = dimensions of $x = [M^0LT^0]$

$\therefore$ Dimensions of A
$= \frac{\text{dimension of } v \times \text{dimensions of } (x+B)}{\text{dimensions of } \sqrt{x}}$

$= \frac{[ML^2T^{-2}][M^0LT^0]}{[M^0L^{1/2}T^0]} = [ML^{5/2}T^{-2}]$

Hence, dimensions of AB
$= [ML^{5/2}T^{-2}][M^0LT^0] = [ML^{7/2}T^{-2}]$

2. Maximum tension in the thread is given by

$$T_{max} = mg + \frac{mv^2}{r}$$

or $T_{max} = mg + mr\omega^2 \quad (\because v = r\omega)$

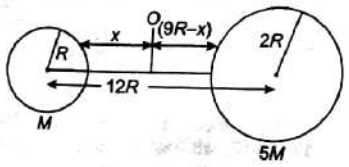
or $\omega^2 = \frac{T_{max} - mg}{mr}$

Given,
$T_{max} = 37$ N, $m = 500\,g = 0.5$ kg, $g = 10$ ms^{-2},
$r = 4$ m

$\therefore \quad \omega^2 = \frac{37 - 0.5\times 10}{0.5\times 4} = \frac{37-5}{2}$

or $\omega^2 = 16$ or $\omega = 4$ rad s^{-1}

3. Let at O there will be a collision. If smaller sphere moves x distance to reach at O, then bigger sphere will move a distance of $(9R - x)$.



$$F = \frac{GM \times 5M}{(12R - x)^2} \quad \ldots(i)$$

$$a_{small} = \frac{F}{M} = \frac{G \times 5M}{(12R-x)^2}$$

$$a_{big} = \frac{F}{5M} = \frac{GM}{(12R-x)^2}$$

$$x = \frac{1}{2}a_{small}t^2 = \frac{1}{2}\frac{G\times 5M}{(12R-x)^2}t^2 \quad \ldots(i)$$

$$(9R - x) = \frac{1}{2}a_{big}t^2 = \frac{1}{2}\frac{GM}{(12R-x)^2}t^2 \quad \ldots(ii)$$

Thus, dividing Eq. (i) by Eq. (ii), we get

$$\frac{x}{9R-x} = 5$$

$\Rightarrow \quad x = 45R - 5x$

$\Rightarrow \quad 6x = 45R$

$\therefore \quad x = 7.5R$

4. The moment of inertia of uniform circular disc about an axis through its centre and normal to its plane

$$I_{CG} = \frac{1}{2}MR^2$$

According to theorem of parallel axis, the moment of inertia of the uniform circular disc about an axis passing from the edge of the disc fand normal to the disc,

$$I = I_{CG} + MR^2 = \frac{1}{2}MR^2 + MR^2 = \frac{3}{2}MR^2$$

5. Time period of satellite

$$T^2 = \frac{4\pi^2}{GM}r^3 \text{ or } T^2 = \frac{4\pi^2}{gR^2}r^3 \quad [\because GM = gR^2]$$

or $T = \frac{2\pi}{R}\sqrt{\frac{r^3}{g}}$ or $T \propto r^{3/2}$

$\therefore \quad \frac{T_1}{T_2} = \left(\frac{r_1}{r_2}\right)^{3/2}$

Given, $T_1 = 3$ h, $T_2 = 24$ h (geostationary satellite) $r_1 = R$, $r_2 = 36000$ km

$\therefore \quad \frac{3}{24} = \left(\frac{R}{36000}\right)^{3/2}$

or $R = \left(\frac{1}{8}\right)^{2/3} \times 36000$

or $R = \frac{1}{4} \times 36000 = 9000$ km

6. Yaung's modulus
$Y = \frac{FL}{Al}$ or $F = \frac{YAl}{L}$
or $F \propto A$ or $F \propto r^2$ or $F \propto d^2$

$\therefore \quad \frac{F_1}{F_2} = \frac{d_1^2}{d_2^2}$

Given, $d_1 = d$, $d_2 = 2d$, $F_1 = 200$ N

$\therefore \quad \frac{200}{F_2} = \frac{(d)^2}{(2d)^2} = \frac{1}{4}$

or $F_2 = 4 \times 200 = 800$ N

7. Shearing modulus of cube

$$\eta = \frac{Fl}{A\Delta l} = \frac{8\times 10^3 \times 40 \times 10^{-3}}{(40\times 10^{-3})^2 \times (0.1\times 10^{-3})}$$
$$= 2\times 10^9 \text{ Nm}^{-2}$$

8. Pressure at neck of bottle

$$P_1 = \frac{F_1}{A_1} = \frac{F_1}{\pi r_1^2}$$

Similarly, pressure at bottom of bottle

$$p_2 = \frac{F_2}{A_2} = \frac{F_2}{\pi r_2^2}$$

According to Pascal's law, liquids transmit pressure equal in all directions.

$\therefore \quad \frac{F_1}{\pi r_1^2} = \frac{F_2}{\pi r_2^2}$

$$\frac{12}{\pi (3)^2} = \frac{F_2}{\pi (15)^2}$$

$$F_2 = \frac{12\times 15\times 15}{3\times 3}$$

$$F_2 = 300 \text{ N}$$

9. Since, the wire frame is dipped in liquid, therefore its membrane has two free surfaces. Total length of square wire frame in contact of membrane = 2 × perimeter of square
$= 2 \times 4L = 8L$
Hence, force acting on a frame
$F = Tl = T \times 8L = 8TL$

10. Volume of big drop = 64 × volume of a small drop

$\Rightarrow \quad \frac{4}{3}\pi R^3 = 64 \times \frac{4}{3}\pi r^3 \Rightarrow R = 4r$

The terminal velocity of spherical rain drop

$$v = \frac{2r^2(\rho - \sigma)}{9\eta} \Rightarrow v \propto r^2$$

$\Rightarrow \quad \frac{v_1}{v_2} = \left(\frac{r}{R}\right)^2 = \left(\frac{1}{4}\right)^2 = \frac{1}{16}$

$\therefore \quad v_2 = 16v_1 = 16 \times 1.5 = 24$ ms^{-1}

11. Equation of wave

$$y = 5\sin\left(\frac{t}{0.04} - \frac{x}{4}\right)$$

The standard equation of a wave in the given form is

$$y = a\sin\left(\omega t - \frac{2\pi x}{\lambda}\right)$$

Comparing the given equation with the standard equation, we get

$$a = 5 \text{ and } \omega = \frac{1}{0.04} = 25$$

Therefore, maximum velocity of particles of the medium,

$v_{max} = a\omega = 5\times 25 = 125$ cms^{-1} $= 1.25$ ms^{-1}

12. Fundamental frequency,

$$\nu = \frac{1}{2l}\sqrt{\frac{T}{m}} = \frac{1}{2l}\sqrt{\frac{T}{\pi r^2 \rho}}$$

or $\nu \propto \frac{1}{lr}$

$\therefore \quad \frac{\nu_1}{\nu_2} = \frac{l_2 r_2}{l_1 r_1} = \frac{2L \times r}{L \times 2r} = 1$

13. Work done by gas in adiabatic process,

$$W = \frac{nR(T_i - T_f)}{\gamma - 1}$$

$\therefore \quad 6R = \frac{1\times R(T - T_2)}{\left(\frac{5}{3} - 1\right)}$

or $6 = \frac{T - T_2}{2/3}$

or $T - T_2 = 4$ or $T_2 = (T - 4)$ K

14. Equivalent thermal conductivity of the compound slab,

$$K_{eq} = \frac{l_1 + l_2}{\frac{l_1}{K_1} + \frac{l_2}{K_2}} = \frac{l + l}{\frac{l}{K} + \frac{l}{2K}}$$

$$= \frac{2l}{\frac{3l}{2K}} = \frac{4}{3}K$$

15. According to Wien's displacement law,

$$\lambda_m T = \text{constant}$$

or $\dfrac{\lambda_2}{\lambda_1} = \dfrac{T_1}{T_2}$

$\therefore$ $\dfrac{\lambda_2}{\lambda} = \dfrac{2000}{3000} = \dfrac{2}{3}$

or $\lambda_2 = \dfrac{2}{3}\lambda$

16. In a plane mirror, the image formed is erect and of same size as of object. Thus, magnification of plane mirror is 1.

17. Given, $I_1 = I$, $I_2 = 4I$

$$I_{max} = (\sqrt{I_1} + \sqrt{I_2})^2$$
$$= (\sqrt{I} + \sqrt{4I})^2 = (3\sqrt{I})^2 = 9I$$
$$I_{min} = (\sqrt{I_1} - \sqrt{I_2})^2 = (\sqrt{I} - \sqrt{4I})^2$$
$$= (-\sqrt{I})^2 = I$$

18. Fringe width, $\beta = \dfrac{D\lambda}{d}$ or $\beta \propto \lambda$

If the experiment is performed in water, wavelength λ decreases, so, fringe width also decreases.

19. According to Gauss's theorem, electric flux through the cube (closed surface),

$$\phi = \frac{q}{\varepsilon_0}$$

Since, cube has six surfaces and all the faces are symmetrical, therefore electric flux through any face

$$\phi' = \frac{q}{6\varepsilon_0} = \frac{4\pi q}{6(4\pi\varepsilon_0)}$$

20. Potential difference between two equipotential surfaces A and B,

$$V_A - V_B = kq\left(\frac{1}{r_A} - \frac{1}{r_B}\right) = kq\left(\frac{r_B - r_A}{r_A r_B}\right) = \frac{kqt_1}{r_A r_B}$$

or $t_1 = \dfrac{(V_A - V_B) r_A r_B}{kq}$

or $t_1 \propto r_A r_B$

Similarly, $t_2 \propto r_B r_C$

Since, $r_A < r_B < r_C$, therefore, $r_A r_B < r_B r_C$

$\therefore$ $t_1 < t_2$

21. In series combination,

$$\frac{1}{C_1} = \frac{1}{1} + \frac{1}{2} + \frac{1}{4} = \frac{4+2+1}{4} = \frac{7}{4}$$

$$\Rightarrow C_1 = \frac{4}{7}\mu F$$

In parallel combination,

$$C_1 = 1 + 2 + 4 = 7\,\mu F$$

$\therefore$ $\dfrac{C_1}{C_2} = \dfrac{4/7}{7} = \dfrac{4}{49}$

22. Drift velocity in a copper conductor

$$v_d = \frac{i}{neA} = \frac{5.4}{8.4 \times 10^{28} \times 1.6 \times 10^{-19} \times 10^{-6}}$$
$$= 0.4 \times 10^{-3} ms^{-1}$$
$$= 0.4\ mms^{-1}$$

23. $R = \dfrac{\rho l}{A}$ or $R \propto l$

$\therefore$ $\dfrac{R_1}{R_2} = \dfrac{l_1}{l_2} = \dfrac{L}{L/4} = 4$

or $R_2 = \dfrac{R}{4}$ $(\because R_1 = R)$

In parallel combination of such four resistances

$$\frac{1}{R'} = \frac{1}{R_2} + \frac{1}{R_2} + \frac{1}{R_2} + \frac{1}{R_2}$$

or $\dfrac{1}{R'} = \dfrac{1}{R/4} + \dfrac{1}{R/4} + \dfrac{1}{R/4} + \dfrac{1}{R/4}$

or $\dfrac{1}{R'} = \dfrac{4}{R} + \dfrac{4}{R} + \dfrac{4}{R} + \dfrac{4}{R}$

or $\dfrac{1}{R'} = \dfrac{16}{R}$

or $R' = \dfrac{R}{16}$

24. In steady state, there will be no current in the capacitor branch.

Net resistance of the circuit

$$R = 1 + 1 + 0.5 = 2.5\,\Omega$$

Current drawn from the cell,

$$i = \frac{V}{R} = \frac{2.5}{2.5} = 1\,A$$

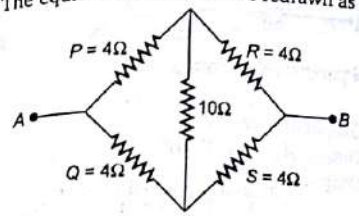
Potential drop across two parallel branches

$$V = E - ir = 2.5 - 1 \times 0.5$$
$$= 2.5 - 0.5$$
$$= 2.0\,V$$

So, charge on the capacitor plates

$$q = CV = 5 \times 2$$
$$= 10\,\mu C$$

25. The equivalent circuit can be redrawn as



We have, $\dfrac{P}{Q} = \dfrac{R}{S}$

ie, $\dfrac{4}{4} = \dfrac{4}{4}$

So, the given circuit is a balanced Wheatstone's bridge. Hence, the equivalent resistance

$$R_{AB} = \frac{(4+4)\times(4+4)}{(4+4)+(4+4)} = \frac{8\times 8}{8+8} = \frac{64}{16} = 4\,\Omega$$

26. The magnetic field at a distance r from the straight wire

$$B = \frac{\mu_0 i}{2\pi r} \text{ or } B \propto \frac{1}{r} \text{ or } \frac{B_2}{B_1} = \frac{r_1}{r_2}$$

$\therefore$ $\dfrac{B_2}{B} = \dfrac{5}{20} = \dfrac{1}{4}$ or $B_2 = \dfrac{B}{4}$

27. In a perpendicular magnetic field,

Magnetic force = centripetal force

ie, $Bqv = \dfrac{mv^2}{r} \Rightarrow r = \dfrac{mv}{Bq}$

$\therefore$ $\dfrac{r_1}{r_2} = \dfrac{v_1}{v_2} \times \dfrac{B_2}{B_1}$

$$\frac{r_1}{r_2} = \frac{1}{2} \times \frac{1}{2}$$

$$r_2 = 4r_1$$

$\Rightarrow$ $r_2 = 4r$

28. Voltmeter has high resistance and is always connected in parallel with the circuit. So, to convert a galvanometer into voltmeter, a high resistance must be connected in series with it so that it draws negligible current from the circuit.

29. When diamagnetic substances are placed in a magnetic field, then they are feebly repelled in the field.

30. Given, $\phi = 5t^3 - 100t + 300$

$$e = -\frac{d\phi}{dt} = \frac{-d}{dt}(5t^3 - 100t + 300)$$
$$= -(15t^2 - 100 + 0)$$
$$= -15t^2 + 100$$

$\therefore$ $\dfrac{e}{t} = -15(3)^2 + 100 = -15 \times 9 + 100$

$$= -135 + 100 = -35\,V$$

Minus sign signifies the Lenz's law.

31. Induced emf,

$$|e| = L\frac{di}{dt} = (60 \times 10^{-3}) \times \frac{(1.5-1)}{0.1}$$
$$= \frac{60 \times 10^{-3} \times 0.5}{0.1} = 0.3\,V$$

Induced current,

$$i = \frac{e}{R} = \frac{0.3}{3} = 0.1\,A$$

32. In L-R circuit,

Impedance $Z = \sqrt{R^2 + X_L^2}$

Here, $X_L = \omega L = 2\pi f L$

$\therefore$ $Z = \sqrt{R^2 + 4\pi^2 f^2 L^2}$

33. Impedance,

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$\therefore$ $10 = \sqrt{(10)^2 + (X_L - X_C)^2}$

$\Rightarrow$ $100 = 100 + (X_L - X_C)^2$

$\Rightarrow X_L - X_C = 0$ ...(i)

Let ϕ is the phase difference between current and voltage

$\therefore$ $\tan\phi = \dfrac{X_L - X_C}{R}$

$\therefore$ $\tan\phi = \dfrac{0}{R}$

$\Rightarrow$ $\phi = 0$ [from Eq. (i)]

34. γ-rays have the smallest wavelength.

35. $KE = eV = 1.6 \times 10^{-19} \times 100 = 1.6 \times 10^{-17}\,J$

36. According to J.J. Thomson's cathode ray tube experiment, the e/m of electrons is much greater than the e/m of protons.

37. Wavelength of light

$$\frac{1}{\lambda} = R\left(\frac{1}{1^2} - \frac{1}{2^2}\right)$$

$\Rightarrow$ $\dfrac{1}{\lambda} = 1.097 \times 10^7 \times \dfrac{3}{4}$

$\therefore$ $\lambda = 1.215 \times 10^{-7}\,m = 1215\,Å$

38. $M = M_0\left(\frac{1}{2}\right)^{t/T_{1/2}}$

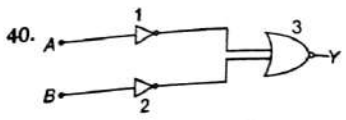
$\therefore \quad M = 200\left(\frac{1}{2}\right)^{24/4} = 200\left(\frac{1}{2}\right)^{6} = \frac{200}{64} = 3.125\text{g}$

39. After one α-emission, the daughter nucleus reduces in mass number by 4 unit and in atomic number by 2 unit. In β-emission the atomic number of daughter nucleus increases by 1 unit. The reaction can be written as

$$_{92}U^{238} \xrightarrow{-8\alpha} {}_{76}X^{206} \xrightarrow{-6\beta} {}_{82}Y^{206}$$

Thus, the resulting nucleus is $_{82}Y^{206}$, *ie*, $_{82}Pb^{206}$.

40.



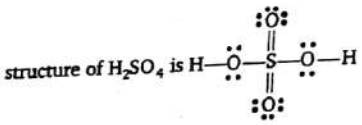
Output of gate-1, $Y_1 = \overline{A}$
Output of gate-2, $Y_2 = \overline{B}$
Output of gate-3,

$$Y = \overline{Y_1 + Y_2} = \overline{\overline{A} + \overline{B}}$$
$$= \overline{\overline{A}}\,\overline{\overline{B}}$$
$$= AB$$

which is the output of AND gate.

Chemistry

1. The structure of H_2SO_4 is



Total number of unshared electrons = 10 × 2 = 20

2. Disaccharides are the carbohydrates which on hydrolysis gives two same or different monosaccharides. Their general formula is $C_{12}H_{22}O_{11}$. *eg*,

$$\underset{\text{sucrose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{H^+} \underset{\text{glucose}}{C_6H_{12}O_6} + \underset{\text{fructose}}{C_6H_{12}O_6}$$

3. s character $\propto$ bond angle
Hence, the correct order is $sp^3 < sp^2 < sp$.

4. $\frac{p^\circ - p_s}{p^\circ} = \frac{n}{n+N} = \frac{\frac{w}{m}}{\frac{w}{m} + \frac{W}{M}}$

$\because \quad \frac{w}{m} < \frac{W}{M}$

$\therefore \quad \frac{p^\circ - p_s}{p^\circ} = \frac{w/m}{W/M} = \frac{w}{m} \times \frac{M}{W}$

$\frac{3000 - 2985}{3000} = \frac{5}{m} \times \frac{18}{100}$

$m = \frac{5 \times 18 \times 3000}{15 \times 100}$

$m = 180$

180 is the molecular weight of glucose ($C_6H_{12}O_6$), thus the substance 'X' is glucose.

5. The minimum amount of energy required to remove the most loosely bound electron from an isolated gaseous atom so as to convert it into a gaseous cation, is called its ionisation energy. Because the size of C is smaller than that of the B due to effective nuclear charge, hence

I^{st} IE of C > I^{st} IE of B

6. In $[MnO_4]^-$, the oxidation state of Mn is +7.

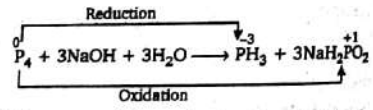
Mn (25) = [Ar] $3d^5 4s^2$

Mn^{7+} = [Ar]

Thus, in $[MnO_4]^-$ no d-electron is present.

7. The ionisation energy of $1s^2, 2s^2, 2p^3$ configuration is highest due to the presence of half-filled (stable) orbitals.

8.



This reaction is an example of disproportionation reaction, *ie*, the reaction in which oxidation and reduction take place simultaneously.

9. Ag_2CrO_4 ionises completely in the solution as

$$\underset{s\text{ mol/L}}{Ag_2CrO_4} \longrightarrow \underset{2s\text{ mol/L}}{2Ag^+} + \underset{s\text{ mol/L}}{CrO_4^{2-}}$$

Hence, the solubility product,
K_{sp} of $Ag_2CrO_4 = [Ag^+]^2[CrO_4^{2-}]$
$= (2s)^2(s)$
$= 4s^3$

10. (a) $\underset{sp^3}{CH_3}—\underset{sp}{C}\equiv\underset{sp}{C}—H$

(b) $\underset{sp^3}{CH_3}—\underset{sp^2}{CH}=\underset{sp^2}{CH}—\underset{sp^3}{CH_3}$

(c) $\underset{sp^2}{CH_2}=\underset{sp^2}{CH}—\underset{sp^2}{CH}=\underset{sp^2}{CH_2}$

(d) $\underset{sp}{HC}\equiv\underset{sp}{CH}$

Hence, $CH_3—C\equiv C—H$ has a bond formed by overlap of $sp - sp^3$ hybrid orbitals.

11. Haemoglobin is metalloprotein (a protein that contains a metal) which binds with oxygen and transport it in the blood stream.

12. $—NH_2$, —OH and —R (alkyl groups) all are o/p-directing and they activates the benzene ring $-X$ (halogens) are however o/p-directing but deactivate the benzene ring by withdrawing electrons from the ring due to $-I$ effect.

13. If both nitrogen and sulphur are present in a organic compound, they will give red blood colour with Lassaigne test due to the formation of ferric thiocyanate.

$$Na + C + S + N \xrightarrow{\Delta} \underset{\text{sodium. thiocyanate}}{NaSCN}$$

$$Fe^{3+} + 3NaSCN \longrightarrow \underset{\substack{\text{ferric thiocyanate}\\ \text{(blood red colouration)}}}{Fe(SCN)_3} + 3Na^+$$

14. Order of a reaction is the sum of the power to which the concentration terms are raised in the rate law equation to express the observed rate of the reaction.

Hence, order $= \frac{1}{2} + 2 = \frac{5}{2} = 2.5$

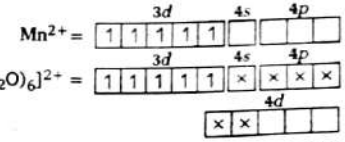
15. Given, $p = 745\text{ mm} = \frac{745}{760}\text{ atm}$

$T = 65^\circ\text{C} = 65 + 273 = 338\text{ K}$

$\therefore \quad M = \frac{dRT}{p} = \frac{1.56 \times 0.0821 \times 338}{745/760}$

$= 44.2\text{ u}$

16. Mn in $[Mn(H_2O)_6]^{2+}$ is present as $Mn^{2+}(3d^5)$.



sp^3d^2 hybridisation occurs in $[Mn(H_2O)_6]^{2+}$. Due to the presence of weak field ligand pairing of electron does not take place, hence the number of unpaired electrons is five.

17. $\underset{\text{ethyl alcohol}}{CH_3CH_2OH} + \underset{\substack{\text{thionyl}\\ \text{chloride}}}{SOCl_2} \rightarrow CH_3CH_2Cl + HCl + SO_2\uparrow$

This method is preferred for the preparation of alkyl halide because both by product of the reaction (*ie*, SO_2 and HCl) are gases and can easily escape leaving behind pure alkyl halide.

18. The quantum numbers $+\frac{1}{2}$ and $-\frac{1}{2}$ indicate the rotation of electrons around its axis in opposite directions. Hence, they represent the two quantum mechanical spin states which have no classical analogues.

19. $Cr^{3+} + 3e^- \longrightarrow Cr(s)$

3 mol or 3 × 96500 C of electricity are needed to deposit 1 mol or 52 g of Cr.

52 g of Cr require current
$= 3 \times 96500\text{C}$

1 g of Cr will require current
$= \frac{3 \times 96500}{52}\text{C}$
$= 5567.3\text{C}$

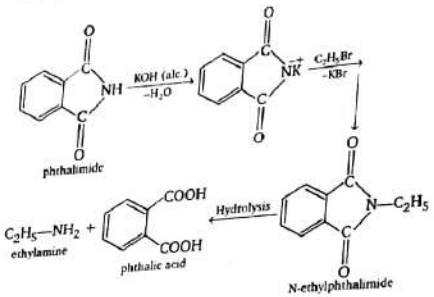
Now, number of coulombs
= current (ampere) × t (seconds)

$\therefore$ Time (s) required $= \frac{\text{no. of coulombs}}{\text{current (ampere)}}$

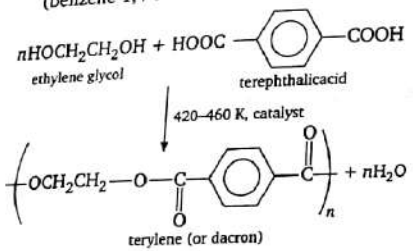
$= \frac{5567.3\text{C}}{1.25\text{A}}$
$= 4453.8\text{ s}$

or $= 1.24\text{ h}$

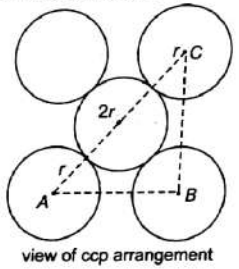
20. Gabriel's phthalimide synthesis is used for the preparation of primary aliphatic amines.



21. Terylene it is a polymer of ethylene glycol (ethane-1,2-diol) and terephthalic acid (benzene-1,4-dicarboxylic acid).



22. Given, the edge length of the unit cell = a
and, radius of the sphere = r



view of ccp arrangement

Consider ΔABC,

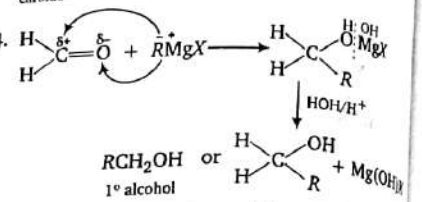
$$AC^2 = AB^2 + AC^2$$
$$= a^2 + a^2$$
$$= 2a^2$$
$$\therefore \quad AC = \sqrt{2}\cdot a$$

But, from the figure, $AC = 4r$

$$\therefore \quad 4r = \sqrt{2}\cdot a$$

23. CaC_2 (calcium carbide) $+ H_2O \longrightarrow HC\equiv CH$ (acetylene) $+ Ca(OH)_2$

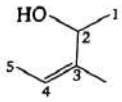
24.



The above reaction with acetaldehyde gives — 2° alcohol
reaction with CO_2 gives — acid.
reaction with H_2O gives— alkane.

25. Proteins are long polymers of α-amino acids linked by peptide $\left(-\overset{O}{\overset{\|}{C}}-NH-\right)$ bonds.

26.



3-methylpent-3-en-2-ol

27. Ammonia is dried over quick lime (CaO). It cannot be dried over conc. H_2SO_4, P_2O_5 and $CaCl_2$ because it reacts with these compounds.

28. Colloidal solution is of heterogeneous nature. It consists of two phases *ie,* a dispersed phase and a dispersion medium.

29. $N_2(7+7=14e^-) = KK^*, \sigma 2s^2, \overset{*}{\sigma} 2s^2, \pi 2p_x^2 \approx \pi 2p_y^2, \sigma 2p_z^2$

$$BO = \frac{1}{2}(8-2) = 3$$

$O_2(8+8=16e^-) = KK^*, \sigma 2s^2, \overset{*}{\sigma} 2s^2, \sigma 2p_z^2, \pi 2p_x^2 \approx \pi 2p_y^2, \overset{*}{\pi} 2p_x^1 \approx \overset{*}{\pi} 2p_y^1$

$$BO = \frac{1}{2}(8-4) = 2$$

$He_2(2+2=4e^-) = \sigma 1s^2, \sigma^* 1s^2$

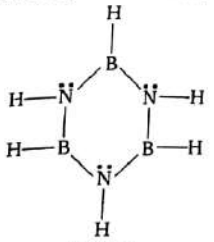
$$BO = \frac{1}{2}(2-2) = 0$$

$H_2(1+1=2e^-) = \sigma 1s^2$

$$BO = \frac{1}{2}(2-0) = 1$$

Hence, N_2 has the highest bond order.

30. $B_3N_3H_6$ (borazine) is known as inorganic benzene. Borazine is isoelectronic (*ie,* same number of electrons) and isosteric (*ie,* same number of atoms) with benzene.


Borazine

31. In modern Periodic Table, the physical and chemical properties of the elements are a periodic function of their atomic number, *ie,* if the elements are arranged in order of their increasing atomic number, the elements with similar properties are repeated after certain regular intervals.

32. Electronegativity, ionisation energy and electron affinity of *s*-block elements in their respective period is low but the atomic radius of the *s*-block elements is larger in their respective period due to less effective nuclear charge.

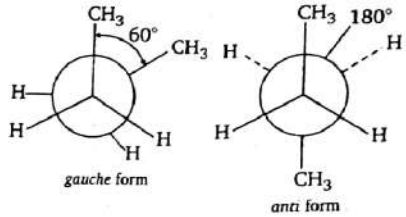
33. In the reaction, two moles of C—H bonds and two moles of C—Cl bonds are broken.
Hence, energy absorbed
$$= 2\times 416 + 2\times 325$$
$$= 1482\ \text{kJ}$$

34. OH^-, F^- and NH_3 are Lewis base because they can donate a lone pair of electrons while H^+ is a Lewis acid because it can accept a lone pair of electrons.

35. When natural rubber is heated with 3-5% sulphur, it becomes non-sticky and more elastic. This process is called vulcanisation.

36. $+I$ group (*ie,* electron donating groups) stabilised the carbocation. $+I$ and $-I$ groups destabilised the carbanion and carbocations respectively. $+I$ groups stabilised the free radicals but $-I$ group destabilised them.

37.



(The angle between C—C and C—H bonds on adjacent carbon atoms in any conformation is called dihedral angle.)
Hence, the dihedral angle in case of *gauche* is 60° and in *anti* form is 180°.

38. For NaCl crystal,
Radius of cation/radius of anion = 0.414

$$\frac{r_{A^+}}{r_{B^-}} = 0.414$$

$$r_{B^-} = \frac{r_{A^+}}{0.414} = \frac{120}{0.414}$$
$$= 290\ \text{pm}$$

39. Common alum is $K_2SO_4\cdot Al_2(SO_4)_3\cdot 24H_2O$.

40. $\mu_{cal} = e\times d = 1.6\times 10^{-19}\times 2.29\times 10^{-10}$
$$= 3.664\times 10^{-29}\ \text{C-m}$$

$$\%\ \text{ionic character} = \frac{\mu_{exp}}{\mu_{cal}}\times 100$$
$$= \frac{6.226\times 10^{-30}}{3.664\times 10^{-29}}\times 100$$
$$= 17\%$$

Zoology

1. **Virus** is a nucleoprotein particle. It is made up of an outermost covering known as envelope, a protein coat, *ie*, capsid and a core of nucleic acid. During virus reproduction, multiple copies of envelope capsid and nucleic acids are formed inside the host cells.
   Since, **ribosomes** are absent in virus cells. So, these are not reproduced during reproduction of viruses.

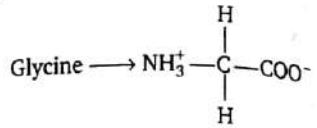
2. **Echinoderms** are marine, spiny skinned animals. All members of phylum-Echinodermata are marine. These have water vascular system which helps in locomotion, *eg*, starfish, *Antedon*. Arboreal insect are insects, which living on trees. Freshwater forms are animals or plants living in freshwater of ponds, *eg*, *Hydrilla*.

3. Class-Insecta of phylum-Arthropoda, is characterised by the presence of three pairs of legs, and absence of respiratory pigments in blood, *eg*, cockroach, mosquito.
   In cockroach, respiration is aerobic and oxygen goes into tissues by diffusion through the trachea.

4. **Tube feet** are extensible tubular processes bearing suckers and present in rows on the under-surface of echinoderms. Tube feet are connected internally with water vascular system. Each tube foot has an ampulla, a podium and a sucker. Tube feet are sensory structures that take part in adhesion, locomotion, respiration and food capturing. They are locomotory organs of echinoderms like **star fishes**. Jelly fish is a member of phylum-Coelenterata. *Scoliodon* is a fish and silver fish is an arthropod.

5. Follicle Stimulating Hormone (FSH) is a glycoproteins secreted from **anterior lobe of pituitary**. So, it is secreted in male and female both. In male, it stimulates spermatogenesis and development of seminiferous tubules and in female, it stimulates formation and growth of ovarian follicle in ovary.

6. **Glycine** is the simplest and smallest amino acid. A compound shows optical activity, when a chiral carbon or asymmetrical carbon (*ie*, carbon which attached to four different groups or atoms) is present. Because chiral carbon is absent in glycine. So, it does not show optical activity.



   Other amino acids contain at least single asymmetric carbon atoms, so they show optical activity, *eg*, valine, leucine and isoleucine.

7.

Vitamin	Function	Source
I. Water soluble		
(a) Vitamin-B complex		
Vitamin-B_1	Anti beri-beri	Yeast, whole grains
Vitamin-B_2	Maintenance of oral mucosa	Milk, egg
(b) Vitamin-C	Antioxidant help in collagen and bone formation	Citrus fruits
II. Fat soluble		
(a) Vitamin-A	Promotes normal vision	Carrot, cabbage
(b) Vitamin-D	Maintenance of Ca and P level in body	Cod and shark liver oil
(c) Vitamin-E	Antioxidant	Green vegetables, oil
(d) Vitamin-K	Anti-haemorrhagic in function	Green vegetables

8. **Ear ossicles** are three small non-supporting bones of body, which present in middle ear of human. These ear ossicles are meant for transmitting as well as amplifying vibrations received from tympanum.

Ear ossicle	Shape	Size
Malleus	Hammer	Largest ear ossicle
Incus	Anvil	Medium sized ear ossicle
Stapes	Stirrup	Smallest ear ossicle

9. During strenuous exercise, deficiency of oxygen takes place. So, anaerobic respiration of glucose takes place. During anaerobic respiration, pyruvic acid (a product of glycolysis of glucose) change into lactic acid. Accumulation of lactic acid is responsible for muscle fatigue. Glycogen is a polysaccharide and storing material of animal body. Glycogen stored in muscle and liver.
   Starch is a polysaccharide and storing material of plant body.

10. Two types of photoreceptor cells are present in retina, *ie*, rods and cones.
    (i) **Rods** : These cells are active in dark Rhodopsin, a vision pigment is present in rods. In strong light, rhodopsin is bleached due to splitting of its two components, *ie*, scotopsin and retinal. But is reformed in dim light, *ie*, dark.
    (ii) **Cones** : These cells are active in strong light. Iodopsin a pigment is present in cones. These cells produce hare coloured image in bright light.

11.

Human Ancestor	Characteristic Feature
Neanderthal man	Believe in "Immortality of soul". Make tools of bones, stones, quartz
Cro-magnon man	Cave painting, highest cranial capacity
Java ape man	Make use of fire
Peking man	Use nonsyllabic and nonarticulate language

12. **Contractile vacuole** is a cell organelle related with osmoregulation, *ie*, removal of excess water and present in free living protozoa like *Amoeba* and absent in parasitic protozoa like *Entamoeba histolytica*.
    Pseudopodia are locomotory organelles of class Sarcodina or Rhizopoda, *eg*, *Entamoeba*, *Amoeba*.
    Nucleus and **ectoplasm** are present in all protozoans.

13. **Heparin** is a proteoglycan. It is an anticoagulant. Heparin prevents coagulation of blood in blood vessels, *ie*, *in vivo* condition. It is mainly synthesised in **liver** and in small amount from mast cells of connective tissues. Other anticoagulants are sodium citrate and EDTA. They inhibit blood coagulation outside blood vessels, *ie*, *in vitro* condition like blood banks.

14. Marine birds (sea gulls) have salt glands which excrete large loads of salt eaten with their food and in the sea water they drink. As sea water contains about 3% salt which is three times saltier than a bird's body fluids. One salt gland is located above each eye. Each gland consists of several lobes arranged in parallel. Salts are secreted into many radially arranged tubules then flows into a central canal that leads into the nose (nares).

15.

Ion	Important for
Ca^{2+}	Muscle contraction and nerve impulse transmission
Mg^{2+}	Muscle contraction
Na^{2+}	Nerve impulse transmission
K^+	Nerve impulse transmission and muscle contraction

16. Ornithine cycle or Krebs-Henseleit cycle or urea cycle was discovered by **Hans Krebs and Kurt Henseleit**. It takes place in liver cells for synthesis of urea. The main component of ornithine cycle are arginine, ornithine and citrulline.

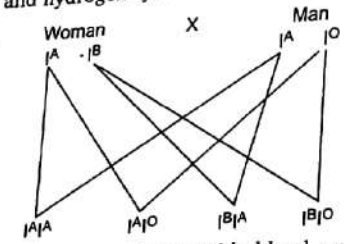
17. Semen is stored in semen banks for artificial insemination or artificial breeding, *eg*, Bull's semen is stored at –196°C temperature. This temperature is obtained by liquid nitrogen.
    Deep freezing is used for keeping seven day old embryos for several years. Deep freezing is also done at –196°C (temperature of liquid nitrogen).

18. **Autonomic Nervous System** (ANS) automatically regulates the activities of smooth muscles, cardiac muscles and glands. This coordination is involuntary. Autonomic nervous system consists of two divisions :
    (i) **Sympathetic ANS** : It shows sympathy, *ie*, generally increases the function and expenditure of energy takes place. Preganglionic nerve secretes acetylcholine and postganglionic nerve secrete "sympathatin" (norepinephrine).
    (ii) **Parasympathetic ANS** : It provides relaxation, comfort, pleasure at the time of rest and conservation of energy takes place. Postganglionic nerve secretes acetylcholine.
    Serotonin is a vasoconstrictor, secreted from mast cells.

19. Bones of Aves (*eg*, pigeon) are pneumatic. Pneumatic bones contain air cavities to reduce weight, which help in aerial mode of life.

20. **JBS Haldane** (1920) used the term **"Prebiotic soup"** or **"hot dilute soup of organic substances"** for oceanic water containing mixture of simple organic compounds. Methane (CH_4) was probably the first organic compound and hydrogen cyanide was formed later.

21.



In this case, progeny with blood group-B is produced only when man is heterozygous, *ie*, I^AI^O.

22. Balbiani rings are large RNA puffs reported in the salivary gland chromosomes of *Chironomus* insect during larval development.

23. Ejaculation or seminal emission is the forceful expulsion of semen during sexual intercourse. On an average (3 mL) ejaculation of semen contains about **300 million** spermatozoa.

24. **Mortality** is the death rate per thousand individuals. Its rate decreases population size and population density. It is due to improved personal hygiene, sanitation and modern medicines.

$$\therefore \quad \text{Mortality} = \left(100 \times \frac{\text{Births}}{\text{Deaths}}\right)$$

25. Vestigial organs are degenerate, non-functional and rudimentary organs correspond to fully developed and functional organs of related organism. Third molar (wisdom teeth), plica semilunaris and pyramidalis muscles are vestigial organs.
Epiglottis is not a vestigial organ in man. Epiglottis is the structure that prevents the entry of food into respiratory tract during swallowing in man.

26. The velocity of conduction of nerve impulse in frog is 30 metres per second.

27. *Neopilina* (mollusc) is considered as a connecting link between Annelida and Mollusca.

28. **Placenta** is a connection between foetus and mother formed from fusion of allantois, chorion and uterine endometrium.
Functions of placenta :
(i) Provides nourishment
(ii) Helps in respiration
(iii) Helps in excretion
Amnion and chorion are foetal membranes. Amnion helps in protection and chorion helps in nourishment.

29. **Ruminants** have the habit of chewing the cud. Stomach of ruminants have four parts, *ie*, rumen, reticulum, omassum and abomassum. They belong to order-Artiodactyla of class-Mammalia, *eg*, cow, sheep, goat.
Elephants belong to order-Proboscidea of class-Mammalia.
Marsupials are the members of subclass-Metatheria, in which a pouch marsupium is present for keeping and nourishing the young ones, *eg* kangaroo.

30.

Disease	Affect/Related to
Polio	Nervous system
Asthma	Respiratory system
Arthritis	Joints
Cancer	Blood, epithelial tissue (*eg*, skin cancer) bones, lymphnode

31. The sciatic vein joins with the renal portal of its side. Thereafter, the renal portal first runs forwards for some distance along the outer border of the kidney of its side and then enters into it an breaks into capillaries.

32. **Antipyretic drug** is the drug which decreases body temperature, *eg*, aspirin.
Antibiotics are drugs, which inhibit growth of microorganism, *eg*, penicillin.
Antiseptics are substances which desroy the living organism from living surfaces like skin, *eg* Savlon.

33. Notochord is present in any stage of life of a chordate. It is replaced by vertebral column in vertebrates. Notochord is present throughout life in members of subphylum Cephalochordata, *eg* *Amphioxus*.
In birds, fishes and snakes, notochord is replaced by vertebral column.

34. **National park** is an area which is strictly reserved for the betterment of wildlife and other activities like forestry. Grazing or cultivation are not permitted. The first national park of India was **Jim Corbett National Park** established in 1935, which is famous for tigers.

National Park	State	Protected animal
Jim Corbett	UK	Tiger
Kaziranga	Assam	Elephant
Gir National Park	Gujarat	Lion

35. Under unfavourable conditions like high temperature, dry condition, sponges body gets divided into numerous small spore like bodies called gemmules to tide over the adverse environmental conditions.
Cysts are formed during unfavourable conditions in *Amoeba*.
Spicules are endoskeletons of sponge body.

36. **Arbor vitae** is the tree like appearance of white matter in the cerebellum.

37. Ventral nerve cord possesses segmental ganglia. It is common between earthworm, leech and centipede.

38. The function of **Eustachian tube** is to equalise air pressure on both the sides (external and middle ear) of tympanic membrane. Thus, it connects middle ear with external ear.

39. Molluscs are the soft bodied, unsegmented animals covered by a shell. In between the shell and body wall, is a covering called **mantle**, which secretes the shell.

40. **Sporogony** is a sexual phase starting with ookinete in stomach wall of mosquito to form haploid sporozoites in oocyst. Sporozoites enter in salivary glands of mosquito. When mosquito sucks human blood, it injects sporozoites along with saliva containing anticoagulant.

Botany

41. Main character of plants is the presence of rigid cell wall around the cell. Bacteria are considered as plants because they have rigid cell wall.
Presence of stomata, chlorophyll and green colour are not the features of all plants, *eg*, chlorophyll is absent in fungi, stomata is absent in submerged acquatic hydrophytes or algae.

42. Photosynthesis starts at quite low intensity of light and very high intensity causes oxidation and destruction of pigments, enzymes and intermediates. This destruction known as **solarisation**. So, solarisation causes reduction in photosynthetic yields.
Photoperiodism is the effect of duration of sunlight on plants for many processes like flowering.

43.

Element	Essential for
Zinc	Auxin synthesis
Calcium	Root hair growth
Molybdenum	Nitrogen fixation
Sulphur	Protein synthesis

44. **Self-fertilisation** is the union of male and female gametes produced by the same individual, *ie*, from a bisexual individual.
Cross-fertilisation is the fertilisation of male and female gametes produced by different individuals.
Isogamous means fusion of isogametes (*ie*, of same morphology and physiology).
Viviparous means giving birth to young ones.

45. *Pisum sativum* is a angiospermic plant. In angiosperms, diploid chromosomes are present in body cells, *ie*, plants body belongs to sporophytic generation ($2n$).
In *Pisum sativum*, $2n = 14$.
So, **seven** types of homologous pairs are present in *Pisum sativum*.

46. **Chicory** powder is a flavouring material, which is mixed with coffee powder (from seeds of *Coffea arabica*). It is obtained from roots of *Cichorium intybus* of family-Compositae.
Tea is dried leaves of *Thea sinensis* (family Theaceae).
Ephedrine is obtained from stem of *Ephedra gerardiana*. It is useful against asthma and as cardiac stimulant.

47. **Gymnosperms** (*Gymno*= naked; *sperma* = seed) are naked seed bearing perennial plants. In gymnosperms, there is no fruit formation (because ovary is absent); xylem without vessels and phloem without companion cells and have distinct branches.

48. Tissue culture is the technique of maintaining and growing cells, tissue, etc. and the differentiation on artificial medium under aseptic condition.

Callus is a irregular, unorganised and undifferentiated mass of actively dividing cell. Differentiation of callus is under control of two hormones, *ie*, auxin and cytokinin.

Development of	Condition
Root	$\frac{\text{Auxin}}{\text{Cytokinin}}$ = High
Shoot	$\frac{\text{Auxin}}{\text{Cytokinin}}$ = Low
Both root and shoot	$\frac{\text{Auxin}}{\text{Cytokinin}}$ = Intermediate

49. **Stem cuttings** are used in rose, *Citrus, Cocoa*. Rooting of stem cuttings is hastened by dipping in NAA or IBA.
Grafting is done in case of mango.
Rhizomes take part in **vegetative propagation** due to presence of buds, *eg*, banana, ginger.

50. The phenotype produced by heterozygotes is identical with that produced by homozygous for the concerned dominant allele. The dominant allele in such a situation is known as completely dominant, *eg*, when pure tall plant is crossed with pure dwarf plant. In F_1 generation, all plants were tall. These tall plants of F_1 generation were selfed than the ratio of tall to dwarf plants obtained was 3 : 1. So, allele of tallness is dominant to allele of dwarfness.

51. Composite fruits develop from entire inflorescence, *eg*, syconus develops from hypanthodium, *eg*, banyan.
Sorosis is the composite fruit develops from spike and catkin, *eg*, in pineapple. Sorosis fruit develops from catkin; and edible part of pineapple fruits is **peduncle** and **perianth**.
Fleshy thalamus is an edible part of pear, apple fruit, *ie*, pome fruits.
Cotyledons are edible part of cashewnut, *ie*, nut fruit. **Endosperm** is an edible part of caryopsis of wheat, rice, etc.

52. **Nut** is a fruit develops from polycarpellary, superior ovary. The pericarp is hard, woody or leathery, *eg*, edible part of chestnut is cotyledons.
Ground nut is lomentum in which edible part is seed.
Walnut is a drupe fruit in which edible part is cotyledon.
Pistachio is a drupe in which edible part is seed.

53. **Psilophytes** are the oldest of seedless vascular plants. The plants are characterised by the absence of roots and presence of rhizoids, *eg*, *Rhynia* is the most primitive member of pteridophytes. *Lycopodium* and *Selaginella* are developed pteridophytes in which plant body is differentiated into roots, stems and leaves.

54.

Botanical Name	Common Name	Family
Cicer arietnum	Gram	Papilionaceae
Phaseolus aureus	Green gram	Papilionaceae
Dolichos lablab	Sem	Papilionaceae

55. Edible dry fruit which is known as chilgoza is seed of *Pinus gerardiana*.
Gymnosperms are plants in of which ovary is absent so, there is production of naked seeds, hence fruits are absent in gymnosperms. Seeds of *Cycas* are not edible.

56. **Ubisch bodies** : Tapetum is the innermost layer of another wall which surrounds the sporogenous tissues. These cells are nutritive in function. In cells of tapetum, ubisch bodies are present, which help in the formation of microspore wall or exine of pollen grain.
Pollen grain (microspore) is generally a round haploid structure from which gametophyte is developed.
Pollen tube helps in carrying male gametes to female gamete for fertilisation.

57. **Obligate parasites** are organism which obtain their food from host throughout their life, *eg*, *Rafflesia, Orobanche* (root parasite).
Facultative parasites are organism which are normally parasitic but can obtain their food from dead organic matter under certain conditions.
Obligate root parasite *Rafflesia, Orobanche.*
Partial stem parasite *Viscum, Loranthus.*
Partial root parasite *Santalum.*
Obligate stem parasite *Cuscuta.*

58.

Member	Botanical Name	Family
Lady finger	*Abelmoschus esculentus*	Malvaceae
Cucumber	*Cucumis sativus*	Cucurbitaceae
Onion	*Allium cepa*	Liliaceae

59. Main differences between dicot and monocot leaves are as follows :

Character	Dicot leaf	Monocot leaf
Type of leaf	Dorsiventral	Isobilateral
Stomata	Usually more on lower epidermis	Equal on lower and upper epidermis
Mesophyll	Differentiated into palisade and spongy parenchyma	Undifferentiated into spongy and palisade parenchyma
Bundle sheath	Made up of parencyma. Just above and below the vascular bundles. Some parenchymatous cells or collenchymatous cells are present upto epidermis.	Made up of parenchyma but just above and below the vascular bundles are found sclerenchymatous cells
Bulliform cells	Absent	Present, these cells help in rolling and unrolling of leaves.
Venation	Reticulate	Parallel

60. When well developed ecotonal communities may contain organisms characteristic of the overlapping communities plus species living only in the ecotone region, this condition is known as **edge effect**.
The yearly or seasonal phenomenon of cyclic fluctuation in population density causing periodic squeezing of some of the genes in a gene pool in random fashion is called **bottleneck phenomenon**.
Pasteur effect is reduction in the amount of breakdown of respiratory substrate and evolution of carbon dioxide when an anaerobically respiring material is brought in oxygen containing environment.

61. **Endoplasmic reticulum** is the network of delicate strands and vesicles which extends from cell membrane to nuclear membrane. It acts as a circulatory system of cell and is of two types—rough endoplasmic reticulum and smooth endoplasmic reticulum. Rough endoplasmic reticulum involves in protein synthesis along with attached ribosomes and smooth endoplasmic reticulum helps in lipid and steroid synthesis.
Cell wall is the outermost covering of plant cell generally made up of cellulose.
Golgi bodies are double membrane bound cell organelles of eukaryotic cells which consist of vesicle, tubule and cisternae.
Mitochondria is a rod-shaped, double membrane bound cell organelles.

62. **Translocation** is the movement of organic nutrients (*ie*, food) from the region of source or supply to the region of sink or utilisation. Translocation of food occurs through **phloem.** This organic food is translocated in the **form of sucrose**, a disaccharide, which is relatively inactive and highly soluble sugar.

63. The fruits of Asteraceae often possess pappus (which is a modification of persistent hairy calyx) which functions as a parachute for the dispersal of, *eg*, *Sonchus, Tagstes*. This dispersal mechanism is known as **parachute mechanism. Censer mechanism** for seed dispersal is found in poppy.

64. **Monocot** is characterised by trimerous flowers, fibrous roots, parallel venation of leaves, *eg*, Family-Liliaceae.
Trimerous flower, superior ovary and axile placentation is characteristics of family-Liliaceae, *eg*, onion.
Cucurbitaceae, Solanaceae and Compositae are dicot families characterised by tetra or pentamerous flowers, tap roots and reticulated venation of leaves.

65.

Plant	Pollination takes place in
Cycas	3-celled stage
Pinus	4 to 5-celled stage
Angiosperm	2 to 3-celled stage

66. **Meiotic division** occurs in reproductive or germ cells. Four haploid cells are produced after meiosis, which are not identical to their parent cell. In this division, homologous chromosomes form bivalent by pairing, during zygotene stage of prophase-I and during anaphase-I. Homologous chromosomes of each bivalent start migrating towards opposite poles of the spindle, because of this separation of homologous chromosomes, each daughter cell receives a haploid group of segregated chromosomes.

67. Cell division has two phase :
(a) Karyokinesis : Division of nucleus
(b) Cytokinesis : Division of cytoplasm.
Karyokinesis also consists of two phase :
(i) Interphase is a resting phase and consists of G_1, S and G_2-phase.

Phase	Activities
G_1	RNA and proteins synthesis takes place
S	DNA replication takes place
G_2	Damaged DNA is repaired and division of centrosomes takes place

(ii) **M-phase** represents the phase of actual division.

68. **Aneuploidy** is the deletion or addition of one or a few chromosomes from the original genomes.
(i) **Monosomy** is $(2n-1)$, *eg,* Tuner's syndrome.
(ii) **Nullisomy** is $(2n-2)$.
(iii) **Trisomy** is $(2n+1)$, *eg,* Klinefelter's syndrome.
(iv) **Tetrasomy** $(2n+2)$

69. **Bioassay** is the testing of biological activity of a substance by employing living material. **Went** used *Avena sativa* (oat) coleoptiles in a technique called *Avena* coleoptile curvature test.
ABA or abscisic acid induces dormancy in buds, seeds and underground storage organs. Unorganised and undifferentiated mass of cells forms during culture of cells known as callus. In callus culture, shoot and root regenerations are controlled, generally by auxin and cytokinin balance.

70. **Clinging roots** are found is orchids, these roots grow as epiphytes upon the trunks or branches of trees. They hang freely in the air and absorb atmospheric moisture with the help of special sponge like tissue called **velamen**. Velamen is the modification of epidermis.

71. Organisms confined to bottom are called **benthos** and their habitat is called **benthic.**

72. **Water blooms** are formed by the growth of some microscopic or semi-microscopic algae, such as, *Anabaena, Arthrospira, Nodularia, Nostoc,* etc.
Water blooms are harmful, as they are responsible for the depletion of oxygen in water bodies.

73. **Transduction** is the transfer of bacterial ... from one bacterium to another through virus ...

74. **Molybdenum** causes mottling (patches on ... and non-green areas).

75. In the atmosphere (stratosphere), about 30 ... above the surface of the earth, the ozone ... molecules (O_3) form an umbrella. It prevents ... penetration of harmful ultra violet radiation ... from the sun and thus protects the life of ... earth. It is now feared that there is danger ... depletion of the ozone layer. The prime suspect ... of ozone thinning or depletion are chlorofluoro ... carbons (CFCs). Because it is odourless ... invisible, that is why, it is widely used ... domestic refrigerators and cold storage facilities. It is calculated that the depletion of ozone layer ... by 1% results in an increase in the incidence ... skin cancer by 5% to 7%.

76. Ephidrine is obtained from several species ... *Ephedra* of family-Ephideraceae. It is used in the ... treatment of respiratory disorders like cold, ... asthma, bronchial congestion.

77. **Decarboxylation** is the removal of carbon from ... compound to make carbon dioxide. During Krebs ... cycle, the acetyl groups pass round the cycle, and ... the two carbon atoms are lost in the form of ... carbon dioxide in to decarboxylation reactions.

78. Osmotic pressure of solution is greater than pure ... solvent. When a solution is separated from pure ... solvent by a semi-permeable membrane, the ... solvent begins to flow towards the solution due ... to development of osmotic pressure.

79. **RH Whittaker** (1969) proposed a Five Kingdom ... Classification. The kingdoms defined by him ... were named—Monera, Protista, Fungi, Plantae ... and Animalia. The main criteria for classification ... used by him include cell structure, thallus ... organisation, mode of nutrition, reproduction ... and phylogenetic relationships. All the ... prokaryotic organisms were grouped together ... under kingdom-Monera and unicellular ... eukaryotic organisms were placed in kingdom ... Protista. The fungi were placed is a separate ... kingdom, *ie,* kingdom-Fungi. The ... kingdom-Plantae and Animalia, commonly ... referred to as plant and animal kingdoms ... respectively.

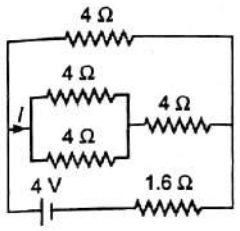
80. **Phylloclade** is a modified stem or branch which ... may be flat or circular, fleshy, like green leaf, eg ... *Opuntia.*

JIPMER
Medical Entrance Exam
Solved Paper 2011

Physics

1. The physical quantity having the dimensions $[M^{-1}L^{-3}T^3A^2]$ is
(a) resistance
(b) resistivity
(c) electrical conductivity
(d) electromotive force

2. In the circuit shown the value of I in ampere is



(a) 1 (b) 0.60
(c) 0.4 (d) 1.5

3. The specific charge of a proton is 9.6×10^7 C/kg. The specific charge of an alpha particle will be
(a) 9.6×10^7 C/kg (b) 19.2×10^7 C/kg
(c) 4.8×10^7 C/kg (d) 2.4×10^7 C/kg

4. If λ_1 and λ_2 are the wavelengths of the first members of the Lyman and Paschen series respectively, then $\lambda_1 : \lambda_2$ is
(a) 1 : 3 (b) 1 : 30
(c) 7 : 50 (d) 7 : 108

5. Activity of a radioactive sample decreases to (1/3)rd of its original value in 3 days. Then, in 9 days its activity will become
(a) (1/27) of the original value
(b) (1/9) of the original value
(c) (1/18) of the original value
(d) (1/3) of the original value

6. A tuning fork A produces 4 beats/s with another tuning fork B of frequency 320 Hz. On filing one of the prongs of A, 4 beats/s are again heard when sounded with the same fork B. Then, the frequency of the fork A before filing is
(a) 328 Hz (b) 316 Hz
(c) 324 Hz (d) 320 Hz

7. If there were no gravity, which of the following will not be there for a fluid?
(a) Viscosity
(b) Surface tension
(c) Pressure
(d) Archimedes' upward thrust

8. A choke is preferred to a resistance for limiting current in AC circuit because
(a) choke is cheap
(b) there is no wastage of power
(c) choke is compact in size
(d) choke is a good absorber of heat

9. Velocity-time curve for a body projected vertically upwards is
(a) parabola (b) ellipse
(c) hyperbola (d) straight line

10. If r_1 and r_2 are the radii of the atomic nuclei of mass numbers 64 and 125 respectively, then the ratio (r_1/r_2) is
(a) $\frac{64}{125}$ (b) $\sqrt{\frac{64}{125}}$ (c) $\frac{5}{4}$ (d) $\frac{4}{5}$

11. The ionization energy of Li^{2+} is equal to
(a) $9hcR$ (b) $6hcR$
(c) $2hcR$ (d) hcR

12. A current of 5 A is passing through a metallic wire of cross-sectional area 4×10^{-6} m^2. If the density of charge carriers of the wire is 5×10^{26} m^{-3}, then the drift velocity of the electrons will be
(a) 1×10^2 m/s (b) 1.56×10^{-2} m/s
(c) 1.56×10^{-3} m/s (d) 1×10^{-2} m/s

13. The numerical ratio of displacement to the distance covered is always
(a) less than one
(b) equal to one
(c) equal to or less than one
(d) equal to or greater than one

14. In Young's double slit experiment with sodium vapour lamp of wavelength 589 nm and the slits 0.589 mm apart, the half angular width of the central maximum is
(a) $\sin^{-1}(0.01)$ (b) $\sin^{-1}(0.0001)$
(c) $\sin^{-1}(0.001)$ (d) $\sin^{-1}(0.1)$

15. The principle of LASER action involves
(a) amplification of particular frequency emitted by the system
(b) population inversion
(c) stimulated emission
(d) All of the above

16. A train is moving towards east and a car is along north, both with same speed. The observed direction of car to the passenger in the train is
(a) east-north direction
(b) west-north direction
(c) south-east direction
(d) None of the above

17. Which of the following is unipolar transistor?
(a) *p-n-p* transistor
(b) *n-p-n* transistor
(c) Field effect transistor
(d) Point contact transistor

18. A solid sphere and a hollow sphere of the same material and of a same size can be distinguished without weighing
(a) by determining their moments of inertia about their coaxial axes
(b) by rolling them simultaneously on an inclined plane
(c) by rotating them about a common axis of rotation
(d) by applying equal torque on them

19. Point masses 1, 2, 3 and 4 kg are lying at the points (0, 0, 0), (2, 0, 0), (0, 3, 0) and (– 2, –2, 0) respectively. The moment of inertia of this system about *X*-axis will be
(a) 43 kg-m^2 (b) 34 kg-m^2
(c) 27 kg-m^2 (d) 72 kg-m^2

20. The radius of gyration of a body about an axis at a distance 6 cm from its centre of mass is 10 cm. Then, its radius of gyration about a parallel axis through its centre of mass will be
(a) 80 cm (b) 8 cm
(c) 0.8 cm (d) 80 m

21. A galvanometer can be changed into an ammeter by using
(a) low resistance shunt in series
(b) low resistance shunt in parallel
(c) high resistance shunt in series
(d) high resistance shunt in parallel

22. A bullet of mass 20 g and moving with 600 m/s collides with a block of mass 4 kg hanging with the string. What is velocity of bullet when it comes out of block, if block rises to height 0.2 m after collision?
(a) 200 m/s (b) 150 m/s
(c) 400 m/s (d) 300 m/s

23. Voltage in the secondary coil of a transformer does not depend upon
(a) frequency of the source
(b) voltage in the primary coil
(c) ratio of number of turns in the two coils
(d) Both (b) and (c)

24. In Carnot engine efficiency is 40% at hot reservoir temperature T. For efficiency 50%, what will be temperature of hot reservoir?
(a) $\frac{T}{5}$ (b) $\frac{2T}{5}$
(c) $6T$ (d) $\frac{6T}{5}$

25. A ball of mass 2 kg moving with velocity 3 m/s collides with spring of natural length 2 m and force constant 144 N/m. What will be length of compressed spring?
(a) 2 m (b) 1.5 m
(c) 1 m (d) 0.5 m

26. A proton moving vertically downward enters a magnetic field pointing towards north. In which direction proton will deflect?
(a) East (b) West
(c) North (d) South

27. Induced emf in the coil depends upon
(a) conductivity of coil
(b) amount of flux
(c) rate of change of linked flux
(d) resistance of coil

28. X-rays are used in determining the molecular structure of crystalline because
(a) its energy is high
(b) it can penetrate the material
(c) its wavelength is comparable to interatomic distance
(d) its frequency is low

29. Light of frequency ν falls on material of threshold frequency ν_0. Maximum kinetic energy of emitted electron is proportional to
(a) $\nu - \nu_0$ (b) ν
(c) $\sqrt{\nu - \nu_0}$ (d) ν_0

30. A light movs from denser to rarer medium, which of the following is correct?
(a) Energy increases
(b) Frequency increases
(c) Phase changes by 90°
(d) Velocity increases

31. Which one of the following statements is true?
(a) Both light and sound waves in air are transverse
(b) The sound waves in air are longitudinal while the light waves are transverse
(c) Both light and sound waves in air are longitudinal
(d) Both light and sound waves can travel in vacuum

32. A metro train starts from rest and in 5 s achieves 108 km/h. After that it moves with constant velocity and comes to rest after travelling 45 m with uniform retardation. If total distance travelled is 395 m, find total time of travelling.
(a) 12.2 s (b) 15.3 s
(c) 9 s (d) 17.2 s

33. A closed organ pipe of length 20 cm is sounded with tuning fork in resonance. What is frequency of tuning fork? (v = 332 m/s)
(a) 300 Hz (b) 350 Hz
(c) 375 Hz (d) 415 Hz

34. The temperature of the sun can be found out by using
(a) Wien's displacement law
(b) Kepler's law of motion
(c) Stefan's Boltzmann law
(d) Planck's law

35. Pressure of an ideal gas is increased by keeping temperature constant. What is effect on kinetic energy of molecules?
(a) Increase
(b) Decrease
(c) No change
(d) Cannot be determined

36. Kirchhoff's law of junction, $\Sigma I = 0$, is based on
(a) conservation of energy
(b) conservation of charge
(c) conservation of energy as well as charge
(d) conservation of momentum

37. A transverse wave is expressed as,
$$y = y_0 \sin 2\pi ft$$
For what value of λ, maximum particle velocity equals to 4 times the wave velocity?
(a) $y_0 \frac{\pi}{2}$ (b) $2y_0\,\pi$ (c) $y_0\,\pi$ (d) $y_0 \frac{\pi}{4}$

38. For a given lens, the magnification was found to be twice as large as when the object was 0.15 m distant from it as when the distance was 0.2 m. The focal length of the lens is
(a) 1.5 m (b) 0.20 m
(c) 0.10 m (d) 0.05 m

39. When sound waves travel from air to water which one of the following remains constant?
(a) Time period (b) Frequency
(c) Velocity (d) Wavelength

40. The Bulk modulus for an incompressible liquid is
(a) zero (b) unity
(c) infinity (d) between 0 and 1

Chemistry

1. 10^{-6} M NaOH is diluted 100 times. The pH of the diluted base is
(a) between 7 and 8
(b) between 5 and 6
(c) between 6 and 7
(d) between 10 and 11

2. An sp^3-hybrid orbital contains
(a) $\frac{1}{4}$ *s*-character (b) $\frac{1}{2}$ *s*-character
(c) $\frac{2}{3}$ *s*-character (d) $\frac{3}{4}$ *s*-character

3. Leaching is a process of
(a) reduction (b) concentration
(c) refining (d) oxidation

4. Electrolysis of fused NaCl will give
(a) Na (b) NaOH
(c) NaClO (d) $NaClO_3$

5. Which of the following fluorides does not exist?
(a) NF_5 (b) PF_5
(c) AsF_5 (d) SbF_5

6. Red lead is
(a) PbO (b) PbO_2
(c) Pb_3O_4 (d) Pb_2O_3

7. Hybridisation states of C in CH_3^+ and CH_3^- are
(a) sp^2, sp^3 (b) sp^3, sp^2
(c) sp, sp^2 (d) sp^2, sp

8. Which one of the following complexes is outer orbital complex?
(a) $[Co(NH_3)_6]^{3+}$ (b) $[Mn(CN)_6]^{4-}$
(c) $[Fe(CN)_6]^{4-}$ (d) $[Ni(NH_3)_6]^{2+}$

9. A solution made by dissolving 40 g NaOH in 1000 g of H_2O is
(a) 1 molar (b) 1 normal
(c) 1 molal (d) None of these

10. 0.1 mol HCl is equal to
(a) 3.65 g (b) 36.5 g
(c) 18 g (d) 1.8 g

11. Which will liberate bromine from a solution of potassium bromide?
(a) I_2 (b) Cl_2 (c) SO_2 (d) HI

12. Which of the following has the maximum number of unpaired electrons?
(a) V^{3+} (b) Fe^{2+}
(c) Mn^{2+} (d) Cu^+

13. The geometry of XeF_6 is
(a) planar hexagon (b) regular octahedron
(c) distorted octahedron (d) square bipyramid

14. The correct statement with regard to H_2^+ and H_2^- is
(a) both H_2^+ and H_2^- are equally stable
(b) both H_2^+ and H_2^- do not exist
(c) H_2^- is more stable than H_2^+
(d) H_2^+ is more stable than H_2^-

15. 2 g of a radioactive sample having half-life of 15 days was synthesised on 1st Jan 2009. The amount of the sample left behind on 1st March, 2009 (including both the days) is
(a) 0 g (b) 0.125 g
(c) 1 g (d) 0.5 g

16. The rate equation for a reaction,
$$A \longrightarrow B$$
is $r = k[A]^0$. If the initial concentration of the reactant is a mol dm^{-3}, the half-life period of the reaction is
(a) $\frac{a}{2k}$ (b) $\frac{k}{a}$
(c) $\frac{a}{k}$ (d) $\frac{2a}{k}$

17. For the reaction,
$$H_2O(l) \rightleftharpoons H_2O(g)$$
at 373 K and 1 atm pressure
(a) $\Delta H = 0$ (b) $\Delta E = 0$
(c) $\Delta H = T\Delta S$ (d) $\Delta H = \Delta E$

18. In electrophilic aromatic substitution reaction, the nitro group is *meta* directing because it
(a) decreases electron density at *ortho* and *para* positions
(b) decreases electron density at *meta* position
(c) increases electron density at *meta* position
(d) increases electron density at *ortho* and *para* positions

19. The best method for the conversion of an alcohol into an alkyl chloride is by treating the alcohol with
(a) PCl_3
(b) PCl_5
(c) $SOCl_2$ in presence of pyridine
(d) dry HCl in the presence of anhydrous $ZnCl_2$

20. The compound which is not formed during the dry distillation of a mixture of calcium formate and calcium acetate is
(a) methanal (b) propanal
(c) propanone (d) ethanal

21. The compound which forms acetaldehyde when heated with dilute NaOH, is
(a) 1,1-dichloroethane
(b) 1,1,1-trichloroethane
(c) 1-chloroethane
(d) 1,2-dichloroethane

22. The one which has least iodine value is
(a) sunflower oil (b) ginger oil
(c) ghee (d) groundnut oil

23. IUPAC name of $(CH_3)_3CCl$ is
(a) *n*-butyl chloride
(b) 3-chloro butane
(c) 2-chloro-2-methylpropane
(d) *t*-butyl chloride

24. The condensation polymer among the following is
(a) rubber (b) protein
(c) PVC (d) polyethene

25. In which of the following, NH_3 is not used?
(a) Tollen's reagent
(b) Nessler's reagent
(c) Group reagent for the analysis of IV group basic radicals
(d) Group reagent for the analysis of III group basic radicals

26. Argon is used
(a) in filling airships
(b) to obtain low temperature
(c) in high temperature welding
(d) in radiotherapy for treatment of cancer

27. Hyperconjugation is most useful for stabilising which of the following carbocations?
(a) *Neo*-pentyl (b) *Tert*-butyl
(c) *Iso*-propyl (d) Ethyl

28. The isomerism that arises due to restricted bond rotation is
(a) metamerism
(b) optical isomerism
(c) position isomerism
(d) geometrical isomerism

29. Amine that cannot be prepared by Gabriel phthalimide synthesis is
(a) aniline (b) benzylamine
(c) methylamine (d) *iso*-butylamine

30. Lactose is made of
(a) α-D-glucose only
(b) α-D-glucose and β-D-glucose
(c) α-D-galactose and β-D-glucose
(d) β-D-galactose and β-D-glucose

31. Cetyltrimethyl ammonium bromide is a popular
(a) anionic detergent
(b) cationic detergent
(c) non-ionic detergent
(d) sweetener

32. The number of electrons, neutrons and protons in a species are equal to 10, 8 and 8 respectively. The proper symbol of the species is
(a) $^{16}_{8}O$ (b) $^{18}_{8}O$
(c) $^{18}_{10}Ne$ (d) $^{16}_{8}O^{2-}$

33. 56 g of nitrogen and 96 g of oxygen are mixed isothermally and at a total pressure of 10 atm. The partial pressures of oxygen and nitrogen (in atm) are respectively
(a) 4, 6 (b) 5, 5
(c) 2, 8 (d) 6, 4

34. Which of the following undergoes reduction with hydrogen peroxide in alkaline medium?
(a) Mn^{2+} (b) I_2
(c) PbS (d) Fe^{2+}

35. The metal that produces red-violet colour in the non-luminous flame is
(a) Ba (b) Ag
(c) Rb (d) Pb

36. According to the first law of thermodynamics which of the following quantities represents the change in a state function?
(a) q_{rev} (b) $q_{rev} - W_{rev}$
(c) $\frac{q_{rev}}{W_{rev}}$ (d) $q_{rev} + W_{rev}$

37. The maximum oxidation state exhibited by actinide ions is
(a) +5 (b) +4
(c) +7 (d) +8

38. The dispersed phase and dispersion medium in soap lather are respectively
(a) gas and liquid (b) liquid and gas
(c) solid and gas (d) solid and liquid

39. The expression for the solubility product of Ag_2CO_3 will be
(a) $K_{sp} = s^2$ (b) $K_{sp} = 4s^3$
(c) $K_{sp} = 27s^4$ (d) $K_{sp} = s$

40. A 600 W mercury lamp emits monochromatic radiation of wavelength 331.3 nm. How many photons are emitted from the lamp per second? ($h = 6.626 \times 10^{-34}$ J-s; velocity of light $= 3 \times 10^8$ ms^{-1})
(a) 1×10^{19} (b) 1×10^{20} (c) 1×10^{21} (d) 1×10^{23}

Zoology

1. In mammals, histamine is secreted by
(a) fibroblasts (b) histocytes
(c) lymphocytes (d) mast cells

2. The layer of cells that secrete enamel of tooth is
(a) dentoblast (b) ameloblast
(c) osteoblast (d) odontoblast

3. Which important green house gas, other than carbon dioxide, is being produced from the agricultural fields?
(a) Arsine (b) Sulphur dioxide
(c) Ammonia (d) Nitrous oxide

4. The exchange of gases in the alveoli of the lungs takes place by
(a) osmosis (b) simple diffusion
(c) passive transport (d) active transport

5. Carbon monoxide is a pollutant because it
(a) reacts with oxygen
(b) inhibits glycolysis
(c) reacts with haemoglobin
(d) makes nervous system inactive

6. Total number of bones in the hindlimb of a man is
(a) 14 (b) 21
(c) 24 (d) 30

7. Calcitonin is a thyroid hormone which
(a) elevates potassium level in blood
(b) lowers calcium level in blood
(c) elevates calcium level in blood
(d) has no effect on calcium

8. A condition of failure of kidney to form urine is called
(a) deamination (b) entropy
(c) anuria (d) None of these

9. Solenocytes are the main excretory structures in
(a) annelids (b) molluscs
(c) echinodermates (d) platyhelminthes

10. A woman with two genes (one on each X-chromosome) for haemophilia and one gene for colour blindness on the X-chromosome marries a normal man. How will the progeny be?
(a) All sons and daughters are haemophilic and colourblind
(b) Haemophilic and colourblind daughters
(c) 50% haemophilic colourblind sons and 50% haemophilic sons
(d) 50% haemophilic daughters and 50% colourblind daughters

11. The functional unit of contractile system in striated muscle is
(a) cross birdge (b) myofibril
(c) sacromere (d) Z-band

12. The contraction of gall bladder is due to
(a) gastrin (b) secretin
(c) cholecystokinin (d) enterogastrone

13. The diversity in the type of beaks of finches adapted to different feeding habits on the Galapagos islands, as observed by Darwin, provides evidence for
(a) origin of species by natural selection
(b) intraspecific variations
(c) intraspecific competition
(d) interspecific competition

14. The most important component of the oral contraceptive pills is
(a) progesterone
(b) growth hormone
(c) thyroxine
(d) luteinising hormone

15. Sympathetic nervous system induces
(a) heart beat
(b) secretion of digestive juice
(c) secretion of saliva
(d) All of the above

16. The middle piece of the sperm contains
(a) proteins (b) centriole
(c) nucleus (d) mitochondria

17. The term 'aquaculture' means
(a) aspergillosis
(b) inland fisheries
(c) marine fisheries
(d) Both (b) and (c)

18. Active immunity means
(a) resistance developed after disease
(b) increasing quantity of blood
(c) resistance developed before disease
(d) increasing rate of heart-beat

19. The canal system is a characteristic feature of
(a) echinoderms
(b) helminthes
(c) coelenterates
(d) sponges

20. Which cranial nerve has the highest number of branches?
(a) Facial nerve
(b) Trigeminal
(c) Vagus nerve
(d) None of these

21. The problem due to Rh^- factor arises when the blood of two (Rh^+ and Rh^-) mixup
(a) during pregnancy
(b) through transfusion
(c) in a test tube
(d) Both (a) and (b)

22. Which of the following is mismatched?
(a) Vitamin-K — Beri-beri
(b) Vitamin-D — Rickets
(c) Vitamin-C — Scurvy
(d) Vitamin-A — Xerophthalmia

23. The joint between atlas and axis is called
(a) pivot joint (b) hinge joint
(c) saddle joint (d) angular joint

24. The blood group with antibody-a and antibody-b is
(a) B (b) A
(c) O (d) AB

25. Rate of heart beat is determined by
(a) Purkinje fibres
(b) papillary muscles
(c) SA-node
(d) AV-node

26. The junction between the axon of one neuron and the dendrite of the next is called
(a) junction point
(b) a synapse
(c) a joint
(d) constant bridge

27. Chondrichthyes is characterised by
(a) placoid scale
(b) ventral mouth
(c) ctenoid scale and ventral mouth
(d) placoid scale and ventral mouth

28. Secondary body cavity with mesodermal lining is called
(a) haemocoel (b) neurocoel
(c) true coelom (d) pseudocoelom

29. Stratified epithelium is found in
(a) seminiferous tubule
(b) fallopian tube
(c) nasal cavity
(d) kidney tubules

30. Dead space air in man is
(a) 500 mL (b) 150 mL
(c) 250 mL (d) 1.5 L

31. Vetebrate brain differentiates from
(a) endoderm (b) mesoderm
(c) ectoderm (d) blastoderm

32. Animals of class–Mammalia have
(a) seven cervical vertebrae
(b) seven cranial nerve
(c) single ventricular chamber
(d) fourteen cervical vertebrae

33. Vaccine for tuberculosis is known as
(a) PAS vaccine (b) BCG vaccine
(c) OPV (d) DPT

34. Sir Godfrey Hounsfield developed the diagonostic technique of
(a) CT scanning (b) MRI
(c) endoscopy (d) bronchoscopy

35. Alcoholism may leads to
(a) skin cancer (b) liver cirrhosis
(c) viral disease (d) eye infections

36. The basic unit of classification is
(a) species (b) genus
(c) family (d) phylum

37. Age of fishes is also known as
(a) Permian Era (b) Silurian Era
(c) Devonian Era (d) Ordovician Era

38. A hereditary disease which is never passed on from father to son is
(a) X-chromosomal linked disease
(b) Autosomal linked disease
(c) Y-chromosomal linked disease
(d) None of the above

39. One animal that does not perform locomotion is
(a) Sycon (b) *Nereis*
(c) *Sepia* (d) *Euglena*

40. Amount of CO_2 in expired air is about
(a) 0.04% (b) 0.03%
(c) 4.5% (d) 21%

Botany

1. The codon for anticodon 3′-UUUA-5′ is
(a) 3′-AAU-5′ (b) 5′-UAAA-3′
(c) 5′-AAAU-3′ (d) 3′-UAAU-5′

2. A kind of biotechnology involving manipulation of DNA is
(a) DNA replication
(b) genetic engineering
(c) denaturation
(d) renaturation

3. Minamata disease is caused due to presence of ..... in water.
(a) cadmium (b) lead
(c) arsenic (d) mercury

4. The phrase '*Omnis cellula e cellula*' was given by
(a) Virchow (b) Pasteur
(c) Schleiden (d) Brown

5. Intermediate community between pioneer and climax communities is called
(a) seral community
(b) biotic community
(c) temporary community
(d) ecosere

6. Ten percent law of energy transfer in a food chain is given by
(a) Schimper
(b) Elton
(c) Haeckel
(d) Lindemann

7. Apoenzyme is
(a) protein (b) carbohydrate
(c) vitamin (d) amino acid

8. Glycogenolysis involves
(a) conversion of sugar into glycogen
(b) oxidation of sugar
(c) conversion of glycogen into sugar
(d) conversion of glycogen into fat

9. A polygenic inheritance in human beings is
(a) skin colour
(b) sickle cell anaemia
(c) colour blindness
(d) phenylketonuria

10. Nucleic acid segment tagged with a radiactive molecule is called
(a) clone (b) probe
(c) plasmid (d) vector

11. Powdery mildew of wheat is caused by a species of
(a) *Puccinia*
(b) *Erysphe*
(c) *Ustilago*
(d) *Albugo*

12. Nucleic acid is absent in
(a) virus (b) viroid
(c) prion (d) mycoplasma

13. In most fungi, cell wall is chiefly made of
(a) cellulose (b) chitin
(c) protein (d) lipid

14. Heterocysts are present in
(a) *Riccia* (b) *Ulothrix*
(c) *Albugo* (d) *Nostoc*

15. Double fertilization occurs in
(a) *Riccia* (b) *Pteridium*
(c) *Cycas* (d) *Capsella*

16. In *Ruscus*, the stem is a
(a) phyllode (b) cladode
(c) offset (d) sucker

17. Catkin inflorescence is found in
(a) wheat (b) oat
(c) mulberry (d) fig

18. Epigynous flowers are present in
(a) mustad (b) brinjal
(c) China rose (d) cucumber

19. In *Dianthus*, placentation is
(a) basal
(b) free central
(c) axile
(d) marginal

20. The term 'keel' is used for special type of
(a) sepals (b) petals
(c) stamens (d) carpels

21. Coffee and quinine are obtained from the
(a) Leguminosae
(b) Asteraceae
(c) Rubiaceae
(d) Poaceae

22. Kranz anatomy can be obseved in leaves of
(a) sorghum (b) spinach
(c) mustrad (d) tulip

23. The term 'bark' refers to
(a) phellem, phelloderm and vascular cambium
(b) periderm and secondary xylem
(c) cork cambium and cork
(d) phellogen, phellem, phelloderm and secondary phloem

24. Light reaction in stroma lamellae of the chloroplast results in the formation of
(a) $NADPH_2$ (b) ATP + $NADPH_2$
(c) ATP (d) O_2

25. In leaves of C_4 plants malic acid synthesis during CO_2 fixation occurs in
(a) bundle sheath (b) mesophyll
(c) epidermis (d) guard cells

26. Membrane is absent in
(a) nucleus (b) nucleolus
(c) vacuole (d) lysosome

27. The quiescent centre in root meristem serves as a
(a) site for storage of food, which is utilised during maturation
(b) reservoir of growth hormones
(c) reserve for replenishment of damaged cells of the meristem
(d) region for absorption of water

28. An example of competitive inhibition of an enzyme is the inhibition of
(a) succinic dehydrogenase by malonic acid
(b) cytochrome oxidase by cyanide
(c) hexokinse by glucose-6-phosphate
(d) carbonic anhydrase by carbon dioxide

29. Biological Oxygen Demand (BOD) is a measure of
(a) industrial wastes poured into water bodies
(b) extent to which water is polluted with organic compound
(c) amount of carbon monoxide inseparably combined with haemoglobin
(d) amount of oxygen needed by green plants during night

30. In prokaryotes, chromatophores are
(a) specialised granules responsible for colouration of cells
(b) structures responsible for organising the shape of the organism
(c) inclusion bodies lying free inside the cells for carrying out various metabolic activities
(d) internal membrane systems that may become extensive and complex in photosynthetic bacteria

31. The Montreal Protocol refers to
(a) persistent organic pollutants
(b) global warming and climate change
(c) substances that deplete the ozone layer
(d) biosafety of genetically modified organisms

32. In the sieve elements, which one of the following is the most likely function of P-proteins?
(a) Deposition of callose on sieve plates
(b) Providing energy for active translocation
(c) Autolytic enzymes
(d) Sealing off mechanism on wounding

33. Which one of the following precedes re-formation of the nuclear envelope during M-phase of the cell cycle?
(a) Decondensation from chromosome and reassembly of the nuclear lamina
(b) Transcription from chromosome and reassembly of the nuclear lamina
(c) Formation of the contractile ring and formation of the phragmoplast
(d) Formaltion of the contractile ring and transcription from chromosomes

34. Viruses that infect bacterimal multiplication and cause their lysis, are called
(a) lysozymes
(b) lipolytic
(c) lytic
(d) lysogenic

35. A plant require magnesium (Mg) for
(a) holding cells together
(b) protein synthesis
(c) chlorophyll synthesis
(d) cell wall development

36. Which one of the following pairs, is not correctly matched?
(a) Abscisic acid — Stomatal closure
(b) Gibberellic acid — Leaf fall
(c) Cytokinin — Cell division
(d) IAA — Cell wall elongation

37. Two cells A and B are contigous. Cell A has osmotic pressure 10 atm, turgor pressure-7 atm and diffusion pressure deficit 3 atm. Cell B has osmotic pressure 8 atm, turgor pressure 3 atm and diffusion pressure deficit 5 atm. The result will be
(a) movement of water from cell B to A
(b) no movement of water
(c) equilibrium between the two
(d) movement of water from cell A to B

38. The Okazaki fragments in DNA chain growth
(a) results in transcription
(b) polymerise in the 3′ to 5′ direction and forms replication fork
(c) prove semi-conservative nature of DNA replication
(d) polymerise in the 5′ to 3′ direction and explain 3′ to 5′ DNA replication

39. One gene-one enzyme relationship was established for the first time in
(a) *Neurospora crassa*
(b) *Salmonella typhimurium*
(c) *Escherichia coli*
(d) *Diplococcus pneumoniae*

40. In gymnosperms, the pollen chamber represents
(a) a cell in the pollen grain in which the sperms are formed
(b) a cavity in the ovule in which pollen grains are stored after pollination
(c) an opening in the megagametophyte through which the pollen tube approaches the egg
(d) the microsporangium in which pollen grains develop

General English

Directions (Q. Nos. 1 to 5) *Four alternatives are given for the underlined idiom/phrase. Choose the alternative which best expresses the meaning of the underlined idiom/phrase.*

1. The principal has to carry out the orders issued by the higher authorities.
(a) obey (b) communicate
(c) execute (d) modify

2. The young engineer was hauled up for spilling the beans about the new project to the competitor.
(a) suppressing the information
(b) hiding the details
(c) revealing the information indiscreetly
(d) spoiling the plans

3. The Government claims that Indian industry is progressing by leaps and bounds.
(a) intermittently
(b) leisurely
(c) at a rapid pace
(d) at a desired pace

4. Laying off of thousands of workers is inevitable under the new economic policy.
(a) Dismissal from jobs of
(b) Offering new jobs to
(c) Reduction of worker's wages of
(d) Sending on leave

5. "I take thee at thy word", said Romeo to Juliet.
(a) Listen to you carefully
(b) Do not believe you
(c) Feel angry with you
(d) Truly believe you

Directions (Q. Nos. 6 to 10) *Out of the four alternatives, choose the one which can be substitued for the given words/sentence.*

6. To be biased against
(a) partial (b) objective
(c) prejudiced (d) predestined

7. Motion of head, hand etc, as a mode of expression indicating attitude
(a) Gesture (b) Grin
(c) Gestation (d) Grimace

8. Bitter and violet attack in words
(a) Diaspora (b) Diacriticism
(c) Diadem (d) Diatribe

9. Treatment by means of exercise and massage
(a) Chemotherapy
(b) Hydrotherapy
(c) Physiotherapy
(d) Psychotherapy

10. The abandonment of one's country or cause
(a) Defection (b) Disloyalty
(c) Desertion (d) Migration

Directions (Q. Nos. 11 to 12) *A part of the sentence is underlined. Below are given alternatives to the underlined parts at* (a), (b) *and* (c) *which may imporve the sentence. Choose the correct alternative. In case no improvement is needed, your answer is* (d).

11. He declined all the allegations against him.
(a) spurned (b) refused
(c) refuted (d) no improvement

12. It is time we leave.
(a) left (b) have to leave
(c) would leave (d) no improvement

13. We spent an hour discussing about his character.
(a) on his character (b) of his character
(c) his character (d) no improvement

14. Afer the letter reached me, I shall know the result.
(a) After the letter reaches
(b) After the letter will reach
(c) After the letter has reached
(d) No improvement

15. I have returned library books yesterday.
(a) had returned
(b) have had returned
(c) returned
(d) no improvement

Directions (Q. Nos. 16 to 20) *The first and the last parts of the sentence are numbered 1 to 6, the rest of the sentence is split into four parts and named* P, Q, R *and* S. *These four parts are not given in their proper order. Read the parts and find out which of the four combinations is correct.*

16. 1. Early to bed, early to rise, makes a man healthy, wealthy and wise.
P. But for the morning tea, I had to wait for someone to get up before me.
Q. This saying inspired me to rise early.
R. That day I was the first to get up.
S. One day I got up early in the morning.
6. Then I realised that it was a waste of time to get up early and wait for the morning tea.
(a) Q S R P (b) Q P R S
(c) P Q R S (d) S P Q R

17. 1. A wood-cutter was cutting a tree on a river bank.
P. He knelt down and prayed.
Q. His axe slipped and fell into the water.
R. God Mercury appeared before him and asked about the matter.
S. He could not get it back as the river was very deep.
6. He dived into the water and came up with an axe of gold.
(a) R P Q S (b) R P S Q
(c) Q S R P (d) Q S P R

18. 1. A dog stole a piece of meat from a butcher's shop.
P. He barked in anger.
Q. He ran to the jungle with the place of meat.
R. He saw his reflection.
S. He crossed a river on the way.
6. He lost his piece of meat.
(a) Q P S R (b) Q S R P
(c) Q P R S (d) S R P Q

19. 1. Ramai and Samai were two poor young men.
P. On market day they sold their labour.
Q. They lived near Mahespu.
R. On other days, they remained in the village looking for work.
S. They wanted regular work.
6. The headman gave them two plots.
(a) Q P R S (b) R P Q S
(c) S P Q R (d) P Q R S

20. 1. Roger wanted to become a doctor.
P. He put away enough money to pay his first year fees.
Q. They could not afford the fees.
R. Undaunted, he got himself a job in the dockyard.
S. However, he came from a poor family.
6. Once enrolled, he was recognised as a gifted student, and scholarships took care of the rest of his studies.
(a) S R P Q (b) P R S Q
(c) S Q R P (d) Q R S P

Directions (Q. Nos. 21 to 25) *Out of the four alternatives, choose the one which expresses the right meaning of the given word.*

21. Dubious
(a) Doubtful (b) Disputable
(c) Duplicate (d) Dangerous

22. Flabbergasted
(a) Scared (b) Embarrassed
(c) Dumbfounded (d) Humiliated

23. Eternal
(a) Innumerable (b) Unmeasurable
(c) Prolonged (d) Perpetual

24. Genuine
(a) Authentic (b) Legitimate
(c) Reliable (d) Pure

25. Obscene
(a) Indecent (b) Incorrigible
(c) Ridiculous (d) Intolerable

Directions (Q. Nos. 26 to 30) *Choose the word opposite in meaning to the given word.*

26. Despair
(a) Belief (b) Trust
(c) Hope (d) Faith

27. In toto
(a) Bluntly (b) Partially
(c) Entirely (d) Strongly

28. Protean
(a) Amateur (b) Catholic
(c) Unchanging (d) Rapid

29. Predilection
(a) Acceptance (b) Attraction
(c) Dislike (d) Choice

30. Admonish
(a) Condemn (b) Bless
(c) Praise (d) Congratulate

Directions (Q. Nos. 31 to 35) *Sentences are given with blanks to be filled in with an appropriate and suitable word. Four alternatives are suggested for each question. Choose the correct alternative out of the four.*

31. Are you really desirous ..... visiting Japan?
(a) of (b) in
(c) to (d) about

32. When Indians from the South move North, they find certain aspects of life quite ..... from their own.
(a) strange (b) separate
(c) different (d) divergent

33. The sky is overcast, we ..... the storm will soon burst.
(a) expect (b) hope
(c) trust (d) suspect

34. Population increase ..... with depletion of foreign reserves has led to great daily hardships.
(a) joined (b) mixed
(c) added (d) coupled

35. The National Anthem is ..... at every official function.
(a) uttered (b) sung
(c) whispered (d) chanted

Directions (Q. Nos. 36 to 40) *Four words are given in each question, out of which only one word is wrongly spelt. Find the wrongly spelt word and indicate it in the answer sheet by blackening the appropriate rectangle.*

36. (a) Accomplice (b) Accompaniment
(c) Accomplishment (d) Accomodation

37. (a) Replaceable (b) Replaceing
(c) Replacement (d) Replaced

38. (a) Relieve (b) Protein
(c) Deceit (d) Frieght

39. (a) Labrinth (b) Laboratory
(c) Laborious (d) Library

40. (a) Comit (b) Comedian
(c) Committee (d) Comunication

Answers

Physics

1. (c)	2. (c)	3. (c)	4. (d)	5. (a)	6. (d)	7. (d)	8. (b)	9. (d)	10. (d)
11. (a)	12. (b)	13. (c)	14. (c)	15. (d)	16. (b)	17. (c)	18. (b)	19. (a)	20. (b)
21. (b)	22. (a)	23. (a)	24. (d)	25. (b)	26. (a)	27. (c)	28. (c)	29. (a)	30. (c)
31. (b)	32. (d)	33. (d)	34. (c)	35. (c)	36. (b)	37. (a)	38. (b)	39. (b)	40. (c)

Chemistry

1. (a)	2. (a)	3. (b)	4. (a)	5. (a)	6. (c)	7. (a)	8. (d)	9. (c)	10. (a)
11. (b)	12. (c)	13. (c)	14. (d)	15. (b)	16. (a)	17. (c)	18. (a)	19. (c)	20. (b)
21. (a)	22. (c)	23. (c)	24. (b)	25. (b)	26. (c)	27. (b)	28. (d)	29. (a)	30. (d)
31. (b)	32. (d)	33. (d)	34. (b)	35. (c)	36. (d)	37. (c)	38. (a)	39. (b)	40. (c)

Zoology

1. (d)	2. (d)	3. (d)	4. (b)	5. (c)	6. (d)	7. (b)	8. (c)	9. (d)	10. (c)
11. (c)	12. (c)	13. (a)	14. (a)	15. (a)	16. (d)	17. (d)	18. (a)	19. (d)	20. (c)
21. (d)	22. (a)	23. (a)	24. (c)	25. (c)	26. (b)	27. (d)	28. (c)	29. (c)	30. (b)
31. (c)	32. (a)	33. (b)	34. (a)	35. (b)	36. (a)	37. (c)	38. (a)	39. (a)	40. (c)

Botany

1. (c)	2. (b)	3. (d)	4. (a)	5. (a)	6. (d)	7. (a)	8. (c)	9. (a)	10. (b)
11. (b)	12. (c)	13. (b)	14. (d)	15. (d)	16. (b)	17. (c)	18. (d)	19. (b)	20. (b)
21. (c)	22. (a)	23. (d)	24. (c)	25. (b)	26. (b)	27. (c)	28. (a)	29. (b)	30. (d)
31. (c)	32. (d)	33. (a)	34. (c)	35. (c)	36. (b)	37. (d)	38. (a)	39. (a)	40. (b)

General English

1. (c)	2. (c)	3. (c)	4. (a)	5. (d)	6. (c)	7. (a)	8. (d)	9. (c)	10. (a)
11. (d)	12. (a)	13. (c)	14. (a)	15. (c)	16. (a)	17. (d)	18. (b)	19. (a)	20. (c)
21. (a)	22. (c)	23. (d)	24. (a)	25. (a)	26. (c)	27. (b)	28. (c)	29. (c)	30. (c)
31. (a)	32. (c)	33. (d)	34. (d)	35. (b)	36. (d)	37. (b)	38. (d)	39. (a)	40. (d)

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Hints & Solutions

Physics

1. Resistivity, $\rho = \frac{m}{ne^2\tau}$

$\because$ $[\rho] = \frac{[M]}{[L^{-3}][AT]^2[T]}$

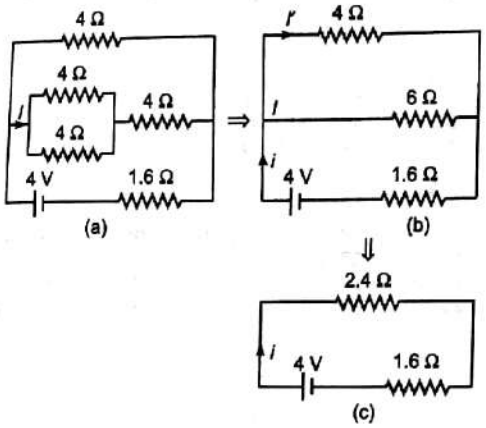
$= [ML^3A^{-2}T^{-3}]$

So, electrical conductivity

$\sigma = \frac{1}{\rho}$

$[\sigma] = \frac{1}{[\rho]} = [M^{-1}L^{-3}A^2T^3]$

2. We can simplify the network as shown



So net resistance,

$R = 2.4 + 1.6 = 4.0\ \Omega$

Therefore, current from the battery,

$i = \frac{V}{R} = \frac{4}{4} = 1\ A$

Now from the circuit (b),

$4I' = 6I$

$\Rightarrow$ $I' = \frac{3}{2}I$

But, $i = I + I' = I + \frac{3}{2}I = \frac{5}{2}I$

$\therefore$ $1 = \frac{5}{2}I$

$\Rightarrow$ $I = \frac{2}{5} = 0.4\ A$

3. Specific charge on proton $= \left(\frac{e}{m}\right)_p$

$= 9.6 \times 10^7$ C/kg

Specific charge on α-particle,

$\left(\frac{q}{m}\right)_\alpha = \frac{2e}{4m} = \frac{1}{2}\left(\frac{e}{m}\right)_p = \frac{1}{2} \times 9.6 \times 10^7$

$= 4.8 \times 10^7$ C/kg

4. For first line of Lyman series,

$n_1 = 1$ and $n_2 = 2$

$\therefore$ $\frac{1}{\lambda_1} = R\left(\frac{1}{1^2} - \frac{1}{2^2}\right) = R\left(1 - \frac{1}{4}\right) = \frac{3R}{4}$

For first line of Paschen series

$n_1 = 3$ and $n_2 = 4$

$\therefore$ $\frac{1}{\lambda_2} = R\left(\frac{1}{3^2} - \frac{1}{4^2}\right) = R\left(\frac{1}{9} - \frac{1}{16}\right)$

$= \frac{7R}{144}$

$\therefore$ $\frac{\lambda_1}{\lambda_2} = \frac{7R}{144} \times \frac{4}{3R} = \frac{7}{108}$

5. $R = R_0\, e^{-\lambda t}$

$\Rightarrow$ $\left(\frac{1}{3}\right) = e^{-\lambda \times 3} = e^{-3\lambda}$ ...(i)

Again, $\frac{R'}{R_0} = e^{-\lambda \times 9} = e^{-9\lambda} = (e^{-3\lambda})^3$

$= \left(\frac{1}{3}\right)^3$ [From Eq. (i)]

$= \frac{1}{27}$

$\therefore$ $R' = \frac{R_0}{27}$

Hence, in 9 days activity will become $\left(\frac{1}{27}\right)$ of the original value.

6. There are 4 beats between A and B, therefore the possible frequencies of A are 316 or 324 that is (320 ± 4) Hz.
When the prong of A is filed, its frequency becomes greater than the original frequency. If we assume that original frequency of A is 324 then on filing its frequency will be greater than 324. The beats between A and B will be more than 4. But it is given that the beats are again 4, therefore, 324 is not possible.

Therefore, required frequency must be 316 Hz. (This is true, because on filing the frequency may increase so as to give 4 beats with B of frequency 320 Hz.)

7. Archimedes' upward thrust will be absent for a fluid, if there were no gravity.

8. In an AC circuit, the coil of high inductance and negligible resistance used to control current, is called the choke coil. The power factor of such a coil is given by

$\cos\phi = \frac{R}{\sqrt{R^2 + \omega^2 L^2}}$

$\approx \frac{R}{\omega L}$ (as $R << \omega L$)

As $R << \omega L$, $\cos\phi$ is very small. Thus, the power absorbed by the coil is very small. The only loss of energy is due to hysteresis in the iron core, which is much less than the loss of energy in the resistance that can also reduce the current if placed instead of the choke coil.

10. $r = r_0\,(A)^{1/3}$

$\therefore$ $\frac{r_1}{r_2} = \left(\frac{A_1}{A_2}\right)^{1/3} = \left(\frac{64}{125}\right)^{1/3}$

$= \left[\left(\frac{4}{5}\right)^3\right]^{1/3} = \frac{4}{5}$

11. Ionization energy $= RchZ^2$

$Z = 3$ for Li^{2+}

$\therefore$ Ionization energy $= (3)^2\, Rch$

$= 9\, Rch$

12. Drift velocity, $v_d = \frac{I}{neA}$

$\Rightarrow v_d = \frac{5}{(5 \times 10^{26}) \times (1.6 \times 10^{-19}) \times (4 \times 10^{-6})}$

$= \frac{1}{64} = 1.56 \times 10^{-2}\ ms^{-1}$

14. In Young's double slit experiment, half angular width is given by

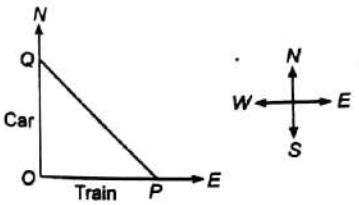
$\sin\theta = \frac{\lambda}{d}$

$= \frac{589 \times 10^{-9}}{0.589 \times 10^{-3}} = 10^{-3}$

$\Rightarrow$ $\theta = \sin^{-1}(0.001)$

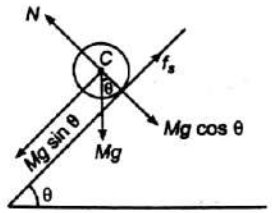
15. Laser action involves all the given phenomena
(i) Amplification of particular frequency
(ii) Population inversion
(iii) Stimulated emission

16. Let O be the origin, then



passenger in the train at P observes the car at Q along direction PQ, where direction PQ is west north direction.

18. The acceleration of a body rolling down the plane $= a$.



$\therefore$ $a = \frac{g \sin\theta}{1 + \frac{K^2}{R^2}}$

where K is radius of gyration and R the radius of sphere.

For solid sphere,

$\frac{K^2}{R^2} = \frac{2}{5}$

$\therefore$ $a = \frac{5}{7} g \sin\theta$

$= 0.7\,(g \sin\theta)$

For hollow sphere,

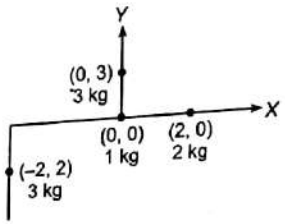
$\frac{K^2}{R^2} = \frac{2}{3}$

$= \frac{3}{5} g \sin\theta$

$= 0.6\,(g \sin\theta)$

Since, acceleration of solid sphere is more than of hollow sphere, it rolls faster, and reaches the bottom of the inclined plane earlier.
Hence, solid sphere and hollow sphere can be distinguished by rolling them simultaneously on an inclined plane.

19. Moment of inertia of the whole system about the axis of rotation will be equal to the sum of the moments of inertia of all the particles.



$I = I_1 + I_2 + I_3 + I_4$

$\therefore\ I = m_1r_1^2 + m_2r_2^2 + m_3r_3^2 + m_4r_4^2$

$I = (1\times 0) + (2\times 0) + (3\times 3^2) + 4(-2)^2$

$I = 0 + 0 + 27 + 16 = 43\ \text{kg-m}^2$

20. From the theorem of parallel axis, the moment of inertia I is equal to

$$I = I_{CM} + Ma^2$$

where I_{CM} is moment of inertia about centre of mass and a the distance of axis from centre.

$\therefore\quad I = MK^2 + M\times(6)^2$

$MK_1^2 = MK^2 + 36M$

$\Rightarrow\quad K_1^2 = K^2 + 36$

$\Rightarrow\quad (10)^2 = K^2 + 36$

$\Rightarrow\quad K^2 = 100 - 36 = 64$

$\Rightarrow\quad K = 8\ \text{cm}$

22. According to conservation of linear momentum,

$$m_1v_1 = m_1v + m_2v_2$$

where v_1 is velocity of bullet before collision, v is velocity of bullet after the collision and v_2 is the velocity of block.

$\therefore\quad 0.02\times 600 = 0.02v + 4v_2$

Here, $\quad v_2 = \sqrt{2gh} = \sqrt{2\times 10\times 0.2} = 2\ \text{m/s}$

$\therefore\quad 0.02\times 600 = 0.02v + 4\times 2$

$\Rightarrow\quad 0.02v = 12 - 8$

$\Rightarrow\quad v = \dfrac{4}{0.02} = 200\ \text{m/s}$

24. The efficiency of a heat engine is defined as the ratio of work done to the heat supplied, *ie,*

$$\eta = \frac{\text{Work done}}{\text{Heat input}} = \frac{W}{Q}$$

or $\quad \eta = 1 - \dfrac{T_2}{T_1}$

where T_2 is temperature of sink,

and T_1 is temperature of hot reservoir.

$\therefore\quad \dfrac{40}{100} = 1 - \dfrac{T_2}{T_1}$

$\Rightarrow\quad \dfrac{T_2}{T_1} = 0.6$

$\Rightarrow\quad T_1 = 0.6T_1$

Again, $\quad \dfrac{50}{100} = 1 - \dfrac{T_2}{T_1'}$

$\Rightarrow\quad \dfrac{T_2}{T_1'} = 0.5$

$\Rightarrow\quad \dfrac{0.6\,T_1}{T_1'} = 0.5$

$\therefore\quad T_1' = \dfrac{0.6}{0.5}T_1 = \dfrac{6}{5}T$

25. Let spring is compressed by a length x.

Kinetic energy of ball

= Potential energy of spring

ie, $\quad \dfrac{1}{2}mv^2 = \dfrac{1}{2}kx^2$

Given, $\quad m = 2\ \text{kg}, v = 3\ \text{m/s}, k = 144\ \text{N/m}$

$\therefore\quad \dfrac{1}{2}\times 2\times(3)^2 = \dfrac{1}{2}\times 144\times x^2$

or $\quad 9 = 72x^2$

$\therefore\quad x = \sqrt{\dfrac{9}{72}} = \dfrac{1}{2\sqrt{2}}\ \text{m}$

Hence, length of compressed spring

$$= 2 - \frac{1}{2\sqrt{2}}$$

$$= \frac{4\sqrt{2}-1}{2\sqrt{2}}$$

$$= 1.5\ \text{m}$$

26. Proton will represent the direction of current, *ie,* the direction of current is vertically downward. According to Fleming's left hand rule, if middle finger represents the direction of current and fore-finger represents the direction of magnetic field then thumb will represent the direction of Lorentz force acting on the proton which deflects the proton in east direction.

27. According to Faraday's law, "the induced emf in a closed loop equals the time rate of change of magnetic flux through the loop".

i.e., $\quad e = -\dfrac{d\phi_B}{dt}$

Hence, induced emf in a coil depends on rate of change of flux.

28. Crystal structure is explored through the diffraction of waves having a wavelength comparable with the interatomic spacing (10^{-10} m) in crystals. Radiation of longer wavelength cannot resolve the details of structure, while radiation of much shorter wavelength is diffracted through inconveniently small angles. Usually diffraction of X-rays is employed in the study of crystal structure as X-rays have wavelength comparable to interatomic spacing.

29. When light falls on a metallic surface, ejection of photoelectron results. In this process, conservation of energy holds.

Thus, from law of conservation of energy, Energy imparted by the photon

= Maximum kinetic energy of the emitted electron + work function of the metal

or $\quad h\nu = (\text{KE})_{max} + \phi$

but $\phi = h\nu_0$, ν_0 being threshold frequency.

$\therefore\quad (\text{KE})_{max} = h\nu - h\nu_0$

or $\quad (\text{KE})_{max} \propto \nu - \nu_0$

30. When a ray of light moves from one medium to other, its velocity changes. This change depends on refractive index of the medium.

Light travels from denser to rarer medium, *ie,* from medium of higher refractive index to lower refractive index. So, in second (rarer) medium, its velocity increases.

32. Given, $v = 108\ \text{km/h} = 30\ \text{m/s}$

For first equation of motion

$$v = u + at$$

$\therefore\quad 30 = 0 + a\times 5 \qquad (\because u = 0)$

or $\quad a = 6\ \text{m/s}^2$

So, distance travelled by metro train in 5 s

$$s_1 = \frac{1}{2}at^2 = \frac{1}{2}\times(6)\times(5)^2 = 75\ \text{m}$$

Distance travelled before coming to rest

$$= 45\ \text{m}$$

So, from third equation of motion

$$0^2 = (30)^2 - 2a'\times 45$$

or $\quad a' = \dfrac{30\times 30}{2\times 45} = 10\ \text{m/s}^2$

Time taken in travelling 45 m is

$$t_3 = \frac{30}{10} = 3\ \text{s}$$

Now, total distance = 395 m

ie, $\quad 75 + s' + 45 = 395\ \text{m}$

or $\quad s' = 395 - (75 + 45) = 275\ \text{m}$

$\therefore\quad t_2 = \dfrac{275}{30} = 9.2\ \text{s}$

Hence, total time taken in whole journey

$$= t_1 + t_2 + t_3$$

$$= 5 + 9.2 + 3$$

$$= 17.2\ \text{s}$$

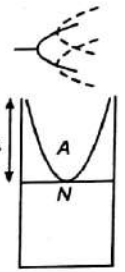
33. If we adjust the length of air-column in closed organ pipe as such its any natural frequency equals to the frequency of tuning fork, then the amplitude of forced vibrations of air-column increases very much. This is the state of resonance.

At first resonance

$$l = \frac{\lambda}{4}$$

So, frequency of tuning fork

$$f = \frac{v}{\lambda} = \frac{v}{4l}$$

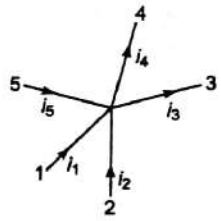


Given, $l = 20\ \text{cm} = 0.2\ \text{m}$, $v = 332\ \text{m/s}$

Hence, $\quad f = \dfrac{0.332}{4\times 0.2} = 415\ \text{Hz}$

35. Kinetic energy of an ideal gas depends only on its temperature. Hence, it remains constant whether its pressure is increased or decreased.

36. Kirchhoff's first law states that in an electric circuit, the algebraic sum of the currents meeting at any junction in the circuit is zero.



i.e., $\quad \Sigma i = 0$

Hence, according to Kirchhoff's law

$$i_1 + i_2 = i_3 + i_4 + i_5$$

Thus, the sum of currents flowing towards the junction is equal to the sum of the currents flowing away from the junction. In other words, when a steady current flows in a circuit, then there is neither any accumulation of charge at any point in the circuit, nor any charge is removed from there. Thus, Kirchhoff's first law expresses the conservation of charge.

37. Given equation is

$$y = y_0 \sin 2\pi ft$$

where $A = y_0$, $k = \dfrac{2\pi}{\lambda}$

According to question,

$$v = 4v_p$$

$$\therefore \quad A\omega = 4\frac{\omega}{k}$$

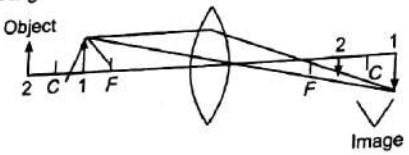
$$\therefore \quad y_0\,\omega = \frac{4\omega}{k}$$

$$\Rightarrow \quad y_0 = \frac{4}{k} = \frac{4}{2\pi} \times \lambda$$

Therefore, wavelength $\lambda = \frac{\pi y_0}{2}$

38. Let as shown, 1 and 2 are positions of objects and images in two different situations.

It is given



$$\left|\frac{v_1}{u_1}\right| = 2\left|\frac{v_2}{u_2}\right|$$

Here, $u_1 = -15$ cm, $u_2 = -20$ cm

$$\therefore \quad v_1 = 2v_2 \times \frac{u_1}{u_2}$$

$$= 2v_2 \times \frac{15}{20} = \frac{3}{2}v_2$$

Now, $\quad \frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$$\therefore \quad \frac{1}{f} = \frac{1}{v_1} - \frac{1}{u_1}$$

and $\quad \frac{1}{f} = \frac{1}{v_2} - \frac{1}{u_2}$

So, $\quad \frac{1}{v_1} - \frac{1}{u_1} = \frac{1}{v_2} - \frac{1}{u_2}$

$$\Rightarrow \quad \frac{2}{3v_2} + \frac{1}{15} = \frac{1}{v_2} + \frac{1}{20}$$

$$\Rightarrow \quad v = 20\,\text{cm}$$

Chemistry

1. $[OH^-]$ in the diluted base $= \frac{10^{-6}}{10^2} = 10^{-8}$

Total $[OH^-] = 10^{-8} + [OH^-]$ of water

$$= (10^{-8} + 10^{-7})\,M$$

$$= 10^{-8}\,[1 + 10]\,M$$

$$= 11 \times 10^{-8}\,M$$

$$pOH = -\log(11 \times 10^{-8})$$

$$= -\log 11 + 8\log 10$$

$$= 6.9586$$

$$pH = 14 - 6.9586$$

$$= 7.0414$$

2. Each sp^3-hybrid orbital has 25% $\left(\text{or } \frac{1}{4}\right)$ s-character and 75% $\left(\text{or } \frac{3}{4}\right)$ p-character.

3. Leaching is a process used for concentration or benefaction of ore. In this process, a powdered ore is treated with a suitable reagent, which can selectively dissolve the ore, but not the impurities.

4. When molten or fused NaCl is electrolysed, it yields metallic sodium and gaseous chlorine. Industrially, this process is called Down's process. Reactions occurring in Down's cell are as follows

$$NaCl(l) \longrightarrow Na^+ + Cl^-$$

$$Na^+ + e^- \longrightarrow Na \qquad \text{(at cathode)}$$

$$Cl^- \longrightarrow \frac{1}{2}Cl_2 + e^- \qquad \text{(at anode)}$$

5. P, As and Sb form pentahalides of the general formula EX_5 (where, E = P, As and Sb) due to the presence of vacant d-orbitals in their respective valence shell. N does not form pentahalides due to the absence of d-orbitals in its valence shell.

6. Red lead (minimum or sindhur), *i.e.*, Pb_3O_4 is a red powder, insoluble in water.

7. In $CH_3^+ = lp + bp = 0 + 3 = 3$

So, the hybridisation is sp^2.

In $CH_3^- = lp + bp = 1 + 3 = 4$

So, the hybridisation is sp^3.

8. Generally weaker field ligands form outer orbital complex. Between $[Co(NH_3)_6]^{3+}$ and $[Ni(NH_3)_6]^{2+}$, the later form outer orbital complex because of its d^8 configuration. (The configuration of $Co^{3+} = d^6$)

9. Number of moles of NaOH (n)

$$= \frac{\text{weight in g}}{\text{molar mass}}$$

$$= \frac{40}{40} = 1$$

As molality of a solution is defined as the number of moles of the solute dissolved in 1000 g (1 kg) of the solvent, thus the given solution of NaOH is '1 molal' solution.

10. Molecular mass of HCl

= 35.5 (at. wt. of chlorine)

+ 1 (at. wt. of hydrogen)

= 36.5

As 1 mole is the amount of the substance which has mass equal to gram molecular mass.

∴ 1 mol HCl is equal to 36.5 g.

and 0.1 mole HCl is equal to 3.65 g.

11. Since, E° of Cl_2 is higher than that of Br_2, therefore Cl_2 has a higher tendency to accept electrons than Br_2. Conversely, Br^- ion has a higher tendency to lose electrons than Cl^- ion. Therefore, the following reaction will occur

$$KBr \longrightarrow K^+ + Br^-$$

$$2Br^- + Cl_2 \longrightarrow 2Cl^- + Br_2$$

Thus, Br^- ions are oxidised to Br_2 by Cl_2, which itself is reduced to Cl^- ions.

12. The outer electronic configuration of the given ions is as

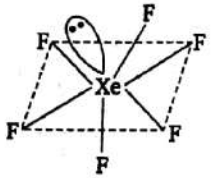
V^{3+} ion : 3d: ↑ ↑ | | | ; 4s: ☐ (two unpaired electrons)

Fe^{2+} ion : 3d: ↿ ↑ ↑ ↑ ↑ ; 4s: ☐ (four unpaired electrons)

Mn^{2+} ion : 3d: ↑ ↑ ↑ ↑ ↑ ; 4s: ☐ (five unpaired electrons)

Cu^+ ion : 3d: ↿ ↿ ↿ ↿ ↿ ; 4s: ☐ (zero unpaired electron)

13. The geometry of XeF_6 is distorted octahedral in which all the six positions are occupied by fluorine atoms and the lone pair of electrons of Xe atom is present at the corner of one of the triangular faces.



Structure of XeF_6

14. $H_2^+ : \sigma 1s^1, \overset{*}{\sigma} 1s^0$

$$\text{Bond order} = \frac{1}{2}$$

$H_2^- : \sigma 1s^2, \overset{*}{\sigma} 1s^1$

$$\text{Bond order} = \frac{2-1}{2} = \frac{1}{2}$$

The bond order of H_2^+ and H_2^- are same but H_2^+ is more stable than H_2^-. It is due to the presence of one electron in the antibonding molecular orbital in H_2^-.

15. $N = N_0\left(\frac{1}{2}\right)^n$

Given, $\quad N_0 = 2\,g$

$$t_{1/2} = 15 \text{ days}$$

$$t = 60 \text{ days}$$

$$\Rightarrow \quad n = \frac{60}{15} = 4$$

$$\therefore \quad N = 2\left(\frac{1}{2}\right)^4$$

or $\quad N = 0.125\,g$

16. $A \longrightarrow B$

$$\because \quad r = k[A]^0 \quad \text{or} \quad r = k$$

This is a zero order reaction.

$$\therefore \quad t_{1/2} = \frac{a}{2k}$$

17. $\Delta G = \Delta H - T \cdot \Delta S$

For the reaction,

$$H_2O(l) \rightleftharpoons H_2O(g)$$

$$\Delta G = 0 \qquad \text{(at equilibrium)}$$

$$\therefore \quad \Delta H = T \cdot \Delta S$$

18. When nitro group is present in the benzene nucleus, it withdraws electrons from o and p-positions. Thus, the electron density at the o and p-positions decreases. m-positions become positions of comparatively higher electron density and therefore, electrophilic attack occurs at m-positions.

19. The best method for the conversion of an alcohol into an alkyl chloride is by treating the alcohol with $SOCl_2$ in the presence of pyridine.

$$ROH + SOCl_2 \longrightarrow RCl + HCl + SO_2$$

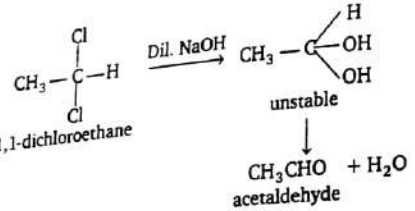
The other products being gases escape leaving behind pure alkyl halide.

20. Propanal is not formed during the dry distillation of a mixture of calcium formate and calcium acetate.

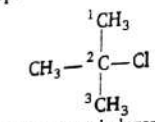
$$(HCOO)_2Ca \xrightarrow{\text{Dry distillation}} HCHO + CaCO_3$$

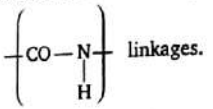
$$(CH_3COO)_2Ca \xrightarrow{\Delta} CH_3COCH_3 + CaCO_3$$

$$(HCOO)_2Ca + (CH_3COO)_2Ca \xrightarrow{\Delta} 2CH_3CHO + 2CaCO_3$$

21. 

22. Ghee has least iodine value among the given options because it is the least unsaturated.

23. 
2-chloro-2-methylpropane

24. Proteins are the condensation polymers of α-amino acids. Proteins contain peptide  linkages.

25. Potassium tetraiodo mercurate (II), *i.e.*, $K_2[HgI_4]$ dissolves in KOH solution to give Nessler's reagent. Nessler's reagent is used to test NH_4^+ ions.

26. Argon is used in high temperature welding and other operations which require a non-oxidising atmosphere and the absence of nitrogen.

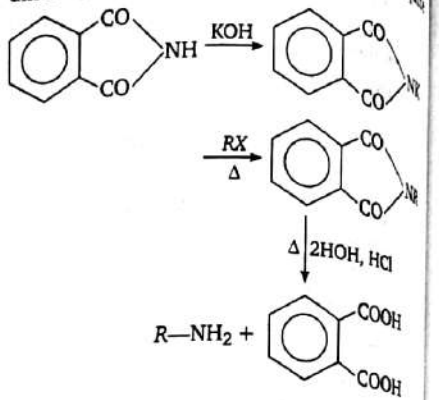
27. On the basis of hyperconjugation, stability order of different alkyl carbocations is

$$3° > 2° > 1° > \text{methyl}$$

In *t*-butyl cation, the C-atom bearing the positive charge is attached to three methyl groups, thus it will have maximum hyperconjugate structures, which give it maximum stability.

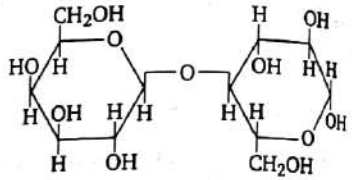
28. Basic needs for geometrical isomerism are
(i) Presence of double bond, *i.e.*, restricted rotation which also may be in case of single bond as in cycloalkanes.
(ii) Doubly bonded carbon atom must be linked to two different groups.

29. Only aliphatic primary amines can be prepared by Gabriel synthesis. Aniline cannot be prepared by this method because aryl halides (C_6H_5Cl or C_6H_5Br) do not undergo nucleophilic substitution with potassium phthalimide under ordinary conditions to give N-phenyl phthalimide (*i.e.*, cleavage of C—*X* bond in haloarenes is quite difficult).



(*RX* = aliphatic halide)

30. Lactose (milk sugar) is a disaccharide, obtained by the condensation of one molecule of β-D-galactopyranose and one molecule of β-D-glucopyranose.


β-D-galactopyranose β-D-glucopyranose
Lactose

31. Cetyltrimethyl ammonium bromide which is a germicide, is a popular cationic detergent.

32. From the given data, it is clear that the atomic number, *Z* or number of protons of the species is 8. Number of neutrons is also 8, hence atomic mass is 16. Since, the number of electrons are two more than the number of protons, hence it is a binegative species. Thus, the species is $^{16}_{8}O^{2-}$.

33. According to Dalton's law,

$$p_{solute} = x_{solute} \times p$$

Given, mass of N_2 = 56 g

$$\therefore \text{Moles of } N_2 (n_{N_2}) = \frac{56}{28} = 2 \text{ mol}$$

Mass of O_2 = 96 g

$$\therefore \text{Moles of } O_2 (n_{O_2}) = \frac{96}{32} = 3 \text{ mol}$$

$$x_{N_2} = \frac{2}{2+3} = 0.4$$

$$x_{O_2} = \frac{3}{2+3} = 0.6$$

$$\therefore \quad p_{N_2} = x_{N_2} \times p = 0.4 \times 10 = 4 \text{ atm}$$

$$p_{O_2} = x_{O_2} \times p = 0.6 \times 10 = 6 \text{ atm}$$

34. It reduces iodine to iodide ion in alkaline medium.

$$I_2(s) + H_2O_2(aq) + 2OH^- \longrightarrow 2I^-(aq) + 2H_2O(l) + O_2(g)$$

35. Alkali metals and their salts impart a characteristic colour to flame. The reason for flame colouration is that the energy of the flame causes an excitation of the outermost electrons which when return to their original position, give out the energy so absorbed in the visible region. Thus, Rb gives red-violet colour to the flame.

36. $\Delta E = q_{rev} + W_{rev}$
ΔE is a state function.

37. Actinoids exhibit variable oxidation states, which vary from +3 to +7.

38. Soap lather is an example of colloidal system foam, in which the dispersed phase is gas and dispersion medium is liquid.

39. $Ag_2CO_3(s) \rightleftharpoons \underset{2s}{2Ag^+} + \underset{s}{CO_3^{2-}}$

$$K_{sp} = [Ag^+]^2[CO_3^{2-}] = (2s)^2 \cdot s$$

$$\therefore \quad K_{sp} = 4s^3$$

40. Given, power = 600 W

$$\lambda = 331.3 \text{ nm} = 331.3 \times 10^{-9} \text{ m}$$

$$\text{Power} = \frac{\text{energy}}{\text{time}}$$

$$= \frac{nh\nu}{t} = \frac{nhc}{\lambda t}$$

or

$$n = \frac{\text{power} \times \lambda t}{hc}$$

$$= \frac{600 \times 331.3 \times 10^{-9} \times 1}{6.626 \times 10^{-34} \times 3 \times 10^8}$$

$$n = 1 \times 10^{21}$$

Zoology

1. **Histamine** is a potent vasodilator formed by decarboxylation of the amino acid histidine and released by mast cells in response to appropriate antigens.
Mast cells which secrete histamine are especially prevalent in the connective tissue of the skin and respiratory tract and in surrounding blood vessels.

2. The pulp cavity contains a mass of dense but soft connective tissue which is called **pulp.** A single layer of **odontoblast cells** line the pulp cavity. These cells secrete **enamel,** which is a bluish-white shiny translucent and the hardest substance of the body.

3. In addition to carbon dioxide some other gases also contribute to green-house effect. These include ozone, CFCs, nitrous oxide.

4. Oxygen diffuses from alveoli to deoxygenated blood, and carbon dioxide diffuses from deoxygenated blood to alveoli by **simple diffusion.** Diffusion is defined as, the flow of the substance (gases) from a region of their higher concentration to a region of lower concentration.

5. Carbon monoxide, when inhaled, **combines with blood haemoglobin** to form carboxyhaemoglobin at a rate 210 times faster than the rate of oxygen forms oxyhaemoglobin. Thus, respiration is impaired.

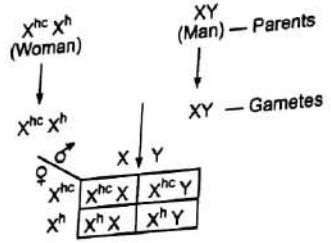
6. 1 femur + 1 fibula + 1 tibia + 1 patella + 7 tarsals + 5 metatarsals + 14 phalanges make **one hind** limb of man.

7. **Calcitonin** is a polypeptide hormone which **lowers calcium and phosphate levels** of plasma by inhibiting bone degradation and stimulating their uptake by bone. Parathyroid hormone elevates calcium level in blood.

8. The terms **anuria, oligonuria, polynuria** and **dysuria** are used for absence of urine, scanty urine, large amounts of urine, and painful urination respectively. Deamination is the removal of amino ($—NH_2$) group frequently from an amino acid by transaminase enzymes.

9. Solenocytes (also called **flame cells**) are meant for excretion and osmoregulation in **Platyhelminthes.** Annelids have **metanephridia** for excretion. Molluscs have **kidneys** (although different from vertebrate kidneys) for excretion.
In echinodermates, no special excretory organs are found for excretion. In them, excretion takes place through diffusion or osmosis or through active transport.

10. Haemophilia and colour blindness both are recessive X-linked traits. They express in males when present in single copy (heterozygous) but in females, they express only when present in homozygous condition.



Results
(a) 50% sons are colourblind and haemophilic.
(b) 50% sons are haemophilic only.
(c) 50% daughters are carrier for colour blindness and haemophilia.
(d) 50% daughters are carrier for haemophilia only.

11. A skeletal muscle consists of a bundle of long fibres running the length of the muscle. Each fibre is a single cell with many nuclei.
Skeletal muscle is also called as striated muscle because the regular arrangement of the myofilaments creates as repeating pattern of light and dark bands. Each repeating unit is a **sarcomere**, the basic functional unit of the muscle. The borders of the sarcomere, the **Z-lines** are lined up in adjacent myofibrils and contribute to the striations visible with a light microscope. The thin filaments are attached to the Z-lines and project toward the centre of the sarcomere while the thick filaments are centered in the sarcomere. At rest, the thick and thin filaments do not overlap completely, and the area near the edge of the sarcomere where there are only thin filaments is called the **I-band.** The **A-band** is the broad region that corresponds to the length of the thick filaments. The thin filaments do not extend completely across the sarcomere. So, the **H-zone** in the centre of the A-band contains only thick filaments. This arrangement of thick and thin filaments is the key to how the sacromere and hence, the whole muscle contracts.

12. **Cholecystokinin** (also called **pancreozymin)** is a hormone of mucosa of small intestine. It is released in response to chyme. It causes pancreas to release pancreatic enzymes and gall bladder to eject bile.

13. Birds of Galapagos islands (Darwin's finches) are believed to have evolved from ancestors on the South American mainland as a result of natural selection due to different feeding niches available to them.

14. Use of contraceptive pills is a widespread form of birth control. Contraceptive pills contain oestrogen and **progesterone.** The production of the pituitary hormones FSH and LH in the normal sexual cycle of a female is shut down by these hormones. In the absence of FSH, the ovarian follicles do not ripen and ovulation does not occur in the absence of LH.

15. Medulla of brain has two regions affecting heart rate—(i) cardiac inhibitory centre, (ii) cardiac accelerator centre. Sensory nerves originating from the accelaertor centre run parallel to the spinal cord and enter the sino-artial node. Stimulation by these nerves, which are the part of sympathetic nervous system cause an increase in heart beat.

16. The middle piece of human sperm contains **mitochondria,** which are coiled around an axial filament called as mitochondrial spiral. These provide energy for the movement of sperms.

17. The term 'aquaculture' refers to the systematic method of cultivation of aquatic organisms to obtain maximum yield of best quality. It includes 'piseiculture' (fish farming) both **inland** and **marine.**

18. **Immunity** is described as an 'active immunity' when an organism's own body manufactures its own antibodies. It may be natural (developing when organism is exposed to an infectious agent) or artificial (achieved by injecting small amount of antigen called vaccine into the body of the individual).

19. **Sponges** possess an extensive system of interconnected cavities called **canal system,** which typically consists of incurrent canals, radial canals, excurrent canals and spongocoel. The system is useful for nutrition, respiration and excretion.

20. **Vagus** nerve has five branches
(i) Superior laryngeal nerve
(ii) Recurrent laryngeal nerve
(iii) Cardiac nerve
(iv) Pneumogastric nerve
(v) Depresser nerve.

21. **Landsteiner** and **Weiner** (1940) disovered Rh antigens in the rhesus monkey.
Now, it is found in most human beings. Human with this factor are said to be Rh^+ and humans without this factor are said to be Rh^-.
The problem due to Rh incompatibility arises when the blood of Rh^+ person and Rh^- women mixes up during **pregnancy** or through **blood transfusion.**

22. Beri-beri is caused by the deficiency of vitamin-B_1 (thiamine).
Vitamin-K is also known as antihaemorrhagic factor. The main sources of vitamin-K are green leafy vegetables such as cauliflower, cabbage, spinach, etc. It is also found in animal sources like egg yolk, liver, etc. Vitamin-K is essential for blood clotting and deficiency of it causes **haemorrhage.**

23. Axis vertebra possesses a peg-like structure called the odontoid process which projects forward from the centrum. It fits into the cavity of the atlas below the ligament so that it is separated from the neural canal. Such an arrangement gives a **pivot joint** which allows head to shake (rotate from one side to the other).

24. Persons having **blood group-O** have no antigens but have both anibodies a and b in their plasma.

25. The contraction of heart depends on small cluster of specialised muscle cells which are embedded in the upper wall of the right atrium. This cluster of cells is called the **sino-atrial node** (SA-node). It automatically and rhythmically sends out impulses that initiate each heart beat.

26. The end-to-end position of the axon of one neuron and the dendrites of another neuron called the **synapse.**
Most neutrons do not actually touch other neurons with which they communicate, instead there is a minute space, separating these two called the **synaptic cleft.**

27. Chondrichthyes is one of the classes of super-class–Pisces, sub-phylum–Vertebrata and phylum–Chordata. The members of class–Chondrichthyes are marine animals with streamlined body and have cartilaginous endoskeleton. Mouth is located ventrally. The skin is tough, containing minute placoid scales. The teeth aremodified placoid scales which are backwardly directed, *e.g.*, Dog fish (*Scoliodon*), saw fish (*Pristis*), great white shark (*Carcharodon*), sting ray (*Trygon*), etc.

28. The body cavity which is lined by mesoderm is called coelom. Animals possessing coelom are called coelomates, *e.g.*, annelids, molluscs, arthropods, echinoderms, hemichordates and chordates.

29. Epithelium made up of a series of layers is called stratified epithelium. The cells of each layer vary in size and shape. It is also called **laminated epithelium.** It is found in olfactory region of the nasal cavity and contains the receptors for the sense of smell.

30. Dead space is the air that is inhaled by the body in breathing but does not take part in gas exchange. In man, it is 150 mL.

31. The brain is the centre of the nervous system in all vertebrates and most invertebrate animals. The neural plate of ectoderm forms the brain, spinal cord and nerves.

32. The number of cervical vertebrae are seven in almost all mammals including human beings.

33. **Baccillus Calmette Guerin** (BCG) is the vaccine for tuberculosis. It was first used in 1921. BCG is the only vaccine available today for protection against tuberculosis. It is most effective in protecting children from the disease. BCG contains a live attenuated (weakened) strain of *Mycobacterium bovis.* This vaccine was developed by **Calmette** and **Guerin** at Pasteur Institute, Paris.

34. **Sir Godfrey Newbold Hounsfield,** an English electrical engineer who shared th 1979 Nobel Prize for Physiology or Medicine with **Allan MacLeod Cormak** for his part in developing diagnostic technique of X-ray computed tomogrpahy (CT) scanning. He died in August 2004.

35. Alcoholism is a chronic, often progressive disease in which a person craves alcohol and drinks despite repeated alcohol related problems. It involves a physical dependence on alcohol. It may lead to liver cirrhosis. Cirrhosis is build up of scar tissue that changes the structure of the liver and blocks blood flow.
Cirrhosis can cause varicose veins, which can rupture and potentially triggering internal bleeding.

36. The basic unit of classification is species. It is the lowest category of classification. It is a group of closely related individuals with similar morphological, anatomical, biochemical and cytological characters. It is a group of naturally interbreeding population with ability to produce fertile offsprings. Individuals of a species share a common gene pool. Species is reproductively isolated, thus genetically closed system. Species has the real existence in nature. The term 'species' was given by **John Ray,** an English naturalist.

37. The Devonian Perioid is known as 'the age of fishes'. It is famous for the thousands of species of fish that developed in Devonian sea. The Devonian Period of Palaeozonic Era lasted from 417 million years ago to 354 million years ago.

38. Man has only one X-chromosome that is inherited to his daughter. Therefore, a hereditary disease, which is X-chromosomal linked, is never passed on from father to son.

39. Sycon (*Scypha*) is a sponge and does not perform locomotion. It is a genus of calcareous sponges belonging to family–Scyettidae, Class–Calcaronea and phylum–Porifera. These sponges are small, growing upto 5 cm in total length, and are tube shaped and often white to cream in colour.

40. Amount of CO_2 in expired air is 4.4%. The air we breathe in contain about 0.04% CO_2. The air we breathe out contains about 4% CO_2. In other words, exhaled air contains about 100 times the concentratioon of CO_2 that inhaled air does.

Botany

1. In RNA the thymine of DNA is replaced by uracil. Codon and anticodon both found on RNA and are complementary to each other so, the codon for anticodon 3'-UUUA-5' will be 5'-AAUU-3'.
2. In genetic engineering rDNA technology is applied to several biotechnological processes for obtaining particular biochemical improvement of genetic make up of an organism and fighting genetic defects.
3. In water mercury gets changed into water soluble dimethyl form and enters the food chain accompanied by biological amplification. It develops a crippling deformity called **Minamata disease.**
4. In 1855 Rudolf Virchow extended the cell theory and stated that all cells arise from pre-existing cells, *i.e., Omnis cellula e cellula.*
5. The first biotic community which develops in a bare area is called pioneer community. Climax community is the stable, self perpetuating and final biotic community that develops at the end of biotic succession. The various biotic communities that develop during biotic succession are termed as seral or transitional communities.
6. According to Lindeman's law of trophic efficiency, the efficiency of energy transfer from one trophic level to next is about 10%.
7. Enzymes are proteinaceous molecules. Simple enzymes are composed of only protein, while holoenzymes are composed of protein part (apoenzyme) and non-protein part (prosthetic group).
8. Glycogenesis—conversion of sugar to glycogen.
   Glycogenolysis—conversion of glycogen to sugar.
9. Genes that when acting individually have a small effect but that collectively produce a significant phenotypic expression are called polygenes, *e.g.,* inheritance of kernel colour in wheat and skin colour in human.
10. Probe are 15-30 bases long radioactive labelled oligonucleotides (RNA or DNA) used to detect complementary nucleotide sequence, used for disease diagonsis, etc.
11. Powdery mildew of wheat–*Erysiphe graminis.*
    Loose smut of wheat–*Ustilago tritici.*
    Black rust of wheat–*Puccinia graminis tritici.*
12. Prions are disease causing proteinaceous molecules. These lack nucleic acid and are formed due to abnormal folding of proteins.
13. The cell wall of fungi consists of fungal cellulose or chitin (a polymer of N-acetyl glucosamine).
14. Heterocysts are modified vegetative cells specified for nitrogen fixation. These are found in blue-green algae, *e.g., Nostoc.*
15. Double fertilization is the characteristic feature of angiosperms, *e.g., Capsella.* It includes fusion of one male gamete with egg and second male gamete with secondary nucleus (this forms endosperm).
16. When the stem becomes green, flattened or fleshy and carry out photosynthesis, this is called phylloclade. The short, green, cylindrical or flattened phylloclade with one or two internode is called clodode, *e.g., Ruscus.*
17. In catkin inflorescence the flowers are sessile and unisexual with pendulous axis, *e.g., Morus* (mulberry).
18. In epigynous type of flowers the thalamus enclosed the ovary entirely and fuses. The sepals, petals and stamens arise from the top of ovary. Such flowers known as epigynous and ovary as inferior, *e.g., Oenothera, Cucurbita.*
19. In free central placentation the syncarpous gynoecium is unilocular and the placentae are borne on a central column formed by extension of base of the gynoecium where the carpels fuse or the suppression of septa, *e.g., Stellaria, Dianthus.*
20. Keel is a special type of petal found in papilionaceous type of corolla. Papilionaceous type is butterfly like, the corolla has one large posterior standard, two lateral wings, two innermost and smaller keels.
21. *Coffea arabica* (Rubiaceae) yields the well known beverage coffee. *Cinchona* sp. (Rubiaceae) yields the quinine which is used in treatment of malaria.
22. Kranz anatomy is found in C_4-plants, *e.g., Sorghum, Zea mays, Saccharum officinarum.* It is characterised by connective, undifferentiated mesophyll around vascular bundles with chloroplast containing bundle sheath.
23. All the dead cells lying outside the phellogen constitute the bark of plant. It may include epidermis, cork, hypodermis and even part of cortex depending upon the position of origin of cork cambium or phellogen.
24. Photosystem-I is located in non-appressed part of grana and stroma lamellae. It is involved both in cyclic and non-cyclic photophosphorylation. Interrelationship of PS-I and PS-II produces ATP and $NADPH_2$.

25. In C_4-plants CO_2 combines with phosphoenol pyruvic acid to form oxaloacetic acid in mesophyll chloroplasts. It is further reduced to malic acid which is transferred to chloroplast in bundle sheath cells.
26. Nucleolus is a darkly stained granular, naked organelle with no limiting membrane. It is formed of proteinaceous part pars amorpha, fibrillar zone and granular zone of ribonucleoprotein and granules.
27. The quiescent centre is found in the centre of the root apex. Cells of this region have lower content of RNA and smaller nuclei. This represents inactive region of root apex (**Clowers;** 1958) and serves as a reserve for replenishment of damaged cells.
28. Classical example of competitive inhibition is reduction of activity of succinate dehydrogenase by malonate, oxaloacetate and other anions. In competitive inhibition, a competitive inhibitor which has the resemblance with substrate molecule, competes with the substrate for the active site of an enzyme. While the inhibitor (I) occupies the active site, it prevents binding of the substrate to the enzyme.
29. **Biological Oxygen Demand** (BOD) is a meaure of polluting organic matter present in a sample of water. BOD is higher in polluted sewage water and is connected with both microbes and organic matters. When larger amount of sewage is dumped in to water, the BOD will increase.
30. In some prokaryotes like, photosynthetic bacteria and blue-green algae possess small membrane lined chromatophores, which is similar to but chemically simpler than the chlorophyll of plants.
31. World's major producers and consumers of pollutants met at Montreal (Canada) on September 16, 1987 to solve the problem of ozone thining in stratosphere. 24 countries signed the protocol that came into force on january 1, 1989.
    This protocol refers to the substances such as CFCs (chlorofluorocarbons), methane that deplete the ozone layer.
32. In most angiospermic plants, sieve tube elements of phloem, are P-proteins. Later is found in all dictos and in many monocots but it is absent in gymnosperms and cryptogams.
    The main function of P-proteins is in sealing off damaged sieve elements by plugging up sieve plate pores.
33. At telophase stage, nuclear membrane vesicles associate with the surface of individual chromosomes and fuse to reform the nuclear membranes, which partially enclose clusters of chromosomes before coalescing to reform the complete nuclear envelope. During this process, the nuclear pores reassemble and (the dephosphorylated reassociate to form the nuclear lamina.) One of the lamina proteins (lamina-B) remains with the nuclear membrane fragments throughout mitosis and may help nucleate ressembly. After the nucleus reforms, the pores pump in nuclear proteins, the chromosome decondense and RNA synthesis resumes, causing the nucleolus to reappear.
34. When bacteriophage infects a bacterium, it entirely depends on the host for its multiplication. It utilises the host machinery for replication and produce a large number of progeny phage particles. The bacterium cell undergoes lysis and dies to liberate a large number of these phage particles, which are each ready to start another cycle by infecting new bacterial cell. This cycle is known as **lytic cycle.**
35. Magnesium is an important constituent of chlorophyll molecule.
36. Gibberellin helps in cell growth of stem, leaves and other aerial parts.
37. The water movs from lower DPD to higher DPD.
38. The Okazaki fragments in DNA chain growth polymerise in the 5' to 3' direction. The replicated DNA result in transcription.
39. One gene-one enzyme relationship was initially proposed by **Beadle** and **Tatum** and based on the experiments conducted on *Neurospora crassa.* They were awarded by Nobel Prize in 1958 for this achievement.
40. In gymnosperms, the pollen chamber is a cavity in the ovule in which pollen grains are stored after pollination.

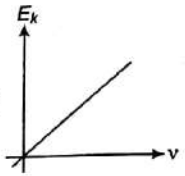
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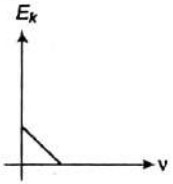
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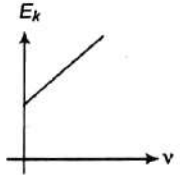
Physics

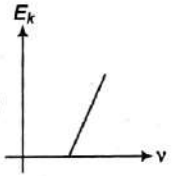
1. The cylindrical tube of a spray pump has a cross-section of 8 cm^2, one end of which has 40 fine holes each of area 10^{-8} m^2. If the liquid flows inside the tube with a speed of 0.15 m min^{-1}, the speed with which the liquid is ejected through the holes is
(a) 50 m/s (b) 5 m/s
(c) 0.05 m/s (d) 0.5 m/s

2. Which one of the following graph represents the variation of maximum kinetic energy (E_k) of the emitted electrons with frequency ν in photoelectric effect correctly?

(a) 

(b) 

(c) 

(d) 

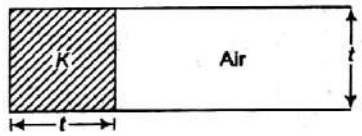
3. A vessel of height $2d$ is half filled with a liquid of refractive index $\sqrt{2}$ and the other half with a liquid of refractive index n (the given liquids are immiscible). Then, the apparent depth of the inner surface of the bottom of the vessel (neglecting the thickness of the bottom of the vessel) will be
(a) $\frac{n}{d(n+\sqrt{2})}$ (b) $\frac{d(n+\sqrt{2})}{n\sqrt{2}}$
(c) $\frac{\sqrt{2}\,n}{d(n+\sqrt{2})}$ (d) $\frac{nd}{d+\sqrt{2}n}$

4. A shell of mass 20 kg at rest explodes into two fragments whose masses are in the ratio 2 : 3. The smaller fragment moves with a velocity of 6 m/s. The kinetic energy of the larger fragment is
(a) 96 J (b) 216 J
(c) 144 J (d) 360 J

5. An electric bulb has a rated power of 50 W at 100 V. If it is used on an AC source 200 V, 50 Hz, a choke has to be used in series with it. This choke should have an inductance of
(a) 0.1 mH (b) 1 mH
(c) 0.1 H (d) 1.1 H

6. In Young's double slit experiment with sodium vapour lamp of wavelength 589 nm and the slits 0.589 mm apart, the half angular width of the central maximum is
(a) $\sin^{-1}(0.01)$ (b) $\sin^{-1}(0.0001)$
(c) $\sin^{-1}(0.001)$ (d) $\sin^{-1}(0.1)$

7. A parallel plate capacitor with air as the dielectric has capacitance C. A slab of dielectric constant K and having the same thickness as the separation between the plates is introduced so as to fill one-fourth of the capacitor as shown in the figure. The new capacitance will be

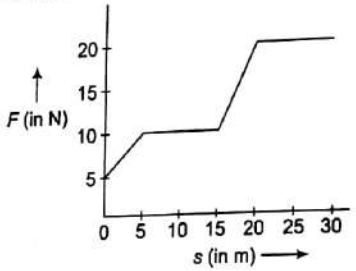


(a) $(K+3)\frac{C}{4}$ (b) $(K+2)\frac{C}{4}$

(c) $(K+1)\frac{C}{4}$ (d) $\frac{KC}{4}$

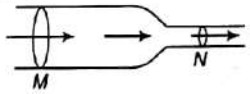
8. Three concurrent co-planar forces 1 N, 2 N and 3 N acting along different directions on a body
   (a) can keep the body in equilibrium if 2 N and 3 N act at right angle
   (b) can keep the body in equilibrium if 1 N and 2 N act at right angle
   (c) cannot keep the body in equilibrium
   (d) can keep the body in equilibrium in 1 N and 3 N act at an acute angle

9. The work done by a force acting on a body is as shown in the graph. The total work done in covering an initial distance of 20 m is



(a) 225 J (b) 200 J
(c) 400 J (d) 175 J

10. Horizontal tube of non-uniform cross-section has radii of 0.1 m and 0.05 m respectively at M and N. For a streamline flow of liquid, the rate of liquid flow is



   (a) changing continuously with time
   (b) greater at M than at N
   (c) greater at N than at M
   (d) same at M and N

11. A coil of n number of turns is wound tightly in the form of a spiral with inner and outer radii a and b respectively. When a current of strength I is passed through the coil, the magnetic field at its centre is

(a) $\frac{\mu_0 nI}{(b-a)}\log_e\frac{a}{b}$ (b) $\frac{\mu_0 nI}{2(b-a)}$

(c) $\frac{2\mu_0 nI}{b}$ (d) $\frac{\mu_0 nI}{2(b-a)}\log_e\frac{b}{a}$

12. A certain vector in the xy-plane has an x-component of 4 m and a y-component of 10 m. It is then rotated in the xy-plane so that its x-component is doubled. Then, its new y-component is (approximately)
   (a) 20 m (b) 7.2 m
   (c) 5.0 m (d) 4.5 m

13. A police party is moving in a jeep at a constant speed v. They saw a thief at a distance x on a motorcycle which is at rest. The moment the police saw the thief, the thief started at constant acceleration a. Which of the following relations is true if the police is able to catch the thief?
   (a) $v^2 < ax$
   (b) $v^2 < 2ax$
   (c) $v^2 \geq 2ax$
   (d) $v^2 = ax$

14. If two soap bubbles of different radii are connected by a tube, then
   (a) air flows from bigger bubble to the smaller bubble till sizes become equal
   (b) air flows from bigger bubble to the smaller bubble till sizes are interchanged
   (c) air flows from smaller bubble to bigger
   (d) there is no flow of air

15. The thermo emf of a hypothetical thermocouple varies with the temperature θ of hot junction as $E = a\theta + b\theta^2$ in volts, where the ratio $\frac{a}{b}$ is 700°C.
   If the cold junction is kept at 0°C, then the neutral temperature is
   (a) 700°C
   (b) 1400°C
   (c) 390°C
   (d) no neutral temperature is possible for this thermocouple

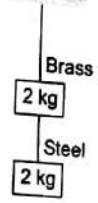
16. A launching vehicle carrying an artificial satellite of mass m is set for launch on the surface of the earth of mass M and radius R. If the satellite is intended to move in a circular orbit of radius $7R$, the minimum energy required to be spent by the launching vehicle on the satellite is
   (Gravitational constant = G)

(a) $\frac{GMm}{R}$ (b) $-\frac{13GMm}{14R}$

(c) $\frac{GMm}{7R}$ (d) $-\frac{GMm}{14R}$

17. The two lenses of an achromatic doublet should have
   (a) equal powers
   (b) equal dispersive powers
   (c) equal ratio of their power and dispersive power
   (d) sum of the product of their powers and dispersive power equal to zero

18. If the ratio of lengths, radii and Young's modulus of steel and brass wires shown in the figure are a, b and c respectively, the ratio between the increase in lengths of brass and steel wires would be



(a) $\frac{b^2a}{2c}$ (b) $\frac{bc}{2a^2}$

(c) $\frac{ba^2}{2c}$ (d) $\frac{a}{2b^2c}$

19. A soap bubble of radius r is blown up to form a bubble of radius $2r$ under isothermal conditions. If T is the surface tension of soap solution, the energy spent in the blowing
   (a) $3\pi Tr^2$ (b) $6\pi Tr^2$ (c) $12\pi Tr^2$ (d) $24\pi Tr^2$

20. A current of 1.6 A is passed through a solution of $CuSO_4$. How many Cu^{++} ions are liberated in one minute? (Electronic charge = 1.6×10^{-19} C)
   (a) 3×10^{20} (b) 3×10^{10}
   (c) 6×10^{20} (d) 6×10^{10}

21. A magnetic field exerts no force on
   (a) a magnet
   (b) an unmagnetised iron bar
   (c) a moving charge
   (d) stationary charge

22. In an L-C-R circuit inductance is changed from L to $L/2$. To keep the same resonance frequency, C should be changed to
   (a) $2C$ (b) $\frac{C}{2}$ (c) $4C$ (d) $\frac{C}{4}$

23. The sound waves after being converted into electrical waves are not transmitted as such because
   (a) they travel with the speed of sound
   (b) the frequency is not constant
   (c) they are heavily absorbed by the atmosphere
   (d) the height of antenna has to be increased several times

24. The tip of a needle does not give a sharp image on a screen. This is due to
   (a) polarisation (b) interference
   (c) diffraction (d) None of these

25. An engine moving towards a wall with a velocity 50 m/s emits a note of 1.2 kHz. Speed of sound in air is 350 m/s. The frequency of the note after reflection from the wall as heard by the driver of the engine is
   (a) 2.4 kHz (b) 0.24 kHz
   (c) 1.6 kHz (d) 1.2 kHz

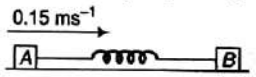
26. The surface temperature of the sun which has maximum energy emission at 500 nm is 6000 K. The temperature of a star which has maximum energy emission at 400 nm will be
   (a) 8500 K (b) 4500 K
   (c) 7500 K (d) 6500 K

27. The truth table given below is for (A and B are the inputs, Y is the output)

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

   (a) NOR (b) AND
   (c) XOR (d) NAND

28. Two rectangular blocks A and B of masses 2 kg and 3 kg respectively are connected by a spring of spring constant 10.8 Nm^{-1} and are placed on a frictionless horizontal surface. The block A was given an initial velocity of 0.15 ms^{-1} in the direction shown in the figure. The maximum compression of the spring during the motion is



   (a) 0.01 m (b) 0.02 m
   (c) 0.05 m (d) 0.03 m

29. 0.1 m^3 of water at 80°C is mixed with 0.3 m^3 of water at 60°C. The final temperature of the mixture is
   (a) 65°C
   (b) 70°C
   (c) 60°C
   (d) 75°C

30. $y = 3\sin\pi\left(\frac{t}{2} - \frac{x}{4}\right)$ represents an equation of a progressive wave, where t is in second and x is in metre. The distance travelled by the wave in 5 s is
(a) 8 m (b) 10 m (c) 5 m (d) 32 m

31. A body of mass $m_1 = 4$ kg moves at 5$\hat{i}$ m/s and another body of mass $m_2 = 2$ kg moves at 10$\hat{i}$ m/s. The kinetic energy of centre of mass is
(a) $\frac{200}{3}$ J (b) $\frac{500}{3}$ J (c) $\frac{400}{3}$ J (d) $\frac{800}{3}$ J

32. A wheel of radius 0.4 m can rotate freely about its axis as shown in the figure. A string is wrapped over its rim and a mass of 4 kg is hung. An angular acceleration of 8 rad-s^{-2} is produced in it due to the torque. Then, moment of inertia of the wheel is ($g = 10$ ms^{-2})
(a) 2 kg-m^2 (b) 1 kg-m^2
(c) 4 kg-m^2 (d) 8 kg-m^2

33. An object start sliding on a frictionless inclined plane and from same height another object start falling freely.
(a) both will reach with same speed
(b) both will reach with same acceleration
(c) both will reach in same time
(d) None of the above

34. A boy on a cycle pedals around a circle of 20 metres radius at a speed of 20 m/s. The combined mass of the body and the cycle makes with the vartical so that it may not fall is ($g = 9.8$ m/s^2)
(a) 60.25° (b) 63.90° (c) 26.12° (d) 30.00°

35. A coin is dropped in a lift. It takes time t_1 to reach the floor when lift is stationary. It takes time t_2 when lift is moving up with constant acceleration. Then,
(a) $t_1 \geq t_2$ (b) $t_2 > t_1$
(c) $t_1 = t_2$ (d) $t_1 >> t_2$

36. The engine of a jet aircraft applies a thrown force of 10^5 N during take off and causes the plane to attain a velocity of 1 km/s in 10 s. The mass of the plane is
(a) 10^2 kg (b) 10^3 kg
(c) 10^4 kg (d) 10^5 kg

37. A stone weighing 1 kg and sliding on ice with a velocity of 2 m/s is stopped by friction in 10 s. The force of friction (assuming it to be constant) will be
(a) – 20 N (b) – 0.2 N
(c) 0.2 N (d) 20 N

38. The potential energy of a body is given by $U = A - Bx^2$ (where x is the displacement) The magnitude of force acting on the particle is
(a) constant
(b) proportional to x
(c) proportional to x^2
(d) inversely proportional to x

39. When a ceiling fan is switched on, it makes 10 revolution in the first 3 s. Assuming a uniform angular acceleration , how many rotation it will make in the next 3 s
(a) 10 (b) 20 (c) 30 (d) 40

40. A hollow sphere of volume V is floating on water surface with half immersed in it. What should be the minimum volume of water poured inside the sphere so that the sphere now sinks into the water
(a) $\frac{V}{2}$ (b) $\frac{V}{3}$ (c) $\frac{V}{4}$ (d) V

Chemistry

1. Which one of the following sets of quantum numbers represents the highest energy level in an atom?
(a) $n = 4, l = 0, m = 0, s = +\frac{1}{2}$
(b) $n = 3, l = 1, m = 1, s = +\frac{1}{2}$
(c) $n = 3, l = 2, m = -2, s = +\frac{1}{2}$
(d) $n = 3, l = 0, m = 0, s = +\frac{1}{2}$

2. $CH_3COOH \xrightarrow{Br_2/P} Y \xrightarrow[(ii)\ H_3O^+]{(i)\ KCN} X$
Here, X is
(a) glycollic acid
(b) α-hydroxy propionic acid
(c) succinic acid
(d) malonic acid

3. Acetic anhydride is prepared in the laboratory by heating sodium acetate with
(a) ethyl chloride (b) acetyl chloride
(c) conc. H_2SO_4 (d) zinc dust

4. For the homogeneous reaction,
$4NH_3 + 5O_2 \rightleftharpoons 4NO + 6H_2O$
the equilibrium constant K_c has the units
(a) conc.$^{+10}$ (b) conc.$^{+1}$
(c) conc.$^{-1}$ (d) it is dimensionless

5. For the reaction,
$NH_3 + OCl^- \longrightarrow N_2H_4 + Cl^-$
occurring in basic medium, the coefficient of N_2H_4 in the balanced equation will be
(a) 1 (b) 2
(c) 3 (d) 4

6. Which one of the following has a coordinate bond?
(a) NH_4Cl (b) $AlCl_3$
(c) NaCl (d) Cl_2

7. Which of the following would exert maximum osmotic pressure?
(a) Decinormal aluminium sulphate
(b) Decinormal barium chloride
(c) Decinormal sodium chloride
(d) A solution obtained by mixing equal volumes of (b) and (c) and filtering

8. Cow milk, an example of natural emulsion, is stabilised by
(a) fat (b) water
(c) casein (d) Mg^{2+} ions

9. For a zero order reaction
(a) $t_{1/2} \propto R_0$ (b) $t_{1/2} \propto 1/R_0$
(c) $t_{1/2} \propto R_0^2$ (d) $t_{1/2} \propto 1/R_0^2$

10. The extraction of which of the following metals involves bessemerisation?
(a) Fe (b) Ag
(c) Al (d) Cu

11. The correct order of decreasing first ionisation energy is
(a) C > B > Be > Li (b) C > Be > B > Li
(c) B > C > Be > Li (d) Be > Li > B > C

12. Consider the following reaction,
$C_6H_5NO_2 \xrightarrow{Sn/HCl} X \xrightarrow{C_6H_5COCl} Y + HCl$
What is Y ?
(a) Acetanilide (b) Benzinilide
(c) Azobenzene (d) Hydrazobenzene

13. Which of the following is most basic in nature?
(a) NH_3 (b) CH_3NH_2
(c) $(CH_3)_2NH$ (d) $C_6H_5N(CH_3)_2$

14. An example of natural biopolymer is
(a) teflon (b) nylon-66
(c) rubber (d) DNA

15. Which of the following is known as invert soap?
(a) Pentaerythritol monostearate
(b) Sodium stearyl sulphate
(c) Trimethyl stearyl ammonium bromide
(d) Ethoxylated nonyphenol

16. Le-blanc process is employed in the manufacture of
(a) baking soda (b) washing soda
(c) potash (d) plaster of Paris

17. Which one of these is not true for benzene?
(a) It forms only one type of monosubstituted product
(b) There are three carbon-carbon single bonds and three carbon-carbon double bonds
(c) Heat of hydrogenation of benzene is less than its theoretical value
(d) The bond angle between carbon-carbon bonds is120°

18. The IUPAC name of acryldehdye is
(a) prop-2-en-l-al (b) propenylaldehyde
(c) but-2-en-l-al (d) propenal

19. The structures of $(CH_3)_3CBr$ and $CH_3[CH_2]_3Br$ represent
(a) chain isomerism
(b) position isomerism
(c) chain as well as position isomerism
(d) functional isomerism

20. Petrol for aviation purpose must contain
(a) straight chain hydrocarbons
(b) aromatic hydrocabrons
(c) olefinic hydrocarbons
(d) highly branched chain paraffins

21. The solubility product of Hg_2I_2 is equal to
(a) $[Hg_2^{2+}][I^-]$ (b) $[Hg^{2+}][I^-]$
(c) $[Hg_2^{2+}][I^-]^2$ (d) $[Hg^{2+}][I^-]^2$

22. The number of atoms contained in a fcc unit cell of a monoatomic substance is
(a) 1 (b) 2 (c) 4 (d) 6

23. In the first order reaction, 75% of the reactant gets disappeared in 1.386 h. The rate constant of the reaction is
(a) $3.0 \times 10^{-3}\ s^{-1}$ (b) $2.8 \times 10^{-4}\ s^{-1}$
(c) $17.2 \times 10^{-3}\ s^{-1}$ (d) $1.8 \times 10^{-3}\ s^{-1}$

24. Moist hydrogen peroxide can not be dried over conc. H_2SO_4 because
(a) it can catch fire
(b) it is reduced by H_2SO_4
(c) it is oxidised by H_2SO_4
(d) it is decomposed by H_2SO_4

25. Glauber's salt is
(a) $Na_2SO_4 \cdot 10H_2O$ (b) $Na_2S_2O_3 \cdot 5H_2O$
(c) $CuSO_4 \cdot 5H_2O$ (d) $Na_2B_4O_7 \cdot 10H_2O$

26. The most basic element is
(a) fluorine (b) iodine
(c) chlorine (d) bromine

27. Propyne on passing through red hot copper tube forms
(a) benzene (b) toluene
(c) mesitylene (d) None of these

28. Which one of the following is mainly responsible for depletion of ozone layer?
(a) Methane
(b) Carbon dioxide
(c) Water
(d) Chlorofluorocarbons

29. On warming with silver powder, chloroform is converted into
(a) acetylene
(b) hexachloroethane
(c) 1, 1, 2, 2-tetrachloroethane
(d) ethylene

30. Ammonia is a Lewis base and it forms complexes with many cations. Which one of the following cations does not form a complex with ammonia?
(a) Ag^+ (b) Cu^{2+}
(c) Cd^{2+} (d) Pb^{2+}

31. Argol, a brown crust, formed during the fermentation of grape juice contains
(a) CO_2
(b) fused oil
(c) potassium hydrogen tartarate
(d) lye

32. $CH_3CHO + HCHO \xrightarrow[\text{Heat}]{\text{Dil. NaOH}} A \xrightarrow[H_3O^+]{HCN} B$

The structure of compound *B* is
(a) $CH_2=CH-\underset{\underset{OH}{|}}{CH}-COOH$
(b) $CH_2=CH-\underset{\underset{CN}{|}}{CH}-OH$
(c) $CH_3CH_2-\underset{\underset{OH}{|}}{CH}-COOH$
(d) $CH_3-\underset{\underset{OH}{|}}{CH}-COOH$

33. The pH value of 0.001 M aqueous solution of NaCl is
(a) 7 (b) 4
(c) 11 (d) unpredictable

34. Which buffer solution comprising of the following has its pH value greater than 7?
(a) $CH_3COOH + CH_3COONa$
(b) $HCOOH + HCOOK$
(c) CH_3COONH_4
(d) $NH_4OH + NH_4Cl$

35. Which of the following has sp^2-hybridisation?
(a) C_2H_6 (b) C_2H_4 (c) $BeCl_2$ (d) C_2H_2

36. Hydrogen molecule differs from chlorine molecule in the following respect.
(a) Hydrogen molecule is non-polar but chlorine molecule is polar
(b) Hydrogen molecule is polar while chlorine molecule is non-polar
(c) Hydrogen molecule can form intermolecular hydrogen bonds but chlorine molecule does not
(d) Hydrogen molecule cannot participate in coordinate bond formation but chlorine molecule can

37. The ratio of the difference in energy between the first and the second Bohr orbit to that between the second and the third Bohr orbit is
(a) 1/2 (b) 1/3 (c) 4/9 (d) 27/5

38. Graphite is a
(a) molecular solid (b) covalent solid
(c) ionic solid (d) metallic solid

39. Which one of the following transition metal ions is diamagnetic?
(a) Co^{2+} (b) Ni^{2+}
(c) Cu^{2+} (d) Zn^{2+}

40. Which of the following metal carbonates decomposes on heating?
(a) $MgCO_3$ (b) Na_2CO_3
(c) K_2CO_3 (d) Rb_2CO_3

Zoology

1. Gel electrophoresis is used for
(a) cutting of DNA into fragments
(b) separation of DNA fragments according to their size
(c) construction of recombinant DNA by joining with cloning vectors
(d) isolation of DNA molecule

2. Polysome is formed by
(a) several ribosomes attached to a single *m*RNA
(b) many ribosomes attached to a strand of endoplasmic reticulum
(c) a ribosome with several sub-units
(d) ribosomes attached to each other in a linear arrangement

3. Which type of white blood cells are concerned with the release of histamine and the natural anticoagulant heparin?
(a) Neutrophils (b) Basophils
(c) Eosinophils (d) Monocytes

4. Which one of the following in birds, indicates their reptilian ancestry?
(a) Scales on their hindlimbs
(b) Four-chambered heart
(c) Two special chambers crop and gizzard in their digestive tract
(d) Eggs with a calcareous shell

5. Select incorrect pair
(a) Porifera — Choanocytes
(b) Coelenterata — Nematocysts
(c) Annelida — Segmentation
(d) Monera — Eukaryote

6. Bilateral symmetry, metameric segmentation, coelom and open circulatory system are the features of
(a) Annelida (b) Arthropoda
(c) Mollusca (d) Echinodermata

7. Ancestor of man who first stood erect was
(a) *Australopithecus* (b) Cro-magnon
(c) Java-ape man (d) Peaking man

8. Core zone, buffer zone and manipulation zone are found in
(a) national park (b) sanctuary
(c) tiger reserve (d) biosphere reserve

9. Which insecticide is more hazardous to human health?
(a) Rotenone (b) Pyrethrum
(c) DDT (d) Humulin

10. Universal donor is
(a) O Rh^+ (b) O Rh^-
(c) AB Rh^+ (d) AB Rh^-

11. One of these is not concerned with wildlife conservation
(a) IVF (b) IUCN (c) WWF (d) IBWL

12. Largest tiger population is found in
(a) Sunderban national park
(b) Corbett national park
(c) Ranthambhor national park
(d) Kanha national park

13. Genetic material found in Human Immunodeficiency Virus (HIV) is
(a) double stranded RNA
(b) single stranded RNA
(c) double stranded DNA
(d) single stranded DNA

14. Gigantism and acromegaly are due to
(a) hypothyroidism (b) hyperthyroidism
(c) hypopituitarism (d) hyperpituitarism

15. If a child is of O blood group and his father is of B blood group, the genotype of father is
(a) $I^O I^O$ (b) $I^A I^B$ (c) $I^O I^B$ (d) $I^O I^A$

16. Spermatogenesis is under the regulatory influence of
(a) ADH (b) FSH (c) LH (d) STH

17. Which of the following can be controlled by using biopesticides?
(a) Insects (b) Diseases
(c) Weeds (d) All of these

18. Which hormone is secreted in a woman if pregnancy has occurred?
(a) Estrogen
(b) Progesterone
(c) Luteinizing hormone
(d) Human chorionic gonadotropin

19. Product of biotechnology is
(a) transgenic crops (GM crops)
(b) humulin
(c) biofertilizer
(d) All of the above

20. Phase common in aerobic and anaerobic respiration is
(a) Krebs' cycle (b) glycolysis
(c) glycogenolysis (d) ETS

21. Oxyntic cells secrete
(a) HCl (b) trypsin
(c) NaOH (d) pepsinogen

22. Menstruation is due to sudden
(a) reduction of FSH
(b) increase of LH
(c) reduction in estrogen and progesterone
(d) None of the above

23. Correctly matched set of phylum, class and example is
(a) Protozoa—Mastigophora—*Entamoeba*
(b) Mollusca—Bivalvia—*Pinctada*
(c) Arthropoda—Diplopoda—*Scolopendra*
(d) Chordata—Cyclostomata—*Phrynosoma*

24. Urea synthesis occurs in
(a) kidney (b) liver
(c) brain (d) muscles

25. Which is common to kidney and skeleton in mammals?
(a) Cortex (b) Medulla
(c) Pelvis (d) Radius

26. Which is regarded as urinary bladder of embryo?
(a) Amnion (b) Allantois
(c) Chorion (d) Yolk sac

27. Deficiency of vitamin-B_{12} causes
(a) cheilosis (b) thalassemia
(c) beri-beri (d) pernicious anaemia

28. Blood is a kind of
(a) areolar tissue
(b) connective tissue
(c) fluid connective tissue
(d) reticular connective tissue

29. Which of these is used to control human population?
(a) Estrogen + progesterone
(b) IUCD and MTP
(c) Tubectomy and vasectomy
(d) All of the above

30. Addiction to alcohol causes
(a) cirrhosis (b) epilepsy
(c) neurosis (d) psychosis

31. The most primitive vertebrates are
(a) ostracoderms
(b) cephalochordates
(c) placoderms
(d) cyclostomes

32. Change in the number of body parts is called
(a) continuous variation
(b) discontinuous variation
(c) meristic variation
(d) substantive variation

33. Which has an additional X-chromosome?
(a) Turner's syndrome
(b) Klinefelter's syndrome
(c) Super female
(d) Down's syndrome

34. Origin of life occurred in
(a) Precambrian (b) Coenozoic
(c) Palaeozoic (d) Mesozoic

35. Branch of zoology dealing with the study of fishes is called
(a) Arthrology (b) Ichthyology
(c) Saurology (d) herpetology

36. Theory of continuity of germplasm was propounded by
(a) Mendel (b) Lamarck
(c) Weismann (d) Haeckel

37. Which extraembryonic membrane in humans prevents desiccation of the embryo inside the uterus?
(a) Chorion
(b) Allantois
(c) Yolk sac
(d) Amnion

38. The most active phagocytic white blood cells are
(a) neutrophils and eosinophils
(b) lymphocytes and macrophages
(c) eosinophils and lymphocytes
(d) neutrophils and monocytes

39. During the propagation of a nerve impulse, the action potential results from the movement of
(a) K^+ ions from extracellular fluid to intracellular fluid
(b) Na^+ ions from intracellular fluid to extracellular fluid
(c) K^+ ions from intracellular fluid to extracellular fluid
(d) Na^+ ions from extracellular fluid to intracellular fluid

40. Darwin's finches are an excellent example of
(a) adaptive radiation
(b) seasonal migration
(c) brood parasitism
(d) connecting links

Botany

1. In which one of the following, the male and female gametophytes don't have free-living independent existence?
(a) *Pteris* (b) *Funaria*
(c) *Polytrichum* (d) *Cedrus*

2. A transgenic food crop, which may help in solving the problem of nightblindness in developing countries is
(a) *Flavr savr* tomatoes
(b) Starlink maize
(c) *Bt* soyabean
(d) Golden rice

3. Vascular tissues in flowering plants develop from
(a) phellogen (b) plerome
(c) periblem (d) dermatogen

4. Nitrogen-fixation in root nodules of *Alnus* is brought about by
(a) *Bradyrhizobium* (b) *Clostridium*
(c) *Frankia* (d) *Azorhizobium*

5. A mature pollen grain of *Pinus* has
(a) 2 cells (b) 3 cells
(c) 4 cells (d) 5 cells

6. Polyploidy can be induced by the application of
(a) auxin (b) kinetin
(c) colchicine (d) ethylene

7. Quantasome are present in
(a) chloroplast (b) mitochondria
(c) Golgi body (d) lysosome

8. In mitochondria, enzyme cytochrome oxidase is present in
(a) outer membrane
(b) perimitochondrial space
(c) inner membrane
(d) matrix

9. Which of the following bio-engineered bacteria is utilized for cleaning of marine oil slicks?
(a) *Escherichia coli*
(b) *Pseudomonas syringae*
(c) *Pseudomonas putida*
(d) *Rhizoctonia solani*

10. Green potatoes are toxic due to
(a) phytoalexins (b) solanin
(c) triazine (d) hormones

11. Cells obtained from cancerous tumours are known as
(a) hybridomas (b) myelomas
(c) lymphocytes (d) monoclonal cells

12. The plant of *Triticum aestivum* is
(a) haploid (b) diploid
(c) tetraploid (d) hexaploid

13. Which of the following is a total root parasite?
(a) *Cuscuta* (b) *Rafflesia*
(c) *Santalum* (d) *Monotrapa*

14. Which of the following tissues consist of living cells?
(a) Vessels (b) Tracheids
(c) Companion cell (d) Sclerenchyma

15. Which is a useful product of epidermal origin?
(a) Saffron (b) Cotton fibres
(c) Clove (d) Jute

16. Fern spores are usually
(a) haploid (b) diploid
(c) triploid (d) tetraploid

17. When pollen tube enters through micropyle, the process is called
(a) porogamy
(b) chalazogamy
(c) mesogamy
(d) apogamy

18. Outer wall of pollen grain is made up of
(a) cellulose (b) sporopollenin
(c) pectocellulose (d) lignin

19. Nucleotides are formed by
(a) purine, sugar and phosphate
(b) purine, pyrimidine and phosphate
(c) purine, pyrimidine, sugar and phosphate
(d) pyrimidine, sugar and phosphate

20. DNA replication occurs in
(a) G_1-phase (b) S-phase
(c) G_2-phase (d) M-phase

21. Which of the following plant cells is not surrounded by a cell wall?
(a) Root hair cell
(b) Stem hair cell
(c) Gamete cell
(d) Bacterial cell

22. Which of the following cell organelles stores hydrolytic enzymes?
(a) Centriole (b) Lysosome
(c) Chromoplast (d) Chloroplast

23. A monocarpic plant is one, which
(a) has only one carpel
(b) flowers once in a life-time
(c) produces only one seed
(d) produces only one fruit

24. AIDS virus cotnains
(a) RNA with protein
(b) DNA with protein
(c) DNA without protein
(d) DNA only

25. Calyptra develops from
(a) venter wall of archegonium
(b) outgrowth of gametophyte
(c) neck wall of archegonium
(d) paraphysis of the archegonial branch

26. Protonema is the stage in the life cycle of
(a) *Cycas* (b) *Funaria*
(c) *Selaginella* (d) *Mucor*

27. A fern differs from a moss in having
(a) swimming archegonia
(b) swimming antherozoids
(c) independent gametophytes
(d) independent sporophytes

28. Female cone of *Pinus* is a
(a) modified needles
(b) modified long shoot
(c) modified dwarf shoot
(d) modified scale

29. Development of an embryo without fertiliz is called as
(a) apomixis (b) polyembryony
(c) parthenocarpy (d) parthenogenesis

30. Which of the following floral parts for pericarp after fertilization?
(a) Nucellus
(b) Outer integument
(c) Ovary wall
(d) Inner integument

31. Prothallus of the fern produces
(a) spores (b) gametes
(c) Both (a) and (b) (d) cones

32. Which of the following cell organelles associated with photorespiration?
(a) Mitochondria (b) Peroxysome
(c) Chloroplast (d) All of these

33. The thickness of unit membrane is
(a) 20 Å (b) 35 Å
(c) 55 Å (d) 75 Å

34. Chromosomes are arranged along the equa during
(a) prophase (b) metaphase
(c) anaphase (d) telophase

35. Width of the DNA molecule is
(a) 15 Å (b) 20 Å
(c) 25 Å (d) 34 Å

36. In gymnosperms, the ovule is naked because
(a) ovary wall is absent
(b) integuments are absent
(c) perianth is absent
(d) nucellus is absent

37. The rupture and fractionation do not usual occur in the water column in vessel/trache during the ascent of sap because of
(a) lignified thick walls
(b) cohesion and adhesion
(c) weak gravitational pull
(d) transpiration pull

38. The fleshy receptacle of syconus of fig encloses number of
(a) achenes
(b) samaras
(c) berries
(d) mericarps

39. Which one of the following is linked to the discovery of bordeaux mixture as a popular fungicide?
(a) Bacterial leaf blight of rice
(b) Downy mildew of grapes
(c) Loose smut of wheat
(d) Black rust of wheat

40. Unisexuality of flowers prevents
(a) autogamy, but not geitonogamy
(b) Both geitonogamy and xenogamy
(c) geitonogamy, but not xenogamy
(d) autogamy and geitonogamy

English

Directions (Q. 1-5) *Out of the four alternatives, choose the one which expresses the correct meaning of the given word and blacken the appropriate rectangle [□] in the Answer Sheet.*

1. Irreproachable
(a) remarkable
(b) extraordinary
(c) faultless
(d) immense

2. Felicity
(a) prosperity (b) honesty
(c) bliss (d) sorrow

3. Knave
(a) emperor (b) enchanter
(c) soldier (d) scoundrel

4. Frontier
(a) edge (b) landmark
(c) boundary (d) corner

5. Rout
(a) death (b) defeat
(c) loss (d) crash

Directions (Q. 6-8) *Choose the word opposite in meaning to the given word and blacken the appropriate rectangle [□] in the Answer Sheet.*

6. Niggardly
(a) hastily (b) lavishly
(c) likely (d) gorgeously

7. Melodious
(a) harmonious (b) tuneless
(c) odious (d) mellifluous

8. Advanced
(a) progressed
(b) outpaced
(c) receded
(d) retarded

Directions (Q. 9-12) *In these questions, four words are given in each question, out of which only one word is wrongly spelt. Find the word and indicate it in the Answer Sheet by blackening the appropriate recatangle.*

9. (a) quadruple (b) quagmaire
(c) quadrangle (d) quadrant

10. (a) postar (b) pastor
(c) posture (d) pasture

11. (a) reference (b) preference
(c) difference (d) preformence

12. (a) agreeablly (b) cruelly
(c) doubtfully (d) fatally

Directions (Q. 13-16) *Four alternatives are given for the underlined or given idiom/phrase. Choose the alternative which best expresses the meaning of the underlined of given idiom/phrase and blacken the appropriate rectangel [□] in the Answer Sheet.*

13. His parents cut him off, without a shilling
(a) disinherited him
(b) snubbed him
(c) gave him only a shilling
(d) sent him away with a shilling

14. The carefully worked-out plan fell through because of an unexpected event
(a) came out successfully
(b) had a steep fall
(c) was shattered
(d) failed

15. He has too many irons in the fire
(a) is engaged in too many enterprises at the same time
(b) has several problems
(c) has many ideas in his head
(d) has a fire burning constantly in his house

16. We wanted to give Rita a surprise party but John let the cat out of the bag
(a) spoilt the party with a cat
(b) gave her a party himself
(c) told her about it unintentionally
(d) prevented her from attending it

Directions (Q. 17-21) *Out of the four alternatives, choose the one which can be substituted for given words/sentence and blacken the appropriate rectangle in the Answer Sheet.*

17. Study of insects is
(a) Etymology (b) Entomology
(c) Ecology (d) Embryology

18. Careful in the spending of money, time, etc.
(a) Punctual (b) Economical
(c) Miserly (d) Calculative

19. Reproducing or memorizing word for word
(a) Verbatim (b) Verbose
(c) Verbiage (d) Verbalism

20. That which cannot be captured
(a) Untakable (b) Ungrippable
(c) Impregnable (d) Slippery

21. One who breaks the law
(a) Aggressor (b) Politician
(c) Transgressor (d) Pedestrian

Directions (Q. 22-25) *A part of the sentence is underlined. Below are given alternatives to the underlined part at (a), (b) and (c). Which may improve the sentence. Choose the correct alternative. In case no improvement is needed your answer is (d). Blacken the appropriate rectangle in the Answer Sheet.*

22. The only way to solve the racial problem is by education.
(a) because of (b) thanks to
(c) on account of (d) no improvement

23. He may be poor now but he appears to be rich.
(a) to seem rich (b) rich to be
(c) to have been rich (d) no improvement

24. The suspected couple was taken away from the airport through a side entrance to the police station for interrogation.
(a) whisked (b) rushed
(c) guided (d) No improvement

25. She left the room feeling contrite.
(a) sorry for what she had done
(b) rather ill
(c) extremely irriated
(d) No improvement

Directions (Q. 26-30) *In these questions the first and the last parts of the sentence are numbered 1 and 6. The rest of the sentence is split into four parts and named P, Q, R and S. These four parts are not given in their proper order. Read the parts and find out which of the four combinations is correct. Then find the correct answer and blacken the appropriate rectangle in the Answer Sheet.*

26. 1. I think the essence of wisdom is emancipation as far as possible, from the tyranny of the here and now.
P. If any one could, he would hardly be able to remain alive.
Q. But it is possible to make a continual approach towards impartiality.
R. No one can view the world with complete impartiality.
S. This is of course a matter of degree.
6. It is this approach towards impartiality that constitutes growth in wisdom.
(a) QRSP (b) RQPS
(c) SRPQ (d) PRSQ

27. 1. But at the moment I glanced round at the crowd that had followd me.
P. It was immense crowd, two thousand at the least and growing every minute.
Q. They were watching me as they would watch a conjurer about to perform a trick.
R. I looked at the sea of yellow faces above the garish clothes-faces all happy and excited over this bit of fun, all certain that the elephant was going to be shot.
S. It blocked the road for a long distance on either side.
6. They did not like me, but with the magical rifle in my hands, I was momentarily worth watching.
(a) RPQS (b) QSRP
(c) SRPQ (d) PSRQ

28. 1. There are many roads into the world of books, but the way of fiction is probably the most common.
P. Then too the appeal of the story, whether told as poem, play, history, biography or novel is primitive and strong.
Q. The reason is plain.
R. They are to us what epic poetry was to the Greeks and Romans, what the stage was to the Elizabethans.
S. The novel and the short story come closer to the experience. If the modern reader then any other form of contemporary writing.
6. Mankind's delight in stories is as timeless and universal as the art of the story teller.
(a) QSRP (b) SRPQ (c) RSQP (d) PRSQ

29. 1. Nehru spent most part of his childhood in studies.
P. He rushed back to India and led an active political life joining hands with Gandhi.
Q. His studies went on uninterrupted abroad until he received a call from India.
R. He went to Cambridge to study.
S. But now and them, he could not help listening to political discussions in his house.
6. Till the end of his career, he made Gandhi his political master.
(a) RSQP (b) SRQP (c) PQRS (d) SRPQ

30. 1. Venice is a strange and beautiful city in the North of Italy.
P. There are about four hundred old stone bridges joining the Islands of Venice.
Q. In this city, there are no motor-cars, no horses and no buses.
R. These small Islands are near one another.
S. It is not one Island but a hundred and seventeen Islands.
6. This is because Venice has no streets.
(a) PQRS (b) RSPQ
(c) SRPQ (d) PSQR

Directions (Q. 31-35) *Sentences are given which blanks to be filled in with an appropriate and suitable word. Four alternativs are suggested for each question. Choose the correct alternative out of the four and blacken the appropriate rectangle in the Answer Sheet.*

31. We warnde her ..... the danger
(a) from (b) about
(c) against (d) of

32. We all laughed ..... the affair.
(a) over (b) about
(c) for (d) on

33. The chairman, as well as the members, ... to blame for this misfortune.
(a) are (b) were
(c) is (d) has

34. The streets are lighted ..... electricity.
(a) with (b) by
(c) on (d) in

35. Homieopathic treatment, they say, cuts ..... the need for operation and risk from surgery.
(a) off
(b) out
(c) down
(d) away

Directions (Q. 36-40) *You have two brief passages with five questions following each passage. Read the passages carefully and choose the best answer to each question out of the four alternatives and blacken the appropriate rectangle in the Answer Sheet.*

"The beauty of the Japanese landscape is that it conveys philosophical messages through each feature. The use of curving pathways rather than straight lines, for instance. This feature springs from the belief that only evil travels in straight lines, good forces tend to wander. Then odd numbers of plants on trees are used in these gardens because these numbers are considered auspicious. Even the plants used are symbolic. For example, the cyprus represents longevity and the bamboo symbolisms abundance," says Sadhana Roy Choudhary.

In Japan, nature is said to be so closely intertwined with human life that parents actually plant a sapling in their garden when a child is born in the family, letting the growth of the child coincide with the growth of the plant.

36. They prefer curving pathways because
(a) they are inauspicious
(b) they can walk easily
(c) they stumble over straight ones
(d) good spirits walk in them

37. 'Abundance' means
(a) long life
(b) happiness
(c) plenty
(d) permanent

38. The Japanese parents plant a sapling at the time of birth of a child because
(a) it is auspicious to plant a sapling
(b) it is closely associated with the growth of the child
(c) it gives longevity to the child
(d) it gives happiness to the child

39. According to the passage the Japanese are
(a) superstitious
(b) philosophical
(c) lovers of nature
(d) lovers of numerology

40. The Japanese pathways tend to be
(a) symbolic (b) beautiful
(c) curved (d) straight

Answers

Physics

1. (b)	2. (d)	3. (b)	4. (a)	5. (d)	6. (c)	7. (a)	8. (c)	9. (b)	10. (c)
11. (d)	12. (b)	13. (c)	14. (c)	15. (*)	16. (b)	17. (d)	18. (d)	19. (d)	20. (a)
21. (d)	22. (a)	23. (c)	24. (c)	25. (c)	26. (c)	27. (d)	28. (c)	29. (a)	30. (b)
31. (c)	32. (a)	33. (a)	34. (b)	35. (a)	36. (b)	37. (b)	38. (b)	39. (c)	40. (a)

Chemistry

1. (c)	2. (d)	3. (b)	4. (b)	5. (a)	6. (a)	7. (a)	8. (c)	9. (a)	10. (d)
11. (b)	12. (b)	13. (c)	14. (d)	15. (c)	16. (c)	17. (b)	18. (a)	19. (c)	20. (d)
21. (c)	22. (c)	23. (b)	24. (d)	25. (a)	26. (b)	27. (c)	28. (d)	29. (a)	30. (d)
31. (c)	32. (a)	33. (a)	34. (d)	35. (b)	36. (d)	37. (d)	38. (b)	39. (d)	40. (a)

Zoology

1. (b)	2. (a)	3. (b)	4. (d)	5. (d)	6. (b)	7. (a)	8. (d)	9. (c)	10. (b)
11. (a)	12. (a)	13. (b)	14. (d)	15. (c)	16. (b)	17. (d)	18. (d)	19. (d)	20. (b)
21. (a)	22. (c)	23. (b)	24. (b)	25. (c)	26. (b)	27. (d)	28. (b)	29. (a)	30. (a)
31. (a)	32. (c)	33. (b)	34. (a)	35. (b)	36. (c)	37. (d)	38. (d)	39. (d)	40. (a)

Botany

1. (a)	2. (d)	3. (b)	4. (c)	5. (c)	6. (c)	7. (a)	8. (c)	9. (c)	10. (b)
11. (b)	12. (d)	13. (b)	14. (c)	15. (b)	16. (a)	17. (a)	18. (b)	19. (c)	20. (b)
21. (c)	22. (b)	23. (b)	24. (d)	25. (a)	26. (b)	27. (d)	28. (d)	29. (d)	30. (c)
31. (c)	32. (d)	33. (d)	34. (d)	35. (b)	36. (a)	37. (b)	38. (a)	39. (b)	40. (a)

English

1. (b)	2. (b)	3. (a)	4. (e)	5. (d)	6. (c)	7. (a)	8. (c)	9. (e)	10. (d)
11. (d)	12. (b)	13. (a)	14. (d)	15. (b)	16. (e)	17. (a)	18. (d)	19. (b)	20. (c)
21. (e)	22. (a)	23. (c)	24. (e)	25. (e)	26. (c)	27. (b)	28. (a)	29. (a)	30. (c)
31. (b)	32. (d)	33. (e)	34. (a)	35. (e)	36. (c)	37. (e)	38. (d)	39. (c)	40. (d)

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Hints and Solutions

Physics

1. According to equation of continuity,
$$av = \text{constant}$$
$$\therefore \text{For tube, } (8\times10^{-4})\times\left(\frac{0.15}{60}\right) = a_1v_1$$
For holes, $(40\times10^{-8})\times v = a_2v_2$
$$\therefore \quad a_2v_2 = a_1v_1$$
$$\therefore \quad 40\times10^{-8}\times v = \frac{8\times10^{-4}\times0.15}{60}$$
$$\Rightarrow \quad v = \frac{8\times10^{-4}\times0.15}{40\times10^{-8}\times60}$$
$$= 5 \text{ m/s}$$

2. According to photoelectric equation
$$E_k = h\nu - h\nu_0 \qquad \ldots(i)$$
If the energy of photon ($h\nu$) is less than the work function ($h\nu_0$) of metallic surface, then electrons will never be ejected from surface regardless of intensity of incident light.
Also, from Eq. (i), when
$$\nu = \nu_0, E_k = 0$$
∴ Graph (d) represents variation of E_k with ν.

3. Refractive index $\mu = \dfrac{\text{Real depth } (d)}{\text{Apparent depth } (x)}$
For 1st liquid, $\sqrt{2} = \dfrac{d}{x_1}$
$$\Rightarrow \quad x_1 = \frac{d}{\sqrt{2}}$$
Similarly, for 2nd liquid,
$$n = \frac{d}{x_2}$$
$$\Rightarrow \quad x_2 = \frac{d}{n}$$
Total apparent depth = $x_1 + x_2$
$$= \frac{d}{\sqrt{2}} + \frac{d}{n} = \frac{d\,(n+\sqrt{2})}{n\sqrt{2}}$$

4. Total mass of the shell = 20 kg
Ratio of the masses of the fragments = 2 : 3
∴ Masses of the fragments are 8 kg and 12 kg
Now, according to the conservation of momentum
$$m_1v_1 = m_2v_2$$
$$\therefore \quad 8\times6 = 12\times v$$
v (velocity of the larger fragment) = 4 m/s
Kinetic energy $= \dfrac{1}{2}mv^2$
$$= \frac{1}{2}\times12\times(4)^2 = 96 \text{ J}$$

5. Resistance of bulb
$$R = \frac{V^2}{P} = \frac{(100)^2}{50}$$
$$= 200\ \Omega$$
Current through bulb $(I) = \dfrac{V}{R}$
$$= \frac{100}{200} = 0.5 \text{ A}$$
In a circuit containing inductive reactance (X_L) and resistance (R), impedance (Z) of the circuit is
$$Z = \sqrt{R^2 + \omega^2L^2} \qquad \ldots(i)$$
Here, $Z = \dfrac{200}{0.5} = 400\ \Omega$
Now, $X_L^2 = Z^2 - R^2$
$$= (400)^2 - (200)^2$$
$$(2\pi fL)^2 = 12\times10^4$$
$$L = \frac{2\sqrt{3}\times100}{2\pi\times50}$$
$$= \frac{2\sqrt{3}}{\pi} = 1.1 \text{ H}$$

6. In Young's double slit experiment half angular width is given by
$$\sin\theta = \frac{\lambda}{d}$$
$$= \frac{589\times10^{-9}}{0.589\times10^{-3}} = 10^{-3}$$
$$\Rightarrow \quad \theta = \sin^{-1}(0.001)$$

7. The condenser with air as the dielectric has capacitance

$$C_1 = \frac{\varepsilon_0}{d}\left(\frac{3A}{4}\right) = \frac{3\varepsilon_0 A}{4d}$$

Similarly, the condenser with K as the dielectric constant has capacitance

$$C_2 = \frac{\varepsilon_0 K}{d}\left(\frac{A}{4}\right) = \frac{\varepsilon_0 AK}{4d}$$

Since, C_1 and C_2 are in parallel

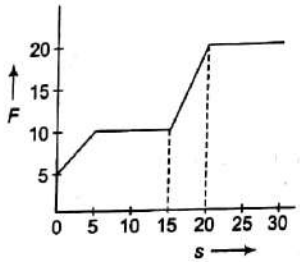
$$C_{net} = C_1 + C_2$$
$$= \frac{3\varepsilon_0 A}{4d} + \frac{\varepsilon_0 AK}{4d} = \frac{\varepsilon_0 A}{d}\left[\frac{3}{4} + \frac{K}{4}\right]$$
$$= \frac{C}{4}(K+3)$$

8. If we keep 1 N and 2 N forces act in same direction then these are balanced by 3 N force, but this is against statement of question.

Hence, options (c) is correct.

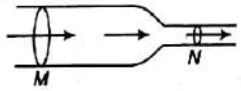
9. Work done W = Area $ABCEFDA$

= Area $ABCD$ + Area $CEFD$



$$= \frac{1}{2}\times(15+10)\times 10 + \frac{1}{2}\times(10+20)\times 5$$
$$= 125 + 75 = 200\ \text{J}$$

10. The velocity of flow will increase if cross-section decreases and *vice-versa*.

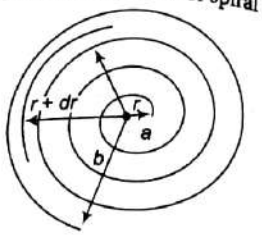


i.e., $A_1 v_1 = A_2 v_2$

or $Av = \text{constant}$

Therefore, the rate of liquid flow will be greater at N than at M.

11. Consider an element of thickness dr at distance r from the centre of spiral coil.



Number of turns in coil = n

Number of turns per unit length

$$= \frac{n}{b-a}$$

Number of turns in element $dr = dn$

Number of turns per unit length in element dr

$$= \frac{ndr}{b-a}$$

i.e., $$dn = \frac{ndr}{b-a}$$

Magnetic field at its centre due to element dr is

$$dB = \frac{\mu_0 I dn}{2r} = \frac{\mu_0 I}{2}\frac{n}{(b-a)}\frac{dr}{r}$$

$$\therefore \quad B = \int_a^b \frac{\mu_0 I n dr}{2(b-a)r} = \frac{\mu_0 I n}{2(b-a)}\int_a^b \frac{dr}{r}$$
$$= \frac{\mu_0 I n}{2(b-a)}\log_e\left(\frac{b}{a}\right)$$

12. Here, $A = 4\mathbf{i} + 10\mathbf{j}$

$$\therefore |A| = \sqrt{(4)^2 + (10)^2} = \sqrt{16+100}$$
$$= \sqrt{116}\ \text{m}$$

Now, according to question,

$$A = 8\mathbf{i} + n\mathbf{j}$$

So, $$|A| = \sqrt{(8)^2 + n^2}$$

$$\therefore \quad \sqrt{116} = \sqrt{(8)^2 + n^2}$$

Squaring on both sides

$$116 = 64 + n^2$$

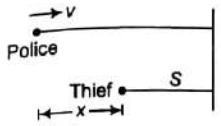
or $$n^2 = 116 - 64 = 52$$

or $$n = 7.2\ \text{m}$$

13. Let the police party catch the thief after t s

$\therefore$ Distance travelled by police party in t s $= vt$

and distance travelled by thief $= x + \frac{1}{2}\alpha t^2$



So, $$x + \frac{1}{2}\alpha t^2 \le vt$$

or $$\frac{\alpha t^2}{2} - vt + x = 0$$

or $$t = \frac{v \pm \sqrt{v^2 - 2\alpha x}}{\alpha}$$

For t to be real, $v^2 \ge 2\alpha x$

14. Air flows from smaller bubble to bigger as the pressure in smaller bubble is higher.

15. Given, $E = a\theta + b\theta^2$

$$\therefore \quad P = \frac{dE}{d\theta} = \frac{d}{d\theta}(a\theta + b\theta^2)$$
$$= a + 2b\theta$$

At $$\theta = T_n,\ P = 0$$

$$\Rightarrow \quad T_n = -\frac{a}{2b} = -350^\circ\text{C}$$

No correct option is given.

16. The energy of artificial satellite at the surface of the earth

$$E_1 = -\frac{GMm}{R}$$

When the satellite is intended to move in a circular orbit of radius $7R$, then energy of artificial satellite

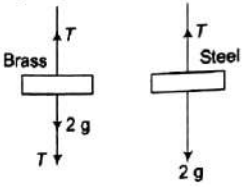
$$E_2 = -\frac{1}{2}\frac{GMm}{7R}$$

The minimum energy required

$$E = E_1 - E_2$$
$$= -\frac{GMm}{R} + \frac{1}{2}\left(\frac{GMm}{7R}\right)$$
$$= \frac{-14\,GMm + GMm}{14R}$$
$$= -\frac{13\,GMm}{14R}$$

17. The two lenses of an achromatic doublet should have, sum of the product of their powers and dispersive power equal to zero.

18. Free body diagram of the two blocks are



Given, $$\frac{l_1}{l_2} = a,\ \frac{r_1}{r_2} = b,\ \frac{Y_1}{Y_2} = c$$

Let Young's modulus of steel is Y_1 and of brass is Y_2

$$\therefore \quad Y_1 = \frac{F_1 \cdot l_1}{A_1 \cdot \Delta l_1} \qquad \ldots(\text{i})$$

and $$Y_2 = \frac{F_2 \cdot l_2}{A_2\,\Delta l_2} \qquad \ldots(\text{ii})$$

Dividing Eq. (i) by Eq. (ii), we get

$$\frac{Y_1}{Y_2} = \frac{\dfrac{F_1 \cdot l_1}{A_1 \cdot \Delta l_1}}{\dfrac{F_2 \cdot l_2}{A_2 \cdot \Delta l_2}}$$

or $$\frac{Y_1}{Y_2} = \frac{F_1 \cdot A_2 \cdot l_1 \cdot \Delta l_2}{F_2 \cdot A_1 \cdot l_2 \cdot \Delta l_1} \qquad \ldots(\text{iii})$$

Force on steel wire from free body diagram

$$T = F_1 = 2g\ \text{N}$$

Force on brass wire from free body diagram

$$F_2 = T' = T + 2g = 4g\ \text{N}$$

Now, putting the values of F_1, F_2 in Eq. (iii), we get

$$\frac{Y_1}{Y_2} = \left(\frac{2g}{4g}\right)\cdot\left(\frac{\pi r_2^2}{\pi r_1^2}\right)\cdot\left[\frac{l_1}{l_2}\right]\cdot\left(\frac{\Delta l_2}{\Delta l_1}\right)$$

or $$c = \frac{1}{2}\left(\frac{1}{b^2}\right)\cdot a\left(\frac{\Delta l_2}{\Delta l_1}\right)$$

or $$\frac{\Delta l_1}{\Delta l_2} = \left(\frac{a}{2b^2 c}\right)$$

19. Initially area of soap bubble

$$A_1 = 4\pi r^2$$

Under isothermal condition radius becomes $2r$,

Then, area $A_2 = 4\pi\,(2r)^2$

$$= 4\pi \cdot 4r^2$$
$$= 16\pi r^2$$

Increase in surface area

$$\Delta A = 2(A_2 - A_1)$$
$$= 2(16\pi r^2 - 4\pi r^2)$$
$$= 24\pi r^2$$

Energy spent

$$W = T \times \Delta A$$
$$= T \cdot 24\pi r^2$$
$$W = 24\pi T r^2 \text{ J}$$

20. Charge flowing in one minute

$$q = I \times t = 1.6 \times 60 \text{ C}$$

Charge required to liberate one copper ion 2C

$$\text{Number of } Cu^{2+} \text{ liberated} = \frac{1.6 \times 60}{2 \times 1.6 \times 10^{-19}}$$
$$= 3 \times 10^{20}$$

21. From $F = qBv$, $F = 0$, when $v = 0$

i.e., a stationary charge experiences no force in a magnetic field.

22. $\nu = \frac{1}{\sqrt{LC}}$

When L is changed to $L/2$, C must be changed to $2C$ to keep ν same.

24. Image is not sharp because of deviation of light from straight line path account of diffraction of light.

25. The reflected sound appears to propagate in a direction opposite to that of moving engine. Thus, the source and the observer can be presumed to approach each other with same velocity.

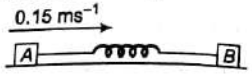
$$\nu' = \frac{\nu(\nu + \nu_o)}{(\nu - \nu_s)}$$
$$= \nu\left(\frac{\nu + \nu_s}{\nu - \nu_s}\right) \qquad (\because \nu_o = \nu_s)$$
$$\Rightarrow \quad \nu' = 1.2\left(\frac{350 + 50}{350 - 50}\right)$$
$$= \frac{1.2 \times 400}{300}$$
$$= 1.6 \text{ kHz}$$

26. By using Wien's displacement law,

$$(\lambda_m)_1 T_1 = (\lambda_m)_2 T_2$$
$$\Rightarrow \quad 500 \times 6000 = 400 \times T_2$$
$$\Rightarrow \quad T_2 = \frac{500 \times 6000}{400}$$
$$T_2 = 7500 \text{ K}$$

27. The output Y is a combination of AND + NOT gate. Hence, the truth table is for NAND gate.

28. As the block A moves with velocity 0.15 ms^{-1}, it compresses the spring which pushes B towards right. A goes on compressing the spring till the velocity acquired by B becomes equal to the velocity of A, *i.e.*, 0.15 ms^{-1}. Let this velocity be v. Now, spring is in a state of maximum compression. Let x be the maximum compression at this stage.



According to the law of conservation of linear momentum, we get

$$m_A u = (m_A + m_B)\nu$$

or
$$\nu = \frac{m_A u}{m_A + m_B}$$
$$= \frac{2 \times 0.15}{2 + 3} = 0.06 \text{ ms}^{-1}$$

According to the law of conservation of energy,

$$\frac{1}{2} m_A u^2 = \frac{1}{2}(m_A + m_B)\nu^2 + \frac{1}{2} kx^2$$
$$\frac{1}{2} m_A u^2 - \frac{1}{2}(m_A + m_B)\nu^2 = \frac{1}{2} kx^2$$
$$\frac{1}{2} \times 2 \times (0.15)^2 - \frac{1}{2}(2 + 3)(0.06)^2 = \frac{1}{2} kx^2$$
$$0.0225 - 0.009 = \frac{1}{2} kx^2$$

or
$$0.0135 = \frac{1}{2} kx^2$$

or
$$x = \sqrt{\frac{0.027}{k}} = \sqrt{\frac{0.027}{10.8}} = 0.05 \text{ m}$$

29. Let the final temperature of mixture be t.

Heat lost by water at 80°C

$$= ms\Delta t$$
$$= 0.1 \times 10^3 \times s_{water} \times (80° - t) \qquad (\because m = V \times d = 0.1 \times 10^3 \text{ kg})$$

Heat gained by water at 60°C

$$= 0.3 \times 10^3 \times s_{water} \times (t - 60°)$$

According to principle of calorimetry

Heat lost = Heat gained

$$\therefore \quad 0.1 \times 10^3 \times s_{water} \times (80° - t)$$
$$= 0.3 \times 10^3 \times s_{water} \times (t - 60°)$$

or
$$(80° - t) = 3 \times (t - 60°)$$

or
$$4t = 260°$$

or
$$t = 65°\text{C}$$

30. The given equation of a progressive wave is

$$y = 3 \sin \pi\left(\frac{t}{2} - \frac{x}{4}\right) = 3 \sin 2\pi\left(\frac{t}{4} - \frac{x}{8}\right)$$

The standard equation of a progressive wave is

$$y = y_0 \sin 2\pi\left(\frac{t}{T} - \frac{x}{\lambda}\right)$$

Comparing these two equations, we get

$$T = 4 \text{ s}, \quad \lambda = 8 \text{ m}$$

$\therefore$ Velocity of wave,

$$\nu = \frac{\lambda}{T} = \frac{8}{4} = 2 \text{ ms}^{-1}$$

Distance travelled by wave in time t is

$$s = \nu t$$

or
$$s = 2 \times 5 = 10 \text{ m}$$

31. $$v_{CM} = \frac{m_1 \frac{dr_1}{dt} + m_2 \frac{dr_2}{dt}}{m_1 + m_2} = \frac{4 \times 5\mathbf{i} + 2 \times 10\mathbf{i}}{4 + 2}$$
$$v_{CM} = \frac{40\mathbf{i}}{6} = \frac{20}{3}\mathbf{i}$$

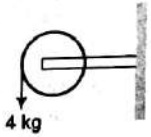
The kinetic energy

$$K = \frac{1}{2} mv^2$$
$$= \frac{1}{2} \times (4 + 2) \times \frac{20 \times 20}{3 \times 3}$$
$$= \frac{1}{2} \times 6 \times \frac{20 \times 20}{3 \times 3}$$
$$K = \frac{400}{3} \text{ J}$$

32. Given, $r = 0.4$ m

$\alpha = 8$ rad s^{-1}

$m = 4$ kg, $I = ?$



Torque, $\tau = I\alpha$

$$mgr = I \cdot \alpha$$

or
$$4 \times 10 \times 0.4 = I \times 8$$
$$\Rightarrow \quad I = \frac{16}{8} = 2 \text{ kg-m}^2$$

or
$$I = 2 \text{ kg-m}^2$$

34. $$\tan\theta = \frac{v^2}{rg} = \frac{400}{20 \times 900}$$
$$\theta = 63.7°$$

35. For stationary lift $t_1 = \sqrt{\frac{2h}{g}}$

and when the lift is moving up with constant acceleration

$$t_2 = \sqrt{\frac{2h}{g}}$$

$\therefore \quad t_1 > t_2$

36. Acceleration produced in jet

$$= \frac{\text{Change in velocity}}{\text{Time}}$$
$$a = \frac{(10^3 - 0)}{10}$$
$$= 100 \text{ m/s}^2$$
$$\therefore \text{ Mass} = \frac{\text{Force}}{\text{Acceleration}} = \frac{10^5}{10^2}$$
$$= 10^3 \text{ kg}$$

37. $u = 2$ m/s, $v = 0$, $t = 0$ s

$$a = \frac{v - u}{t}$$
$$= \frac{0 - 2}{10} = -\frac{2}{10}$$
$$= -\frac{1}{5}$$
$$= -0.2 \text{ m/s}^2$$
$$\therefore \text{ Friction force} = ma$$
$$= 1 \times (-0.2) = -0.2 \text{ N}$$

38. $U = A - Bx^2$

$$F = -\frac{dU}{dv} = 2Bx$$
$$F \propto x$$

39. Angle turned in three second and θ_3 $s = 2\pi \times 10$

$$= 20\pi \text{ rad}$$
$$\theta_1 = \omega_0 t + \frac{1}{2}\alpha t^2$$

$$\alpha = \frac{49\pi}{9}\ \text{rad/s}^2$$

Now, angle turned in 6 s from the starting

$$\theta_2 = \omega_0 t + \frac{1}{2}\alpha t^2$$

$$= 0 + \frac{1}{2} \times \left(\frac{40\pi}{9}\right) + (6)^2$$

$$= 80\ \pi\ \text{rad}$$

Angle turned between $t = 3$ s to $t = 6$ s

$$\theta_{\text{lost}} = \theta_2 - \theta_3 = 80\ \pi - 20\ \pi$$

$$= 60\ \pi$$

$$\text{Number of revolution} = \frac{60\pi}{2\pi} = 30$$

Chemistry

1. For highest energy level in an atom, $(n + l)$ should be maximum.

2. $CH_3COOH \xrightarrow{Br_2/P} \underset{'Y'}{BrCH_2—COOH}$

$$\xrightarrow{KCN\ (alc)} NC—CH_2COOH$$

$$\xrightarrow{H_3O^+} \underset{\text{malonic acid}\ 'X'}{HOOC—CH_2—COOH}$$

3. In laboratory, acetic anhydride is prepared by heating sodium acetate with acetyl chloride.

$$CH_3COONa + \underset{\text{acetyl chloride}}{CH_3COCl} \xrightarrow[-\ NaCl]{\Delta} \underset{\text{acetic anhydride}}{CH_3COOCOCH_3}$$

4. For the given reaction, $\Delta n_g = n_p - n_r$

(where, n_p = number of moles of gaseous products and n_r = number of moles of gaseous reactants).

$$\Delta n_g = (6 + 4) - (4 + 5) = +1$$

Units of K_c = (concentration)$^{\Delta n_g}$

= (concentration)$^{+1}$

5. The two half-reactions for the given reaction are

$$2NH_3 \longrightarrow N_2H_4 + 2H^+ + 2e^-$$

$$OCl^- + 2H^+ + 2e^- \longrightarrow Cl^- + H_2O$$

On adding both the reactions. we get

40. When a body (sphere) is half immersed, then Upthrust = weight of sphere

$$\frac{V}{2} \times \rho_{liq} \times g = v \times \rho \times g$$

$$\therefore \quad \rho = \frac{\rho_{liq}}{2}$$

When body (sphere) is fully immersed then, Upthrust = weight of sphere + weight of water pourd in sphere

$$V \times \rho_{liq} \times g = V \times \rho \times g + V' \times \rho_{liq} \times g$$

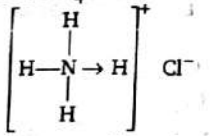
$$V \times \rho_{liq} = \frac{v \times \rho_{liq}}{2} + V' \times \rho_{liq}$$

$$V' = \frac{V}{2}$$

$$2NH_3 + OCl^- \longrightarrow N_2H_4 + Cl^- + H_2O$$

The obtained equation is a balanced equation and in it, the coefficient of N_2H_4 is 1.

6. The structure of NH_4Cl is as



Thus, NH_4Cl has a coordinate bond along with covalent and ionic bonds.

7. Osmotic pressure is a colligative property, *i.e.*, depends upon the number of particles of solute. Thus, the solution in which solute gives maximum number of ions, exerts maximum osmotic pressure. Number of particles,

(a) In decinormal aluminium sulphate

$$Al_2(SO_4)_3 \longrightarrow \underbrace{2Al^{3+} + 3SO_4^{2-}}_{5\ \text{particles}}$$

(b) In decinormal barium chloride,

$$BaCl_2 \longrightarrow \underbrace{Ba^{2+} + 2Cl^-}_{3\ \text{particles}}$$

(c) In decinormal sodium chloride,

$$NaCl \longrightarrow \underbrace{Na^+ + Cl^-}_{2\ \text{particles}}$$

(d) When equal volumes of (b) and (c) are mixed, the concentration becomes half of present concentration.

Thus, decinormal aluminium sulphate exerts maximum osmotic pressure.

8. Cow milk, a natural emulsion, is stabilised by casein (milk protein).

9. For a zero order reaction

$$\text{rate}, -\frac{d[R]}{dt} = k$$

On integrating, we get

$$[R] = -kt + [C]$$

When $t = 0, [R] = [R_0]$

$$\therefore \quad [C] = [R_0]$$

$$\therefore \quad [R] = -kt + [R_0]$$

When, $t = t_{1/2}, [R] = \frac{[R_0]}{2}$

$$\therefore \quad \frac{[R_0]}{2} - [R_0] = -kt_{1/2}$$

$$\therefore \quad t_{1/2} = \frac{[R_0]}{2k}$$

$$t_{1/2} \propto [R_0]$$

10. In a Bessemer converter, copper pyrites are oxidised to FeO and Cu_2O, FeO is slagged off. Cu_2O reacts with Cu_2S left unoxidised to give Cu.

$$2Cu_2S + 3O_2 \longrightarrow 2Cu_2O + 2SO_2\uparrow$$

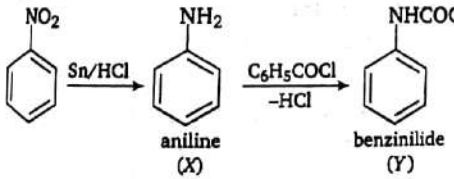
$$2Cu_2O + Cu_2S \longrightarrow 6Cu + SO_2\uparrow$$

Thus, extraction of Cu involves bessemerisation.

11. On moving from left to right in a period, as the size decreases, ionisation energy increases. But first IE of elements of II A group is higher than that of the elements of III A group because of the stable ns^2 configuration (of II A group). Hence, the order of first ionisation energy is

	C	>	Be	>	B	>	Li
Group no.	(IV)		(II)		(III)		(I)

12.



13. Basicity of amines depends upon the availability of lone pair of nitrogen for donation. Electron releasing group like $—CH_3$ increases the basicity of amines by increasing electron density over nitrogen, which facilitate the donation of lone pair of electrons.

Electron withdrawing groups like –Ph group withdraws electrons and thus, make amines less basic by decreasing electron density over nitrogen. Hence, the order of basic nature of the given amines is

$(CH_3)_2NH > C_6H_5N(CH_3)_2 > CH_3NH_2 > NH_3$

Thus, $(CH_3)_2NH$ is most basic.

14. The natural polymer which controls the various life processes in the body of organism is called biopolymer, *e.g.*, DNA, RNA.

Rubber is also a natural polymer but not a biopolymer. Teflon and nylon-66 are synthetic polymers.

15. Trimethyl stearyl ammonium bromide has a chiral nitrogen atom, thus is known as invert soap.

16. Le-blanc process is used in the manufacture of potash, *i.e.*, K_2CO_3.

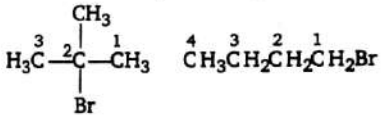
17. Benzene does not contain 3 single bonds and 3 double bonds. These are all partially double due to resonance.

18. The structure of acryldehyde is

$$\overset{3}{CH_2}=\overset{2}{CH}—\overset{1}{CHO}$$

Thus, its IUPAC name is prop-2-en-1-al.

19. The structures of the given compounds are as



Since, in these, the chain of carbon atoms and the position of functional group *i.e.*, Br both are different, they exhibit chain as well as position isomerism.

20. Petrol for aviation purpose must contain highly branched chain paraffins (alkanes) which are obtained through catalytic cracking.

21. $Hg_2I_2(s) \rightleftharpoons Hg_2^{2+} + 2I^-$

$$\therefore \quad K_{sp} = [Hg_2^{2+}][I^-]^2$$

22. In a fcc unit cell, the number of corner atoms $= 8 \times \frac{1}{8} = 1$

(∵ Each corner is shared with 8 other unit cells)

The number of face atoms $= 6 \times \frac{1}{2} = 3$

Thus, the total number of atoms per unit cell

$= 1 + 3 = 4$

23. For a first order reaction,

$$k = \frac{2.303}{1.386 \times 60 \times 60} \log \frac{a}{a - 0.75a}$$

$$= \frac{2.303}{1.386 \times 60 \times 60} \log 4$$

$$= 2.8 \times 10^{-4}\ s^{-1}$$

24. Conc. H_2SO_4 decomposes H_2O_2, thus H_2O_2 can not be dried over it.

$$H_2O_2 + |O| \longrightarrow H_2O + O_2$$

25.

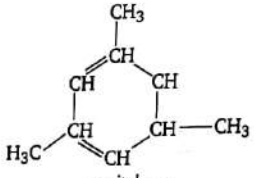
Formula of compound	Name of compound
$Na_2SO_4 \cdot 10H_2O$	Glauber's salt
$Na_2S_2O_3 \cdot 5H_2O$	Hypo
$CuSO_4 \cdot 5H_2O$	Blue vitriol
$Na_2B_4O_7 \cdot 10H_2O$	Borax

26. The basic nature of elements increases from top to bottom in a group. Therefore, iodine is the most basic element.

$$F_2 < Cl_2 < Br_2 < I_2$$

27. $3CH_3CH{\equiv}CH \xrightarrow[\text{tube}]{\text{Red hot Cu}}$

propyne



mesitylene

28. Chlorofluorocarbons are responsible for the depletion of ozone layer as they provide Cl free radical which infact reacts with ozone and converts it into O_2 as

$$Cl^{\bullet} + O_3 \longrightarrow ClO^{\bullet} + O_2$$

29. Chloroform, $CHCl_3$, when warmed with silver powder, gives acetylene.

$$2CHCl_3 + 6Ag \xrightarrow{\Delta} \underset{\text{acetylene}}{CH{\equiv}CH} + 6AgCl$$

30. Ammonia is a Lewis base. It forms complexes with transition elements like Ag^+, Cu^{2+} and Cd^{2+} while it does not form complex with Pb^{2+} because Pb is not a transition element.

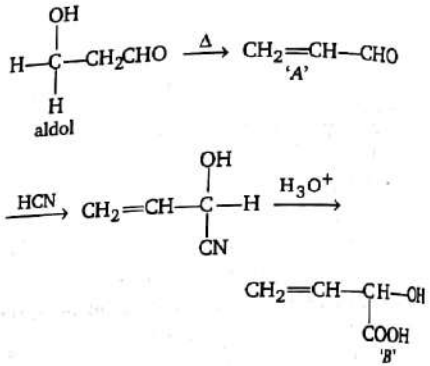
$$AgCl + 2NH_4OH \longrightarrow [Ag(NH_3)_2]Cl + 2H_2O$$

$$CuSO_4 + 4NH_4OH \longrightarrow [Cu(NH_3)_4]SO_4 + 4H_2O$$

$$CdSO_4 + 4NH_4OH \longrightarrow [Cd(NH_3)_4]SO_4 + 4H_2O$$

31. Argol is potassium hydrogen tartarate.

32. $CH_3CHO + HCHO \xrightarrow[\Delta]{\text{Dil. NaOH}}$ (aldol condensation)



'A'

aldol

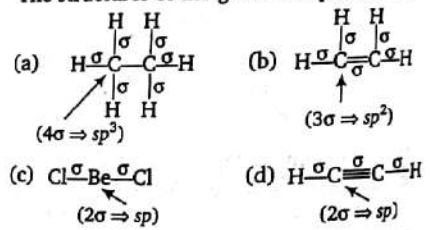
'B'

33. NaCl is a neutral salt, thus the pH value of its aqueous solution is 7.

34. The pH value of basic buffer solutions is always greater than 7. Among the given, only $NH_4OH + NH_4Cl$ constitutes the basic buffer (a mixture of weak base and its conjugated salt), thus, has pH greater than 7.

35. When there is 3σ bonds, the hybridisation is sp^2.

The structures of the given compounds are



(a) $(4\sigma \Rightarrow sp^3)$ (b) $(3\sigma \Rightarrow sp^2)$ (c) $(2\sigma \Rightarrow sp)$ (d) $(2\sigma \Rightarrow sp)$

Thus, $CH_2{=}CH_2$ has sp^2 hybridisation.

36. Hydrogen molecule contains no lone pair, hence not able to take part in coordinate bond formation but Cl_2 can.

37. $\Delta E = E_2 - E_1 = \frac{1312}{1^2} - \frac{1312}{2^2} = 1312\left(\frac{3}{4}\right)$,

$$E_3 - E_2 = \frac{1312}{2^2} - \frac{1312}{3^2} = 1312\left(\frac{5}{36}\right)$$

$$\therefore\ E_2 - E_1 : E_3 - E_2 = \frac{3}{4} : \frac{5}{36} = 27 : 5$$

38. In graphite, the constituent particles are atoms and intermolecular force is covalent bonding.

Thus, it is an example of covalent solid.

39. Transition metal ion having absence of unpaired electron is diamagnetic.

(a) $Co^{2+} = [Ar]\ 3d^7$ (three unpaired electrons)

(b) $Ni^{2+} = [Ar]\ 3d^8$ (two unpaired electrons)

(c) $Cu^{2+} = [Ar]\ 3d^9$ (one unpaired electron)

(d) $Zn^{2+} = [Ar]\ 3d^{10}$ (no unpaired electron)

Thus, Zn^{2+} is diamagnetic.

40. $MgCO_3$ decomposes on heating to give MgO and CO_2 while alkali metal carbonates (except Li_2CO_3) do not.

Zoology

1. When genomic DNA extracted from any tissue of a plant or animal species is digested with a restriction enzyme, it is cleaved into segments. The segments of different sizes can be separated through gel electrophoresis. Gel electrophoresis involves movement of fragments or molecules on the basis if molecule size and shape under the influence of electric field.

   Endonucleases are enzymes that produce internal cuts called cleavage in DNA molecules. It cleaves DNA only within or near recognition sites, which have specific base sequences, such endonucleases are known as restriction endonucleases.

   The selected vector is cut open with a restriction enzyme that has a unique target site located in the sequence, where the DNA insert should be integrated to facilitate the selection of recombinant DNA.

2. In prokaryotes, ribosomes attach to the 5′ end of *m*RNA as soon as transcription begins. A bunch of ribosome moves along a single *m*RNA molecule adding 15 amino acids/second to the polypeptide chain, almost the same speed at which RNA polymerase transcribes the *m*RNA. The group of ribosomes together with the single *m*RNA molecules, they are translating is called polysome. The use of polysomes is advantageous to a cell since, the overall rate of protein synthesis is increased compared to the rate that would occur if there were no polysomes.

   In eukaryotic cells, the ribosomes are attached to rough endoplasmic reticulum by ribophorin protein. Electron microscopy reveals that membranes of homogenised endoplasmic reticulum disrupt to form closed vesicles called microsomes. Microsomes derived from rough endoplasmic reticulum are studied with ribosomes and are called rough ribosomes.

3. The basophils are probably like mast cells of connective tissue. They release heparin, histamine and serotonin. Their nucleus is usually three lobed and their granules take basic stain strongly.

   Monocytes are largest of all types of leucocytes. Their nucleus is bean-shaped. They are motile and phagocytic in nature. They engulf bacteria and cellular debris. Generally, they will change into macrophages after entering tissue spaces. Eosinophils have two-lobed nucleus. They are non-phagocytic and help in dissolving blood clot. Their number increases in people with allergic conditions such as asthma or hay fever. Neutrophils are most numerous of all leucocytes. They eat harmful germs and are therefore, phagocytic in nature. Their nucleus is many lobed and stain weakly with both acid and basic stains.

4. Nearly a century ago **TH Huxley** called birds 'glorified reptiles' thereby meaning that birds have evolved from some reptilian ancestor. Both birds and reptiles lay the same type of eggs, which are deposited outside water. Eggs are

large and telolecithal. The ovum is surrounded by albumen, an egg membrane and a thick hard calcareous shell, which are all secreted by special glands located in the walls of oviduct.

Birds like mammals have completely four chambered heart with double circulation, in which there is no mixing of pure and impure bloods. Whereas the ventricle is imperfectly divided in reptiles, resulting in partial mixing of bloods.

All birds have horny epidermal scales confined to the lower parts of their legs and feet, which are exactly like the epidermal scales of the reptiles. Besides birds are covered by feathers, which are homologous to the reptilian horny scales as they have a similar origin and develop from similar germ buds.

5. Kingdom—Monera includes all prokaryotes (autotrophic or heterotrophic) *viz.*, mycoplasmas, bacteria, Actinomycetes (mycelial bacteria) and photosynthetic cyanobacteria, while all unicellular eukaryotic organisms like flagellates, diatoms, dinoflagellates, slime moulds, sarcodina, etc. are included in kingdom–Protista.

6. The members of phylum–Arthropoda show bilateral symmetry, three germ layers in body wall, external metamerism, jointed and paired appendages, haemocoel and open type of circulatory system with dorsal heart.

7. *Australopithecus* are considered as connecting link between ape and man. They were the ancestors of man who first stood erect. Their cranial capacity was 300-500 cc.

8. Biosphere reserves are a special category of protected areas of land and/or coastal environments, wherein people are an integral component of the ecosystem. It represents a specified area zonated for particular activity and consists of core zone without any human activity, buffer zone with limited human activities and manipulation zone with several manipulating human activities.

9. DDT is the most hazardous, non-biodegradable insecticide, which is fat soluble but insoluble in water. It persists in the environment for a very long period. Being fat soluble, it accumulates in the animal tissues and gets concentrated at different trophic levels of food chain. It each step, DDT is more concentrated. This is also called biomagnification.

10. With regard to transfusions of whole blood or packed red blood cells, individuals with O type negative blood are often called universal donors and those with type AB positive blood are called universal recepients. Person with blood group O^- do not have anytype of antigen present on surface of the RBC so recepient will not form any antibody against it.

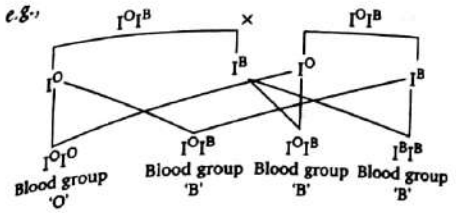
11. *In Vitro* Fertilization (IVF) is also known as test tube baby technique. It involes fertilizing of one or more eggs outside the female's body and then transferring the zygotes (known as pre embryos) back into the uterus (*i.e.*, embryo transfer).

12. As compared to other reserves in the world, Sunderban National Park has the largest tiger population. It also reserves the salt water crocodiles, Gangetic dolphins, chitals, wild boars, rhesus macaques, etc.

13. Human Immunodeficiency Virus (HIV) is the causal organism of AIDS (Acquired Immuno Deficiency Syndrome). It is a retrovirus belonging to the family—Retroviridae. The core of HIV contains two molecules of single stranded RNA (as genetic material) and reverse transcriptase.

14. Hypersecretion of Growth Hormone (GH) or Somatotropin Hormone (STH) from adenohypophysis of pituitary gland causes gigantism in children and acromegaly in adulthood. Gigantism involves excessive growth (lengthening) of bones with enlargement of internal organs as well. Acromegaly causes abnormal thickening of bones (due to ossification of periosteum) especially at face and margins of hand and feet.

15. Genotype of a person with blood group 'B' may be I^BI^B or I^OI^B, person with genotype I^BI^B can not produce offsprings with blood group 'O' in any case but if the person's genotype is I^OI^B, then its offsprings may have blood group 'O'.



16. Follicle Stimulating Hormone (FSH) is produced by basophilic cells of adenohypophysis of pituitary gland. In females, this hormone is responsible for the growth of ovarian follicles up to ovulation, while in males, its functions are development of seminiferous tubules and maintenance of spermatogenesis.

17. Biopesticides are pesticides of biological origin, which may be of various types depending upon the types of pests killed or controlled by them, *e.g.*, algicides, fungicides, bacteriocides, herbicides or weedicides, insecticides, nematicides and rodenticides, etc. These were initially employed to protect crop plants against pests but they are non-equally important for destroying or controlling vectors for various animals and human pathogens, thus, can be used for controlling various diseases also.

18. If fertilization occurs and the foetus is implanted in the endometrium, the trophoblast cells of the developing placenta secrete a hormone called Human Crionic Gonadtrophic hormone (HCG). This hormone like LH maintains the corpus luteum and secretion of progesterone and estradiol by it. These two hormone check the breakdown of the endometrium of the uterus. The absence of menstrual bleeding is the earliest sign of pregnancy.

19. Biotechnology may be, simply defined as the use of microorganisms animals or plant's cells or thin components to generate products and services useful to human beings. Now-a-days, biotechnology is very helpful in producing transgenic crops or Genetically Modified (GM) crops, transgenic animals, biofertilizers, antibodies, hormones like humulin (genetically engineered human insulin), antibodies and various other useful products.

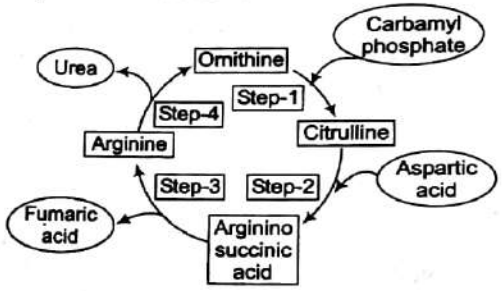
20. Glycolysis is an essential and first path of respiration. It is common in both aerobic and anaerobic respiration and occurs in the cytosol of all living cells of prokaryotes as well as eukaryotes.

21. Oxyntic cells or parietal cells are large and rounded cells located upon the surface of gastric gland and secrete HCl and CIF (Castle's Intrinsic Factor). This HCl gives the gastric fluids, a pH of about 2.0.

22. The corpus luteum plays an important role in the preparation of endometrium for the implantation of fertilized egg by secreting estrogen and progesterone hormones. But if the egg is not fertilized then the corpus luteum begins to degenerate and it stops the production of progesterone and estrogen hormones, which causes shedding of the endometrium lining with menstrual bleeding.

23. *Pinctada* sp. are the bivalve molluscs, commonly known as pearl oysters. These belong to sub-class–Lamellibranchia, class–Bivalvia or Pelycipoda, phylum–Mollusca and kingdom–Animalia.

24. The formation of urea from NH_3 and CO_2 occurs in liver. Through Ornithine cycle or Krebs' Hansleit cycle. All the steps of this cycle are enzymatic and can be visualized as follows.



25. The term 'pelvis' is common to both kidney and skeleton in mammals. In relation to kidney, it can be described as a chamber in the kidney into which the urine drains from renal tubules before passing to the ureter. For skeleton, it is related with pelvic girdle or hip girdle.

26. Allantois is an extraembryonic membrane developed as an outgrowth from hindgut. In the eggs of reptiles and birds, it functions as a urinary bladder and stores the waste excretory products. It also provides oxygen (in reptiles,

birds and mammals) and food (in mammals) to the embryo.

27. The deficiency (hypovitaminosis) of vitamin-B_{12} or cyanocobalamine causes pernicious anaemia, demyelination of nerve fibres and glossitis (inflammation of tongue).

28. Blood is a living, vascular, fluid connective tissue, which is made of 60% plasma, 40% blood cells and platelets.

29. To control the human population many birth control methods can be used, such as **hormonal method**, *i.e.*, use of contraceptive pills (estrogen and progesterone are main constituents), mechanical **prevention method**, *i.e.*, use of IUCDs (Intrauterine Contraceptive Device), surgical **sterilization methods**, like tubectomy (surgical removal of fallopian tubules) or vasectomy (surgical removal of vas deferens).

30. In alcoholic person, some part of alcohol is changed into acetaldehyde, which stimulates the formation of fat. This fat is deposited over the wall of arteries and also accumulates in liver cells. Due to which liver gets failed and there is very little regulation of carbohydrate, protein and fat metabolism. This disorder is known as **fatty liver syndrome**. Later on, the liver gets turned into solid, hard, fibrous organ causing **liver cirrhosis**.

31. Class–Ostracodermi of vertebrata includes most primitive vertebrates, *e.g.*, *Cephalaspis* and *Drepanaspis*.

32. Meristic variations involve any change in the number of body parts. In other words, it may be defined as the numerical variation in the taxonomic characters, *e.g.*, number of spots, vertebrae, etc.

33. Klinefelter's syndrome is caused by one or more extra X-chromosome (*i.e.*, XXY, XXXY). The man with such a syndrome is sterile, has small testes, long legs and feminine characters like breasts.

34. The first living form is named as protocell or eobiont or protobiont, which evolved into prokaryotic cell. These were originated about 3900-3500 million years ago, during Precambrian era.

35.

Branch of Zoology	Area
Arthrology	Study of joints
Ichthyology	Study of fishes
Saurology	Study of lizards
Herpetology	Study of reptiles

36. Theory of continuity of germplasm was proposed by August Weismann (1892), a German Biologist, he suggested that the changes occurring in germplasm are inherited by offsprings, whereas in somatoplasm are not transmitted to next generation.

37. Amnion is an extraembryonic membrane that surrounds embryo in reptiles, birds and mammals. It provides a kind of private aquarium to the embryo and protects it from mechanical shock and desiccation.

Chorion (serosa) is the outermost extra embryonic membrane in reptiles, birds and mammals. It surrounds the whole embryonic system of embryo.

Yolk sac contains yolk in reptiles and birds. In mammals, yolk sac is also known as umbilical vesicle. It is connected to enteron of embryo by a slender yolk stalk.

Allantois functions as an embryonic urinary bladder or as a respiratory extension of hind gut in reptiles and birds. In mammals, it is modified to carry blood vessels to and from the placenta.

38. Neutrophils are most abundant granulecytes which engulf microbes by phagocytosis. These have 2-7 lobulated nucleus and do not stain any basic or acidic dye monocytes are large sized leucocytes, which are highly motile and phagocytic in nature.

39. During the propagation of nerve impulse when a stimulus of adequate strength is applied to a polarized membrane, the permeability of the membrane to Na^+ is greatly increased at the point of stimulatioin. As a result, the sodium ion channels permit the influx of Na^+ by diffusion. Since, there are more Na^+ ions entering than leaving, the electrical potential of the membrane changes from – 70 mV towards zero.

At 0 mV the membrane is said to be depolarized. While the resting potential is determined largely by K^+ ions, the action potential is determined largely by Na^+ ions. Action potential is another name of nerve impulse. The stimulated negatively charged point on the outside of the membrane sends out an electrical current to the positive point adjacent to it. This local current causes the adjacent inner part of the membrane to reverse its potential from – 70 mV to + 30 mV.

40. Adaptive radiation represents evolution of new forms in several directions from the common ancestral type. In 1831, Darwin got an opportunity to travel by HMS Beagle for a voyage of world exploration. Beagle sailed to the Galapagos Islands, here Darwin found a living laboratory of evolution. The common birds of Galapagos Islands, the finches were markedly different from the finches of main land. The closely related species of finches had beaks of different shapes and sizes and adapted for feeding on completely different diet showing adaptive radiation.

The transitional fossil forms, which show characteristic of two different groups of living animals are called connecting links, *e.g.*, *Archaeopteryx*, *Seymouria*, etc.

Botany

1. In *Pteris* (also *Dryopteris*), the spore germinates to produce the prothallus. The prothallus is a small, green, flat, surface loving, thallus-like object. It is monoecious and bears sex organs on the ventral side. The antheridia (male sex organs) arise among the rhizoids towards the posterior side of the prothallus and are emergent. The archegonia develop in central cushion behind the apical notch. In these plants, male and female gametophytes do not have free living independent existence.

All species of *Polytrichum* are dioecious. The antheridia and archegonia are borne on different gametophore. The plant body is an erect leafy shoot but is not the entire gametophyte. The leafy shoot arise from protonema (the juvenile stage).

The leafy gametophore of *Funaria* reproduces sexually by formation of antheridia and archegonia. The antheridia are formed at the summit of a relatively small, thin, leafy shoot, which develops first. The female branch arises later as a lateral outgrowth from the base of parent male shoot.

2. Vitamin-A deficiency causes nightblindness among children. Vitamin-A deficiency often occurs, where rice is the staple food since, rice grain does not contain β-carotene. Three transgenes providing phytoene synthase, phytoene desaturase, β carotene desaturase and lycopene cyclase activities were transferred into rice by *Agrobacterium* mediated transformation. The resulting transgenic rice popularly called Golden rice contains good quantities of β-carotene.

Flavr savr is genetically modified tomato, which remains fresh and retains their flavour much longer than normal tomato due to blocking of synthesis of fruit softening enzyme polygalacturonase.

3. Histogen theory for shoot apical meristem has been proposed by Hanstein (1870). It advocates that there are three distinct meristematic zones (layers) called dermatogen periblem and plerome. The dermatogen is the outermost histogen giving rise to epidermis, periblem is the middle on producing the cortex and plerome is the innermost resulting in central cylinder (*i.e.*, vascular tissue).

Cork cambium (phellogen) is the secondary lateral meristem found in outer cortical region. Its cells divide periclinally cutting off cells towards the outside (forming cork or phellem) and inside (forming secondary cortex or phelloderm).

4. Nitrogen is the most critical element. Atmosphere is the greatest reservior of nitrogen. Molecular nitrogen cannot be utilized directly by plants. It has to be fixed or converted into compounds prior to utilization. Symbiotic nitrogen fixation is accomplished by *Rhizobium* species, which occurs on the roots of leguminous plants. Certain non-leguminous plants also form nodules to fix nitrogen. The best known example in temperate region is

alder (*Alnus* sp.) The bacteria involved in nodule formation is an Actinomycetes, the *Frankia*.

Clostridium is anaerobic, saprotrophic, free-living nitrogen fixing bacteria.

Bradyrhizobium is symbiont in plants of *Parasponia* and soyabean.

The *Azorhizobium* forms both stem and root nodules in *Sesbania* (aquatic plant).

5. In *Pinus*, the microspore nucleus divides by a periclinal wall and forms a very small prothallial cell and large central cell. The central cell cuts off a second prothallial cell and antheridial cell. The nucleus of the antheridial cell divides to form generative cell and tube cell. Thus, the pollen grain of *Pinus* is shed at four cell stage when it consists of two vegetative prothallial cells, a generative cell and a tube cell.

6. Colchicine is a poisonous chemical, isolated from seeds and bulbs of autumn crocus (*Colchicum autumnale*). It blocks spindle formation and thus, inhibits the movement of sister chromatids to the opposite poles. The resulting restitution nucleus includes all the chromatids. As a result, the chromosome number of the cell is doubled, which leads to polyploidy.

7. Quantasomes are the photosynthetic units present in the thylakoids of chloroplast. Each of the quantasomes contain about 250-300 chlorophyll molecules.

8. Mitochondria contains various enzymes as follows :

   (i) **Outer membrane** Acetyltransferase, glycerophosphatase, phospholipase-A, monoamine oxidase, etc.

   (ii) **Inner membrane** Cytochrome oxidase, dehydrogenase, succinate NADH, dehydrogenase, ATPase, etc.

   (iii) **Perimitochondrial space** Adenylate kinase, nucleoside diphosphokinase, etc.

   (iv) **Matrix** Pyruvate dehydrogenase, citrate synthase, aconitase, isocitrate dehydrogenase, fumarase, α-ketoglutarate dehydrogenase, malate dehydrogenase, etc.

9. *Pseudomonas putida* is a genetically engineered bacterium with many different plasmids to degrade the pollutants. It is developed by Dr. Anand Mohan Chakraborty and is known as superbug or oil eating bug or Chakraborty's superbug. Now-a-days, this genetically engineered bacterium is utilized for cleaning of marine oil slicks.

10. Solanin is a glycoalkaloid poison or natural nerve toxin produced in the green part of the potato. It is a bitter poisonous crystalline alkaloid, which helps the plant to defend against predators, insects, diseases, etc. Ingestion of it may cause vomiting, diarrhoea, headache and even paralysis of central nervous system.

11. Myeloma is a type of cancer that develops from plasma cells occurring in the bone marrow. It may develop, wherever the plasma cells occur.

12. The common bread wheat (*Triticum aestivum*) is an allohexaploid, which has two copies of each of the genomes A, B and D. Its somatic complement is represented by AABBDD.

13. *Rafflesia* is a total root parasite, which remains attached to the roots of the host plants and derives all of its nutritions from them.

    Cuscuta (dodder or amarbel) is a total stem parasite, while *Santalum album* (sandal wood) is a partial root parasite.

14. Companion cells are present between sieve tubes in the phloem of angiosperms. These are the living cells with large nucleus that controls the activity of non-nucleated sieve tubes.

15. Cotton is obtained from the epidermal hair present on the surface of seeds of *Gossypium* sp. These are made up of cellulose only and may be of two types, *i.e.*, extractable lint and non-extractable fluffy fuzz. Cotton fibres are mainly used for textiles, celluloid, cellophane, rayon and paper pulp.

16. In pteridophytes, spore is a haploid structure, which develops after meiosis in the spore mother cell. On germination, it gives rise to a green haploid prothallus (gametophyte) which is monoecious, *i.e.*, has both antheridia (male sex organs) and archegonia (female sex organs).

17. The pollen tube may enter the ovule by following one of three routes given below :

    (a) **porogamy** Pollen tube enters the ovule through micropyle, *e.g.*, most angiosperms.

    (b) **Mesogamy** Pollen tube enters the ovule through integuments (*e.g.*, *Cucurbita*) or through funiculus (*e.g.*, *Pistacia*).

    (c) **Chalazogamy** Pollen tube enters the ovule through chalazal tissues, *e.g.*, *Casuarina*, *Beta vulgaris*, *Juglens regia*, etc.

18. A pollen grain contains two layered cell wall, the outer exine and inner intine. Sporopollenin is found in the exine of pollen grains, which is the most resistant biological material known, of microbial and chemical decomposition. Due to this, pollen grains are well preserved during fossilization. Intine of pollen grain is made up of pectocellulose.

19. The nucleotide is formed by the union of a phosphate group with a nucleoside. A nucleoside infact contains a sugar molecule alongwith an organic nitrogenous base. Thus, a nucleotide contains an organic nitrogenous base (purine or pyrimidine) alongwith a sugar molecule and a phosphate group, *i.e.*, Nucleoside = Sugar molecule + organic nitrogenous base.

    Nucleotide = Nucleoside + Phosphate group.

20. The S-phase of cell cycle is also called 'synthesis phase', in which the cell synthesizes the replica of its genome, *i.e.*, DNA replication occurs during this stage, which ultimately results to the duplication of chromosomal material.

21. Gamete is the haploid reproductive cell that fuse with another gamete to form a diploid zygote. These are not surrounded by the cell wall. On the other hand, root hair cell, stem hair cell and bacterial cell, all possess a well defined cell wall.

22. Lysosomes are the single membrane bound cell organelles, which contain hydrolytic enzymes. These are also known as suicidal bags.

23. On the basis of the frequency of flowering or fruiting in the life time, plants may be either monocarpic or polycarpic. Monocarpic plants are those, in which flowering and fruiting occurs only once in their life, *e.g.*, all annual and biennial plants and some perennial plants like bamboo and *Agave*. In contrast, polycarpic plants bear flowers and fruits repeatedly after attaining maturity, *e.g.*, mango, *Acacia*, *Eucalyptus*, etc.

24. AIDS is caused by Human Immunodeficiency Virus (HIV). It is a lentivirus belonging to the family—Retroviridae. The core of this virus contains two single strands of RNA molecules (genetic material) proteins and the enzyme reverse transcriptase.

25. Calyptra is a covering developed from the ventre of archegonium in bryophytes and pteridophytes. It acts as a transpiration shield around the immature capsule and provides protection to the young capsule.

26. Protonema is the juvenile stage of moss resulting from the germinating meiospore and consists of a slender, green, branching system of filaments. In *Funaria*, the protonema stage is only vegetative and transitory, which precedes the upright, leafy gametophyte.

27. A fern (pteridophyte) differs from a moss (bryophyte) in having independent gametophyte, while in moss the sporophyte is simpler than the gametophyte and remains attached to the parent gametophyte throughout its life. This sporophyte is dependent upon gametophyte partially or wholly for its nutrition.

28. The female cone of *Pinus* is formed by the aggregation of megasporophylls, which bear ovules. Each megasporophyll consists of a lower bract scale and a larger upper ovuliferous scale.

29. Parthenogenesis (virgin origin) is the development of an embryo from an unfertilized egg or if a spermatozoan does penetrate the egg, there is no union of male and female pronuclei. It is found in many plants (dandelions and hawk weeds) and (aphids and honey bees).

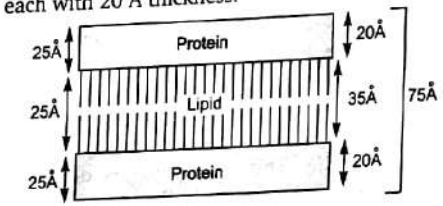
30. After fertilization, the mature, ripened ovary develops into fruit. The ovary wall forms the covering of the fruit called fruit wall or pericarp. Some other post fertilization changes also occur like nucellus develops into perisperm, ovules develop into seeds, outer integument forms testa, inner integument forms tegmen, etc.

31. Prothallus is a small, flattened, multicellular structure that represents the independent

gametophyte generation of a fern. The prothalli bear antheridia (male sex organs) and archegonia (female sex organs) which produce male and female gametes, respectively.

32. Photorespiration (C_2-cycle) is a special type of respiration shown by many green plants (C_3-plants) when they are exposed to light. It is a light dependent process during, which O_2 is used and CO_2 is released. The process of photorespiration takes place only in chlorophyllous tissues of plants. Therefore, the main site for photorespiration is chloroplast. But mitochondria and peroxysomes are also required to complete the process.

33. The unit membrane, described by J David Robertson, was considered as 75 Å thick trilaminar (3 layered membrane). According to his unit membrane or trilaminar model, unit membrane consists of 35 Å thick bimolecular phospholipid layer between two protein layers, each with 20 Å thickness.



Unit membrane

34. In plant cells, during metaphase chromosomes line up around the equator of the spindle and attached by their centromere to the spindle fibres (microtubules). In animal cells, during metaphase, smaller chromosomes are usually central in position with larger ones peripheral in position.

35. The 3-D structure of DNA is represented by a double helix, in which each turn has a diameter of 34 Å and contains 10 base pairs at a distance of 3.4 Å. The width of DNA molecule is 20 Å.

36. Gymnosperms are commonly known as 'naked seed plants' because the ovary wall is not present and hence, the ovules remain unprotected or naked.

37. The vertical conduction of water from root to aerial parts of plant is called ascent of sap. The water molecules remain joined to each other due to a force of attraction called cohesion force. This attraction is due to the presence of hydrogen bonds between them. The magnitude of this force is very high therefore, the continuous water column in the xylem cannot be broken easily due to the force of gravity or other obstructions offered by internal tissues in the upward movement of water. This adhesive property of water, *i.e.*, attraction between the water molecules and the walls of xylem ensures the continuity of water column in the xylem.

Due to transpiration water evaporates to outer atmosphere through stomata. As a result leaf cells develop low water potential and water from leaf veins moves into leaf cells. The xylem vessel in turn draw water from xylem of main stem. A pressure (pull) is thus, exerted by all the leaves on the stems, which is called transpiration pull. This is strong enough to pull up the column of water to a great height.

38. Syconus is a composite fruit develops from hypanthodium inflorescence, *e.g.*, *Ficus carica*, *Ficus benghalensis*. The flask-shaped receptacle encloses female flowers that give rise to achene-like fruitlets. This fruit possesses a small pore protected by scaly leaves. The receptacle that becomes fleshy is edible.

Samara is a single seeded, dry indehiscent fruit. Its pericarp becomes membranous and flat-like wings that help in dispersal, *e.g.*, *Ulmus*, *Holoptelia indica*.

A berry is a pulpy-indehiscent, few to multiseeded fruit derived from multicarpellary syncarpous gynoecium. The fleshy pericarp of berry consists of three parts-epicarp, mesocarp and endocarp.

Schizocarpic fruits are simple, dry, multiseeded fruits, which breakup into single seeded parts. The single seeded parts, which further do not dehisce are called mericarps.

39. Bordeaux mixture was discovered by Millardet in France in 1882. It is prepared by dissolving 40 g of copper sulphate and 40 g of calcium hydroxide in 5 L of water. It was first used to control downy mildew disease of grape-vine that is caused by a fungus *Plasmopara viticola*.

Black rust of wheat is caused by *Puccinia graminis tritici*. The use of fungicide dithane Z-78 and dithane M-45 control the disease even at lower concentration.

Loose smut of wheat is caused by *Ustilago tritici*. The use of fungicides (systemic fungicide like D-785 and F-461) give quite encouraging result.

40. The transfer of pollen from anther to stigma is called pollination. Autogamy also called self-pollination involves the transfer of pollen grains of one flower to the stigma of same flower. Self-pollination occurs only in bisexual or hermaphrodite flowers.

Geitonogamy involves the transfer of pollen grains from a male flower to stigma of female flower of same plant. Thus, geitonogamy operates only in monoecious plants, *i.e.*, the plants having male and female flowers on different places.

Allogamy or xenogamy also known as cross-pollination involves the transfer of pollen grains of male flower to the stigma of genetically different female flower. It takes place *via* various agencies like wind, water, insects, etc.

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Medical Entrance Exam

Solved Paper 2013

Physics

1. A car of mass 1000 kg moves on a circular track of radius 40 m. If the coefficient of friction is 1.28. The maximum velocity with which the car can be moved, is
   (a) 22.4 m/s
   (b) 112 m/s
   (c) $\frac{0.64 \times 40}{1000 \times 100}$ m/s
   (d) 1000 m/s

2. The escape velocity for the earth is 11.2 km/s. The mass of another planet 100 times mass of earth and its radius is 4 times radius of the earth. The escape velocity for the planet is
   (a) 280 km/s (b) 56.0 km/s
   (c) 112 km/s (d) 56 km/s

3. Light travels faster in air than that in glass. This is accordance with
   (a) wave theory of light
   (b) corpuscular theory of light
   (c) neigther (a) nor (b)
   (d) Both (a) and (b)

4. The speed of air flow on the upper and lower surfaces of a wing of an aeroplane are v_1 and v_2 respectively. If A is the cross section area of the wing and ρ is the density of air, then the upward life is
   (a) $\frac{1}{2}\rho A(v_2 - v_2)$ (b) $\frac{1}{2}\rho A(v_1 + v_2)$
   (c) $\frac{1}{2}\rho A(v_1^2 - v_2^2)$ (d) $\frac{1}{2}\rho A(v_1^2 - v_2^2)$

5. A body is thrown with a velocity of 9.8 m/s making an angle of 30° with the horizontal. It will hit the ground after a time
   (a) 1.5s (b) 1s
   (c) 3s (d) 2s

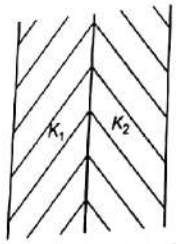
6. A radioactive element ${}_{90}X^{238}$ decays into ${}_{83}Y^{222}$. The number of β-particles emitted are
   (a) 1 (b) 2
   (c) 4 (d) 6

7. Minimum excitation potential of Bohr's first orbit in hydrogen atom is
   (a) 3.6 V
   (b) 10.2 V
   (c) 13.6 V
   (d) 3.4 V

8. A gas expands 0.25 m^3 at constant pressure 10^3 N/m^2, the work done is
   (a) 250 N
   (b) 250 W
   (c) 250 J
   (d) 2.5 erg

9. The work done in increasing the size of a soap film for 10 cm × 6 m to 10 cm × 11 cm is 3×10^{-4} J. The surface tension of the film is
   (a) 1.0×10^{-2} N/m
   (b) 6.0×10^{-2} N/m
   (c) 3.0×10^{-2} N/m
   (d) 1.5×10^{-2} N/m

10. A parallel palte condenser is filled with two dielectrics as shown in figure. Area of each pate is $A\ m^2$ and the separation is d metre. The dielectric constants are K_1 and K_2 respectively. Its capacitance in farad will be



(a) $\frac{2\varepsilon_0 A}{d}\left(\frac{K_1+K_2}{K_1K_2}\right)$

(b) $\frac{2\varepsilon_0 A}{d}\left(\frac{K_1K_2}{K_1+K_2}\right)$

(c) $\frac{\varepsilon_0 A}{d}\left(\frac{K_1+K_2}{2K_1K_2}\right)$

(d) $\frac{\varepsilon_0 A K_1 K_2}{2(d_2K_1+d_1K_2)}$

11. A luminous object is placed at a distance of 30 cm from the convex lens of focal length 20 cm. On the other side of the lens, at what distance from the lens a convex mirror of radius of curvature 10 cm be placed in order to have an upright image of the object coincident with it

(a) 30 cm (b) 60 cm
(c) 50 cm (d) 12 cm

12. A battery of emf 10 V and internal resistance of 0.5 ohm is connected across a variable resistance R. The maximum value of R is given by

(a) 0.5Ω (b) 1.00Ω (c) 2.0Ω (d) 0.25Ω

13. For a gas $\frac{R}{C_v} = 0.67$. This gas is made up of molecules which are

(a) mono atomic
(b) poly atomic
(c) mixture of diatomic and poly atomic molecules
(d) diatomic

14. A point source of light is placed 4 m below the surface of water of refractive index 5/3. The minimum diameter of a disc which should be placed over the source on the surface of water to cut-off all light coming out of water is

(a) 6 m (b) 3 m (c) 4 m (d) 2 m

15. A moving body of mass m and velocity 3 km/h collides with a rest body of mass 2 m and stick to it. Now the combined mass starts to move. What will be the combined velocity?

(a) 4 km/h (b) 1 km/h
(c) 2 km/h (d) 3 km/h

16. A transverse wave is represented by the equation

$$y = y_0 \sin\frac{2\pi}{\lambda}(vt - k)$$

For what value of λ is the particle velocity equal to two times the wave velocity

(a) $\lambda = \pi y_0$ (b) $\lambda = \frac{\pi y_0}{2}$
(c) $\lambda = \frac{\pi y_0}{3}$ (d) $\lambda = 2\pi y_0$

17. Ionisation potential of hydrogen atom is 13.6 eV. Hydrogen atom on the ground state is rarely excited by monochromatic radiation of photon 12.1 eV. The special line emitted by a hydrogen atom according to Bohr's theory will be

(a) one (b) two
(c) three (d) four

18. The internal resistance of a primary cell is 4Ω. It generates a current of 0.2 A in an external resistance of 21 Ω. The rate at which chemical energy to consumed in providing current is

(a) 1 J/s (b) 5 J/s
(c) 0.42 J/s (d) 0.8 J/s

19. The binding energy per nucleon is maximum in the case

(a) $^{235}_{92}U$ (b) $^{141}_{56}Ba$
(c) $^{56}_{26}Fe$ (d) $^{2}_{4}He$

20. Two rigid bodies A and B rotate with rotational kinetic energies E_A and E_B respectively. The moments of inertia of A and B about the axis of rotation are I_A and I_B respectively.

If $I_A = \frac{I_B}{4}$ and $E_A = 100 = E_B$, the ratio of angular momentum (L_A) of A to the angular momentum (L_B) of B is

(a) 25 (b) 5/4 (c) 5 (d) 1/4

21. The working principle of a ball point pen is

(a) Bernoulli's theorem (b) surface tension
(c) gravity (d) viscosity

22. Progressive waves are represented by the equation

$$y_1 = a\sin(\omega t - x)$$

and $$y_2 = b\cos(\omega t - x)$$

The phase difference between waves is

(a) 0° (b) 45° (c) 90° (d) 180°

23. Two simple pendulums of length 0.5 m and 20 m respectively are given small linear displacement in one direction at the same time. They will again be in the phase when the pendulum of shorter length has completed x oscillations, where k is

(a) 1 (b) 3 (c) 2 (d) 5

24. A balloon contains 500 m^3 of helium at 27°C and 1 atmosphere pressure. The volume of the helium at −3°C temperature and 0.5 atmosphere pressure will be

(a) 1000 m^3 (b) 900 m^3
(c) 700 m^3 (d) 500 m^3

25. 220 V, 50 Hz, AC source is connected to an inductance of 0.2 H and a resistance of 20 Ω in series. What is the current in the circuit?

(a) 3.33 A (b) 33.3 A (c) 5 A (d) 10 A

26. In 0.2 s, the current in a coil increases from 2.0 A to 3.0 A. If inductance of coil is 60 mH, then induced current in external resistance of 3 Ω will be

(a) 1 A (b) 0.5 A
(c) 0.2 A (d) 0.1 A

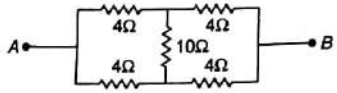
27. Two coherent light beams of intensities I and $4I$ are superposed. The maximum and minimum possible intensities in the resulting beam are

(a) 5 I and I (b) 5 I and 3I
(c) 9 I and I (d) 9 I and 3I

28. A galvanometer acting as a voltmeter should have

(a) low resistance in series with its coil
(b) low resistance in parallel with its coil
(c) high resistance in series with its coil
(d) high resistance in parallel with its coil

29. The equivalent resistance across A and B is



(a) 2 Ω (b) 3 Ω (c) 4 Ω (d) 5 Ω

30. A black body has a wavelength of λ at temperature 2000 K. Its corresponding wavelength at temperature 3000 K will be

(a) $\frac{2\lambda}{3}$ (b) $\frac{3\lambda}{2}$
(c) $\frac{4\lambda}{9}$ (d) $\frac{9\lambda}{4}$

31. At room temperature, copper has free electron density of $8.4 \times 10^{28}\ m^{-3}$. The electron drift velocity in a copper conductor of cross-sectional area of $10^{-6} m^2$ and carrying a current of 5.4 A, will be

(a) 4 ms^{-1} (b) 0.4 ms^{-1}
(c) 4 cm s^{-1} (d) 0.4 mm s^{-1}

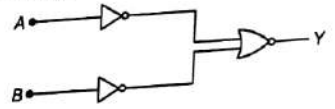
32. A uniform wire of resistance R and length L is cut into four equal parts, each of length $L/4$ which are then connected in parallel combination. The effective resistance of the combination will be

(a) R
(b) $4R$
(c) $\frac{R}{4}$
(d) $\frac{R}{16}$

33. The half-life of radio isotope is 4 h. If initial mass of the isotope was 200 g, then mass remaining after 24 h will be

(a) 1.042 g (b) 2.084 g
(c) 3.125 g (d) 4.167 g

34. Which logic gate is represented by the following combination of logic gates?



(a) OR (b) NOR
(c) AND (d) NAND

35. The work function for metals A, B and C are respectively 1.92 eV, 2.0 eV and 5eV. According to Einstein's equation the metals which will emit photo, electrons for a radiation of wavelength 4100 Å is/are

(a) none (b) A only
(c) A and B only (d) All the three metals

36. Two boys are standing at the ends A and B of a ground, where $AB = a$. The boy at B starts running in a direction perpendicular to AB with velocity v_1. The boy at A starts running simultaneously with velocity v and catches the other boy in a time t, where t is

(a) $\frac{a}{\sqrt{v^2 + v_1^2}}$ (b) $\sqrt{\frac{a^2}{v^2 - v_1^2}}$
(c) $\frac{a}{(v - v_1)}$ (d) $\frac{a}{(v + v_1)}$

37. A 5 amp fuse wire can withstand a maximum power of 1 W in circuit. The resistance of the fuse wire is

(a) 0.2 Ω (b) 5 Ω (c) 0.4 Ω (d) 0.04 Ω

38. A force F is given $F = at + bt^2$, where, t is time. What are the dimensions of a and b?

(a) $[MLT^{-1}]$ and $[MLT^0]$ (b) $[MLT^{-3}]$ and $[ML^2T]$
(c) $[MLT^{-4}]$ and $[MLT^1]$ (d) $[MLT^{-3}]$ and $[MLT]$

39. Two equal negative charges $-q$ are fixed at the point $(0, a)$ and $(0, -a)$ on the y-axis. A positive charge Q is released from rest at the point $(2a, 0)$ on the x-axis. The charge will

(a) execute SHM about the origin
(b) move to the origin and remain at rest
(c) move to infinity
(d) execute oscillatory but not SHM

40. An ice-cube of density 900 kg/m^3 is floating in water of density 1000 kg/m^3. The percentage of volume of ice-cube outside the water is

(a) 20% (b) 35% (c) 10% (d) 25%

Chemistry

1. $CH_3(CH_2)_4CH_3 \xrightarrow{\text{Anhy. } AlCl_3/HCl}$

n-hexane

$CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-(CH_2)_2-CH_3$

2-methyl pentane

$+ CH_3CH_2-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-CH_3$

3-methyl pentane

The above reaction is known as

(a) aromatisation (b) pyrolysis
(c) isomerisation (d) oxidation

2. Number of hydrogen-bonded water molecules associated in $CuSO_4 \cdot 5H_2O$ is

(a) one (b) two
(c) three (d) All the five

3. Which of the following species do not show disproportionation on reaction?

ClO^-, ClO_2^-, ClO_3^- and ClO_4^-

(a) ClO_4^- (b) ClO_3^-
(c) ClO^- (d) None of these

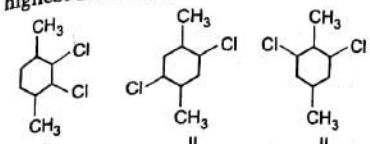
4. Which one of the following acts as a nucleophile?

(a) $(CH_3)_3N$ (b) BF_3
(c) $\overset{+}{N}O_2$ (d) $CH_3-\overset{+}{C}=O$

5. During estimation of nitrogen in the organic compound by Kjeldahl's method, the ammonia evolved from 0.5 g of the compound in Kjeldahl's estimation of nitrogen, neutralised 10 mL of 1M H_2SO_4. Find out the percentage of nitrogen in the compound.

(a) 14% (b) 28% (c) 56% (d) 68%

6. Which of the following compounds have highest melting point?



(a) Only I (b) Only II (c) I and II (d) II and III

7. Identify the major product 'X' obtained in the following reaction.

2, 3-dimethyl butan -2- ol $\xrightarrow{\text{Conc. } H_2SO_4} X$

(a) $CH_3-\underset{\displaystyle CH_3CH_3}{\underset{|}{C}}=\underset{}{C}-CH_3$

(b) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-\underset{\displaystyle CH_3}{\underset{|}{C}}=CH_2$

(c) $CH_2=\underset{\displaystyle CH_3}{\underset{|}{C}}-\underset{\displaystyle CH_3}{\underset{|}{C}}=CH_2$

(d) $CH_3-CH_2-\underset{\displaystyle CH_3}{\underset{|}{C}}=CH_2$

8. Addition of water to alkynes occurs in acidic medium and in the presence of Hg^{2+} ions as a catalyst. Which of the following products will be formed on addition of water to but-1-yne under these conditions?

(a) $CH_3CH_2CH_2CHO$ (b) $CH_3CH_2COCH_3$
(c) $CH_3CH_2COOH + CO_2$ (d) $CH_3COOH + HCHO$

9. The correct order of increasing acidic strength is

(a) phenol < ethanol < chloroacetic acid < acetic acid
(b) ethanol < phenol < chloroacetic acid < acetic acid
(c) ethanol < phenol < acetic acid < chloroacetic acid
(d) chloroacetic acid < acetic acid < phenol < ethanol

10. KF has ccp structure. How many F^- ions and octahedral voids are there in this unit cell respectively?

(a) 4 and 4 (b) 4 and 8
(c) 8 and 4 (d) 6 and 6

11. The osmotic pressure of blood is 8.21 atm at 37°C. How much glucose would be used for an injection that is at the same osmotic pressure as blood?

(a) 22.17 gL^{-1} (b) 58.14 gL^{-1}
(c) 61.26 gL^{-1} (d) 75.43 gL^{-1}

12. At equilibrium, the rate of dissolution of a solid solute in a volatile liquid solvent is

(a) less than the rate of crystallisation
(b) greater than the rate of crystallisation
(c) equal to the rate of crytallisation
(d) zero

13. A chelating agent has two or more than two donor atoms to bind a single metal ion. Which of the following is not a chelating agent?

(a) Thiosulphato
(b) Glycinato
(c) Oxalato
(d) Ethane-1, 2-diamine

14. On addition of small amount of $KMnO_4$ to conc. H_2SO_4, a green oily compound is obtained which is highly explosive in nature. Identify the compound from the following.

(a) Mn_2O_7
(b) MnO_2
(c) $MnSO_4$
(d) Mn_2O_3

15. The magnetic nature of elements depends on the presence of unpaired electrons. Identify the configuration of transition element, which shows highest magmetic moment.

(a) $3d^7$ (b) $3d^5$
(c) $3d^8$ (d) $3d^2$

16. Which of the following elements can be involved in $p\pi - d\pi$ bonding?

(a) Carbon
(b) Nitrogen
(c) Phosphorus
(d) Boron

17. On addition of conc. H_2SO_4 to a chloride salt, colourless fumes are evolved but in case of iodide salt, violet fumes come out. This is because.

(a) H_2SO_4 reduces HI to I_2
(b) HI is of violet colour
(c) HI gets oxidised to I_2
(d) HI changes to HIO_3

18. Affinity for hydrogen decreases in the group from fluorine to iodine. Which of the halogen acids should have highest bond dissociation enthalpy?

(a) HF (b) HCl
(c) HBr (d) HI

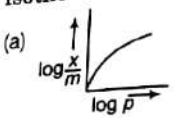
19. Which of the following statement is not correct about an inert electrode in a cell?

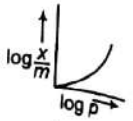
(a) It does not participate in the cell reaction.
(b) It provides surface either for oxidation or for reduction reaction.
(c) It provides surface for conduction of electrons.
(d) It provides surface for redox reaction

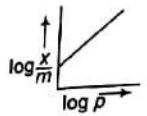
20. Which of the following statement is correct?

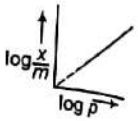
(a) E_{cell} and $\Delta_r G$ of cell reaction both are extensive properties.
(b) E_{cell} and $\Delta_r G$ of cell reaction both are intensive properties.
(c) E_{cell} in the intensive property while $\Delta_r G$ of cell reaction is an extensive property.
(d) E_{cell} is an extensive property while $\Delta_r G$ of cell reaction is an intensive property.

21. Which of the following curves is in accordance with Freundlich adsorption isotherm?

(a) 

(b) 

(c) 

(d) 

22. A number of elements available in earth's crust but most abundant elements are

(a) Al and Fe (b) Al and Cu
(c) Fe and Cu (d) Cu and Ag

23. The element which forms oxides in all oxidation states + 1 to + 5 is

(a) nitrogen (b) phosphorus
(c) arsenic (d) antimony

24. Which of the following is the increasing order of enthalpy of vaporization?

(a) NH_3, PH_3, AsH_3 (b) AsH_3, PH_3, NH_3
(c) NH_3, AsH_3, PH_3 (d) PH_3, AsH_3, NH_3

25. When Br_2 is treated with aqueous solutions of NaF, NaCl, NaI separately

(a) F_2, Cl_2 and I_2 are liberated
(b) only F_2 and Cl_2 are liberated
(c) only I_2 is liberated
(d) only Cl_2 is liberated

26. In the presence of a catalyst, the heat evolved or absorbed during the reacton

(a) increases
(b) decreases
(c) remains unchanged
(d) may increase or decrease

27. The rate of a gaseous reaction is given by the expression $k[A][B]$. If the volume of the reaction vessel is suddenly reduced to $\frac{1}{4}$ th of the initial volume, the reaction rate relating to original rate will be

(a) $\frac{1}{10}$ (b) $\frac{1}{8}$ (c) 8 (d) 16

28. Which of the following is 3° amine?

(a) 1-methylcyclohexylamine
(b) Triethyl amine
(c) *Tert*-butylamine
(d) N-methyl aniline

29. Which of the following enhances lathering property of soap?

(a) Sodium carbonate
(b) Sodium rosinate
(c) Sodiume stearate
(d) Trisodium phosphate

30. The deficiency of vitamin C causes

(a) scurvy (b) rickets
(c) pyrrohea (d) pernicious anaemia

31. Excess fluoride (over 10 ppm) in drinking water can cause

(a) harmful effect of bones and teeth
(b) methemoglobinemia
(c) kidney damage
(d) laxative effect

32. For the process to occur under adiabatic conditions, the correct condition is

(a) $\Delta T = 0$ (b) $\Delta p = 0$
(c) $q = 0$ (d) $W = 0$

33. $\frac{3}{2}O_2(g) \longrightarrow O_3(g)$; K_p for this reaction is 2.47×10^{-29}. At 298K, $\Delta_r G°$ for conversion of oxygen to ozone will be

(a) 100 kJ mol^{-1} (b) 150 kJ mol^{-1}
(c) 163 kJ mol^{-1} (d) 2303 kJ mol^{-1}

34. Which one of the following statements about C_2 molecule is wrong?

(a) The bond order of C_2 is 2.
(b) In vapour phase, C_2 molecule is diamagnetic.
(c) Double bond in C_2 molecule consists of both π- bonds because of the presence of $4e_s^-$ in two π- molecular orbitals.
(d) double bond in C_2 molecule consists of one σ- bond and on π-bond.

35. The type of hybridisation in SF_6 molecule is

(a) sp^3d (b) dsp^3 (c) sp^3d^2 (d) d^2sp^3

36. Among LiCl, $BeCl_2$, BCl_3 and CCl_4, the covalent bond character follows the order

(a) $LiCl < BeCl_2 < BCl_3 < CCl_4$
(b) $BCl_3 < CCl_4 < BeCl_2 < LiCl$
(c) $BeCl_2 < LiCl < CCl_4 < BCl_3$
(d) $CCl_4 < BCl_3 < BeCl_2 < LiCl$

37. Maximum number of electrons in a subshell of an atom determined by the following?

(a) $4l + 2$ (b) $2n^2$ (c) $4l - 2$ (d) $2l + 1$

38. The average kinetic energy of an ideal gas per molecule in SI units at 25°C will be

(a) 6.17×10^{-21} JK^{-1} (b) 6.17×10^{-21} kJK^{-1}
(c) 6.17×10^{20} JK^{-1} (d) 7.16×10^{-20} JK^{-1}

39. pK_a of acetic acid and pK_b of ammonium hydroxide are 4.76 and 4.75 respectively. Calculate the pH of ammonium acetate solution.

(a) 6.02 (b) 7.005 (c) 8 (d) 5.602

40. The value of K_c for the reaction, $2A \rightleftharpoons B + C$ is 2×10^{-3}. At a given time, if the composition of reaction mixture is $[A] = [B] = [C] = 3 \times 10^{-3}$ M. Which is true?

(a) The reaction will proceed in forward direction
(b) The reaction will proceed in backward direction
(c) The reaction will proceed in any direction
(d) None of the above

Zoology

1. Pellagra is caused by deficiency of vitamins

(a) B_5 (b) B_2
(c) B_6 (d) B_1

2. Notochord originates from

(a) mesoderm (b) ectoderm
(c) endoderm (d) None of these

3. Parthenogenesis is a term of

(a) budding (b) asexual reproduction
(c) sexual reproduction (d) regeneration

4. Bartholin's gland is found in

(a) penis (b) stomach
(c) liver (d) vagina

5. Which one of the following statements best characterise the testis?

(a) The seminiferous epithelium contains only proliferative cells
(b) Functional compartmentalisation of the seminiferous epithelium depends on tight junctions
(c) The interstitial tissue contains few capillaries
(d) The seminiferous epithelium contains numerous capillaries

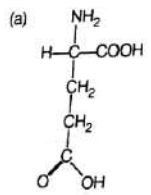
6. Drugs that cause malformation in developing embryo during pregancy are called

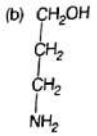
(a) teratogens (b) nicotine
(c) tranquillisers (d) alcoholic beverages

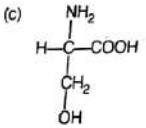
7. Which set is similar?

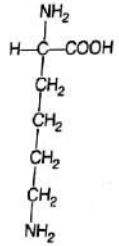
(a) Corpus luteum – Graafian follicles
(b) Sebum – Sweat
(c) Vitamin-B_7 – Niacin
(d) Bundle of His – Pacemaker

8. Which one out of (a) to (d) given below correctly represents the structural formula of the basic amino acid?

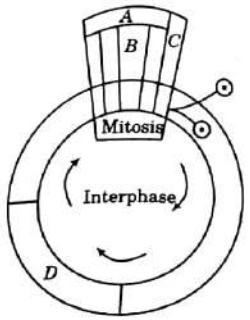
(a)


(b)


(c)


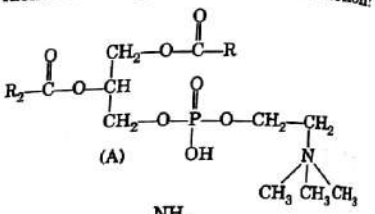
(d)


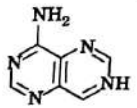
9. Given below is a schematic break-up of the phases/stages of cell cycle. Which one of the following is the correct indication of the stage/ phase in the cell cycle?



(a) C–karyokinesis (b) S–synthetic phase
(c) A–cytokinesis (d) B–metaphase

10. Which one of the following structural formula of two organic compounds is correctly identified along with its related function?





(a) B–uracil – a component of DNA
(b) A–triglyceride - major source of energy
(c) A–lecithin - a component of cell membrane
(d) B–adenine - a nucleotide that makes up nuclec

11. Which is substitution of mitochondria in *E. coli*?

(a) Golgi body (b) Mesosome
(c) Ribosome (d) Glyoxysomes

12. Animal cell differ from plant cell in possessing

(a) vacuoles
(b) centrosomes
(c) pastids
(d) mitochondria

13. Which of the following organelles does not contain RNA?

(a) Plasmalemma (b) Ribosome
(c) Chromosome (d) Nucleolus

14. Dutrochet has given the concept about cell in

(a) 1834 (b) 1814 (c) 1822 (d) 1824

15. The scientific name of gharial is

(a) *Naja bungarus*
(b) *Gavialis gangeticus*
(c) *Hemidactylus flavivridis*
(d) None of the above

16. Which of the given option is correct regarding the statments?

Statement I Cephalochordata bears notochord all along the body throughout life.

Statements II Urochordate bears vertebral column only in tail region throughout the life.

(a) I wrong, II correct (b) I correct, II wrong
(c) Both I and II are wrong (d) Both are correct

17. In which of the following haemocyanin pigment is found?

(a) Lower invertebrates (b) Echinodermata
(c) Insecta (d) Annelida

18. Which of the following cells in earthworm play a role similar to liver in vertebrates?

(a) Amoebocytes (b) Mucocytes
(c) Chloragogen cells (d) Epidermal cells

19. Match the following and select the correct option.

List I	List II
A. Cyclostomes	1. Hemichordata
B. Aves	2. Urochordata
C. Tunicates	3. Agantha
D. *Balanoglossus*	4. Pisces
E. *Osteichthyes*	5. Tetrapod

Codes

	A	B	C	D	E
(a)	3	5	2	1	4
(b)	3	1	5	2	4
(c)	1	2	3	4	5
(d)	2	3	4	1	5

20. Chondrichthyes is characterised by

(a) placoid scale
(b) placoid scale and ventral mouth
(c) ventral mouth
(d) ctenoid scale and ventral mouth

21. Ichthyology is study of

(a) aves (b) amphibians
(c) reptiles (d) fishes

22. What will happen if ligaments are torn?

(a) Bone will become unfixed
(b) Bone will become fixed
(c) Bone less movable at joint and pain
(d) Bone will move freely at joint and no pain

23. Achondroplasia is a disease related with the defect in the formation of

(a) membrane (b) mucosa
(c) bone (d) cartilage

24. Yellow bone marrow is found specially in the medullary cavity

(a) long bones
(b) spongy bones
(c) short bones
(d) All of the above

25. Match the items of column I with column II and choose the correct option from the codes given below.

Column I		Column II	
A.	Neuron	1.	Ossein
B.	Bone-matrix	2.	Nissl's bodies
C.	RBCs of man	3.	Antibodies
D.	Lymphocytes	4.	Non-nucleated

Codes

	A	B	C	D
(a)	4	1	2	3
(b)	2	1	4	3
(c)	3	4	1	2
(d)	2	3	4	1

26. Space in the jaw bone unoccupied by teeth is called

(a) dentine
(b) diastema
(c) enamel
(d) crown

27. Identify the correct set, which shows the name of the enzyme from where it is secreted and substrate upon which it acts.
(a) Ptyalin – Intestine – Maltose
(b) Ptyalin – Pancreas – Lipid
(c) Pepsin – Stomach wall – Caesin
(d) Chymotrypsin – Salivary gland – Lactose

28. Endemic goitre is a state of
(a) normal thyroid function
(b) moderate thyroid function
(c) increased thyroid function
(d) decreased thyroid function

29. Hormone responsible for the secretion of milk after parturition is
(a) ACTH (b) LH (c) ICSH (d) Prolactin

30. What is another name for the wind pipe?
(a) Trachea (b) Larynx
(c) Oesophagus (d) Lungs

31. Soil salinity is measured by
(a) Porometer (b) Calorimeter
(c) Conductivity meter (d) Potometer

32. Predation and parasitism are which type of interactions.
(a) (+, +) (b) (+, 0) (c) (−, −) (d) (+, −)

33. The ultimate source of energy for living being is
(a) sunlight (b) ATP
(c) fats (d) carbohydrates

34. Which of the following species are restricted to an area?
(a) Sympatric species (b) Sibling species
(c) Allopatric species (d) Endemic species

35. Select the incorrect statement.
(a) Stellar's sea cow and passenger pigeon got extinct due to over exploitation by men
(b) The mitotic convention on biological diversity was held in 1992
(c) Species diversity increase as we move away from the equator towards the poles
(d) *Lantana* and *Eichhornia* are invasive weed species in India

36. The effect of cigarette smoking and radon in combination on lungs is
(a) fatal
(b) synergistic
(c) mutualistic
(d) antagonistic

37. The thermostable enzymes, *Taq* and *Pfu*, isolated from thermophilic bacteria are
(a) RNA polymerases
(b) DNA ligases
(c) DNA polymerases
(d) restriction endonucleases

38. Biolistic technique is used in
(a) gene transfer process
(b) tissue culture process
(c) hybridisation process
(d) germplasm conservation process

39. The largest gene in man is
(a) insulin gene
(b) tumour suppressor gene
(c) beta globin gene of haemoglobin
(d) dystrophin

40. Herbicide resistant gene in plant is
(a) *Mt* (b) *Gt*
(c) *Ct* (d) *Bt*

Botany

1. In photosynthesis carbon dioxide is converted to carbohydrates. It is a ..... process.
(a) reductive
(b) oxidative
(c) catabolic and exergonic
(d) None of the above

2. Which of the following is not an auxin?
(a) IAA (b) IBA (c) Zeatin (d) NAA

3. Which of the following properties is shown by cytokinins?
(a) Delay leaf senescence
(b) Cause leaf abscission
(c) Promote seed dormancy
(d) Promote stomatal closing

4. Which of the following characteristics is are exhibited by C_4-plants?
I. Kranz anatomy.
II. The first product of photosynthesis is oxaloacetic acid.
III. Both PEP carboxylates and ribulose biphosphate carboxylate act as carboxylating enzymes.
The correct option is
(a) I and III, but not II
(b) I and II, but not III
(c) II and III, but not I
(d) II and III

5. Which of the following plant keeps its stomata open during night and closed during the day?
(a) Orchid (b) Cactus
(c) Tea (d) Wheat

6. Genetic dwarfism can be overcome by
(a) gibberellin (b) ethylene
(c) auxin (d) ABA

7. Hormone inducing fruit ripening is
(a) cytokinin
(b) ethylene
(c) abscissic acid
(d) gibberellic acid

8. The year 1900 AD is highly significant for geneticists due to
(a) discovery of genes
(b) principle of linkage
(c) chromosome theory of heredity
(d) rediscovery of Mendelism

9. F_1-generation means
(a) first filial generation
(b) first seed generation
(c) first flowering generation
(d) first fertile generation

10. Skin colour is controlled by
(a) single gene
(b) 3 pairs of genes
(c) 2 pairs of genes
(d) 2 pairs of genes with an intragene

11. Which of the following cross will produce terminal flower in garden pea?
(a) AA × 4a (b) AA × aa
(c) Aa × Aa (d) Aa × AA

12. Which one of the following pairs of plants are not seed producers?
(a) *Funaria* and *Ficus*
(b) Fern and *Funaria*
(c) *Funaria* and *Pinus*
(d) *Ficus* and *Chlamydomonas*

13. Which one of the following is heterosporous?
(a) *Equisetum* (b) *Dryopteris*
(c) *Salvinia* (d) *Adiantum*

14. *Cycas revoluta* is popularly known as
(a) sago palm (b) royal palm
(c) date palm (d) sea palm

15. Match the following with correct combination.

Column I	Column II
A. *Cuscuta*	1. Saprophyte
B. *Eichhornia*	2. Pneumatophare
C. *Monotropa*	3. Insectivorous plant
D. *Rhizophora*	4. Parasite
E. *Utricularia*	5. Root pocket

Codes

	A	B	C	D	E
(a)	3	1	5	4	2
(b)	2	3	1	5	4
(c)	4	3	1	5	2
(d)	4	5	1	2	3

16. Bacterial endotoxin is
(a) a toxic protein that stays inside the bacterial cell
(b) a toxic protein that is excreted into the medium
(c) lipopolysaccharide located on the surface of the bacteria
(d) None of the above

17. Endosperm of gymnosperms is
(a) haploid (b) tetraploid
(c) diploid (d) None of these

18. First vascular plant is
(a) thallophyta (b) pteridophyta
(c) bryophyta (d) spermatophyta

19. Diatomaceous earth is obtained from
(a) Bacillarophyceae (b) Xanthophyceae
(c) Rhodophyceae (d) Chrysophyceae

20. Which of the following is an epidermal cell containing chloroplast?
(a) Stomata (b) Hydathode
(c) Guard cell (d) None of these

21. The structures present in the roots to absorb water and minerals is
(a) epidermal extensions
(b) hypodermis
(c) endodermis
(d) epidermal appendages

22. Lady finger belongs to family
(a) Malvaceae (b) Cucurbitaceae
(c) Brassicaceae (d) Liliaceae

23. The interxylary phloem is found in the stem of
(a) *Cucurbita* (b) *Salvia*
(c) *Calotropis* (d) None of these

24. Wound healing is due to
(a) ventral meristem (b) secondary meristem
(c) primary meristem (d) All of these

25. Angular collenchyma occurs in
(a) *Salvia* (b) *Helianthus*
(c) *Althaea* (d) *Cucurbita*

26. In pteridophytes, phloem is without
(a) bast fibers (b) sieve tubes
(c) companion cells (d) sieve cells

27. Match the following entities of column I with their respective orders of column II and choose the correct combination form the option.

Column I	Column II
A. Wheat	1. Primate
B. Mango	2. Diptera
C. Housefly	3. Sapindales
D. Man	4. Poales

Codes

	A	B	C	D
(a)	4	3	2	1
(b)	1	2	4	3
(c)	3	4	2	1
(d)	2	4	1	3

28. Agar-agar is produced by
(a) fungi (b) algae
(c) bacteria (d) blue-green algae

29. In DNA, when AGCT occurs, their association is as per which of the following pair
(a) A-G, C-T (b) A-T, G-C
(c) A-C, G-T, A-C, E-T (d) All of these

30. A segment of DNA has 120 adenine and 120 cytosine bases. The total number of nucleotides present in the segment is
(a) 60 (b) 240 (c) 120 (d) 480

31. Lactose is composed of
(a) glucose + glucose (b) glucose + galactose
(c) glucose + fructose (d) fructose + galactose

32. Meiosis is best observed in dividing
(a) cell of lateral meristem
(b) cells of apical meristem
(c) microsporocytes
(d) microspores and anther wall

33. Study the following statements and select the correct option.
I. Tapetum nourishes the developing pollen grains.
II. Hilum represents the junction between ovule and funicle.
III. In aquatic plants such as water hyacinth and water lily, pollination is by water.
IV. The primary endosperm nucleus is triploid.
(a) I, II, and IV are correct, but III is incorrect
(b) I and II are correct, but III and IV are incorrect
(c) I and IV are correct, but II and III are incorrect
(d) I, III and IV are correct, but I is incorrect

34. Masses of pollen grains, *i.e.*, pollinia is found in
(a) Gramineae (b) Solanaceae
(c) Orchidaceae (d) Malvaceae

35. Morphine, which is used as an analgesic is obtained from
(a) *Taxus brevifolia*
(b) *Berberis nilghiriensis*
(c) *Cinchona officinalis*
(d) *Papaver somniferum*

36. Pebrine is a disease of
(a) fish
(b) honey bee
(c) silk worm
(d) lac insect

37. Factor govering the earth surface is
(a) topographic
(b) edaphic
(c) temperature
(d) biotic

38. The direction of energy flow is
(a) Producers → Herbivores → Decomposers → Omnivores
(b) Producers → Carnivore → Herbivores → Decomposes
(c) Decomposers → Carnivores → Herbivores → Producers
(d) Producers → Herbivores → Carnivores → Decomposers

39. If the Bengal tiger become extinct
(a) hyenas and wolves will become scarce
(b) its gene pool will be lost forever
(c) the wild areas will be safe far man and domestic
(d) the population of beautiful animals like deers will get stabilised

40. Biological treatment of water pollution is done with the help of
(a) fungi
(b) lichen
(c) phytoplanktons
(d) None of the above

English

Directions (Q. Nos. 1-5) *In the following questions, sentences are given with blanks to be filled in with an appropriate word. Four alternatives are suggested for each questions. Choose the correct alternative out of the four.*

1. The little girl.....for the light switch in the dark.
(a) groped (b) grappled
(c) gripped (d) grovelled

2. The summit meeting provided him the much.....shot in the arm.
(a) required (b) desired
(c) needed (d) urgent

3. We must.....the tickets for the movie in advance.
(a) draw (b) buy
(c) remove (d) take

4. The State Transport Corporation has.....a loss of ₹ 5 crore this year.
(a) obtained (b) derived
(c) incurred (d) formulated

5. One..... and you know who among them is the culprit.
(a) look (b) peep
(c) sight (d) gaze

Directions (Q. Nos. 6-10) *In the following questions, out of the four alternatives, choose the one which best expresses the meaning of the given word.*

6. GAINSAY
(a) Advantage (b) Proposal
(c) Contradict (d) Suggestion

7. PROFOUND
(a) Profuse (b) Boundless
(c) Deep (d) Fathomless

8. FLAK
(a) Adventure (b) Advice
(c) Criticism (d) Praise

9. HOODLUM
(a) Pioneer (b) Criminal
(c) Devotee (d) Scholar

10. SPASMODIC
(a) Continuous (b) Gradual
(c) Intermittent (d) Spontaneous

Directions (Q. Nos. 11-15) *In the following questions, choose the word opposite in meaning to the given word.*

11. FILTHY
(a) Stainless (b) Shining
(c) Sterilised (d) Clean

12. CROWDED
(a) Deserted (b) Lonely
(c) Empty (d) Barren

13. VAGUE
(a) Known (b) Published
(c) Popular (d) Definite

14. SUPERVISE
(a) Overlook (b) Misdirect
(c) Neglect (d) Forget

15. MAGNANIMOUS
(a) Selfish (b) Naive
(c) Generous (d) Small

Directions (Q. Nos. 16-20) *In the following questions, four alternatives are given for the idiom/phrase printed in bold in the sentence. Choose the alternative which best expresses the meaning of the idiom/phrase.*

16. We have to **keep our fingers crossed** till the final result is declared.
(a) keep praying
(b) feel suspicious
(c) wait expectantly
(d) feel scared

17. The members of the group were **at odds** over the selection procedure.
(a) acting foolishly (b) in dispute
(c) unanimous (d) behaving childishly

18. The popularity of the yesteryears' superstar **is on the wane.**
(a) growing more (b) at its peak
(c) growing less (d) at rock-bottom

19. His father advised him to be **fair and square** in his dealings lest he should fall into trouble.
(a) considerate (b) upright
(c) careful (d) polite

20. There **is no love lost** between the two neighbours.
(a) close friendship
(b) intense dislike
(c) a love-hate relationship
(d) cool indifference

Directions (Q. Nos. 21-25) *In the following questions, a part of the sentence is printed in bold. Below are given alternatives to the bold part at (a), (b), (c) which may improve the sentence. Choose the correct alternative. In case no improvement is needed, your answer is (d).*

21. Ravi has got many friends because he has got *much money.*
(a) Enough money (b) A lot of money
(c) Bags of money (d) No improvement

22. You must try *making him to understand.*
(a) Make him understand
(b) To making him understand
(c) To make him understand
(d) No improvement

23. He has cooked that meal so often he can do it with his *eyes closed.*
(a) Mind blank (b) Eyes covered
(c) Hands full (d) No improvement

24. Not a word *they spoke* to the unfortunate wife about it.
(a) They had spoken (b) Did they speak
(c) They will speak (d) No improvement

25. There is sufficient fund to meet the requirement of *the entire schools* in our zone.
(a) Schools (b) All the schools
(c) All of the schools (d) No improvement

Directions (Q. Nos. 26-30) *In the following questions, out of the four alternatives, choose the one which can be substituted for the given words/sentence.*

26. Word for word reproduction.
(a) Copying (b) Mugging
(c) Verbatim (d) Photostat

27. A person who collects coins.
(a) Philatelist (b) Numismatist
(c) Narcissist (d) Fatalist

28. That which is perceptible by touch
(a) Tangible (b) Tenacious
(c) Contagious (d) Contingent

29. One who possesses many talents.
(a) Versatile (b) Gifted
(c) Exceptional (d) Nubile

30. A person who studies the formation of the Earth.
(a) Meteorologist
(b) Anthropologist
(c) Geologist
(d) Seismologist

Directions (Q. Nos. 31-35) *In the following questions, the first and the last parts of the sentence are numbered 1 and 6. The rest of the sentence is split into four parts named P, Q, R and S. These parts are not given in their proper order. Rearrange these parts in their proper order and find out which of the given four combination is correct?*

31. (1) In reply to a question
(P) that securing extradition
(Q) operating from the UK soil remained
(R) of anti-India elements
(S) the spokesman said
(6) New Delhi's first priority.
(a) PRQS (b) QSPR
(c) RQSP (d) SPRQ

32. (1) The first component is
(P) and vocational training
(Q) so as to enable them
(R) the provision of further technical
(S) to both rural and urban youth
(6) to secure employment in industry and the services sector.
(a) PRSQ (b) RPSQ
(c) RSQP (d) SRPQ

33. (1) The move to revert to a six-day week
(P) among the employees
(Q) while the leaders represented to the Chief Minister
(R) that they be taken into confidence
(S) led to an animated decision
(6) before any decision was taken.
(a) QPSR
(b) RSPQ
(c) SPQR
(d) SQPR

34. (1) It was obvious
(P) made by him
(Q) submitted at the meeting
(R) from the comments
(S) on the draft proposals
(6) that he was not satisfied with them.
(a) PSRQ (b) QRSP
(c) RPSQ (d) SQRP

35. (1) The Minister of state for power
(P) laying emphasis
(Q) in conservation of electricity in industries
(R) has written to his counterparts in State Government
(S) on bringing about improvement
(6) by introduction of energy efficient equipment.
(a) QPSR (b) RPSQ
(c) SPQR (d) SQPR

Directions (Q. Nos. 36-40) *Read the following passage carefully and answer the questions given below it.*

In this work of incessant and feverish activity, men have little time to think, much less to consider ideals and objectives. Yet how are we to act, even in the present, unless we know which way we are going and what our objectives are? It is only in the peaceful atmosphere of a university that these basic problems can be adequately considered.

It is only when the young men and women, who are in the university today and on whom the burden of life's problems will fall tomorrow, learn to have clear objectives and standards of values that there is hope for the next generation.The past generation produced some great men but as a generation it led the world repeatedly to disaster. World Wars IInd are the price that has been paid for the lack of wisdom on man's part in this generation.

I think that there is always a close and intimate relationship between the end we aim at and the means adopted to attain it.

Even, if the end is right, but the means are wrong, it will vitiate the end or divert us in a wrong direction. Means and ends are thus intimately and inextricably connected and cannot be separated.

That indeed has been the lesson of old taught us by many great men in the past, but unfortunately it seldom remembered.

36. People have little time to consider ideals and objectives because
(a) they consider these ideals meaningless
(b) they do not want to burden themselves with such ideas
(c) they have no inclination for such things
(d) they are excessively engaged in their routine activities

37. 'The burden of life's problems' in the fourth sentence refers to
(a) the incessant and feverish activities
(b) the burden of family responsibilities
(c) the onerous duties of life
(d) the sorrows and sufferings

38. The World Wars IInd are the price that man paid due to
(a) the absence of wisdom and sagacity
(b) his not caring to consider the life's problems
(c) his ignoring the ideals and objectives of life
(d) his excessive involvement in feverish activities

39. According to the writer the adoption of wrong means even for the right end would
(a) not let us attain our goal
(b) bring us dishonour
(c) impede our progress
(d) deflect us from the right path

40. The word 'vitiate' used in the second paragraph means
(a) negate (b) debase (c) tarnish (d) destroy

Answers

Physics

1. (a)	2. (b)	3. (a)	4. (c)	5. (b)	6. (a)	7. (b)	8. (c)	9. (c)	10. (b)
11. (c)	12. (a)	13. (a)	14. (a)	15. (b)	16. (a)	17. (c)	18. (a)	19. (c)	20. (c)
21. (b)	22. (c)	23. (c)	24. (b)	25. (a)	26. (d)	27. (c)	28. (c)	29. (c)	30. (a)
31. (d)	32. (d)	33. (c)	34. (c)	35. (c)	36. (b)	37. (d)	38. (d)	39. (d)	40. (c)

Chemistry

1. (c)	2. (a)	3. (a)	4. (a)	5. (c)	6. (b)	7. (a)	8. (b)	9. (c)	10. (a)
11. (b)	12. (c)	13. (a)	14. (a)	15. (b)	16. (c)	17. (c)	18. (a)	19. (d)	20. (c)
21. (c)	22. (a)	23. (a)	24. (d)	25. (c)	26. (c)	27. (d)	28. (b)	29. (b)	30. (a)
31. (a)	32. (c)	33. (c)	34. (d)	35. (c)	36. (a)	37. (a)	38. (a)	39. (b)	40. (b)

Zoology

1. (a)	2. (a)	3. (c)	4. (d)	5. (b)	6. (a)	7. (a)	8. (d)	9. (b)	10. (c)
11. (b)	12. (b)	13. (a)	14. (d)	15. (b)	16. (b)	17. (a)	18. (c)	19. (a)	20. (b)
21. (d)	22. (c)	23. (d)	24. (a)	25. (b)	26. (b)	27. (c)	28. (d)	29. (d)	30. (a)
31. (c)	32. (d)	33. (a)	34. (d)	35. (c)	36. (b)	37. (c)	38. (a)	39. (d)	40. (d)

Botany

1. (d)	2. (c)	3. (a)	4. (d)	5. (b)	6. (a)	7. (b)	8. (d)	9. (a)	10. (b)
11. (c)	12. (b)	13. (c)	14. (a)	15. (d)	16. (c)	17. (a)	18. (b)	19. (a)	20. (c)
21. (a)	22. (a)	23. (c)	24. (b)	25. (d)	26. (c)	27. (a)	28. (b)	29. (b)	30. (d)
31. (b)	32. (c)	33. (a)	34. (c)	35. (d)	36. (c)	37. (a)	38. (d)	39. (b)	40. (c)

English

1. (a)	2. (c)	3. (b)	4. (c)	5. (a)	6. (c)	7. (c)	8. (c)	9. (b)	10. (c)
11. (d)	12. (a)	13. (d)	14. (b)	15. (a)	16. (c)	17. (b)	18. (c)	19. (b)	20. (b)
21. (b)	22. (c)	23. (d)	24. (b)	25. (b)	26. (c)	27. (b)	28. (a)	29. (a)	30. (c)
31. (d)	32. (b)	33. (c)	34. (c)	35. (b)	36. (d)	37. (c)	38. (a)	39. (d)	40. (b)

Hints & Solutions

Physics

1. The maximum velocity $v_{max} = \sqrt{\mu r g}$

$= \sqrt{1.28 \times 40 \times 9.8}$

$= 22.4\,m/s$

2. The escape velocity of the the planet

$$v_{escape} = \sqrt{\frac{2Gm}{R}} \propto \sqrt{\frac{M}{R}}$$

$$\therefore \quad \frac{v_p}{v_e} = \sqrt{\frac{M_p}{R_p} \times \frac{R_e}{M_e}}$$

or $$\frac{v_p}{v_e} = \sqrt{100 \times \frac{1}{4}} = 5$$

$$v_p = 5 \times 11.2 = 56\,km/s$$

3. Light travels faster in air than that in glass. This is accordance with wave theory of light.

4. Due to the specific shape of wings when the aeroplane runs air passes at higher speed over it as compared to its lower surface. This difference of air speeds above and below the wings, in accordance with Bermoulli's principle, creates a pressure difference, due to which an upward force called called dynamic lift act son the plate.

Upward lift = pressure difference × area of wing

$$= \frac{1}{2}\rho A(v_1^2 - v_1^2)$$

5. The time of flight $= \frac{2u \sin\theta}{g}$

$$= \frac{2 \times 9.8 \times \sin 30^\circ}{9.8} = 1\,\text{s}$$

6. α-particles are emitted $= \frac{238 - 222}{4} = 4$

The atomic number is decreased

$$90 - 4 \times 2 = 82$$

As atomic number of ${}_{83}Y^{222}$. So, atomic number is increased by 1, therefore, one β-particle is emitted.

7. From the relation

$$\Delta E = 13.6\,\text{eV} - \frac{13.6\,\text{eV}}{n^2}$$

$$= 13.6\,\text{eV} - \frac{13.6\,\text{eV}}{(2)^2} = 10.2\,\text{eV}$$

Therefore, excitation potential

$$= \frac{10.2}{e}\,\text{eV} = 10.2\,\text{V}$$

8. From the formula of work done

$$W = p\Delta V = 10^3 \times 0.25 = 250\,\text{J}$$

9. Work done = Area increased

$\times$ surface tension.

So, surface tension

$$S_T = \frac{3 \times 10^{-4}}{2 \times (10 \times 11 - 10 \times 6) \times 10^{-4}}$$

$$= 3 \times 10^{-2}\,\text{N/m}$$

10. From the formula

$$C = \frac{\varepsilon_0 A}{\frac{1}{k_1} + \frac{1}{k_2}} = \frac{\varepsilon_0 A}{t}\left(\frac{k_1 k_2}{k_1 + k_2}\right)$$

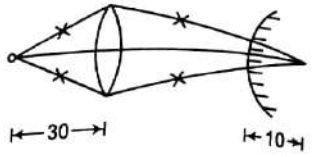
$$= \frac{2\varepsilon_0 A}{d}\left(\frac{k_1 k_2}{k_1 + k_2}\right)$$

11. Using the formula

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$$\frac{1}{v} - \frac{1}{-30} = \frac{1}{20}$$

$$v = 60\,\text{cm}$$



If the image is formed at the centre of curvature of the mirror, the coincidence is possible. Then the rays refracting through the lens will fall normally on the convex mirror and retrace their path of form the image at O. Hence, the distance between lens and mirror will be $60 - 10 = 50$ cm.

12. We know that for obtaining maximum power, the internal resistance must be equal to variable resistance so, the value of R will be $0.5\,\Omega$.

13. Given, $\frac{R}{C_V} = 0.67$

So, $C_V = \frac{R}{0.67} = 1.5R = \frac{3}{2}R$

This value corresponds to monoatomic.

14. Given, $\sin i = \frac{1}{\mu} = \frac{3}{5}$,

So, $\tan i = \frac{3}{4} = \frac{r}{4}$

It gives $r = 3\,\text{m}$

So, the diameter $= 6\,\text{m}$.

15. Applying law of conservation of momentum

$$m \times 3 = (m + 2m)\, v_1$$

So, $v_1 = 1\,\text{km/h}$

16. Comparing the given equation of the standard equation of wave

$$wy_0 = 2v$$

$$2\pi n y_0 = 2n\lambda,$$

$$\lambda = \pi\, y_0$$

17. From the relation

$$E_3 - E_1 = (-1.5) - (-13.6) = 12.1$$

As the energy is equal to the energy taken by $n = 1, n = 2, n = 3$. Hence there will be three spectral line.

18. Rate of energy $\frac{H}{t} = i^2 R$

(But total Resistance $R = 21 + 4 = 25\,\Omega$)

So, $\frac{H}{t} = 0.2 \times 0.2 \times 25 = 1\,\text{J/s}$

19. We know that binding energy per nucleon increases with atomic number binding energy for iron is maximum, after that it decreases.

20. From, the formula, rotational KE

$$E_{\text{rotational}} = \frac{1}{2} I\omega^2 = \frac{L^2}{2I} \quad (\because L = I\omega)$$

Therefore, $L^2 = 2EI$

Hence $L_A^2 = 2E_A I_A$ ...(i)

and $L_B^2 = 2E_B I_B$ ...(ii)

From Eq. (i) and (ii)

$$\frac{L_A}{L_B} = \sqrt{\frac{2E_A I_B}{2E_B I_A}} = \sqrt{\frac{100}{4}} = 5$$

$$\left(\because \frac{E_B}{E_A} = 100 \text{ and } \frac{I_A}{I_B} = 4\right)$$

21. The principle of working of ball pen corresponds to surface tension.

22. As it is clear that the phase difference between $\cos\theta$ and $\sin\theta$ representing two simple harmonic motion is 90°.

23. Time period of simple pendulum

For Ist pendulum $T_1 = 2\pi\sqrt{\frac{5}{g}}$

$$= 2\pi\sqrt{\frac{5}{9.8}} = \sqrt{20}\,\text{s}$$

For IInd pendulum $T_2 = 2\pi\sqrt{\frac{20}{g}}$

$$= 2\pi\sqrt{\frac{20}{9.8}} = 2\sqrt{20}\,\text{s}$$

Suppose the time will be in same phase is t then

$$\frac{1}{t} = \frac{1}{T_1} - \frac{1}{T_2}$$

$$= \frac{1}{\sqrt{20}} - \frac{1}{2\sqrt{20}}$$

$$= \frac{1}{2\sqrt{20}}$$

So, $t = 2\sqrt{20}$

Hence, the number of oscillation of simple pendulum of shorter length $(x) = \frac{2\sqrt{20}}{\sqrt{20}} = 2$.

24. Using gas equation law

$$\frac{p_1 V_1}{T_1} = \frac{p_2 V_2}{T_2}$$

or $\frac{1 \times 500}{300} = \frac{0.5 \times V_2}{270}$

$$V_2 = 900\,\text{m}^3$$

25. From the formula

$$I = \frac{V}{\sqrt{R^2 + (\omega L)^2}}$$

$$I = \frac{220}{\sqrt{(20)^2 + (2\pi \times 50 \times 0.2)^2}}$$

$$= \frac{220}{66} = 3.33\,\text{A}$$

26. Induced emf

$$|e| = L\frac{di}{dt} = (60 \times 10^{-3}) \times \frac{(3.0 - 2.0)}{0.2}$$

$$= \frac{60 \times 10^{-3} \times 1}{0.2} = 0.3\,\text{V}$$

Induced current,

$$t\, i = \frac{e}{R} = \frac{0.3}{3} = 0.1\,\text{A}$$

27. Given $I_1 = I, I_2 = 4I$

$$I_{\max} = (\sqrt{I_1} + \sqrt{I_2})^2$$

$$= (\sqrt{I} + \sqrt{4I})^2 = (3\sqrt{I})^2$$

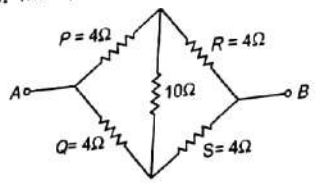
$$= 9I$$

and $I_{\min} = (\sqrt{I_1} - \sqrt{I_2})^2 = (\sqrt{I} - (\sqrt{4I})^2$

$$= (+\sqrt{I})^2 = I$$

28. Voltmeter has high resistance and is always connected in parallel with the circuit. So to convert a galvanometer into voltmeter, a high resistance must be connected in series with it so that is draws negligible current from the circuit.

29. The equivalent circuit can be redrawn as



We have, $\frac{P}{Q}=\frac{R}{S}$

i.e., $\frac{4}{4}=\frac{4}{4}$

So, the given circuit is a balanced Wheatstone's bridge.

Hence, the equivalent resistance

$$R_{AB}=\frac{(4+4)\times(4+4)}{(4+4)+(4+4)}=\frac{8\times 8}{8+8}$$

$$=\frac{64}{16}=4\,\Omega$$

30. According to Wien's displacement law,

$$\lambda_m T = \text{constant}$$

or $$\frac{\lambda_2}{\lambda_1}=\frac{T_1}{T_2}$$

$$\therefore \quad \frac{\lambda_2}{\lambda}=\frac{2000}{3000}=\frac{2}{3}$$

or $$\lambda_2=\frac{2}{3}\lambda$$

31. Drift velocity in a copper conductor

$$v_d=\frac{i}{neA}=\frac{5.4}{8.4\times10^{28}\times1.6\times10^{-19}\times10^{-6}}$$

$$=0.4\times10^{-3}\,\text{ms}^{-1}$$

$$=0.4\,\text{mms}^{-1}$$

32. $R=\frac{\rho l}{A}$ or $R\propto l$

$$\therefore \quad \frac{R_1}{R_2}=\frac{l_1}{l_2}=\frac{L}{L/4}=4$$

or $$R_2=\frac{R}{4} \quad (\because R_1=R)$$

In parallel combination of such four resistance

$$\frac{1}{R'}=\frac{1}{R_2}+\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_2}$$

or $$\frac{1}{R'}=\frac{1}{R/4}+\frac{1}{R/4}+\frac{1}{R/4}+\frac{1}{R/4}$$

or $$\frac{1}{R'}=\frac{4}{R}+\frac{4}{R}+\frac{4}{R}+\frac{4}{R}$$

or $$\frac{1}{R'}=\frac{16}{R}$$

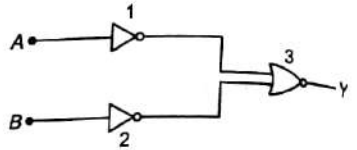
or $$R'=R/16$$

33. $M=M_0\left(\frac{1}{2}\right)^{t/t_{1/2}}$

$$\therefore$$

$$M=200\left(\frac{1}{2}\right)^{24/2}=200\left(\frac{1}{2}\right)^{6}=\frac{200}{64}=3.125_g$$

34.



Output of gate 1, $Y_1=\overline{A}$

Output of gate 2, $Y_2=\overline{B}$

Output of gate 3,

$$Y=\overline{Y_1+Y_2}=\overline{\overline{A}+\overline{B}}$$

$$=\overline{\overline{A}}\times\overline{\overline{B}}$$

$$=AB$$

Which is the output of AND gate.

35. Work function for wavelength of 4100 Å is

$$W=\frac{hc}{\lambda}$$

$$=\frac{6.63\times10^{-34}\times3\times10^{8}}{4100\times10^{-10}}$$

$$=4.8\times10^{-19}\,\text{J}$$

$$=\frac{4.8\times10^{-19}}{1.6\times10^{-19}}\,\text{eV}$$

$$=3\,\text{eV}$$

Now, we have

$$W_A=1.22\,\text{eV}$$

$$W_B=2.0\,\text{eV}$$

$$W_C=5\,\text{eV}$$

Since, $W_A<W$

and $W_B<W$, hence A and B will emit photoelectrons.

36. Distance covered by boy A in time t

$$AC=v\,t \qquad \ldots(i)$$

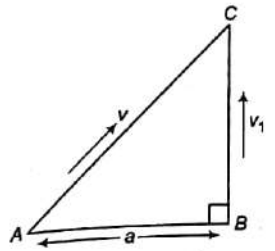
Distance covered by boy B in time t

$$BC=v_1\,t \qquad \ldots(ii)$$

Using Pythagourus theorem

$$AC^2=AB^2+BC^2$$

or $$(vt)^2=a^2+(v_1t)^2$$



or $$v^2t^2-v_1^2t^2=a^2$$

or $$t^2(v^2-v_1^2)=a^2 \therefore\ t=\sqrt{\frac{a^2}{(v^2-v_1^2)}}$$

37. Power $P=i^2R$

$$\Rightarrow \quad R=\frac{P}{i^2}$$

given, $P=1$ W, and $i=5$ A

$$\therefore \quad R=\frac{1}{(5)^2}=0.04\,\Omega$$

38. Force $F=at+bt^2$

From principle of homogeneity,

Dimension of $at=\frac{[F]}{[t]}=\frac{[MLT^{-2}]}{[T]}$

$$=[MLT^{-3}]$$

Similarly, dimensions of

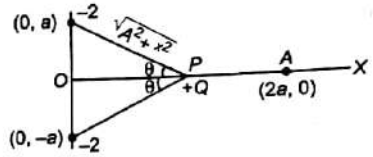
$$b=\frac{[F]}{[t^2]}=\frac{[MLT^{-2}]}{[T^2]}[MLT^{-4}]$$

39. Component of force on charge of $+Q$ at P, along x-axis,

$$F_x=\frac{2Qq}{4\pi\varepsilon_0(a^2+x^2)}\times\frac{x}{\sqrt{a^2+x^2}}$$

$$=\frac{2Qqx}{4\pi\varepsilon_0(a^2+x^2)}\times\frac{x}{\sqrt{a^2+x^2}}$$

$$=\frac{2Qqx}{4\pi\varepsilon_0(a^2+x^2)^{3/2}}$$



Which is not directly proportional to x.

So, motion is oscillatory but not SHM.

40. The percentage of volume of ice cube outside the water is

$$=\frac{\rho_{water}-\rho_{ice}}{\rho_{water}}\times100$$

$$=\frac{1000-900}{1000}\times100=10\%$$

Chemistry

1. n-alkanes, in presence of anhy. $AlCl_3$/HCl undergo isomerisation to form branched chain alkanes.

2. Only one water molecule, which is outside the brackets (coordination sphere) is hydrogen bonded. The other four molecules of water are coordinated.

3. Among the oxoanions if chlorine given in the question, ClO_4^- does not disproportionate because in this oxoanion chlorine is present in its highest oxidation state *i.e.*, +7.

4. $(CH_3)_3N$ have unshared pair of electrons which can be donated and shared with an electrophile.

5. 1 M of 10 mL H_2SO_4 = 1 M of 20 mL NH_3

1000 mL of 1 M ammonia contains

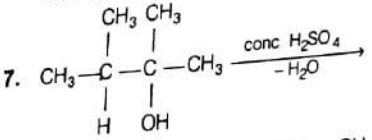
= 14 g nitrogen

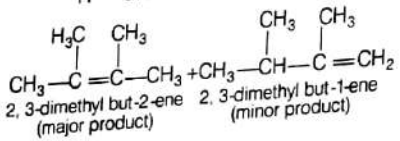
20 mL of 1 M NH_3 contains

$$=\frac{14\times20}{1000}\,\text{g nitrogen}$$

$$\%\text{ age of nitrogen}=\frac{14\times20\times100}{1000\times0.5}=56.0\%$$

6. Compound (II) is most symmetrical because it has both CH_3 groups and Cl atoms *p*-to each other. Therefore, it fits in the crystal lattice better than the other two isomers and hence it has highest melting point.

7.




8. $CH_3CH_2C{\equiv}CH \xrightarrow{H^+/H_2O,\ Hg^{2+}} CH_3CH_2COCH_3$

9. Due to $-I$ effect of Cl, chloroacetic acid is a stronger acid than acetic acid. Further dur to stablisation of phenoxide ion by resonance and no such stabilisation in case of ethoxide ion, phenol is a stronger acid than ethanol.

Hence, overall acid strength increases in the order; ethanol < phenol < acetic acid < chloroacetic acid.

10. In fcc structure, there are $4F^-$ ions in the packing and hence 4 octahedral voids.

11. $\pi = CRT$ or $C = \frac{\pi}{RT}$

$= 8.21\ \text{atm}/0.0821\ \text{L atm K}^{-1}\ \text{mol}^{-1} \times 310\text{K}$

$= 0.323\ \text{M} = 0.323 \times 180\ \text{gL}^{-1}$

$= 58.14\ \text{gL}^{-1}$

12. At equilibrium, rate of dissolution = rate of crystallisation.

13. Thiosulphato (SCN) is ambidentate/unidentats ligand.

14. $2\,KMnO_4 + 2\,H_2SO_4\ (\text{conc.}) \longrightarrow Mn_2O_7 + 2\,KHSO_4 + H_2O$

15. $3d^5$ has maximum unpaired electrons ($5e^-$), so it has magnetic moment.

16. Phosphorus belongs to 3rd period and hence contains *d*-orbitals which can form $p\pi$-$p\pi$ bonds.

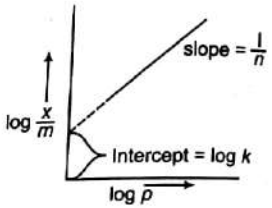
17. HI being a stronger reducing agent than H_2SO_4, reduces H_2SO_4 to SO_2 and is itself oxidised to I_2.

18. F being smallest has the shortest HF bond and hence HF has the highest bond dissociation energy.

19. Inert electrodes provide surface for oxidation or reduction reaction but not for redox reaction. Hence, option (d) is incorrect.

20. E_{cell} is intensive while $\Delta_r G$ is extensive. (In the relation, $\Delta G = -nFE$, E depends only on the nature of the cell reaction so it is intensive whereas value of ΔG depends upon the value of n. So it is extensive.)

21. Option (c) is correct



According to Freundlich adsorption isotherm, a graph between $\log \frac{x}{m}$ against $\log p$ is a straight line with slope equal to $1/n$ and intercept equal to $\log k$.

22. Aluminium is the third most abundant element by mass and iron is the second most abundant metal in the earth's crust.

23. Nitrogen in, N_2O, NO, N_2O_3, NO_2 or N_2O_4 and N_2O_5 nitrogen shows + 1, + 2, + 3, + 4 and +5 oxidation states respectively.

24. $PH_3 < AsH_3 < NH_3$ (enthalpy of vaporisation)

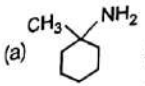
25. A halogen of lower atomic number oxidises halide ions of higher atomic number.

$Br_2 + 2\,NaI \longrightarrow 2NaBr + I_2$

26. A catalyst does not alter the enthalpy change ΔH of the reaction.

27. Rate $= k\,[A]\,[B]$; when volume is reduced to $\frac{1}{4}$th, concentration will become 4 times: Therefore, new rate $= k[4A]\,[4B] = 16\,k[A]\,[B]$

$= 16$ times

28. (a)


;

(b) $(C_2H_5)_3N$; 3°

(c) $(CH_3)_3C-NH_2$; 1°

(d) $C_6H_5-NH-CH_3$; 2°

29. Sodium rosinate enhance the lathering porperty of soap.

30. Deficiency of vitamin 'C' causes scurvy.

31. Excess fluoride over 10 ppm causes harmful effects to bones and teeth.

32. Adiabatic process is a process in which there is no transfer of heat between the system and surroundings, ($q = 0$).

33. $\Delta_r G^\circ = 2.303 \log Kp\ (R = 8.314\ \text{JK}^{-1}\ \text{mol}^{-1})$

$\Delta_r G^\circ = -2.303 \times 8.314\ \text{JK}^{-1}\ \text{mol}^{-1} \times 298\text{K} \times \log 2.47 \times 10^{-29}$

$= 163000\ \text{Jmol}^{-1} = 163\ \text{kJmol}^{-1}$

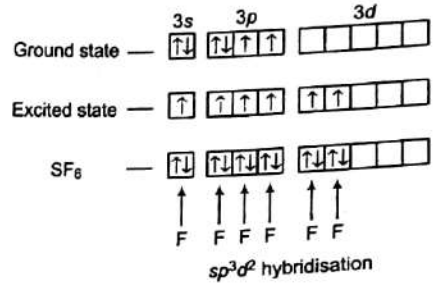
34. Option (d) is wrong statement.

$C_2\ (12e^-) = \sigma 1s^2\ \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2$

$(\pi 2p_{x_2} = \pi 2p_{y_2})$

In C_2 molecule, double bond consists of both π bonds.

35. S(16 e^-) ground state $= 1s^2, 2s^2, 2p^6, 3s^2, 3p^4$



36. Covalent character increases with decrease in the value of difference in electronegativites of binding atoms. Thus, the correct order is

$LiCl < BeCl_2 < BCl_2 < CCl_4$

37. Maximum number of electrons in a subshell of atom is determined by $4l + 2$.

38. Average kinetic energy per molecule $= \frac{3}{2}KT$

$= \frac{3}{2} \times 1.38 \times 10^{-23} \times 298$

$= 6.17 \times 10^{-21}\ \text{JK}^{-1}\ \text{molecule}^{-1}$

39. $\text{pH} = 7 + \frac{1}{2}[pK_a - pK_b]$

$= 7 + \frac{1}{2}[4.76 - 4.75]$

$= 7 + \frac{1}{2} \times 0.01 = 7 + 0.005$

$= 7.005$

40. Reaction quotient, $Q_c = [B]\,[C]/[A]^2$

as $[A] = [B] = [C] = 3 \times 10^{-4}\text{M}$

$Q_c = (3 \times 10^{-4}) \times (3 \times 10^{-4})/(3 \times 10^{-4})^2 = 1$

As $Q_c > K_c$, so the reaction will proceed in the reverse direction.

Zoology

1. Pellagra is caused by deficiency of vitamin-B_5. Therefore, vitamin-B_5 is also known as antipellagra factor. Symptoms of this disease are thick pigmented skin of head, swollen lips and patient feels irritable.

2. Notochord originates from mesoderm germ layer.

3. Parthenogenesis is a form of sexual reproduction in which the ovum develops into a new individual without fertilisation.

4. Bartholin's gland is found in vagina. Bartholin glands are a pair of small glands, which occur on each side of the vaginal opening. These glands correspond to cowper's gland of male.

5. Each testis contains seminiferous tubules for spermatogenesis and interstitial (Intertubullar) tissue rich in Leyding cells for steroidgenesis. Seminiferous epithelium contains a continuous layer of Sertoli cells, which are joined by tight intercellular junctions. These junctions divide the epithelium into a basal compartment that contains spermatogonia and an abdominal compartment.

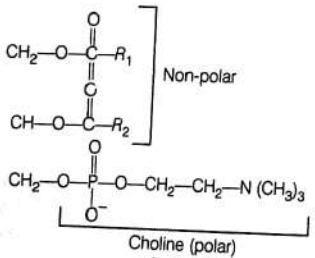
6. Teratogens is an agent that can cause malformations of an embryo on foetus. This can be a chemical substance, a virus or ionising radiation. Mostly, during first three months of pregnancy the pregnant lady should avoid all contact with teratogen.

7. A mature ovarian follicle is called Graafian follicle. After ovulation, the empty Graafian follicle shows deposition of luetin and forms corpus luteum that ultimately degenerates.

8. Basic amino acids have an additional amino group without forming amides thus, they are diaminomonocarboxylic acids. *e.g.*, lysine arginine, etc.

9. In cell cycle there are two main phases-interphase and mitotic phase. Interphase is divided into three stage G_1, S and G_2. G_1 is first growth phase. S is synthetic phase and G_2 is second growth phase.

10. 'A' is a structural formula of lecithin. It is probably the most common phospholipid. Phospholipids are major components in the lipid bilayers of cell membrane.



Lecithin

11. Mesosomes will be equivalent to mitochondria of eukaryotes because of respiratory enzymes present in aerobic bacteria.

12. Centrosome is a self-propagating cytoplasmic organelle, located near nucleus of animal cell.

13. The plasmalemma series as the interface between the machinery in the interior of the cell and the Extracellular Fluid (ECF) that bathes all cells. It is devoid of ribosome.

14. In 1824, Pene Dutrochet, a French scientist wrote that all animal and plant tissues were aggregate of globular cells.

15. Scientific name of gharial or gavial is *Gavialis gangeticus*, which lives in rivers Ganga and Brahamputra.

16. Cephalochordate have notochord all along the body through out life. But urochordates have notochord in the tail region in their larval stage only.

17. In molluscs, the blood is colourless, often having copper containing blue respiratory pigment called haemocyanin.

18. Chlorogogen cells are excretory in function. The chlorogogen cells take up excretory matter from the blood capillaries of the gut and from the coelomic fluid of the coelom. They also store glycogen and fat. So, these cells are analogous to the liver of vertebrates.

19.

Cyclostomes	—	Agantha
Aves	—	Tetrapod
Tunicates	—	Urochordata
Balanoglossus	—	Hemichordata
Osteichthyes	—	Pisces

20. Chondrichthyes (cartilaginous fishes) are marine. Their mouth is ventral and they have cartilaginous endoskeleton. Dermal placoid scales are present, e.g., Scoliodon, Pristis, etc.

21. Study of amphibians and reptiles is called Herpetology. Study of aves is called Ornithology. Study of fishes is called Ichthyology.

22. Ligaments join a bone with another bone in movable/synovial joints. Torn ligaments make movement at joints very painful and restricted. It heals only after prolonged movement restriction.

23. Achondroplasia is a defect in the formation of cartilage at the epiphyses of long bones producing a form of dwarfism.

24. Bone marrow is of two types; red and yellow. The yellow marrow is found especially in medullary cavity of long bones, while red is in spongy bones.

25.

Neuron	—	Nissl's bodies
Bone-matrix	—	Ossein
RBCs of man	—	Non-nucleated
Lymphocytes	—	Antibodies

26. Diastema is the gap that separates the biing teeth from the grinding teeth in herbivores. It creates a space in which food can be held ready for the grinding action of the teeth.

This space is filled by large canine teeth in carnivores.

27. Pepsin is released from peptic cells of the gastric gland on the stomach wall and it can digest milk protein caesin.

Chymotrypsin is released from the intestine and digest proteins. Ptyalin is released from salivary glands and acts on starch.

28. Goitre is a swelling of the neck due to enlargement of the thyroid gland. This may be due to lack of dietary iodine, which occurs due to decreases thyroid function, which is necessary for the production of thyroxine hormone.

This was the cause of endemic goitre, formerly common in regions, where the people lacked in their diet iodine.

29. Prolactin or luteotrophic hormone or luteotrophin is a hormone, synthesised and stored in the anterior pituitary gland, that stimulates milk production after child birth and also stimulates production of progesterone by the corpus luteum in the ovary.

30. At its bottom, the trachea (another name for the wind pipe) branches into two tubes called bronchi, which lead into the lungs.

The larynx is the voice box. It is connected to the windpipe. The oesophagus, like the windpipe, is a tube that runs through the neck. The lungs are the ballon like structure in the chest.

31. Conductivity meter measures soil salinity. Porometer is an apparatus for knowing the relative sizes of stomata. Potometer is used for measuring the rate of transpiration.

32. Both predation and parasitism show negative interactions. In negative interaction one species is harmed (–) while the other is benefitted.

33. Sunlight is the ultimate source of energy as it is the only inexhaustible resource, which is utilised by green plants and is passed on to higher tropic levels through food chain.

34. Endemic species represents a population that are restricted geographically to a particular area in a given time.

35. Species diversity on earth is not uniformly distributed but shows interesting patterns. It is generally highest in the tropics and decreases towards the poles.

36. The effect of cigarette smoking and radon in combination on lungs is synergistic.

37. '*Taq*' and '*Pfu*' are thermostable enzymes, which are isolated from thermophilic bacteria.

They are DNA polymerase in nature, which are widely used in polymerase chain reaction.

38. Biolistics is a technique far introducing genetic material into living cells, especially plant cells in which DNA- coated microscopic particles are fired into the cell using a special gun.

39. The largest known gene in human is the dystrophin gene, which has 79 axons spanning at least 2300 kb. The human dystrophin gene requires 16 hours to be transcribed.

40. Herbicide resistant gene in plants is *Bt* gene *Bacillus thuringiensis* is the bacterium that occur naturally in soil. It is now used as herbicide or biopesticide.

Botany

1. Photosynthesis is an oxidation reduction process in which water is oxidised and carbon dioxide is reduced to carbohydrates. Hence, it is anabolic and endergonic process.

2. Zeatin is a cytokinin. IAA or indole acetic acid is a natural auxin. IBA or indole butyric acid and NAA or nepthalene acetic acid are synthetic auxin.

3. Cytokinin is a plant growth hormone, which is mostly synthesised in the roots, cytokinin delays leaf senescence.

4. C_4-plants have an alternative CO_2 fixation pathway called Hatch and Slack cycle. These plants have Kranz anatomy in leaf, where vascular bundles are surrounded by bundle sheath.

   In C_4 cycle light reaction occurs in, mesophyll chloroplast by PEP carboxylaes and the assimilation of CO_2 takes place in, *i.e.*, dark phase in bundle sheath chloroplast by Rubisco.

5. Scotoactive mechanism of opening of stomata is seen in fleshy xerophytes like *Opuntia*, cactus, etc. They keep their stomata open at night and closed during daytimes.

6. Genetic dwarfism is overcome by the usage of gibberellins. Ethylene is a gaseous hormone, which induces ripening in unripe fruits. ABA cause ageing and abscission of leaves.

7. Ethylene is a natural gaseous hormone, which is predominantly known for inducing fruit ripening.

8. In the year 1900 Hugo de Vries, Karl Correns and Erich Tschermark independently rediscovered the research carried out by Mendel, his experiments on heredity and variations and laid the basic of modern genetics.

9. The 1st generation obtained from crossing two parents is called as first filial generation or F_1-generation.

10. Skin colour in humans is controlled by three pair of genes Aa, Bb, Cc.

11. Axillary position (A) is dominant over terminal (a) position. When Aa × Aa is crossed we get 3 :1 ratio. of axillary and terminal flowers.

Aa × Aa

Ⓐ ⓐ Ⓐ ⓐ Gametes

	A	a
A	AA	Aa
a	Aa	aa

3 Axillary : 1 Terminal

12. Seed producing plants belong to spermatophyta. It includes gymnosperms and angiosperms. Seed orginated in gymnosperms. Fern and *Funaria* belong to pteridophytes and bryophytes respectively. So, they do not reproduce by producing seeds.

13. The sporophyte of pteridophyte produces meiospores inside sporangia, which may be homosporous (*e.g.*, *Adiantum*, *Dryopteris*, *Equisetum*, etc.) or heterosporous (*e.g.*, *Salvinia*, *Selaginella*, etc.)

14. A starch called sago is obtained from the pith of *Cycas revoluta*. That is why it is called sago palm.

15.

Column I	Column II
A. *Cuscuta*	4. Parasite
B. *Eichhornia*	5. Root pocket
C. *Monotropa*	1. Saprophyte
D. *Rhizophora*	2. Pneumatophore
E. *Utricularia*	3. Insectivorous plant

16. Lipopolysaccharide present on cell wall of bacteria acts as endotoxin.

17. Endosperm of gymnosperm is a pre-fertilisation tissue. It is basically the female gametophyte hence it is haploid unlike triploid in angiosperm.

18. Pteridophyte are called vascular cryptogams. They are seedless vascular plant as they possess water conducting xylem and food translocating phloem but do not produce seed (instead spare formation takes place).

19. Bacillariophyceae contains unicellular golden brown autotrophic protists (diatoms). As the name diatoms indicates the body is covered with bivalved Silicaceous shell or frustule having an upper half or epitheca and a lower half or hypotheca.

20. Guard cell are the specialised epidermis cells containing chloroplast.

21. Epidermal extensions are always unicellular, while epidermal appendages may be uni or multicellular. Root hairs are epidermal extensions formed by outward elongated bulging of wall of epidermal cells.

22. Lady finger (*Abelmoschus esculents*) belongs to family—Malvacae. This family is distinguished by presence of epicalyx, staminal tube, extrose anthers, monothecous, and syncarpous ovary.

23. Interxylary phloem is found in *Calotropis* stem. It is said to be interxylary due to its presence inside xylem. It is also found in same member of family– Solanceae.

24. Secondary meristem are the meristem that are formed secondarly from the permanent tissue. Healing of wound in plant take place by the activity of secondary meristem.

25. Angular collenchyma occurs in *Cucurbita*. It has thickening at the angles and there are no intercellular spaces. It is generally found in leaf petioles.

26. In angiosperm, companion cells are living cells along with sieve tube and phloem parenchyma of the phloem. In pteridophytes and gymno sperm phloem is without companion cell.

27.

Common Name	Scientific Name	Family	Order	Class
Wheat	*Triticum aestivum*	Poaceae	Poales	Monocotyledons
Mango	*Mangifera indica*	Anacardiaceae	Sapindales	Dicotyledons
Housefly	*Musca domestica*	Muscidal	Diptera	Insecta
Man	*Homo sapiens*	Hominidal	Primata	Mammalia

28. Agar-agar is obtained from members of Rhodophyceae algae collectively called agarophytes. These include *Gelidium*, *Gracillaria*, etc.

    Agar is a jelly, like substance used for culturing processes. It is used as laxatives in bacteriological and mycological media.

29. DNA molecule has four bases-adenine guanine cytosine and thymine. Adenine always pairs with thymine and guanine pairs with cytosine. Their association is A-T and G-C.

30. According to Chargaff's rules, the amount of adenine is always equal to that of thymine, and the amount of guanine is always equal to that of cytosine.

    A = T(120)

    G = C(120)

    The total number of nucleotides would be 120 × 4 = 480.

31. Lactose is popularly known as milk sugar. It is a disaccharide composed of one molecule of glucose and one molecule of galactose.

    It is a reducing sugar.

32. Meiosis is best observed in dividing microsporocytes. Microsporocytes or microspore mother cell after meiosis give rise to microspore.

    Other cell do not divide by meiosis.

33. In a majority of water plants like water hyacinth and flowers, water lily emerge above the water level and are pollinated by insects.

34. Pollinia is a coherent mass of pollen grains. They are the product of only one anther lobe, but are transferred during pollination as a single unit.

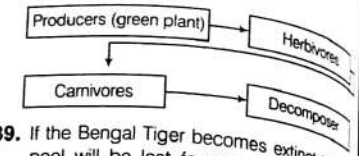
    This is found in orchids (Orchidaceae).

35. Morphine is the principle opium alkaloid. It is a strong analgesic. Opium is dried latex of unripe capsular fruits of poppy plant, *Papaver somniferum*. It is eaten or smoked.

36. Pebrine is a disease of silkworm caused by a small parasite *Nosema*, which has a devastating effect on silk industry.

37. Topographical conditions greatly influence the soil profile (earth surface) within a given climatic region.

38. In an ecosystem, the direction of flow of energy is always in this pattern.



39. If the Bengal Tiger becomes extinct its gene pool will be lost forever. Gene pool is the collective name for all the genes of a particular population.

40. Water hyacinth (phytoplankton), can purify water polluted by biological and chemical wastes-water hyacinth has remarkable capacity to accumulate poisonous metals including radioactive substances.

Solved Paper 2014

JIPMER

Medical Entrance Exam

Physics

1. A ball is released from certain height which losses 50% of its kinetic energy on striking the ground, it will attain a height again

(a) $\frac{1}{4}$th of initial height

(b) $\frac{1}{2}$th of initial height

(c) $\frac{3}{4}$th of initial height

(d) None of the above

2. If applied torque on a system is zero, *i.e.*, $\tau = 0$, then for that system

(a) $\omega = 0$ (b) $\alpha = 0$
(c) $J = 0$ (d) $F = 0$

3. A steel wire of 1 m long and $1mm^2$ cross section area is hanged from rigid end when weight of 1 kg is hang from it, then change in length will be
(Young's coefficient for wire $Y = 2 \times 10^{11}$ N/m^2)

(a) 0.5 mm (b) 0.25 mm
(c) 0.05 mm (d) 5 mm

4. When plate voltage in diode valve is increased from 100V to 150V. Then, plate increases from 7.5 mA to 12 mA, then dynamic plate resistance will be

(a) 10 kΩ (b) 11 kΩ
(c) 15 kΩ (d) 11.1 kΩ

5. If the sun rays are incidenting at 60° angle and intensity is I. If the sun rays are made incident at 30° angle, then what will be the intensity?

(a) $\frac{I}{\sqrt{3}}$ (b) $\sqrt{3}I$
(c) $3I$ (d) $\frac{I}{3}$

6. The reason of current flow in p-n junction in forward bias is

(a) drifting of charge carriers
(b) drifting of minority charge carriers
(c) diffussion of charge carriers
(d) All of the above

7. A charged particle is accelerated by a potential of 200V. If its velocity is 8.4×10^8 m/s, then value of e/m for that particle is

(a) 17.6×10^{16} (b) 14.5×10^{12}
(c) 1.76×10^{15} (d) 1.45×10^{15}

8. When an open organ is dipped in water upto half of its height, then its frequency will become

(a) half (b) double
(c) remain same (d) four time

9. A sound source producing waves of frequency 300 Hz and wavelength 1m observer is stationary, while source is going away with the velocity 30 m/s, then apparent frequency heared by the observer is

(a) 270 Hz (b) 273 Hz (c) 383 Hz (d) 300 Hz

10. A particle moves towards east for 2 s with velocity 15 m/s and move towards north for 8 s with velocity 5 m/s. Then, average velocity of the particle is

(a) 1 m/s (b) 5 m/s (c) 7 m/s (d) 10 m/s

11. Relation between wavelength of photon and electron of same energy is

(a) $\lambda_{ph} > \lambda_e$ (b) $\lambda_{ph} < \lambda_e$
(c) $\lambda_{ph} = \lambda_e$ (d) $\frac{\lambda_e}{\lambda_{ph}}$ = constant

12. Match the following.

A. Angular momentum	1. $[M^{-1}L^2T^{-2}]$
B. Torque	2. $[M^1T^{-2}]$
C. Gravitational constant	3. $[M^1L^2T^{-2}]$
D. Tension	4. $[M^1L^2T^{-1}]$

(a) C – 2, D – 1 (b) A – 4, B – 3
(c) A – 3, C – 2 (d) B – 2, A – 1

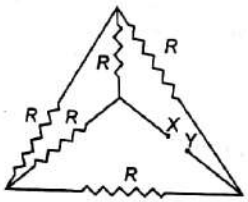
13. If we increase kinetic energy of a body 300%, then per cent increase in its momentum is
(a) 50% (b) 300%
(c) 100% (d) 150%

14. Change in acceleration due to gravity is same upto a height h from each other the earth surface and below depth x, then relation between x and h is (h and $x << R_e$)
(a) $x = h$ (b) $x = 2h$ (c) $x = \frac{h}{2}$ (d) $x = h^2$

15. A mass of 1 kg is suspended from a spring of force constant 400 N, executing SHM total energy of the body is 2J, then maximum acceleration of the spring will be
(a) 4 m/s^2 (b) 40 m/s^2
(c) 200 m/s^2 (d) 400 m/s^2

16. Two capacitors of capacities C_1 and C_2 are charged upto the potential V_1 and V_2, then condition for not flowing the charge between on connected them in parallel is
(a) $C_1 = C_2$ (b) $C_1V_1 = C_2V_2$
(c) $V_1 = V_2$ (d) $\frac{C_1}{V_1} = \frac{C_2}{V_2}$

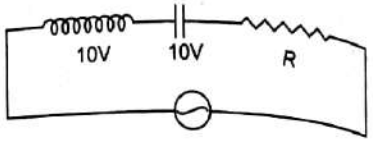
17. Find equivalent resistance between X and Y



(a) R (b) R/L (c) $2R$ (d) $5R$

18. Vibrations of rope tied by two rigid ends shown by equation $y = \cos 2\pi t \sin 2\pi x$, then minimum length of the rope will be
(a) 1 m (b) $\frac{1}{2}$ m (c) 5 m (d) 2π m

19. If we change the value of R, then



(a) voltage does not change on L
(b) voltage does not change on LC combination
(c) voltage does not change on C
(d) voltage changes on LC combination

20. If $V = ary$, then electric field at a point will be proportional to
(a) r (b) r^{-1}
(c) r^{-2} (d) r^2

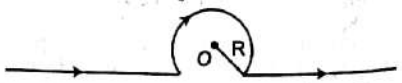
21. Electric field at point 20 cm away from the centre of dielectric sphere is 100 V/m, radius of sphere is 10 cm, then the value of electric field at a distance 3 cm from the centre is
(a) 100 V/m (b) 125 V/m
(c) 120 V/m (d) 0

22. 50 g ice at 0°C in insulator vessel, 50 g water of 100°C is mixed in it, then final temperature of the mixture is (neglect the heat loss)
(a) 10°C (b) 0° << T_m < 20°C
(c) 20°C (d) above 20°C

23. Real power consumption in a circuit is less when it contains.
(a) high R, low L (b) high R, high L
(c) low R, high L (d) high R, low C

24. Linear density of a string of is 1.3×10^{-4} kg/m and wave equation is $y = 0.021 \sin(x + 30t)$. Find, the tension in the string where, x in metre and t in second.
(a) 0.12 N
(b) 0.21 N
(c) 1.2 N
(d) 0.012 N

25. Magnetic field at point O will be



(a) $\frac{\mu_0 I}{2R}$ interior (b) $\frac{\mu_0 I}{2R}$ exterior
(c) $\frac{\mu_0 I}{2R}\left(1 - \frac{I}{\pi}\right)$ interior (d) $\frac{\mu_0 I}{2R}\left(1 + \frac{I}{\pi}\right)$ exterior

26. If prism angle $\alpha = 1°$, $\mu = 1.54$, distance between screen and prism (D) = 0.7 m, distance between prism and source $a = 0.3$ m, $\lambda = 180\pi$ nm, then in Fresnal biprism find the value of β (fringe width).
(a) 10^{-4} m
(b) 10^{-3}mm
(c) $10^{-4} \times \pi$ m
(d) $\pi \times 10^{-3}$m

27. According to Bohr's model of hydrogen atom, relation between principal quantum number n and radius of stable orbit is
(a) $r \propto \frac{1}{n}$ (b) $r \propto n$
(c) $r \propto \frac{1}{n^2}$ (d) $r \propto n^2$

28. An observer is approaching with velocity v towards a light source. If the velocity of light is c, then velocity of light with respect to observer will be
(a) $c - v$ (b) c
(c) $c + v$ (d) $\sqrt{1 - v^2/c^2}$

29. Magnetic field of the earth is $H = 0.3$ g. A magnet is vibrating 5 oscillations per min then the dippreciation required in the magnetic field of the earth of increase time period upto 10 oscillations per minute is
(a) 2.25 g (b) 0.6 g
(c) 0.9 g (d) 0.12 g

30. Work function of a metal is 5.2×10^{-18}, then its threshold wavelength will be
(a) 736.7 Å (b) 760.7 Å
(c) 301 Å (d) 344.4 Å

31. Remaining quantity (in%) of radioactive element after 5 half lives is
(a) 4.125% (b) 3.125%
(c) 31.1% (d) 42.125%

32. A engine pumps up 100 kg of water through a height of 10 m in 5s. Given that, the efficiency of engine is 60%. If $g = 10$ ms^{-2}, the power of this engine is
(a) 3.3 kW
(b) 0.33 kW
(c) 0.033 kW
(d) 33 kW

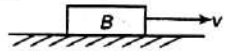
33. The angular amplitude of a simple pendulum is θ_0. The maximum tension in its string will be
(a) $mg(1 - \theta_0)$ (b) $mg(1 + \theta_0)$
(c) $mg(1 - \theta_0^2)$ (d) $mg(1 + \theta_0^2)$

34. If the electric flux entering and leaving an enclosed surface respectively are ϕ_1 and ϕ_2, the electric charge inside the surface will be
(a) $\frac{\phi_2 - \phi_1}{\varepsilon_0}$ (b) $\frac{\phi_2 + \phi_1}{\varepsilon_0}$
(c) $\frac{\phi_1 - \phi_2}{\varepsilon_0}$ (d) $\varepsilon_0(\phi_1 + \phi_2)$

35. During an adiabatic process, the pressure of a gas is found to be proportional to the cube of absolute temperature. The ratio $\frac{C_p}{C_V}$ for the gas is
(a) $\frac{4}{3}$ (b) 2
(c) $\frac{5}{3}$ (d) $\frac{3}{2}$

36. Three points charges $+q$, $-2q$ and $+q$ are placed at points $(x = 0, y = a, z = 0)$, $(x = 0, y = 0, z = 0)$ and $(x = a, y = 0, z = 0)$, respectively. The magnitude and direction of the electric dipole moment vector of this charge assembly are
(a) $\sqrt{2}qa$ along + y direction
(b) $\sqrt{2}qa$ along the line joining points $(x = 0, y = 0, z = 0)$ and $(x = a, y = a, z = 0)$
(c) qa along the line joining points $(x = 0, y = 0, z = 0)$ and $(x = a, y = a, z = 0)$
(d) $\sqrt{2}qa$ along + x direction

37. A block B is pushed momentarily along a horizontal surface with an initial velocity v. If μ is the coefficient of vlicling friction between B and the surface, block B will come to rest after a time



(a) $\frac{v}{g\mu}$ (b) $\frac{g\mu}{v}$
(c) $\frac{g}{v}$ (d) $\frac{v}{g}$

38. To get three images of a single object, we should have two plane mirrors at an angle of
(a) 60° (b) 90°
(c) 120° (d) 30°

39. A particle of mass M and charge Q moving with velocity v describes a circular path of radius R when subjected to a uniform transverse magnetic field of induction B. The work done by the field, when the particle completes one full circle, is

(a) $\left(\frac{Mv^2}{R}\right)2\pi R$ (b) zero

(c) $BQ2\pi R$ (d) $BQv2\pi R$

40. A particle of mass 100 g is thrown vertically upward with a speed of 5 m/s. The work done by the force of gravity during the time the particle goes up is

(a) −0.5 J

(b) −1.25 J

(c) 1.25 J

(d) 0.5 J

Chemistry

1. The relative reactivities of acyl compounds towards nucleophilic substitution are in the order of

(a) acyl chloride > acid anhydride > ester > amide

(b) ester > acyl chloride > amide > acid anhydride

(c) acid anhydride > amide > ester > acyl chloride

(d) acyl chloride > ester > acid anhydride > amide

2. Clemmensen reduction of a ketone is carried out in the presence of which of the following?

(a) Zn-Hg with HCl

(b) $LiAlH_4$

(c) H_2 and Pt as catalyst

(d) Glycol with KOH

3. In Duma's method of estimation of nitrogen, 0.35 g of an organic compound gave 55 mL of nitrogen collected at 300 K temperature and 715 mm pressure. The percentage composition of nitrogen in the compound would be

(Aqueous tension at 300 K = 15 mm)

(a) 16.45 (b) 17.45

(c) 14.45 (d) 15.45

4. Which of the following is not correct?

(a) Ammonia is used as refrigerant

(b) A mixture of $Ca(CN)_2$ and C is known as nitrolim

(c) A mixture of $Ca(H_2PO_4)_2$ and $CaSO_4 \cdot 2H_2O$ is known as superphosphate of lime

(d) Hydrolysis of NCl_3 gives NH_3 and HOCl

5. Which one of the following is aromatic?

(a) Cyclopentadienyl cation

(b) Cyclooctatetraene

(c) Cycloheptatriene

(d) Cycloheptatrienylcation

6. The complexes $[Co(NH_3)_6][Cr(CN)_6]$ and $[Cr(NH_3)_6][Co(CN)_6]$ are the examples of which type of isomerism?

(a) Ionisation isomerism

(b) Coordination isomerism

(c) Geometrical isomerism

(d) Linkage isomerism

7. A solution with negative deviation among the following is

(a) ethanol-acetone

(b) chlorobenzene-bromobenzene

(c) chloroform-acetone

(d) benzene-toluene

8. Which of the following compounds is soluble in benzene but almost insoluble in water?

(a) C_2H_5OH (b) CH_3CO_2H

(c) CH_3CHO (d) $C_6H_5NO_2$

9. The correct order of magnitude of bond angles among the compounds CH_4, NH_3 and H_2O is

(a) $CH_4 > H_2O < NH_3$ (b) $H_2O < NH_3 < CH_4$

(c) $NH_3 < CH_4 < H_2O$ (d) $NH_3 < H_2O < CH_4$

10. Which one of the following reactions does not form gaseous product?

(a) $PbO_2 + H_2O_2 \rightarrow$

(b) Acidified $KMnO_4 + H_2O_2 \rightarrow$

(c) $PbS + H_2O_2 \rightarrow$

(d) $Cl_2 + H_2O_2 \rightarrow$

11. Observe the following reaction

$$2A + B \longrightarrow C$$

The rate of formation of C is 2.2×10^{-3} mol L^{-1} min^{-1}. What is the value of $-\frac{d[A]}{dt}$ (in mol L^{-1} min^{-1})?

(a) 2.2×10^{-3} (b) 1.1×10^{-3}

(c) 4.4×10^{-3} (d) 5.5×10^{-3}

12. Which one of the following is employed as antihistamine?

(a) Diphenyl hydramine

(b) Norethindrone

(c) Omeprazole

(d) Chloramphenicol

13. If x is amount of adsorbate and m is amount of adsorbent, which of the following relations is not related to adsorption process?

(a) $\frac{x}{m} = f(T)$ at constant p

(b) $p = f(T)$ at constant $\left(\frac{x}{m}\right)$

(c) $\frac{x}{m} = p \times T$

(d) $\frac{x}{m} = f(p)$ at constant T

14. Standard electrode potential of three metals X, Y and Z are −1.2 V, +0.5 V and −3.0 V respectively. The reducing power of these metals will be

(a) $Y > X > Z$ (b) $Z > X > Y$

(c) $X > Y > Z$ (d) $Y > Z > X$

15. Which of the following compounds has the lowest melting point?

(a) $CaBr_2$ (b) CaI_2

(c) CaF_2 (d) $CaCl_2$

16. The dissociation equilibrium of a gas AB_2 can be represented as

$$2AB_2(g) \rightleftharpoons 2AB(g) + B_2(g)$$

The degree of dissociation is 'x' and is small compared to 1. The expression relating the degree of dissociation (x) with equilibrium constant K_p and total pressure p is

(a) $(2K_p / p)$ (b) $(2K_p / p)^{1/3}$

(c) $(2K_p / p)^{1/2}$ (d) (K_p / p)

17. A buffer solution is prepared in which the concentration of NH_3 is 0.30 M and the concentration of NH_4^+ is 0.20 M. If the equilibrium constant, K_b for NH_3 equals 1.8×10^{-5}, what is the pH of this solution?

(log 2.7 = 0.43)

(a) 9.43 (b) 11.72

(c) 8.73 (d) 9.08

18. If a gas expands at constant temperature indicates that

(a) kinetic energy of molecules decreases

(b) pressure of the gas increases

(c) kinetic energy of molecules remains as same

(d) number of the molecules of gas increase

19. If $n = 6$, the correct sequence for filling of electrons will be

(a) $ns \longrightarrow (n-1)d \longrightarrow (n-2)f \longrightarrow np$

(b) $ns \longrightarrow (n-2)f \longrightarrow np \longrightarrow (n-1)d$

(c) $ns \longrightarrow np \longrightarrow (n-1)d \longrightarrow (n-2)f$

(d) $ns \longrightarrow (n-2)f \longrightarrow (n-1)d \longrightarrow np$

20. Which of the following is least likely to behave as Lewis base?

(a) NH_3 (b) BF_3

(c) OH^- (d) H_2O

21. In DNA, the complimentary bases are

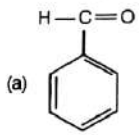
(a) adenine and thymine; guanine and cytosine

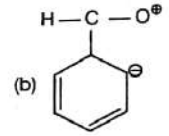
(b) adenine and thymine; guanine and uracil

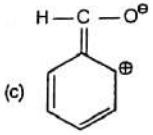
(c) adenine and guanine, thymine and cytosine

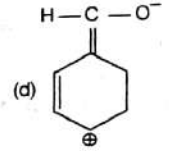
(d) uracil and adenine; cytosine and guanine

22. Which of the following is not a resonating form of benzaldehyde?

(a) 

(b) 

(c) 

(d) 

23. Which one of the following does not undergo iodoform reaction?

(a) Secondary butyl alcohol

(b) *Iso*-propyl alcohol

(c) Diethyl ketone

(d) Ethyl alcohol

24. Percentage of free space in a body centre cubic unit cell is

(a) 30%

(b) 32%

(c) 34%

(d) 28%

25. For the reaction, $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$, the equilibrium constant is K_1. The equilibrium constant is K_2 for the reaction, $2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$. What is K for the reaction, $NO_2(g) \rightleftharpoons \frac{1}{2}N_2(g) + O_2(g)$?
(a) $1/(4K_1K_2)$ (b) $[1/K_1K_2]^{1/2}$
(c) $1/(K_1K_2)$ (d) $1/(2K_1K_2)$

26. Acidified $K_2Cr_2O_7$ solution turns green when Na_2SO_3 is added to it. This is due to the formation of
(a) CrO_4^{2-} (b) $Cr_2(SO_3)_3$
(c) $CrSO_4$ (d) $Cr_2(SO_4)_3$

27. Among the following the least thermally stable is
(a) K_2CO_3 (b) Na_2CO_3 (c) $BaCO_3$ (d) Li_2CO_3

28. Which one of the following is '*d*'-block element?
(a) Gd (b) Hs
(c) Es (d) Cs

29. The angular shape of ozone molecule (O_3) consists of
(a) 1 sigma and 2 pi bonds
(b) 2 sigma and 2 pi bonds
(c) 1 sigma and 1 pi bonds
(d) 2 sigma and 1 pi bonds

30. If the E°_{cell} for a given reaction has a negative value then which of the following gives the correct relationships for the values of ΔG° and K_{eq}?
(a) $\Delta G^\circ < 0;\ K_{eq} > 1$ (b) $\Delta G^\circ < 0;\ K_{eq} < 1$
(c) $\Delta G^\circ > 0;\ K_{eq} < 1$ (d) $\Delta G^\circ > 0;\ K_{eq} > 1$

31. Among the following the molecule possessing highest dipole moment is
(a) CO_2 (b) BF_3
(c) SO_2 (d) *Trans* – 2-butene

32. An electron is moving in Bohr's fourth orbit. Its de-Broglie wave length is λ. What is the circumference of the fourth orbit?
(a) $\frac{2}{\lambda}$ (b) 2λ (c) 4λ (d) $\frac{4}{\lambda}$

33. The standard enthalpies of formation of $A(NH_3)$, $B(CO_2)$, $C(HI)$ and $D(SO_2)$ are -46.19, -393.4, $+24.94$ and -296.9 kJ mol^{-1} respectively. The increasing order of their stability is
(a) $B < D < A < C$ (b) $C < A < D < B$
(c) $D < B < C < A$ (d) $A < C < D < B$

34. Green chemistry means such reactions which
(a) produce colour during reactions
(b) reduce the use and production of hazardous chemicals
(c) are related to the depletion of ozone layer
(d) study the reactions in plants

35. Which of the following compounds gives carbylamine test?
(a) N-methyl-o-methyl aniline
(b) N, N-dimethyl aniline
(c) 2 4-diethyl aniline
(d) *p*-methyl-N-methyl benzylamine

36. Which of the following is an example for heterogeneous catalysis reaction?
(a) $2SO_2(g) + O_2(g) \xrightarrow{NO(g)} 2SO_3(g)$
(b) Hydrolysis of aqueous sucrose solution in the presence of a aqueous mineral acid
(c) $2H_2O_2(l) \xrightarrow{Pt(s)} 2H_2O(l) + O_2(g)$
(d) Hydrolysis of liquid in the presence of aqueous mineral acid

37. Which of the following pair of metals is purified by van- Arkel method?
(a) Zr and Ti
(b) Ag and Au
(c) Ni and Fe
(d) Ga and In

38. Name the type of the structure of silicate in which one oxygen atom of $[SiO_4]^{4-}$ is shared?
(a) Sheet silicate
(b) Pyrosilicate
(c) Three dimensional silicate
(d) Linear chain silicate

39. In Fischer-Ringe's method of separation of nobles gas mixture from air, ... is used
(a) 90% CaC_2 + 10%$CaCl_2$
(b) coconut charcol
(c) soda lime + potash solution
(d) 90% $CaCO_3$ + 10% urea

40. Which one of the following is present as an active ingredient in bleaching powder for bleaching action?
(a) $Ca(OCl)_2$
(b) CaO_2Cl
(c) $CaCl_2$
(d) $CaOCl_2$

Zoology

1. The most recent and direct pre-historic ancestor is
(a) cro-magnon (b) neanderthal
(c) pre-neaderthal (d) None of these

2. Rh-factor can produce disease
(a) AIDS
(b) Turner's syndrome
(c) Erythroblastosis foetalis
(d) Sickle cell anaemia

3. Pneumotoxic centre which can moderate the functions of the respiratory rhythm centre is present at
(a) pons region in brain
(b) thalamus
(c) spinal cord
(d) right cerebral hemisphere

4. Which type of cells are absent in sponges?
(a) Trophocytes (b) Myocytes
(c) Archeocytes (d) Cnidocytes

5. Zero growth means
(a) natality balance mortality
(b) natality is more than mortality
(c) natality is less than mortality
(d) natality is zero

6. Which of the following hormone secretes a gastric secretion?
(a) Entero gastrone (b) Gastrin
(c) CCK-PZ (d) Villikinin

7. The protein $\alpha - 1$ antitrypsin is used to treat which of the following disease?
(a) Cancer
(b) Rhematoid arthritis
(c) Emphysema
(d) ADA deficiency disease in children

8. Darwins finches represent
(a) morphological variations
(b) geographical isolations
(c) climate variations
(d) reproductive isolation

9. Food storage in *Leucosolenia* occur by
(a) ostia
(b) osculam
(c) thesocyte
(d) spongocoel

10. Hardy-Weinberg equilibrium is known to be affected by gene flow, genetic drift, mutation, genetic recombination and
(a) evolution (b) limiting factors
(c) saltation (d) natural selection

11. Which one of the following in birds indicates their reptilian ancestry?
(a) Scales on their hindlimbs
(b) Four-chambered heart
(c) Two special chambers crop and gizzards in their digestive tract
(d) Egg with a calcareous shell

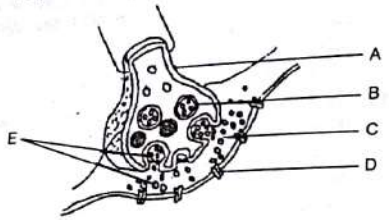
12. Darwinism explains all the following except
(a) within each species, there are variations
(b) organisms tend to produce more number of offspring that can survive
(c) offspring with better traits that overcome competition are best suited for the environment
(d) variations are inherited from parents to offspring through genes

13. Which of the following disorder is an outcome of irregularities in metabolism of the nitrogenous waste?
(a) Osteoporosis (b) Gouty arthritis
(c) Osteroarthritis (d) Rheumatoid arthritis

14. During urine formation, which of the following processes create high osmotic pressure in the uriniferous tubule?
(a) Active Na^+ absorption, followed by absorption of Cl^-
(b) Active Cl^- absorption, followed by absorption of Na^+
(c) Active secretion of Na^+ into efferent arteriole followed by absorption of Cl^- into efferent renal arteriole
(d) Active secretion of Cl^- and absorption of N^+a into efferent renal arteriole

15. Steroid hormones work as
(a) they enter into target cells and binds with specific receptor and activates specific genes to form protein
(b) they binds to cell membrane
(c) they catalyse formation of cAMP
(d) None of the above

16. In the following diagram showing axon terminal and synapse A, B, C, D and E respectively represents



(a) A-axon terminal, B-synaptic cleft, C-synaptic vesicles, D-neurotransmitters, E-receptors
(b) A-axon terminal, B-synaptic vesicles, C-synaptic cleft, D-receptors, E-neurotransmitters
(c) A-synaptic cleft, B-synaptic vesicles, C-axon terminal, D-neurotransmitters, E-receptors
(d) A-synaptic cleft, B-axon terminal, C-synaptic vesicles, D-neurotransmitters, E-receptors
(e) A-synaptic vesicles, B-axon terminal, C-synaptic cleft, D-receptors, E-neurotransmitters

17. Adrenaline and noradrenaline are hormones that act as
(a) energy producing agents
(b) food storage materials
(c) neurotransmitters
(d) energy storing substances

18. If due to some injury the chordae tendinae of the tricuspid valve of the human heart is partially non-functional, what will be the immediate effect?
(a) The flow of blood into the aorta will be slowed down
(b) The 'pace maker' will stop working
(c) The blood will tend to flow back into the left atrium
(d) The flow of blood into the pulmonary artery will be reduced

19. The vector for T-DNA is
(a) *Thermus aquaticus*
(b) *Salmonella typhimurium*
(c) *Agrobacterium tumefaciens*
(d) *Escherichia coli*

20. Match the enzyme in column I with its function in column II and choose the correct option.

Column I	Column II
A. β-galactosidase	1. Joining of DNA fragments
B. Permease	2. Peptide bond formation
C. Ligase	3. Hydrolysis of lactose
D. Ribozyme	4. Increases permeability to β-galactosidase

	A	B	C	D
(a)	2	1	4	3
(b)	3	2	1	4
(c)	2	4	1	3
(d)	1	2	4	3

21. In the central nervous system, myelinated fibres form the....., while the non-myelinated fibre cells form the ..... .
(a) grey matter, white matter
(b) white matter, grey matter
(c) ependymal cells, neurosecretory cells
(d) neurosecretory cells, ependymal cells

22. Haemoglobin is
(a) an oxygen carrier in human blood
(b) a protein used as food supplement
(c) an oxygen scavenger in root nodules
(d) a plant protein with high lysine content

23. Which of the following tissue is a vascular?
(a) Cowpait bone
(b) Skeletal muscle
(c) Stratified squamous epithelium
(d) Adipose tissue

24. Many elements are found in living organisms either free or in form of compounds. One of the following is negligible is living organisms
(a) silicon (b) magnesium
(c) iron (d) sodium

25. Which of the following represent uridylic acid?
(a) Uracil+Ribose
(b) Uridine+Phosphoric acid
(c) Uracil+Phosphoric acid
(d) Uridine+Ribose+Phosphoric acid

26. Consider the following statements with two blanks X and Y and select the option which correctly fills up these blanks?

In the centre of the inter vertebrel disc, a soft area is present called ....X... .

Which is supposed to be remnant of ....Y.. .

X	Y
(a) Nucleus pulposus	Nerve cord
(b) Centrum	Noto cord
(c) Nucleus pulposus	Noto cord
(d) Centrum	Nerve cord

27. Six highly chitinous plate-like teeth are found in ..... of cockroach
(a) mandible (b) gizzard
(c) mexilla (d) rectum

28. The statement All biological catalysts are proteins is no longer valid after the discovery of
(a) ribonuclease (b) ribozyme
(c) RNAs (d) DNAs

29. The structure present in all adult vertebrates is
(a) notochord (b) dorsal tubular nerve cord
(c) pharyngeal gill slits (d) All of these

30. Which one of the following is not a vertebrate?
(a) Sea cow (b) Sea lion
(c) Sea horse (d) Sea hare

31. In human during fertilisation a sperm firstly comes in contact with which layer of ovum
(a) zona pellucida (b) vitelline membrane
(c) jelly coat (d) zona radiata

32. Newly formed Biosphere Reserve of India (2013) is
(a) Pachmarhi (b) Himalaya
(c) Cold desert (d) Panna

33. Which statement is correct for bacterial transduction?
(a) Transfer of some genes from one bacteria to another bacteria through virus
(b) Transfer of genes from one bacteria to another bacteria by conjugation
(c) Bacteria obtain DNA directly
(d) Bacteria obtain DNA from other external source

34. Theory of pangenesis was given by
(a) Darwin (b) Lamarck
(c) Hugo de Vries (d) Oparin

35. Which part of animal virus is not reproduced in multiple copies?
(a) Capsid (b) Proteins
(c) Envelops (d) Ribosome

36. Viroids have
(a) ssRNA not enclosed by protein coat
(b) ssDNA not enclosed by protein coat
(c) dsDNA enclosed by protein coat
(d) dsRNA enclosed by protein coat

37. Biotic potential or potential natality means
(a) natural increase of population under ideal/optimum conditions
(b) potential of organism in a biome
(c) number of organisms in a biome
(d) species of maximum number in a population

38. The world's highly prized wool yielding 'Pashmina' breed is
(a) sheep
(b) goat
(c) goat-sheep cross
(d) Kashmiri sheep-Afghan sheep cross

39. Probes, used in DNA fingerprinting, are initially
(a) single stranded RNA
(b) mini-satellite
(c) 19 base long oligonucleotide
(d) All of the above

40. Satellite DNA is useful tool in
(a) organ transplantation (b) sex determination
(c) forensic science (d) genetic engineering

Botany

1. Which of the following is non-symbiotic nitrogen fixer organism?
(a) VAM (b) *Azotobacter*
(c) *Anabaena* (d) *Rhizobium*

2. Aleurone grains are rich in
(a) fat (b) protein
(c) carbohydrates (d) auxins

3. Match the following columns and choose the correct option.

Column I	Column II
A. Mutation breeding	1. Laborious and expensive process to obtain gene variation
B. Selection	2. Hybrid vigour can be maintained for several generations
C. Hybridisation	3. Simplest and easiest method of plant improvement
D. Introduction	4. Oldest breeding method
	5. Quick method to obtain gene variation

	A	B	C	D
(a)	5	4	1	2
(b)	5	4	1	3
(c)	4	2	3	1
(d)	1	2	4	5

4. The ruptere and fractionation do not usually occur in water column in vessel/trachieds during the ascent of sap because of
(a) lignified thick walls
(b) cohesion and adhesion
(c) weak grauitational pull
(d) transpiration pull

5. Stability of ecosystem depends upon
(a) primary productivity
(b) interchange between producers and consumers
(c) number of producers
(d) number of consumers

6. The material, which arrests cell division, is obtained from
(a) *Crocus* (b) *Colchicum*
(c) *Dalbergis* (d) *Chysanthomum*

7. *Viscum album* grown on trees. This is an example of
(a) symbiosis (b) parasitism
(c) commensalism (d) predation

8. Which of the following is responsible for biological nitrogen-fixation?
(a) Nife gene
(b) Nitrogenase
(c) Yeast alanin *t*RNA synthetase
(d) RNA synthetase

9. The respiratory quotient during cellular respiration would depend on the
(a) nature of enzymes involved
(b) nature of the substrate
(c) amount of carbon dioxide released
(d) amount of oxygen utilised

10. Which of the following supports a dense population of plankton and littoral vegetation?
(a) Oligotrophic (b) Eutrophic
(c) Lithotrophic (d) Agroecotrophic

11. Which of the following is not true for a species?
(a) Members of a species can interbreed
(b) Variations occur among members of species
(c) Each species is reproductively isolated from every other species
(d) Gene flow does not occur between the populations of a species

12. Given below is the chemical formula of

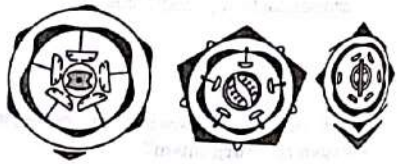
$$CH_3(CH_2)_{14}—\overset{\overset{O}{\|}}{C}—OH$$

(a) palmitic acid (b) glycerol
(c) galactose (d) stearic acid

13. Choose the wrong pair
(a) *Cenchrus* –Savanna
(b) *Abies* – Coniferous forest
(c) *Quercus* – Broad leaf forest
(d) *Tectona* – Temperate forest

14. Rarely among angiosperms, the pollen grains influenced the endosperm. This is called as
(a) meta xenia
(b) nemec phenomenon
(c) xenia
(d) mesogamy

15. Three floral diagrams are given here. Their respective families are assigned in the answer key. Find out the families to which these diagrams belong to



A B C

A - $\oplus\,♀\,K_{pappus}C_{(5)}A_5G_{\underline{(2)}}$

B - $♂\,♀\,K_{(5)}C_{(5)}A_5G_{\underline{(2)}}$

C - $\oplus\,♂\,♀\,K_{2+2}C_4A_{2+4}G_{\underline{(2)}}$

(a) A–Liliaceae, B–Asteraceae, C–Solanaceae
(b) A–Asteraceae, B–Solanaceae, C–Brassicaceae
(c) A–Asteraceae, B–Solanaceae, C–Asteraceae
(d) A–Poaceae, B–Solanaceae, C–Asteraceae

16. Tyloses an out growth from ray or axial parenchyma cell into the lumen of a vessel, which partially or completely blocks the cavity are present in
(a) periderm
(b) heart wood
(c) sap wood
(d) secondary cortex

17. Overlapping region between two ecosystems is called
(a) biome (b) ecotone
(c) niche (d) photic zone

18. Phage genome site on bacterial chromosome resulted in the structure
(a) nucleic acid (b) heterocyst
(c) prophage (d) None of these

19. 'Sun basket' is
(a) the device to utilise sun rays directly to meet the requirement of heat energy
(b) the sufficient amount of sunlight stored in a cell
(c) a device of taking sunbath
(d) All of the above

20. The dominant epistasis ratio is
(a) 9:3: 3:1 (b) 12:3:1
(c) 9:3:4 (d) 9:6:1

21. Benthic organisms are found in
(a) surface of marine water
(b) middle of water in sea
(c) bottom of sea
(d) on ground

22. Ethylene is related with
(a) aerobic respiration
(b) climecteric phenomenon
(c) anaerobic respiration
(d) fermentation

23. Select the correct statement from the one's given below with respect to dihybrid cross.
(a) tightly linked gene on the same chromosome show higher recombinations
(b) genes for apert on same chromosomes show very few recombination
(c) genes loosely linked on the same chromosomes show similar recombination as lightly linked ones
(d) tightly linked genes on the same chromosomes show very few recombination

24. Maximum green house gases are released by
(a) India (b) Britain
(c) USA (d) France

25. In a coal fired power plant, electrostatic precipitators are installed to control emission of
(a) SO_2 (b) NO_x (c) SPM (d) CO

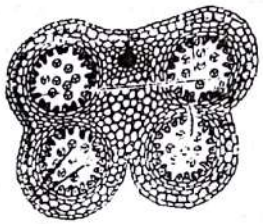
26. Two genes R and y are located very close on the chromosome linkage map on maize plant. When RRYY and rryy genotypes are hybridised, then F_2 segregation will show
(a) higher number of the recombinant types
(b) Segregation with expected 9:3:3:1 ratio
(c) Segeragation is 3 1 ratio
(d) higher number of the parental types

27. A lake with an inflow of domestic sewage rich in organic waste may result in
(a) drying of the lake very soon due to algal bloom
(b) an increased production of fish due to lot of nutrients
(c) death of fish due to lack of oxygen
(d) increased population of aquatic food web organisms

28. Allelic sequence variation where more than one variant allele at a locus in a human population with a frequency greater than 0.01 is referred to as
(a) DNA polymorphism (b) multiple allelism
(c) SNP (d) EST

29. Besides dung, the weed that can be used in biogas production is
(a) *Hydrilla*
(b) *Solanum nigrum*
(c) *Eichhornia Crassipes*
(d) *Parthenium hysterophorus*

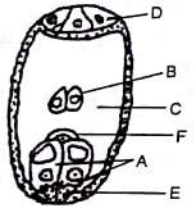
30. The following is the diagram of TS of anther. Identify the parts labelled as A, B and C.



(a) A–Connective, B– Endothecium, C– Pollen grain
(b) A–Endothecium, B–Connective, C–Pollen grain
(c) A–Pollen grain, B–Connective, C–Endothecium
(d) A–Endothecium, B–Pollen grain, C–Connective

31. *Bacillus thuringiensis* (*Bt*) strains have been used for designing novel
(a) bio metallurgical technique
(b) bio mineralisation processes
(c) bio insecticidal plants
(d) bio fertilisers

32.



In the given diagram, parts labelled as A, B, C, D, E and F are respectively indentified as
(a) synergids, polar nuclei, central cell, antipodals, filiform apparatus and egg
(b) polar nuclei, egg, antipodals, central cell, filiform apparatus and synergids
(c) egg, synergids, central cell, filiform apparatus, antipodals and polar nuclei
(d) central cell, polar nuclei filiform apparatus, antipodals, synergids and egg

33. In some organisms, karyokinesis is not followed by cytokinesis as a result of which, multinucleate condition arises leading to the formation of syncytium. The perfect example for this is
(a) appearance of a furrow in cell membrane
(b) liquid endosperm in coconut
(c) sexual reproduction
(d) fertilisation

34. Jacob and Monod named some enzymes as allosteric whose activity is regulated by
(a) end product (b) substrate
(c) by product (d) coenzyme

35. The mobile genetic element is
(a) transposon (b) mutation
(c) endonuclease (d) variation

36. In recombinant DNA technique, the term vector refers to
(a) donor DNA, is identified and picked up through electrophoresis
(b) plasmid, transfers DNA into living cell
(c) collection of entire genome in form of plasmid
(d) enzyme, cuts the DNA at specific sites

37. The net requirement of assimilatory power for the formation of 6 hexose molecules in maize plant is
(a) 72 ATP, 48 NADPH (b) 90 ATP, 60 NADPH
(c) 108 ATP, 72 NADPH (d) 180 ATP, 72 NADPH

38. When two unrelated individuals or lines are crossed, the performance of F_1 hybrid in often superior to both of its parents. This phenomenon is called
(a) transformation (b) heterosis
(c) splicing (d) meta morphosis

39. Given below is a sample of portion of DNA strand given the base sequence on the opposite strand. What is so special show in it?

5'– GAATTC...3'

3'– CTTAAG ... 5'

(a) Detection mutation
(b) Start codon at 5' end
(c) Palindromic sequence of base pairs
(d) Replication completed

40. *Rauwolffia serpentina* is used in
(a) curing high blood pressure
(b) kidney failure
(c) eye defect
(d) diabetes

English

Directions (Q. Nos. 1-5) *Choose the word/ group of words which is the most nearly SAME in meaning as the word/group of words given in* **bold** *as used in the passage.*

1. SINCERE
(a) Open (b) Earnest
(c) Dissolute (d) Upright

2. ENCOURAGE
(a) Animate (b) Urge
(c) Stimulate (d) Dissuade

3. SELF-SUFFICIENT
(a) Adequate (b) Dpendent
(c) Overflowing (d) Self-reliant

4. FOCUS
(a) Adjust (b) Concentrate
(c) Meditate (d) Circulate

5. SUPERFICIAL
(a) Artificial (b) Shallow
(c) Complete (d) Profound

Directions (Q.Nos. 6-15) Pick out the most effective word/phrase from the given words to fill in the blank to make the sentence meaningfully complete.

6. He knelt at his side and comforted him with ..... words.
(a) harsh (b) silent
(c) kind (d) cruel

7. A man who is perpetually ..... which of the two things he will do first, will do neither.
(a) confuses
(b) forced
(c) orders
(d) hesitating

8. We cannot ..... of life without suitable environment.
(a) live (b) buy
(c) extract (d) think

9. He thought the boy ..... to benefit the blacksmith.
(a) wants (b) wanting
(c) desire (d) harm

10. The fisherman gladly ..... up the baby and took it home.
(a) loaded
(b) picked
(c) dragged
(d) pushed

Directions (Q.Nos. 11-15) Read each sentence to find out whether there is any grammatical error or idiomatic error in it. The error, if any, will be in one part of the sentence. The number of that part is the answer. If there is no error, the answer is (d) i.e., 'No error (Ignore errors of punctuation, if any).

11. He is neither in (a)/ favour of arms race or in favour of (b)/ simple nuclear disarmament.(c)/No error (d)

12. Naturalisation is the process by which (a)/ a immigrant becomes a citizen (b)/of his new country. (c)/ No error (d)

13. A high fat diet not only increases the risks (a)/ of heart ailments (b) / however also that of other disorders. (c)/ No error (d)

14. When two vowel (a)/ sounds occurs in direct succession, (b) / the transition between them is often difficult to make. (c)/ No error (d)

15. The solutions is to avoid the impasse altogether, (a)/ by taking a (b) / slightly different route. (c)/ No error (d)

Directions (Q.Nos.16-20) *Rearrange the following sentences to make a meaningful paragraph and then answer the questions given below them.*

A. A classroom discussion can be initiated in order to answer this very question.
B. An electric current could not be made to traverse distilled water.
C. Yet when salt and distilled water were mixed, then the solution became a liquid through which electricity could pass with ease.
D. Neither would solid salt offer free passage to electricity.
E. How could one explain this strange behaviour of solution.
F. And, as the current passed through this solution, a deep seated decomposition took place.

16. Which of the following will be the **FIFTH** sentence?
(a) A (b) C
(c) B (d) E

17. Which of the following will be the **FOURTH** sentence?
(a) A (b) B
(c) F (d) E

18. Which of the following will be the **LAST** (SIXTH) sentence?
(a) C (b) A
(c) B (d) E

19. Which of the following will be the **THIRD** sentence?
(a) C (b) D
(c) F (d) A

20. Which of the following will be the **FIRST** sentence?
(a) A (b) D
(c) B (d) C

Directions (Q.Nos. 21-25) *Which of the phrases* (a), (b) *and* (c) *given below each sentence should replace the phrase printed in bold in the sentence to make it grammatically correct? If the sentence is correct as is given and no correction is required, mark* (d) *as the answer.*

21. Your doctor may explain the importance of **a proper and balanced** diet in the human body.
(a) an proper and balanced
(b) a proper or balance
(c) a prosperous and balance
(d) No correction required

22. English today **is closer to been** a world language than any other language has been in history.
(a) is closer for been
(b) is closer upon being
(c) is closer to being
(d) No correction required

23. In almost every occupation one **needs simple** a understanding of electricity.
(a) needed simple an
(b) need a simple
(c) needs a simple
(d) No correction required

24. When ice and water **existed together on** the same volume, the temperature remains constant.
(a) exist together in
(b) will exist together on
(c) existed together in
(d) No correction required

25. Scientific method as a rote item in the syllabus **had little valued.**
(a) had belittled value
(b) has little value
(c) have little value
(d) No correction required

Directions (Q.Nos. 26-30) *In each sentence below three words have been printed in bold which are numbered* (a), (b) *and* (c). *One of these words may be misspelt or inappropriate in the context of the sentence. Find out the wrongly spelt or inappropriate word. The number of that word is the answer. If all the words are correctly spelt and are appropriate the answer is* (d) i.e. *all correct.*

26. The **importanse** (a) given to content-oriented approach has affected the **methodology** (b) of this **project**. (c) All correct (d)

27. Almost all **risk-taking** (a) work **involve** (b) decision making under **uncertainty**. (c) All correct (d)

28. In **developing** (a) countries there is **increesing** (b) concern for fostering human **potential**. (c) All correct (d)

29. I want to **express** (a) my **appreciation** (b) of the help offered by my former **colleages**. (c) All correct (d)

30. The **research** (a) reported in this valume (b) assumes **importance**. (c) All correct (d)

Directions (Q.Nos. 31-40) *In the following passage there are blanks, each of which has been numbered. These numbers are printed below the passage and against each, four words are suggested, one of which fits the blank appropriately. Find out the appropriate word in each case.*

Working under the psychometric approach, both scientists and practitioners have placed undue emphasis upon a unitary concept of intelligence as reflected in the single I.Q. They seem to have ....(31).... too much attention to the products of intelligent behaviour rather than the processes used to acquire ....(32).... products. Such attention to product rather than to process tends to mark qualitative differences in the processes by ....(33).... individuals interact with their environment and to ....(34).... attention away from the possibility of qualitative changes in the nature of these processes ....(35).... the course of cognitive development.

Haywood points out that there is no such thing as intelligence. There are in fact many intelligences. Factor analysts, ...(36).... have studied the nature of intellect by examining its apparent structure across different age groups and different segments of the population have to a great ....(37).... discredited the unitary concept of intelligence. Even so, the structure theories of intelligence are ....(38).... concerned with products and not with processes.

A very promising approach to the nature of intelligence in recent years is the process development (Cognitive Development) approach. It ....(39).... upon the cognitive processes used to receive, code and ....(40).... information.

31. (a) gives (b) gave
(c) forced (d) given

32. (a) those (b) these
(c) that (d) raw

33. (a) how (b) way
(c) speech (d) which

34. (a) draw (b) seek
(c) force (d) drag

35. (a) at (b) plan
(c) during (d) follow

36. (a) who (b) should
(c) might (d) will

37. (a) meaning (b) person
(c) extend (d) extent

38. (a) uptill (b) till
(c) until (d) still

39. (a) focus (b) focuses
(c) jumps (d) emphasise

40. (a) pack (b) transmits
(c) store (d) stocked

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Answers

Physics

1. (b)	2. (b)	3. (c)	4. (d)	5. (b)	6. (c)	7. (c)	8. (c)	9. (b)	10. (c)
11. (a)	12. (b)	13. (c)	14. (b)	15. (b)	16. (b)	17. (a)	18. (b)	19. (d)	20. (c)
21. (d)	22. (a)	23. (c)	24. (a)	25. (a)	26. (b)	27. (d)	28. (c)	29. (a)	30. (c)
31. (b)	32. (a)	33. (d)	34. (d)	35. (d)	36. (b)	37. (a)	38. (b)	39. (b)	40. (c)

Chemistry

1. (a)	2. (a)	3. (a)	4. (b)	5. (d)	6. (b)	7. (c)	8. (d)	9. (b)	10. (c)
11. (c)	12. (a)	13. (c)	14. (b)	15. (b)	16. (b)	17. (a)	18. (c)	19. (d)	20. (b)
21. (a)	22. (b)	23. (c)	24. (b)	25. (b)	26. (d)	27. (d)	28. (b)	29. (d)	30. (c)
31. (c)	32. (c)	33. (b)	34. (b)	35. (c)	36. (c)	37. (a)	38. (b)	39. (a)	40. (a)

Zoology

1. (a)	2. (c)	3. (a)	4. (d)	5. (a)	6. (b)	7. (c)	8. (b)	9. (c)	10. (c)
11. (d)	12. (d)	13. (b)	14. (a)	15. (b)	16. (b)	17. (c)	18. (a)	19. (c)	20. (b)
21. (b)	22. (a)	23. (c)	24. (a)	25. (d)	26. (c)	27. (b)	28. (b)	29. (b)	30. (d)
31. (d)	32. (d)	33. (a)	34. (a)	35. (c)	36. (a)	37. (a)	38. (b)	39. (b)	40. (c)

Botany

1. (b)	2. (b)	3. (b)	4. (b)	5. (b)	6. (b)	7. (b)	8. (a)	9. (b)	10. (b)
11. (d)	12. (a)	13. (d)	14. (c)	15. (b)	16. (b)	17. (b)	18. (c)	19. (b)	20. (b)
21. (c)	22. (b)	23. (d)	24. (c)	25. (c)	26. (d)	27. (c)	28. (a)	29. (c)	30. (a)
31. (c)	32. (a)	33. (b)	34. (a)	35. (a)	36. (b)	37. (d)	38. (b)	39. (c)	40. (a)

English

1. (d)	2. (c)	3. (d)	4. (b)	5. (b)	6. (c)	7. (d)	8. (d)	9. (a)	10. (b)
11. (a)	12. (b)	13. (a)	14. (b)	15. (a)	16. (d)	17. (c)	18. (b)	19. (a)	20. (c)
21. (d)	22. (c)	23. (c)	24. (a)	25. (b)	26. (a)	27. (d)	28. (b)	29. (c)	30. (b)
31. (d)	32. (b)	33. (d)	34. (d)	35. (c)	36. (a)	37. (d)	38. (d)	39. (b)	40. (c)

Hints & Solutions

Physics

1. Ratio of heights

$$\frac{h_1}{h_2} = \frac{100}{100 - 50} = 2$$

$h_2 = \frac{h_1}{2} = \frac{1}{2}$ of the initial height.

2. $\tau = I\alpha$

I = moment of inertia

α = angular acceleration

If $\tau = 0 \Rightarrow I\alpha = 0$

But $I \neq 0$

$\therefore \alpha = 0$

3. Young's coefficient of elasticity

$$Y = \frac{mgL}{\pi r^2 \Delta L}$$

Substituting the values, we get

$\Delta L = 0.05\,\text{mm}$

4. Plate resistance $= \frac{\Delta V_{P_2} - \Delta V_{P_1}}{\Delta i_{P_2} - \Delta i_{P_1}}$

$$= \frac{150 - 100}{(12 - 7.5) \times 10^{-3}} = \frac{50 \times 10^3}{4.5}$$

$= 11.1\,\text{k}\Omega$

5. Ratio of intensities $\frac{I_1}{I_2} = \frac{\cos\theta_1}{\cos\theta_2} = \frac{\cos 60^\circ}{\cos 30^\circ}$

$I_2 = \sqrt{3} I_1$

6. Due to diffusion of charge carriers current flows throw in p-n junction.

7. If electron is accelerated by voltage V, then its kinetic energy $= \frac{1}{2}mv^2 = qV$

$$\frac{q}{m} = \frac{v^2}{2V}$$

$$= \frac{(8.4 \times 10^8)^2}{2 \times 200} = 1.76 \times 10^{15}$$

8. Frequency of open organ pipe is double than that of closed pipe.

If frequency of open pipe $= n$

$\therefore$ Frequency of closed pipe $= \frac{n}{2}$

On inserting an open pipe into water upto half of its height, it will behave like a closed pipe of half length and frequency is inversely proportional to the length of air column.

Hence, frequency of closed pipe will become double $= 2 \times \frac{n}{2} = n$

9. Apparent frequency $n' = n\left(\frac{v}{v + v_s}\right)$

v = velocity of sound,

v_s = velocity of source

$\therefore \quad n' = 300\left(\frac{332}{332 + 30}\right) = 273\,\text{Hz}$

10. Distance covered towards east

$= 2 \times 15 = 30\,\text{m}$

Distance covered towards north

$= 8 \times 5 = 40\,\text{m}$

Total displacement

$= \sqrt{40^2 + 30^2} = 50\,\text{m}$

Average velocity $= \frac{\text{Total displacement}}{\text{Total time}}$

$$= \frac{50}{2 + 8} = 5\,\text{m/s}$$

11. Wavelength $\lambda = \frac{hc}{p}$

$\therefore \quad \lambda = \frac{hc}{\sqrt{2mE}} \therefore \lambda \propto \frac{1}{\sqrt{m}}$

Mass of photon is less than that of electron.

$\therefore$ Wavelength of photon is greater than that of electron $\lambda_{ph} > \lambda_e$.

12. Dimension of torque $= [ML^2T^{-2}]$

Dimension of angular momentum $= [ML^2T^{-1}]$

$\therefore$ Relation $A - 4$, $B - 3$ is right.

13. $p^2 = 2ME$

$\therefore \quad p \propto \sqrt{E}$

$\therefore \quad \frac{p_1}{p_2} = \sqrt{\frac{E_1}{E_2}} = \sqrt{\frac{E}{E + 3E}} = \frac{1}{2}$

$$\Rightarrow \quad \rho_2 = 2\rho_1$$

$$\% \text{ Increase} = \frac{\rho_2 - \rho_1}{\rho_1} \times 100$$

$$\Rightarrow \frac{2\rho_1 - \rho_1}{\rho_1} \times 100 = 100\%$$

14. Variation in g at a height h from the earth surface $g' = g\left(1 - \frac{2h}{R_e}\right)$

Variation in g at a depth x below the earth surface $g'' = g\left(1 - \frac{x}{R_e}\right)$

But variations are same

$$\therefore \quad g\left(1 - \frac{2h}{R_e}\right) = g\left(1 - \frac{x}{R_e}\right)$$

$$\therefore \quad x = 2h$$

15. $T = 2\pi\sqrt{\frac{m}{R}} = 2\pi\sqrt{\frac{1}{400}} = \frac{2\pi}{20}$

Frequency $n = \frac{20}{2\pi}$

$$\omega = 2\pi n = 2\pi \times \frac{20}{2\pi} = 20$$

Total energy $E = \frac{1}{2} m\omega^2 r^2$

$$2 = \frac{1}{2} \times 1 \times 400 \times r^2$$

$$r = \frac{1}{10} \text{m}$$

$$\text{Acceleration} = \omega^2 r = 400 \times \frac{1}{10} = 40 \text{ m/s}^2$$

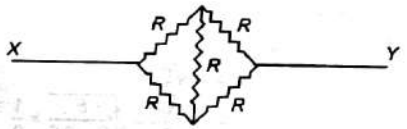
16. If charge on both the capacitors is same, then transfer of energy does not take place.

$$Q = CV$$

$$\therefore \quad C_1V_1 = C_2V_2$$

It is the required condition.

17. The given circuit can be shown in the following way. No, current will be flown in the middle resistance.



Equivalent resistence of R and $R' = 2R$

$$\text{Total resistance } \frac{1}{R'} = \frac{1}{2R} + \frac{1}{2R}$$

$$R' = R$$

18. Equation of vibration

$$y = 1\cos 2\pi t \sin 2\pi x$$

$$= 1\cos 2\pi \sin \frac{\pi x}{1/2}$$

Comparing this equation with

$$y = a\cos 2\pi \sin \frac{\pi x}{\lambda} \Rightarrow a = 1$$

Minimum length of string

$$= \frac{1}{2}a = \frac{1}{2} \times 1 = \frac{1}{2} \text{m}$$

19. If we change the value of R, then voltage on LC combination changes.

20. Electric field $E \propto r^2$.

21. Inside a dielectric sphere, electric field is zero.

22. According to galvanometer principle,

Heat given = Heat taken

$$m_1 s_1(100 - t) = mL + m_2 s_2(t - 0)$$

$$50 \times 1(100 - t) = 50 \times 80 + 50 \times 1(t - 0)$$

$$t = 10°\text{C}$$

23. Power consumption $= I_{rms}V_{rms}\cos\phi$

where, $\cos\phi$ is power factor.

$$\cos\phi = \frac{R}{Z}$$

For $\cos\phi$ to be minimum, R should be minimum and Z should be higher. So, higher Z (impedance), L (inductance) should be high.

24. Mass per unit length $m = 1.3 \times 10^{-4}$ kg/m

$$y = 0.021\sin(x + 30t)$$

Comparing with $y = a\sin\left(\omega t + \frac{2\pi x}{\lambda}\right)$

$$a = 0.021, \omega = 30$$

$$2\pi n = 30$$

$$\Rightarrow \quad n = \frac{30}{2\pi}$$

We know that $\frac{2\pi}{\lambda} = 1$

$$\therefore \quad \lambda = \frac{1}{2\pi}$$

$$\text{Frequency, } n = \frac{1}{\lambda}\sqrt{\frac{T}{m}}$$

$$\frac{30}{2\pi} = \frac{1}{2\pi}\sqrt{\frac{T}{1.3 \times 10^{-4}}}$$

$$T = 1.3 \times 10^{-4} \times 900$$

$$= 0.117 = 0.12 \text{ N}$$

25. Magnetic field at the centre of circular loop $B = \frac{\mu_0 I}{2R}$ interior.

26. $a = 0.3$, $\alpha = 1°$, $\mu = 1.54$, we know that $d = 2a(\mu - 1)\alpha$

$$= 2 \times 0.3(1.54 - 1) \times 1$$

$$= 2 \times 0.3 \times 0.54 = 0.324$$

$$\text{Fringe width } F = \frac{D\lambda}{d}$$

$$= \frac{0.7 \times 180\pi \times 10^{-9}}{0.324}$$

$$= \frac{7 \times 180\pi \times 10^{-6}}{324} = 10^{-3}\text{mm}$$

27. According to Bohr's model, relation between principal quantum number (n) and radius of stable orbit (r) are related as

$$r \propto n^2$$

28. Observer and light are moving towards each other, so relative velocity is $c + v$.

29. We know that $T \propto \frac{1}{\sqrt{H}}$

$$\therefore \quad \frac{T_1}{T_2} = \sqrt{\frac{H_2}{H_1}},$$

$$\frac{5}{10} = \sqrt{\frac{H_2}{3}} \Rightarrow \frac{1}{2} = \sqrt{\frac{H_2}{3}}$$

$$\frac{1}{4} = \frac{H_2}{3}$$

$$\therefore \quad H_2 = 0.75$$

Dippreciation in field $= 3 - 0.75 = 2.25$

30. Work function $W = \frac{hc}{\lambda}$

$$\lambda = \frac{hc}{W}$$

$$= \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{5.26 \times 10^{-18}} = 3444\,\text{Å}$$

31. Remaining quantity

$$N = N_0\left(\frac{1}{2}\right)^n = N_0\left(\frac{1}{2}\right)^5 = \frac{N_0}{32}$$

In percentage $N = \frac{N_0}{30 \times N_0} \times 100 = 3.125\%$

32. Efficiency of engine $\eta = 60\%$.

$$\text{Thus, power} = \frac{\text{work/time}}{\eta}$$

$$= \frac{100}{60} \times \frac{mgh}{t}$$

Given, $m = 100$ kg, $h = 10$ m, $t = 5$ s and $g = 10\text{ ms}^{-2}$

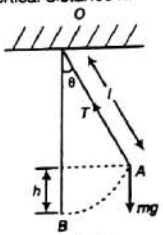
$$\text{Hence, power} = \frac{100}{60} \times \frac{100 \times 10 \times 10}{5}$$

$$= 3.3 \times 10^3 \text{ W} = 3.3 \text{ kW}$$

33. The simple pendulum at angular amplitude θ_0 is shown in the figure.

$$T_{max} = mg + \frac{mv^2}{l} \quad \ldots(i)$$

When, bob of pendulum comes from A to B, it covers a vertical distance h.



$$\therefore \quad \cos\theta_0 = \frac{l - h}{l}$$

$$\Rightarrow \quad h = l(l - \cos\theta) \quad \ldots(ii)$$

Also during A to B, potential energy of bob converts into kinetic energy

$$\therefore \quad mgh = \frac{1}{2}mv^2 \quad \therefore \quad v = \sqrt{2gh} \quad \ldots(iii)$$

Thus, using Eqs. (i), (ii) and (iii) we obtain

$$T_{max} = mg + \frac{2mg}{l} l(1 - \cos\theta_0)$$

$$= mg + 2mg\left[1 - 1 + \frac{\theta_0^2}{2}\right]$$

(By using binomial theorem)

$$= mg(1 + \theta_0^2)$$

34. According to Gauss theorem "the net electric flux through any closed surface is equal to the net charge inside the surface divided by ε_0".

Therefore, $\phi \propto \frac{q}{\varepsilon_0}$

Let $-q_1$ be the charge, due to which flux ϕ_1 is entering the surface,

$$\phi_1 = \frac{-q_1}{\varepsilon_0}$$

$$-q_1 = \varepsilon_0 \phi_1$$

Let $+q_2$ be the charge, due to which flux ϕ_2 is entering the surface.

$$\phi_2 = \frac{q_2}{\varepsilon_0}$$

or $$q_2 = \varepsilon_0 \phi_2$$

So, electric charge inside the surface

$$= q_2 - q_1$$
$$= \varepsilon_0 \phi_2 + \varepsilon_0 \phi_1$$
$$\Rightarrow = \varepsilon_0 (\phi_2 + \phi_1)$$

35. Given, that $p \propto T^3$

or $$pT^{-3} = \text{constant} \quad \ldots(i)$$

Also for adiabatic process,

$$pV^{\gamma} = \text{constant}$$

But $pV = RT$ (ideal gas law)

or $$V = \frac{RT}{p}$$

$$\therefore \quad p\left(\frac{RT}{p}\right)^{\gamma} = \text{constant}$$

$$p^{1-\gamma} T^{\gamma} = \text{constant}$$

or $$pT^{\gamma/(1-\gamma)} = \text{constant} \quad \ldots(ii)$$

Equating Eqs. (i) and (ii), we get

$$\frac{\gamma}{1-\gamma} = -3$$

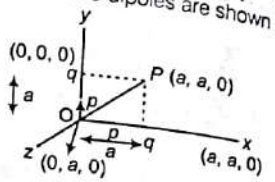
or $$\gamma = -3 + 3\gamma$$

or $$2\gamma = 3$$

$$\therefore \quad \gamma = \frac{3}{2}$$

or $$\frac{C_p}{C_v} = \frac{3}{2}$$

36. O is the origin at which $-2q$ charge is placed. The system is equivalent to two dipoles along x and y-directions respectively. The dipole moments of two dipoles are shown in figure



The resultant dipole moment will be directed along OP where $P = (a, a, 0)$. The magnitude of resultant dipole moment is

$$p' = \sqrt{p^2 + p^2} = \sqrt{(qa)^2 + (qa)^2} = \sqrt{2}qa$$

37. Block will come to rest, if force applied on it, it will vanish due to frictional force acting between block B and surface, *i.e.*,

Force applied = Frictional force

i.e., $\mu mg = ma$

or $$\mu mg = m\left(\frac{v}{t}\right) \text{ or } t = \frac{v}{\mu g}$$

38. $n = \frac{360°}{\theta} - 1$

$$3 = \frac{360°}{\theta} - 1$$

$$\theta = 90°$$

39. When particle describes circular path in a magnetic field, its velocity is always perpendicular to the magnetic force?

Power $P = \mathbf{F} \cdot \mathbf{v} = Fv\cos\theta$

Hence, $\theta = 90°$

$P = 0$

But $P = \frac{W}{t} \Rightarrow W = P \cdot t$

Hence, work done $W = 0$ (everywhere)

40. The height (h) transversed by particle while going up is

$$n = \frac{u^2}{2g} = \frac{25}{2 \times 9.8}$$

Work done by gravity force $= mg \cdot h$

$$= 0.1 \times g \times \frac{25}{2 \times 9.8} \cos 180°$$

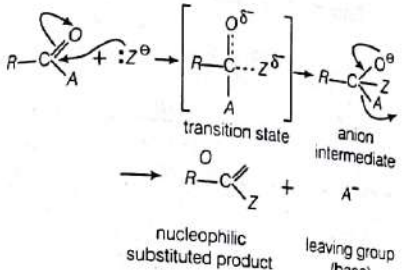
(angle between force and displacement is 180°)

$$\therefore \quad W = -0.1 \times \frac{25}{2} = -1.25$$

Chemistry

1. The ease of nucleophilic substitution is depend upon the nature of leaving group. When the leaving tendency of a group in a compound is high, then the compound is more reactive towards nucleophilic substitution.

The nucleophilic acyl substitution is completed in two steps as shown below



The reactivity of the compound may be explained on the basicity of the leaving group. A weaker base is a better leaving group. The basicity order is as

$$Cl^- > RCOO^- > RO^- > NH_2^-$$

Hence, the order of the leaving tendency is

$$Cl^- > RCOO^- > R{-}O^- > NH_2^-$$

and therefore, the order of reactivity of acyl compound is as

$$RCOCl > \begin{matrix} RCO \\ RCO \end{matrix}\!\!>O > RCOOR > RCONH_2$$

Acyl chloride > Acid anhydride > Ester > Amide

2. The reducing agent used in Clemmensen reduction is Zn-Hg and HCl. It converts $>C=O$ group into $-CH_2$ group.

$$>C=O \xrightarrow{Zn\text{-}Hg/HCl} >CH_2$$

3. $\frac{p_1 V_1}{T_1} = \frac{p_2 V_2}{T_2}$

or $\frac{(p - p_1)}{T_1} V_1 = \frac{p_2 V_2}{T_2}$

where,

$p_1 = p - p_1$

$p = 715$ mm (pressure at which N_2 collected).

p_1 = aqueous tension of water = 15 mm

$t_1 = t + 273 = 300$ K

$V_1 = 55$ mL = Volume of moist nitrogen in nitrometer

p_2 = pressure of N_2 at STP = 760 mm

t_2 = temperature of N_2 at STP = 273 K

$V_2 = ?$

$$\therefore V_2 = \frac{(715 - 15)}{300} \times 55 \times \frac{273}{760} = 46.098 \text{ mL}$$

% of nitrogen in the given compound

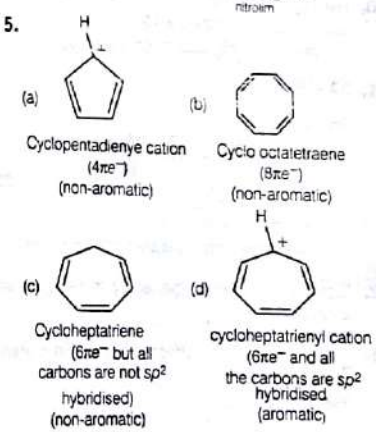
$$= \frac{28}{22400} \times \frac{V_2}{W} \times 100 = \frac{28}{22400} \times \frac{46.098}{0.35} \times 100$$

$= 16.45\%$

4. A mixture of calcium cyanamide $CaCN_2$ and coke (C) is called nitrolim. It is used as a fertilizer and can be prepared by passing nitrogen on CaC_2

$$CaC_2 + N_2 \xrightarrow{1100°C} \underset{\text{nitrolim}}{CaCN_2} + C$$

5.

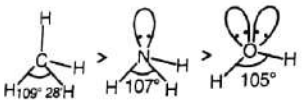


6. The complexes $[Co(NH_3)_6][Cr(CN)_6]$ and $[Cr(NH_3)_6][Co(CN)_6]$ are the examples of coordination isomerisms. This isomerism occurs only in those complexes in which both cation and anion are complex. It occurs due to exchange of ligands between cation and anion.

7. When the attraction forces between the two components of a solution are greater than that between the components themselves, the obtained solution exhibit negative deviation from Raoult's law. In case of solution of chloroform and acetone, the forces of attraction between chloroform and acetone is greater than that exists between the molecules of chloroform or between the molecules of acetone, thus this solution shows negative deviation.

8. Nitrobenzene being a covalent compound is insoluble in water but soluble in benzene, alcohol etc.

9. Bond angles depend upon number of lone pair (s) of electrons. Higher the number of lone pairs of electrons, lesser the bond angle.



10. Hydrogen peroxide oxidise lead sulphide into lead sulphate which is a solid.

$$PbS + 4H_2O_2 \longrightarrow PbSO_4 + 4H_2O$$

11. $2A + B \longrightarrow C$

Rate of reaction,

$$= -\frac{1}{2}\frac{d[A]}{dt} = -\frac{d[B]}{dt} = \frac{d[C]}{dt}$$

$$\therefore \quad -\frac{d[A]}{dt} = 2\frac{d[C]}{dt}$$

$$= 2 \times 2.2 \times 10^{-3} = 4.4 \times 10^{-3} \text{ mol } L^{-1} \text{ min}^{-1}$$

12. Diphenyl hydramine (benadryl) is used as an antihistamine.

13. $\frac{x}{m} = p \times T$ is the incorrect relation. The correct relation is $\frac{x}{m} \propto \frac{p}{T}$.

14. $E^\circ_y = -1.2\text{ V};$

$E^\circ_x = +0.5\text{ V};$

$E^\circ_z = -3.0\text{ V};$

$\because$ Higher the reduction potential, lesser the reducing power.

$\therefore$ Order of reducing power is $Z > X > Y$

15. As covalent character increases, melting point decreases, thus order of melting point is $CaF_2 > CaCl_2 > CaBr_2 > CaI_2$.

16.

$$2AB_2(g) \rightleftharpoons 2AB(g) + B_2(g)$$

Initial moles	1	0	0
At equ.	$2(1-x)$	$2x$	x

where, x = degree of dissociation

Total moles at equilibrium $= 2 - 2x + 2x + x$

$$= (2 + x)$$

So, $$p_{AB_2} = \frac{2(1-x)p}{(2+x)}$$

$$p_{AB} = \frac{2xp}{(2+x)}$$

$$p_{B_2} = \frac{xp}{(2+x)}$$

$$K_p = \frac{(p_{AB})^2 (p_{B_2})}{(p_{AB_2})^2}$$

$$= \frac{\left(\frac{2xp}{2+x}\right)^2 \left(\frac{x}{2+x}p\right)}{\left(\frac{2(1-x)}{(2+x)}p\right)^2} = \frac{x^3 p}{(2+x)(1-x)^2}$$

$[\because x <<< 1 \text{ and } 2, \text{ so } (1-x) \approx 1, (2+x) = 2]$

$$= \frac{x^3 p}{2}$$

$$x = \left(\frac{2K_p}{p}\right)^{1/3}$$

17. $$pOH = p K_b + \log \frac{[Salt]}{[Base]}$$

$$= -\log K_b + \log \frac{[Salt]}{[Base]}$$

$$= -\log 1.8 \times 10^{-5} + \log \frac{0.20}{0.30}$$

$$= 5 - 0.25 + (-0.176)$$

$$= 4.75 - 0.176 = 4.57$$

$\therefore$ $pH = 14 - 4.57 = 9.43$

18. $\because$ $KE = \frac{3}{2}RT$

$KE \propto T$

Here, the temperature of gas remains constant hence kinetic energy of molecules remains the same.

19. For $n = 6$, electron are filled as $6s \rightarrow 4f \rightarrow 5d \rightarrow 6p$

This is because electron first enters in that orbitals for which $(n + l)$ is lower. In case, if $(n + l)$ is same, it goes first in that orbital for which n is lower.

20. BF_3 is an electron deficient species, thus behaves like as Lewis acid.

21. Deoxyribonucleic acid (DNA) has the purine bases adenine and guanine and pyrimidine bases thymine and uracil. According to base pairing rule adenine paired with thymine (A═T) and cytosine paired with guanine (C≡G).

22. The structure in which, more electronegative atom carries positive charge and electropositive atom carries negative charge highly unstable or in other words such structure is not possible.

23. Iodoform reaction is given by only those compounds that have either $CH_3-\underset{\underset{}{}}{\overset{\overset{O}{\|}}{C}}-$ or $CH_3\underset{\underset{}{}}{\overset{\overset{H}{|}}{C}}-OH$ group.

(a) $C_2H_5-\underset{\underset{OH}{|}}{CH}-CH_3$

(sec-butyl alcohol gives iodoform reaction)

(b) $CH_3-\underset{\underset{OH}{|}}{CH}-CH_3$

(iso-propyl alchohol gives iodoform reaction)

(c) $C_2H_5-\overset{\overset{O}{\|}}{C}-C_2H_5$

diethyl ketone
(does not give iodoform reaction)

(d) $CH_3\overset{\overset{H}{|}}{C}H$ with OH below

ethyl alcohol
(gives iodoform reaction)

24. Packing fraction

$$= \frac{\text{Volume occupied by atoms in a unit cell}}{\text{Volume of the unit cell}}$$

For body centred cube,

$$\text{Packing fraction} = \frac{2 \times \frac{4}{3}\pi r^3}{\left(\frac{4r}{\sqrt{3}}\right)^3} = \frac{\sqrt{3}\pi}{8} = 0.68$$

$\therefore$ Volume occupied = 68%

and volume vacant = 32%

25. $N_2(g) + O_2(g) \rightleftharpoons 2NO(g);\ K_1$ ...(i)

$2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g);\ K_2$ ...(ii)

$N_2(g) + 2O_2(g) \rightleftharpoons 2NO_2(g);\ K = K_1 \times K_2$

$\therefore$ For $NO_2(g) \rightleftharpoons \frac{1}{2}N_2(g) + O_2(g)$;

$$K = \left[\frac{1}{K_1 K_2}\right]^{1/2}$$

26. $K_2Cr_2O_7 + 3Na_2SO_3 + 4H_2SO_4 \longrightarrow$

$$3Na_2SO_4 + K_2SO_4 + Cr_2(SO_4)_3 + 4H_2O$$

27. Thermal stability of carbonates increases on moving down a group. Thus, lithium carbonate, Li_2CO_3 is least thermally stable.

$$Li_2CO_3 \xrightarrow{\Delta} Li_2O + CO_2$$

28. The element in which last electron enters in d-orbital is called d-block element. The electronic configuration of the given elements are as follows

$Gd(64) = [Xe]\,6s^2, 4f^7, 5d^7$

$Hs(108) = [Rn]\,7s^2, 5f^{14}, 6d^6$

$Es(99) = [Rn]\,7s^2, 5f^{11}$

$Cs(55) = [Xe]\,6s^1$

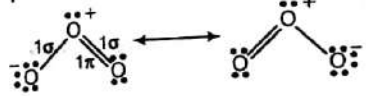
Thus, Hs is a d-block element.

29. Single bond contains = 1σ bond

Double bond contains = 1σ bond + 1π bonds

Triple bond contains = 1σ bond + 2π bonds

The molecule of O_3 is bent with an angle 116.8° and equal O—O distance of 128 pm. The ozone molecule consists of 2 sigma and 1 pi bonds. The angular shape of molecule is represented as



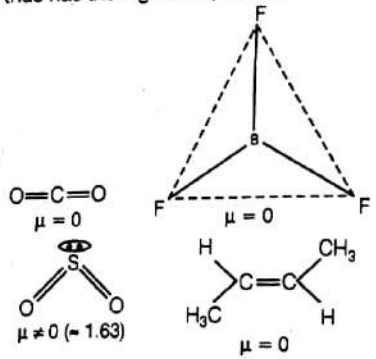
30. $\Delta G^\circ = -nFE^\circ$

When E° is negative, then $\Delta G^\circ > 0$

$\Delta G^\circ = -RT \text{ in } K_{eq}$

When, $\Delta G^\circ > 0$, $K_{eq} = 10^{-x}$ which is less than one, *i.e.*, $K_{eq} < 1$.

31. Among the given compounds/molecules, only SO_2 has unsymmetrical (angular) structure, thus has the highest dipole moment.



32. According to Bohr's concept, an electron always move in the orbit with angular momentum (mvr) equal to $nh/2\pi$.

$$\therefore \quad mvr = \frac{nh}{2\pi}$$

or $$r = \frac{n}{2\pi} \cdot \left(\frac{h}{mv}\right)$$

or $$r = \frac{n\lambda}{2\pi}$$

(from de-Broglie equation, $\lambda = \frac{h}{mv}$)

For fourth orbit ($n = 4$),

$$r = \frac{2\lambda}{\pi}$$

$$\therefore \text{ Circumference} = 2\pi r = 2\pi \times \frac{2\lambda}{\pi} = 4\lambda$$

33. Lower the value of standard enthalpy of formation, higher the stability. The increasing order of standard enthalpies of formation of given molecules is

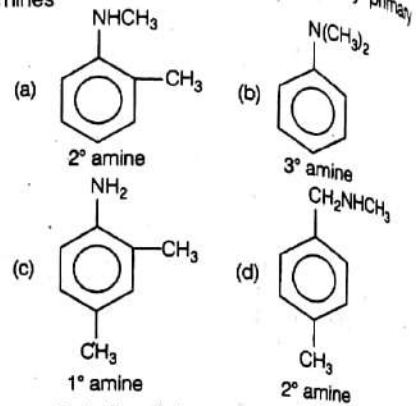
$$\underset{B(CO_2)}{393.4} < \underset{D(SO_2)}{296.9} < \underset{A(NH_3)}{-46.19} < \underset{C(HI)}{+24.94}$$

Thus, the increasing order of stability is

$$C < A < D < B$$

34. Green chemistry involves such reactions which reduce the use and production of hazardous or toxic chemical to reduce pollution from environment.

35. Carbylamine reaction is given by only primary amines



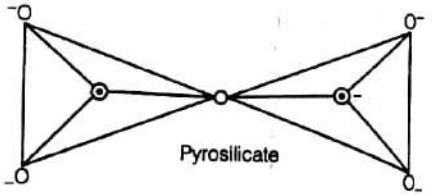
Hence, 2, 4-dimethylaniline gives carbylamine test.

36. $2H_2O_2(l) \xrightarrow{Pt(s)} 2H_2O(l) + O_2(g)$

In this reaction, reactant and catalyst are in different phase, hence it is an example of heterogeneous catalysis.

37. Zr and Ti are purified by van-Arkel method.

38. In pyrosilicate, only one oxygen atom is shared.



39. In Fischer Ringe's method, air free from moisture and CO_2 is passed over a heated mixture (800°C) of 90% CaC_2 + 10% $CaCl_2$ in an iron tube, when following reactions take place

$$CaC_2 + N_2 \xrightarrow{800°C} CaCN_2 + C$$

$$2C + O \longrightarrow 2CO$$

$$C + O_2 \longrightarrow CO_2$$

$$2CaC_2 + 3CO_2 \longrightarrow 2CaCO_3 + 5C$$

$$CuO + CO \longrightarrow Cu + CO_2$$

CO_2 gas is now absorbed by KOH solution. Thus a mixture of inert gases is obtained.

40. $Ca(OCl)_2$, calcium hypochlorite is the active ingredient in bleaching powder which releases chlorine.

Zoology

1. The cro-magnon man (*Homo sapiens fossalis*) is the most recent and direct prehistoric ancestor of present man. It arose about 3,40,000 years ago.
2. Erythroblastosis is a haemolytic disease of new borns. It occurs when father is Rh-positive and mother Rh-nagetive.
3. Pneumotoxic centre which can moderate the functions of the respiratory rhythm centre is present in the pons region of the brain. Neural signals from this centre can reduce the duration of inspiration and there by alter the respiration rate.
4. **Cnidocytes** or stinging cells are spherical or oval cells found in entire epidermis except that of basal disc and are found only in cnidarians. Other cells are found in sponges.
5. Zero growth rate means natality (*i.e.*, birth rate), balances the mortality (*i.e.*, death rate)
6. Gastrin hormone is secreted by gastric glands to release gastric juice. Enterogastrone is secreted by the duodenal epithelium which inhibits the secretion of gastric juice.
7. GMO can be created by the introduction of the portion of DNA (or gene) which codes for a particular product such as human protein, α-1-antitrypsin. This protein is used to treat emphyseme a respiratory disorder.
8. There are thirteen types of finches described by Darwin, they are geographically isolated and found in galapagos islands of South Pacific.
9. It occur by thesocyte which have lobose pseudopodia and are filled with food reserves, thus acting as storage cells.
10. **Hardy-Weinberg** law states that the genes and the genotypic frequencies in the Mendelion populations remain constant generations after generations of there is no selection, mutation, migration or random drift.
11. The birds have evolved from reptiles. Both birds and reptiles lay eggs which are large and telo lecithal with thick hard calcarious shell *i.e.*, cleiodic eggs.
12. Variation is one of the main postulates of Darwinism. Darwin recognised two types of variations-continous and dis-continous variation, but he could not explain the inheritance of variations.
13. Uric acid, a normal waste product of nucleic acid matabolism gets excreted normally through urine. When over concentration in blood, it get deposited in the form of crystals in joints causing gouty arthritis.
14. Osmotic pressure is a measure of tendency to take water by osmosis. During urine formation, 2/3 of Nacl and water filtered in bowman's capsule, is immediately absorbed by PCT.
15. Steroid hormone are lipid soluble, so easily pass through plasma membrane.
16. A — Axon terminal
    B — Synaptic vesicle
    C — Synaptic cleft
    D — Receptors
    E — Neurotransmitters
17. There are four neurotransmitters identified in vertebrates acetylcholine, serotonin, adranaline and noradrenaline.
18. If cordae tendinae of the tricuspid valve become partially non-functional due to injury then flow of blood into the pulmonary artery will be reduced.
19. The vector is a plasmid or virus DNA used to introduce genes into a host cell, where the genes may be amplified, gene cloning or otherwise manipulated.
20. β-gal, coded by *Z* structural gene is primarily responsible for the hydrolysis of the diasaccharide lactose into its monomeric units, galactose and glucose.
21. The grey matter is composed of nerve cells, nerve fibres and neuroglia, which are non-myelinated while white matter is composed of mostly with myelinated axons.
22. In human body 98.5% of O_2 is transported by haemoglobin present in RBC. One molecule of haemoglobin carries four molecules of oxygen.
23. Stratified squamous epithelial tissue is present on skin. The outermost larger of this tissue is a vascular.

24. Silicon is a micronutrient/trac element which is found only in few organisms.
25. It is a nucleoside of uridine formed in hydrolysis of RNA.
26. It is a gel-like substance in the middle of spinal cord. It represents the ramnant of noto cord.
27. Gizzard in cockroaches do the mastication of hard substances and act like teeth.
28. Ribozyme is a RNA molecule (non-proteinaceous) and is capable of catalysing reaction's.
29. Dorsal tubular nerve cord is the characteristic feature of all adult vertebrate. It is a gel-like substance and is ramnant of notochord.
30. See hare belongs to phyllum-Mollusca and is not a vertebrate.
31. Zona radiata is cellular layer around a mature ovum. Sperm has to penetrate through this by using hyaluronidase enzyme to reach upto zone pellucide membrane, which is acellular.
32. Panna Biosphere Reserve is situated in Chhattarpur Districts of Madhya Pradesh in India.
33. **Transduction** involves the picking up of DNA by bacteriophage from one bacterial cell and carrying it to another where the DNA fragment may get incorporated into the bacterial host's genome.
34. **Darwin** proposed the **theory of pangenesis** to explain the inheritance of characteristics from parents to offsprings. According to this theory every somatic cells produces gemmules and the actual germ cells are the sites of collection of gemmules coming from different somatic cells.
35. Envelop of animal virus usually arise from host cells nuclear or plasma membrane. Viruses do not have ribosomes. Protein of envelops and capsid are coded by viral genes.
36. **Viroids** are small, single stranded, circular RNA molecules not enclosed by protein coat. They were discovered by **T O Diener** in 1971. Viroid replication requires host encoded RNA polymerase.
37. Biotic potential is natality under optimum condition. The actual birth rate under existing conditions is called **realised natality**.
38. Pashmina wool is obtained from Kashmiri goat.
39. Probes used for DNA finger printing are usually prepared from mini-satellite or micro-satellite DNA.
40. All eukaryotes except yeast contain satellite DNA. Satellite DNA regions like NTR/RFLP are the basis of DNA fingerprinting (forensic science).

Botany

1. *Anabaena, Nostoc* and *Aulosira* are symbiotic Rhizobium N_2-fixing microbes, while.
2. Aleurone grains are rich in protein. This is the peripheral part of endosperm and is very important physiologically because it secrete or accumulates the hydrolysing enzymes which help in digestion of reserve food material during seed germination.
3. A–5
   B–4
   C–1
   D–3
4. The vertical conduction of water from root to arial part of plant is called **ascent of sap**. The water molecules remain joined to each other due to a force of attraction called **cohesion** force. Attraction between water molecules and the walls of xylem is due to adhesion forces. These forces help to ensure the continuity of water column in xylem.
5. Network of food chains inter connected at various levels (food web) is meant for increasing the stability of an ecosystem by providing alternative source of food.
6. Colchicine is an antibiotic drug (alkloid), which is obtained from *Colchicum* (family—Liliacae). It binds to one tubulin molecule and prevents its polymerisation. The depolymerisation of tubulin result in disappearance of mitotic spindle blocking the cell's mitotic chromosomal division at metaphase and anaphase.
7. *Viscum album* is a partial stem parasite that grows on poplar, apple, walnut, oats, etc. The parasite send primary haustorium into the host for deriving food from them.
8. *Azo* tobacterk and clostrodium are free livingnitrogen fixing are microorganisms. VAM is symbiotic relationship between fungi and higher plants. *Nif* gene is responsible for biological nitrogen-fixation, which directs the synthesis of nitrogenase enzyme.
9. R Q is the ratio of the volume of CO_2 eleased to the volume of oxygen taken in respiration. It depends on the nature of the substrate, which is oxidised, for carbohydrates R Q is one, for fats and protein less then one, and is more than one for organic acids.
10. Eutrophication means nutrient enrichment. The main factor that caused eutrophication is the release of large amount of phosphate into water body.
11. Gene flow means the spread of genes through population as affected by movements of individuals and other propagules, *e.g.*, spores, seeds, etc.
12. $C_3(CH_2)_{14}COOH$ is the chemical formula of palmitic acid. It is a saturated fatty acid.
13. *Tectona grandis* (Teak) is found in tropical moist deciduous forests.
14. The direct or indirect effect of pollen is seed or fruit has been termed by **Foke** (1881) as xenia. This phenomenon is seen is *Zea mays* alone and in limited to the endosperm part only.
15. 'Pappus', a hairy structure is a modification of calyx and is the characteristic feature of family–Asteraceae.

    So, $\oplus \female K_{Pappus} C_{(5)}\ A_5\ G_{(2)}$ is the floral formula of family–Asteraceae.

    Calyx 5, gamosepalous, persistant, corolla 5, gamopetalous. Androecium 5, polyandrous and gynoecium bicarpellary and syncarpous are the diagnositc feature of family–Solanaceae, shown by floral formula

    $\oplus \female K_{(5)} C_{(5)}\ A_5\ G_{(2)}$

    Calyx 4, polysepalous and arranged in 2 whorld of 2 each, corolla 4, polypetalous and cruciform.

Androecium 6, polyandrous, tetradynamous.

Gynoecium, bicarpellary, syncarpous and superior, placentation parietial with a partition called **replum**.

These are the diagnostic feature of family–Brassicaceae or Cruciferae, shown by floral formula

$\oplus \female K_{2+2} C_4\ A_{2+4}\ G_{(2)}$

16. Tyloses are found in heart wood, sometimes the xylem parenchyma develop balloon-like structure to which penetrates into the adjacent xylem. Vessels, which are called **tyloses**, block the luman of the xylem.
17. The zone of transition between two different communities presenting a situation of overlapping is known as ecotone.
18. Prophage is the DNA of bacteriophage that is repressed for lytic functions and is maintained in the host bacterium in a stable state. The phage genome is integrated into DNA of its bacterial host and may be replicated along with the host DNA, as in the case or bacteriophage lamda or may be maintained as extra chromosomal DNA, as in the case for bacteriophage, lambda P_1.
19. Green plants are called **sun basket** because they store solar energy by converting it into chemical energy with the help of chloroplast by the process called **photosynthesis**.
20. In dominant epistatis, a dominant gene (epistatic) marks the expression of another dominant or recessive gene (hypostatic), such interactions give the modified F_2 ratio as 12:3:1.
21. Benthic organism are found at the bottom of the sea. Surface of marine waterecosystem is occupied by planktons white nekton are found on surface and middle of sea ecosystem.
22. Ethylene is connected with climecteric phenomenon in which there is 1000 fold increase in the production of basal ethylene level during ripening of climecteric fruits.
23. Morgan and his group found that when genes were grouped on the same chromosomes some genes were very tightly linked while other were loosely linked.

24. According to Homes etall 1933, USA is responsible for the largest portion of man made contribution to the green house effect 21% followed by Russia 14%.

25. The electrostatic precipitation controls SPM (Suspended particulate matter) in coal fire power plant.

26. Law of independent assortment does not applicable when the gene of different character occupy on the same homologous chromosomes, *i.e.*, linked genes.

27. Oxygen level goes down due to algel bloom. These bloom also release some toxic chemical which kill fishes and other animals.

28. Allelic sequence variation is described as DNA polymorphism if more than one variant (allele) at a locus occurs in human population with a frequency greater than 0.01. In simple terms if an inheritable mutation is observed in a population at high frequency, it is referred to as DNA polymorphism.

29. An aquatic weed-like water hyacinth is used as a source of biogas through harvesting, chopping, crushing and digesting.

30. The typical anther is tetrasporangiate. It has column of sterile tissue called **connective tissue.** Mature anther is comprised of an epidermis followed by endothecium, 2 or 3 middle layer and single layered tapetum (inner most).

31. *Bt* strain have been used to design bioinsecticidal plants through genetic engineering.

32. *Polygonum* type of ovule. Emhryo sac 7 celled 8 nucleate, 3 antipodal, 2 synergids, one egg and one central cell.

33. Coconut endosperm is unique because of its early liquid syncytical stages which form the hard matured kernel at later stages of fruit development.

34. Allosteric modulation or feed back inhibition of enzymes is influenced by end product. It was shown by **Jacob** and **Monod** 1961 through lac operon in *E.coli*.

35. The mobile genetic element is broadly any genetic element capable of moving itself with or without duplication from one site in a genome to another.

36. Vector is a plasmid or virus DNA used to introduced genes into a host cell, where the genes may be amplified (gene cloning or otherwise manipulated.

37. C_4 plants (maize) require 30 ATP and 12 NADPH for synthesis of one hexose molecule. Therefore synthesis of six hexose molecules require 180 ATP and 72 NADPH.

38. Superiority of hybrids over either of the parent is called **heterosis** or **hybrid.**

39. Palindromic DNA is base sequence of DNA which reads the same forward and backward. It has similar sequence in both the strands. Different types of palindromic sequences are recognised by restriction endonucleases.

40. Alkloid reserpine is obtained from the root of *Rauwolffia serpantina*. It is used to cure high blood pressure.v

Solved Paper **2015**

JIPMER

Medical Entrance Exam

Physics

1. The angle between two linear transmembrane domains is defined by following vectors $\mathbf{a} = \hat{\mathbf{i}} + \hat{\mathbf{j}} - \hat{\mathbf{k}}$ and $\mathbf{b} = \hat{\mathbf{i}} - \hat{\mathbf{j}} + \hat{\mathbf{k}}$

(a) $\cos^{-1}\left(\frac{1}{3}\right)$ (b) $\cos^{-1}\left(\frac{-1}{3}\right)$

(c) $\sin^{-1}\left(\frac{-1}{3}\right)$ (d) $\sin^{-1}\left(\frac{1}{3}\right)$

2. The distance x (in μm) covered by a molecule starting from point A at time $t = 0$ and stopping at another point B in given by the equation

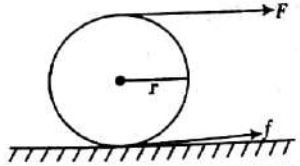
$$x = t^2\left(2 - \frac{t}{3}\right)$$

The distance between A and B (in μm) is closed to

(a) 10.7 (b) 20.7

(c) 40.7 (d) 50.7

3. A tangential force acting on the top of sphere of mass m kept on a rough horizontal place as shown in figure.

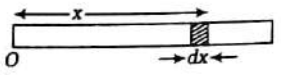


If the sphere rolls without slipping, then the acceleration with which the centre of sphere moves, is

(a) $\frac{10F}{7m}$ (b) $\frac{F}{2m}$

(c) $\frac{3F}{7m}$ (d) $\frac{7F}{2m}$

4. The density of a rod having length l varies as $\rho = c + dx$, where x is the distance from the left end. The centre of mass is



(a) $\frac{3cl + 2Dl^2}{3(2c + Dl)}$ (b) $\frac{2cl + 3Dl^2}{2(4c + 8l)}$

(c) $\frac{2cl + 3Dl^2}{3(2c + l)}$ (d) $\frac{cl + Dl^2}{3(2c + Dl)}$

5. One end of a massless spring of constant 100 N/m and natural length 0.5 m is fixed and the other end is connected to a particle of mass 0.5 kg lying on a frictionless horizontal table. The spring remains horizontal. If the mass is made to rotate at angular velocity of 2 rad/s, then elongation of spring is

(a) 0.1 m (b) 10 cm (c) 1 cm (d) 0.01 cm

6. A block slides down on an incline of angle 30° with an acceleration $\frac{g}{4}$. Find the kinetic friction coefficient.

(a) $\frac{1}{2\sqrt{2}}$ (b) 0.6

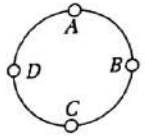
(c) $\frac{1}{2\sqrt{3}}$ (d) $\frac{1}{\sqrt{2}}$

7. Two long straight wires, each carrying an electric current of 5 A, are kept parallel to each other at a separation of 2.5 cm. Find the magnitude of the magnetic force experiment by 10 cm of a wire.

(a) 4.0×10^{-4}N (b) 3.5×10^{-6}N

(c) 2.0×10^{-5}N (d) 2.0×10^{-9}N

8. A wire of resistance 10Ω is bent to form a complete circle. Find its resistance between two diametrically opposite point.



(a) 5 Ω (b) 2.5 Ω
(c) 1.25 Ω (d) $\frac{10}{3}$ Ω

9. Find the resistance of a hollow cylindrical conductor of length 1.0 mm and 2.0 mm respectively. The resistivity of the material is 2.0×10^{-8} Ω m.

(a) 2.1×10^{-3} Ω (b) 1.3×10^{-4} Ω
(c) 3.2×10^{-4} Ω (d) 4.6×10^{-2} Ω

10. Three equal charges, each having a magnitude of 2.0×10^{-6}C, are placed at the three corners of a right angled triangle of sides 3 cm, 4 cm and 5 cm. The force (in magnitude) on the charge at the right angled corner is

(a) 50 N (b) 26 N (c) 29 N (d) 45.9 N

11. A diatomic gas ($\gamma = 1.4$) does 200 J of work when it is expanded isobarically. Find the heat given to the gas in the process.

(a) 500 J (b) 700 J
(c) 600 J (d) 900 J

12. A uniform ring of mass m and radius a is placed directly above a uniform sphere of mass m and of equal to radius. The centre of the ring is at a distance $\sqrt{3}a$ from the centre of the sphere. The gravitational force (F) exerted by the sphere on the ring is

(a) $\frac{3GMm}{8a^2}$ (b) $\frac{2GMm}{3a^2}$
(c) $\frac{7GMm}{\sqrt{2}a^2}$ (d) $\frac{3GMm}{a^2}$

13. A projectile is fired with a velocity u at angle θ with the ground surface. During the motion at any time it is making an angle α with the ground surface. The speed of particle at this time will be

(a) $u\cos\theta \sec\alpha$ (b) $u\cos\theta \cdot \tan\alpha$
(c) $u^2\cos^2\alpha \sin^2\alpha$ (d) $u\sin\theta \cdot \sin\alpha$

14. The earth receives solar radiation at a rate of 8.2 J $cm^{-2}min^{-1}$. If the sun radiates as the black bodies, the temperature at the surface of the sun will be (the angle subtended by sun on the earth in suppose 0.53° and Stefan constant is $\sigma = 5.67 \times 10^{-8}$ Wm^{-2} K^4)

(a) 5800 K (b) 6700 K
(c) 8000 K (d) 7800 K

15. The rms speed (in m/s) of oxygen molecules of the gas at temperature 300 K, is

(a) 483 (b) 504
(c) 377 (d) 346

16. A horizontal tube of length l closed at both ends, contains an ideal gas of molecular weight M. The tube is rotated at a constant angular velocity ω about a vertical axis passing through an end. Assuming the temperature to be uniform and constant. If p_1 and p_2 denote the pressure at free and the fixed end respectively, then choose the correct relation.

(a) $\frac{p_2}{p_1} = e^{\frac{M\omega^2 l^2}{2RT}}$

(b) $\frac{p_1}{p_2} = e^{\frac{M\omega l^2}{RT}}$

(c) $\frac{p_1}{p_2} = e^{\frac{\omega lM}{3RT}}$

(d) $\frac{p_2}{p_1} = e^{\frac{M^2\omega^2 l^2}{3RT}}$

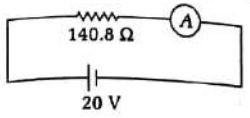
17. The parts of two concentric circular arcs joined by two radial lines and carries current i. The arcs subtend an angle θ at the centre of the circle. The magnetic field at the centre O, is

(a) $\frac{\mu_0 i(b-a)\theta}{4\pi ab}$ (b) $\frac{\mu_0 i(b-a)}{(\pi-\theta)}$
(c) $\frac{\mu_0 i(b-a)\theta}{\pi ab}$ (d) $\frac{\mu_0 i(a-b)}{2\pi ab}$

18. 1 kg of water is converted into steam at the same temperature and at 1 atm (100 kPa). The density of water and steam are 1000 kgm^{-3} and 0.6 kgm^{-3} respectively. The latent heat of vaporisation of water is 2.25×10^6 Jkg^{-1}. What will be increase in energy?

(a) 3×10^5J (b) 4×10^6 J
(c) 2.08×10^6 J (d) None of these

19. The ammeter shown in figure consists of a 480 Ω coil connected in parallel to a 20 Ω shunt. The reading of ammeter is



(a) 0.125 A (b) 1.67 A
(c) 0.13 A (d) 0.67 A

20. A lead ball at 30°C is dropped from a height of 6.2 km. The ball is heated due to the air resistance and it completely melts just before reaching the ground. The molten substance falls slowly on the ground. If the specific heat of lead = 126 $Jkg^{-1}°C^{-1}$ and melting point of lead = 130 °C and suppose that any mechanical energy lost is used to heat the ball, then the latent heat of fusion of lead is

(a) 2.4×10^4 J kg^{-1} (b) 3.6×10^4 J kg^{-1}
(c) 7.6×10^2 J kg^{-1} (d) 4.2×10^3 J kg^{-1}

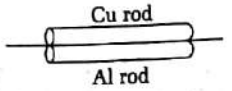
21. An inductor ($L = 20$ H), a resistor ($R = 100$ Ω) and a battery ($E = 10$ V) are connected in series. After a long time, the circuit is short-circuited and then the battery is disconnected. Find the current in the circuit at 1 ms after short circuiting.

(a) 4.5×10^5 A (b) 3.2×10^{-5} A
(c) 9.8×10^{-5} A (d) 6.7×10^{-4} A

22. Two charges of + 10 μC and +20 μC are separated by a distance 2 cm. The net potential (electric) due to the pair at the middle point of the line joining the two changes, is

(a) 27 MV (b) 18 MV (c) 20 MV (d) 23 MV

23. A copper rod of length 20 cm and cross-sectional area 2 mm^2 is joined with a similar aluminium rod as shown below



The resistance of pair of rods is ($\rho_{Al} = 2.6 \times 10^{-8}$ Ω-m and $\rho_{Cu} = 1.7 \times 10^{-8}$ Ω-m)

(a) 1.0 mΩ (b) 2.0 mΩ
(c) 3.0 mΩ (d) None of these

24. A particle is subjected to two simple harmonic motions along X-axis while other is along a line making angle 45° with the X-axis. The two motions are given by $x = x_0 \sin\omega t$ and $s = s_0 \sin\omega t$.
The amplitude of resultant motion is

(a) $x_0 + s_0 + 2x_0 s_0$
(b) $\sqrt{x_0^2 + s_0^2}$
(c) $\sqrt{x_0^2 - s_0^2 + 2x_0 s_0}$
(d) $[x_0^2 + s_0^2 + \sqrt{2}x_0 s_0]^{1/2}$

25. What is the change in the volume of 1.0 L kerosene, when it is subjected to an extra pressure of 2.0×10^5 Nm^{-2} from the following data? Density of kerosene = 800 kg m^{-3} and speed of sound in kerosene = 1330 ms^{-1}.

(a) 0.97 cm^{-3}
(b) 0.66 cm^{-3}
(c) 0.15 cm^{-3}
(d) 0.59 cm^{-3}

26. A 4 kg block is suspended from the ceiling of an elevator through a spring having a linear mass density of 19.2×10^{-3} kg m^{-3}. Find the speed with respect to spring with which a wave pulse can proceed on the spring if the elevator accelerates up at the rate of 2.0 ms^{-2}. Take $g = 10$ ms^{-2}

(a) 30 m/s (b) 42 m/s
(c) 46 m/s (d) 50 m/s

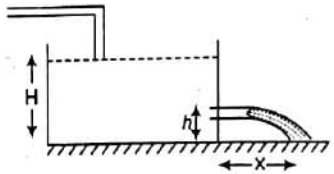
27. The lower end of capillary tube is immresed in mercury. The level of mercury in the tube is found to be 2 cm below the outer level. If the same tube is immersed in water, upto what height will the water rise in the capillary?

(a) 5.9 (b) 4.9
(c) 2.9 (d) 1.9

28. Find the increase in pressure required to decrease the volume of water sample by 0.01%. Bulk modulus of water = 2.1×10^9 Nm^{-2}.

(a) 4.3×10^4 N/m^2
(b) 1.8×10^7 N/m^2
(c) 2.1×10^5 N/m^2
(d) 3.7×10^4 N/m^2

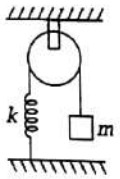
29. Water level is maintained in a cylindrical vessel upto a fixed height H. The vessel is kept on a horizontal plane. At what height above the bottom should a hole be made in the vessel, so that the water stream coming out of the hole strikes the horizontal plane of the greatest distance from the vessel?



(a) $h = \frac{H}{2}$ (b) $h = \frac{3H}{2}$

(c) $h = \frac{2H}{3}$ (d) $h = \frac{3}{4}H$

30. Figure shows spring + block + pulley system which are light. The time period of mass would be



(a) $2\pi\sqrt{\frac{k}{m}}$ (b) $\frac{1}{2\pi}\sqrt{\frac{k}{m}}$

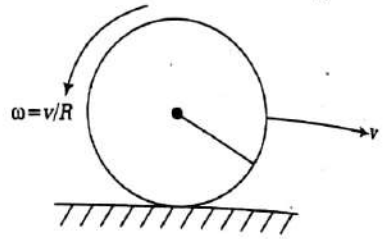
(c) $2\pi\sqrt{\frac{m}{k}}$ (d) $\frac{1}{2\pi}\sqrt{\frac{m}{k}}$

31. A pendulum having a bob of mass m is hanging in a ship sailing along the equator form east to west. When the strip is stationary with respect to water, the tension in the string is T_0. The difference between T_0 and earth attraction on the bob, is

(a) $\frac{mg + m\omega^2 R}{2}$ (b) $\frac{m\omega^2 R}{3}$

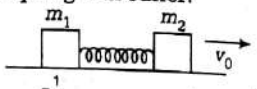
(c) $\frac{m\omega^2 R}{2}$ (d) $m\omega^2 R$

32. A solid sphere is set into motion on a rough horizontal surface with a linear speed v in the forward direction and an angular speed $\frac{v}{R}$ in the anticlockwise direction as shown in figure. Find the linear speed of the sphere when it stops rotating and $\omega = \frac{v}{R}$.



(a) $\frac{3v}{5}$ (b) $\frac{2v}{5}$ (c) $\frac{4v}{3}$ (d) $\frac{7v}{3}$

33. Two blocks of masses m_1 and m_2 are connected by a spring of spring constant k. The block of mass m_2 is given a sharp empulse so that it acquires a velocity v_0 towards right. Find the maximum elongation that the spring will suffer.

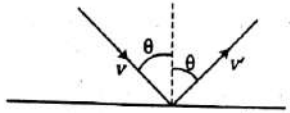


(a) $\left[\frac{m_1 m_2}{m_1 + m_2}\right]^{\frac{1}{2}} v_0$ (b) $\left(\frac{m_1 + m_2}{m_1 - m_2}\right) v_0$

(c) $\left[\frac{m_1 + m_2}{m_1 - m_2}\right]^{\frac{1}{2}} v_0$ (d) $\left[\frac{2m_1 + m_2}{m_1 m_2}\right]^{\frac{1}{2}} v_0$

34. A ball of mass m hits the floor with a speed v making an angle of incidence θ with the normal. The coefficient of restitution is e.

The speed of reflected ball and the angle of reflection of the ball will be



(a) $v' = v, \theta = \theta'$ (b) $v' = \frac{v}{2}, \theta = 2\theta'$

(c) $v' = 2v, \theta = 2\theta'$ (d) $v' = \frac{3v}{2}, \theta = \frac{2\theta'}{3}$

35. A particle slides on surface of a fixed smooth sphere starting from topmost point. The angle rotated by the radius through the particle, when it leaves contact with the sphere, is

(a) $\theta = \cos^{-1}\left(\frac{1}{3}\right)$ (b) $\theta = \cos^{-1}\left(\frac{2}{3}\right)$

(c) $\theta = \tan^{-1}\left(\frac{1}{3}\right)$ (d) $\theta = \sin^{-1}\left(\frac{4}{3}\right)$

36. What is the radius of curvature of the parabola traced out by the projectile in the previous problem at a point where the particle velocity makes an angle $\frac{\theta}{2}$ with the horizontal?

(a) $r = \frac{v^2 \cos^2\theta}{g\cos^2\frac{\theta}{2}}$ (b) $r = \frac{2v\sin\theta}{g\tan\theta}$

(c) $r = \frac{v\cos\theta}{g\sin^2\frac{\theta}{2}}$ (d) $r = \frac{3v\cos\theta}{g\cot\theta}$

37. A block of mass 2 kg is pushed against a rough vertical wall with a force of 40 N, coefficient of static friction being 0.5. Another horizontal force of 15 N, is applied on the block in a direction parallel to the wall. If the block will move, then its direction would be

(a) 15° with 15 N force (b) 53° with 15 N force

(c) 45° with 15 N force (d) 75° with 15 N force

38. A block is kept on the floor of an elevator at rest. The elevator starts descending with an acceleration of 12 m/s^2. Find the displacement of the block during the first 0.2 s after the start. (Take, $g = 10$ m/s^2)

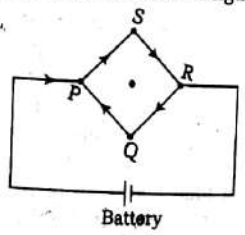
(a) 30 cm (b) zero (c) 20 cm (d) 25 cm

39. A monkey of mass 15 kg is climbing on a rope with one end fixed to the ceiling. If it wishes to go up with an acceleration 1 m/s^2, how much force should it apply to the rope if rope is 5 m long and the monkey starts from rest?

(a) 150 N (b) > 160 N

(c) 165 N (d) $150 < T \leq 160$ N

40. A square loop is made by a uniform conductor wire as shown in figure



The net magnetic field at the centre of the loop if side length of the square is a

(a) $\frac{\mu_0 i}{2a}$ (b) zero

(c) $\frac{\mu_0 i^2}{a^2}$ (d) None of these

41. The electron of an H-atom is revolving around the nucleus in circular orbit having radius $\frac{h^2}{4\pi me^2}$ with $\left(\frac{2\pi e^2}{h}\right)$. The current produced due to the motion of electron is

(a) $\frac{2\pi m^2 e^2}{3h^2}$ (b) zero

(c) $\frac{2\pi^2 me}{h^2}$ (d) $\frac{4\pi^2 me^5}{h^3}$

42. Two small balls, each carrying a charge q are suspended by equal insulator strings of length l m from the hook of a stand. This arrangement is carried in a satellite in space. The tension in each string will be

(a) $\frac{1}{4\pi\varepsilon_0}\frac{q}{l^2}$ (b) $\frac{1}{4\pi\varepsilon_0}\frac{q^2}{4l^2}$

(c) $\frac{1}{4\pi\varepsilon_0}\frac{q^2}{l^2}$ (d) $\frac{1}{(4\pi\varepsilon_0)}\frac{q}{l}$

43. A vessel of depth t is half filled with a liquid having refractive index n_1 and the other half is filled with water of having refractive index n_2. The apparent depth of the vessel as viewed from top is

(a) $\frac{2t(n_1 + n_2)}{n_1 n_2}$ (b) $\frac{t\, n_1 n_2}{(n_1 + n_2)}$

(c) $\frac{t(n_1 + n_2)}{2\, n_1 n_2}$ (d) $\frac{n_1 n_2}{(n_1 + n_2)t}$

44. In photoelectric effect, the number of photo-electrons emitted is proportional to

(a) velocity of incident beam

(b) frequency of incident beam

(c) intensity of incident beam

(d) work function for cathode material

45. A change of 8.0 mA in the emitter current brings a change of 7.9 mA in the collector current. The value of α will be

(a) 0.96 (b) 0.93

(c) 0.90 (d) 0.99

46. The half-life of ^{198}Au is 2.7 days. The average life is

(a) 4 days

(b) 3.4 days

(c) 3.9 days

(d) None of the above

47. The de-Broglie wavelength of electron falling on the target in an X-ray tube is λ. The cut-off wavelength of the emitted X-ray is

(a) $\lambda_0 = \frac{(mc\lambda)^2}{h}$ (b) $\lambda_0 = \frac{m^2c\lambda}{h^2}$

(c) $\lambda_0 = \frac{2mc\lambda^2}{h}$ (d) $\lambda_0 = \frac{mc\lambda^2}{h^2}$

48. If M_O is the mass of an oxygen isotope ${}_8O^{17}$, M_p and M_n are the masses of a proton and a neutron, respectively, the nuclear binding energy of the isotope is

(a) M_Oc^2

(b) $(M_O - 17M_n)c^2$

(c) $(M_O - 8M_p)c^2$

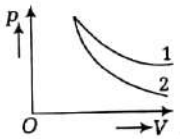
(d) $(8M_p + 9M_n - M_O)$

49. A nucleus disintegrates into two nuclear parts which have their velocities in the ratio 2 : 1. The ratio of their nuclear size will be

(a) $2^{1/3} : 1$ (b) $1 : 3^{1/2}$

(c) $3^{1/2} : 1$ (d) $1 : 2^{1/3}$

50. The given p-V diagram shows gases during adiabatic process. Plots 1 and 2 should correspond respectively to



(a) He and O_2

(b) O_2 and He

(c) He and Ar

(d) O_2 and N_2

51. For an adiabatic expansion of a mono atomic perfect gas, the volume increases by 24%. What is the percentage decrease in pressure?

(a) 24% (b) 40%

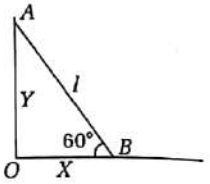
(c) 48% (d) 71%

52. A body weighing 8 g when placed in one pan and 18 g when placed on the other pan of a false balance. If the beam is horizontal when both the pans are empty, then the true weight of the body is

(a) 13 g (b) 9 g

(c) 22 g (d) 12 g

53. A rod PQ of length l is moving with ends remaining in contact with frictionless wall and floor. If at the instant, shown the velocity of end Q is 2 m/s towards negative direction of x. The speed of end P will be



(a) $\sqrt{3}$ ms^{-1} (b) $\frac{2}{\sqrt{3}}$ ms^{-1}

(c) $\sqrt{2}$ ms^{-1} (d) $\frac{\sqrt{5}}{2}$ ms^{-1}

54. Universal time is based on

(a) rotational effect of the earth about its axis

(b) vibrations of cesium atom

(c) orbital motion of the earth around the sun

(d) oscillation of quartz crystal

55. A slab consists of portions of different materials of same thickness and having the conductivities K_1 and K_2. The equivalent thermal conductivity of the slab is

(a) $K_1 + K_2$

(b) $\sqrt{K_1 + K_2}$

(c) $\frac{2K_1K_2}{K_1 + K_2}$

(d) $\sqrt{\frac{K_1K_2}{K_1 + K_2}}$

56. Two rigid boxes containing different ideal gases are placed on table. Box A contains one mole of nitrogen at temperature T_0, while box B contains 1 mole of helium at temperature $7/3\ T_0$. The boxes are then put into thermal contact with each other and heat flows between them until the gases reach a common final temperature (ignore the heat capacity of boxes) then the final temperature of gases, T_f in terms of T_0 is

(a) $\frac{2T_0}{5}$ (b) $\frac{3T_0}{7}$

(c) $\frac{5T_0}{3}$ (d) $\frac{9T_0}{7}$

57. The temperature of the cold junction of thermocouple is 0°C and the temperature of hot junction is T °C. The emf is $E = 16T - 0.04T^2$ μV. The inversion temperature T_i is

(a) 300°C (b) 200°C (c) 500°C (d) 400°C

58. The galvanometer resistance is 30 Ω and it is connected to 2 V battery along with a resistance 2000 Ω in series. A full scale deflection of 25 divisions is obtained. In order to reduce this deflection to 20 divisions, the resistance in series should be

(a) 2470 Ω (b) 2320 Ω (c) 2180 Ω (d) 2210 Ω

59. A thin bar magnet of length 2 L is bent at the mid-point so that the angle between them is 60°. The new length of the magnet is

(a) $\frac{L}{2\sqrt{3}}$ (b) $\frac{\sqrt{3}L}{2}$

(c) L (d) $\frac{2L}{3}$

60. The magnetic flux through each turn of a coil having 200 turns is given as $(t^2 - 2t) \times 10^{-3}$ Wb, where t is in second. The emf induced in the coil at $t = 3$ s is

(a) 0.7 V (b) 1.2 V (c) 0.8 V (d) 0.9 V

Chemistry

1. Given that the reduced temperature, $\theta = \frac{T}{T_C}$

the reduced pressure, $\pi = \frac{F}{F_C}$

the reduced volume, $\phi = \frac{V}{V_C}$

Thus, it can be said that the reduced equation of state may be given as

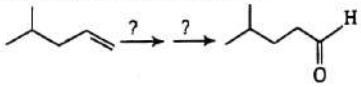
(a) $\left(\frac{\pi}{3} + \frac{1}{\varphi}\right)(3\phi - 1) = \frac{8}{3}\theta$

(b) $\left(\frac{\pi}{4} + \frac{1}{\varphi}\right)(3\theta - 1) = \frac{3}{8}\varphi$

(c) $\left(\frac{\pi}{3} + \frac{1}{\varphi}\right)(\phi - 1) = \frac{3}{8}\theta$

(d) $\left(\frac{\pi}{3} + \frac{1}{\varphi^2}\right)(3\phi - 1) = \frac{8}{3}\theta$

2. The suitable reaction steps to carry out the following transformation is



(a) $\xrightarrow[\text{(ii) } H_2O_2,\ NaOH]{\text{(i) } BH_3,\ THF} \xrightarrow{HIO_4}$

(b) $\xrightarrow[(CH_3)_3C.COOH,\ OH^-]{OsO_4} \xrightarrow[H_2O]{K_3Cr_2O_7 \cdot H_2SO_4}$

(c) $\xrightarrow[\text{(ii) } H_2O_2,\ NaOH]{\text{(i) } BH_3,\ THF} \xrightarrow[CH_2Cl_2]{PCC}$

(d) $\xrightarrow{H_2O,\ H_2SO_4\ (dil.)} \xrightarrow[CH_2Cl_2]{PCC}$

3. $SF_4 \xrightarrow{\text{Hydrolysis}} X + Y$

$X + H_2S \longrightarrow Z$

Here, Z is

(a) SO_3 (b) colloidal sulphur

(c) gaseous sulphur (d) solid sulphur

4. For preparing 3.00 L of 1M NaOH by mixing portions of two stock solutions (A and B) of 2.50 M NaOH and 0.40 M NaOH respectively. Find out the amount of B stock solution (in L) added.

(a) 8.57 L

(b) 2.14 L

(c) 1.28 L

(d) 7.51 L

5. Sodium sulphite is used in preserving squashes and other mildly acidic foods due to

(a) potassium salt has preservative action

(b) potassium metabisulphite prevents oxidation

(c) potassium metabisulphite is not influenced by acid

(d) sulphur dioxide and sulphurous acid formed kill bacteria and germs

6. The Vividh Bharti Station of All India Radio, Delhi, broadcasts on a frequency of 1,368kHz (Kilohertz). Calculate the wavelength (λ) of the electromagnetic radiation emitted by transmitter. Which part of the electromagnetic spectrum does it belong to?

(a) 319.4 m and X-rays

(b) 319.4 m and radiowave

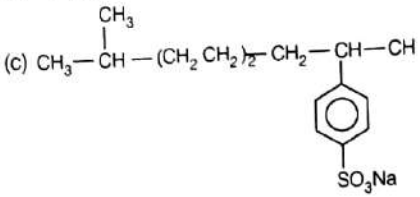
(c) 219.3 m and microwave

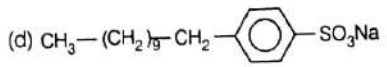
(d) 219.3 m and radiowave

7. Which of the following soap/detergent is least, reduce space biodegradable?

(a) $CH_3—(CH_2)_{11}—OSO_2Na$

(b) $C_{17}H_{35}—COONa$

(c) 

(d) 

8. In an atom, an electron is moving with a speed of 600 m/s with an accuracy of 0.005%. Certainty with which the position of the electron can be located is
(Given, $h = 6.6 \times 10^{-34}$ kg $m^2 s^{-1}$, mass of electron $e_m = 9.1 \times 10^{-31}$ kg)

(a) 2.15×10^{-3} m (b) 2.78×10^{-3} m
(c) 1.92×10^{-3} m (d) 3.24×10^{-3} m

9. Buna-N, a synthetic rubber is copolymer of

(a) $H_2C = CH—CH = CH_2$ and $H_5C_6—CH = CH_2$

(b) $H_2C = CH—CN$ and $H_2C = CH—CH = CH_2$

(c) $H_2C = CH—\underset{Cl}{\underset{|}{C}} = CH_2$ and $H_2C = CH—CH = CH_2$

(d) $H_2C = CN—CN$ and $H_2C = CH—\underset{Cl}{\underset{|}{C}} = CH_2$

10. What would be the heat released when an aqueous solution containing 0.5 mole of HNO_3 is mixed with 0.3 mole of OH^-?
(enthalpy of neutralisation is – 57.1 kJ)

(a) 28.5 kJ (b) 17.1 kJ
(c) 45.7 kJ (d) 1.7 kJ

11. The number average molar mass and mass average molar mass of a polymer are respectively 30,000 and 40,000. The polydispersity index (PDI) of the polymer is

(a) –1 (b) 0
(c) > 1 (d) < 1

12. The charge/size ratio of a cation determines its polarising power. Which one of the following sequences represents the increasing order of the polarising power of the cationic species, K^+, Ca^{2+}, Mg^{2+}, Be^{2+}?

(a) $K^+ < Ca^{2+} < Mg^{2+} < Be^{2+}$
(b) $Be^{2+} < K^{2+} < Ca^{2+} < Mg^{2+}$
(c) $Mg^{2+} < Be^{2+} < K^+ < Ca^{2+}$
(d) $Ca^{2+} < Mg^{2+} < Be^{+} < K^+$

13. In an amino acid, the carboxyl group ionises at $pK_{a_1} = 2.34$ and - ammonium ion at $pK_{a_2} = 9.60$. The isoelectric point of the amino acid is at pH

(a) 4.32
(b) 3.34
(c) 9.46
(d) 5.97

14. 0.40 g of helium in a bulb at a temperature of T K had a pressure of p atm. When the bulb was immersed in water bath at temperature 50 K more than the first one, 0.08 g of gas had to be removed to restore the original pressure. T is

(a) 500 K (b) 400 K
(c) 600 K (d) 200 K

15. What percentage of β-D-(+)-glucopyranose is found at equilibrium in the aqueous solution?

(a) 64%
(b) 36%
(c) ≈ 100%
(d) ≈ 50%

16. Which of the following is correctly arranged in order of increasing weight?

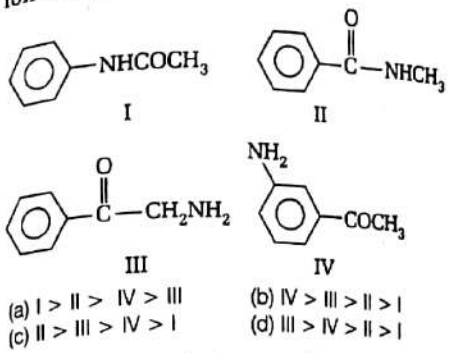
(a) 0.0105 equivalent of $H_2C_2O_4 \cdot 2H_2O$ < 0.625 g of Fe < 0.006 g atom of Ag < 6.0×10^{21} atoms of Zn

(b) 0.625 g of Fe < 0.0105 equivalent of $H_2C_2O_4 \cdot 2H_2O$ < 6.0×10^{21} atoms of Zn < 0.006 g atom of Ag

(c) 0.625 g of Fe < 6.0×10^{21} atoms of Zn < 0.006 g atom of Ag < 0.0105 equivalent of $H_2C_2O_4 \cdot 2H_2O$

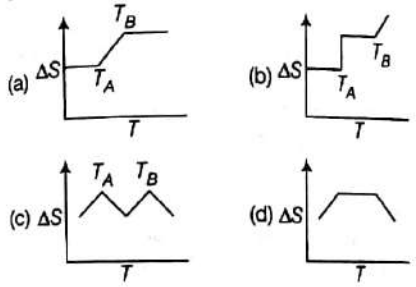
(d) 0.0105 equivalent of $H_2C_2O_4 \cdot 2H_2O$ < 0.006 g atom of Ag < 6.0×10^{21} atoms of Zn < 0.625 g of Fe

17. The correct order of basic strength of the following are



(a) I > II > IV > III (b) IV > III > II > I
(c) II > III > IV > I (d) III > IV > II > I

18. If for a given substance, melting point is T_B and freezing point is T_A then correct variation of entropy by graph between entropy change and temperature is



19. When a mixture of 1-hexanol and hexanoic acid in diethyl ether is shaken with an aqueous $NaHCO_3$ solution, then which of the following is right distribution?

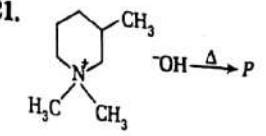
	In ether	In sodium bicarbonate solution
(a)	Sodium hexanoate	1-hexanol
(b)	1-hexanol	Hexanoic acid
(c)	1-hexanol	Sodium hexanoate
(d)	Hexanoic acid	1-hexanol

20. ΔH and ΔS for the reaction,

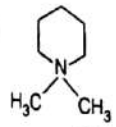
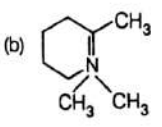
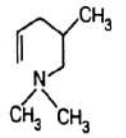
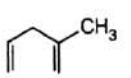
$Ag_2O(s) \longrightarrow 2Ag(s) + \frac{1}{2}O_2(g)$, are 30.56 kJ mol^{-1} and 66.00 JK^{-1} mol^{-1} respectively. The temperature at which the free energy change for the reaction will be zero, is

(a) 3528 K (b) 463 K
(c) 73 K (d) 144 K

21.



The major product P will be

(a) 
(b) 
(c) 
(d) 

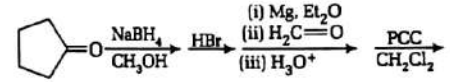
22. If $Ag^+ + 2NH_3 \rightleftharpoons Ag(NH_3)_2^+$; $K_1 = 1.7 \times 10^7$

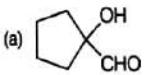
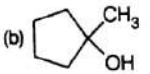
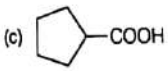
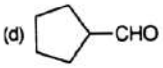
$Ag^+ + Cl^- \rightleftharpoons AgCl$; $K_2 = 5.4 \times 10^9$

Then, for $AgCl + 2NH_3 \rightleftharpoons [Ag(NH_3)_2]^+ + Cl^-$ equilibrium constant will be

(a) 4.68×10^{-3} (b) 5.2×10^{-17}
(c) 0.31×10^{-2} (d) 3.1×10^{-2}

23. What is product of the following sequence of reactions?



(a) 
(b) 
(c) 
(d) 

24. For the following equilibrium (omitting charges)

I. $M + Cl \longrightarrow MCl$, $K_{eq} = \beta_1$
II. $MCl + Cl \longrightarrow MCl_2$, $K_{eq} = \beta_2$
III. $MCl_2 + Cl \longrightarrow MCl_3$, $K_{eq} = \beta_3$
IV. $M + 3Cl \longrightarrow MCl_3$, $K_{eq} = K$

then relationship between K, β_1, β_2 and β_3 is

(a) $K = \beta_1 \beta_2 \beta_3$
(b) $\log K = \log \beta_1 + \log \beta_2 + \log \beta_3$
(c) $p_K = p_{\beta_1} + p_{\beta_2} + p_{\beta_3}$
(d) All of the above

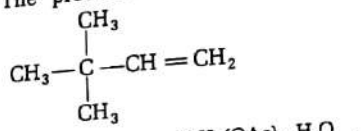
25. $R—CH_2—CH_2—OH$ can be converted into RCH_2CH_2COOH by the following sequence of steps.

(a) PBr_3, KCN, H_2/Pt
(b) PBr_3, KCN, H_3O^+
(c) HCN, PBr_3, H_3O^+
(d) KCN, H_3O^+

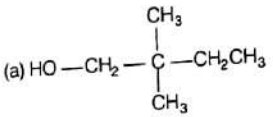
26. When $KMnO_4$ acts as an oxidising agent and ultimately forms MnO_4^{2-}, MnO_2, Mn_2O_3 and Mn^{2+}, then the number of electrons transferred in each case respectively are

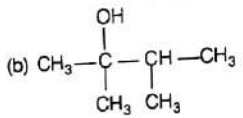
(a) 1, 3, 4, 5 (b) 3, 2, 1, 4
(c) 1, 5, 3, 7 (d) 4, 3, 2, 1

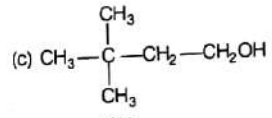
27. The product P of the given reaction is

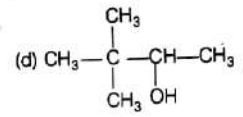


$\xrightarrow[\text{(ii) } NaBH_4]{\text{(i) } Hg(OAc)_2,\ H_2O}$

(a)


(b)


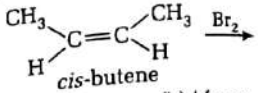
(c)


(d)


28. In acidic medium, dichromatic ion oxidises ferrous ion to 'ferric ion. If the gram molecular weight of potassium dichromate is 294 g, its gram equivalent weight (in grams) is

(a) 24.5 (b) 49
(c) 125 (d) 250

29. Find out the correct stereoisomeric product for the following reaction,



cis-butene

(a) *d*-form (b) *l*-from
(c) meso-form (d) racemic mixture

30. Ferrous oxide has a cubic structure. The length of edge of the unit cell is 5 Å and the density of the oxide is 4.0 g cm^{-3}. Then the number of Fe^{2+} and O^{2-} ions present in each unit cell will be

(a) four Fe^{2+} and two O^{2-}
(b) four Fe^{2+} and four O^{2-}
(c) two Fe^{2+} and four O^{2-}
(d) two Fe^{2+} and two O^{2-}

31. In the reaction

$$C_7H_8 \xrightarrow{3Cl_2/\Delta} X \xrightarrow{Br_2/Fe} Y \xrightarrow{Zn/HCl} Z$$

Z is

(a) o-bromotoluene
(b) *m*-bromotoluene
(c) *p*-bromotoluene
(d) 3-bromo-2, 2, 6 - trichlorotoluene

32. Which of the following arrangements correctly represents hexagonal and cubic close packed structure respectively?

(a) *ABAB* ..... and *ACBACB* .....
(b) *ABCABC* ..... and *ABAB* .....
(c) Both have *ABCABC* ..... arrangement
(d) Both have *ABAB* ..... arrangement

33. 0.001 mole of $[Co(NH_3)_5(NO_3)(SO_4)]$ was passed through a cation exchanger and the acid coming out of it required 20mL of 0.1 M NaOH for neutralisation. Thus, the complex is

(a) $[Co(NH_3)_5(NO_3)]SO_4$
(b) $[Co(NH_3)_5(SO_4)]NO_3$
(c) $[Co(NH_3)_5]NO_3 \cdot SO_4$
(d) None of the above

34. The molal freezing point depression constant for benzene (C_6H_6) is 4.90 K Kg mol^{-1}. Selenium exists as a polymer of the type Se_x. When 3.26 g of selenium is dissolved in 226 g of benzene, the observed freezing point is 0.112°C lower than that of pure benzene. The molecular formula of selenium is (atomic mass of Se = 78.8 g mol^{-1})

(a) Se_8 (b) Se_6 (c) Se_4 (d) Se_2

35. In the complexes $[Fe(H_2O)_6]^{3+}$, $[Fe(CN)_6]^{3-}$, $[Fe(C_2O_4)_3]^{3-}$ and $[FeCl_6]^{3-}$, more stability is shown by

(a) $[FeCl_6]^{3-}$ (b) $[Fe(C_2O_4)_3]^{3-}$
(c) $[Fe(H_2O)_6]^{3+}$ (d) $[Fe(CN)_6]^{3-}$

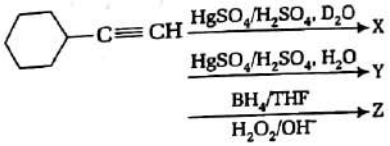
36. For an ideal binary liquid solution with $p_x^0 > p_y^0$ in which relation between X_x (mole fraction of X in liquid phase) and Y_x (mole fraction of X in vapour phase) is correct, X_y and Y_y are mole fraction of Y in liquid and vapour phase respectively

(a) $X_x > Y_x$
(b) $X_x = Y_x$
(c) $\frac{X_x}{X_y} < \frac{Y_x}{Y_y}$
(d) X_x, Y_x, X_y and Y_y cannot be correlated

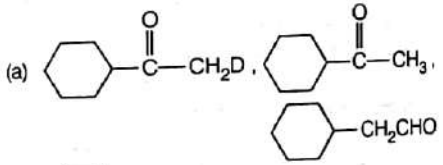
37. Point out the incorrect reaction from the following.

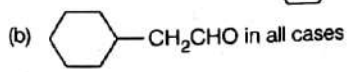
(a) $2Na_2CrO_4 + H^+ \longrightarrow Na_2Cr_2O_7 + 2Na^+ + H_2O$
(b) $4MnO_2 + 4KOH + O_2 \longrightarrow 4KMnO_4 + 2H_2O$
(c) $2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$
(d) $MnO_4^- + 8H^+ + 5Fe^{2+} \longrightarrow 5Fe^{3+} + Mn^{2+} + 4H_2O$

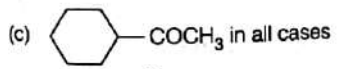
38.

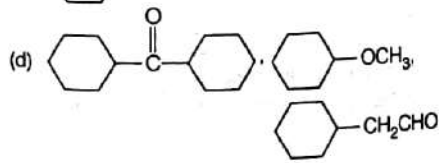


X, Y and Z respectively are

(a)


(b)

CH_2CHO in all cases

(c)

$COCH_3$ in all cases

(d)


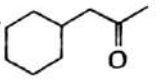
39. A student made the following observations in the laboratory.

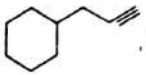
I. Clean copper metal did not react with 1 molar $Pb(NO_3)_2$ solution
II. Clean lead metal dissolved in a 1 molar $AgNO_3$ solution and crystals of Ag metal appeared
III. Clean silver metal did not react with 1 molar $Cu(NO_3)_2$ solution

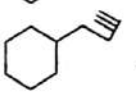
The order of decrease in reducing character of three metals is

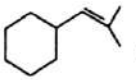
(a) Pb, Cu, Ag (b) Pb, Ag, Cu
(c) Cu, Ag, Pb (d) Cu, Pb, Ag

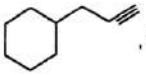
40. Choose the correct alkyne and reagents for the preparation of



(a)

, $HgSO_4$, H_2SO_4, H_2O

(b)

, $HgSO_4$, H_2SO_4, H_2O

(c)

, BH_3, H_2O_2, NaOH

(d)

, BH_3, H_2O_2, NaOH

41. The conductivity of 0.001028 mol L^{-1} acetic acid is 4.95×10^{-5} S cm^{-1}. Find out its dissociation constant if Λ_m for acetic acid is 390.5 S cm^{-1} mol^{-1}.

(a) 2.18×10^{-5} mol^{-1} L^{-1} (b) 1.78×10^{-5} mol L^{-1}
(c) 3.72×10^{-4} mol L^{-1} (d) 2.37×10^{-4} mol L^{-1}

42. In order to prepare one litre 1N solution of $KMnO_4$, how many grams of $KMnO_4$ are required, if the solution to be used in acid medium for oxidation?

(a) 128 g (b) 41.75 g (c) 31.60 g (d) 62.34 g

43. Which of the following represents the correct order of decreasing number of S = O bonds?

(a) $H_2SO_4 > H_2SO_3 > H_2S_2O_8$
(b) $H_2S_2O_8 > H_2SO_3 > H_2SO_4$
(c) $H_2S_2O_8 > H_2SO_4 > H_2SO_3$
(d) $H_2SO_3 > H_2S_2O_8 > H_2SO_4$

44. A hypothetical reaction,

$X_2 + Y_2 \longrightarrow 2XY$ follows the following mechanism

$X_2 \rightleftharpoons X + X$..... fast

$X + Y_2 \longrightarrow XY + Y$..... slow

$X + Y \longrightarrow XY$..... fast

The order of the overall reaction is

(a) 2 (b) 3/2 (c) 1 (d) 0

45. The major role of fluorspar (CaF_2) which is added in small quantity in the electrolytic reduction of alumina dissolved in fused cryolite (Na_3AlF_6) is

I. as a catalyst.

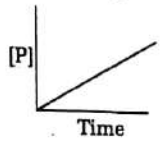
II. to make the fused mixture very conducting.

III. to lower the temperature of melting.

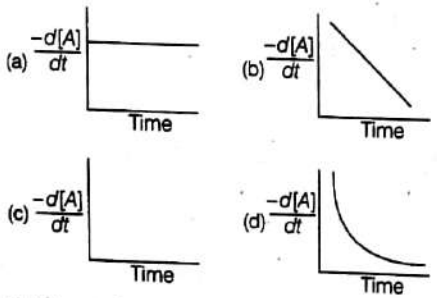
IV. to decrease the rate of oxidation of carbon at the anode.

(a) I, II (b) II, III (c) I, II, III (d) III, IV

46. The variation of concentration of the product P with time in the reaction, $A \rightarrow P$ is shown in following graph.



The graph between $\frac{-d[A]}{dt}$ and time will be of the type



47. Point out the correct statement.

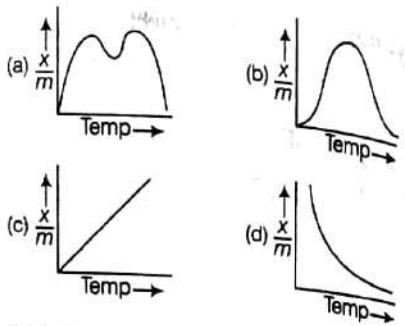
(a) Below 710°C, C is better reducing agent than CO

(b) Below 710°C, CO is better reducing agent than C

(c) Below 710°C, CO is an oxidising agent

(d) Below 710°C, CO_2 is a reducing agent

48. Which of the following represents physical adsorption?



49. $KMnO_4$ reacts with ferrous sulphate according to the following equation,

$MnO_4^- + 5Fe^{2+} + 8H^- \longrightarrow Mn^{2+} + 2Fe^{3+} + 4H_2O$

Here, 10 mL of 0.1 M $KMnO_4$ is equivalent to

(a) 50 mL of 0.1 M $FeSO_4$

(b) 20 mL of 0.1 M $FeSO_4$

(c) 40 mL of 0.1 M $FeSO_4$

(d) 30 mL of 0.1 M $FeSO_4$

50. In an experiment, addition of 4.0 mL of 0.005 M $BaCl_2$ to 16.0 mL of arsenious sulphide sol just causes complete coagulation in 2 h. The flocculating value of the effective ion is

(a) Ba^{2+}, 1.0 (b) Ba^{2+}, 2.0

(c) Cl^-, 1.0 (d) Cl^-, 2.0

51. Which of the following atomic and physical properties of hydrogen is false?

(a) Hydrogen > Deuterium > Tritium; (melting point/K)

(b) Hydrogen < Deuterium < Tritium; (boiling point/K)

(c) Hydrogen < Deuterium < Tritium; (density/gL^{-1})

(d) Hydrogen > Deuterium > Tritium; (% relative abundance)

52. Eutrophication of a lake means, it

(a) is low is nutrients

(b) is high in nutrients

(c) has a high temperature

(d) has excess amount of organic matter

53. When H_2O_2 is added to ice cold solution of acidified potassium dichromate in ether and the contents are shaken and allowed to stand

(a) a blue colour is obtained in ether because of formation of CrO_5

(b) a blue colour is obtained in ether because of formation of CrO_3

(c) a blue colour is obtained in ether because of formation of $Cr_2(SO_4)_3$

(d) chromyl chloride is formed

54. 500 mL of a sample of water required 19.6 mg of $K_2Cr_2O_7$ for the oxidation of dissolved organic matter in it in the presence of H_2SO_4. The COD of water sample is

(a) 3.2 ppm

(b) 7.2 ppm

(c) 6.4 ppm

(d) 4.6 ppm

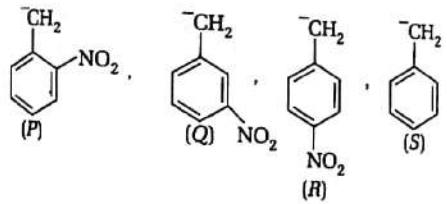
55. $X + Na_2CO_3 \longrightarrow Y + Z$

$X + CO_2 \longrightarrow Z$ (milky cloud)

The chemical formulae of X, Y and Z are

	X	Y	Z
(a)	CaO	$Ca(OH)_2$	NaOH
(b)	NaOH	CaO	$CaCO_3$
(c)	NaOH	$Ca(OH)_2$	$CaCO_3$
(d)	$Ca(OH)_2$	NaOH	$CaCO_3$

56. For carbanion



Stability order will be

(a) $P > Q > S > R$

(b) $P > R > Q > S$

(c) $Q > R > S > R$

(d) $S > R > Q > P$

57. The aqueous solution of an unknown sodium salt gives the following reactions.

I. It decolourises a solution of iodine in potassium iodide.

II. It gives white turbidity with dil.HCl solution.

III. It gives a white precipitate with $AgNO_3$ solution which changes colours and finally becomes black on standing.

The unknown sodium salt is

(a) sodium thiosulphate

(b) sodium bisulphite

(c) sodium sulphite

(d) sodium sulphide

58. The catenation tendency of C, Si and Ge is in the order Ge < Si < C. The bond energies (in kJ mol^{-1}) of C—C, Si—Si and Ge—Ge bonds, respectively are

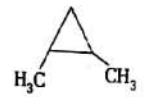
(a) 348, 167, 180

(b) 348, 180, 167

(c) 167, 180, 348

(d) 180, 167, 348

59. What is correct about the following structure?



(a) Total stereoisomers = 4

(b) Number of chiral carbons = 1

(c) Number of optical isomers = 2

(d) Number of meso compounds = 2

60. Number of oxygen atoms shared per SiO_4^{4-} tetrahedron in

I. two dimensional sheet structured silicates

II. cyclic silicates and

III. single strand chain silicates respectively are

(a) 3, 3, 2 (b) 3, 2, 2

(c) 4, 3, 1 (d) 4, 3, 2

Biology

1. Which of the following is the most primitive ancestor of man ?
(a) *Ramapithecus*
(b) *Homo habilis*
(c) *Australopithecus*
(d) *Homo sapiens neanderthalensis*

2. Vitamin-B_{12} is absorbed primarily in the
(a) stomach (b) duodenum
(c) jejunum (d) ileum

3. The faster breathing in high fever is due to the
(a) additional requirement of O_2 for the invader germs
(b) high temperature of the body
(c) mental worry of a patient
(d) loss of appetiate

4. Which of the following animals possess non-elastic lungs with elastic air sacs connected to them?
(a) Reptiles (b) Birds
(c) Amphibians (d) Mammals

5. Which of the following is not correctly matched?
(a) *Trichomonas vaginalis* – Leishmaniasis
(b) *Glossina palpalis* – Sleeping sickness
(c) *Aedes agypti* – Yellow fever
(d) *Culex pipceins* – Filariasis

6. Carotid labyrinth contains
(a) olfactory receptors
(b) baroreceptors
(c) chemoreceptors
(d) phonoreceptors

7. Occupational lung diseases that occurs in humans, among those given below is
(a) dyspnea (b) anthracosis
(c) atelectasis (d) cyanosis

8. Epiphyseal plates at the extremities of long bones help in
(a) bone moulding
(b) elongation of bone
(c) bone formation
(d) formation of Haversian canal

9. The strongest muscle in the human is
(a) biceps (b) gluteus maximus
(c) stapedius (d) masseter

10. Parkinsonism is related with
(a) brain (b) spinal nerve
(c) cranial nerves (d) All of these

11. Meniere's disease is associated with
(a) ear (b) eye
(c) nose (d) throat

12. If the threshold for hearing increasing 1000 times, the hearing loss is
(a) 40 decibels (b) 50 decibels
(c) 60 decibels (d) None of these

13. Gonads are derived from
(a) ectoderm
(b) mesoderm
(c) endoderm
(d) None of the above

14. The number of chromosomes in a primary spermatocyte is
(a) same as in spermatid
(b) same as in spermatogonium
(c) help of that in spermatogonium
(d) same as in secondary spermatocyte

15. The portion of the endometrium that covers the embryo and is located between the embryo and the uterine cavity is the
(a) decidua basalis
(b) desidua umbilicus
(c) desidua capsularis
(d) decidua functionalis

16. Depo-provera refers to
(a) injectible contraceptive
(b) intra uterine device
(c) implant
(d) oral contraceptive

17. What base is responsible for hot spots for spontaneous point mutations?
(a) Adenine (b) Guanine
(c) 5-bromouracil (d) 5-methyl cytosine

18. During which geological period of evolution did the greatest diversification of life occurred on the earth?
(a) Permian (b) Jurassic
(c) Cambrian (d) Ordovician

19. Specific radioacitve identification of ribosomal RNA can be achieved by using C^{14} labelled
(a) guanine (b) uracil
(c) thymine (d) cytocine

20. Which of the following is the Pribnow box?
(a) 5′-T A T A A T-3′ (b) 5′-T A A T A T-3′
(c) 5′-A A T A A T-3′ (d) 5′-A T A T T A-3′

21. The genome of *Caenorhabditis elegans* consists of
(a) 3 billion base pairs and 30,000 genes
(b) 12 million base pairs and 6000 genes
(c) 4.7 million base pairs and 4000 genes
(d) 97 million base pairs and 18,000 genes

22. About how long ago was the earth formed?
(a) 3 billion years ago (b) 10 billion years ago
(c) 4.6 billion years ago (d) 20 billion years ago

23. Gas gangrene is caused by
(a) *Clostridium botulinum*
(b) *Xanthomonas campestris*
(c) *Pseudomonas*
(d) *Clostridium perfringens*

24. Who received Nobel Prize in 1951 for the development of vaccine for yellow fever?
(a) Max Theiler
(b) Ronald Ross
(c) Max Delbruck
(d) Francis Peyton Rous

25. Continuous exposer to vinyl chloride may cause cancer of the
(a) liver (b) spleen
(c) vagina (d) prostate gland

26. Which of the following T-cells are destroyed by HIV?
(a) Cytotoxic T-cells (b) Killer T-cells
(c) Suppressor T-cells (d) Helper T-cells

27. An autoimmune disease is
(a) AIDS (b) haemophilia
(c) allergy (d) myasthenia gravis

28. Which hormone produces calorigenic effect?
(a) Thyroxine (b) FSH
(c) Insulin (d) All of these

29. Which of the following act as an antigen, but do not induce antibody production?
(a) Haustra (b) Histones
(c) Haptens (d) None of these

30. Haldane effect refers to
(a) more acidity in the blood
(b) less acidity in the blood
(c) more basicity in the blood
(d) less basicity in the blood

31. The plant whose seeds are known to leave the longest viability period is
(a) *Carica papaya* (b) *Triticum aestivum*
(c) *Zizypus mauritiana* (d) *Nelumbo nucifera*

32. Jute is a
(a) bast fibre from secondary xylem
(b) bast fibre from primary xylem
(c) bast fibre from secondary phloem
(d) bast fibre from primary phloem

33. Chlorosis is produced in the leaves due to the deficiency of Fe, Mg, Mn, S or N of these essential elements, those that are exclusive constituents of chlorophyll molecule are
(a) Fe, S (b) N, S
(c) Mg, S (d) Mg, N

34. Read the following statements and choose the correct option.
I. Leptosporangiate development of sporangium is found in all members *Pteropsida*.
II. Seed habit is shown by *Sellaginella*.
III. *Gnetum* leaves are monomorphic and pinnately compound.
IV. Sporic meiosis is found in *Volvox*, *Chlamydomonas* and *Ulothrix*.
Choose the correct option.
(a) I and IV (b) I and II
(c) I, II and IV (d) All of these

35. Which of the following characteristics out of I, II and III are exhibited by C_4 plants?
I. Kranz anatomy.
II. The product of photosynthesis is oxalo acetic acid.

III. Both PEP carboxylase and ribulose-bis phosphate carboxylase act as carboxylating enzyme.

Choose the corrent option.

(a) I and II, but not III
(b) II and III, but not I
(c) I and III, but not II
(d) All of these

36. Match the following column I and II for organismic respiration.

Column I	Column II
A. Respiration in bacteria	1. Mitochondria
B. Respiration in cyanobacteria	2. Cytoplasmic membrane
C. Respiration in eukaryotic cell	3. Mesosomes

Codes

	A	B	C
(a)	2	3	1
(b)	3	2	1
(c)	1	3	2
(d)	3	1	2

37. Compare the statements I and II and choose correct option.

Statement (I) Auxin promote apical dominance by suppressing the activity of lateral buds.

Statement (II) In moriculture, periodic prunning of shoot tips is done to make mulberry plants bushy.

Choose the correct options.

(a) I is false, but II is true (b) II is false, but I is true
(c) Both I and II are true (d) Both I and II are false

38. The one advantage of cleistogamy is

(a) it leads to greater genetic diversity
(b) seed dispersal is more efficient and wide spread
(c) seed set is not dependent on pollinators
(d) each visit of a pollinator results in transfer of hundreds of pollen grains

39. In coconut, the liquid endosperm is formed because

(a) karyokinesis is not followed by cytokinesis
(b) karyokinesis is followed by cytokinesis
(c) formation of liquid endosperm is not dependent upon karyokinesis and cytokinesis
(d) None of the above

40. Keeping is view the structure of cell membrane, which one of the following statements is correct with respect to the movements of liquid and proteins from one liquid monolayer to the other (flip flop movement).

(a) While proteins can flip flop, liquids can not
(b) Neither lipids, nor proteins can flip flop
(c) Both lipids and proteins can flip flop
(d) While lipids can rarely flip flop, proteins can not

41. Ribosomes are particles about 200 Å units in diameter consisting of protein and RNA. The percentage of protein and RNA is respectively

(a) 80% and 20% (b) 60% and 40%
(c) 50% and 50% (d) 40% and 60%

42. Match the biological molecule listed under column I with their biological function listed under column II. Choose the answer which gives correct combination of alphabets of the two columns.

Column I (Biological Molecule)	Column II (Function)
A. Glycogen	1. Hormone
B. Globulin	2. Biocatalyst
C. Steroid	3. Antibody
D. Thrombin	4. Storage product

Codes

	A	B	C	D
(a)	3	2	4	1
(b)	4	2	1	3
(c)	2	4	3	1
(d)	4	3	1	2

43. In pea plants, yellow seeds are dominant to green. If a heterozygous yellow seeded plant is crossed with a green seeded plant, what ratio of yellow and green seeded plants could you expect in F_1-generation.

(a) 9 : 1 (b) 1 : 3
(c) 3 : 1 (d) 50 : 50

44. In a mutational event, when adenine is replaced by guanine, it is a case of

(a) frameshift mutation
(b) transcription
(c) transition
(d) transversion

45. Independent assortment of gene occurs due to the orientation of chromosomes at

(a) metaphase-I of mitosis
(b) metaphase-I of meiosis
(c) metaphase-II of meiosis
(d) any phase of the cell division

46. The non-disjunction, in meiosis may result is extra copy of a chromosome in a sperm cell. During which phase the above phenomenon may occur?

(a) Prophase-I, prophase-II
(b) Metaphase-I, anaphse-II
(c) Anaphase-I, anaphase-II
(d) Anaphase-I, telophase-II

47. Which of the following is true regarding the phage lambda, a virus which infects bacteria?

(a) In the lytic cycle, the bacterial host replicates viral DNA, passing it on to daughter cells during binary fission
(b) In the lysogenic cycle, the bacterial host replicates viral DNA, passing it onto daughter cells during binary fission
(c) In the lytic cycle, viral DNA is integrated into the host genome
(d) In the lysogenic cycle, the host bacterial cell burst, releasing phases

48. The part of the bacterial chromosome sharing homology with genome fragment transferred from the recipients to cell during merozygote formation is known as

(a) eugenic (b) exogenate
(c) endogenate (d) dysgenic

49. In 1944, Avery, McCarty and MacLeod isolated a substance from heat killed virulent form of bacteria and added to non-virulent form of bacteria which changed the non-virulent to virulent from this substance can be distroyed by

(a) DNAase (b) protease
(c) lipase (d) amylase

50. *Thermococcus*, *Methanococcus* and *Methanobacterium* are groups of

(a) bacteria containing a cytoskeleton and all membrane bound organelles
(b) archaebacteria with peptidoglycan in their cell wall
(c) archaebacteria that consists of protein homologous to eukaryotic core histones
(d) most advanced type of bacteria

51. Match the following Column I with Column II.

Column I	Column II
A. Complementary ratio	1. 9 : 7
B. Supplementary ratio	2. 9 : 3 : 4
C. Epistatic ratio (Masking)	3. 12 : 3 : 1
D. Inhibitory ratio	4. 13 : 3

Codes

	A	B	C	D
(a)	4	1	3	2
(b)	1	2	3	4
(c)	4	1	2	3
(d)	1	3	2	4

52. Which of the following sequences represent a possible pathway in the production of a secretory protein?

(a) Rough ER ⟶ Secretory vesicle ⟶ Ribosome ⟶ Golgi apparatus
(b) Ribosome ⟶ Rough ER ⟶ Golgi apparatus ⟶ Secretory vesicle
(c) Secretory vesicle ⟶ Golgi apparatus ⟶ Ribosomes ⟶ Rough ER
(d) Rough ER ⟶ Ribosomes ⟶ Secretory vesicles ⟶ Golgi apparatus

53. A connecting link between plant and animal kingdom is

(a) *Paramecium* (b) *Chlamydomonas*
(c) *Chlorella* (d) *Euglena*

54. Which of the following statements is false regarding SDS-polyacrylamide gel electrophoresis?

(a) Proteins are separated by molecular weight
(b) SDS is a detergent which gives charge to protein
(c) Large protein move more slowly through gel
(d) SDS is used to maintain the 3-dimentional structure of protein

55. If the free energy change of a reaction is greater than zero, then the reaction is

(a) spontaneous (b) non-spontaneous
(c) at equilibrium (d) endothermic

56. Organisms who are able to freely interbreed producing fertile offsprings and having similar blue print for making these organisms are referred to as

(a) speceis
(b) tribe
(c) genus
(d) sub-genus

57. The enzyme hexokinase which catalysis glucose to a glucose-6-phosphate in glycolysis is inhibited by glucose-6-phosphate. This is an example of

I. competitive inhibition

II. non-competitive inhibition

III. feedback allosteric inhibition

Which of the above statements is/are correct?

(a) I and II (b) I and III
(c) Only III (d) All of these

58. The protein products of tumour suppressor gene may

(a) be present in non- cancerous cells
(b) cause signal cell death
(c) regulate the cell cycle
(d) All of the above

59. The mitotic cell cycle is divided typically into four phases: G_1, S, G_2 and M. Considering a mitotic cycle time of 18 hrs; the distribution of period of time (in hrs) for each of these phases will be

	G_1	S	G_2	M
(a)	1	3	5	9
(b)	9	1	3	5
(c)	9	5	3	1
(d)	3	5	9	1

60. Match the following column I with column II

Column I	Column II
A. Carcinogen	1. Cancerous tumour
B. Anaphase-I	2. Disjunction
C. Mitosis	3. Synapse
D. Zygotene	4. Plectonemic coiling

Codes

	A	B	C	D
(a)	1	2	4	3
(b)	3	1	4	2
(c)	2	3	1	4
(d)	4	1	3	2

Quantitative Aptitude & English

1. When the bus reaches Shivani's house, it faces South. After starting from Shivani's house to the school, it turns twice to its left and once to its right. In which direction it is running now?

(a) North (b) West
(c) East (d) South

2. A men travels 12 km West, then 3 km towards South and then 8 km towards East. How far is he from the start?

(a) 23 km
(b) 20 km
(c) 15 km
(d) 5 km

3. From the given alternative words, select the one which can be formed using the letters of the given word EXAMINATION.

(a) ANIMAL
(b) EXAMINER
(c) NATIONAL
(d) ANIMATION

4. If ACNE can be coded as 3, 7, 29, 11, then BOIL will be coded as

(a) 5, 29, 19, 27
(b) 5, 29, 19, 25
(c) 5, 31, 21, 25
(d) 5, 31, 19, 25

5. QPRS : TUVW :: JIKL : ?

(a) NMOP (b) NMPO
(c) MNPO (d) MNOP

Directions (Q.No. 6-7) *Find the odd letter pair from the given alternatives.*

6. (a) Wool (b) Feather
(c) Hair (d) Grass

7. (a) Sport : Ground (b) Cinema : Screen
(c) Drama : Stage (d) Rubber : Erase

8. If + means −, − means ×, × means + and + means +, then $48 \times 4 + 7 + 8 - 2 = ?$

(a) 3 (b) − 5
(c) 35 (d) 16

9. If February 1, 2004 is Wednesday, what day is March 3, 2004?

(a) Monday (b) Sunday
(c) Saturday (d) Friday

10. How many triangles are there in the given figure?

(a) 5 (b) 4
(c) 3 (d) 8

Directions (Q.Nos. 11-12) *Out of the four alternatives, choose the one which best expresses the meaning of the given word.*

11. Instigate

(a) Initiate (b) Incite
(c) Force (d) Cause

12. Voracious

(a) Quick (b) Angry
(c) Hungry (d) Wild

Directions (Q.No. 13-14) *Choose the word opposite in meaning to the given word.*

13. Epilogue

(a) Dialogue (b) Prelude
(c) Post script (d) Epigram

14. Indiscreet

(a) Reliable (b) Honest
(c) Prudent (d) Stupid

Directions (Q.No. 15) *Out of the four alternatives, choose the one which can be substituted for the given words/sentence.*

15. The absence of law and order

(a) Rebellion (b) Anarchy
(c) Mutiny (d) Revolt

Directions (Q.Nos. 16-18) *In the following question, a sentence has divided into four parts. Arrange these parts to make the sentence meaningful.*

16. In favour of English,

P : has chances of securing employment
Q : we may say that
R : in all parts of India and in foreign countries
S : an English knowing Indian

(a) QSPR
(b) SPQR
(c) SRQP
(d) QRPS

17. The hungry man

P : and said
Q : replied in the negative
R : that he only wanted a meal
S : to his question

(a) SQPR
(b) QSPR
(c) SPRQ
(d) QPRS

18. It is

P : that people read fewer books today
Q : than they did
R : even about a decade ago
S : a matter of grave concern

(a) PSRQ (b) SPRQ
(c) PSQR (d) SPQR

Directions (Q.Nos. 19-20) *Groups of four words are given. In each group, one word is correctly spelt. Find the correctly spelt word.*

19. (a) Paraphamelia (b) Parsimonious
(c) Peccadilo (d) Peadialriis

20. (a) Tussel (b) Tunnle
(c) Tumble (d) Trable

Answers

Physics

1. (b)	2. (a)	3. (a)	4. (a)	5. (c)	6. (c)	7. (c)	8. (b)	9. (a)	10. (d)
11. (b)	12. (a)	13. (a)	14. (a)	15. (a)	16. (a)	17. (a)	18. (c)	19. (a)	20. (a)
21. (d)	22. (a)	23. (a)	24. (d)	25. (c)	26. (d)	27. (c)	28. (c)	29. (a)	30. (c)
31. (d)	32. (a)	33. (a)	34. (a)	35. (b)	36. (a)	37. (b)	38. (c)	39. (c)	40. (b)
41. (d)	42. (b)	43. (c)	44. (c)	45. (d)	46. (c)	47. (c)	48. (d)	49. (d)	50. (a)
51. (b)	52. (d)	53. (b)	54. (a)	55. (c)	56. (c)	57. (d)	58. (a)	59. (c)	60. (c)

Chemistry

1. (d)	2. (c)	3. (b)	4. (b)	5. (d)	6. (d)	7. (c)	8. (c)	9. (b)	10. (b)
11. (c)	12. (a)	13. (d)	14. (d)	15. (a)	16. (c)	17. (d)	18. (b)	19. (c)	20. (b)
21. (c)	22. (c)	23. (d)	24. (d)	25. (b)	26. (a)	27. (d)	28. (b)	29. (d)	30. (b)
31. (b)	32. (a)	33. (a)	34. (a)	35. (b)	36. (c)	37. (b)	38. (a)	39. (a)	40. (a)
41. (b)	42. (c)	43. (c)	44. (b)	45. (b)	46. (a)	47. (b)	48. (d)	49. (a)	50. (a)
51. (a)	52. (b)	53. (a)	54. (c)	55. (d)	56. (b)	57. (a)	58. (b)	59. (c)	60. (b)

Biology

1. (a)	2. (d)	3. (b)	4. (b)	5. (a)	6. (b)	7. (b)	8. (b)	9. (d)	10. (a)
11. (a)	12. (d)	13. (b)	14. (b)	15. (c)	16. (a)	17. (c)	18. (c)	19. (b)	20. (a)
21. (b)	22. (c)	23. (d)	24. (a)	25. (a)	26. (d)	27. (d)	28. (a)	29. (c)	30. (a)
31. (d)	32. (c)	33. (d)	34. (c)	35. (d)	36. (b)	37. (c)	38. (c)	39. (c)	40. (d)
41. (b)	42. (d)	43. (d)	44. (c)	45. (b)	46. (c)	47. (b)	48. (c)	49. (a)	50. (c)
51. (b)	52. (d)	53. (d)	54. (d)	55. (b)	56. (a)	57. (c)	58. (a)	59. (c)	60. (a)

Quantitative Aptitude & English

1. (c)	2. (d)	3. (d)	4. (d)	5. (c)	6. (d)	7. (d)	8. (a)	9. (c)	10. (d)
11. (b)	12. (c)	13. (b)	14. (c)	15. (b)	16. (a)	17. (b)	18. (d)	19. (b)	20. (c)

Solutions

physics

1. The angle between two vectors is given by

$$\cos\theta = \frac{\mathbf{a}\cdot\mathbf{b}}{ab} = \frac{1-1-1}{\sqrt{3}\times\sqrt{3}}$$

$$\Rightarrow \quad \cos\theta = -\frac{1}{3}$$

$$\therefore \quad \theta = \cos^{-1}\left(-\frac{1}{3}\right)$$

2. Given that distance

$$x = t^2(2 - t/3)$$

On differentiating

$$\frac{dx}{dt} = 4t - t^2$$

For x to be maximum, $\frac{dx}{dt} = 0$

$$\Rightarrow \quad 4t - t^2 = 0$$

$$\Rightarrow \quad t = 4$$

$\therefore$ Maximum distance

$$x_{max} = 4^2(2 - 4/3)$$

$$16 \times \left[\frac{6-4}{3}\right]$$

$$= 16 \times \frac{2}{3}$$

$$= 10.7$$

3. Let a be the acceleration of centre of sphere. The angular acceleration about the centre of the sphere is $\alpha = \frac{a}{r}$, as there is no slipping.

For the linear motion of the centre

$$f + F = ma \qquad \ldots(i)$$

and for the rotational motion about the centre

$$Fr - fr = I\alpha = \left(\frac{2}{5}mr^2\right)\left(\frac{a}{r}\right)$$

$$\Rightarrow \quad F - f = \frac{2}{5}ma \qquad \ldots(ii)$$

From Eqs. (i) and (ii)

$$2F = \frac{7}{5}ma \Rightarrow a = \frac{10F}{7m}$$

4. Let the cross-sectional area is α. The mass of an element of length dx located at a distance x away from the left end is $(C + Dx)\alpha\, dx$. The x-coordinate of the centre of mass is given by

$$X_{cm} = \frac{\int x\, dm}{\int dm}$$

$$= \frac{\int_0^l x(C + Dx)\,\alpha\, dx}{\int_0^l (C + Dx)\alpha\, dx}$$

$$= \frac{C\frac{l^2}{2} + \frac{Dl^3}{3}}{Cl + \frac{Dl^2}{2}} = \frac{3Cl + 2Dl^2}{3(2C + Dl)}$$

5. For the circular motion acceleration towards the centre is $\frac{v^2}{r}$. The horizontal force on the particle is due to the spring and kl, where l is the elongation and k is spring constant of spring

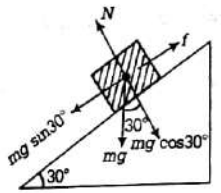
$$kl = \frac{mv^2}{r} = m\omega^2 r = m\omega^2(l_0 + l)$$

$$\Rightarrow \quad (k - m\omega^2)l = m\omega^2 l_0$$

$$\Rightarrow \quad l = \frac{m\omega^2 l_0}{k - m\omega^2}$$

Putting the values $l = \frac{0.5\times4\times0.5}{100 - 0.5\times4} = \frac{1}{98}$ m = 1 cm

6. Consider the situation



Let the mass of block be m.

The equation of forces

$$mg\sin 30° - f = \frac{mg}{4}$$

$$f = \frac{mg}{4}$$

Also, $N = mg\cos 30° = mg\frac{\sqrt{3}}{2}$

As the block is slipping on the incline, friction is

$$\mu_s = \frac{F}{N} = \frac{mg}{4mg\frac{\sqrt{3}}{2}}$$

$$= \frac{1}{2\sqrt{3}}$$

7. The field at the site of one wire due to the other is

$$B = \frac{\mu_0 i}{2\pi d} = \frac{2\times10^{-7}\times5.0}{25\times10^{-2}}$$
$$= 4.0\times10^{-5}\ \text{T}$$

The force experienced by 10 cm of this wire due to other is

$$F = ilB$$
$$= (5.0)\times(10\times10^{-2})\times(4.0\times10^{-5})$$
$$= 2.0\times10^{-5}\ \text{N}$$

8. The wires ADC and ABC will have resistance 5 Ω each. These two are joined in parallel between A and C. The equivalent resistance R between A and C is, therefore given by

$$R = \frac{5\,\Omega\times5\,\Omega}{5\,\Omega+5\,\Omega} = 25\,\Omega$$

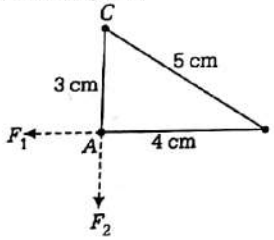
9. The area of cross-section of the conductor through which charges will be flow is

$$A = \pi(2.0\ \text{mm})^2 - \pi(1.0\ \text{mm})^2$$
$$= 3\times\pi\ \text{mm}^2$$

The resistance of the wire is therefore

$$R = \rho\frac{l}{A} = \frac{(2.0\times10^{-8})\times(10)}{3.0\times\pi\times10^{-6}}$$
$$= 2.1\times10^{-3}\,\Omega$$

10. Consider the diagram



The situation is shown in figure.

The force on A due to B is

$$F_1 = \frac{(2.0\times10^{-6})(2.0\times10^{-6})}{4\pi\varepsilon_0(4\ \text{cm})^2}$$
$$= 9\times10^9\times4\times10^{-12}\times\frac{1}{16\times10^{-4}}$$
$$= 22.5\ \text{N}$$

As the force due to C on A is 40 N.

Thus, net force (electric)

$$F = \sqrt{F_1^2 + F_1^2}$$
$$= \sqrt{(22.5)^2 + (40)^2} = 45.9\ \text{N}$$

11. For a diatomic gas

$$C_V = \frac{5}{2}R \text{ and } C_p = \frac{7}{2}R$$

The work done in an isobaric process is

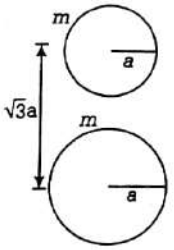
$$W = p(V_2 - V_1) = nR(T_2 - T_1)$$
$$\Rightarrow\ T_2 - T_1 = \frac{W}{nR}$$

The heat given in an isobaric process is

$$Q = nC_p(T_2 - T_1)$$
$$nC_p\frac{W}{nR} = \frac{7}{2}W$$
$$= \frac{7}{2}\times200\ \text{J}$$
$$= 700\ \text{J}$$

12. Now, the gravitational field due to the ring at a distance $d = \sqrt{3}\,a$ on its axis is

$$E = \frac{Gmd}{(a^2+d^2)^{3/2}} = \frac{\sqrt{3}Gm}{8a^2}$$



The force in a particle of mass M placed here is

$$F = ME = \frac{\sqrt{3}GMm}{8a^2}$$

This is also the force due to the sphere in the ring.

13. Horizontal component of velocity is always same

$$\Rightarrow\quad v\cos\alpha = u\cos\theta$$
or, $$v = \frac{u\cos\theta}{\cos\alpha}$$
or, $$v = u\cos\theta\sec\alpha$$

14. Let diameter of the sun is d while radius of the earth is r then

$$\frac{D}{2} \simeq 0.53\times\frac{\pi}{180}$$
$$= 9.25\times10^{-3}$$

The radiation emitted per unit area of the sun is

$$4\pi\left(\frac{d}{2}\right)^2\sigma T^4 = \pi D^2\sigma T^4$$

The radiation received at the earths surface per unit time per unit area is $\frac{\pi\sigma dT^4}{4\pi r^2} = \frac{\sigma T^4}{4}\left(\frac{d}{R}\right)^2$

$$\Rightarrow\quad \frac{\sigma T^4}{4}\left(\frac{D}{R}\right)^2 = 8.2\ \text{Jcm}^{-2}\text{min}^{-1}$$

or $$\frac{1}{4}\times5.67\times10^{-8}\times T^4\times(9.25\times10^{-3})^2$$
$$= \frac{8.2}{10^{-4}\times60}\ \text{Wm}^{-2}$$

$$\Rightarrow\quad T = 5794\ \text{K} \cong 5800\ \text{K}$$

15. The rms speed is given by $v_{rms} = \sqrt{\frac{3RT}{M_0}}$

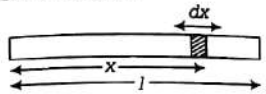
where, R = gas constant

T = Temperature of the gas

and M_0 = Molecular weight of the gas

$$= \sqrt{\frac{3\times8.3\times300}{32\times10^{-3}}}$$
$$= 483\ \text{m/s}$$

16. Consider the diagram



Consider the elemetary part of thickness dx at a distance x from axis of rotation, then force on this part

$$Adp = (dm)\omega^2 x \quad \text{(i)}$$

where, dm = mass of element

Now, from ideal gas equation

$pV = nRT$ we get

$$pAdx = \frac{dm}{M}RT$$

$$\Rightarrow\quad dm = \frac{MpA}{RT}dx \quad \text{(ii)}$$

From Eqs. (i) and (ii)

$$Adp = \frac{MpA}{RT}\omega^2 x\,dx$$

$$\int_{P_1}^{P_2}\frac{dp}{p} = \int_0^l\frac{M\omega^2}{RT}x\,dx$$

$$\Rightarrow\quad \ln\frac{p_2}{p_1} = \frac{M\omega^2 l^2}{2RT}$$

$$\Rightarrow\quad \frac{p_2}{p_1} = e^{\frac{M\omega^2 l^2}{2RT}}$$

17. The field at the centre of a circular loop is given by

$$B = \frac{\mu_0 i}{2a}$$

The field due to circular arc of inner circle is

$$B_1 = \left(\frac{\theta}{2\pi}\right)\frac{\mu_0 i}{2a}$$

The field due to circular arc of outer circle is

$$B_2 = \left(\frac{\theta}{2\pi}\right)\left(\frac{\mu_0 i}{2b}\right)$$

$$B = B_1 - B_2 = \frac{\mu_0 i(b-a)\theta}{4\pi ab}$$

18. The volume of 1 kg water $= \frac{1}{100}\ \text{m}^3$

and volume of 1 kg steam

$$= \frac{1}{0.6}\ \text{m}^3$$

The increase in volume

$$= \frac{1}{0.6}\ \text{m}^3 - \frac{1}{1000}\ \text{m}^3$$
$$= (1.7 - 0.001)\ \text{m}^3$$
$$\cong 1.7\ \text{m}^3$$

The work done by steam is

$$W = (100\ \text{kPa})(1.7\ \text{m}^3)$$
$$= 1.7\times10^5\ \text{J}$$

The change in internal energy

$$\Delta U = \Delta Q - \Delta W$$
$$= 2.25\times10^6\ \text{J} - 1.7\times10^5\ \text{J}$$
$$= 2.08\times10^6\ \text{J}$$

19. The equivalent resistance of the ammeter is

$$\frac{(480)(20)}{480+20} = 19.2\,\Omega$$

The equivalent resistance of the circuit is

$$140.8 + 19.2\,\Omega = 160\,\Omega$$

The current, $i = \frac{20\ \text{V}}{160\,\Omega} = 0.125\ \text{A}$

Hence, ammeter reading is 0.125 A.

20. The gravitational potential energy of the ball = mgh

$$= m\times10\times6.2\times10^3$$
$$= m\times6.2\times10^4\ \text{J}$$

Now energy required to take ball from 30°C to 330°C is

$$m\times126\times300 = m\times37800$$

Energy required to melt the ball = mL

where, L = latent heat

$$\Rightarrow\quad m\times6.2\times10^4\times L = m\times37800 + mL$$
$$L = 2.4\times10^4\ \text{J kg}^{-1}$$

21. The initial current $i = i_0 = \frac{E}{R} = \frac{10}{100}$

$$= 0.10\ \text{A}$$

the time constant, $\tau = \frac{L}{R} = \frac{20\ \text{mH}}{100\,\Omega}$

$$= 0.20\ \text{ms}$$

The current at $t = 1$ ms is

$$i = i_0 e^{-t/\tau}$$

$$= (0.10) e^{\left(\frac{-1\text{ ms}}{0.20\text{ ms}}\right)}$$

$$= (0.10)\, e^{5} = 6.7 \times 10^{-4}\text{ A}$$

22. Using the equation $V = \dfrac{Q}{4\pi\varepsilon_0 r}$

The potential due to + 10 μC is

$$V_1 = \frac{(10 \times 10^{-6}) \times (9 \times 10^{9})}{1 \times 10^{-2}} = 9\text{ MV}$$

The potential due to + 20 μC is

$$V_2 = \frac{20 \times 10^{-6} \times 9 \times 10^{9}}{1 \times 10^{-2}} = 18\text{ MV}$$

The net potential at the given point is

$$9\text{ MV} + 18\text{ MV} = 27\text{ MV}$$

23. The resistance of the copper rod $= \rho \dfrac{l}{a}$

$$= \frac{1.7 \times 10^{-8} \times 20 \times 10^{-2}}{2.0 \times 10^{-6}} = 1.7 \times 10^{-3}\ \Omega$$

Similarly the resistance of aluminium rod

$$= 2.6 \times 10^{-3}\ \Omega$$

The equivalent resistance

$$\frac{1}{R} = \frac{1}{1.7 \times 10^{-3}} + \frac{1}{2.6 \times 10^{-3}}$$

$$R = \frac{1.7 \times 2.6}{4.3} \times 10^{-3} = 1.0\text{ m}\Omega$$

24. Two SHMs are separated at angle 45°.
So, resultant amplitude is

$$A_R = \sqrt{(s_0 + x_0 \cos 45°)^2 + (x_0 \sin 45°)^2}$$

$$= \sqrt{(s_0^2 + x_0^2 \cos^2 45° + 2x_0 s_0 \cos 45° + x_0^2 \sin^2 45°)}$$

$$= \sqrt{s_0^2 + x_0^2 + \sqrt{2} x_0 s_0}$$

25. As, we know that

$$v = \sqrt{\frac{R}{\rho}}$$

where, k = bulk modulus of elasticity

$$\Rightarrow \quad k = v^2 \rho = (1330)^2 \times 800\text{ N/m}^2$$

Also, $\quad k = \dfrac{F/A}{\Delta V/V}$

$$\Rightarrow \quad \Delta V = \frac{\text{pressure}}{k} = \frac{2 \times 10^5}{1330 \times 1330 \times 800}$$

$$= 0.15\text{ cm}^3$$

26. Given, $m = 19.2 \times 10^{-3}$ kg/m

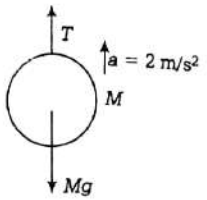
Now see the free body diagram.

The equation for the motion

$$T - 4g - 4a = 0$$

$$\Rightarrow \quad T = 4(a + g) = 4(2 + 10)$$

$$= 48\text{ N}$$



Now wave speed,

$$v = \sqrt{\left(\frac{T}{m}\right)}$$

$$= \sqrt{25 \times 10^{-3}} = 50\text{ m/s}$$

27. $$h_{Hg} = \frac{2T_{Hg} \cos\theta_{Hg}}{gr\,\rho_{Hg}}$$

and $$h_w = \frac{2T_w \cos\theta_w}{\rho_w\, rg}$$

where, the symbols have their usual meanings

Now, $$\frac{h_w}{h_{Hg}} = \frac{h_w}{h_{Hg}} \times \frac{\rho_{Hg}}{\rho_w} \times \frac{\cos\theta_w}{\cos\theta_{Hg}}$$

$$= \left[\frac{0.075}{0.465}\right] \times (13.6) \times \left[\frac{\cos 0°}{\cos 40°}\right] = 2.9$$

28. As, $\beta = 2.1 \times 10^9\ \text{N/m}^2$

Also given that $\dfrac{\Delta V}{V} = 0.1\% = 10^{-4}$

We know that, $B = \dfrac{pV}{\Delta V}$

$$\Rightarrow \quad p = B\left(\frac{\Delta V}{V}\right)$$

$$= 2.1 \times 10^9 \times 10^{-4}$$

$$= 2.1 \times 10^5\ \text{N/m}^2$$

29. The velocity with which water will came out

$$v = \sqrt{2g(H - h)}$$

The time of flight of water ejected from the hole

$$t = \sqrt{\frac{2h}{g}} = \text{time of flight}$$

$$\therefore \quad x = v \times t$$

$$= \sqrt{2g(H - h)} \times \sqrt{\frac{2h}{g}} = \sqrt{4(Hh - h^2)}$$

For x to be maximum

$$\frac{dx}{dh} = 0$$

$$\Rightarrow \quad d\,\frac{\sqrt{4(Hh - h^2)}}{dh} = 0$$

$$\Rightarrow \quad 0 = H - 2h \Rightarrow h = \frac{H}{2}$$

30. Let when m is hanging, the extension in the spring is l, then tension in the string is,

$$T_1 = kl = mg$$

when force is applied, let the further extension is x.
The tension in the spring is

$$T_2 = k(x + l)$$

$$\therefore \text{ Driving force} = T_2 - T_1 = k(x + l) - kl = kx$$

$$\therefore \text{ Acceleration} = \frac{kl}{m}$$

$$\Rightarrow \quad T = 2\pi \sqrt{\frac{\text{displacement}}{\text{acceleration}}}$$

$$= 2\pi \sqrt{\frac{x}{\frac{kx}{m}}} = 2\pi\sqrt{\frac{m}{k}}$$

31. Speed of ship due to rotation of the earth $v = \omega R$

The net force

$$T_0 = mg - m\omega^2 R$$

$$\Rightarrow \quad T_0 - mg = m\omega^2 R$$

32. If we take moment at A, then external torque will be zero. Therefore, the initial angular momentum = the angular momentum after rotation stop (i.e. only linear velocity exist)

$$\Rightarrow \quad Mv \times R - \left(\frac{2}{5}\right) I\omega = Mv_0 \times R$$

$$\Rightarrow \quad MvR - \frac{2}{5} MR^2 \times \frac{v}{R} = Mv_0 R$$

$$\Rightarrow \quad v_0 = \frac{3v}{5}$$

33. The velocity of centre of mass

$$v_{cm} = \frac{m_1 v_1 + m_2 v_2}{m_1 + m_2}$$

When $v_1 = 0$ and $v_2 = v_0$, then

$$v_{cm} = \frac{m_2 v_0}{m_1 + m_2}$$

Now, let x be the elongation in the spring.

Change in potential energy

= potential energy stored in spring

$$\Rightarrow \quad \frac{1}{2} m_2 v_0^2 - \frac{1}{2}(m_1 + m_2)\left(\frac{m_2 v_0}{m_1 + m_2}\right)^2 = \frac{1}{2} kx^2$$

This gives, $\quad x = \left(\dfrac{m_1 m_2}{m_1 + m_2}\right)^{\frac{1}{2}} v_0$

34. The parallel component of velocity of the ball remains unchanged. This gives

$$v' \sin\theta' = v \sin\theta \quad \ldots(i)$$

For the components normal to the floor, the velocity of separation $= v' \cos\theta'$

and the velocity of approach $= v \cos\theta$

Hence, $\quad v' \cos\theta' = e\, v \cos\theta \quad \ldots(ii)$

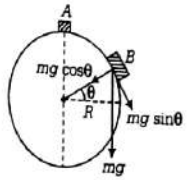
From Eqs (i) and (ii)

$$v' = v\sqrt{\sin^2\theta + e^2 \cos^2\theta}$$

and $$\tan\theta' = \frac{\tan\theta}{e}$$

For electric collision, $e = 1$, so that $\theta' = \theta$ and $v' = v$

35. See the diagram



Let the velocity be v when the body leaves the surface. From free body diagram,

$$\frac{mv^2}{R} = mg\cos\theta$$

$$\Rightarrow \quad v^2 = Rg\cos\theta \quad \ldots(i)$$

Again from work energy principle,

change in KE = work done

$$\Rightarrow \frac{1}{2} mv^2 - 0 = mg[R - R\cos\theta]$$

$$v^2 = 2gR(1 - \cos\theta) \quad \ldots(ii)$$

From Eqs. (i) and (ii)

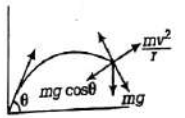
$$Rg\cos\theta = 2gR(1 - \cos\theta)$$

$$3gR\cos\theta = 2gR$$

$$\Rightarrow \quad \cos\theta = \frac{2}{3} \Rightarrow \theta = \cos^{-1}\left(\frac{2}{3}\right)$$

36. Let v be the velocity at the point where it makes an angle $\dfrac{\theta}{2}$ with the horizontal.

The horizontal component remains unchanged. So,



$$v_m \cos\left(\frac{\theta}{2}\right) = u\cos\theta$$

$$\Rightarrow \quad v = \frac{u\cos\theta}{\cos\left(\frac{\theta}{2}\right)} \quad \ldots(i)$$

From figure, $mg\cos\left(\frac{\theta}{2}\right) = \frac{mv^2}{r}$

$$\Rightarrow \quad r = \frac{v^2}{g\cos\frac{\theta}{2}}$$

Putting the value of v from Eq (i), we get

$$r = \frac{v^2\cos^2\theta}{g\cos^2\frac{\theta}{2}}$$

37. The net force $= \sqrt{20^2 + 15^2} - 0.5 \times 40$

$$= 25 - 20 = 5\,\text{N}$$

$$\therefore \quad \tan\theta = \frac{20}{15} = \frac{4}{3}$$

$$\therefore \quad \theta = \tan^{-1}\left(\frac{4}{3}\right) = 53^\circ$$

So, the block will move at an angle 53° with the 15 N force.

38. The acceleration (downward) of the elevator is 12 m/s^2 which is greater than gravitational acceleration g. So, the block will act as a freely falling body.

From the motion of the block

$$s = ut + \frac{1}{2}gt^2$$

$$= 0 \times t + \frac{1}{2} \times 10 \times (0.2)^2$$

$$= \frac{1}{2} \times 10 \times 0.2 \times 0.2$$

$$= 20\,\text{cm}$$

39. The mass of monkey = 15 kg

$$a = 1\,\text{m/s}^2$$

For the motion of the monkey $T - [15g - 15(1)] = 0$

Hence, T is tension in the string $T = 15g + 15$

$$T = 15(10 + 1) = 15 \times 11$$

$$= 165\,\text{N}$$

40. The current will be equally divided at junction P. The field at the centre due to wires PQ and SR will be equal in magnitude but opposite in the direction, so its effective field will be zero. Similarly, net field due to wires PS and QR is zero. Therefore, the net field at the centre of the loop is zero.

41. As we know that time period, $T = \frac{2\pi r}{v}$

$$\therefore \quad T = 2\pi \times \frac{h^2}{4\pi me^2} \times \frac{h}{2\pi e^2}$$

$$= \frac{h^3}{4\pi^2 me^4}$$

$$\therefore \quad \text{Current, } i = \frac{\text{Charge}\,(q)}{T}$$

$$= \frac{e}{T} = \frac{e}{\frac{h^3}{4\pi^2 me^4}}$$

$$= \frac{4\pi^2 me^5}{h^3}$$

42. Suppose, T be the tension in the spring T. Also in the satellite, two balls will be in a straight line. So, force acting on the balls

$$F = \frac{1}{4\pi\varepsilon_0}\frac{q^2}{(2l)^2} \quad \text{(i)}$$

This force will be balanced by tension in the string i.e., $T = F$

Now, from Eqs (i) and (ii), we get (ii)

$$T = \frac{1}{4\pi\varepsilon_0}\frac{q^2}{4l^2}$$

43. The apparent depth is given by

$$l' = \frac{t_1}{n_1} + \frac{t_2}{n_2}$$

$$= \frac{t/2}{n_1} + \frac{t/2}{n_2} = \frac{t(n_1 + n_2)}{2n_1n_2}$$

44. By increasing the intensity of incident beam, the number of emitted photo-electrons can be increased. Hence, number of photo-electrons emitted is proportional to the intensity of the incident beam.

45. We have,

$$I_E = I_B + I_C$$

$$\Rightarrow \quad \Delta I_E = \Delta I_B + \Delta I_C$$

According to question,

$$\Delta I_E = 8.0\,\text{mA}$$

$$\Delta I_C = 7.9\,\text{mA}$$

Thus, $\Delta I_B = 8.0\,\text{mA} - 7.9\,\text{mA}$

$$= 0.1\,\text{mA}$$

Now, $\alpha = \frac{I_C}{I_E} = \frac{\Delta I_C}{\Delta I_E} = \frac{7.9\,\text{mA}}{8.0\,\text{mA}} \equiv 0.99$

46. The half-life and the decay constant are related as

$$t_{12} = \frac{\ln 2}{\lambda} = \frac{0.693}{\lambda}$$

$$\Rightarrow \quad \lambda = \frac{0.693}{t_{1/2}} = \frac{0.693}{2.7\,\text{day}}$$

$$= \frac{0.693}{2.7 \times 24 \times 3600\,\text{s}}$$

$$= 2.9 \times 10^{-6}\,\text{s}^{-1}$$

Now average life

$$t_{av} = \frac{1}{\lambda} = 3.9\,\text{days}$$

47. The de-Broglie wavelength is given by

$$\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mE}} \quad \text{(i)}$$

where, E is the energy of the electron. The cut-off wavelength λ_0 is given by

$$\lambda_0 = \frac{hc}{E} \quad \text{(ii)}$$

From Eq. (i), $\lambda^2 = \frac{h^2}{2mE}$

$$\Rightarrow \quad E = \frac{h^2}{2m\lambda^2} \quad \text{(iii)}$$

Substituting the value of E from Eq. (ii), we get

$$\lambda_0 = \frac{hc}{\frac{h^2}{2m\lambda^2}} = \frac{2mc\lambda^2}{h}$$

48. The binding energy is given as

$$BE = \Delta mc^2$$

where, Δm = mass defect

and c = speed of light

$$\Rightarrow \quad BE = (8\,M_p + 9M_n - M_O)c^2$$

49. According to the law of conservation of momentum, we get

$$m_1v_1 = m_2v_2$$

or $\left(\frac{m_1}{m_2}\right) = \left(\frac{v_2}{v_1}\right)$

But $m = \frac{4}{3}\pi r^3\rho$ or $m \propto r^3$

$$\Rightarrow \quad \frac{m_1}{m_2} = \frac{r_1^3}{r_2^3}$$

$$\therefore \quad \frac{r_1^3}{r_2^3} = \frac{v_2}{v_1} = \frac{1}{2}$$

$$\Rightarrow \quad \frac{r_1}{r_2} = \left(\frac{1}{2}\right)^{1/3}$$

$$\therefore \quad r_1 : r_2 = 1 : (2)^{1/3}$$

50. We know that

$$\left(\frac{dp}{dV}\right) = -\gamma\left(\frac{p}{V}\right)$$

$$\therefore \quad \text{Slope} \propto \gamma$$

From the Fig. (1), slope of 2 > slope of 1.

So, plots 1 and 2 should correspond to He and O_2 respectively.

51. As we know that

$$pV^\gamma = K$$

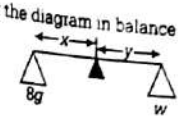
$$\therefore \Delta pV^\gamma + p\gamma V^{\gamma-1}\Delta V = 0$$

$$\Rightarrow \quad \left(\frac{\Delta p}{p}\right) = -\gamma\left(\frac{\Delta V}{V}\right)$$

For monoatomic gas, $\gamma = \frac{5}{3}$

$$\therefore \quad \frac{\Delta p}{p} = \frac{5}{3} \times 24\% = 40\%$$

52. Consider the diagram in balance



$$8x = wy$$

$$\Rightarrow \quad \frac{x}{y} = \frac{w}{8} \quad \text{(i)}$$

Also, $wx = 18y$

$$\Rightarrow \quad \frac{x}{y} = \frac{18}{w} \quad \text{(ii)}$$

Dividing Eq. (i) and Eq. (ii) we get

$$\frac{x/y}{x/y} = \frac{\frac{w}{8}}{\frac{18}{w}}$$

$$\Rightarrow \quad w = \sqrt{18 \times 8} = 12\,\text{g}$$

53. From the diagram in question,

$$x = l\cos\theta \text{ and } y = l\sin\theta$$

$$\therefore \quad v_x = \frac{dx}{dt} = -l\sin\theta \cdot \frac{d\theta}{dt}$$

and $v_y = \frac{dy}{dt} = l\cos\theta\frac{d\theta}{dt}$

$$\therefore \quad \frac{v_y}{v_x} = -\cot\theta \text{ or } v_y = -v_x\cot\theta$$

Since, $v_x = -2\,\text{m/s}$

Hence, $v_y = (-2)\cot 60^\circ = -2 \times \frac{1}{\sqrt{3}}$

$$= -\frac{2}{\sqrt{3}}\,\text{ms}^{-1}$$

The negative sign indicates the motion towards negative direction of Y.

54. Time defined in terms of the rotation of the earth is called Universal Time (UT).

55. As two portions of the slab are connected in series, therefore

$$K = \frac{\Sigma x_i}{\Sigma x_i / K_1} = \frac{d + d}{\frac{d}{K_1} + \frac{d}{K_2}}$$

$$= \frac{2d}{d\left(\frac{1}{K_1} + \frac{1}{K_2}\right)} = \frac{2K_1K_2}{K_1 + K_2}$$

56. As $T = \frac{n_1T_1 + n_2T_2}{n_1 + n_2}$

$$\therefore \quad T_f = \frac{1(T_0) + 1\left(\frac{7}{3}T_0\right)}{1+1}$$

$$= \frac{10T_0}{3\times 2} = \frac{5T_0}{3}$$

57. As, $E = 16T - 0.04T^2$

At inversion temperature, $E = 0$

$\Rightarrow \quad 16T - 0.04T^2 = 0$

$\Rightarrow \quad T_i = \frac{16}{0.04} = 400°C$

58. Total initial resistance

$$= G + R = 30 + 2000 = 2030\,\Omega$$

Current $\quad i = \frac{2}{2030}$ A

Let x be the effective resistance of the circuit, then

$$2V = 2030 \times \frac{2}{2030} \times 10^3$$

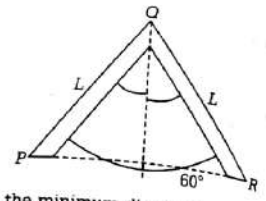
$$= x \times \frac{2}{25}$$

$\Rightarrow \quad x = \frac{2\times 25}{2} \times 10^3$

$$= 2500\,\Omega$$

$\therefore$ Resistance to be added $= 2500 - 30 = 2470\,\Omega$

59. On bending the magnet, the angle between two parts of the magnet is expressed in diagram below



Now, the minimum distance between the ends P and R

$$= L\sin 30° + L\sin 30°$$

$$= 2L\sin 30° = 2L\sin 30°$$

$$= 2L \times \frac{1}{2} = L$$

60. Given magnetic flux

$$\phi = (t^2 - 2t) \times 10^{-3}$$

On differentiating with recpect to time t

$$\frac{d\phi}{dt} = (2t - 2) \times 10^{-3}$$

At time $\quad t = 3$ s

$$\left|\frac{d\phi}{dt}\right|_{t=3\,s} = (2\times 3 - 2) \times 10^{-3}$$

$$= 4 \times 10^{-3}\ \text{Wb s}^{-1}$$

Now, $|e| = N\left|\frac{d\phi}{dt}\right|$

$$= 200 \times 4 \times 10^{-3}$$

$$= 800 \times 10^{-3} = 0.8\,V$$

Chemistry

1. $p = p_C\,\pi = \left(\frac{a}{27b^2}\right)\pi$

$V = V_C\,\phi = (3b)\,\phi$

$T = T_C\,\theta = \left(\frac{8a}{27\,Rb}\right)\theta$

Thus, substituting in the van der Waals' equation,

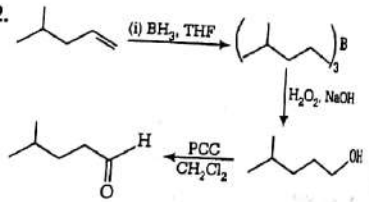
$$\left(p + \frac{a}{V_2}\right)(V - b) = RT$$

or $\quad \left(\pi + \frac{3}{\varphi^2}\right)(3\varphi - 1) = 8\theta$

This is reduced state equation

or, $\quad \left(\frac{\pi}{3} + \frac{1}{\varphi^2}\right)(3\varphi - 1) = \frac{8}{3}\theta$

2.



3. $SF_4 + 2H_2O \longrightarrow \underset{(X)}{SO_2} + \underset{(Y)}{4HF}$

$SO_2 + 2H_2S \longrightarrow \underset{(X)}{2H_2O} + \underset{(Z)}{3S}$ (colloidal)

Thus, Z = colloidal sulphur

4. Moles needed = (3.00 L) (1.00 M) = 3 mol.

Suppose that x L of 2.50 M NaOH added, then $(3 - x)$ L of 0.40 M NaOH added The number of moles of solute from the more concentrated solution is 2.50, that become less concentrated solution is (0.40) (3.00 − x)

The total number of moles is 3.00.

$(2.50x) + (0.40)(3.00 - x) = 3.00$

or $\quad 2.10x + 1.2 = 3$

or $\quad 2.10x = 1.8$

or $\quad x = 0.857$ L of 2.50 M NaOH

$\therefore \quad (3 - 0.857) = 2.14$ L of 0.40 M NaOH

5. $K_2S_2O_5 \longrightarrow K_2SO_3 + SO_2$

$SO_2 + H_2O \longrightarrow H_2SO_3$

SO_2 and sulphurous acid (H_2SO_3) kill the bacteria and prevent the decay of food.

6. $\nu = 1.368 \times 10^3$ Hz

$$\lambda = \frac{c}{\nu} = \frac{3\times 10^8\ \text{m/s}}{1368\times 10^3\ \text{s}^{-1}} = 219.3\ \text{m}$$

The range of wavelength of radiowaves is 100 m to radiation is 10000 m.

7. Alkyl benzenesulphonates derived from branch chain alkanes have much lower biodegradability.

8. Given that velocity of electron, $v = 600$ m/s

Accuracy of velocity = 0.005%

$$\therefore \quad \Delta v = \frac{600 \times 0.005}{100} = 0.03$$

According to Heisenberg's uncertainty principle

$$\Delta x \cdot m\Delta v \geq \frac{h}{4\pi}$$

or, $\quad \Delta x = \frac{6.6\times 10^{-34}}{4\times 3.14\times 9.1\times 10^{-31}\times 0.03}$

$$= 1.92\times 10^{-3}\,\text{m}$$

9. Buna-N is a copolymer of butadiene and acrylonitrile.

$$n\underset{\text{1,3-butadiene}}{CH_2{=}CH{-}CH{=}CH_2} + n\underset{\text{Acrylonitrile}}{CH_2{=}\overset{CN}{\overset{|}{C}}H} \longrightarrow$$

$$\left[-CH_2-CH=CH-CH_2-CH_2-\overset{CN}{\overset{|}{C}}H-\right]$$

Buna–N

10. 0.5 mole of HNO_3 equivalents to 0.5 mole of H^+. But only 0.3 mole of OH^- ions are available. Thus, 0.3 mole of H^+ ions will combine with 0.3 mole of OH^- ions to form 0.3 mole of H_2O and 0.2 mole of H^+ ions will remain unreacted. Heat evolved when 1 mole of H^+ ions combine with 1 mole of OH^- ions = 57.1 kJ Therefore, heat evolved wher 0.3 mole of H^+ ions combine with 0.3 mole of OH^- ions = 0.3 × 57.1 = 17.13 kJ

11. Polydispersity index (PDI)

$$= \frac{\text{Mass average molar mass}}{\text{Number average molar mass}} = \frac{M_w}{M_n}$$

$$\frac{40.000}{30.000} = 1.3 > 1$$

12. High charge and small size of the cations increases polarisation.

As the size of the given cations decreases as

$K^+ > Ca^{2+} > Mg^{2+} > Be^{2+}$

Thus, polarising power increases as

$K^+ < Ca^{2+} < Mg^{2+} < Be^{2+}$

13. Isoelectric point, $pH = \frac{pK_{a1} + pK_{a2}}{2}$

$$= \frac{2.34 + 9.60}{2} = 5.97$$

14. As pressure and volume remains constant,

$n_1T_1 = n_2T_2$

$n_1 = \frac{0.4}{4} = 0.1,\ T_1 = T$K

$n_2 = \frac{0.40 - 0.08}{4} = 0.08,\ T_2 = (T + 50)$ K

On putting the values,

$0.1 \times T = 0.08 \times (T + 50)$

or $\quad 0.1T = 0.08T = 4$ or $0.1T - 0.08T = 4$

or $\quad 0.02T = 4$ or $T = 200$ K

15. Ordinary glucose is α-glucose, with a fresh aqueous solution has specific rotation, $[\alpha]_D = +110°$. On keeping the solution for sometimes, α-glucose slowly changes into an equilibrium mixture of α-glucose (36%) and β-glucose (64%) and the mixture has specific rotation + 52.5°.

16. 0.625 g Fe

0.0105 eq. of $H_2C_2O_4 \cdot 2H_2O = 0.0105 \times 63$

$= 0.66$ g (Eq. wt = 63)

6×10^{21} atoms of $Zn = \frac{6\times 10^{21}}{6.023\times 10^{23}} \times 65 = 0.647$ g

0.006 g atom of Ag = 0.006 × 108 = 0.648 g

$\therefore$ Increasing order of weight

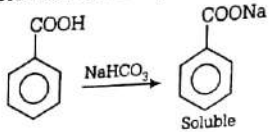
$Fe < Zn < Ag < H_2C_2O_4 \cdot 2H_2O$

17. Electron releasing groups increase the basic strength of amines while electron withdrawing groups decrease. Thus, the order is III > IV > II > I,

as in  —$NHCOCH_3$, —NH group is hanked by two electron withdrawing groups

18. For a pure substance T_A and T_B are same. Above to this temperature, entropy will increase and below this temperature entropy remains constant

19. Hexanoic acid is soluble in ether whereas alcohol is not soluble in $NaHCO_3$ solution.



20. From the Gibb's - Helmholtz equation,

$$\Delta G = \Delta H - T\Delta S$$

At equilibrium, $\Delta G = 0$

Hence, $\Delta H - T\Delta S = 0$ or, $\Delta H = T\Delta S$

or, $$T = \frac{\Delta H}{\Delta S}$$

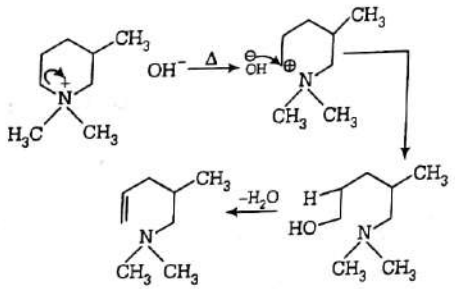
Given that, $\Delta H = 30.56 \text{ kJ mol}^{-1}$

$= 30560 \text{ J mol}^{-1}$

$\Delta S = 66.0 \text{ J K}^{-1} \text{ mol}^{-1}$

$\therefore$ $$T = \frac{30560}{66.0} = 463 \text{ K}$$

21.



22. For the given reaction,

$$Ag^+ + 2NH_3 \rightleftharpoons Ag(NH_3)_2^+; K_1 = 1.7 \times 10^7$$

$$Ag^+ + Cl^- \rightleftharpoons AgCl, K_2 = 5.4 \times 10^9$$

Hence for

$$AgCl \rightleftharpoons Ag^+ + Cl^-$$

$$K_2' = \frac{1}{K_2} = \frac{1}{5.4 \times 10^9}$$

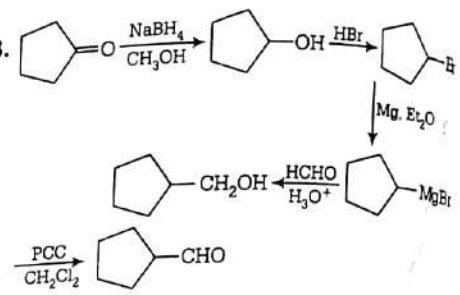
Now for the reaction,

$$AgCl + 2NH_3 \rightleftharpoons [Ag(NH_3)_2]^+ + Cl^-$$

$$K = K_1 \times K_2' = 1.7 \times 10^7 \times \frac{1}{5.4 \times 10^9}$$

$$= 0.31 \times 10^{-2}$$

23.



24. On adding I, II and III, we get IV

$\therefore$ $K = \beta_1 \beta_2 \beta_3$

or, $\log K = \log \beta_1 + \log \beta_2 + \log \beta_3$

or $-\log K = -\log \beta_1 - \log \beta_2 - \log \beta_3$

$$p_K = p_{\beta_1} + p_{\beta_2} + p_{\beta_3} \text{ (where, } p_x = -\log x)$$

25. $R—CH_2CH_2—OH \xrightarrow{PBr_3} RCH_2CH_2—Br \xrightarrow{KCN}$

$$RCH_2CH_2—COOH \xleftarrow[\text{Or } H_3O^+]{H_2O/H^+} R—CH_2CH_2—CN$$

26. $\overset{+7}{KMnO_4} \longrightarrow \overset{+6}{MnO_4^{2-}}$

Transferred electron = 1

$\overset{+7}{KMnO_4} \longrightarrow \overset{+4}{MnO_2}$

Number of transferred electrons = 3

$\overset{+7}{KMnO_4} \longrightarrow \overset{+3}{Mn_2O_3}$

Number of transferred electrons = 4

$\overset{+7}{KMnO_4} \longrightarrow Mn^{2+}$

Number of transferred electrons = 5

27. Oxymercuration - demercuration of alkenes leads to hydration according to Markownikoff's rule Hence,

$$(CH_3)_3C—CH=CH_2 \xrightarrow[\text{(ii) } NaBH_4]{\text{(i) } Hg(OAc)_2, H_2O} (CH_3)_3\underset{\displaystyle OH}{\underset{|}{C}}CH—CH_3$$

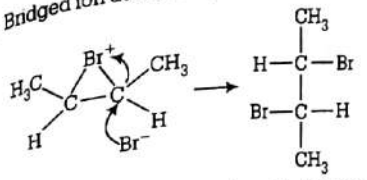
28. In acidic medium, $K_2Cr_2O_7$ acts as strong oxidising agent and itself gets reduced to Cr^{3+}.

$$\overset{+6}{Cr_2O_7^{2-}} + 6e^- \longrightarrow 2Cr^{3+}$$

Equivalent weight of $K_2Cr_2O_7$

$$= \frac{\text{Molecular weight}}{6} = \frac{294}{6} = 49$$

29. Bridged ion attacked by Br^- ion form *trans* product.



d- and *l*- enantiomers

Therefore, *cis*-2-butene on addition of Br_2 forms *d*-and *l*-forms in 1 : 1 equivalent amount resulting in the formation of racemic mixture.

30. $\because$ $$d = \frac{Z \times M}{N_A \times V}$$

$\therefore$ $$Z = \frac{d \times N_A \times V}{M}$$

As $a = 5$ Å $= 5 \times 10^{-8}$ cm $\therefore$ $V = (5 \times 10^{-8})^3 \text{ cm}^3$

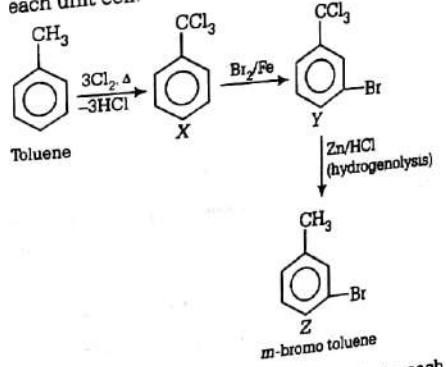
Molecular mass, $M = 56 + 16 = 72$ g

$$Z = \frac{4 \times 6.023 \times 10^{23} \times (5 \times 10^{-8})^3}{72}$$

$$= 4.16 \approx 4$$

Four molecules of ferrous oxide, FeO per unit cell, it means that 4 Fe^{2+} and 4 O^{2-} ions are present in each unit cell.

31.



32. In hexagonal close packed (hcp) structure, each sphere of third layer lies exactly above the sphere of first layer. Hence, hcp is abbreviated as *ABABAB* .....

In cubic close packed (ccp) structre, the spheres of third layer do not come over those of first layer and sphere of fourth layer correspond with those in first layer. Hence, it can be shown as *ABC ABC* .....

33. Millimoles of acid required for neutralisation

$= 20 \times 0.1 = 2$ millimoles

$= 0.002$ moles

If 0.001 mole is neutralising 0.002 moles of base, thus, 0.001 mole of base remains unreacted. Hence, acid coming out should be basic.

$$[Co(NH_3)_5(NO_3)]SO_4 \longrightarrow [Co(NH_3)_5(NO_3)]^{2+} + SO_4^{2-}$$

34. To calculate the molar mass of selenium (Se)

$$M_B = \frac{K_f \times W_B}{\Delta T_f \times W_A}$$

Mas of selenium (W_B) = 3.26 g

Mass of benzene (W_A) = 226 g = 0.226 kg

Depression in freezing point (ΔT_f) = 0.112°C

Molar depression constant (K_f) = 4.9 K kg mol^{-1}

$$\therefore M_B = \frac{(4.9 \text{ K kg mol}^{-1})(3.26 \text{ g})}{(0.112 \text{ K})(0.226 \text{ kg})} = 631.08 \text{ g mol}^{-1}$$

Given, gram atomic mass of selenium

$= 78.8$ g/mol

For Se_x (78.8 g mol^{-1}) = 631.08 g mol^{-1}

or, $$x = \frac{631.08 \text{ g mol}^{-1}}{78.8 \text{ g mol}^{-1}} = 8$$

Thus, molecular formula of selenium = Se_8

35. More basic and chelate forming ligand stabilises the complex to more extent $C_2O_4^{2-}$ is a bidentate chelating ligand thus stabilises the complex $[Fe(C_2O_4)_3]^{3-}$ to a high extent.

36. $p_x^1 = p_x^0 \cdot X_x = p_T \cdot Y_x$

$p_y^1 = p_y^0 \cdot X_y = p_T \cdot Y_y$

Therefore, $$\frac{p_x^0}{p_y^0} \frac{X_x}{X_y} = \frac{Y_x}{Y_y}$$

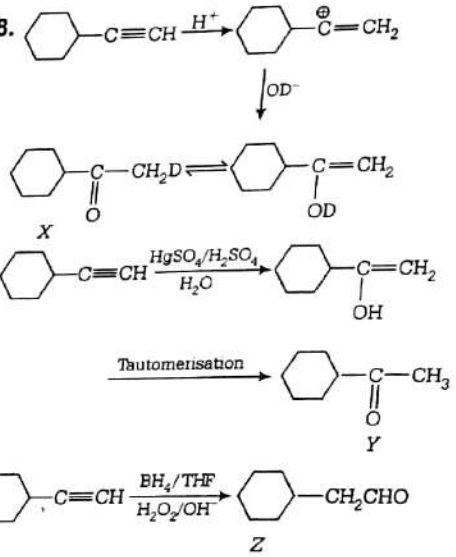
$\because$ $$\frac{p_x^0}{p_y^0} > 1$$

$\therefore$ $$\frac{X_x}{X_y} < \frac{Y_x}{Y_y}$$

37. Pyrolusite ore, MnO_2 on fusion with KOH in presence of air forms potassium manganate, K_2MnO_4

$$2MnO_2 + 4KOH + O_2 \longrightarrow 2K_2MnO_4 + 2H_2O$$

38.



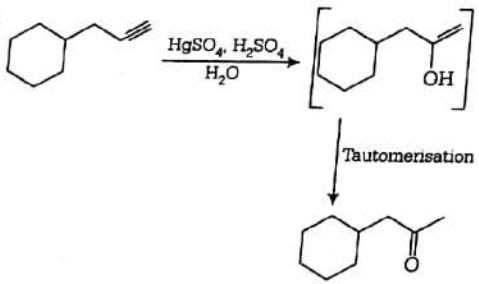
39. Metal placed above in electrochemical series replaces the other from its salt solution which is lower in the series.

The low E° value containing metals have the high reducing character.

Thus, order of reducing character of three metals is

$$Pb > Cu > Ag$$

40.



41. $\Lambda_m = \frac{K}{C} = \frac{4.95 \times 10^{-5}\ S\ cm^{-1}}{0.001028\ mol\ L^{-1}} \times \frac{1000\ cm^3}{L}$

$= 48.15\ S\ cm^2\ mol^{-1}$

$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ} = \frac{48.15}{390.5} = 0.1233$

$K = \frac{C\alpha^2}{(1-\alpha)} = \frac{0.001028 \times (0.1233)^2}{(1-0.1233)}$

$= 178 \times 10^{-5}\ mol\ L^{-1}$

42. In acidic medium,

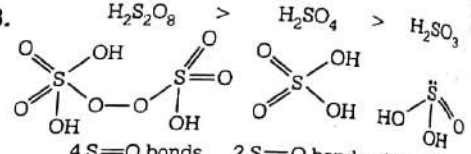
$MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$

(From $KMnO_4$)

Hence, equivalent weight of $KMnO_4$ in acidic medium $= \frac{\text{Moleculer weight}}{5} = \frac{158}{5} = 31.6$

$\therefore$ 1N solution can be prepared by dissolving 31.6 g $KMnO_4$ in 1L solution.

43. $H_2S_2O_8$ > H_2SO_4 > H_2SO_3



4 S=O bonds, 2 S=O bonds, 1S=O bond

44. Rate $= k\,[X]\,[Y_2]$

But, $k = \frac{[X]^2}{[X_2]}$ or, $[X] = \sqrt{k \cdot [X_2]}$

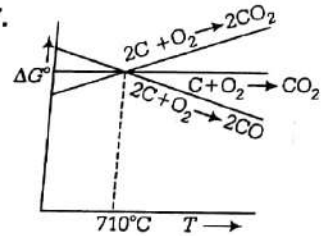
Rate $= k \cdot \sqrt{k}\ \sqrt{[X_2]}\ [Y_2] = k'\,[X_2]^{1/2}\,[Y_2]$

Thus, order, $= 1 + \frac{1}{2} = \frac{3}{2}$

45. Fluorspar is added in small quantity in the electrolytic reduction of alumina dissolved in fused cryolite (Na_3AlF_6) to make the fused mixture more conducting and to lower the melting point of fused mixture at 1140 K.

46. Concentration of the product increases linearly with time t, thus order = 0 and $-\frac{d[A]}{dt}$ = constant.

47.



48. The physical adsorption isobar shows a decrease in x/m throughout with rise in temperature.

49. For the reaction,

$MnO_4^- + 5Fe^{2+} + 8H^+ \longrightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$

5 times quantity of Fe^{2+} consumed than $KMnO_4$

Thus, 10 mL of 0.1 M $KMnO_4$ is equivalent to 50 mL of 0.1 M $FeSO_4$.

50. As_2S_3 sol is negatively charged owing to preferential adsorption of S^{2-} ions. Cation would be effective in causing coagulation.

Flocculating value = minimum millimole of the effective ion per litre of sol

$= \frac{4 \times 0.005}{(4+16) \times 10^{-3}} = 1.0$

51.

Property	T	D	H
Melting point (K)	20.62	> 18.5	> 13.9
Boiling point (K)	24.9	> 23.5	> 20.4
Density (g/L)	0.27	> 0.18	> 0.09
Relative abundance (%)	10^{-15}	< 0.016	< 99.984

52. Eutrophication means high concentration of phosphates and nitrates from fertiliser and detergents in aquatic ecosystems.

53. When H_2O_2 is added to acidified potassium dichromate in ether solution, potassium dichromate is oxidised to blue peroxide of chromium (CrO_5) which is soluble in ether and produces blue coloured solution.

$K_2Cr_2O_7 + H_2SO_4 + 4\,H_2O_2 \longrightarrow$

$2CrO_5 + K_2SO_4 + 5H_2O$

54. 500 mL $H_2O \longrightarrow 19.6 \times 10^{-3}$ g $K_2Cr_2O_7$

106 mL $H_2O \longrightarrow 39.2$ g $K_2Cr_2O_7$

49 g of $K_2Cr_2O_7 \longrightarrow 8$ g of O_2

39.2 g of $K_2Cr_2O_7 \longrightarrow 6.4$ g of O_2

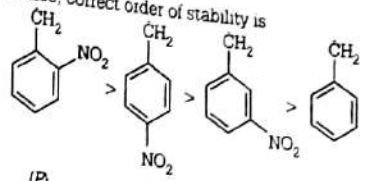
$\therefore$ COD = 6.4 ppm

55. $\underset{X}{Ca(OH)_2} + Na_2CO_3 \longrightarrow \underset{Y}{2NaOH} + \underset{Z}{CaCO_3}$

$\xrightarrow{CO_2}$ $CaCO_3$ (Z)

56. As $-M$ and $-I$-effect increase, stability of carbanion increases. $-M$-effect is possible only at *ortho* and *para*-position and $-I$-effect is more pronounced at *ortho* position.

Hence, correct order of stability is



(P) Both $-I$ and $-M$ effect, $-I$ more pronounced > (R) Both $-I$ and $-M$ effect, $-I$ less pronounced > (Q) Only $-M$ > (S)

57. I. $KI_3 + 2Na_2S_2O_3 \longrightarrow KI + 2NaI + Na_2S_4O_6$

II. $Na_2S_2O_3 + 2HCl \longrightarrow 2NaCl + SO_2 + H_2O + S$

III. $2AgNO_3 + Na_2S_2O_3 \longrightarrow$

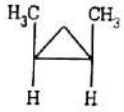
$Ag_2S_2O_3\downarrow$ (White) $+ 2NaNO_3$

$\downarrow$

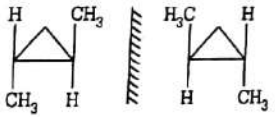
$Ag_2S + H_2SO_4$ (Black)

58. Catenation tendency decreases with the decrease in M—M bond energy. Thus, bond energies of C—C, Si—Si and Ge—Ge must be 348, 180 and 167 kJ mol^{-1} respectively.

59.



Meso-form, thus optically inactive



Optical isomers = 2

Total stereoisomers = 3

60. In two dimensional sheet silicates, three oxygens of each SiO_4^{4-} units are shared. Hence, it contain $(Si_2O_5)_n^{2-}$ type anions. Cyclic silicates are obtained by sharing of two oxygenatoms of each SiO_4^{4-} tetrahedron. Chain silicates are also formed by the sharing of two oxygen atoms of each SiO_4^{4-} units.

Biology

1. *Ramapithecus* was the most primitive hominid It is fossils were obtained from Asia and Africa It's features suggested that they were the beginning of the linkages leading to human

2. The parietal cells of gastric mucosa secrete certain intrinsic factors. This help in the absorption of vitamin-B_{12}. It is propelled along the small intestine to the terminal ileum and is absorbed by an active transport process.

3. Fever increases metabolic activity by 7% per degree celcius increasing the requirement of O_2. It increase the rate of breathing.

4. It is the feature of birds (Aves) to have non-distensible lungs continuous with thin elastic air sacs.

5. *Trichomonas vaginalis* is a flagellate found in vagina of female (humans) causing vaginalis. It leads to burning sensation, itching and frothy vaginal discharge.

   Leishmaniasis or kala-azar is caused by *Leishmania donovani*. It is characterised by the presence of cutaneous oriental roses along with fever.

6. Carotid labyrinth or a gland is found at the base of internal carotid. It is probably a sense organ containing baroceptors that control blood pressure in the human body.

7. Anthracosis is an occupational hazard occurring in coal workers.

   Due to the inhalation of organic and inorganic pollutants pneumoconiosis occurs. Deposition of fibrous tissue leads to bronchitis and emphysema.

   Dyspnea is a distressed breathing.

   Atelectasis is inability of the lungs to expand at birth cyanosis is bluish or violet discolouration of skin and mucous membranes due to the reduced Hb.

8. Epiphyseal plate is found between diaphysis and epiphysis. It contributes in the elongation of bone during growth period.

9. Masseter is a thick rectangular muscle in the cheek, one of the four muscles of mustication.

10. Parkinsonism is named after **James Parkinson**, is caused by various lesion's in the extra-pyramedal motor system of brain. It frequently occurs in old persons or in the patients, which are treated with antipsychotic drugs.

11. Meniere's disease is named after the French physician **Prosper Meniere**. It is a chronic disease of inner ear.

12. A decibel is a measure of the ratio between two sound stimuli. The decibel level of a sound that a normal human can hear and is calculated using formula.

    Intensity (in decibles) = 10 × log (sound/threshhold)

    Therefore, the intensity of a sound that is 1000 times, thresh hold is 30 decibels.

13. Gonads are derived from the mesodermal germinal ridges of the embryo which contain mesodermal epithelium and large spherical primitive germs cells.

14. Both spermatogonium and primary spermatocyte in human testes are diploid cells ($2n$).

15. **Desidua basalis** is the portion of endometrium between chorion and stratum basalis of the uterus.

    Desidua parietalis is the part of the endometrium not involved in the implantation.

    Decidua umbilicus no such structure exists in endometrium.

16. Depo-provera injections contains the active ingredient medroxy progesterone acetate, which is a synthetic form of naturally occurring female sex hormone progesterone.

17. Hot spots in any region in a gene that mutates at very high frequency than the neighbouring regions of the gene.

18. The Cambrian explosion in Cambrian period marks the occurrence of greatest diversification on the earth.

    Most major phyla appeared (indicated by fossil study), divergence of modern Metazoan phyla occurred and major diversification of other organisms.

    Before this period, most organisms were simple however, this changed after Cambrian period, diversification rate accelerated and the diversity of life began to resemble that of today.

19. The pyrimidine, thymine and the sugar deoxyribose are incorporated into DNA, not RNA. Adenine, cytocine and guanine are incorporated into DNA, not RNA. Adenine, cytosine and guanine are incorported into both RNA and DNA. Ribose sugar and the base uracil are specific to all the forms of RNA.

20. The promoters is bacterial and viral genes usually contains a consensus sequence of 5'-TATAAT-3' forming RNA polymerase binding site or the Pribnow box, after its discoverer Pribnow box lies with in the promoter about 10 base pairs before the starting point of transcription.

21. *Caenorhabditis elegans* is a microscopic (~ 1 mm) nematode that normally lives in soil. It has become one of the 'model' organism in biology.

22. On the basis of geological, chemical and physical data, the scientist have come to the conclusion that solar system came into being about 4.57 billion years ago.

23. Gas gangrene is caused by Gram-positive, spore forming bactena called *Clostridium perfringens*. This develops when blood flow ceases to a part of a body, usually as a result of blockage of dead tissue.

24. **Max Theiler** received Nobel Prize in 1951 for the development of vaccines for yellow fever.

25. Vinyl chloride is used to make Poly Venyl Chloride (PVC) plastic and vinyl products. Long term exposer to vinyl chloride through inhalation and oral exposer in human result in liver damage or cancer.

26. HIV attaches to CD_4 receptor site of helper T-cells by the help of GP-120 on the protein coat of the virus.

27. Myasthenia gravis is an autoimmune disease characterised by the chronic fatigability and weakness of muscles, specially in the face and throat, as a result of defect in the conduction of nerve impulses at the myoneural junction.

28. Calorigenic effect refers to the substance or process that produces heat or energy or that increases the consumption of O_2.

29. The hapten is a low weight molecular that can be made immunogenic conjugation to suitable carrier.

30. Oxyhaemoglobin behaves as a strong acid. As more and more oxyhaemoglobin forms in the lungs, it releases more and more H^+ ions increasing the acidity of the blood. This is known as **Haldane effect**.

31. Viability is the ability of seed to possess power of germination over a period of time *Nelumbo nucifera* seed have maximum viability of seed of about 1000 yrs.

32. Fibres are elongated cells with usually lignified walls. Bast fibres from phloem is called jute. There are secondary phloem cells.

33. Magnesium is present in the central position of tetrapyrrole ring of the chlorophyll molecule. Porphyrin is a cyclic tetrapyrrole ring made up of four nitrogen containing pyrrole rings arranged in a cyclic fashion in the chlorophyll molecule.

34. I, II and IV are correct statements.

    Pinus leaves are polymorphic and pinnately compound. In *Gnetum*, leaves are evergreen, opposite 8-20 cm long and 3-10 cm broad, enter at maturity glossy dark.

35. C_4 plants have an alternative CO_2 fixation pathways called Hatch and Slack cycle where OAA, a 4C compound is the first stable product. These plants have Kranz anatomy in leaf.

36. Respiration is carried out by different types of organisms at different sites. In bacteria and cyanobacteria, the mitochondria is not present, so respiration occurs in them in mesosomes.

    Eukaryotes have distinct well developed mitochondria which has respiratory enzymes and hence, it is called power house of the cell.

37. Periodic prunning of lateral buds always make a plant bushy.

38. Cleistogamous flowers do not open so, they self-pollinate and thus, do not depend on pollinators.

39. In coconut the karyokinesis is not followed by cytokinesis after a free nuclear division. So, the endosperm takes a liquid form.

40. The flip flop movement refers to transfer of lipid molecules from one side of the bilayer to the other. Enzymes are concerned with the enzymatic activity of the membrane.

41. Chemically, ribosomes is made up of *r*RNA 60% and protein 40%. These are known as protein factories as these are the sites for protein synthesis.

42. Glycogen is stored in liver and muscles of animals. All steroid hormones are derived from cholesterol. Immunoglobulin is an antibody that freely circulates in blood plasma. Thrombin brings about the conversion of fibrinogen to fibrin during blood clotting mechanism.

43. Yellow seeds are dominant is green (Y). So, a heterozygous yellow seeded plant will have the genotype of (Y,y) and a green seeded plant will have genotype (yy). When these plants are crossed, the F_1-generation will have the ratio of yellow : green as 50 : 50.

44. Transition are substitution gene mutation in which a purine (adenine) is replaced by another purine (guanine) or a pyrimidine (thymine is

replaced by another pyrimidine cytosine). Change of codon ATC to GTC or ATT or ACC is an example of transition.

Transversion in substitution gene mutation in which a purine (A or G) is replaced by a pyrimidine (T or C) or *vice-versa*.

45. The independent assortment of gene occurs due to the orientation of chromosomes at late metaphase-I of meiotic cell division at the time of gamete formation.

46. In anaphase-I and II chromosomes become shorter and thicker and migrate towards opposite poles of the cell. In case of non-disjunction of chromosomes an extra copy of a chromosome will be present in the cell.

47. In the lysogenic cycle, the bacterial host replicates phage lambda viral DNA, passing it onto daughter cells the during binary fission.

48. Endogenate is the native DNA of the recipient bacterial cell which shares homology with the DNA fragment inserted into it.

Exogenate is the DNA fragment that has been transferred into a recipient cell.

Eugenic is the study or practice of attempting to improve the human gene pool by encouraging reproduction among people with desirable traits. Dysgenics is the study of factors causing propagation of undesirable or disadvantageous genes and traits.

49. Avery, MacLeod and McCarty carried out an experiment from which they reported that DNA is a substance that causes bacterial transformation from non-virulent to virulent bacteria, but DNAase acts as a waste management endonucleases responsible for DNA fragmentation.

50. Archaebacteria are the most primitive and ancient bacterial species.

Key characteristic features are

(i) Lack of peptidoglycan in cell wall instead pseudomurein is present.

(ii) Lipids in cell membrane have different structure than in all other organisms.

(iii) They lack membrane bound organelles.

51. Epistasis is interaction between two or more genes to control a single phenotype. Dominant epistasis also called masking has a ratio 12 : 3 : 1 in the F_2 phenotype. Supplementary genes which is recessive epistasis has ratio 9 : 3 : 4.

Complementary gene where both dominant alleles are needed for phenotype has ratio 9 : 7. Inhibitor gene where one gene inhibits the expression of another gene has ratio 13 : 3 in F_2 progeny.

52. Ribosome are the place where protein synthesis takes place → rough ER produces proteins and helps them fold properly → Golgi bodies does packaging of proteins → secretory vesicles does transport of proteins.

53. *Euglena* can be considered as both plants as well as an animal. It can perform photosynthesis in presence of light, but in the absence of light it opts holozoic mode of nutrition, which is the feature of animals. Thus, *Euglena* is considered as connecting link between plant and animal kingdom.

54. For protein SDS (Sodium Dodecyl Sulphate) is an anionic detergent applied to protein sample linearize proteins and to impart a negative charge to linearzed proteins.

55. An endergonic reaction (also called a non-spontaneous reaction) is a chemical reaction in which the standard change in free energy is positive and energy is absorbed.

56. The term species was given by John Ray and is the lowest category of classification. Species is a group of closely related individuals having similar morphological, anatomical, biochemical and cytological characteristics. It consists of naturally interbreeding population with the ability to produce fertile offsprings. This group is reproductively isolated and genetically closed.

57. Hexokinase catalyses the phosphorylation of hexose in general and is found in all cells that metabolise glucose. It has low K_m (high affinity, strong bonding) with glucose in such a way that it is active at low glucose concentration. It shows allostenc feed beat inhibition by to product glucose-6-phosphate.

58. A tumour suppressor gene or anti oncogene, is a gene that protects a cell from one step on the path to a cancer. It regulates the cell cycle, cause signal cell death and present is non-cancerous cell.

59. The longest phase of cell cycle is G_1 where these rapid growth and metabolic activity, followed by S phase for DNA synthesis and replication then G_2 phase for preparation of cell division and lastly mitotic phase.

∴ Ratio is 9 : 5 : 3 : 1

60. Carcinogen causes cancerous tumour disjunction of chromosomes takes place in anaphase-I and II when chromosomes more to the opposite poles of the cell.

Plectonemic coiling refers to inter-twining of a double helix DNA molecule in such a way that for its correction unwinding of DNA helix molecule is required, this take place in mitosis in which sister chromatids are tightly coiled upon each other. In zygotene stage, homologs login to synapse by coming to approximate alignment.

SOLVED PAPER 2016 JIPMER Medical Entrance Exam

Physics

1. The displacement x of a particle varies with time t as $x = ae^{-\alpha t} + be^{\beta t}$, where a, b, α and β are positive constants. The velocity of the particle will

(a) decrease with time
(b) be independent of α and β
(c) drop to zero when $\alpha = \beta$
(d) increase with time

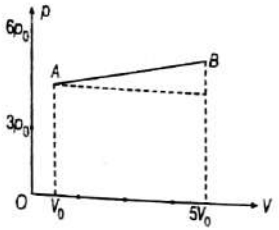
2. A transformer having efficiency of 75% is working on 220 V and 4.4 kW power supply. If the current in the secondary coil is 5A. What will be the voltage across secondary coil and the current in primary coil?

(a) $V_s = 220\,V, i_p = 20\,A$
(b) $V_s = 660\,V, i_p = 15\,A$
(c) $V_s = 660\,V, i_p = 20\,A$
(d) $V_s = 220\,V, i_p = 15\,A$

3. A fish rising vertically to the surface of water in a lake uniformly at the rate of 2 m/s observes a kingfisher diving vertically towards the water at a rate of 10 m/s. If refractive index of water $n = \frac{4}{3}$, what will be the actual velocity of the kingfisher

(a) 10 m/s
(b) 8 m/s
(c) 6 m/s
(d) 9 m/s

4. One mole of a monoatomic ideal gas undergoes the process $A \rightarrow B$ in the given p-V diagram. The molar heat capacity for this process is



(a) $\frac{3R}{2}$ (b) $\frac{13R}{6}$
(c) $\frac{5R}{2}$ (d) $2R$

5. A pan with a set of weights is attached to a light spring. The period of vertical oscillation is 0.5s. When some additional weights are put in pan, then the period of oscillations increases by 0.1s. The extension caused by the additional weight is

(a) 5.5 cm
(b) 3.8 cm
(c) 2.7 cm
(d) 1.3 cm

6. A cylinder of radius R and length L is placed in a uniform electric field E parallel to the cylinder axis. The total flux for the surface of the cylinder is given by

(a) $2\pi R^2 E$ (b) $\frac{\pi R^2}{E}$
(c) $\frac{R}{E}$ (d) zero

7. If $\mathbf{A}+\mathbf{B}=\mathbf{C}$ and that $\mathbf{C}$ is perpendicular to $\mathbf{A}$. What is the angle between $\mathbf{A}$ and $\mathbf{B}$, if $|\mathbf{A}|=|\mathbf{C}|$?

(a) $\frac{\pi}{4}$ rad (b) $\frac{\pi}{2}$ rad (c) $\frac{3\pi}{4}$ rad (d) π rad

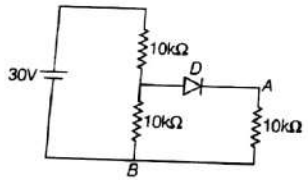
8. A beam of light travelling along X-axis is described by the electric field $E_y = 600\ \frac{V}{m}\cdot \sin\omega\left(t-\frac{x}{c}\right)$, the maximum magnetic force on a charge $q = 2e$, moving along Y-axis with the speed of 3×10^8 m/s is

(a) 19.2×10^{-17} N (b) 1.92×10^{-17} N
(c) 0.192 N (d) None of these

9. A body is whirled in a horizontal circle of radius 25 cm. It has an angular velocity of 13 rad/s. What is its linear velocity at any point on circular path?

(a) 2 m/s (b) 3 m/s
(c) 3.25 m/s (d) 4.25 m/s

10. In the given figure, potential difference between A and B is

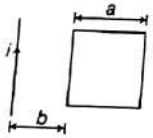


(a) 0 (b) 5 V (c) 10 V (d) 15 V

11. A block having 12g of element is placed in a room. This element is a radioactive element with half-life of 15 yr. After how many years will there be just 1.5 g of the element in the box?

(a) 40 yr (b) 45 yr (c) 20 yr (d) 15 yr

12. In the given figure what will be the coefficient of mutual inductance



(a) $\frac{\mu_0 a}{2\pi}\ln\left(1+\frac{a}{2b}\right)$ (b) $\frac{\mu_0 a}{\pi}\ln\left(1+\frac{b}{2a}\right)$
(c) $\frac{\mu_0 a}{2\pi}\ln\left(1+\frac{a}{b}\right)$ (d) $\frac{\mu_0 a}{2\pi}\ln\left(1+\frac{b}{a}\right)$

13. An L-C-R series circuit with a resistance of 100Ω is connected to 200 V (AC source) and angular frequency 300 rad/s. When only the capacitor is removed, then the current lags behind the voltage by 60°. When only the inductor is removed the current leads the voltage by 60°. The average power dissipated in original L-C-R circuit is

(a) 50 W (b) 100 W (c) 200 W (d) 400 W

14. The intensity of each of the two slits in Young's double slit experiment is I_0. Calculate the minimum separation between the points on the screen, where intensities are $2I_0$ and I_0. If fringe width is b

(a) $\frac{b}{5}$ (b) $\frac{b}{8}$ (c) $\frac{b}{12}$ (d) $\frac{b}{4}$

15. A metal rod at a temperature of 145°C, radiates energy at a rate of 17W. If its temperature is increased to 273°C, then it will radiate at the rate of

(a) 49.6 W (b) 17.5 W (c) 50.3 W (d) 67.5 W

16. Two wires are stretched through same distance. The force constant of second wire is half as that of the first wire. The ratio of work done to stretch first wire and second wire will be

(a) 2 : 1 (b) 1 : 2 (c) 3 : 1 (d) 1 : 3

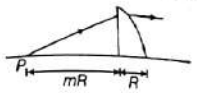
17. A square wire of side 2.0 cm is placed 20 cm in front of a concave mirror of focal length 10 cm with its centre on the axis of the mirror and its plane normal to the axis. The area enclosed by the image of wire is

(a) 7.5 cm² (b) 6 cm² (c) 2 cm² (d) 4 cm²

18. A lead bullet penetrates into a solid object and melts. Assuming that 50% of its kinetic energy was used to heat it, the initial speed of the bullet is (the initial temperature of the bullet is 25°C and its melting point is 300°C). Latent heat of fusion of lead = 2.5×10^4 J/kg and specific heat capacity of lead = 125 J/kg-K

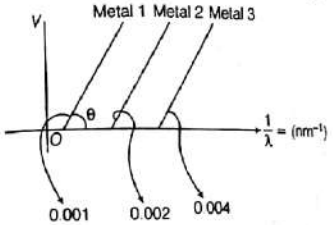
(a) 100 m/s (b) ≈ 490 m/s
(c) 520 m/s (d) 360 m/s

19. A quarter cylinder of radius R and refractive index 1.5 is placed on a table. A point object P is kept at a distance of mR from it as shown in figure. For what value of m for which a ray from P will emerge parallel to the table?



(a) $\frac{2}{3}$ (b) $\frac{3}{2}$
(c) $\frac{4}{3}$ (d) $\frac{3}{4}$

20. The graph $\frac{1}{\lambda}$ and stopping potential (V) of three metals having work function ϕ_1, ϕ_2 and ϕ_3 in an experiment of photoelectric effect is plotted as shown in the figure. Which one of the following statement is/are correct? [Here λ is the wavelength of the incident ray]



(i) Ratio of work functions $\phi_1:\phi_2:\phi_3 = 1:2:4$

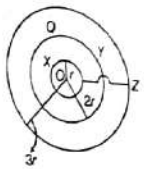
(ii) Ratio of work functions $\phi_1:\phi_2:\phi_3 = 4:2:1$

(iii) $\tan\theta \propto \frac{hc}{e}$, where h = Planck's constant, c = speed of light

(iv) The violet colour-light can eject photoelectrons from metals 2 and 3

(a) (i), (iii) (b) (i), (iv)
(c) (ii), (iii) (d) (i), (ii) and (iv)

21. The concentric, conducting spherical shells X, Y and Z with radii r, $2r$ and $3r$, respectively. X and Z are connected by a conducting wire and Y is uniformly charged to charge Q as shown in figure. Charges on shells X and Z will be

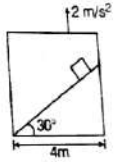


(a) $q_x = \frac{Q}{4}, q_z = \frac{-Q}{6}$ (b) $q_x = \frac{-Q}{4}, q_z = \frac{Q}{4}$
(c) $q_x = \frac{Q}{4}, q_z = \frac{-Q}{4}$ (d) $q_x = \frac{-Q}{6}, q_z = \frac{Q}{4}$

22. The temperature of a gas is raised from 27° C to 927° C. The root mean square speed

(a) gets halved
(b) gets doubled
(c) is $\sqrt{\left(\frac{927}{27}\right)}$ times the earlier value
(d) remains the same

23. A particle slides down on a smooth incline of inclination 30°, fixed in an elevator going up with an acceleration 2 m/s². The box of incline has a length 4m. The time taken by the particle to reach the bottom will be

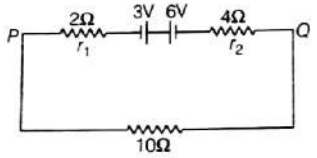


(a) $\frac{8}{9}\sqrt{3}$ s (b) $\frac{9}{8}\sqrt{3}$ s
(c) $\frac{4}{3}\sqrt{\frac{\sqrt{3}}{2}}$ s (d) $\frac{3}{4}\sqrt{\frac{\sqrt{3}}{2}}$ s

24. A stone projected with a velocity u at an angle θ with the horizontal reaches maximum height H_1. When it is projected with velocity u at an angle $\left(\frac{\pi}{2}-\theta\right)$ with the horizontal, it reaches maximum height H_2. The relation between the horizontal range R of the projectile, H_1 and H_2 is

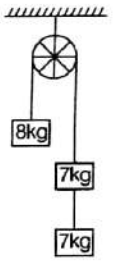
(a) $R = 4\sqrt{H_1H_2}$ (b) $R = 4(H_1 - H_2)$
(c) $R = 4(H_1 + H_2)$ (d) $R = \frac{H_1^2}{H_2^2}$

25. Two batteries of emf 3V and 6V with internal resistances 2Ω and 4Ω are connected in a circuit with resistance of 10Ω as shown in figure. The current and potential difference between the points P and Q are



(a) $\frac{3}{16}$ A and $\frac{8}{15}$ V
(b) $\frac{16}{3}$ A and $\frac{15}{8}$ V
(c) $\frac{3}{16}$ A and 8 V
(d) $\frac{3}{16}$ A and $\frac{15}{8}$ V

26. A light string passes over a frictionless pulley. To one of its ends a mass of 8 kg is attached. To its other end two masses of 7 kg each are attached. The acceleration of the system will be



(a) 10.2 g (b) 5.10 g
(c) 20.36 g (d) 0.27 g

27. A capillary tube of length L and radius r is connected with another capillary tube of the same length but half the radius in series. The rate of steady volume flow of water through first capillary tube under a pressure difference of p is V. The rate of steady volume flow through the combination will be (the pressure difference across the combination is p)

(a) 17 V (b) $\frac{16}{17}V$
(c) $\frac{V}{17}$ (d) $\frac{17}{16}V$

28. A system consist of a cylinder surrounded by a cylindrical shell. A cylinder is a radius R and is made of material of thermal conductivity K, whereas a cylindrical shell has inner radius R and outer radius $2R$ and is made of material of thermal conductivity twice as that of cylinder. Assuming the system in steady state and negligible heat loss across the cylindrical surface, find the effective thermal conductivity of the system, if the two ends of the combined system are maintained at two different temperatures.

(a) $3K$ (b) $\frac{2}{3}K$
(c) $\frac{7K}{4}$ (d) $\frac{5K}{4}$

29. An isotropic point source emits light with wavelength 500 nm. The radiation power of the source is $P = 10$ W. Find the number of photons passing through unit area per second at a distance of 3 m from the source.

(a) $5.92 \times 10^{17}/m^2$ s
(b) $2.23 \times 10^{17}/m^2$ s
(c) $2.23 \times 10^{18}/m^2$ s
(d) $5.92 \times 10^{18}/m^2$ s

30. If a proton and anti-proton come close to each other and annihilate, how much energy will be released?

(a) 1.5×10^{-10} J
(b) 3×10^{-10} J
(c) 4.5×10^{-10} J
(d) 2×10^{-10} J

31. A body at rest slides down a 30° inclined plane. The time taken by it to slide down is twice the time it takes when it slides down the same distance in the absence of friction. The coefficient of friction between the body and the inclined plane is

(a) 0.43 (b) 0.37
(c) 0.64 (d) 0.75

32. A bat emitting an ultrasonic wave of frequency 4.5×10^4 Hz at speed of 6 m/s between two parallel walls. The two frequencies heared by the bat will be

(a) 4.67×10^4 Hz, 4.34×10^4 Hz
(b) 4.34×10^4 Hz, 4.67×10^4 Hz
(c) 4.5×10^4 Hz, 5.4×10^4 Hz
(d) 4.67×10^3 Hz, 4.34×10^4 Hz

33. The charges on two spheres are +7 μC and −5μC respectively. They experience a force F. If each of them is given an additional charge of −2μC, then the new force of attraction will be

(a) F (b) $\frac{F}{2}$ (c) $\frac{F}{\sqrt{3}}$ (d) $2F$

34. A rod made up of metal is 1.2 m long and 0.8 cm in diameter. Its resistance is 3.5×10^{-3} Ω. Another disc made of the same metal is 2.0 cm in diameter and 1.25 mm thick. What is the resistance between the round faces of the disc?

(a) 1.35×10^{-8} Ω (b) 2.70×10^{-7} Ω
(c) 5.82×10^{-7} Ω (d) 8.10×10^{-5} Ω

35. A body is moving along a rough horizontal surface with an initial velocity of 10 ms^{-1}. If the body comes to rest after travelling a distance of 12m, then the coefficient of sliding friction will be

(a) 0.5 (b) 0.2
(c) 0.4 (d) 0.6

36. The magnification produced by a astronomical telescope for normal adjustment is 10 and the length of the telescope is 1.1 m. The magnification, when the image is formed atleast distance of distinct vision is

(a) 6 (b) 18 (c) 16 (d) 14

37. A circular current carrying coil has a radius R. The distance from the centre of the coil, on the axis, where B will be $\frac{1}{8}$ of its value at the centre of the coil is

(a) $\frac{R}{\sqrt{3}}$ (b) $\sqrt{3}R$ (c) $2\sqrt{3}R$ (d) $\frac{2R}{\sqrt{3}}$

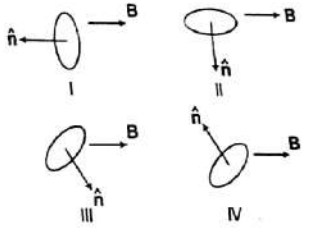
38. Angular width of central maximum in the Fraunhoffer diffraction pattern of a slit is measured. The slit is illuminated by light of wavelength 6000 Å. When the slit is illuminated by light of another wavelength, then the angular width decreases by 30%. The same decrease in angular width of central maximum is obtained when the original apparatus is immersed in a liquid. The refractive index of the liquid will be

(a) 1.25 (b) 1.42 (c) 1.67 (d) 1.5

39. An energy of 68.0 eV is required to excite a hydrogen-like atom in its second Bohr energy level to third energy level the charge of nucleus is Ze. The wavelength of a radiation required to eject the electron from first orbit to infinity is

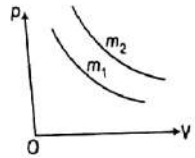
(a) 2.2 nm (b) 2.85 nm
(c) 3.2 nm (d) 2.5 nm

40. A current carrying loop is placed in a uniform magnetic field in four different orientations I, II, III and IV as shown in figure. Arrange them in decreasing order of potential energy.



(a) I > III > II > IV (b) I > II > III > IV
(c) I > IV > II > III (d) III > IV > I > II

41. Two different isotherms representing the relationship between pressure p and volume V at a given temperature of the same ideal gas are shown for masses m_1 and m_2, then

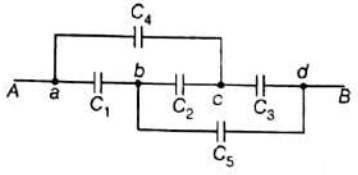


(a) Nothing can be predicted
(b) $m_1 < m_2$
(c) $m_1 = m_2$
(d) $m_1 > m_2$

42. A ^{7}Li target is bombarded with a proton beam current of 10^{-4} A for one hour to produce ^{7}Be of activity 1.8×10^8 disintegrations per second. Assuming that one ^{7}Be radioactive nuclei is produced by bombarding 1000 protons, its half-life is

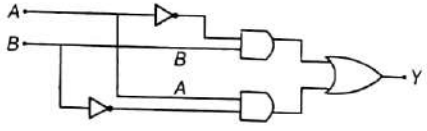
(a) 0.87×10^7 s (b) 0.2×10^7 s
(c) 0.67×10^8 s (d) 0.87×10^8 s

43. In the given figure, the capacitors C_1, C_3, C_4, C_5 have a capacitance 4 μF each. If the capacitor C_2 has a capacitance 10 μF, then effective capacitance between A and B will be



(a) 2 μF (b) 6 μF
(c) 4 μF (d) 8 μF

44. The truth table for the following logic circuit is



(a)

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

(b)

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	1

(c)

A	B	Y
0	0	1
0	1	0
1	0	1
1	1	0

(d)

A	B	Y
0	0	1
0	1	1
1	0	0
1	1	1

45. A sphere of mass m moving with velocity v hits inelastically with another stationary sphere of same mass. The ratio of their final velocities will be (in terms of e)

(a) $\frac{v_1}{v_2} = \frac{1+e}{1-e}$
(b) $\frac{v_1}{v_2} = \frac{1-e}{1+e}$
(c) $\frac{v_1}{v_2} = \frac{1+e}{2}$
(d) $\frac{v_1}{v_2} = \frac{1-e}{2}$

46. A small spherical drop fall from rest in viscous liquid. Due to friction, heat is produced. The correct relation between the rate of production of heat and the radius of the spherical drop at terminal velocity will be

(a) $\frac{dH}{dt} \propto \frac{1}{r^5}$ (b) $\frac{dH}{dt} \propto r^4$
(c) $\frac{dH}{dt} \propto \frac{1}{r^4}$ (d) $\frac{dH}{dt} \propto r^5$

47. A galvanometer of resistance 25 Ω shows a deflection of 5 divisions when a current of 2 mA is passed through it. If a shunt of 4Ω is connected and there are 20 divisions on the scale, then the range of the galvanometer is

(a) 1 A
(b) 58 A
(c) 58 mA
(d) 30 mA

48. The total charge induced in a conducting loop when it is moved in magnetic field depends on

(a) the rate of change of magnetic flux
(b) initial magnetic flux only
(c) the total change in magnetic flux
(d) final magnetic flux only

49. Particles of masses m, $2m$, $3m$, ..., nm are placed on the same line at distances $L, 2L, 3L, \ldots, nL$ from O. The distance of centre of mass from O is

(a) $\frac{(2n+1)L}{4}$ (b) $\frac{L}{(2n+1)}$
(c) $\frac{n(n^2+1)L}{2}$ (d) $\frac{(2n+1)L}{3}$

50. The length of a given cylindrical wire is increased by 150%. Due to the consequent decrease in diameter the change in the resistance of the wire will be

(a) 200% (b) 525% (c) 300% (d) 400%

51. An ideal solenoid having 5000 turns/m has an aluminium core and carries a current of 5A. If $\chi_{Al} = 2.3 \times 10^{-5}$, then the magnetic field developed at centre will be

(a) 0.031 T
(b) 0.048 T
(c) 0.027 T
(d) 0.050 T

52. A ball of radius R rolls without slipping. Find the fraction of total energy associated with its rotational energy, if the radius of the gyration of the ball about an axis passing through its centre of mass is K.

(a) $\frac{K^2}{K^2+R^2}$ (b) $\frac{R^2}{K^2+R^2}$
(c) $\frac{K^2+R^2}{R^2}$ (d) $\frac{K^2}{R^2}$

53. A capacitor is charged and then made to discharge through a resistance. The time constant is τ. In what time will the potential difference across the capacitor decrease by 10%?

(a) $\tau \ln 0.1$ (b) $\tau \ln 0.9$
(c) $\tau \ln \frac{10}{9}$ (d) $\tau \ln \frac{11}{10}$

54. A body of mass $2m$ is placed on earth's surface. Calculate the change in gravitational potential energy, if this body is taken from earth's surface to a height of h, where $h = 4R$.

(a) $\frac{2\,mgh}{R}$ (b) $\frac{2}{3}mgR$
(c) $\frac{8}{5}mgR$ (d) $\frac{mgR}{2}$

55. The slope of isothermal and adiabatic curves are related as

(a) isothermal curve slope = adiabatic curve slope
(b) isothermal curve slope = γ × adiabatic curve slope
(c) adiabatic curve slope = γ × isothermal curve slope
(d) adiabatic curve slope = $\frac{1}{2}$ × isothermal curve slope

56. A solid sphere of mass M and radius $2R$ rolls down an inclined plane of height h without slipping. The speed of its centre of mass when it reaches the bottom is

(a) $\sqrt{\frac{6}{7}gh}$ (b) $\sqrt{3gh}$
(c) $\sqrt{\frac{10}{7}gh}$ (d) $\sqrt{\frac{4}{3}gh}$

57. A liquid of density 800 kg/m³ is filled in a cylindrical vessel upto a height of 3 m. This cylindrical vessel stands on a horizontal plane. There is a circular hole on the side of the vessel. What should be the minimum diameter of the hole to move the vessel on the floor, if plug is removed. Take the coefficient of friction between the bottom of the vessel and the plane as 0.5 and total mass of vessel plus vessel as 95 kg.

(a) 0.107 m
(b) 0.053 m
(c) 0.206 m
(d) 0.535 m

58. The transfer ratio β of a transistor is 50. The input resistance of the transistor when used in the common emitter configuration is 2kΩ. The peak value of the collector AC current for an AC input voltage of 0.02 V peak is

(a) 200 μA
(b) 0.01 mA
(c) 0.25 mA
(d) 500 μA

59. The volume of an ideal gas is doubled in an isothermal process. Then, which of the following is true?

(a) Work done by the gas is positive
(b) Work done by the gas is negative
(c) Internal energy of the system decreases
(d) Internal energy of the system increases

60. A prism of a certain angle deviates the red and blue rays by 8 and 12, respectively. Another prism of the same angle deviates the red and blue rays by 10 and 14, respectively. The prisms are small angled and made of different materials. The dispersive power of the materials of the prisms are in the ratio

(a) 5 : 6
(b) 9 : 11
(c) 6 : 5
(d) 11 : 9

Chemistry

1. Temperature of a gas is t K. What would be the temperature at which volume and pressure, both will reduced to half of the initial values?
(a) $t/2$ (b) $t/4$
(c) $t/3$ (d) $t/8$

2. What will be the number of waves formed by a Bohr electron in one complete revolution in its second orbit?
(a) Three (b) Two
(c) One (d) Zero

3. When 2-methyl butyl bromide is treated with sodium ethoxide in ethanol, what will be the major product?
(a) 2-methyl but-2-ene
(b) 3-methyl but-1-ene
(c) 2-methyl but-1-ene
(d) 2-methyl sodium-butoxide

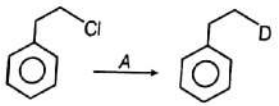
4. Solid $NaHCO_3$ will be neutralised by 40.0 mL of 0.1 M H_2SO_4 solution. What would be the weight of solid $NaHCO_3$ in gram?
(a) 0.672 g (b) 6.07 g
(c) 17 g (d) 20 g

5. The pair of boiling point and compound are given as,

C_6H_6,	CH_3OH	$C_6H_5NO_2$	$C_6H_5NH_2$
80°C	65°C	212°C	184°C
(I)	(II)	(III)	(IV)

Which will show lowest vapour pressure at room temperature?
(a) C_6H_6 (b) CH_3OH
(c) $C_6H_5NO_2$ (d) $C_6H_5NH_2$

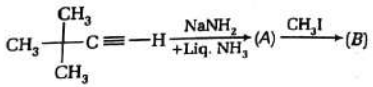
6. In the following conversion,



Identify 'A' from the following option
(a) $NaBD_4$
(b) $LiAlD_4$
(c) Mg, ether/D_2O
(d) BH_3, D_2O

7. Ethers like ROR can be cleaved by concentrated HI but not by HCl because
(a) I^- is a weaker nucleophile than Cl^-
(b) I^- is stronger nucleophile than Cl^-
(c) S_N1 mechanism carried out in this reaction is rapidly in presence of HI.
(d) None of the above

8. In the reaction,



How many electron donating groups are attached with the carbon atom of unsaturated part of the product 'B' ?
(a) Two (b) Three
(c) Four (d) None of these

9. At 27°C, one mole of an ideal gas is compressed isothermally and reversibly from a pressure of 2 atm to 10 atm.
Choose the correct option from the following.
(a) Change in internal energy is positive
(b) Heat is negative
(c) Work done is − 965.84 cal
(d) All are incorrect

10. Which of the following hydrocarbons is the most reactive towards addition of H_2SO_4?
(a) Ethene (b) Propylene
(c) 3-methyl but-1-ene (d) 1-butene

11. Choose the incorrect statement about noble gas?
(a) Boiling point increases with increasing atomic mass
(b) Helium has least tendency to form compound
(c) Noble gases have some value of electron affinity
(d) Xenon has maximum number of compounds

12. For the cell reaction
$Pb + Sn^{2+} \longrightarrow Pb^{2+} + Sn$
Given that, $Pb \longrightarrow Pb^{2+}$, $E^\circ = 0.13$ V
$Sn^{2+} + 2e^- \longrightarrow Sn$; $E^\circ = -0.14$ V
What would be the ratio of cation concentration for which $E = O$?
(a) 1/4 (b) 1/2 (c) 1/3 (d) 1/1

13. $[CuCl_4]^{2-}$ exists while $[CuI_4]^{2-}$ does not exist, because
(a) I^- is stronger reductant than Cl^-
(b) I^- is weaker reductant than Cl^-
(c) I^- is stronger oxidant than Cl^-
(d) None of the above

14. In the reaction,
$X + I_2 + 2HCl \longrightarrow SnCl_4 + 2HI$
The correct option regarding X is/are
(a) It is an strong reducing agent
(b) It is an angular molecule
(c) It is used as a reagent in test of Hg^{2+} radical
(d) All of the above

15. If oxide ions are arranged in hcp and the aluminium ions occupy two thirds of octahedral voids. What will be the formula of the compound?
(a) AlO_3 (b) Al_2O_3 (c) $(Al_2O_3)_2$ (d) Al_3O_4

16. Actinides exhibit larger number of oxidation state than that of corresponding lanthanides. The reason behind this aspect is
(a) lesser energy difference between 5f and 6d-orbitals than between 4f and 5d-orbitals
(b) larger atomic size of actinides than the lanthanides
(c) more energy difference between 5f and 6d orbitals than between 4f and 5d-orbitals
(d) greater reactive nature of the actinides than the lanthanides

17. Aqueous solution of $AlCl_3$ is acidic towards litmus while of NaCl is not. The correct reason behind this is
(a) $AlCl_3$ furnishes OH^- ion in the solution
(b) $AlCl_3$ furnishes H^+ ion in the solution
(c) $AlCl_3$ furnishes both H^+ well as OH^- ion in the solution
(d) $AlCl_3$ is the salt of strong base and strong acid

18. The melting point of solid substances is directly proportional to pressure acting on them. However, ice-melts at a temperature lower than its usual melting point, when the pressure increases. This is because
(a) ice is not a true solid
(b) the bonds break under pressure
(c) ice is loss denser than water
(d) pressure generates heat

19. The E° values for Mn and Zn are more negative than expected because
(a) they have either half-filled and fully-filled configurations
(b) they can easily donate electrons
(c) it is Quite easy to remove electrons from their orbitals
(d) None of the above

20. For the formation of Cr_2O_3 and Al_2O_3, values of $\Delta_f G^\circ$ are 540 kJ mol^{-1} and − 827 kJ mol^{-1} respectively. What will be the possibility for reaction of Cr_2O_3 by Al?
(a) Reduction of Cr_2O_3 by Al will take place
(b) Oxidation of Cr_2O_3 by Al will take place
(c) Neither oxidation nor reduction will take place
(d) Reaction is not feasible

21. Work is being performed, when a weight lifter lifts a base ball off a weight rack. This is due to
(a) magnetic attraction
(b) gravity
(c) electrostatic repulsion
(d) mechanical force

22. Magnetic moment of $[Ti(H_2O)_6]^{4+}$, $[Mn(H_2O)_6]^{2+}$ and $[Cr(H_2O)_6]^{3+}$ can be represented as X, Y and Z.
They are in order of
(a) $X < Z < Y$ (b) $Z < Y < X$
(c) $X < Y < Z$ (d) $Z < Y < X$

23. Beryllium differs in properties from other elements of its own group but shows resemblance with aluminium because of
(a) relatively bigger ionic radius and high polarising power of Be
(b) relatively smaller ionic radius and high polarising power of Be
(c) relatively bigger ionic radius is the only reason behind this
(d) None of the above

24. Two similar reactions have the same rate constant at 25°C, but at 35°C, one of the reaction has a higher rate constant than the other. The appropriate reason for this is
(a) due to effective collisions
(b) due to different activation energies
(c) due to different threshold energies
(d) due to higher population of molecules

25. In $[CO(H_2O)_6]^{2+}$, there are three unpaired electrons present. The $\mu_{calculated}$ is 3.87 BM which is quite different from the $\mu_{experimental}$ of 4.40 BM.

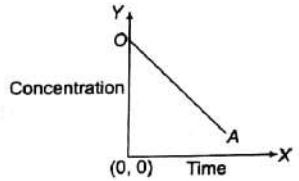
This is because of

(a) increase in number of unpaired electrons
(b) some contribution of the orbital motion of the electron to the magnetic moment
(c) change in orbital spin of the electron
(d) *d-d* transition

26. When excess of NaOH solution is added to aqueous solution of iodine, the colour of solution becomes

(a) blue (b) yellow
(c) colourless (d) pale green

27. Look at the graph,



Choose the correct equation from the following which best suited to the above graph

(a) $[A_t] = [A]_0 - Kt$ (b) $[A_t] = [A]_0 + Kt$
(c) $[A_t] = [A_0]e^{-Kt}$ (d) $[A_t] = Kt^2 + [A_0]$

28. Choose the correct statement from the following

(a) NH_4^+ and CH_4 are not isoelectronic species
(b) BF_3 does not have dipole moment
(c) O—Cl—O obeys octet rule
(d) O^- in O_3 is Sp^3-hybridised

29. Lauryl alcohol on treatment with H_2SO_4 followed by neutralisation forms a product which is

(a) cationic detergent (b) anionic detergent
(c) neutral detergent (d) antidepressant

30. When an iron object is plated with tin, tin does not act as sacrificial anode in protecting against corrosion, because.

(a) tin is more reactive than iron
(b) tin is less reactive than iron
(c) reactivity of tin and iron is same
(d) tin is oxidising agent while iron is not so

31. Which of the following pair of compounds will have three sp^2-hybrid orbitals?

(a) SO_2, CH_4 (b) SO_3, C_2H_4
(c) BF_3, SF_4 (d) I_3^-, SF_4

32. Consider the reaction,

$H_2 + X_2 \longrightarrow 2HX$, where X is halogen. The reactivity of halogens decrease in the order of

(a) $Cl_2 > F_2 > Br_2 > I_2$ (b) $I_2 > Br_2 > F_2 > Cl_2$
(c) $F_2 > Cl_2 > Br_2 > I_2$ (d) $I_2 > Br_2 > Cl_2 > F_2$

33. Choose the correct statement from the following.

(a) The greater positive value of E°_{OP} indicates greater reactivity of metal
(b) F^- is strong oxidant while Cu^{2+} is weak reductant
(c) The metals placed above Mg in the electrochemical series do not decompose water at ordinary temperature
(d) Oxides of Hg do not decompose on heating

34. 100 mL of a solution contains 2 g of acetic acid and 3g of sodium acetate providing $K_a = 1.8 \times 10^{-5}$, then choose the correct option.

(a) This solution is basic in nature
(b) This solution is acidic in nature
(c) This solution is amphoteric in nature
(d) This solution is neutral in nature

35. Consider the following structures.



Choose the correct statement regarding the above structures.

(a) Dipole moment varies as II > III > I
(b) II is more stable than I
(c) I is the most reactive among three
(d) All of the above

36. On the basis of Langmuir adsorption isotherm the amount of gas adsorbed at very high pressure.

(a) Reaches a constant limiting value
(b) Goes on increasing with pressure
(c) Goes on decreasing with pressure
(d) First increasing and then decreasing with pressure

37. Both Mg and Fe metal can reduce copper from a solution having Cu^{2+} ion, according to equilibria.

$Mg_{(s)} + Cu^{2+} \rightleftharpoons Mg^{2+} + Cu_{(s)}$; $K_1 = 6 \times 10^{90}$

$Fe_{(s)} + Cu^{2+} \rightleftharpoons Fe^{2+} + Cu_{(s)}$; $K_2 = 3 \times 10^{26}$

Choose the correct option regarding above equilibrium

(a) Mg removes more Cu^{2+} from solution
(b) Fe removes more Cu^{2+} from solution
(c) Both will equally remove Cu^{2+} from solution
(d) Both metals cannot remove Cu^{2+} from solution

38. Consider the following reaction sequence

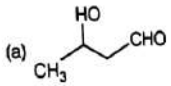
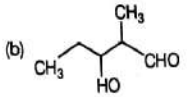
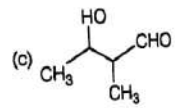
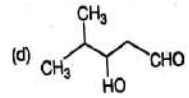
$$CH_3OH \xrightarrow{HBr} 'A' \xrightarrow{KCN} 'B' \xrightarrow{H_2/Ni} 'C' \xrightarrow{HNO_2} 'D'$$

Choose the correct option regarding the different products obtained in the above reaction sequence.

(a) '*D*' is an alcohol consisting one carbon more than the starting alcohol
(b) Product '*B*' is formed via S_N2-pathway
(c) '*C*' is an amine
(d) All of the above

39. Which of the following is crossed aldol product in the reaction?

$$CH_3CHO + CH_3CH_2CHO \xrightarrow[25^\circ C]{OH^-} 'P'$$

(a) 
(b) 
(c) 
(d) 

40. Which of the following statements is incorrect regarding the reaction?

$$CH_3CHO + [Ag(NH_3)_2]^{\oplus} + \bar{O}H \longrightarrow CH_3COO^- + Ag$$

(a) The equivalent weight of CH_3CHO is 22
(b) Three moles of OH^- are required in the above reaction
(c) CH_3CHO is an oxidising agent
(d) Reduction of $[Ag(NH_3)_2]^{\oplus}$ occurs

41. Consider the following compounds.

$Cl_3C-COOH$ (I) $Br_3C-COOH$ (II) $I_3C-COOH$ (III)

The decreasing order of decarboxylation is

(a) I > II > III (b) III > II > I
(c) III > I > II (d) II > I > III

42. Which of the following is an example of carbylamine reaction?

(a) $2PhNH_2 + CS_2 \xrightarrow[\Delta]{\text{(i) KOH (ii) conc.HCl}} Ph-NCS$

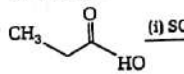
(b) $R-NH_2 + HNO_2 \xrightarrow{0-5^\circ C} R-OH + N_2 + HCl$

(c) $Ph-NH_2 + CHCl_3 + 3KOH(alc.) \xrightarrow{\Delta} Ph-NC + 3KCl + 3H_2O$

(d) $Ph_2-NH + HONO \longrightarrow Ph_2-N-N=O + H_2O$

43. C_3H_9N reacts with Hinsberg reagent and the product is insoluble in alkali but soluble in ether. This nitrogen containing compound is

(a) primary amine (b) secondary amine
(c) tertiary amine (d) methyl isocyanide

44. 

$$\xrightarrow{\text{(i) } SOCl_2} 'P' \xrightarrow{C_2H_7NH_2} 'Q'$$

Product '*Q*' is

(a) an amide (b) an amine
(c) nitro compound (d) nitrile compound

45. Which of the following statements is incorrect?

(a) Polypropylene is a thermoplastic polymer
(b) Melamine-formaldehyde is a thermosetting polymer
(c) Mixture of styrene and methyl methacrylate can form ionic addition polymer
(d) Low-density polythene is a poor conductor of electricity

46. Match the particle with its characteristic.

Column I	Column II
A. α-particle	(p) Slow moving
B. Isobar	(q) High penetration power
C. γ-ray	(r) Same atomic mass
D. β-particle	(s) Consists of electron

Codes	A	B	C	D
(a)	p	r	q	s
(b)	p	q	r	s
(c)	r	s	p	q
(d)	s	r	p	q

47. The magnitude of screening effect depends upon the number of
(a) inner electrons (b) outer electrons
(c) bond order (d) Both (a) and (b)

48. Highest energy will be absorbed to eject out the electron in the configuration.
(a) $1s^2\ 2s^2\ 2p^1$ (b) $1s^2\ 2s^2\ 2p^3$
(c) $1s^2\ 2s^2\ 2p^2$ (d) $1s^2\ 2s^2\ 2p^4$

49. Sugars are seperated by using the solvent BAW (*n*-butanol acetic acid $-H_2C$) and detected by spraying the plate with
(a) aniline hydrogen phthalate solution
(b) hydrogen peroxide solution
(c) crystals of I^2
(d) cupric oxide

50. Duma's method involves the determination of nitrogen content in the organic compound in the form of
(a) NH_3 (b) N_2
(c) NaCN (d) $(NH_4)_2SO_4$

51. Which of the following statement(s) is not correct?
(a) Suspended particulate matter is an important pollutant released by diesel vehicles
(b) Soot particles (size < 5 μ) cause fibrosis of the lung living
(c) H_2SO_4 particulates have size of 500 – 1000 nm
(d) Photochemical smog is formed by oxides of sulphur, smoke and dust particles

52. At radioactive equilibrium, the ratio between two atoms of radioactive elements *A* and *B* is 3.1×10^9:1. If the half-life period of *A* is 2×10^{10} yrs, then the half-life of *B* is
(a) 9.54 yrs (b) 2.14 yrs
(c) 3.29 yrs (d) 6.45 yrs

53. The effective neutron capture radius of a nucleus having a cross-section of 1.0 barr is [Given, 1 barr = 1.0×10^{-24} cm^2]
(a) 5.6×10^{-13} cm (b) 4.3×10^{-13} cm
(c) 2.3×10^{-11} cm (d) 5.6×10^{-24} cm

54. Lime stone is added in the extraction of lead from galena why?
(a) It prevents the formation of $PbSO_4$
(b) It remove the impurity of silica as fusible slag
(c) It converts lead silicate to lead oxide
(d) All of the above

55. A hypothetical reaction $A \longrightarrow 2B$ proceeds through the following sequence of steps

I. $A \longrightarrow C;\ \Delta_r H = q_1$

II. $C \longrightarrow D;\ \Delta_r H = q_2$

III. $\frac{1}{2}D \longrightarrow B;\ \Delta_r H = q_3$

The heat of hypothetical reaction is
(a) $q_1 + q_2 - 2q_3$ (b) $q_1 + q_2 + 2q_3$
(c) $q_1 + 2q_2 - 2q_3$ (d) $q_1 - q_2 + 2q_3$

56. Anhydrous mixture of KF and HF contain which types of ions?
(a) K^+, H^+, F^- (b) $\{KF^+, (HF^-)\}$
(c) KH^+, F^- (d) K^+, HF_2^-

57. Polypropylene can be obtained by polymerisation of
(a) $CH_2 = CH—CH_2—Cl$
(b) $CH_2 = CH—Cl$
(c) $CH_3—Cl$
(d) $CH_3—CHCl_2$

58. $C_6H_5—NHOH + C_6H_5—NO \xrightarrow{NaOH}$

(*X*), (*X*) formed in the above reaction is
(a) $C_6H_5N(OH)—N(OH)—C_6H_5 \longrightarrow N$
(b) $(C_6H_5)_2NOH$
(c) $C_6H_5—N=N(\downarrow O)—C_6H_5$
(d) $C_6H_5—NH—N(OH)—C_6H_5$

59. 11.2 L of gas at STP Weight 14g.
The gas would be
(a) H_2 (b) CO
(c) B_2H_6 (d) All of these

60. The value of *n* in
$MnO_4^- + 8H^+ + ne^- \longrightarrow Mn^{2+} + 4H_2O$ is
(a) 5 (b) 4 (c) 2 (d) 3

Biology

1. 'GIFT' refers to
(a) Gamete *In vitro* Fertilisation Technique
(b) Gamete Inter Fallopian Tube
(c) Gamete Intra Fallopian Transfer
(d) Gamete *In vitro* Fertilisation Transfer

2. Consider following statements and Choose correct ones from given options.
I. Shark do not have any bone in its body.
II. Water snake and salamander belongs to same class and have largest RBC.
III. Silver fish is a true fish while cuttle and star fishes are molluscs and echinoderms respectively.
IV. *Ornithorhynchus* is a connecting link between reptiles and mammals.
(a) I, II and IV (b) I and IV
(c) I, II and III (d) III and IV

3. Which one of the following is not correctly matched?
(a) Diphtheria – *Corynebacterium*
(b) Elephantiasis – *Wuchereria*
(c) Plague – *Paramyxo*
(d) Lockjaw – *Clostridium*

4. The largest muscle in the human is
(a) biceps (b) gluteus maximus
(c) stapedius (d) masseter

5. The best description of natural selection is
(a) the reproductive success of the members of a population best adapted to environment
(b) it acts when the resources are unlimited
(c) a change in the proportion of variations within a population
(d) it follows Hardy-Weinberg principle

6. The chromosome of cell duplicates during the
(a) S-phase of cell cycle
(b) G_1-phase of cell cycle
(c) G_2- phase of cell cycle
(d) prophase of cell division

7. Adenosine triphosphate was discovered by
(a) Jack Lipman
(b) A Bloor
(c) Karl Lohmann
(d) Emil Fisher

8. Lens of eyes is derived from
(a) ectoderm
(b) mesoderm
(c) endoderm
(d) Both (b) and (c)

9. Schneiderian and tympanic membranes respectively belongs to
(a) ear and nose (b) ear and eye
(c) ear and ear (d) nose and ear

10. Due to alcohol abuse brain related disease Korsakoff's syndrome occurs. Which nutrient is responsible for this syndrome?
(a) Vitamin-B_{12} (b) Fat
(c) Protein (d) Vitamin-B_1

11. Who received Nobel Prize in 2008 for the discovery of HIV?
(a) Harald Zur Hausen (b) Luc Montagnier
(c) Jack Szostak (d) Carol Greider

12. Which one of the following is a recognisation site for restriction enzyme *Bam* HI?
(a) 5′ – GAATTC – 3′ 3′ – CTTAAG – 5′
(b) 5′ – GGATCC – 3′ 5′ – CCATGG – 3′
(c) 5′ – GGATCC – 3′ 3′ – CCTAGG – 5′
(d) 5′ – GAATTC – 3′ 5′ – GTTAAC – 3′

13. Golden ages of reptiles and fishes are respectively
(a) Mesozoic and Devonian
(b) Jurassic and Permian
(c) Triassic and Silurian
(d) Palaeozoic and Mesozoic

14. Match the following Columns.

Column I (Disease)	Column II (Related Hormone)
A Cretinism	1 Glucocorticoid
B Cushing's syndrome	2 Testosterone
C Diabetes insipidus	3 Thyroid
D Eunuchoidism	4 ADH

	A	B	C	D
(a)	3	4	1	2
(c)	3	4	1	2

	A	B	C	D
(b)	2	3	4	1
(d)	3	1	4	2

15. Which one of the following pair is not correctly matched?
(a) Almond – Drupe (b) Brinjal – Berry
(c) Guava – Pepo (d) Loquat – Pome

16. The powerhouse of cell is first discovered by
(a) C Benda in 1897
(b) Kolliker in 1850
(c) Claude in 1880
(d) Kingsburg in 1882

17. During chloride shift or Hamburger phenomenon, when the whole blood is saturated with CO_2, following changes occurs. Which one of them is not correct?
(a) Bicarbonate content of plasma and corpuscles increase
(b) Chloride content of plasma diminished and that of the cell is increased
(c) Total base of blood remain unchanged
(d) Water content and volume of corpuscles decrease

18. Which one of the following elements is activator for both ribulose bisphosphate, carboxylase oxygenase and phosphoenol pyruvate carboxylase in photosynthetic carbon fixation?
(a) Mg^{2+} (b) Zn^{2+}
(c) Mn^{2+} (d) Cl^- and K^+

19. Common phase in aerobic and anaerobic respiration is
(a) Krebs' cycle (b) glycolysis
(c) glycogenolysis (d) ETS

20. *'Treponema pallidum'* pathogen is a cause of
(a) leprosy (b) plague
(c) syphilis (d) pertussis

21. Which one of the following pair is not correct?
(a) Mangolian idiocy – 21st chromosome
(b) Patau syndrome – 13th chromosome
(c) Cri-Du-Chat – 11th chromosome
(d) Edward syndrome – 18th chromosome

22. Bacteriophage $\phi \times 174$ is different from other bacteriophage due to the presence of
(a) single-stranded DNA
(b) single-stranded RNA
(c) double-stranded DNA
(d) None of the above

23. An irregular mode of reproduction resulting in the development of an embryo without fertilisation is called
I. parthenogenesis
II. apogamy
III. sporophytic budding

Select the correct answer using the code given below.
(a) Only I (b) Only II
(c) II and III (d) I, II and III

24. In which one of the family formation of endosperm doesn't take place?
(a) Orchidaceae
(b) Cactaceae
(c) Ranunculaceae
(d) Malvaceae

25. In cardiac cycle maximum time is taken by
(a) atria systole
(b) atria diastole
(c) ventricle systole
(d) ventricle diastole

26. A horse and a donkey can breed to produce mule which is an infertile animal. The infertility is because horse and donkey belong to different
(a) class (b) order
(c) species (d) genus

27. Source of commercial chewing gum latex is
(a) *Hevea brasiliensis*
(b) *Carica papaya*
(c) *Ficus elastica*
(d) *Achras sapota*

28. Compare the statement I and II and choose the correct option.

Statement I In the flowering plants due to higher accumulation of auxins dormancy of lateral buds occurs.

Statement II In Maryland Mammoth (a tobacco variety) flowering occurred at different time at different latitude due to gibberellin concentration.
(a) Statement I is true, but II is false
(b) Statement I is false, but II is true
(c) Both statements are true
(d) Both statements are false

29. Which one of the given pollination technique/adaptation is different than others?
(a) Herkogamy (b) Geitonogamy
(c) Dichogamy (d) Heterostyly

30. The phenotypic ratio of trihybrid cross in F_2 - generation is
(a) 27 : 9 : 9 : 9 : 3 : 3 : 3 : 1
(b) 9 : 3 : 3 : 1
(c) 1 : 4 : 6 : 4 : 1
(d) 27 : 9 : 3 : 3 : 9 : 1 : 2 : 1

31. A point mutation where guanine is replaced by cytosine is also called
(a) frame shift mutation
(b) transition mutation
(c) translocation mutation
(d) transversion mutation

32. Match the following Columns.

	Column I (Organism)	Column II (Connecting link)
A	*Echidna*	1 between Annelida and Mollusca
B	*Peripatus*	2 between Reptiles and Mammals
C	*Neopilina*	3 between Annelida and Arthropoda
D	*Protopterus*	4 between Pisces and Amphibian

(a) A B C D 4 3 2 1
(b) A B C D 2 3 1 4
(c) 3 1 2 4
(d) 4 2 1 3

33. Match the following Columns.

	Column I (Cell organelle)	Column II (Discovered by)
A	Ribosome	1 Fontana
B	Nucleolus	2 Tolbert and Yamazaki
C	Glyoxysome	3 Palade
D	Peroxisome	4 Beevers

(a) A B C D 1 4 2 3
(b) A B C D 3 4 1 2
(c) 1 3 2 4
(d) 3 1 4 2

34. Which one of the following antibodies plays an important role as mediator in allergic response?
(a) Ig E (b) Ig G
(c) Ig D (d) Ig A

35. Which one of the following human ancestors is known as tool maker?
(a) *Homo erectus*
(b) Java man
(c) *Homo habilis*
(d) Heidelberg man

36. Which one of the following is a matching pair of vector and the disease?
(a) *Culex* – Filariasis
(b) Housefly – Leprosy
(c) *Aedes aegypti* – Chickenpox
(d) Sandfly – Cholera

37. Consider these following sentences and choose the correct ones.
I. Each gene contains a specific promoter region and a leader sequence for guiding the beginning of transcription.
II. Only one strand of DNA, called template strand is copied by RNA polymerase this strand runs in $3' \rightarrow 5'$ direction.
III. RNA polymerase adds complementary nucleotides forming single strand *m*RNA in $3' \rightarrow 5'$ direction.
IV. Section of DNA that has been transcribed is rewound into its original configuration.
(a) II, III and IV (b) II and IV
(c) I, II and IV (d) I, II,IIIand IV

38. Which one of the following is not correct pair of type of cancer and origin place?
(a) Benign tumour – Non-cancerous tumour
(b) Carcinomas – Cancer of epithelial tissues
(c) Lymphomas – Haematopoietic cells tumour
(d) Sarcomas – Cancer of glands (secretory tissues)

39. In animals normally which organism has maximum number of chromosomes?
(a) Butterfly (b) Elephant
(c) Hermit crab (d) Chimpanzee

40. During meiosis-I, the bivalent chromosomes clearly appear as tetrads during
(a) diakinesis (b) diplotene
(c) pachytene (d) zygotene

41. Snapdragon flower is an exception of Mendel's laws. It is a good example of
(a) law of dominance
(b) complementary gene
(c) codominance
(d) incomplete dominance

42. Consider these sentances regarding to the structure and nature of DNA.
I. DNA has two pyrimidine bases which contain single ring structure.
II. In DNA, composition of bases should be $\frac{A+T}{G+C}=1$.
III. Each base pair of DNA is 3.4Å apart from othes base pair.
IV. The nucleosome model DNA packaging was proposed by Kornberg and Thomas.

Choose the correct statements from given options.
(a) I and III (b) I, II and III
(c) II, III and IV (d) I, III and IV

43. The term 'prebiotic soup' for organic water containing mixture of simple organic compounds was given by
(a) Richter (b) Haldane
(c) Arrhenius (d) Miller

44. Number of Barr body which will found in case of Turner's syndrome will be
(a) 1
(b) 2
(c) 0
(d) Can't be determine by given data

45. Which one of the following options is not a sexually transmitted disease?
(a) AIDS (b) Hepatitis-B
(c) Pertussis (d) Syphilis

46. The Sub-units of 80S ribosome will be
(a) 40S, 40S (b) 60S, 40S
(c) 60S, 20S (d) 55S, 25S

47. Pyloric sphincter guards the opening between
(a) stomach and duodenum
(b) cardia and fundus
(c) oesophagus and stomach
(d) fundus and pylorus

48. Vegetative propagation in *Bryophyllum* takes place through
(a) bulbil (b) corms
(c) leaf buds (d) eyes

49. Pappus helps in dispersal of pollen in
(a) Asteraceae
(b) Brassicaceae
(c) Malvaceae
(d) Solanaceae

50. Diphtheria is caused by
(a) poison released by living bacterial cell into the host
(b) poison released from dead bacterial cell into the host
(c) poison released by virus into the host
(d) excessive immune response by the body of host

51. Which one of the following microbes is the source for vitamin-C?
(a) *Pseudomonas* sp.
(b) *Acetobacter* sp.
(c) *Aspergillus* sp.
(d) *Chlorella*

52. The fact that DNA is a genetic material was established by the experiment of
(a) Meselson and Stahl
(b) Hershey and Chase
(c) Avery, Macleod and McCarty
(d) Rosalind Franklin and Kornberg

53. Match the following Columns.

Column I (Pollination technique)	Column II (Pollinator)
A. Cheiropterophily	1 Ant
B. Anemophily	2 Bat
C. Myrmecophily	3 Snail
D. Malacophily	4 Wind

	A	B	C	D
(a)	3	2	1	4
(b)	2	4	1	3
(c)	4	3	2	1
(d)	1	3	2	4

54. Which one of the following hormones is released by posterior lobe of pituitary gland?
(a) FSH (b) ADH
(c) ACTH (d) MSH

55. During the transmission of nerve impulse through a nerve fibre, the potential on the innerside of the plasma membrane has which type of electric charge?
(a) First negative then positive and again back to negative
(b) First positive then negative and continue to be negative
(c) First negative then positive and continue to be positive
(d) First positive then negative and again back to positive

56. Uric acid is the excretory waste of
(a) adult amphibians
(b) birds
(c) amphibian larvae
(d) mammals

57. In case of pregnancy the heartbeat of embryo starts at
(a) 4th week (b) 7th week
(c) 6th week (d) 5th week

58. PPLO are smallest cell in the living world. The extend form of PPLO is
(a) Pseudo Pneumonia Length Orge
(b) Pseudo Plank Leg Organelle
(c) Pneumonia Plank Like Organism
(d) Pleuro Pneumonia Like Organism

59. Slime-mould belongs to
(a) kingdom— Protista (b) kingdom— Monera
(c) kingdom— Fungi (d) kingdom— Plantae

60. Which one of the following is not a flower?
(a) Shoe-flower (b) Sunflower
(c) Larkspur (d) Water lily

English & Quantitative Reasoning

Directions (Q.Nos. 1-5) *Fill up the blanks in the passage given below with the most appropriate word from the options given for each blank.*

The ...(1)... age is the age of machines. From the ...(2)... the industrial Revolution began in Europe. Man's life has been changing ...(3)... many ways. At first the change was ...(4).... Now machines have become ...(5)... of our daily lives.

1. (a) modern (b) new
(c) civilised (d) present

2. (a) birth (b) time
(c) beginning (d) start

3. (a) into (b) to
(c) in (d) with

4. (a) slow (b) steady
(c) fast (d) stagnant

5. (a) component (b) part
(c) necessity (d) support

Directions (Q.Nos. 6-8) *Read each sentence to find out whether there is any error in it. The error, if any, will be in one part of the sentence. The alphabet number of that part is the answer. If there is no error, then the answer is (e).*

6. We (a)/ saw (b)/ a elephant (c)/ In the zoo. (d)/No error (e)

7. It is (a)/ a most (b)/ beautiful (c)/ painting of the gallery. (d)/ No error (e)

8. Mr Gaurav Sharma (a)/ is (b) / coming to (c)/ dinner. (d) / No error (e)

Directions (Q. Nos. 9-10) *Select the word which is most nearly the same in meaning as the given words.*

9. DEMISE
(a) Result (b) Default
(c) Death (d) Apprehension

10. DISPARITY
(a) Distaste (b) Dissimilarity
(c) Criticism (d) Distinction

➡ **Directions** (Q. Nos. 11-12) *Find the missing number/letter from the given alternatives.*

11. BMO, EOQ, HQS,?

(a) SOW (b) LMN
(c) KSU (d)SOV

12. 4117, 5138, 6159, 71710, ?

(a) 71382
(b) 76599
(c) 81911
(d) 81798

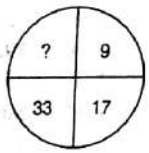
➡ **Directions** (Q. Nos. 13-14) *In each of the following questions, select the missing number from the given alternatives.*

13.

2	7	9
7	3	4
9	8	?
126	168	216

(a) 8 (b) 3
(c) 6 (d) 36

14.



(a) 60 (b) 39 (c) 55 (d) 65

15. If the Ist of November falls on Monday, what day will the 25th of November will be?

(a) Tuesday (b) Thursday
(c) Wednesday (d) Friday

16. Which one set of letters when sequentially placed at the gaps in given letter series shall complete it?

m_st_u_t_ _st

(a) ummmu (b) umsmu
(c) muumm (d) ttssuu

17. A and B are standing at a distance of 20 km from each other on a straight East-West road. A and B start walking simultaneously Eastwards and Westwards respectively and both cover a distance of 5 km. Then, A turns to his left and walks 10 km. B turns to his right and walks 10 km at the same speed. What will be the distance between them?

(a) 10 km (b) 30 km
(c) 20 km (d) 25 km

18. There are three baskets of fruits. 1st basket has twice the number of fruits in the 2nd basket. 3rd basket has three-fourth of the fruits in the first. The average of the fruits in all the baskets is 30. What is the number of fruits in the first basket?

(a) 20 (b) 30
(c) 35 (d) 40

19. Find the word which cannot be formed from the letters used in the given word.

GERMINATION

(a) ORNAMENT (b) TERMINAL
(c) IGNITE (d) GERMAN

20. In a certain code, MODEL is written as 513 # 2 and DEAR is written as 3 # % 8. How is LOAD written in that code ?

(a) 23%1 (b) 21%3
(c) 25%3 (d) 21#3

Answers

Physics

1. (d)	2. (c)	3. (c)	4. (b)	5. (c)	6. (d)	7. (c)	8. (b)	9. (c)	10. (c)
11. (b)	12. (c)	13. (d)	14. (c)	15. (a)	16. (a)	17. (d)	18. (b)	19. (c)	20. (a)
21. (b)	22. (b)	23. (c)	24. (a)	25. (d)	26. (d)	27. (c)	28. (c)	29. (b)	30. (b)
31. (a)	32. (b)	33. (a)	34. (c)	35. (c)	36. (d)	37. (b)	38. (b)	39. (d)	40. (c)
41. (b)	42. (a)	43. (c)	44. (a)	45. (b)	46. (d)	47. (c)	48. (c)	49. (d)	50. (b)
51. (a)	52. (a)	53. (c)	54. (c)	55. (c)	56. (c)	57. (a)	58. (d)	59. (a)	60. (c)

Chemistry

1. (b)	2. (b)	3. (a)	4. (a)	5. (c)	6. (c)	7. (b)	8. (a)	9. (b)	10. (c)
11. (c)	12. (b)	13. (a)	14. (d)	15. (b)	16. (a)	17. (b)	18. (c)	19. (a)	20. (a)
21. (b)	22. (a)	23. (b)	24. (b)	25. (b)	26. (c)	27. (b)	28. (b)	29. (b)	30. (b)
31. (b)	32. (c)	33. (a)	34. (b)	35. (d)	36. (a)	37. (a)	38. (d)	39. (c)	40. (c)
41. (a)	42. (c)	43. (b)	44. (a)	45. (c)	46. (a)	47. (a)	48. (b)	49. (a)	50. (b)
51. (d)	52. (d)	53. (a)	54. (d)	55. (b)	56. (d)	57. (c)	58. (c)	59. (d)	60. (a)

Biology

1. (c)	2. (b)	3. (c)	4. (b)	5. (a)	6. (a)	7. (c)	8. (a)	9. (d)	10. (d)
11. (b)	12. (c)	13. (a)	14. (d)	15. (c)	16. (b)	17. (d)	18. (a)	19. (b)	20. (c)
21. (c)	22. (a)	23. (d)	24. (a)	25. (b)	26. (c)	27. (d)	28. (a)	29. (b)	30. (a)
31. (d)	32. (b)	33. (d)	34. (a)	35. (c)	36. (a)	37. (d)	38. (d)	39. (a)	40. (c)
41. (d)	42. (d)	43. (b)	44. (c)	45. (c)	46. (b)	47. (a)	48. (c)	49. (a)	50. (a)
51. (b)	52. (b)	53. (b)	54. (b)	55. (a)	56. (b)	57. (d)	58. (d)	59. (a)	60. (b)

English & Quantitative Reasoning

1. (a)	2. (b)	3. (c)	4. (a)	5. (b)	6. (c)	7. (b)	8. (e)	9. (c)	10. (b)
11. (c)	12. (c)	13. (c)	14. (d)	15. (b)	16. (b)	17. (a)	18. (d)	19. (b)	20. (b)

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Explanations

Physics

1. Given,

$$x = ae^{-\alpha t} + be^{\beta t}$$

We know that, velocity, $v = \frac{dx}{dt}$

$$\frac{d}{dt}(ae^{-\alpha t} + be^{\beta t})$$

$$= -a\alpha e^{-\alpha t} + b\beta e^{\beta t}$$

$$= A + B$$

where, $A = -a\alpha e^{-\alpha t}$, $B = b\beta e^{\beta t}$

The value of term $A = -a\alpha e^{-\alpha t}$ increases and of term $B = b\beta e^{-\beta t}$ increases with time. As a result, velocity goes on increasing with time.

2. Given, $P_{in} = 4.4\text{kW}$, $V_p = 220\text{V}$, $i_s = 5\text{A}$, $V_s = ?$

We know that, $i_P = \frac{P_{in}}{V_p} = \frac{4.4\times 10^3}{220} = 20\text{ A}$

$\therefore$ Efficiency, $\eta = \frac{\text{Output power}}{\text{Input power}}$

Percentage efficiency $\eta = \frac{P_{out}}{P_{in}} \times 100$

$$75\% = 100 \times \frac{P_{out}}{4.4\times 10^3}$$

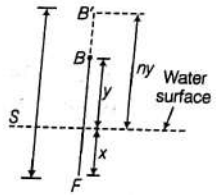
$$\therefore \quad P_{out} = \frac{75\times 4.4\times 10^3}{100}$$

$$= 3300\text{ W}$$

$$\therefore \quad P_{out} = V_S \cdot i_S$$

$$\Rightarrow \quad V_S = \frac{3300}{5} = 660\text{ V}$$

3.



$\because$ Velocity of bird w.r.t. fish,

$v_{B\to F} = 10$ m/s

and velocity of fish w.r.t. ground

$v_{F\to G} = 2$ m/s

$\therefore$ Distance between bird and fish, as seen by fish

$S = x + ny$

on differentiating w.r.t. time, we get

$$\frac{dS}{dt} = \frac{dx}{dt} + n\frac{dy}{dt}$$

$$v_{B\to F} = v_{F\to G} + n \cdot v_{B\to G}$$

$$\Rightarrow \quad 10 = 2 + \frac{4}{3} v_{B\to G}$$

$$\Rightarrow \quad v_{B\to G} = \frac{8}{4/3} = 6\text{ m/s}$$

4. $W_{A\to B}$ = Area under p-V diagram

$$= 4V_0 \times 3p_0 + \frac{1}{2} 4V_0 \times 3p_0 = 18p_0V_0$$

$$\therefore \quad \Delta U = nC_V\Delta T$$

$$= 1 \cdot \frac{3}{2} R\,(T_B - T_A)$$

$$= \frac{3}{2}R\left(\frac{30\,p_0V_0}{R} - \frac{3p_0V_0}{R}\right)$$

$$= \frac{81}{2} p_0V_0$$

Thus, $\Delta Q_{A\to B} = \Delta W_{A\to B} + \Delta U_{A\to B}$

$$= 18p_0V_0 + \frac{81}{2} p_0V_0 = \frac{117}{2} p_0V_0$$

$\therefore$ Molar heat capacity, $C = \frac{\Delta Q}{n\Delta T}$

$$= \frac{117\,p_0V_0/2}{\frac{30\,p_0V_0}{R} - \frac{3\,p_0V_0}{R}} = \frac{117\,p_0V_0/2}{\frac{27\,p_0V_0}{R}} = \frac{13R}{6}$$

5. Given, $T = 0.5$s,

We know that, $T = 2\pi\sqrt{\frac{m}{k}} \Rightarrow 0.5 = 2\pi\sqrt{\frac{m}{k}}$

$$\Rightarrow \quad \frac{1}{4\pi} = \sqrt{\frac{m}{k}}$$

On squaring both sides, we get

$$\frac{m}{k} = \frac{1}{16\pi^2} \qquad \ldots(i)$$

$$\Rightarrow \quad T + 0.1 = 2\pi\sqrt{\frac{m+m'}{k}}$$

$$\Rightarrow \quad 0.5 + 0.1 = 2\pi\sqrt{\frac{m+m'}{k}}$$

$$\Rightarrow \quad \left(\frac{0.6}{2\pi}\right)^2 = \frac{m+m'}{k} = \frac{m}{k} + \frac{m'}{k}$$

$$\Rightarrow \quad \left(\frac{0.6}{2\pi}\right)^2 = \frac{1}{16\pi^2} + \frac{m'}{k} \qquad \text{[using Eq. (i)]}$$

$$\Rightarrow \quad \frac{(0.6)^2}{4\pi^2} - \frac{1}{16\pi^2} = \frac{m'}{k}$$

$$\Rightarrow \quad \frac{m'}{k} = \frac{1.44-1}{16\pi^2} \Rightarrow \frac{m'}{k} = \frac{0.44}{16\pi^2} \qquad \ldots(ii)$$

$\because$ $m'g = kx$

$\therefore$ $x = \frac{m'}{k}g$

$$= \frac{0.44}{16\pi^2} \times 10 \qquad \text{[using Eq. (ii)]}$$

$$= 0.0279$$

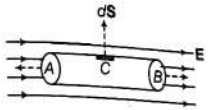
$$= 2.79\times 10^{-2}\text{ m}$$

$$= 2.7\text{ cm}$$

6. Flux through surface A,

$\phi_A = E \times \pi R^2$

$\phi_B = -E \times \pi R^2$



Flux through curved surface, $C = \int E \cdot dS$

$= \int E dS \cos 90^\circ = 0$

$\therefore$ Total flux through cylinder $= \phi_A + \phi_B + \phi_C = 0$

7. Given, $\mathbf{A} + \mathbf{B} = \mathbf{C}$

and $\mathbf{B} = \mathbf{C} - \mathbf{A}$

Since, $\mathbf{C} \perp \mathbf{A}$, therefore

$B^2 = C^2 + A^2$

Also, $|\mathbf{C}| = |\mathbf{A}|$, therefore

$B^2 = 2A^2 \Rightarrow B = \sqrt{2}\,A$

Now, $A^2 + B^2 + 2AB\cos\theta = C^2 = A^2$

$$\therefore \quad \cos\theta = -\frac{1}{\sqrt{2}}$$

This gives $\theta = \frac{3\pi}{4}$ rad

8. Given, electric field, $E_y = 600\frac{\text{V}}{\text{m}} \cdot \sin\omega\left(t - \frac{x}{c}\right)$ ...(i)

We know that,

$$E = E_0\sin\omega\left(t - \frac{x}{c}\right) \qquad \ldots(ii)$$

On comparing Eqs. (i) and (ii), we get

$E_0 = 600$ V/m and $C = 3\times 10^8$ m/s

Maximum magnetic field,

$$B_0 = \frac{E_0}{C}$$

$$B_0 = \frac{600}{3\times 10^8} = 2\times 10^{-6}\text{ T}$$

$$\therefore \quad F_m = qvB_0 = 2evB_0$$

$$= 2\times 1.6\times 10^{-19} \times 3\times 10^8 \times 2\times 10^{-6}$$

$$= 19.2\times 10^{-17}\text{ N}$$

9. Given, $r = 25$ cm $= 0.25$ m

$\omega = 13$ rad/s

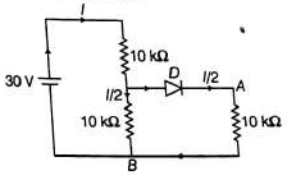
$\because$ Linear speed = Radius $\times$ Angular speed

or $v = r\omega$

$\therefore$ $= 0.25 \times 13$

$\Rightarrow$ $v = 3.25$ m/s

10.



Equivalent resistance, $R = 10 + \frac{10}{2} = 15\text{ k}\Omega$

$\therefore$ Current, $I = \frac{V}{R} = \frac{30}{15\times 10^3} = 2\times 10^{-3}\text{ A}$

Hence, potential difference between A and B,

$$V = \left(\frac{2\times 10^{-3}}{2}\right) \times 10\times 10^3 = 10\text{V}$$

11. Given, $T_{1/2} = 15$ yr

$N_0 = 12$ g

$N = 1.5$ g

$\therefore$ $N = N_0e^{-\lambda t}$

$\Rightarrow$ $e^{-\lambda t} = \frac{N}{N_0}$

$\Rightarrow$ $-\lambda t = \ln\left(\frac{N}{N_0}\right)$

$\Rightarrow$ $t = \frac{1}{\lambda}\ln\left(\frac{N_0}{N}\right) = \frac{T_{1/2}}{0.693}\ln\left(\frac{N_0}{N}\right)$

$\left[\because \lambda = \frac{0.693}{T_{1/2}}\right]$

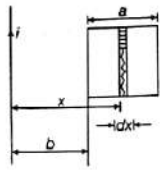
$$= \frac{15}{0.693} \times \ln\left(\frac{12}{1.5}\right)$$

$$= 45\text{ yr}$$

12. Magnetic field due to wire

$$B = \frac{\mu_0}{2\pi x} \cdot i$$

$dA = adx$



and $d\phi = B \cdot dA$

On integrating both sides, we get

$$\int d\phi = \int B\,dA$$

$$\Rightarrow \quad \phi = \frac{\mu_0 i}{2\pi}\int_b^{a+b}\frac{a\,dx}{x}$$

$$= \frac{\mu_0 i}{2\pi} a \ln x \Big|_b^{a+b}$$

$$= \frac{\mu_0 i}{2\pi} a\,[\ln(a+b) - \ln b]$$

$$= \frac{\mu_0 i}{2\pi} a\left[\ln\left(1+\frac{a}{b}\right)\right] = Mi$$

where, M = coefficient of mutual inductance

$$\therefore \quad M = \frac{\mu_0 a}{2\pi}\ln\left(1+\frac{a}{b}\right)$$

13. Given, $R = 100\,\Omega$, $V = 200$ V, $\theta = 60°$, $\omega = 300$ rad/s

$\therefore$ Phase angle, $\tan\theta = \dfrac{X_L}{R} = \dfrac{X_C}{R}$

$$\Rightarrow \quad \tan 60° = \frac{X_L}{R} = \frac{X_C}{R}$$

$$\therefore \quad X_L = X_C = \sqrt{3}\,R$$

i.e. $$Z = \sqrt{R^2 + (\sqrt{3}\,R - \sqrt{3}\,R)^2} = R$$

So, average power,

$$P = \frac{V^2}{R} = \frac{200 \times 200}{100} = 400\text{ W}$$

14. We know that, intensity, $I = 4I_0\cos^2\dfrac{\phi}{2}$

Case I $2I_0 = 4I_0\cos^2\dfrac{\phi}{2}$

$$\therefore \quad \phi = \frac{2\pi}{\lambda}\cdot\Delta x$$

$$\frac{\pi}{2} = \frac{2\pi}{\lambda}\cdot\frac{Yd}{D}\quad\left[\because \Delta x = \frac{Yd}{D}\text{ and }\phi = \frac{\pi}{2}\right]$$

$$\Rightarrow \quad Y_1 = \frac{\lambda D}{4d} \qquad ...(i)$$

Case II $I_0 = 4I_0\cdot\cos^2\dfrac{\phi}{2}$

$$\therefore \quad \phi = \frac{2\pi}{\lambda}\cdot\Delta x$$

$$\frac{2\pi}{3} = \frac{2\pi}{\lambda}\cdot\frac{Y_2 d}{D}\quad\left[\because \phi = \frac{2\pi}{3}\text{ and }\Delta x\,\frac{Y_2 d}{D}\right]$$

$$\therefore \quad Y_2 = \frac{\lambda D}{3d} \qquad ...(ii)$$

$$\therefore \quad \Delta Y = Y_2 - Y_1 = \frac{\lambda D}{3d} - \frac{\lambda D}{4d} = \frac{\lambda D}{12d}$$

$$\because \quad \frac{\lambda D}{d} = b \qquad \text{[given]}$$

$$\Delta Y = \frac{b}{12}$$

15. Given, initial temperature of metal rod $(T_1) = 145°$ C $= 418$ K

Rate of radiated energy $(E_1) = 17$ W

Final temperature $(T_2) = 273° \text{ C} = 273 + 273 = 546$ K

We know, from the Stefan's law, $E \propto T^4$

or $$\frac{E_1}{E_2} = \left(\frac{T_1}{T_2}\right)^4 = \left(\frac{418}{546}\right)^4$$

$$\therefore \quad \frac{E_1}{E_2} = 0.343$$

Therefore, final radiated energy, $E_2 = \dfrac{E_1}{0.343}$

$$= \frac{17}{0.343} = 49.6\text{ W}$$

16. As $W = \dfrac{1}{2}kx^2$

If both wires are stretched through same distance, then $W \propto k$.

It is given that $k_2 = \dfrac{k_1}{2}$

$$\therefore \quad \frac{W_1}{W_2} = \frac{k_1}{k_2}$$

$$= \frac{k_1}{\frac{k_1}{2}} = \frac{2}{1} = 2:1$$

17. Given, square wire of side = 2 cm,

$u = -20$ cm, $f = -10$ cm,

Area of second wire = ?

$$\therefore \quad \frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

$$\Rightarrow \quad \frac{1}{v} + \frac{1}{(-20)} = \frac{1}{-10} \Rightarrow \frac{1}{v} = -\frac{1}{10} + \frac{1}{20}$$

$$\Rightarrow \quad v = -20\text{ cm}$$

We know that, $m = -\dfrac{v}{u} = \dfrac{-(-20)}{-20} = -1$

$$\because \quad \frac{\text{Area of image}}{\text{Area of object}} = m^2 \Rightarrow \frac{A_i}{A_0} = (-1)^2$$

$$\frac{A_i}{2\times 2} = 1$$

$$\Rightarrow \quad A_i = 4\text{ cm}^2$$

18. Given, $S = 125$ J/kg - K

$\theta = 25°$ C, $\theta = 300°$ C, $m = 2.5 \times 10^4$ J/kg, then

$$\frac{1}{2}mv^2 \times \frac{1}{2} = mS\Delta\theta + mL$$

$$\Rightarrow \quad \frac{v^2}{4} = 125\,(300 - 25) + 2.5 \times 10^4$$

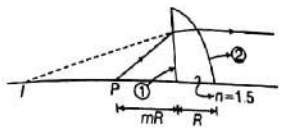
$$\Rightarrow \quad \frac{v^2}{4} = 59375$$

$$\Rightarrow \quad v^2 = 59375 \times 4$$

$$\Rightarrow \quad v = \sqrt{237500} \Rightarrow v = 487.3\text{ m/s}$$

$$\Rightarrow \quad = 490\text{ m/s}$$

19.



Refraction at plane surface (1),

$n_1 = 1, n_2 = 1.5 = \dfrac{3}{2}, u = -mR, v = ?$

Using formula, $\dfrac{n_2}{v} - \dfrac{n_1}{u} = \dfrac{n_2 - n_1}{R}$

$\because$ $R = \infty$ for plane surface.

$$\therefore \frac{3/2}{v} - \frac{1}{(-mR)} = 0$$

$$\therefore \quad v = -\frac{3}{2}mR$$

Refraction at spherical surface (2)

$u = -\left(\dfrac{3}{2}mR + R\right)$ and $R = -R, v = \infty$,

$n_1 = \dfrac{3}{2}, n_2 = 1$

$$\frac{1}{\infty} - \frac{3/2}{\left[-\left(\frac{3}{2}mR + R\right)\right]} = \frac{1 - 3/2}{-R}$$

$$\Rightarrow \quad \frac{3/2}{\frac{R(3m+2)}{2}} = \frac{1/2}{R}$$

$$\Rightarrow \quad \frac{6}{3m+2} = 1 \Rightarrow 3m + 2 = 6$$

$$m = \frac{4}{3}$$

20. According to Einstein photoelectric equation,

$$E = K_{max} + \phi$$

$$\frac{hc}{\lambda} = \phi + eV_S$$

$$\therefore \quad V_S = \left[\frac{hc}{\lambda} - \phi\right]\frac{1}{e}$$

V_S versus $\dfrac{1}{\lambda}$ graph is a straight line.

Slope, $$\tan\theta = \frac{hc}{e}$$

The curves intersect the $\dfrac{1}{\lambda}$ axis, where V_S is zero

$$\therefore \quad \frac{hc}{\lambda} - \phi = 0$$

$$\Rightarrow \quad \frac{1}{\lambda} = \frac{\phi}{hc}$$

For metal 1	For metal 2	For metal 3
$\dfrac{\phi_1}{hc} = 0.001$	$\dfrac{\phi_2}{hc} = 0.002$	$\dfrac{\phi_3}{hc} = 0.004$

$$\therefore \quad \phi_1\ \phi_2\ \phi_3 = 1\ 2\ 4$$

For metal 2, threshold wavelength,

$$\lambda_{o_2} = \frac{hc}{\phi} = \frac{1}{0.002} = 500\text{ nm}$$

Similarly, $\lambda_{o_3} = 250$ nm

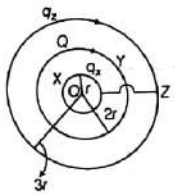
$\lambda_{violet} = 400$ nm So $\lambda_{violet} < \lambda_{threshold}$ for metal 1, $\lambda_{violet} > \lambda_{threshold}$ for metal 3

Thus, violet light will eject photoelectron for metal 2 and not metal 3.

21. Let charges on X and Z be q_X and q_Z

By conservation of charge,

$$q_X + q_Z = 0 \Rightarrow q_Z = -q_X$$



$$\therefore \quad V_X = \frac{1}{4\pi\varepsilon_0}\left[\frac{q_X}{r} + \frac{Q}{2r} + \frac{q_Z}{3r}\right]$$

$$V_Z = \frac{1}{4\pi\varepsilon_0}\left[\frac{q_X}{3r} + \frac{Q}{3r} + \frac{q_Z}{3r}\right]$$

Since, X and Z are connected.

$$\therefore \quad V_X = V_Z$$

$$\Rightarrow \quad \frac{q_X}{r} + \frac{Q}{2r} + \frac{q_Z}{3r} = \frac{q_X}{3r} + \frac{Q}{3r} + \frac{q_Z}{3r}$$

$$\Rightarrow \quad \frac{2q_X}{3} = \frac{-Q}{6}$$

$$\therefore \quad q_X = \frac{-Q}{4}$$

$$\because \quad q_X + q_Z = 0 \Rightarrow q_Z = -q_X$$

$$= \frac{Q}{4}$$

22. Given, $T_1 = 27°C = 300\,K$

$T_2 = 927°C = 1200\,K$

$$v_{rms} = \sqrt{\left(\frac{3kT}{m}\right)}$$

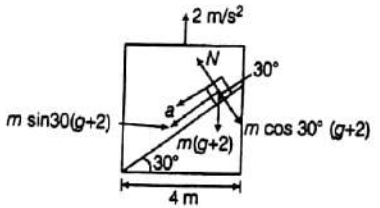
$$\Rightarrow \quad v_{rms} \propto \sqrt{T}$$

$$\therefore \quad \frac{(v_{rms})_1}{(v_{rms})_2} = \sqrt{\frac{T_1}{T_2}}$$

$$\frac{(v_{rms})_1}{(v_{rms})_2} = \sqrt{\frac{300}{1200}} = \frac{1}{2}$$

$$\Rightarrow \quad (v_{rms})_2 = 2\,(v_{rms})_1$$

23.



In the frame of elevator,

a = acceleration of the particle with respect to the elevator

$\therefore \quad m \sin 30\,(g + 2) = ma$

$$a = (g + 2)\sin 30°$$

$$= (10 + 2)\cdot\frac{1}{2}$$

$$= 6\ m/s^2$$

$\therefore$ The distance travelled by the particle from the top to the bottom,

$$d = \frac{4}{\cos 30°} = \frac{4}{\sqrt{3}/2} = \frac{8\sqrt{3}}{3}\ m$$

Using $s = ut + \frac{1}{2}at^2$,

$$\frac{8\sqrt{3}}{3} = 0 \times t + \frac{1}{2}6t^2$$

$$\Rightarrow \quad t^2 = \frac{16\sqrt{3}}{3 \times 6}$$

$$\therefore \quad t = \frac{4}{3}\sqrt{\frac{\sqrt{3}}{2}}\ s$$

24. We know that, $H_1 = \dfrac{u^2 \sin^2\theta}{2g}$

and $\quad H_2 = \dfrac{u^2 \sin^2(90 - \theta)}{2g}$

$$\Rightarrow \quad H_2 = \frac{u^2 \cos^2\theta}{2g}$$

$$\because \quad H_1H_2 = \frac{u^2 \sin^2\theta}{2g} \times \frac{u^2 \cos^2\theta}{2g}$$

$$= \frac{4}{4} \times \frac{U^2 \sin^2\theta}{2g} \times \frac{U^2 \cos^2\theta}{2g}$$

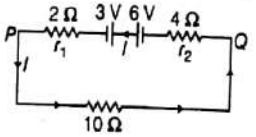
$$= \frac{(u^2 \sin 2\theta)^2}{16\,g^2} \qquad [\because \sin^2\theta = 2\sin\theta\cos\theta]$$

$$= \frac{R^2}{16}$$

$$R^2 = 6H_1H_2$$

$$\therefore \quad R = 4\sqrt{H_1H_2}$$

25. Applying Kirchhoff's voltage law in the given loop,



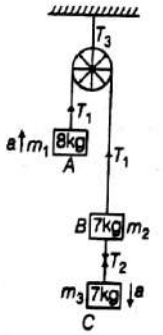
$$-4I + 6 - 3 - 2I - 10I = 0$$

$$-16I = -3$$

$$I = \frac{3}{16}\ A$$

$\because$ Potential difference across $PQ = \dfrac{3}{16} \times 10 = \dfrac{15}{8}\ V$

26. From free body diagram of body A,



$$m_1a = T_1 - m_1g \qquad ...(i)$$

For body B,

$$m_2a = m_2g + T_2 - T_1 \qquad ...(ii)$$

For body C,

$$m_3a = m_3g - T_2 \qquad ...(iii)$$

On solving Eqs. (i), (ii) and (iii), we get

$$a = \frac{[(m_2 + m_3) - m_1]\,g}{m_1 + m_2 + m_3}$$

As, $\quad m_1 = 8\ kg,\ m_2 = m_3 = 7\ kg$

$$a = \frac{6}{22}g = 0.27\,g$$

27. Problems of series and parallel combination of pipes can be solved in the similar manner as is done in case of an electrical circuit. The only difference is potential difference is replaced by Δp and electrical resistance as, $R_1 = \dfrac{8\eta L}{\pi r^4} = R$

and $\quad R_2 = \dfrac{8\eta L}{\pi\left(\frac{r}{2}\right)^4} = 16R$

Electric current is replaced by rate of volume flow V'.

$$\Rightarrow \quad p = VR_1 = VR$$

$$p' = p = V'R_{eq} = V'(R_1 + R_2) = V'(R + 16R) \qquad ...(i)$$

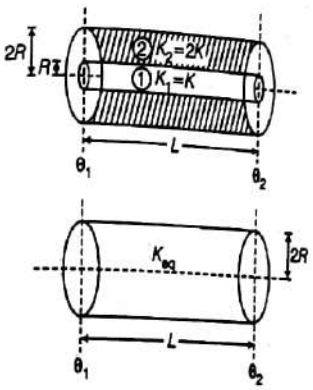
$$= 17\,V'R$$

From Eqs. (i) and (ii), we get ...(ii)

$$VR = 17\,V'R$$

$$\Rightarrow \quad V' = \frac{V}{17}$$

28.



$$\therefore \quad R_1 = \frac{L}{K_1 \cdot \pi R^2}$$

and $\quad R_2 = \dfrac{L}{K_2(4\pi R^2 - \pi R^2)} = \dfrac{L}{3K_2\pi R^2}$

$$R_{eq} = \frac{L}{K_{eq} \cdot 4\pi R^2}$$

R_1 and R_2 are in parallel.

$$\therefore \quad \frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\Rightarrow \quad \frac{4\pi R^2 K_{eq}}{L} = \frac{\pi R^2 K_1}{L} + \frac{3\pi R^2 K_2}{L}$$

$$\Rightarrow \quad 4K_{eq} = K_1 + 3K_2$$

On putting values of K_1 and K_2, we get

$$4K_{eq} = K + 3(2K) \qquad [\because K_1 = K, K_2 = 2K]$$

$$K_{eq} = \frac{K + 6K}{4} = \frac{7K}{4}$$

29. Given, $\lambda = 500\ nm = 500 \times 10^{-9}\ m$,

As, $\quad P = n_0\dfrac{hc}{\lambda}$

$$n_0 = \frac{P\lambda}{hc} \qquad ...(i)$$

where, n_0 is number of photons per second

At distance r from point source, number of photons/area/time

$$n' = \frac{n_0}{4\pi r^2} = \frac{P\lambda}{hc \cdot 4\pi r^2} \qquad [\text{from Eq. (i)}]$$

$$= \frac{10 \times 500 \times 10^{-9}}{6.6 \times 10^{-34} \times 3 \times 10^8 \times 4\pi\,(3)^2}$$

$$= 2.23 \times 10^{17}/m^2 \cdot s$$

30. Mass of proton = mass of anti-proton

$$= 1.67 \times 10^{-27}\ kg = 1\ amu$$

Energy equivalent to 1 amu = 931 MeV.

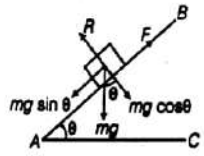
So, energy equivalent to 2 amu = 2 × 931 MeV

$$= 1862 \times 10^6 \times 1.6 \times 10^{-19}$$

$$= 2.97 \times 10^{-10}\ J$$

$$= 3 \times 10^{-10}\ J$$

31. When a plane is inclined to the horizontal at an angle θ, which is greater than the angle of repose, then the body placed on the inclined plane slides down with an acceleration a.



From figure,

$$R = mg\cos\theta \qquad ...(i)$$

Net force on the body down the inclined plane

$$f = mg\sin\theta - F \qquad ...(ii)$$

i.e. $\quad f = ma = mg\sin\theta - \mu R \qquad \left[\because \mu = \dfrac{F}{R}\right]$

$$\therefore \quad ma = mg\sin\theta - \mu\,mg\cos\theta \qquad [\text{from Eq. (i)}]$$

$$= mg\,(\sin\theta - \mu\cos\theta)$$

$$\Rightarrow \quad a = g(\sin\theta - \mu\cos\theta)$$

Time taken by the body to slide down the plane

$$t_1 = \sqrt{\frac{2s}{a}} = \sqrt{\frac{2s}{(g\sin\theta - \mu g\cos\theta)}}$$

$$t_2 = \sqrt{\frac{2s}{g\sin\theta}} \qquad [\text{in absence of friction}]$$

$$\because \quad t_1 = 2t_2$$

$$\Rightarrow \quad t_1^2 = 4t_2^2 \qquad [\text{given}]$$

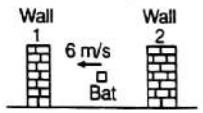
$$\left|\sqrt{\frac{2s}{(g\sin\theta-\mu g\cos\theta)}}\right|^2 = 4\times\left|\sqrt{\frac{2s}{g\sin\theta}}\right|^2$$

$$\Rightarrow \quad \frac{2s}{g(\sin\theta-\mu\cos\theta)} = 4\times\frac{2s}{g\sin\theta}$$

$$\Rightarrow \quad \sin\theta = 4\sin\theta - 4\mu\cos\theta$$

$$\Rightarrow \quad \mu = \frac{3}{4}\tan\theta = \frac{3}{4}\tan 30^\circ = 0.43$$

32.



Frequency received by bat after reflection from wall (1),

$$f_1 = f\left[\frac{v+u}{v-u}\right]$$

$$= 4.5\times 10^4\left[\frac{330+6}{330-6}\right]$$

[given, $f = 4.5\times 10^4$ Hz]

$$= 4.67\times 10^4 \text{ Hz}$$

Frequency received by bat after reflection from wall (2),

$$f_2 = f\left[\frac{v-u}{v+u}\right]$$

$$= 4.5\times 10^4\left[\frac{330-6}{300+6}\right]$$

$$= 4.34\times 10^4 \text{ Hz}$$

33. Given, $q_1 = +7g\mu C = +7\times 10^{-6}C$

$q_2 = -5\,\mu C = -5\times 10^{-6}C$

New force $F' = ?$

We know that, $F = \frac{1}{4\pi\varepsilon_0}\cdot\frac{q_1q_2}{r^2}$

$$F = \frac{1}{4\pi\varepsilon_0}\frac{(+7\times 10^{-6})(-5\times 10^{-6})}{r^2}$$

$$= -\frac{1}{4\pi\varepsilon_0}\frac{35\times 10^{-12}}{r^2}\text{N}$$

$$F' = \frac{1}{4\pi\varepsilon_0}\frac{(+5\times 10^{-6})(-7\times 10^{-6})}{r^2}$$

$$= -\frac{1}{4\pi\varepsilon_0}\frac{35\times 10^{-12}}{r^2}\text{N}$$

$$\Rightarrow \quad F' = F$$

34. Given, $l = 1.2$ m, $d = 0.8$ cm,

$R = 3.5\times 10^{-3}\Omega$, thickness = 1.25 mm,

Resistivity of the material of the rod

$$\rho = \frac{RA}{l} = \frac{3.5\times 10^{-3}\times\pi(0.4\times 10^{-2})^2}{1.2}$$

$$= 46.6\times 10^{-9}\,\pi\,\Omega\,\text{m}$$

Resistance of disc, $R = \frac{\rho\,(\text{Thickness})}{\text{Area of cross-section}}$

$$= \frac{46.6\times 10^{-9}\pi\times(1.25\times 10^{-3})}{\pi\,(1\times 10^{-2})^2}$$

$$= 5.82\times 10^{-7}\Omega$$

35. Given, $u = 10\,\text{ms}^{-1}$, $s = 12$ m, $v = 0$

By third equation of motion,

$$v^2 = u^2 - 2as$$

$$0 = (10)^2 - 2\times a\times 12$$

$$24a = 100$$

$$a = 4.17\,\text{ms}^{-2}$$

Coefficient of sliding friction is given by

$$\mu = \frac{a}{g} = \frac{4.17}{10} = 0.41$$

36. Given, $m = 10$, length of telescope = 1.1 m

We know that,

Magnification, $m = \frac{f_o}{f_e}$

$$10 = \frac{f_o}{f_e}$$

$$f_o = 10f_e$$

$$\because \quad f_e + f_o = 1.1\text{ m}$$

$$\Rightarrow \quad f_e + 10f_e = 1.1\text{ m} \qquad [\because f_o = 10f_e]$$

$$\Rightarrow \quad f_e(1+10) = 1.1\text{ m}$$

$$\Rightarrow \quad f_e = 0.1\text{ m or } 10\text{ cm}$$

Magnification least distance of distinct vision,

$$M_b = \frac{f_o}{f_e}\left(1+\frac{f_e}{D}\right)$$

$$= 10\left(1+\frac{10}{25}\right) \qquad [\because D = 25\text{cm}]$$

$$= 10\times\frac{35}{25}$$

$$= 14$$

37. $B = \frac{\mu_0 Ni\,R^2}{2(R^2+x^2)^{3/2}}$

$$= \frac{\mu_0 Ni}{2R}\cdot\frac{1}{\left[1+\frac{x^2}{R^2}\right]^{3/2}}$$

$$= B_C\cdot\frac{1}{\left(1+\frac{x^2}{R^2}\right)^{3/2}} \qquad \left[\text{Let } B_C = \frac{\mu_0 Ni}{2R}\right]$$

$$\Rightarrow \quad \frac{B_C}{8} = \frac{B_C}{\left(1+\frac{x^2}{R^2}\right)^{3/2}} \qquad \left[\because B = \frac{B_C}{8}\right]$$

$$\Rightarrow \quad \left(1+\frac{x^2}{R^2}\right)^{3/2} = 8$$

$$\Rightarrow \quad 1+\frac{x^2}{R^2} = 4$$

$$\Rightarrow \quad \frac{x^2}{R^2} = 3$$

$$\therefore \quad x = R\sqrt{3}$$

38. Given, $\lambda_1 = 6000$ Å,

$\lambda_2 = ?$

Angular width of central maximum $= \frac{2\lambda}{a}$

$$\theta_1 = \frac{2\lambda_1}{a} \qquad \ldots(i)$$

and $\quad \theta_2 = \frac{2\lambda_2}{a}$

$$\because \quad \theta_2 = \theta_1\times 0.7$$

$$\therefore \quad \theta_1\times 0.7 = \frac{2\lambda_2}{a} \qquad \ldots(ii)$$

From Eqs. (i) and (ii), we get

$$\frac{1}{0.7} = \frac{\lambda_1}{\lambda_2}$$

$$\Rightarrow \quad \lambda_2 = \lambda_1\times 0.7 = 6000\times 0.7$$

$$= 4200\text{ Å}$$

When immersed in liquid,

$$\lambda_2 = \frac{\lambda_1}{\mu}$$

$$\because \quad \theta_2 = \theta_1\times 0.7$$

$$\Rightarrow \quad \frac{2\lambda_2}{a} = \frac{2\lambda_1}{a}\times 0.7 \qquad \left[\because \lambda_2 = \frac{\lambda_1}{\mu}\right]$$

$$\Rightarrow \quad \frac{2\lambda_1/\mu}{a} = \frac{2\lambda_1}{a}\times 0.7$$

$$\Rightarrow \quad \frac{1}{\mu} = 0.7 \Rightarrow \mu = 1.42$$

39. Given, $n_1 = 2$, $n_2 = 3$ and $\Delta E = 68$ eV

The difference in energies of two orbits

$$\Delta E = 13.6\,Z^2\left[\frac{1}{n_1^2}-\frac{1}{n_2^2}\right]$$

where, $n_1 < n_2$

$$68 = 13.6\,Z^2\left[\frac{1}{2^2}-\frac{1}{3^2}\right]$$

$$= 13.6\,Z^2\left[\frac{1}{4}-\frac{1}{9}\right]$$

$$= 13.6\,Z^2\left[\frac{9-4}{36}\right]$$

$$= 13.6\,Z^2\times\frac{5}{36}$$

$$\therefore \quad Z^2 = \frac{68\times 36}{13.6\times 5} = 36$$

$$Z = 6$$

$\because$ Wavelength of photon, $\frac{1}{\lambda} = Z^2R\left[\frac{1}{n_1^2}-\frac{1}{n_2^2}\right]$

$n_1 = 1$ and $n_2 = \infty$

$$\frac{1}{\lambda} = 6^2\times R\left[\frac{1}{1^2}-\frac{1}{\infty}\right] = 36R$$

$$\therefore \quad \lambda = \frac{1}{36R} = \frac{1}{36\times 1.097\times 10^7}$$

$$= \frac{10^{-7}}{39.5}\text{m}$$

$$= 0.025\times 10^{-7}\text{ m}$$

$$= 2.5\text{ nm}$$

40. As we know that, potential energy of a magnet in a magnetic field

$$U = -\mathbf{m}\cdot\mathbf{B}$$

$$= -mB\cos\theta$$

where, m = magnetic dipole moment of the magnet

B = magnetic field

Case I $\theta = 180^\circ$

$$\therefore \quad U_1 = -mB\cdot\cos 180^\circ$$

$$= mB \qquad [\because \cos 180^\circ = -1]$$

Case II $\theta = 90^\circ$

$$U_2 = 0 \qquad [\because \cos 90^\circ = 0]$$

Case III θ is acute angle

$$\theta\in(0, 90^\circ)$$

$$\therefore \quad \cos\theta = \text{positive}$$

Thus, $\quad U_3 = \text{negative}$

Case IV θ is obtuse

$$\theta\in(90^\circ, 180^\circ)$$

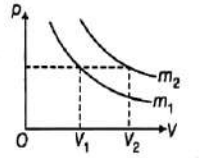
$$\therefore \quad \cos\in(0, -1)$$

Thus, $\quad U_4 = \text{positive}$

Therefore, decreasing order of PE is

$$I > IV > II > III$$

41.



$$\because \quad pV = nRT = \frac{m}{M}RT$$

For m_1, $\quad p = \frac{m_1}{M}\cdot\frac{RT}{V_1}$ ...(i)

For m_2, $\quad p = \frac{m_2}{M}\cdot\frac{RT}{V_2}$ ...(ii)

From Eqs. (i) and (ii), we get

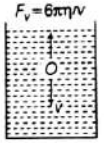
$$\frac{m_1}{M}\cdot\frac{RT}{V_1}=\frac{m_2}{M}\cdot\frac{RT}{V_2}\Rightarrow\frac{m_1}{V_1}=\frac{m_2}{V_2}$$

Thus, $V\propto m$

$\because$ $V_2>V_1$

$\therefore$ $m_2>m_1$

42. Given, $i=10^{-4}$ A, $t=1\text{ h}=3600$ s



We know that, $q=it$

$=10^{-4}\times1\times3600=0.36$ C

$\therefore$ Number of protons $=\frac{q}{e}=\frac{0.36}{1.6\times10^{-19}}$ $[\because e=1.6\times10^{-19}\text{C}]$

$=2.25\times10^{18}$

Number of ^{7}Be nuclei produced

$$=\frac{2.25\times10^{18}}{1000}=2.25\times10^{15}$$

Activity of ^{7}Be $=1.8\times10^8$ disintegration/s

$\therefore$ Activity, $A=\lambda N$

$$=\frac{\ln 2}{t_{1/2}}N \qquad \left[\because\lambda=\frac{\ln 2}{t_{1/2}}\right]$$

$$1.8\times10^8=\frac{0.693}{t_{1/2}}\times2.25\times10^{15}$$

$\therefore$ $$t_{1/2}=\frac{0.693\times2.25\times10^{15}}{1.8\times10^8}=0.87\times10^7\text{ s}$$

43. When a battery is applied across A and B, then the points b and c will be at the same potential $(\because C_1=C_4=C_3=C_5=4\,\mu\text{F})$

Therefore, no charge flows through C_2.

As, C_1 and C_5 are in series.

$\therefore$ Their equivalent capacitance,

$$C'=\frac{C_1\times C_5}{C_1+C_5}=\frac{4\times4}{4+4}=2\,\mu\text{F}$$

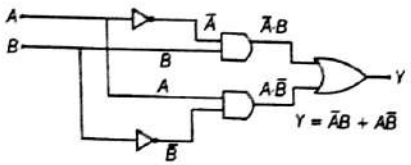
Similarly, C_4 and C_3 are in series. Therefore, their equivalent capacitance

$$C''=\frac{C_3\times C_4}{C_3+C_4}=\frac{4\times4}{4+4}=2\,\mu\text{F}$$

Now, C' and C'' are in parallel. Therefore, effective capacitance between A and B

$=C'+C''=2+2=4\,\mu\text{F}$

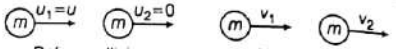
44.



The truth table for the given logic circuit is

A	B	$\bar{A}$	$\bar{B}$	$\bar{A}\cdot B$	$A\bar{B}$	$Y=\bar{A}B+A\bar{B}$
0	0	1	1	0	0	0
0	1	1	0	1	0	1
1	0	0	1	0	1	1
1	1	0	0	0	0	0

45.



Before collision After collision

As coefficient of restitution, $e=\frac{v_2-v_1}{u_1-u_2}=\frac{v_2-v_1}{u-0}$

$\Rightarrow$ $v_2-v_1=eu$ ...(i)

By conservation of momentum,

Momentum before collision = Momentum after collision

$mu=mv_1+mv_2$

$\Rightarrow$ $v_1+v_2=u$ ...(ii)

On solving Eqs. (i) and (ii), we get

$$v_1=\frac{u}{2}(1-e)\text{ and }v_2=\frac{u}{2}(1+e)$$

$\therefore$ $$\frac{v_1}{v_2}=\frac{1-e}{1+e}$$

46. Viscous force acting on spherical drop

$F_v=6\pi\eta rv$

$\therefore$ Terminal velocity, $v=\frac{2}{9}\frac{r^2(\sigma-\rho)g}{\eta}$

where, η = coefficient of viscosity of liquid

σ = density of material of spherical drop

ρ = density of liquid

Power imparted by viscous force

= Rate of production of heat

$$P=\frac{dH}{dt}=F_v\cdot v=6\pi\eta rv^2$$

$$=6\pi\eta r\cdot\left(\frac{2}{9}\frac{r^2(\sigma-\rho)g}{\eta}\right)^2$$

$\Rightarrow$ $$\frac{dH}{dt}\propto r^5$$

47. There are 20 divisions on scale.

Initially, current for 20 divisions $=\frac{2\times20}{5}=8$ mA

$\therefore$ $I_g=8$ mA

$\because$ $\frac{I_g}{I}=\frac{S}{S+G}$

$\Rightarrow$ $I=\left(\frac{S+G}{S}\right)I_g\Rightarrow I=\left(\frac{4+25}{4}\right)\times8$

$=29\times2=58$ mA

48. Induced emf is given by

$$e=-\frac{d\phi}{dt}$$

As, $$i=\frac{e}{R}=-\frac{1}{R}\frac{d\phi}{dt}$$

$\therefore$ Total charge induced $=\int i\,dt$

$$=-\int\frac{1}{R}\frac{d\phi}{dt}dt=-\frac{1}{R}\int_{\phi_1}^{\phi_2}d\phi$$

$$=\frac{1}{R}\int_{\phi_1}^{\phi_2}d\phi=\frac{1}{R}(\phi_1-\phi_2)$$

Thus, the induced charge in a conducting loop, moving in a magnetic field depends on the total change in magnetic flux.

49.



$\because$ $$x_{CM}=\frac{mL+2m\times2L+\ldots+nm\times nL}{m+2m+\ldots+nm}$$

$$=\frac{L(1^2+2^2+\ldots+n^2)}{(1+2+\ldots+n)}$$

$$=L\frac{\Sigma n^2}{\Sigma n}=L\frac{\frac{n(n+1)(2n+1)}{6}}{\frac{n(n+1)}{2}}$$

$$=\frac{(2n+1)L}{3}$$

50. If suppose initial length, $l_1=100$, then

$l_2=100+150=250$

$\because$ $$\frac{R_1}{R_2}=\left(\frac{l_1}{l_2}\right)^2=\left(\frac{100}{250}\right)^2$$

$\Rightarrow$ $$\frac{R_1}{R_2}=\frac{4}{25}\Rightarrow R_2=\frac{25}{4}R_1$$

$\Rightarrow$ $$\frac{\Delta R}{R}\times100=\frac{R_2-R_1}{R_1}\times100$$

$$=\frac{\frac{25}{4}R_1-R_1}{R_1}\times100=525\%$$

51. Given, $n=5000$ turns/m, $i=5$ A, $\chi_{Al}=2.3\times10^{-5}$, $B=?$

As, $B=\mu_0(H+I)$

where, $H=\frac{B_0}{\mu_0}=\frac{\mu_0 ni}{\mu_0}=ni$

$=5000\times5=2.5\times10^4$ A/m

and $I=\chi H=2.3\times10^{-5}\times2.5\times10^4$

$=0.575$ A/m

$\therefore$ $B=\mu_0(H+I)$

$=4\pi\times10^{-7}(2.5\times10^4+0.575)$ T

$=0.031$ T

52. Kinetic energy of rotation is

$$K_{rot}=\frac{1}{2}I\omega^2=\frac{1}{2}MK^2\frac{v^2}{R^2}$$

where, k is radius of gyration.

Kinetic energy of translation is $K_{trans}=\frac{1}{2}Mv^2$

Thus, total energy,

$$E=K_{rot}+K_{trans}$$

$$=\frac{1}{2}MK^2\frac{v^2}{R^2}+\frac{1}{2}Mv^2$$

$$=\frac{1}{2}Mv^2\left(\frac{K^2}{R^2}+1\right)$$

$$=\frac{1}{2}\frac{Mv^2}{R^2}(K^2+R^2)$$

Hence, $$\frac{K_{rot}}{\text{Total energy, }E}=\frac{\frac{1}{2}MK^2\frac{v^2}{R^2}}{\frac{1}{2}\frac{Mv^2}{R^2}(K^2+R^2)}$$

$$=\frac{K^2}{K^2+R^2}$$

53. As, we know that $q=q_0e^{-t/\tau}$

According to the question, $V_C=\frac{q}{C}=\frac{q_0}{C}e^{-t/\tau}$

$$\frac{q_0}{10}=\frac{q_0}{C}e^{-t/\tau}$$

$\Rightarrow$ $$e^{t/\tau}=\frac{10}{9}$$

$\Rightarrow$ $$t=\tau\ln\frac{10}{9}$$

54. Potential energy, $U=-\frac{GMm}{r}=\frac{-2GMm}{r}$ $[\because m=2m]$

At earth's surface, $r=R$

$\therefore$ $$U_e=-\frac{2GMm}{R}$$

Now, if a body is taken to height, $h=4R$, then the potential energy is given by

$$U_h=-\frac{2GMm}{R+h} \qquad [\because r=h+R]$$

$$=\frac{-2GMm}{5R}$$

Thus, change in gravitational potential energy,

$$\Delta U=U_h-U_e$$

$$=-\frac{2GMm}{5R}+\frac{2GMm}{R}=\frac{8}{5}\frac{GMm}{R}$$

$\therefore$ $$\Delta U=\frac{8}{5}\frac{gR^2m}{R} \qquad [\because GM=gR^2]$$

$$=\frac{8}{5}mgR$$

55. For isothermal process pV = constant

$$\Rightarrow \quad \left(\frac{dp}{dV}\right) = -\frac{p}{V} = \text{slope of isothermal curve}$$

For adiabatic process, pV^{γ} = constant

$$\Rightarrow \quad \left(\frac{dp}{dV}\right) = -\frac{\gamma p}{V} = \text{slope of adiabatic curve}$$

Clearly, $\left(\frac{dp}{dV}\right)_{adiabatic} = \gamma \left(\frac{dp}{dV}\right)_{isothermal}$

56. When solid sphere rolls down on an inclined plane, then it has both rotational and translational kinetic energy

$$K = K_{rot} + K_{trans}$$

or $$K = \frac{1}{2} I\omega^2 + \frac{1}{2} Mv^2$$

where, I = moment of inertia of solid sphere $= \frac{2}{5} MR^2$

$$\therefore \quad K = \frac{1}{2}\left(\frac{2}{5} M (2R)^2\right)\omega^2 + \frac{1}{2} Mv^2 \qquad [\because R = 2R]$$

$$= \frac{4}{5} MR^2 \left(\frac{v}{2R}\right)^2 + \frac{7}{2} Mv^2 \qquad [\because v = r\omega]$$

$$= \frac{1}{5} Mv^2 + \frac{1}{2} Mv^2 = \frac{1}{10} Mv^2$$

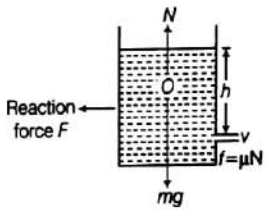
Now, gain in KE = loss in PE

$$\frac{7}{10} Mv^2 = Mgh$$

$$v = \sqrt{\frac{10}{7} gh}$$

57. Given, $\rho = 800\ kg/m^3$,

$h = 3\ m, \mu = 0.5, m = 95\ kg, d_{min} = ?$



Let area of hole be a

$\therefore$ Reaction force, $F = \rho a v^2 = \rho a \cdot 2gh \qquad [\because v = \sqrt{2gh}]$

and $$f_{max} = \mu N = \mu mg$$

$$F \geq f_{max}$$

$$2\rho agh \geq \mu mg$$

$$a \geq \frac{\mu m}{2\rho h} = \frac{0.5 \times 95}{2 \times 800 \times 3} = 0.009$$

$$\pi r^2 \geq 0.009$$

$$r \geq \sqrt{\frac{0.009}{\pi}}$$

$$r_{min} = 0.0535\ m$$

$$d_{min} = 2r_{min} = 2 \times 0.0535 = 0.107\ m$$

58. Given, $\beta = 50, R = 2\ k\Omega = 2 \times 10^3 \Omega$,

$\Delta V_b = 0.02\ V$,

$i_c = ?$

Input current,

$$i_b = \frac{\Delta V_b}{R_b} = \frac{0.02}{2000} = 10^{-5}\ A$$

Also, current gain, $\beta = \frac{i_c}{i_b}$

$$\therefore \quad i_c = \beta i_b = 50 \times 10^{-5}\ A$$

$$= 500 \times 10^{-6}\ A = 500\mu A$$

59. For isothermal process,

$$dU = 0$$

Work done $= dW = p(V_2 - V_1)$

$$\therefore \quad dW = +\ pV \qquad [\because V_2 = 2V_1 = 2V]$$

60. For prism 1,

$$\delta = \frac{\delta_B + \delta_R}{2} = \frac{12 + 8}{2} = 10$$

[given, $\delta_R = 8, \delta_B = 12$]

$$\therefore \quad \omega_1 = \frac{\delta_B - \delta_R}{\delta} = \frac{12 - 8}{10} = \frac{4}{10} = \frac{2}{5}$$

For prism 2,

$$\delta = \frac{\delta_B + \delta_R}{2} = \frac{14 + 10}{2} = 12$$

[given, $\delta_B = 14, \delta_R = 10$]

$$\therefore \quad \omega_2 = \frac{\delta_B - \delta_R}{\delta} = \frac{14 - 10}{12} = \frac{1}{3}$$

So, $$\frac{\omega_1}{\omega_2} = \frac{2/5}{1/3} = \frac{6}{5}$$

Chemistry

1. Given that,

$$p_1 = p, T_1 = t, V_1 = v$$

$$p_2 = p/2, V_2 = v/2, T_2 = ?$$

By using $\frac{p_1 V_1}{T_1} = \frac{p_2 V_2}{T_2}$

$$\frac{p \times V}{t} = \frac{p \times V}{2 \times 2 \times T_2} \Rightarrow T_2 = t/4$$

2. Number of waves $= \frac{\text{Circumeference of orbit}}{\text{de - Broglie wavelength of electron}}$

But, $$\lambda = \frac{h}{mv}$$

So, $$\lambda = \frac{2\pi r \times \mu}{h} = \frac{2\pi}{n} \times mvr$$

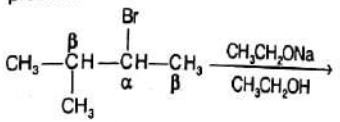
but $$mvr = \frac{nh}{2\pi} = \frac{2\pi}{h} \times \frac{nh}{2\pi}$$

$$mvr = n$$

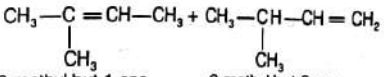
For second orbit, $n = 2$

$\therefore$ Number of waves = 2

3. When 2-methyl butyl bromide is treated with sodium ethoxide in ethanol, two alkenes are possible. The more substituted alkene, i.e. 2-methyl-2-butene is the major product.



2-methyl butyl bromide



3-methyl but-1-ene 2-methyl but-2-ene

4. The required neutralisation reaction is,

$$2NaHCO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O + 2CO_2$$

Mole ratio: 2 mole = 168 g; 1 mole = 98 g

m-moles of $H_2SO_4 = M \times V_{mL} = 40.0 \times 0.1 = 4$ m-mole

or m-moles of $NaHCO_3$ neutralised $= 4 \times 2 = 8$ m-mole

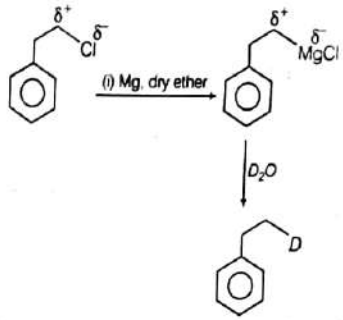
But, m-mole $= \frac{w}{m} \times 1000$

$$8 = \frac{w}{84} \times 1000$$

$$\Rightarrow \quad w = \frac{84 \times 8}{1000} \Rightarrow w = 0.672\ g$$

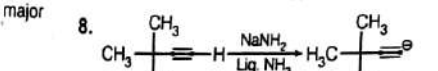
5. As boiling point is inversely proportional to vapour pressure. Hence, nitrobenzene having bp 212°C will show lowest vapour pressure at room temperature.

6.

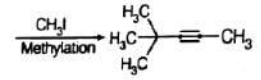


$\therefore$ 'A' is Mg, dry ether and D_2O.

7. The cleavage of ether (ROR) by a halogen hydracid is eventually a S_N2 type displacement where halide ion (X^-) acts as a nucleophile. Since, I^- is a very strong nucleophile compared to Cl^-, reaction easily occurs when HI is used and not by HCl.



8.



There are two electron donating groups present at the carbon of unsaturated part of product 'D', i.e. C≡C.

Those gropus are $-CH_3$ and $H_3C-\underset{CH_3}{\overset{CH_3}{|}}C-$

9. Work done in isothermal reversible process is

$$w = -2.303\ nRT \log_{10} \frac{p_1}{p_2}$$

Given, $n = 1, R = 2\ cal\ K^{-1}\ mol^{-1}$

$T = (27 + 273)\ K = 300\ K$

$p_1 = 2\ atm, p_2 = 10\ atm$

$$\therefore \quad w = -2.303 \times 1 \times 2 \times 300 \log_{10} \frac{2}{10}$$

$$w = +\ 965.54\ cal$$

For isothermal change, $\Delta U = 0$

Now, from first law of thermodynamics,

$$q = \Delta U - W = 0 - 965.84 \text{ cal}$$

$$q = -965.84 \text{ cal}$$

10. As π-bond is more activated, the addition of H_2SO_4 is carried out fastly.

In the given compound, 3-methyl but-1-ene. Undergoes rapid addition, because π-bond is activated by hyperconjugation and after addition the most stable 3°-carbocation is formed.

$$CH_2 = CH_2 \xrightarrow{H_2SO_4} CH_3-\overset{\oplus}{C}H_2$$

1°-carbocation

$$CH_3-CH = CH_2 \xrightarrow{H_2SO_4} CH_3-\overset{\oplus}{C}H_2-CH_3$$

2°-carbocation

$$\begin{array}{l} CH_3 \\ | \\ HC-CH = CH_2 \end{array} \xrightarrow{H_2SO_4} \begin{array}{l} CH_3 \\ | \\ HC-\overset{\oplus}{C}H-CH_3 \\ | \\ CH_3 \end{array}$$

$\downarrow$ 1, 2 — H^- shift

$$\begin{array}{l} H_3C-\overset{\oplus}{C}-CH_2-CH_3 \\ | \\ CH_3 \end{array}$$

3°-carbocation

$$CH_3-CH_2-CH = CH_2 \xrightarrow{H_2SO_4} CH_3-CH_2-\overset{\oplus}{C}H-CH_3$$

2°-carbocation

11. (a) Intermolecular van der Waals' force exists between atoms of noble gases. The magnitude of these forces increases with increasing atomic mass which directly related to boiling point.

(b) As ionisation energy of helium is maximum, thus, electrons are lightly held to the nucleus and therefore has least tendency to form compound.

(c) As valence shells of noble gases are complete, thus they do not show tendency to gain electrons. Therefore, they have zero electron affinity.

(d) As Xenon has lowest ionisation energy, they have maximum number of compounds.

12. For the given cell reaction,

$$E^\circ_{cell} = -0.14V + 0.13V = -0.01V$$

According to Nernst equation

$$E_{cell} = E^\circ_{cell} - \frac{0.0591}{2} \log \frac{[Pb^{2+}]}{[Sn^{2+}]}$$

$$\Rightarrow \quad 0 = -0.01 - \frac{0.0591}{2} \log \frac{[Pb^{2+}]}{[Sn^{2+}]}$$

$$\Rightarrow \quad \log \frac{[Pb^{2+}]}{[Sn^{2+}]} = \frac{0.01}{-0.0296} = -0.3$$

$$\Rightarrow \quad \frac{[Pb^{2+}]}{[Sn^{2+}]} = \text{antilog}(-0.3)$$

$$\Rightarrow \quad \frac{[Pb^{2+}]}{[Sn^{2+}]} = 0.5$$

13. As I^- is stronger reducing agent, i.e., reductant than Cl^- and reduces Cu^{2+} into CuI and itself is oxidised into I_2. Cl^- is not that much strong reducing agent and does not reduce Cu^{2+}.

Therefore, $[CuCl_4]^{2-}$ exists but $[CuCl_4]^{2-}$ does not.

14. $SnCl_2 + I_2 + 2HCl \longrightarrow SnCl_4 + 2HI$

'X'

$SnCl_2$ is an strong reducing agent because it is readily oxidised into Sn^{4+} ion.

Since, Sn-atom in $SnCl_2$ is sp^2-hybridised.

So, it is an angular molecule.

On the other hand, it is used as a reagent in test of Hg^{2+} radical.

15. In hcp arrangement of oxide ion.

Number of octabedral (oh) voids for each oxide ion = 1

Number of tetrahedral (Td) voids for each oxide ion = 2

Al^{3+} occupies only 2/3 of octahedral voids.

Thus, number of Al^{3+} for each oxide ion = 2 / 3

$\Rightarrow$ Ratio of oxide ion : Aluminium ion

$\Rightarrow 3 : 2$

Thus, formula is Al_2O_3.

16. Because of lesser energy difference between 5*f* and 6*d* orbitals than that between 4*f* and 5*d*-orbitals actinides exhibit larger number of oxidation state than that of corresponding lanthanides.

17. $AlCl_3$ is the salt of weak base and strong acid which renders H^+ ions on hydrolysis. Thus, aqueous solution of $AlCl_3$ is acidic in nature.

$$Al^{3+} + 3H_2O \rightleftharpoons Al(OH)_3 + 3H^+$$

On the other hand, NaCl is the salt of strong acid and strong base which does not undergo hydrolysis.

18. Ice melts at a temperature lower than its usual melting point because ice is less denser than water.

19. The values of standard electrode potentials for Mn, and Zn are more negative than expected. The reason behind this is that they have exactly half-filled and fully-filled configuration ons.

$$_{25}Mn: [Ar]_{18}\, 3d^5\, 4s^2$$

$$_{30}Zn: [Ar]\, 3d^{10}\, 4s^2$$

20. $2Cr + \frac{3}{2}O_2 \longrightarrow Cr_2O_3;\ \Delta_fG^\circ = -540 \text{ kJ mol}^{-1}$ ... (i)

$2Al + \frac{3}{2}O_2 \longrightarrow Al_2O_3;\ \Delta_fG^\circ = -827 \text{ kJ mol}^{-1}$ ... (ii)

Substrating equation (i) from (ii)

$$2Al + Cr_2O_3 \longrightarrow Al_2O_3 + 2Cr$$

$\Delta_fG = [-827 - (-540)]$ kJ mol^{-1} $= -287$ kJ mol^{-1}

because for the reduction by Al, value of ΔG° is negative, therefore reaction is feasible.

21. Due to gravity, barbell is lifted and hence work is done

22. $X = [Ti(H_2O)_6]^{4+}$, E·C of $Ti^{4+} = 3d^0$

$n = 0$

$\mu_B = 0$

$Y = [Mn(H_2O)_6]^{2+}$, E·C of $Mn^{+2} = 3d^5$

$n = 3$

$\mu_B = 3.87$ BM

$Z = [Cr(H_2O)_6]^{3+}$, E·C of $Cr^{3+} = 3d^3$

$n = 3$

$\mu_B = 3.87$ BM

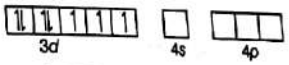
Hence, the correct order of magnetic moment of X, Y, Z is

$$X < Z < Y$$

23. Due to relatively smaller ionic radius and high polarising power, Be differs in properties from other elements of its own group. Polarising powers of Be^{2+} and Al^{3+} ions are almost the same, thus they show similarities in their properties.

24. At room temperature i.e., 25°C, two similar reactions have the same rate constant. But when this temperature increases to 10°C the rate constant becomes 2 to 3 times greater than other. This is happened because at higher temperature, activation energies of reacting molecules are different so that collisions be effective. Therefore, at different activation energies rate constant also become higher than initial one.

25. In $[Co(H_2O)_6]^{2+}$, there are three unpaired electrons present as,



$$\mu_{cal} = \sqrt{n(n+1)}\ BM = \sqrt{3(3+1)}\ BM = 3.87\ BM$$

As, the t_{2g} orbital is unsymmetrically filled hence due to orbital motion contribution, magnetic moment goes with the value 4.40 BM

26. The colour of solution is due to iodine present in it. When NaOH solution is added, it reacts with I_2 and solution becomes colourless.

$$I_2 + 2NaOH \longrightarrow NaI + NaIO + H_2O$$

$$3I_2 + 6NaOH \xrightarrow[\text{Hot}]{\text{Cold}} 5NaI + NaIO_3 + 3H_2O$$

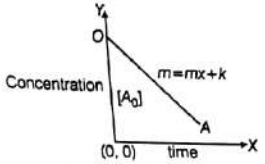
27. The equation is $[A_t] = [A_0] + Kt$

On comparing it with general straight line equation, $Y = mx + c$

Slope $(m) = +K$

intercept $(c) = [A_0]$

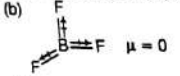
Therefore, the graph is



28. For NH_4^+; No. of V·E = 10

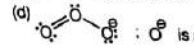
For CH_4; No. of V·E = 10

They are isoelectronic species.

(b) 

$\mu = 0$

(c) O — Cl — O does not follow octet rule.

(d)  : O^B is sp^2-hybridised

29. $CH_3(CH_2)_{10}CH_2OH \xrightarrow{H_2SO_4} CH_3(CH_2)_{10}CH_2OSO_3H$

Lauryl alcohol — Lauryl hydrogen sulphate

$\downarrow NaOH_{(aq)}$

$CH_3(CH_2)_{10}CH_2OSO_3Na$

Sodium lauryl sulphate (Anionic detergent)

30. Because tin is less reactive than iron, so when an iron object is plated with tin, it does not act as sacrificial anode in protecting against corrosion.

31. SO_2 : trigonal planar : three sp^2-hybride orbitals

CH_4 : tetrahedral : four sp^3-hybrid orbitals

SO_3 : trigonal planar : three sp^2-hybrid orbitals

C_2H_4 : trigonal planar : three sp^2-hybrid orbitals

BF_3 : trigonal planar : three sp^2-hybrid orbitals

SF_4 : irregular tetrahedral : five sp^3d-hybrid orbitals

I_3^- L linear five sp^3d-hybrid orbitals

32. H—H + X—X $\longrightarrow$ 2HX, where X = halogen.

The correct decreasing order of reactivity of halogen molecule towards H_2 is $F_2 > Cl_2 > Br_2 > I_2$.

33. According to the applications of electrochemical series on moving from top to bottom in electrochemical series, the values of E°_{Red} of metals decrease, and thus reactivity of metals of E°_{Red} indicates greater reactivity of metal. On the other hand, F^- is poor reductant while Cu^{2+} is strong oxidant.

The metals placed above Mg in ECS decompose water at ordinary temperature to liberate H_2. Oxides of Hg decomposes on heating.

34. We have the formula for pH

$$pH = -\log K_a + \log\frac{[Salt]}{[Base]}$$

$$[Salt] = \frac{3\times 1000}{82\times 100}\ mol\ L^{-1}$$

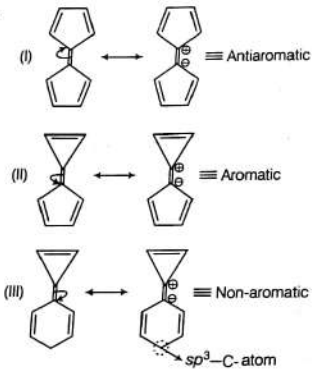
and $$[Acid] = \frac{2\times 1000}{60\times 100}\ mol\ L^{-1}$$

$$pH = -\log 1.8\times 10^{-5} + \log\frac{\frac{3\times 1000}{82\times 100}}{\frac{2\times 1000}{60\times 100}}$$

$$pH = 4.7851$$

Therefore, this solution is acidic in nature.

35.



Hence,

Dipole moment decreases as II > III > I

Stability = II > III > I

Reverse is correct for reactivity.

36. According to Langmuir adsorption isotherm the amount of gas adsorbed at very high pressure reaches a constant limiting value.

37. Since, $K_1 > K_2$, the product in the first reaction is much more favoured than in the second one. Mg thus removes more Cu^{2+} from solution than Fe does.

38. $CH_3OH \xrightarrow[S_N2]{HBr} CH_3Br\ (A) \xrightarrow[S_N2]{KCN}$

$CH_3CN\ (B) \xrightarrow[\text{Reduction}]{H_2/Ni} CH_3CH_2NH_2\ (C) \xrightarrow{HNO_2} CH_3CH_2OH\ (D)$

Diazotisation followed by hydrolysis

We can see in this reaction sequence that '*D*' is ethyl alcohol which consists of one carbon atom more than methyl alcohol, the starting alcohol.

Product '*B*', i.e., CH_3CN is a product formed *via* S_N2 pathway on the treatment of CH_3Br and KCN.

Product '*C*' is ethyl amine formed by the reduction of methyl cyanide.

39. $CH_3CHO + CH_3CH_2CHO \xrightarrow[25°C]{OH^-} 'P'$

Acetaldehyde Propanal

$CH_3CH_2CHO \xrightarrow[H_2O]{OH^-} CH_3-\overset{\oplus}{C}H-CHO$ (enolate, N.A.R $CH_3-C(=O)-H$)

$CH_3-CH(OH)-CHO \xrightarrow[\text{Proton taken from solvent}]{H^+} CH_3-CH(OH)-\overset{\ominus}{C}(=O)-CH_3$

40. Oxidation:

$$CH_3CHO + 3\bar{O}H \longrightarrow CH_3COO^- + 2e^- + 2H_2O \quad ...(i)$$

Reduction :

$$\{[Ag(NH_3)_2]^+ + e^- \longrightarrow Ag + 2NH_3\}\times 2 \quad ...(ii)$$

$$\therefore\ CH_3CHO + [Ag(NH_3)_2]^{\oplus} + 3\bar{O}H \longrightarrow CH_3COO^- + 2H_2O + 2Ag + 4NH_3$$

Molecular mass of $CH_3CHO = 44$

$$\text{Equivalent weight} = \frac{MW}{n\text{-factor}} = \frac{44}{2} = 22$$

Therefore, acetaldehyde is not an oxidising agent.

41. $-I$ effect of Cl > Br > I. The decreasing order of stabilities of carbanion is

$$Cl_3C^- > Br_3C^- > I_3C^-$$

Hence, the decreasing order of ease of decarboxylation is I > II > III.

42. (a) $2Ph-NH_2 + S=C=S \xrightarrow[\Delta]{\text{(i) } 2KOH,\ \text{(ii) conc.HCl}} Ph-N=C=S + Ph\overset{\oplus}{N}H_3Cl^-$

Hofmann mustard oil reaction

(b) $R-NH_2 + HNO_2 \xrightarrow{0-5°C} R-OH + N_2 + HCl$

Diazotisation reaction

(c) $Ph-NH_2 + CHCl_3 + 3KOH(alc.) \xrightarrow{\Delta} Ph-NC + 3KCl + 3H_2O$

Carbylamine reaction

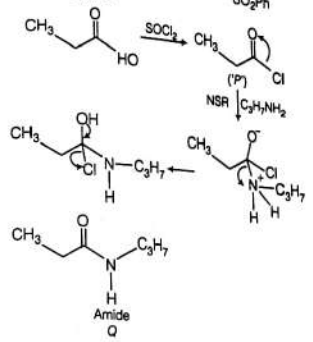
(d) $Ph_2NH + HONO \longrightarrow Ph_2-N-N=O + H_2O$

Lieber mann's nitroso reaction

43. The compound with molecular formula C_3H_9N is a secondary amine. When it reacts with Hinsberg reagent, the product obtained is soluble in ether.

$CH_3-N(H)-CH_3$ (2°-amine) $\xrightarrow{Ph-SO_2Cl}$ $CH_3-N(CH_3)-SO_2Ph$

44.



45. Mixture of styrene and methyl methacrylate can form acopolymer.

Other statements are correct.

47. The magnitude of screening effect depends upon the number of inner electrons, i.e. higher the number of inner electrons, greater shall be the value of screening effect.

48. The electron will move from a lower stationary state to a higher stationary state when required amount of energy is absorbed by the electron or energy is emitted when electron moves from higher stationary state to lower stationary state. The energy does not take place in a continuous manner.

49. It is detected by spraying the plate with aniline hydrogen phthalate solution.

50. Duma's method involves the determination of nitrogen content in the organic compound in the form of N_2

$$N_2O + Cu \longrightarrow N_2 + CuO$$

$$\%\ N = \frac{28}{22400}\times\frac{\text{volume of } N_2 \text{ at NTP}}{\text{weight of compound}}\times 100$$

51. When climate is warm, dry and sunny, the oxides of nitrogen and unsaturated hydrocarbons are converted in the components such as PAN, formaldehyde which form photochemical song, by the action of sunlight.

52. At radioactive equilibrium,

$$A \longrightarrow B$$

$$\frac{N_A}{N_B} = \frac{K_B}{K_A} = \frac{t_{1/2A}}{t_{1/2B}}$$

$$\therefore\ \frac{3.1\times 10^9}{1} = \frac{2\times 10^{10}}{t_{1/2B}}\ \text{and, } t_{1/2B} = 6.45\ \text{yrs.}$$

53. 1.0 barr = $1.0\times 10^{-24}\ cm^2 = 10^{-28}\ m^2$

The area of a circle is given by $A = \pi r^2$

Hence, $r = \sqrt{A/\pi}$

$$= \sqrt{(1.0\times 10^{-24}cm^2)/3.14}$$

$$= 5.6\times 10^{-13}\ cm$$

54. $CaO + SiO_2 \longrightarrow CaSiO_3$ (Slag)

$PbO + SiO_2 \longrightarrow PbSiO_3$

CaO converts $PbSiO_3$ to PbO,

$PbSiO_3 + CaO \longrightarrow PbO + CaSiO_3$

and also prevents the formation of $PbSO_4$.

55. One mole of *A* as reactant

So, we write down equation

(i) Two moles of *B* as product, so we multiply equation (iii) by (b). Finally, we add the three equation term-by-term

$A \longrightarrow C \quad q_1$

$C \longrightarrow D \quad q_2$

$D \longrightarrow 2B \quad 2q_3$

$A \longrightarrow 2B \quad q_1 + q_2 + 2q_3$

Therefore, the heat of hypothetical reaction is $q_1 + q_2 + 2q_3$.

56. Anhydrots mixture of KF and HF contains K^+, HF_2^- types ions.

57. $n CH_3-C=CH_2 \longrightarrow \{-CH_2-CH(CH_3)-\}_n$ Porypropylene

$n(CH_2=CH-Cl) \longrightarrow (-CH_2-CH(Cl)-)_n$

58. $C_6H_5-\ddot{N}H-OH + ON-C_6H_5 \longrightarrow$

$C_6H_5-N^{\oplus}(H)-N(OH)-C_6H_5 \xrightarrow[-H_2O]{OH^-}$

$C_6H_5-\ddot{N}-\ddot{N}-C_6H_5 \rightarrow C_6H_5-\ddot{N}=N-C_6H_5$ (OH, OH, O)

59. Molecular weight of gas $= \frac{14\times 22.4}{112} = 28$

i.e., CO, N_2, B_2H_6

60. $MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$

Biology

1. Gamete Intra Fallopian Transfer (GIFT) is an Assisted Reproductive Technology (ART). In this technique, eggs are removed from the woman and placed in one of the Fallopian tubes, alongwith the man's sperm. This allows fertilisation to take place inside the woman's body. Therefore, this variation is actually an *in vivo* fertilisation, not an *in vitro* fertilisation.

2. • Shark is a member of Chondrichthyes class, which is a cartilaginous fish.
   • Water snake is a reptile and salamander is an amphibian having largest RBC in animal kingdom.
   • Silver fish *(Lepisma)* is an arthropod, cuttle fish *(Sepia)* is a mollusc and star fish *(Asterias)* is an echinodermate. So none of them is a true fish (Pisces).
   • Ornithorhychus is a mammal which is also known as duck-billed playtypus. It is a member of Monotremata order which is a connecting link between reptiles and mammals.

3. Plague (black death) is caused by *Pasteurella* bacteria. Diphtheria is caused by *Corynebacterium diphtheriae* bacteria and tetanus (lockjaw) is caused by *Clostridium tetani* bacteria, while filariasis (elephantiasis) is caused by *Wuchereria bancrofti*.

4. In human body masseter muscle is the strongest muscle, gluteus maximus is the largest and stapedius is the smallest muscle.

5. Natural selection is show by the reproductive success of the members of a population best adapted to the environment. The organisms which adapt useful variation successfully survive in changing environment and reproduce.

6. S-phase (synthesis phase) is the part of the interphase of cell cycle occurring between G_1 and G_2-phase. This is the phase in which DNA replication takes place, i.e. chromosomes are replicated.

7. Adenosine Triphosphate (ATP) was discovered by Karl Lohmann in 1929 from muscles.

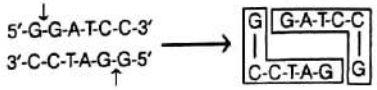
8. Eye lens is derived from ectoderm.

9. Schneiderian and tympanic membranes respectively belongs to nose and ear.

10. Alcohol interferes with the metabolism of thiamine in the liver. Thus, alcohol intake with deficiency of vitamin-B_1 is the basis of brain related diseases called **Wernicke's syndrome** and **Korsakoff's syndrome**. Both the syndromes are associated with the destruction of cells in brain with the memory loss even of recent events and mental confusion along with the impairment of speech.

11. Luc Montagnier received Nobel Prize in 2008 for the discovery of Human Immunodeficiency Virus (HIV) which is the cause for AIDS.

12. For restriction enzyme *Bam* HI the unique recognition site is



13. Mesozoic period was golden age for reptiles. In this period reptiles were dominant species, like dinosaurs. Devonian period was golden age for fishes due to their abundance and diversity.

14. **Disease and Related Hormones**

Cretinism	–	Thyroid
Cushing's syndrome	–	Glucocorticoid
Diabetes insipidus	–	ADH (Anti Diuretic Hormone)
Eunuchoidism	–	Testosterone

15. Guava *(Psidium guajava)* fruit is an pseudocapric berry, in which pericarp and placenta are edible.

16. Mitochondria which is also known as the power house of the cell was first discovered by Kolliker in 1850. It is the site of cellular respiration.

17. According to Hamburger phenomenon, when the whole blood is saturated with carbon dioxide, the following changes are seen
   (i) The bicarbonate contents of plasma and corpuscles increase.
   (ii) The chloride content of plasma is diminished and that of the cell is increased.
   (iii) The total base (cations) of both plasma and corpuscles remain unchanged.
   (iv) The water content and the volume of corpuscles increase.
   (v) When the carbon dioxide is removed from the blood reverse changes takes place.
   (vi) When CO_2 enters blood, Cl^- from plasma enters RBCs leaving Na^+ behind. When CO_2 escapes from blood. Cl^- leaves the cell and combines with Na^+ again. Due to this alternate movement of Cl^- ions, this phenomenon is called **chloride shift.**

18. In photosynthetic carbon fixation magnesium ion (Mg^{2+}) is an activator for both ribulose bisphosphate carboxylase oxygenase and phosphoenol pyruvate carboxylase enzymes.

19. Glycolysis is a common phase for aerobic and anaerobic respiration where 1 molecule of glucose (6 C) breakdown into 2 molecules of pyruvic acid (3 C).

20. Syphilis is a Sexually Transmitted Disease (STD) which is caused by *Treponema pallidum* bacteria.

21. **Cri-Du-Chat** (Cat Cry) **Syndrome** was first described by **Lejeune** in 1963 in France. The affected newborn cries-like mewing of a cat. This condition is due to a deletion in the short arm of the chromosome number 5.

22. Bacteriophage $\phi \times 174$ has single-stranded DNA (ssDNA).

23. In parthenogenesis formation of fruit occurs without fertilisation.
   In apogamy haploid (n) vegetative cell forms embryo without gametogenesis and fertilisation.
   In sporophytic budding diploid ($2n$) vegetative cell forms embryo from bud by vegetative reproduction.
   Thus, all of these processes are irregular modes of reproduction.

24. No endosperm formation takes place in the members of Orchidaceae, Podostemonaceae and Trapaceae families.

25. **Cardiac cycle** is the event during, which one heartbeat or one cycle of contraction (systole) and relaxation (diastole) of cardiac muscle occurs. A cardiac cycle consists of systole and diastole of atria and systole and diastole of ventricles. The time of cardiac cycle is in reverse ratio of the rate of heartbeat. In man, the heart rate is about 72 times/min, therefore time of a cardiac cycle is 60/72 = 0.8 sec approx.

Time taken	Atria		Ventricle	
	Systole	Diastole	Systole	Diastole
	0.1 sec	0.7 sec	0.3 sec	0.5 sec

26. A horse *(Equus ferus caballus)* and a donkey *(Equus africanus asinus)* can breed to produce mule, which is an infertile animal. The infertility is because horse and donkey belong to different species. Mule are medium weight animals that are more hardworking and long-lived than horse and donkey.

27. The latex of some plants is commercially important such as
   (i) Source of **commercial rubber** is latex of *Hevea brasiliensis, Ficus elastica, Cryptostegia, Manihot glaziovii.*
   (ii) Source of **chewing** or **chickle gum** is latex of *Achras sapota.*
   (iii) Source of enzyme **papain** is latex of *Carica papaya.*

28. Auxin is responsible for apical dominance in apical buds, which inhibits the lateral buds to grow.
   Plants require a certain day length to flower. This relative length of day and night needed for flowering is called as **photoperiod**. The effect of photoperiod or daily duration of light hours and dark periods on the growth and development of plants, especially flowering, is called **photoperiodism**.
   This phenomenon was first discovered by Garner and Allard (1920, 1922) on Maryland Mammoth variety of tobacco. They observed that the Maryland Mammoth could be made to flower only by reducing the light hours with artificial darkening. It could be made to remain vegetative in winter by providing extra light.

29. **Geitonogamy** is a technique of self-pollination, in which pollen of one flower is deposited on the stigma of another flower of same plant.
   While others are mechanisms adopted by bisexual flowers to avoid self-pollination and promote cross-pollination.
   • **Dichogamy** The condition where maturing time of anther and stigma is different. Anther matures first, i.e. protandry, stigma matures first, i.e. protogyny.
   • **Herkogamy** Includes mechanical barrier in flower to ensure cross-pollination.
   • **Heterostyle** The height of stigma and anther is different to avoid self-pollination.

30. The phenotypic ratio of trihybrid cross in F_2-generation will be 27 : 9 : 9 : 9 : 3 : 3 : 3 : 1.

31. The base pair mutations are most common type of mutations. These can be further categorised into two types
   (a) **Transitions**, i.e. in which a purine base is replaced by another purine and pyrimidine is replaced by another pyrimidine.
   (b) **Transversion**, i.e. those in which a purine (guanine) is replaced by a pyrimidine (cytosine) and *vice-versa*.

32.

Organism		Connecting link
Echidna	–	between Reptile and Mammals
Peripatus	–	between Annelida and Arthropoda
Neopilina	–	between Annelida and Mollusca
Protopterus	–	between Pisces and Amphibia

33.

Cell Organelle		Discovered by
Ribosome	–	Palade
Nucleolus	–	Fontana
Glyoxysome	–	Beevers
Peroxisome	–	Tolbert and Yamazaki

34. Antibody Ig E acts as mediator in allergic response.

35. *Homo habilis* was also known as tool maker because it was the first human who made weapons and tools from rocks.

36. *Culex* mosquito is responsible for carrying pathogen of filariasis as vector. Housefly is vector for amoebiasis, typhoid, etc. *Aedes aegypti* mosquito is vector for dengue virus. Sandfly is vector for kala azar.

37. All four statements are correct.

38. Sarcomas cancer originate in lymphatic tissues, connective tissues, muscles and bones.

39. Butterflies have most numbers of chromosome in animal kingdom about 380.

40. During meiosis-I, in pachytene phase of prophase-I the bivalent chromosomes clearly appear as tetrads for crossing over.

41. 4 O'clock and snapdragon flower are best examples of incomplete dominance where in heterozyous condition pink flowers are produced from white and red parents. It is an exception to Mendel's law of dominance.

42. Erwin Chargaff (1950) made quantitative analysis of DNA and showed that the composition of DNA molecules varies in complex ways depending upon the source of DNA. He proposed **Base Equivalence rule or Chargaff's rule**, which states that, for double-stranded DNA, the proportion of adenine always equals to that of thymine and proportion of guanine always equals to that of cytosine,

i.e. A = T and G = C.

It follows that, an equal proportion of purines and pyrimidines is always seen in a double-stranded DNA, i.e.

$$A + G = T + C \text{ or } \frac{A + G}{T + C} = 1$$

43. The term 'prebiotic soup' is used by Haldane for organic water containing mixture of simple organic compounds during early stage of origin of life.

44. The number of barr body in human = one less than the number of X Chromosome.

In case of Turner syndrome 45 (44+ X) chromosomes are found. So number of Barr bodies will be zero.

45. Pertussis (whooping cough) is not a Sexually Transmitted Disease (STD), while other diseases are transmitted by sexual relationships.

46. 60S and 40S are sub-units of eukaryotic (80S) ribosomes.

47. Pyloric sphincter guards are the opening between the pylorus of **stomach** and the **duodenum** of small intestine. It periodically permits partially digested food to leave the stomach and enter the duodenum.

48. Vegetative reproduction in *Bryophyllum* takes place through leaf buds.

49. Pappus are modified bracts of Asteraceae family. These hairy structures help in dispersal of pollen by wind.

50. Diphtheria is caused by poison released by living bacterial cell of *Corynebacterium diphtheriae* into host body.

51. *Acetobacter* sp. is a source of Vitamin-C.

52. The experiment of Hershey and Chase by bacteriophage first time proved that DNA is a genetic material.

53.

Pollination techniques	– Pollinator
Chiropterophily	– Bat
Anemophily	– Wind
Myrmecophily	– Ant
Malacophily	– Snail

54. Anti Diuretic Hormone (ADH) is released by posterior lobe of pituitary gland which is also called vasopressin. It increase reabsorption of water by kidneys.

55. During the transmission of nerve impulse through a nerve fibre, the potential on the innerside of the plasma membrane has first negative charge, then positive and again negative by repolarisation.

56. Birds are uricotelic organisms which excrete uric acid to reduce their weight.

57. On the 5th week of pregnancy a large tube (premitive heart) starts to beat and pump blood in embryo.

58. Pleuro Pneumonia Like Organism (PPLO) is smallest organism or cell containing size of 0.1 to 0.3 mm.

59. Slime-moulds are also called fungus like protists, which share characteristics of both animal and fungi.

60. Sunflower *(Helianthus annuus)* is a member of Asteraceae family. Its flower is not a real flower but a whole inflorescence having a group of many small flowers. This inflorescence is known as capitulum or head inflorescence.

Jipmer

Medical Entrance Exam

SOLVED PAPER 2017

PHYSICS

1. Two 20 g flatworms climb over a very thin wall, 10 cm high. One of the worm is 20 cm long, the other is wider and only 10 cm long. Which of the following statement is correct regarding them?

(a) 20 cm worm has done more work against gravity
(b) 10 cm worm has done more work against gravity
(c) Both worms have done equal work against gravity
(d) Ratio of work done by both the worms is 4 : 5

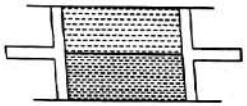
2. A rocket is intended to leave the Earth's gravitational field. The fuel in its main engine is a little less than the amount that is necessary and an auxiliary engine, (only capable of operating for a short time) has to be used as well. When is it best to switch on the auxiliary engine?

(a) at take-off
(b) when the rocket has nearly stopped with respect to the Earth.
(c) It doesn't matter.
(d) Can't say

3. The turns of a solenoid, designed to provide a given magnetic flux density along its axis, are wound to fill the space between two concentric cylinders of fixed radii. How should the diameter d of the wire used be chosen so as to minimize the heat dissipated in the windings?

(a) Wire should be multiple of $5d$
(b) Wire should be multiple of $d/3$
(c) Wire is independent of d
(d) Can't say

4. A cylindrical tube of uniform cross-sectional area A is fitted with two air tight frictionless pistons. The pistons are connected to each other by a metallic wire. Initially, the pressure of the gas is p_0 and temperature is T_0, atmospheric pressure is also p_0. Now, the temperature of the gas is increased to $2T_0$, the tension of wire will be



(a) $2p_0A$ (b) p_0A (c) $\frac{p_0A}{2}$ (d) $4p_0A$

5. A particle of mass m is executing oscillation about the origin on X-axis. Its potential energy is $V(x) = K|x|^3$. Where K is a positive constant. If the amplitude of oscillation is a, then its time period T is proportional to

(a) $1/\sqrt{a}$ (b) a (c) $\sqrt{a}$ (d) $a^{3/2}$

6. A body is projected vertically upwards. The times corresponding to height h while ascending and while descending are t_1 and t_2, respectively.

Then, the velocity of projection will be (take g as acceleration due to gravity)

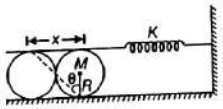
(a) $\frac{g\sqrt{t_1t_2}}{2}$ (b) $\frac{g(t_1 + t_2)}{2}$

(c) $g\sqrt{t_1t_2}$ (d) $g\frac{t_1t_2}{(t_1 + t_2)}$

7. A long straight wire is carrying current I in $+z$ direction. The $x-y$ plane contains a closed circular loop carrying current I_2 and not encircling the straight wire. The force on the loop will be
(a) $\mu_0 I_1 I_0 / 2\pi$
(b) $\mu_0 I_1 I_2 / 4\pi$
(c) zero
(d) depends on the distance of the centre of the loop from the wire

8. When the radioactive isotope ${}_{88}Ra^{220}$ decays in a series by emission of three alpha (α) and a beta (β) particle, the isotope X which remains undecay is
(a) ${}_{83}X^{214}$ (b) ${}_{84}X^{218}$
(c) ${}_{84}X^{220}$ (d) ${}_{87}X^{223}$

9. A solid cylinder is attached to a horizontal massless spring as shown in figure. If the cylinder rolls without slipping, the time period of oscillation of the cylinder is



(a) $2\pi\sqrt{\frac{x}{g}}$ (b) $2\pi\sqrt{\frac{2M}{3K}}$
(c) $2\pi\sqrt{\frac{3M}{8K}}$ (d) $2\pi\sqrt{\frac{3M}{2K}}$

10. N lamps each of resistance r, are fed by a machine of resistance R. If light emitted by any lamp is proportional to the square of the heat produced, prove that the most efficient way of arranging them is to place them in parallel arcs, each containing n lamps, where n is the integer nearest to
(a) $\left(\frac{r}{NR}\right)^{3/2}$ (b) $\left(\frac{NR}{r}\right)^{1/2}$
(c) $(NRr)^{3/2}$ (d) $(NRr)^{1/2}$

11. Radioactive decay will occur as follows
${}^{220}_{86}Rn \longrightarrow {}^{216}_{84}PO + {}^{4}_{2}He$ Half life = 55 s
${}^{218}_{84}Po \longrightarrow {}^{212}_{82}Pb + {}^{4}_{2}He$ Half life = 0·66 s
${}^{812}_{82}Pb \longrightarrow {}^{212}_{82}BL + \lambda^{\circ}e$ Half life = 10·6 h
If a certain mass of radon ($Rn = 220$) is allowed to decay in a certain container; then after 5 minutes the element with the greater mass will be
(a) radon (b) polonium
(c) lead (d) bismuth

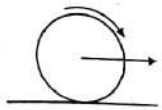
12. A stream of a liquid of density ρ flowing horizontally with speed v rushes out of a tube of radius r and hits a vertical wall nearly normally. Assuming that the liquid does not rebound from the wall, the force exerted on the wall by the impact of the liquid is given by
(a) $\pi r\rho v$ (b) $\pi r\rho v^2$ (c) $\pi r^2\rho v$ (d) $\pi r^2\rho v^2$

13. The x and y coordinates of a particle moving in a plane are given by $x(t) = a\cos(pt)$ and $y(t) = b\sin(pt)$ where a, b ($< a$) and p are positive constants of appropriate dimensions and t is time. Then, which of the following is not true?
(a) The path of the particle is an ellipse.
(b) Velocity and acceleration of the particle are perpendicular to each other at $t = \frac{\pi}{2p}$
(c) Acceleration of the particle is always directed towards a fixed point.
(d) Distance travelled by the particle in time interval between $t = 0$ and $t = \frac{\pi}{2P}$ is a

14. White light is used to illuminate two slits in Young's double slit experiment. The separation between the slits is b and the screen is at a distance $d(>> b)$ from the slits. At a point on the screen directly in front of one of the slits, which wavelengths are missing?
(a) $\frac{b}{d}, \frac{b}{3d}, \frac{b}{5d}$
(b) $\frac{b^2}{2d}, \frac{b^2}{4d}, \frac{b^2}{6d}$
(c) $\frac{b^2}{d}, \frac{b^2}{3d}, \frac{b^2}{5d}$
(d) $\frac{b}{2d}, \frac{b}{4d}, \frac{b}{6d}$

15. A skier starts from rest at point A and slides down the hill without turning or breaking. The friction coefficient is μ. When he stops at point B, his horizontal displacement is S. What is the height difference between points A and B? (The velocity of the skier is small so that the additional pressure on the snow due to the curvature can be neglected. Neglect also the friction of air and the dependence of μ on the velocity of the skier.)
(a) $h = \mu S$ (b) $h = \frac{\mu}{S}$
(c) $h = 2\mu S$ (d) $h = \mu S^2$

16. A bicycle wheel rolls without slipping on a horizontal floor. Which one of the following is true about the motion of points on the rim of the wheel, relative to the axis at the wheel's centre?



(a) Points near the top move faster than points near the bottom
(b) Points near the bottom move faster than points near the top
(c) All points on the rim move with the same speed
(d) All points have the velocity vectors that are pointing in the radial direction towards the centre of the wheel

17. The planets with radii R_1 and R_2 have densities ρ_1, ρ_2 respectively. Their atmospheric pressures are p_1 and p_2 respectively. Therefore, the ratio of masses of their atmospheres, neglecting variation of g within the limits of atmosphere is
(a) $\rho_1 R_2 \rho_1 / \rho_2 R_1 \rho_2$ (b) $\rho_1 R_2 \rho_2 / \rho P_2 R_1 \rho_1$
(c) $\rho_1 R_1 \rho_1 / \rho_2 R_2 \rho_2$ (d) $\rho_1 R_1 \rho_2 / \rho_2 R_2 \rho_1$

18. A thin symmetrical double convex lens of refractive index $\mu_2 = 1{\cdot}5$ is placed between a medium of refractive index $\mu_1 = 1.4$ to the left and another medium of refractive index $\mu_3 = 1{\cdot}6$ to the right. Then, the system behaves as
(a) a convex lens
(b) a concave lens
(c) a glass plate
(d) a convexo concave lens

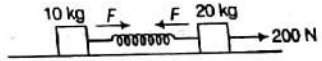
19. A wide hose pipe is held horizontally by a fireman. It delivers water through a nozle at one lirte per second. On increasing the pressure, this increass to two litres per second. The fireman has now to
(a) push forward twice as hard
(b) push forward four times as hard
(c) push backward four times as hard
(d) push backward twice as hard

20. The wavelength λ of a photon and the de-Broglie wavelength of an electron have the same value. Find the ratio of energy of photon to the kinetic energy of electron in terms of mass m, speed of light c and planck constant.
(a) $\frac{\lambda mc}{h}$ (b) $\frac{hmc}{\lambda}$
(c) $\frac{2hmc}{\lambda}$ (d) $\frac{2\lambda mc}{h}$

21. A non-conducting ring of radius 0.5m carries a total charge of $1{\cdot}11 \times 10^{-10}$ C distributed non-uniformly on its circumference producing on its circumference on electric field $\mathbf{E}$, everywhere in space.
The value of the line integral $\int_{l=\infty}^{l=0}(-\mathbf{E}\cdot\mathbf{dl})$ ($l = 0$ being centre of ring) in volts is
(a) + 2 (b) − 1
(c) − 2 (d) Zero

22. The upper half of an inclined plane of inclination θ is perfectly smooth while the lower half rough. A block starting from rest at the top of the plane will again come to rest at the bottom if the coefficient of friction between the block and the lower half of the plane is given by
(a) $\mu = 2\tan\theta$
(b) $\mu = \tan\theta$
(c) $\mu = 2/(\tan\theta)$
(d) $\mu = 1/\tan\theta$

23. Two masses 10 kg and 20 kg respectively are connected by a massless spring as shown in figure. A force of 200 N acts on the 20 kg mass. At the instant shown is figure the 10 kg mass has acceleration of 12 m/s^2. The value of acceleration of 20 kg mass is



(a) 4 m/s^2 (b) 10 m/s^2
(c) 20 m/s^2 (d) 30 m/s^2

24. A cylinder rolls up an inclined plane, reaches some height and then rolls down (without slipping throughout these motions). The directions of the frictional force acting on the cylinder are

(a) up the incline while ascending and down the incline while descending.
(b) up the incline while ascending as well as descending.
(c) down the incline while ascending and up the incline while descending.
(d) down the incline while ascending as well as descending.

25. A liquid is allowed into a tube of truncated cone shape. Identify the correct statement from the following.

(a) The speed is high at the wider end and low at the narrow end.
(b) The speed is low at the wider end and high at the narrow end.
(c) The speed is same at both ends in a streamline flow.
(d) The liquid flows with uniform velocity in the tube.

26. Two soap bubbles coalesce. It is noticed that, whilst joined together, the radii of the two bubbles are a and b where $a > b$. Then the radius of curvature of interface between the two bubbles will be

(a) $a - b$ (b) $a + b$
(c) $ab/(a - b)$ (d) $ab/(a + b)$

27. The displacement of a particle along the x-axis is given by $x = a\sin^2 \omega t$. The motion of the particle corresponds to

(a) simple harmonic motion of frequency ω/π
(b) simple harmonic motion of frequency $3\omega/2\pi$
(c) non simple harmonic motion
(d) simple harmonic motion of frequency $\omega/2\pi$

28. Mercury boils at 367°C. However, mercury thermometers are made such that they can measure temperature upto 500°C. This is done by

(a) maintaining vacuum aboves mercury column in the stem of the thermometer.
(b) filling nitrogen gas at high pressure above the mercury column.
(c) filling oxygen gas at high pressure above the mercury column.
(d) filling nitrogen gas at low pressure above the mercury column.

29. Two identical glass spheres filled with air are connected by a horizontal glass tube. The glass tube contains a pellet of mercury at its mid-point. Air in one sphere is at 0°C and the other is at 20°C. If both the vessels are heated through 10°C, then neglecting the expansions of the bulbs and the tube

(a) the mercury pellet gets displaced towards the sphere at lower temperature.
(b) the mercury pellet gets displaced towards the sphere at higher temperature.
(c) the mercury pellet does not get displaced at all
(d) the temperature rise causes the pellet to expand without any displacement.

30. A nucleus ${}^{A}_{Z}X$ has mass represented by $m(A, Z)$. If m_p and m_n denote the mass of proton and neutron respectively and BE the binding energy (in MeV) then,

(a) $BE = [m(A, Z) - Zm_p - (A - Z)m_n]c^2$
(b) $BE = [Zm_p + (A - Z)m_n - m(A, Z)]c^2$
(c) $BE = [Zm_p + Am_n - m(A, Z)]c^2$
(d) $BE = m(A, Z) - Zm_p - (A - Z)m_N$

31. A graph between pressure P (along y-axis) and absolute temperature, T(along x-axis) for equal moles of two gases has been drawn. Given that volume of second gas is more than volume of first gas. Which of the following statement is correct?

(a) Slope of gas 1 is less than gas 2
(b) Slope of gas 1 is more than gas 2
(c) Both have some slopes
(d) None of the above

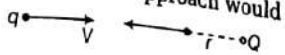
32. A piece of blue glass heated to a high temperature and a piece of red glass at room temperature are taken inside a dimly-lit room. Then,

(a) the blue piece will look blue and the red piece will look red as usual.
(b) the red piece will look brighter red and the blue piece will look ordinary blue.
(c) the blue will look brighter as compared to the red piece.
(d) both the pieces will look equal red.

33. A certain charge Q is divided into two parts q and $Q - q$. How the charge Q and q must be related so that when q and $(Q - q)$ is placed at a certain distance apart experience maximum electrostatic repulsion?

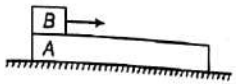
(a) $Q = 2q$ (b) $Q = 3q$
(c) $Q = 4q$ (d) $Q = 4q + c$

34. A charged particle 'q' is shot with speed v towards another fixed charged particle Q. It approaches Q upto a closest distance r and then returns. If q were given a speed $2v$, the closest distance of approach would be



(a) r (b) $2r$ (c) $r/2$ (d) $r/4$

35. A long block A of mass M is at rest on a smooth horizontal surface. A small block B of mass $M/2$ is placed on A at one end and projected along A with some velocity v. The coefficient of friction between the block is μ. Then, the accelerations of blocks A and B before reaching a common velocity will be respectively



(a) $\frac{\mu g}{2}$ (towards right), $\frac{\mu g}{2}$ (towards left)
(b) μg (towards right), μg (towards left)
(c) $\frac{\mu g}{2}$ (towards right), μg (towards left)
(d) μg (towards right), $\frac{\mu g}{2}$ (towards left)

36. A beam of light composed of red and green rays is incident obliquely at a point on the face of a rectangular glass slab. When coming out on the opposite parallel face, the red and green rays emerge from

(a) two points propagating in two different non-parallel directions.
(b) two points propagating in two different parallel directions.
(c) one point propagating in two different directions.
(d) one point propagating in the same direction.

37. The plane face of a plano convex lens is silvered. If μ be the refractive index and R, the radius of curvature of curved surface, then system will behave like a concave mirror of curvature

(a) μR (b) R^2/μ
(c) $R/(\mu - 1)$ (d) $[(\mu + 1)/(\mu - 1)]R$

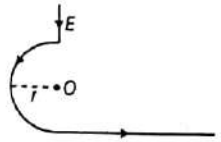
38. The maximum numbers of possible interference maxima for slit separation equal to twice the wavelength in Young's double slit experiment is

(a) infinite (b) five
(c) three (d) zero

39. An isotropic point source of light is suspended h metre vertically above the centre of circular table of radius r metre. Then, the ratio of illumenances at the centre to that at the edge of the table is

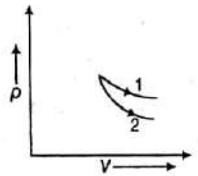
(a) $1 + \left(\frac{r^2}{h^2}\right)$ (b) $1 + \left(\frac{h^2}{r^2}\right)$
(c) $\left\{1 + \frac{r^2}{h^2}\right\}^{3/2}$ (d) $\left\{1 + \frac{h^2}{r^2}\right\}^{3/2}$

40. In the given figure, what is the magnetic field induction at point O.



(a) $\frac{\mu_0 I}{4\pi r}$ (b) $\frac{\mu_0 I}{4r} + \frac{\mu_0 I}{2\pi r}$
(c) $\frac{\mu_0 I}{4r} + \frac{\mu_0 I}{4\pi r}$ (d) $\frac{\mu_0 I}{4r} - \frac{\mu_0 I}{4\pi r}$

41. p-V plots for two gases during adiabatic process as shown in figure plots 1 and 2 should correspond respectively to



(a) He and O_2
(b) O_2 and He
(c) He and Ar
(d) O_2 and N_2

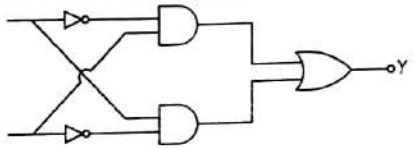
42. The half-life period of a radioactive element X is same as the mean life of another radioactive element Y. Initially, both of them have the same numbers of atoms then,

(a) X and Y have the same decay rate initially.
(b) X and Y decay at the same rate always
(c) Y will decay at a faster rate than X
(d) X will decay at a faster rate than Y

43. A source emits electromagnetic waves of wavelength 3m. One beam reaches the observer directly and other after reflection from a water surface, travelling 1.5m extra distance and with intensity reduced to 1/4 as compared to intensity due to the direct beam alone. The resultant intensity will be

(a) (1/4) fold (b) (3/4) fold
(c) (5/4) fold (d) (9/4) fold

44. The following circuit represents



(a) OR gate (b) XOR gate
(c) AND gate (d) NAND gate

45. Two identical conducting balls A and B have positive charges q_1 and q_2 respectively. But $q_1 \neq q_2$. The balls are brought together so that they touch each other and then kept in their original positions. The force between them is

(a) less than that before the balls touched
(b) greater than that before the balls touched
(c) same as that before the balls touched
(d) zero

46. A positively charged ball hangs from a silk thread. We put a positive test charge q_0 at a point and measure F / q_0, then it can be predicted that the electric field strength E

(a) $> F/q_0$ (b) $= F/q$
(c) $< F/q_0$ (d) cannot be estimated

47. Capacitor C_1 of capacitance 1 μF and capacitor C_2 of capacitance 2 μF are separately charged fully by a common battery. The two capacitors are then separately allowed to discharged through equal resistors at time $t = 0$

(a) the current in each of the two discharging circuits is zero at $t = 0$
(b) the currents in the two discharging circuits at $t = 0$ are equal but non-zero
(c) the currents in the two discharging circuits at $t = 0$
(d) Capacitor C_1 loses 40% of its initial charge sooner than C_2 loses 40% of initial charge.

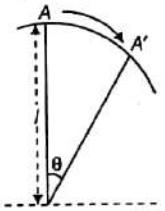
48. A uniform electric field and a uniform magnetic field acting along the same direction in a certain region. If an electron is projected along the direction of the fields with a certain velocity, then

(a) it will turn towards left of direction of motion.
(b) it will turn towards right of direction of motion.
(c) its velocity will increase.
(d) its velocity will decrease.

49. To reduce the range of voltmeter, its resistance need to be reduced. A voltmeter has resistance R_0 and range V. Which of the following resistances when connected in parallel will convert it into a voltmeter of range V / n?

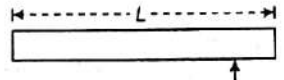
(a) nR_0 (b) $(n + 1) R_0$
(c) $(n - 1)R$ (d) None of these

50. A uniform rod of length l is free to rotate in a vertical plane about a fixed horizontal axis through B. The rod begins rotating from rest from its unstable equilibrium position. When, it has turned through an angle θ, its angular velocity ω is given by



(a) $\sqrt{\left(\frac{6g}{l}\right)}\sin\frac{\theta}{2}$ (b) $\sqrt{\left(\frac{6g}{l}\right)}\cos\frac{\theta}{2}$
(c) $\sqrt{\left(\frac{6g}{l}\right)}\sin\theta$ (d) $\sqrt{\left(\frac{6g}{l}\right)}\cos\theta$

51. A stick of length L and mass M lies on a frictionless horizontal surface on which it is free to move in any way. A ball of mass m moving with speed V collides elastically with the stick as shown in fig below. If after the collision, the ball comes to rest, then what should be the mass of the ball?

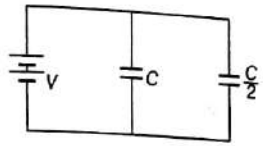


(a) $m = 2M$ (b) $m = M$
(c) $m = M/2$ (d) $m = M/4$

52. The mass of a proton is 1847 times that of an electron. A electron and a proton are injected into a uniform electric field at right angle to the direction of the field with the same initial K.E.

(a) the electron trajectory will be less curved than the proton trajectory.
(b) both the trajectories will be straight.
(c) the proton trajectory will be less curved than the electron trajectory.
(d) both the trajectories will be equally curved.

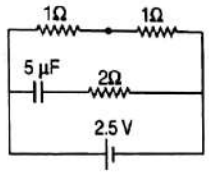
53. Two condensers, one of capacity C and the other of capacity $\frac{C}{2}$, are connected to a V-volt battery, as shown.



The work done in charging fully both the condensers is

(a) CV^2 (b) $\frac{1}{4}CV^2$
(c) $\frac{3}{4}CV^2$ (d) $\frac{1}{2}CV^2$

54. A capacitor of capacitance 5μF is connected as shown in the figure. The internal resistance of the cell is 0.5Ω. The amount of charge on the capacitor plates is

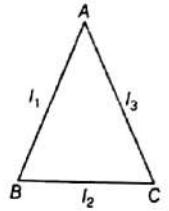


(a) 80 μC (b) 40 μC
(c) 20 μC (d) 10 μC

55. A photo cell is illuminated by a small bright source placed 1m away. When the same source of light is placed 2m away, the electrons emitted by photo cathode

(a) carry one quarter of their previous energy
(b) carry one quarter of their previous momenta
(c) are half as numerous
(d) are one quarter as numerous

56. ABC is right angled triangular plane of uniform thickness. The sides are such that $AB > BC$ as shown in figure. I_1, I_2, I_3 are moments of inertia about AB, BC and AC, respectively. Then which of the following relations is correct?



(a) $I_1 = I_2 = I_3$ (b) $I_2 > I_1 > I_3$
(c) $I_3 < I_2 < I_1$ (d) $I_3 > I_1 > I_2$

57. An ice-berg of density 900 kgm^{-3} is floating in water of density 1000 kgm^{-3}. The percentage of volume of ice-berg outside the water is

(a) 20% (b) 35% (c) 10% (d) 11%

58. The potential of an atom is given by $V = V_0 \log_e(r / r_0)$ where r_0 is a constant and r is the radius of the orbit. Assuming Bohr's model to be applicable, which variation of r_n with n is possible (n being principal quantum number)?

(a) $r_n \propto n$ (b) $r_n \propto 1/n$ (c) $r_n \propto n^2$ (d) $r_n \propto 1/n^2$

59. The temperature of source and sink of a heat engine are 127°C and 27°C, respectively. An inventor claims its efficiency to be 26%, then

(a) it is impossible
(b) it is possible with high probability
(c) it is possible with low probability
(d) Data are insufficient

60. You are given resistance wire of length 50 cm and a battery of negligible resistance. In which of the following cases is largest amount of heat generated?

(a) When the wire is connected to the battery directly
(b) When the wire is divided into two parts and both the parts are connected to the battery in parallel.
(c) When the wire is divided into four parts and all the four parts are connected to the battery in parallel.
(d) When only half of the wire is connected to the battery.

CHEMISTRY

61. The compressibility of a gas is less than unity at STP, therefore

(a) $V_m > 22.4$ L (b) $V_m < 22.4$ L
(c) $V_m = 22.4$ L (d) $V_m = 44.8$ L

62. Among the following set of quantum numbers, the impossible set is

	n	l	m	s
(a)	3	2	− 3	$-\frac{1}{2}$
(b)	4	0	0	$\frac{1}{2}$
(c)	5	3	0	$-\frac{1}{2}$
(d)	3	2	− 2	$\frac{1}{2}$

63. Phenol $\xrightarrow[\text{(ii) } CO_2/140°C]{\text{(i) NaOH}} A \xrightarrow{H^+/H_2O}$

$B \xrightarrow{Ac_2O} C$

In the above reaction, end product 'C' is

(a) salicylaldehyde
(b) salicylic acid
(c) phenyl acetate
(d) aspirin

64. The normality of 10% (w/v) of acetic acid is

(a) 1 N (b) 1.3 N
(c) 1.7 N (d) 1.9 N

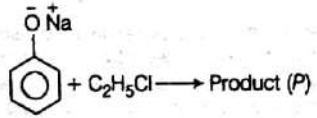
65. Which of the following is least soluble in water?

(a) C_2H_6 (b) CH_3OH
(c) CH_3NH_2 (d) C_6H_5OH

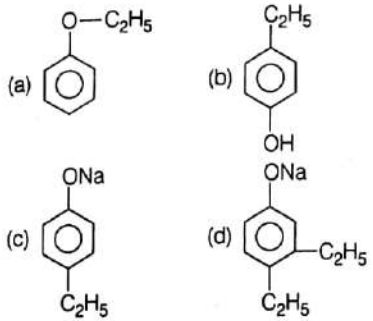
66. *Iso*-propyl chloride $+ A \xrightarrow{\Delta}$ 2-ethoxy propane + NaCl. The compound (A) is

(a) C_2H_5Cl (b) C_2H_5ONa
(c) CH_2N_2 (d) CH_3ONa

67.



The product (P) is



68. 1-butyne on oxidation with hot alkaline $KMnO_4$ would yield. Which of the following as end product?

(a) $CH_3CH_2CH_2COOH$
(b) CH_3CH_2COOH
(c) $CH_3CH_2COOH + CO_2 + H_2O$
(d) $CH_3CH_2COOH + HCOOH$

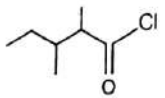
69. A cubic unit cell of a metal with molar mass of 63.55 g mol^{-1} has an edge length of 362 pm. Its density is 8.92 g cm^{-3}. The type of unit cell is

(a) primitive (b) face centred
(c) end centred (d) body centred

70. Which of the following is the major product in the reaction of HOBr with propene?

(a) 2-bromo, 1-propanol (b) 3-bromo, 1-propanol
(c) 2-bromo, 2-propanol (d) 1-bromo, 2-propanol

71. Which of the following is the correct IUPAC name?



(a) 3, 4-dimethyl pentanoyl chloride
(b) 1-chloro-1-oxo-2, 3-dimethyl pentane
(c) 2-ethyl-3-methyl butanoyl chloride
(d) 2, 3-dimethyl pentanoyl chloride

72. Consider the following solutions,

$A = 0.1$ M glucose, $B = 0.05$ M NaCl,

$C = 0.05$ M $BaCl_2$, $D = 0.1$ M $AlCl_3$

Which of the following pairs is isotonic?

(a) A and B (b) A and D (c) A and C (d) B and C

73. Which of the following compound is not coloured?

(a) Na_2CuCl (b) $Na_2Cd \cdot Cl_4$
(c) $FeSO_4$ (d) VI_3

74. Which of the following oxide is most acidic?

(a) As_2O_3 (b) P_2O_5 (c) Sb_2O_3 (d) Bi_2O_3

75. When CO_2 is bubbled through a solution of barium peroxide in water then

(a) carbonic acid is formed
(b) O_2 is released
(c) H_2O_2 is formed
(d) no reaction occurs

76. The correct increasing order of ionic radii of the following Ce^{3+}, La^{3+}, Pm^{3+} and Yb^{3+} is

(a) $Yb^{3+} < Pm^{3+} < Ce^{3+} < La^{3+}$
(b) $Ce^{3+} < Yb^{3+} < Pm^{3+} < La^{3+}$
(c) $Yb^{3+} < Pm^{3+} < La^{3+} < Ce^{3+}$
(d) $Pm^{3+} < La^{3+} < Ce^{3+} < Yb^{3+}$

77. The shape of gaseous $SnCl_2$ is

(a) tetrahedral (b) linear
(c) angular (d) T-shape

78. Which of the following aqueous solution should have highest boiling point?

(a) 1.0 M NaOH (b) 1.0 M Na_2SO_4
(c) 1.0 M NH_4NO_3 (d) 1.0 M KNO_3

79. When a lead storage battery is discharged;

(a) SO_2 is evolved
(b) lead sulphate is consumed
(c) lead is formed
(d) sulphuric acid is consumed

80. Combustion of glucose takes place according to the equation,

$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O$, $\Delta H = -72$ k-cal

The energy required for combustion of 1.6 g of glucose is

(a) 0.064 k-cal (b) 0.64 k-cal
(c) 6.4 k-cal (d) 64 k-cal

81. When the heat of reaction at constant pressure is -2.5×10^3 cal and entropy change is 7.4 cal deg^{-1} at 25° C, the reaction is predicted as

(a) reversible (b) spontaneous
(c) non-spontaneous (d) irreversible

82. Which of the following is not expected to show paramagnetism?

(a) $[Ni(H_2O)]^{2+}$ (b) $Ni(CO)_4$
(c) $[Ni(NH_3)_4]^{2+}$ (d) $[Co(NH_3)_6]^{2+}$

83. In which of the following compounds, sulphur show maximum oxidation number?

(a) H_2SO_4
(b) SO_3
(c) $H_2S_2O_7$
(d) All have same oxidation number for sulphur

84. For the chemical reaction, $2O_3 \rightleftharpoons 3O_2$

The reaction proceed as follows

$O_3 \rightleftharpoons O_2 + O$ (fast)

$O + O_3 \longrightarrow 2O_2$ (slow)

The rate law expression will be

(a) $r = k'[O_3]^2$ (b) $r = k'[O_3]^2 [O_2]^{-1}$
(c) $r = k'[O_3][O_2]$ (d) Unpredictable

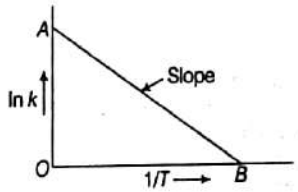
85. Which of the following is the correct order of stability for the given superoxides?

(a) $KO_2 < RbO_2 < CsO_2$ (b) $CsO_2 < RbO_2 < KO_2$
(c) $RbO_2 < CsO_2 < KO_2$ (d) $KO_2 < CsO_2 < RbO_2$

86. Among the following compounds, which will produce $POCl_3$ with PCl_5.

(a) Only O_2
(b) O_2 and CO_2
(c) CO_2, O_2 and P_4O_{10}
(d) SO_2, H_2O, H_2SO_4 and P_4O_{10}

87. In the following graph.



The slope of line AB gives the information of the

(a) value of $\frac{E_a}{2.303}$ (b) value of $\frac{2.303}{E_a}$
(c) value of $-\frac{E_a}{2.303\,R}$ (d) value of $-\frac{E_a}{2.303\,RT}$

88. Among the following compounds, which compound is polar as well as exhibit sp^2-hybridisation by the central atom

(a) H_2CO_3 (b) SiF_4
(c) BF_3 (d) $HClO_3$

89. Which one among the following is added to soap to impart antiseptic property?

(a) Sodium lauryl sulphate
(b) Sodium dodecyl benzene sulphonates
(c) Rosin
(d) Bithional

90. How many Faradays are required to reduce 1 mol of BrO_3^- to Br^-.

(a) 3 (b) 5
(c) 6 (d) 4

91. The energy released when 6 moles of octane is burnt in air will be [Given, ΔH_f for $CO_2(g)$, $H_2O(g)$ and $C_8H_{18}(l)$, respectively are – 490, – 240 and + 160 J/mol]

(a) – 37.4 kJ (b) – 20 kJ
(c) – 6.2 kJ (d) – 35.5 kJ

92. When I^- is oxidised by MnO_4^- in alkaline medium, I^- converts into

(a) IO_3^- (b) I_2
(c) IO_4^- (d) IO^-

93. The value of reaction quotient (Q), for the following cell

$Zn(s) \mid Zn^{2+}(0.01\ M) \mid\mid Ag^+\ (1.25\ M) \mid Ag(s)$ is

(a) 156 (b) 125
(c) 1.25×10^{-2} (d) 6.4×10^{-3}

94. When 750 mL of 0.5 M HCl is mixed with 250 mL of 2M NaOH solution, the value of pH will be

(a) pH = 7 (b) pH > 7
(c) pH < 7 (d) pH = 0

95. The most stable carbonium ion among the following is

(a) $C_6H_5-CH_2\overset{+}{C}H_2$ (b) $CH_3\overset{+}{C}H_2$
(c) $C_6H_5-\overset{+}{C}-C_6H_5$ (d) $C_6H_5\overset{+}{C}H_2$

96. Which of the following is not applicable to the phenomenon of adsorption?

(a) $\Delta H > 0$
(b) $\Delta G < 0$
(c) $\Delta S < 0$
(d) $\Delta H < 0$

97. In cyamide extraction process of silver from argentite ore, the oxidising and reducing agents are respectively.

(a) O_2 and CO_2
(b) O_2 and Zn dust
(c) HNO_3 and Zn dust
(d) HNO_3 and CO

98. The product of acid hydrolysis of (P) and (Q) can be distinguished by

$P \Rightarrow H_2C=C(CH_3)-O-COCH_3$

$Q \Rightarrow CH_3-CH=CH-OCOCH_3$

(a) Lucas reagent (b) 2, 4-DNP
(c) Fehling's solution (d) $NaHSO_3$

99. Clemmensen reaction of ketone is carried out in the presence of

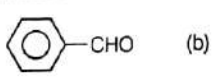
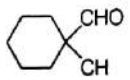
(a) $LiAlH_4$
(b) Zn-Hg with HCl
(c) glycol with KOH
(d) H_2 with Pt as catalyst

100. The standard reduction potential for Zn^{2+}/Zn, Ni^{2+}/Ni and Fe^{2+}/Fe are – 0.76, – 0.23 and – 0.44 V, respectively.

The reaction $X + Y^{2+} \longrightarrow X^{2+} + Y$ will be spontaneous when

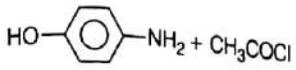
(a) X = Ni, Y = Fe
(b) X = Ni, Y = Zn
(c) X = Fe, Y = Zn
(d) X = Zn, Y = Ni

101. Cannizzaro reaction is not shown by

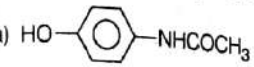
(a)  (b) 

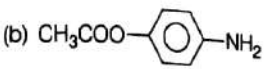
(c) CH_3CHO (d) HCHO

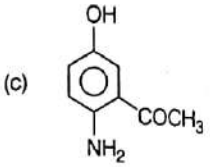
102. The main product formed in the following reaction is

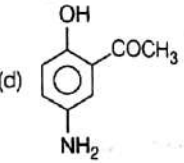


(1 equivalent) ⟶ Product.

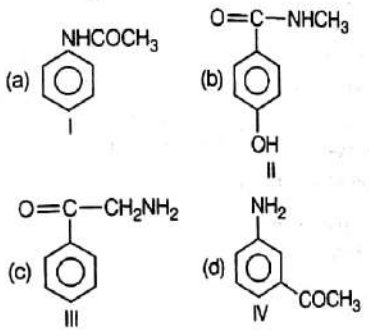
(a) 

(b) 

(c) 

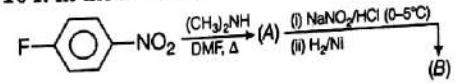
(d) 

103. The correct order of basic strength of the following are

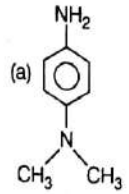


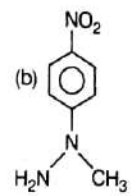
(a) I > II > III > IV
(b) IV > II > III > I
(c) III > IV > II > I
(d) III > II > IV > I

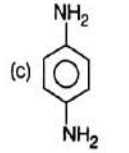
104. In the reaction,

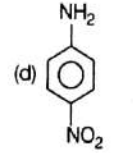


In the given reaction (B) is

(a) 

(b) 

(c) 

(d) 

105. Polymer formation from monomers starts by

(a) condensation reaction between monomers
(b) coordination reaction between monomers
(c) conversion of one monomer into other monomer
(d) hydrolysis of monomers

106. Match the type of series given in Column I with the wavelength range given in Column II and choose the correct option.

Column I	Column II
A. Lyman	1. Ultraviolet
B. Paschen	2. Near infrared
C. Balmer	3 Far infrared
D. Pfund	4. Visible

Codes

	A	B	C	D
(a)	1	2	4	3
(b)	4	3	1	2
(c)	3	1	2	4
(d)	4	3	2	1

107. Which of the following coordination compounds would exhibit optical isomerism?

(a) Pentamminenitrocobalt (III) iodide
(b) *Tris*-(ethylenediamine) cobalt (III) bromide
(c) *Trans*-dicyanobis (ethylenediamine)
(d) Diamminedinitroplatinum (II)

108. The electrons identified by quantum numbers n and l, are as follows

I. $n = 4, l = 1$
II. $n = 4, l = 0$
III. $n = 3, l = 2$
IV. $n = 3, l = 1$

If we arrange them in order of increasing energy, i.e. from lowest to highest, the correct order is

(a) IV < II < III < I (b) II < IV < I < III
(c) I < III < II < IV (d) III < I < IV < II

109. On hydrolysis of starch, we finally get

(a) glucose (b) fructose
(c) Both (a) and(b) (d) sucrose

110. Which of the following sodium compound/compound(s) are formed when an organic compound containing both nitrogen and sulphur is fused with sodium?

(a) Cyanide and sulphide
(b) Thiocyanate
(c) Sulphite and cyanide
(d) Nitrate and sulphide

111. Which of the following region is coldest?

(a) Stratosphere (b) Troposphere
(c) Mesosphere (d) Thermosphere

112. A solid *AB* has NaCl structure. If the radius of cation A^+ is 170 pm, then the maximum possible radius of the anion B^- is

(a) 397.4 pm (b) 347.9 pm
(c) 210.9 pm (d) 410.6 pm

113. A first order reaction is 50% completed in 1.26×10^{14} s. How much time would it takes for 100% completion?

(a) 1.26×10^{15} s (b) 2.52×10^{14} s
(c) 2.52×10^{28} s (d) Infinite

114. Flux is used to

(a) remove all type of impurities
(b) reduce metal oxide
(c) remove carbonate and sulphate
(d) remove silica and undesirable metal oxides

115. Sulphur reacts with chlorine in 1 : 2 ratio and forms *X*. Hydrolysis of *X* gives a sulphur compound *Y*. The hydridisation of central atom in the anion *Y* is

(a) sp^3 (b) sp^2 (c) sp^3d (d) sp

116. Aqueous 10% $NaHCO_3$ solution is used as a reagent for identifying '*A*'. Which of the following compounds yield '*A*' on hydrolysis?

(a) $CH_3COOC_2H_5$ (b) $C_2H_5—COO—C_2H_5$
(c) CH_3CHO (d) CH_3CH_2OH

117. Which of the following fibres is made of polyamides?

(a) Dacron (b) Orion
(c) Nylon (d) Rayon

118. Consider the following reaction,

$$X \xrightarrow{\text{Bromination}} Y \xrightarrow[+\ HCl]{NaNO_2}$$

$$Z \xrightarrow[C_2H_5OH]{\text{Boiling}} \text{Tribromo-benzene.}$$

X is

(a) benzoic acid (b) salicylic acid
(c) phenol (d) aniline

119. The volume of water to be added to 100 cm^3 of 0.5 N H_2SO_4 to get decinormal concentraction is

(a) 100 cm^3 (b) 450 cm^3 (c) 500 cm^3 (d) 400 cm^3

120. In which of the following, the oxidation number of oxygen has been arranged in increasing order?

(a) $BaO_2 < KO_2 < O_3 < OF_2$
(b) $OF_2 < KO_2 < BaO_2 < O_3$
(c) $BaO_2 < O_3 < OF_2 < KO_2$
(d) $KO_2 < OF_2 < O_3 < BaO_2$

BIOLOGY

121. One of the breeding techniques useful to eliminate harmful recessive genes by selection is

(a) artificial insemination
(b) outbreeding
(c) inbreeding
(d) MOET

122. Herbicide that blocks electron transport from PS-II to PS-I by inhibiting electron flow between plastoquinone → cytochrome is

(a) DCMU (b) Paraquat
(c) DCPIP (d) None of these

123. **Statement I** Microtubules are formed only in animal cells.

Statement II Microtubules are made up of a protein called myosin.

Choose the correct option

(a) Statement I is correct and statement II is incorrect.
(b) Statement II is correct and statement I is incorrect.
(c) Both statements are correct.
(d) Both statements are incorrect.

124. Some functions of nutrient element are given below

I. Important constituent of proteins involved in ETS.
II. Activator of catalase.
III. Important constituent of cytochrome.
IV. Essential for chlorophyll synthesis.

The concerned nutrient is

(a) Cu (b) Fe
(c) Ca (d) Mo

125. Torsion of visceral mass is seen in animals belonging to class

(a) Cephalopoda (b) Scaphopoda
(c) Amphineura (d) Gastropoda

126. A plant is provided with ideal conditions for photosynthesis and supplied with isotope 14 CO_2. When the products of the process are analysed carefully, what would be the nature of products?

(a) Glucose and oxygen are labelled
(b) Oxygen is labelled, but glucose is normal
(c) Glucose and oxygen are normal
(d) Glucose is labelled, but oxygen is normal

127. Match the following columns.

Column I	Column II
A. Sacral nerves	1. 1 Pair
B. Thoraic nerves	2. 8 Pairs
C. Cocygeal nerves	3. 7 Pairs
D. Cervical nerves	4. 12 Pairs
	5. 5 Pairs

Codes

	A	B	C	D
(a)	4	1	3	2
(b)	5	3	1	2
(c)	5	4	1	2
(d)	2	5	3	1

128. Pick the hormone which is not secreted by human placenta.

(a) hCG (b) hPL
(c) Prolactin (d) Oestrogen

129. Fixation of one CO_2 molecule through Calvin cycle requires.

(a) 1 ATP and 2$NADPH_2$
(b) 2 ATP and 2$NADPH_2$
(c) 3ATP and 2$NADH_2$
(d) 2ATP and 1$NADPH_2$

130. Oxygen dissociation curve of haemoglobin is

(a) sigmoid (b) hyperbolic
(c) linear (d) hypobolic

131. A hormone, secreted by the endocrinal cells of duodenal mucosa which influences the release of pancreatic juice is

(a) relaxin
(b) cholecystokinin
(c) secretin
(d) progesterone

132. Cotyledons and testa are edible parts of

(a) ground nut and pomegranate
(b) walnut and tamarind
(c) french bean and coconut
(d) cashew nut and litchi

133. Intrinsic and extrinsic pathways of blood clotting are interlinked at the activation steps of which of the following factors?
(a) Factor IX (b) Factor IV
(c) Factor X (d) Factor XIII-a

134. Match the storage products listed under column I with the organism given under column II, choose the appropriate option from the given options

Column I	Column II
A. Glycogen	1. *Sargassum*
B. Pyrenoids	2. *Nostoc*
C. Laminarin and mannitol	3. *Polysiphonia*
D. Floridean starch	4. *Spirogyra*
	5. *Agaricus*

Codes

	A	B	C	D
(a)	3	4	1	5
(b)	4	3	5	2
(c)	5	4	1	3
(d)	2	1	4	3

135. With respect to angiosperms, identify the incorrect pair from the following
(a) antipodal —2*n*
(b) vegetative all of male gametophyte —*n*
(c) primary endosperm nucleus —3*n*
(d) cell of nucellus of ovule —2*n*

136. The globular head of myosin contains
(a) calcium ions in large quantities
(b) troponin
(c) ATPase enzyme
(d) ATP

137. Parbhani Kranti, a variety of bhindi (lady finger) is resistant to
(a) bacterial blight (b) yellow mosaic virus
(c) black rot (d) leaf curl

138. Gastrula is the embryonic stage in which
(a) cleavage occurs (b) blastocoel forms
(c) germinal layers form (d) villi form

139. Dense regular connective tissue is present in
(a) ligament and tendons
(b) joint capsule and Wharton's Jelly
(c) periosteum and endosteum
(d) pericardium and heart valves

140. Minisatellites or VNTR's are used in
(a) DNA fingerprinting
(b) Polymerase Chain Reaction, (PCR)
(c) gene therapy
(d) gene mapping

141. Note the following features and choose the ones applicable to *Wuchereria bancrofti*.
I. Coelozoic parasite
II. Histozoic parasite
III. Monogenetic parasite
IV. Digenetic parasite
V. Monomorphic, acoelomate parasite
VI. Dimorphic, pseudocoelomate parasite
(a) II, III, V (b) II, III, VI
(c) II, IV, VI (d) I, III, VI

142. *hn*RNA undergoes two additional process. Out of them in one process an unusual nucleotide (methyl GPT) is added to the 5' end of molecule. What would you called this?
(a) Tailing (b) Splicing
(c) Termination (d) Capping

143. Which type of immunoglobin is/are abundantly found in foetus?
(a) IgE (b) IgG
(c) IgM (d) IgD

144. IUCN stands for
(a) Indian Union for Conservation of Nature
(b) International Union for Conservation of Nature
(c) Indian Union for Chemical Nomenclature
(d) International Union for Conservation of Nutrients

145. The secretory phase in the human menstrual cycle is also called as
(a) luteal phase and last for about 6 days
(b) follicular phase lasting for about 6 days
(c) luteal phase and last for about 13 days
(d) follicular phase and last for about 13 days

146. Which one of the following statements is correct?
(a) Hard outer layer of pollen is called intine
(b) Sporogenous tissue is haploid
(c) Endothelium produces the microspores
(d) Tapetum nourishes the developing pollen

147. Variation in gene frequencies within population can occur by chance rather than by natural selection. This is reffered to as
(a) genetic flow (b) genetic drift
(c) random mating (d) genetic load

148. The first stable product of fixation of atmospheric nitrogen in leguminous plant is
(a) NO_2^- (b) ammonia
(c) NO_3^- (d) glutamate

149. If two persons with 'AB' blood group marry and have suffeciently large number of children, these children could be classified as 'A' blood group. 'AB blood group 'B' blood group in 1 : 2 : 1 ratio.

Modern technique of protein electrophoresis reveals presence of both 'A' and 'B' type proteins in 'AB' blood group individuals. This is an example of
(a) codominance
(b) incomplete dominance
(c) partial dominance
(d) complete dominance

150. Which of the following DNA sequences qualifies to be designated as a palindrome?
(a) 5'-GACCAG-3' in one strand
(b) 3'-GACCAG-5' in one strand
(c) 5'-GACGAG-3', 3'-CIGGIC-5'
(d) 5'-AGCGCT-3', 3'-TCGCGA-5'

151. Which one of the following pairs is not correctly matched?

(a)	Vitamin-B_{12}	Pernicious anaemia
(b)	Vitamin-B_6	Loss of appetite
(c)	Vitamin-B_1	Beri-beri
(d)	Vitamin-B_2	Pellagra

152. Humoral immunity is mediated by
(a) R-cells (b) T-cells
(c) NK-cells (d) plasma cells

153. In the lac operon model, lactose molecules function as
(a) inducers, which bind with the operator gene
(b) repressors, which bind with the operator gene
(c) inducers, which bind with the repressor protein
(d) corepressors, which bind with repressor protein

154. Which one of the following generally acts as an antagonist to gibberellins?
(a) Zeatin (b) Ethylene (c) ABA (d) IAA

155. The ornithine cycle removes two waste products from the blood in liver. These products are
(a) CO_2 and urea
(b) ammonia and urea
(c) CO_2 and ammonia
(d) ammonia and uric acid

156. Macromolecule chitin is
(a) nitrogen containing polysaccharide
(b) phosphorous containing polysaccharide
(c) sulphur containing polysaccharide
(d) simple polysaccharide

157. Which of the following statement is correct in relation to the endocrine system?
(a) Adenohypophysis is under direct neural regulation of the hypothalamus
(b) Organs in the body like gastro-intestinal tract, heart, kidney and liver do not produce any hormones
(c) Non-nutrient chemicals produced by the body in trace amount that act as inter-cellular messanger are known as hormones
(d) Releasing and inhibitory hormones are produced by the pituitary gland

158. Following are the two statements regarding the origin of life.
I. The earliest organisms that appeared on the earth were non-green and presumably an aerobes.
II. The first autotrophic organisms were the chemoautotrophs that never released oxygen of the above statements which on of the following options is correct?
(a) II is correct, but I is false
(b) Both I and II are correct
(c) Both I and II are false
(d) I is correct, but II is false

159. Taxonomic key is one of the taxonomic tools in the identification and classification of plants and animals. It is used in the preparation of
(a) monographs (b) flora
(c) Both (a) and (b) (d) None of these

160. Match the following columns.

Column I	Column II
A. Pinocytosis	1. *Euglena gracilis*
B. Holozoic	2. *Paramecium*
C. Parasitic	3. *Amoeba proteus*
D. Mixotrophic	4. *Monocystis*

Codes

	A	B	C	D
(a)	3	2	4	1
(b)	2	3	4	1
(c)	4	3	1	2
(d)	1	4	2	3

161. Phellogen and phellem respectively denote
(a) cork and cork cambium
(b) cork cambium and cork
(c) secondary cortex and cork
(d) cork and secondary cortex

162. Which one of the following combinations is incorrect?

(a) Rio convention	Air pollution
(b) Kyoto protocol	Climate change
(c) Montreal protocol	Ozone depletion
(d) Ramsar convention	Wetland conservation

163. 'Organ of Jacobson' helps in
(a) touch (b) vision (c) smell (d) hearing

164. Which one correctly describe reproduction and life cycle of fern?
(a) Spore → Gamete → Prothallus → Sporophyte
(b) Gamete → Spore → Prothallus → Plant
(c) Prothallus → Sporophyte → Gamete → Fern
(d) Sporangia → Spore → Prothallus → Sporophyte → Plant

165. Monoclonal antibodies and polyclonal antibodies are produced by
(a) T-memory cells
(b) NK-cells
(c) plasma cells of B-lymphocytes
(d) memory cells of B-lymphocytes

166. All monerons
(a) contain DNA and RNA
(b) demonstrate a long circular strand of DNA, not formed enclosed in a nuclear membrane
(c) are bacteria
(d) All of the above

167. Match the following columns

Column I	Column II
A. *Opuntia*	1. Stem thorns
B. *Asparagus*	2. Phylloclades
C. *Citrus*	3. Cladodes

Codes

	A	B	C
(a)	1	2	3
(b)	2	3	1
(c)	3	2	1
(d)	2	1	3

168. The chromosome in which centromere is situated close to one end are
(a) metacentric (b) acrocentric
(c) telocentric (d) sub-metacentric

169. Sliding filament theory can be best explained as
(a) when myofilaments slide pass each other actin filaments shorten while myosin filament donot shorten
(b) actin myosin filaments shorten and slide pass each other
(c) actin and myosin filaments do not shorten, but rather slide pass each other
(d) when myofilament slide pass each other myosin filament shorten while actin filament do not shorten

170. Select the correct combination of statements regarding Myasthenia gravis
I. It is an auto immune disorder.
II. It causes insufficient acetylcholine binding that effects muscular contraction.
III. Antibodies are developed against acetylcholine.
IV. Antibodies are developed against acetylcholine receptors.
V. It causes drooping of eyelids.
(a) I, III, IV, VI (b) I, III, V, II
(c) I, II, IV, VI (d) II, III, IV, V

171. Study the following statements and select the option with correct statements.
I. Pulvinus leaf base is present in some leguminous plants.

II. In *Eichhornia* the petioles expand, becomes green and synthesise food.
III. Opposite phyllotaxy is seen in guava.
(a) I and II
(b) I and III
(c) II and III
(d) I, II and III

172. The method of directly injecting a sperm into ovum in assisted reproductive technology is called
(a) GIFT (b) ZIFT
(c) ICSI (d) ET

173. Appearance of antibiotic resistant bacteria is an example of
(a) adaptive radiation
(b) transduction
(c) pre-existing variation
(d) divergent evolution in the population

174. Post mitotic gap phase is characterised by all, except
(a) synthesis of RNA and nucleotides
(b) no change in DNA content
(c) synthesis of histone proteins
(d) growth phase of the cell

175. Munch hypothesis is based on
(a) translocation of food due to Turgor Pressure (TP) gradient and imbibition force
(b) translocation of food due to Turgor Pressure (TP) gradient
(c) translocation of food due to imbition force
(d) None of the above

176. Match the following columns

Column I	Column II
A. Molecular oxygen	1. α-ketoglutaric acid
B. Electron acceptor	2. Hydrogen acceptor
C. Pyruvate dehydrogenase	3. Cytochrome-C
D. Decarboxylation	4. Acetyl Co-A

Codes

	A	B	C	D
(a)	2	3	4	1
(b)	3	4	2	1
(c)	2	1	3	4
(d)	4	3	1	2

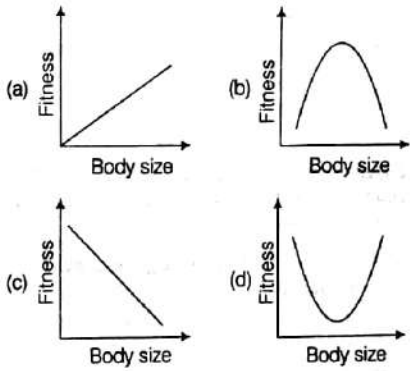
177. Roquefort cheese is ripened by using a
(a) type of yeast (b) fungus
(c) bacterium (d) cyanobacteria

178. Identify the wrong combination

(a) *Dryopteris*	Rhizome
(b) *Cycas*	Coralloid roots
(c) *Volvox*	Colonial form
(d) *Marchantia*	Pseudoelaters

179. Foramen ovale
(a) connects the two atria in the foetal heart.
(b) is a condition in which the heart valves do not completely close
(c) is a shallow depression in the inter ventricular septum
(d) is a connection between the pulmonary trunk and the aorta in the foetus

180. Which one of the following graphs correctly describes disruptive selection? When studying fitness level associated with body size?



ENGLISH & QUANTITATIVE REASONING

Directions (Q. Nos. 181-183) *Choose the word which best expresses the meaning of the underlined word in the sentence*

181. Decay is an <u>immutable</u> factor of human life.
(a) important (b) unique
(c) unchangeable (d) awful

182. It was an <u>ignominious</u> defeat for the team.
(a) shameful (b) admirable
(c) unaccountable (d) worthy

183. His <u>conjecture</u> was better than mine.
(a) guess (b) fact
(c) surprise (d) doubt

Directions (Q. Nos. 184-186) *Fill in the blank.*

184. Freedom and equality are the ..... rights of every human.
(a) inalienable
(b) inscrutable
(c) incalculable
(d) incredible

185. Pradeep's face spoke ..... for the happiness he was feeling.
(a) elegantly (b) tons
(c) volumes (d) much

186. His speech was disappointing : it ..... all the major issues.
(a) projected (b) revealed
(c) skirted (d) analysed

Directions (Q. Nos. 187-189) Choose the word which is closest to the opposite in meaning of the following sentence.

187. Hydra is biologically believed to be **immortal.**
(a) undying (b) perishable
(c) ancient (d) eternal

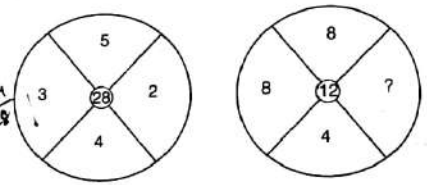
188. The Gupta rulers **advocated** all cultural activities and thus Gupta period was called the golden era in Indian History.
(a) fostered (b) enriched
(c) opposed (d) spurned

189. This is a **barbarous** act.
(a) bad (b) good
(c) civilised (d) exemplary

190. Though **novice** in art shows great promise.
(a) tyro (b) inexperienced
(c) veteran (d) green horn

191. If 15th August 2011 was Tuesday, then what day of the week was it on 17th September, 2011?
(a) Thursday (b) Friday
(c) Saturday (d) Sunday

192. In the following question, five figures are given. Out of them, find the three figures that can be joined to form a square.



(a) 1 (b) 2
(c) 4 (d) 5

193. In a certain code language, 'DOME' is written as '8943' and 'MEAL' is written as '4321'. What group of letters can be fomed for the code '38249'?
(a) EOADM (b) MEDOA
(c) EDAMO (d) EMDAO

194. Replace the question mark(?) in the series given below with the correct option.
4, 5, 7, 11, 19, 35, ?
(a) 67 (b) 76
(c) 55 (d) 45

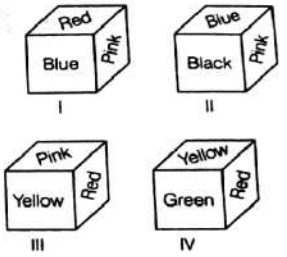
195. Complete the series by replacing '?' mark.
G4T, J9R, M20P, P43N, S90L, ?
(a) S90L (b) V185J
(c) M20P (d) P43N

196. Neeraj starts walking towards South. After walking 15 m, he turns towards North. After walking 20 m, he turns towards East and walks 10 m. He then turns towards South and walks 5 m. How far is he from his original position and in which direction?
(a) 10 m, East
(b) 10 m, South-East
(c) 10 m, West
(d) 10 m, North-East

197. Shikha is mother-in-law of Ekta who is sister-in-law of Ankit. Pankaj is father of Sanjay, the only brother of Ankit. How is Shikha related to Ankit?
(a) Mother-in-law
(b) Aunt
(c) Wife
(d) Mother

198. In a row of forty children, P is thirteenth from the left end and Q is ninth from the right en(d) How many children are there between P and R, if R is fourth to the left of Q?
(a) 12 (b) 13
(c) 14 (d) 15

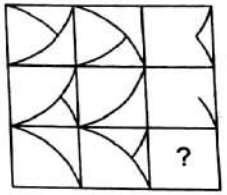
199. From the given four positions of a single dice, find the colour at the face opposite to the face having red colour.



(a) Yellow (b) Pink (c) Green (d) Black

200. Choose the answer figure which completes the problem figure matrix.

Problem Figure



Answer Figures



(a) (b) (c) (d) (e)

ANSWERS

Physics

1. (b)	2. (a)	3. (c)	4. (b)	5. (a)	6. (b)	7. (d)	8. (a)	9. (c)	10. (b)
11. (c)	12. (d)	13. (d)	14. (c)	15. (a)	16. (a)	17. (d)	18. (c)	19. (b)	20. (d)
21. (a)	22. (a)	23. (a)	24. (b)	25. (b)	26. (c)	27. (c)	28. (b)	29. (c)	30. (b)
31. (b)	32. (c)	33. (a)	34. (d)	35. (c)	36. (b)	37. (c)	38. (b)	39. (c)	40. (c)
41. (b)	42. (c)	43. (d)	44. (b)	45. (b)	46. (a)	47. (b)	48. (d)	49. (d)	50. (a)
51. (d)	52. (d)	53. (c)	54. (d)	55. (d)	56. (b)	57. (c)	58. (a)	59. (a)	60. (c)

Chemistry

61. (b)	62. (a)	63. (d)	64. (c)	65. (a)	66. (b)	67. (a)	68. (c)	69. (b)	70. (d)
71. (d)	72. (a)	73. (b)	74. (b)	75. (c)	76. (a)	77. (c)	78. (b)	79. (d)	80. (b)
81. (b)	82. (b)	83. (d)	84. (b)	85. (a)	86. (d)	87. (c)	88. (a)	89. (d)	90. (c)
91. (d)	92. (a)	93. (d)	94. (b)	95. (c)	96. (d)	97. (b)	98. (c)	99. (b)	100. (d)
101. (c)	102. (a)	103. (d)	104. (a)	105. (a)	106. (a)	107. (b)	108. (a)	109. (a)	110. (b)
111. (c)	112. (d)	113. (d)	114. (d)	115. (a)	116. (a)	117. (c)	118. (d)	119. (d)	120. (a)

Biology

121. (c)	122. (a)	123. (d)	124. (b)	125. (d)	126. (d)	127. (c)	128. (c)	129. (c)	130. (a)
131. (b)	132. (a)	133. (c)	134. (c)	135. (a)	136. (c)	137. (b)	138. (c)	139. (a)	140. (a)
141. (c)	142. (d)	143. (b)	144. (b)	145. (c)	146. (d)	147. (b)	148. (b)	149. (a)	150. (d)
151. (d)	152. (d)	153. (c)	154. (c)	155. (b)	156. (a)	157. (c)	158. (b)	159. (b)	160. (a)
161. (b)	162. (a)	163. (c)	164. (d)	165. (c)	166. (d)	167. (a)	168. (b)	169. (b)	170. (c)
171. (b)	172. (c)	173. (c)	174. (c)	175. (b)	176. (a)	177. (b)	178. (d)	179. (a)	180. (d)

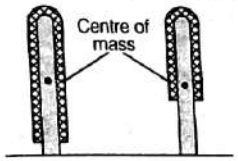
English & Quantitative Reasoning

181. (c)	182. (a)	183. (a)	184. (d)	185. (c)	186. (c)	187. (b)	188. (c)	189. (c)	190. (c)
191. (d)	192. (a)	193. (d)	194. (b)	195. (d)	196. (b)	197. (c)	198. (a)	199. (a)	200. (c)

HINTS & SOLUTIONS

Physics

1. ***(b)*** The work done against gravity can be calculated from the increases in height of the centre of mass. The centre of mass of a worm folded in two is located at the middle of either half, i.e. at a point one-quarter of the worm's total length from one end, as given in the figure below:



Thus, the centre of mass of the narrow flat worm travels 5 cm up the wall, while that of the broad one moves 7.5 cm. Hence, work done by 10 cm worm is more against gravity. Also,the ratio of the work done is 2 : 3.

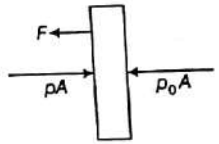
2. ***(a)*** The rocket has to reach the highest possible total energy. If the zero level of gravitational potential energy is 'infinitely' far away, then the energy of the rocket standing on the surface of the earth is negative. The energy released during the operation of the engines increases the total energy of the rocket, and the rocket can leave, the earth's gravitational field if the sum of its potential and kinetic energies becomes positive.

The energy released in the course of the operation of the principal and auxiliary engines increases the total energy of the rocket and its ejected combustion products by a fixed value; this increase is independent of the moment when the engines are scratched on. However, the speed at which the combustion products fall back to the earth does depend on the timing of the rocket's operations. Indeed, if the auxiliary engine starts working when the rocket is at a greater height, the combustion products fall further and their speed and total energy are higher when they hit the ground. This means that the sooner the auxiliary engine is switched on, the higher the energy ultimately acquired by the rocket. The same argument is valid for the principal engine, and if the only energy consideration apply, it is best to operate the engines for the shortest time and at the highest thrust.

3. ***(c)*** The cross-sectional area of the space to be filled is fixed, whilst that of the wire varies as d^2. Thus, $n \propto d^{-2}$. The resistance of one turn is inversely proportional to the cross-sectional area of the wire, i.e. varies as d^{-2} and hence the resistance per unit length of the solenoid is $R \propto nd^{-2} \propto d^{-4}$. The flux density B is $\propto nI$ and therefore the required current $I \propto n^{-1} \propto d^2$. The heat dissipated per unit length is RI^2, which $\propto d^{-4}(d^2)^2$, i.e. independent of d. Thus, within limits, it does not matter what diameter wire is chosen so far as the heating effect is concerned.

4. ***(b)*** Volume of the gas is constant i.e. V =constant

$\therefore \quad p \propto T$ i.e. pressure will be doubled if temperature is doubled.



Let F be the tension in the wire. Then, equilibrium of any one pipes gives.

$F = (p - p_0)A = (2p_0 - p_0)A = p_0A$

5. ***(a)*** Given, $V = kx^3$

Total energy (E) = Maximum potential energy

$= ka^3$

From conservation of energy

$$\frac{1}{2}m\left(\frac{dx}{dt}\right)^2 + kx^2 = ka^3$$

$$\Rightarrow \quad \frac{1}{2}m\left(\frac{dx}{dt}\right)^2 = k(a^3 - x^3)$$

$$\Rightarrow \quad \frac{dx}{dt} = \sqrt{\frac{2k}{m}(a^3 - x^3)}$$

$$\frac{dx}{\sqrt{a^3 - x^3}} = \sqrt{\frac{2k}{m}}\,dt$$

or Integrating $\int_0^a \frac{dx}{\sqrt{a^3 - x^3}} = \sqrt{\frac{2k}{m}} \int_0^{T/4} dt$

or $\int_0^a \frac{dx}{\sqrt{a^3 - x^3}} = \sqrt{\frac{2k}{m}} \frac{T}{4}$

Let $x = a\sin\theta \Rightarrow dx = a\cos\theta d\theta$

$\therefore \int_0^{\pi/2} \frac{a\cos\theta d\theta}{\sqrt{a^3 - (a\sin\theta)^3}} = \sqrt{\frac{2k}{m}} \frac{T}{4}$

6. *(b)* Let v be initial velocity of vertical projection and t be the time taken by the body to reach a height h from ground.

Here, $u = u$, $a = -g$, $s = h$, $t = t$

Using, $s = ut + \frac{1}{2}at^2$, we have

$h = ut + \frac{1}{2}(-g)t^2$ or $gt^2 - 2ut + 2h = 0$

$\therefore t = \frac{2u \pm \sqrt{4u^2 - 4g \times 2h}}{2g} = \frac{u \pm \sqrt{u^2 - 2gh}}{g}$

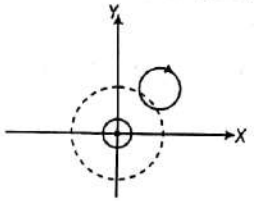
It means t has two values, i.e.

$t_1 = \frac{u + \sqrt{u^2 - 2gh}}{g}$

$t_2 = \frac{u - \sqrt{u^2 - 2gh}}{g}$

$t_1 + t_2 = \frac{2u}{g}$ or $u = \frac{g(t_1 + t_2)}{2}$

7. *(d)* Situation is shown in the figure given below



Thus, the force depends on the distance of the centre of the loop from the wire.

8. *(a)* Due to emission of 3α particles, the mass number is reduced by 12 while atomic number is decreased by 6. Due to emission of β particle, the atomic number is increased by one while there is no change in mass number. Now, resulting mass will be decreased by 12 and atomic number is decreased by 5. So, isotope X is ${}_{83}X^{214}$.

9. *(c)* Let x be the extension in the spring,

Then, $x = 2R\theta$

$\therefore$ Torque acting on the cylinder about point of contact,

$T = F \times 2R = -Kx(2R) = -4R^2K \cdot \theta$

$\therefore T = 2\pi\sqrt{\frac{I}{Ke}} = 2\pi\sqrt{\frac{\frac{3}{2}MR^2}{4R^2K}} = 2\pi\sqrt{\frac{3M}{8K}}$

10. *(b)* As each are containing n lamps, hence,

Resistance of each arc $= nr$

Number of arcs $= N/n$

Total resistance S is given by

$$\frac{1}{S} = \Sigma\frac{1}{nr} = \frac{N}{n}\left(\frac{1}{nr}\right)$$

$$S = \frac{n^2r}{N}$$

$\therefore$ Total resistance $= R + S = R + (n^2r)N$

If E is the emf of the machine, current entering the arcs is $E/(R+S)$ and in each arc is $nE/(R+S)N$.

Hence, current passing through each lamp

$$I = \frac{nE}{N(R + n^2r/N)} = \frac{E}{N}\left[\frac{R}{n} + \frac{nr}{N}\right]^{-1}$$

Now, heat produced per second in the lamps is

$H = N_r I^2$

Since, light emitted is proportional to H^2 therefore light produced is maximum when H^2 and hence H is maximum or $\left[\frac{R}{n} + \frac{nr}{N}\right]$ is minimum. Hence, we can write,

$$\frac{R}{n} + \frac{nr}{N} = \left[\left(\frac{R}{n}\right)^{1/2} - \left(\frac{nr}{N}\right)^{1/2}\right]^2 + 2\left(\frac{Rr}{N}\right)^{1/2}$$

This is minimum when $\sqrt{R/n} - \sqrt{nr/N} = 0$

or very small or n is closely equal to $(NR/r)^{1/2}$.

11. *(c)* Let M_0 be initial mass of $Rn - 220$

Number of half-lives of Rn in 5 minutes $= \frac{5\text{ min}}{55\text{s}}$

$$= \frac{5 \times 60}{55} \approx 5 \cdot 5$$

$\therefore$ Mass of $Rn - 220$ (left) $= \left(\frac{1}{2}\right)^{5\cdot5} M_0 = \frac{M_0}{45}$

$\therefore$ The mass converted into $Po - 216$ is (44/45) M_0, Number of half-lives of $Po - 216$ in 5 minutes

$= \frac{5\text{ min}}{0\cdot66} = \frac{300}{0\cdot66} \approx 455$

$\therefore$ Mass of $Po - 216$ left $= \left(\frac{1}{2}\right)^{455} \times \frac{44}{45} M_0 \longrightarrow 0$

This means that $Po - 216$ formed will soon decay to lead. Hence, lead will have maximum mass nearly $\left(\frac{44}{45}\right) M_0$

12. *(d)* Cross-sectional area $A = \pi r^2$,

Volume of liquid flowing per second $= AV = \pi r^2 v$

Mass of the liquid flowing out per second $= \pi r^2 v\rho$

Initial momentum of liquid per second

= mass of liquid flowing × Speed of liquid

$= \pi r^2 v\rho \times v = \pi r^2 v^2 \rho$

Since the liquid does not rebound after impact, the momentum after impact is zero.

$\therefore$ Rate of change of momentum $= \pi r^2 v^2 \rho$

According to Newton's second law, the force exerted on wall

= rate of change of momentum $= \pi r^2 \rho v^2$

13. *(d)* $x = a\cos(pt)$, $y = b\sin(pt)$

$\therefore \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, i.e. equation of ellipse

Now, $r = x\hat{\mathbf{i}} + y\hat{\mathbf{j}} = a\cos(pt)\,\hat{\mathbf{i}} + b\sin(pt)\hat{\mathbf{j}}$

$v = \frac{dr}{dt} = -pa\sin(pt)\,\hat{\mathbf{i}} + pb\cos(pt)\hat{\mathbf{j}}$

$a = \frac{dv}{dt} = -p^2 a\cos(pt)\,\hat{\mathbf{i}} - p^2 b\sin(pt)\hat{\mathbf{j}}$

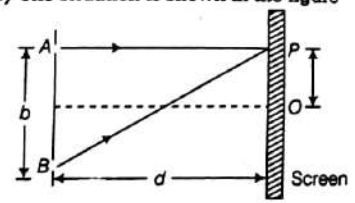
at $t = \frac{\pi}{2p}$

$v = -pa\hat{\mathbf{i}}$ and $\mathbf{a} = -p^2 b\hat{\mathbf{j}}$

v perpendicular to a

Also, $a = -p^2 r$, i.e. directed towards a fixed point

14. *(c)* The situation is shown in the figure



The path difference between the waves reaching the point P is

$\Delta p = BP - AP$

$= (d^2 + b^2)^{1/2} - d = d\left(1 + \frac{b^2}{d^2}\right)^{1/2} - d$

$\approx d\left[1 + \frac{1}{2}\frac{b^2}{d^2}\right] - d = \frac{b^2}{2d}$

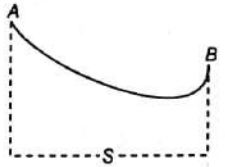
For a dark band

$\Delta p = \frac{b^2}{2d} = (2n-1)\frac{\lambda}{2}$

where, $n = 1, 2, 3$ or $\lambda = \frac{1}{(2n-1)} \cdot \frac{b^2}{d}$

Hence, the missing wavelengths are $\frac{b^2}{d}, \frac{b^2}{3d}, \frac{b^2}{5d}$, ...

15. *(a)* According to question, the situation is shown in the figure



For a sufficiently safe-horizontal displacement ΔS can be considered straight. If the corresponding length of path element is ΔL, the friction force is given by $\mu_{mg}\frac{\Delta S}{\Delta L}$ and the work done by the friction force equals force times displacement

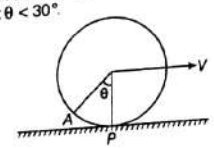
$\mu_{mg}\frac{\Delta S}{\Delta L}\Delta L = \mu_{mg}\Delta S$

Adding up, we find that along the whole path the total work done by the friction force is $\mu_{mg}s$. By energy conservation this must equals the decrease mgh in potential energy of skier.

Hence, $h = \mu S$

16. *(a)* We have, $V_A = 2v\sin\theta/2$

Hence, velocity of point on rim increases with θ for $0° < \theta < 180°$ and decreases with θ for $180° < \theta < 30°$.



17. *(d)* Acceleration due to gravity,

$$g = \frac{GM}{R^2} = \frac{4}{3}\pi\rho GR$$

$$\therefore \frac{g_1}{g_2} = \frac{\rho_1 R_1}{\rho_2 R_2}$$

Atmospheric pressure can be given by

$$p = \frac{W}{S}$$

where, W = Weight of atmosphere,

S = Surface area of the planet

$$\therefore \quad \frac{m_1}{m_2} = \frac{\rho_1 S_1 g_2}{\rho_2 S_2 g_1} = \frac{\rho_1 \cdot (4\pi R_1^2)}{\rho_2 (4\pi R_2^2)} \cdot \frac{\rho_2 R_1}{\rho_1 R_1} = \frac{\rho_1 R_1 \rho_2}{\rho_2 R_2 \rho_1}$$

18. *(c)* For first refracting surface,

For parallel beam of light; $-\frac{\mu_1}{u} + \frac{\mu_2}{V} = \frac{\mu_2 - 1}{R}$

$$\Rightarrow -\frac{1\cdot4}{-\infty} + \frac{1\cdot5}{V} = \frac{1\cdot5 - 1\cdot4}{R}$$

$$V = 15R$$

For second refracting surface,

$$-\frac{\mu_2}{1\cdot5R} + \frac{\mu_3}{V'} = \frac{\mu_3 - \mu_2}{R}$$

$$\Rightarrow -\frac{1\cdot5}{15R} + \frac{1\cdot6}{V'} = \frac{1\cdot6 - 1\cdot5}{R} \Rightarrow V' = \infty$$

Hence, the combination behaves as glass plate.

19. *(b)* Rate of change of mass, $\frac{dm}{dt} = avp$

$$\therefore \quad F = \frac{vdm}{dt} = (avp)v = av^2p$$

Volume of liquid flowing per second = av

This is proportional to velocity.

By doubling the volume of liquid flow per second, the force becomes four times. When liquid flows forward, the hose pipe tends to come backward. So, to keep it intact, it should be pushed forward. Thus, the hose pipe should be pushed forward four times.

20. *(d)* The de-Broglie wavelength

$$h = \frac{h}{mv} \Rightarrow v = \frac{h}{m\lambda} \qquad \ldots (i)$$

Energy of photon

$$E_p = \frac{hc}{\lambda} \text{ (since } \lambda \text{ is same)} \qquad \ldots (ii)$$

Energy of Photon

$$\text{Kinetic energy of photon} = \frac{E_p}{E_e} = \frac{hc/\lambda}{\frac{1}{2}1mu^2} = \frac{2hc}{\lambda mv^2}$$

Substituting value of v from Eq. (i), we get

$$\frac{E_p}{E_e} = \frac{2hc}{\lambda_m\left(\frac{h}{m\lambda}\right)^2} = \frac{2\lambda mc}{h}$$

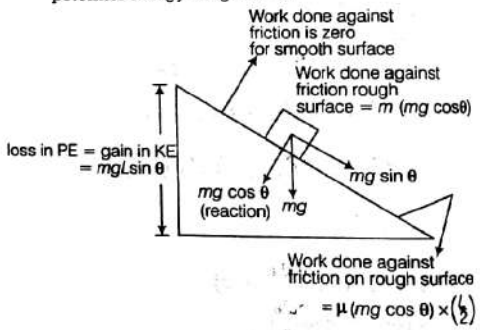
21. *(a)* From definition of potential difference $\int_{l=\infty}^{l=0} \mathbf{E}\cdot\mathbf{dl}$ = potential difference at infinity and at centre of ring $= V_{centre} - V_{infinity}$

But by convention $V_{infinity} = 0$ and $V_{centre} = \frac{1}{4\pi\varepsilon_0}\frac{q}{R}$

$$= 9\times10^9 \times \frac{1\cdot11\times10^{-10}}{0\cdot5} = 2 \text{ volt}$$

$$\therefore \int_{l=\infty}^{l=0}(-\mathbf{E}\cdot\mathbf{dl}) = 2 \text{ volt} - 0 \text{ volt} = 2 \text{ volt}$$

22. *(a)* Suppose length of plane is L. When block descends the plane, rise in kinetic energy = fall in potential energy = $mg\,L\sin\theta\,i$



Work done by friction = $\mu \times$ (reaction) $\times$ distance

$$0 + \mu\,(mg\cos\theta)\times(L/2)$$

$$= \mu\,(mg\cos\theta)\times(L/2)$$

Now, work done = change in KE

$$mgL\sin\theta = \mu\,(mg\cos\theta)\times(L/2)$$

$$\Rightarrow \quad \tan\theta = \mu/2$$

$$\therefore \quad \mu = 2\tan\theta$$

23. *(a)* Equation of motion of $m_1 = 10$ kg mass is

$$F_1 = m_1 a_1 = 10\times12 = 120 \text{ N}$$

Force on 10kg-mass is 120 N to the right. As action and reaction are equal and opposite, the reactions force F-on 20 kg mass $F = 120$ N to the left.

$\therefore$ Equation of motion of mass $m_2 = 20$ kg is

$$200 - F = 20\,a_2$$

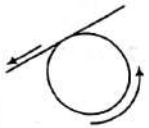
$$200 - 120 = 20a_2$$

$$20a_2 = 80$$

$$a_2 = \frac{80}{20} = 4 \text{ m/s}^2$$

24. *(b)* See given the figure.

It is obvious from figure, that during ascending, a retarding, i.e. anticlockwise moment is required. It should be remembered that torque due to friction has the same sense the angular acceleration.

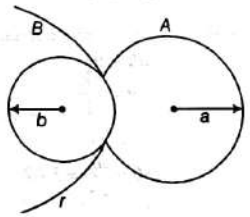


25. *(b)* For an incompressible liquid equation of continuity

$$AV = \text{constant or } A \propto \frac{1}{V}$$

Therefore, at the wider end speed below and at the narrow end speed will be high.

26. *(c)* According to given figure,



Let the radius of curvature of the common internal film surface of the double bubble formed by two bubbles be r. Excess of pressure as compared to atmosphere inside A is $(4T/a)$. In double bubble, the pressure difference between A and B on either side of the common surface

$$= \frac{4T}{b} - \frac{4T}{a}$$

This will be equal to $(4T/r)$

$$\therefore \quad \frac{4T}{r} = \frac{4T}{b} - \frac{4T}{a}$$

$$\text{or} \quad \frac{1}{r} = \left(\frac{1}{b} - \frac{1}{a}\right) = \frac{a-b}{ba} \text{ or } r = \frac{ab}{a-b}$$

27. *(c)* Given, $X = a\sin^2\omega t$

$$\text{or } X = a\left(\frac{1-\cos2\omega t}{2}\right) \qquad [\because \cos2\theta = 1 - 2\sin^2\theta]$$

$$\text{or } X = \frac{a}{2} - \frac{a\cos2\omega t}{2}$$

Now, $V = \frac{dx}{dt} = a\omega\sin2\omega t$

and $a = dv/dt = 2a\omega^2\cos2\omega t$

Here, a is not directly proportional to $(-x)$ which is a condition for SHM.

28. *(b)* If we fill nitrogen gas at high pressure above mercury level, the boiling point of mercury is increased which can extend to the range upto 500°(C).

29. *(c)* Let n_1 and n_2 be the number of moles in the bulbs at 0°C and 20°C, respectively. Then,

$$pV = 273n_1\,R = 293n_2R$$

$$\therefore \quad \frac{n_1}{n_2} = \frac{293}{273} \qquad \ldots (i)$$

When the vessels are heated, let the volume of low temperature be V_1 and that of the other be V_2. Since, pressure are same, hence

$$V_1 p = 283\,n_1 R \quad \text{and} \quad V_2 p = 303\,n_2 R$$

$$\therefore \quad \frac{V_1}{V_2} = \frac{283n_1}{303n_2} \qquad \ldots (ii)$$

From Eqs. (i) and (ii), we get

$$\frac{V_1}{V_2} = \frac{283}{303}\times\frac{293}{273} = 1$$

Thus, the mercury pellet remains at the same position.

30. *(b)* In the case of formation of nucleus the evolution of energy equals to the binding energy of the nucleus takes place due to disappearance of a fraction of total mass. If the quantity of mass disappearing is Δm, then the binding energy is

$$BE = \Delta mc^2$$

From the above discussion, it is clear that the mass of the nucleus must be less than the sum of the masses of the constituent neutrons and protons. We can then write

$$\Delta m = Zm_p - Nm_n - m(A, Z)$$

where $m(A, Z)$ is the mass of the atom of mass number A atomic number Z. Hence, the binding energy of nucleus is

$$BE = [Zm_p + Nm_n - m(A, Z)]c^2$$

$$BE = [Zm_p + (A - Z)m_n - m(A, Z)]c^2$$

31. *(b)* According to ideal gas equation, $pV = nRT$

or $\frac{p}{T} = \frac{nR}{V}$, $\frac{p}{T}$ represents slope of the graph

As the number of moles are the same for the two gases,

$\therefore \quad \frac{p}{T} \propto \frac{1}{V}$

$\because \quad V_2 > V_1$ (Given)

$\therefore \quad (\text{Slope})_2 < (\text{Slope})_1$

or $\quad (\text{Slope})_1 > (\text{Slope})_2$

32. *(c)* When blue glass is heated at high temperature, it absorbs all the radiation of higher wavelength except blue. If it is taken inside a dimly-lit room, it emits all the radiation of higher wavelength, hence it looks brighter as compared to the red piece.

33. *(a)* The electrostatic force of repulsion between the charge q and $(Q - q)$ at separation r is given by

$$F = \frac{1}{4\pi\varepsilon_0}\frac{q(Q-q)}{r^2} = \frac{1}{4\pi\varepsilon_0}\frac{qQ - q^2}{r^2}$$

If F is maximum, then $\partial F / \partial q = 0$

i.e. $\frac{1}{4\pi\varepsilon_0}\cdot\frac{(Q - 2q)}{r^2} = 0$

As $\frac{1}{4\pi\varepsilon_0 r^2}$ is constant, therefore

$$Q - 2q = 0 \text{ or } Q = 2q$$

34. *(d)* At closest distance r its whole KE is converted into PE

$$\therefore \quad \frac{1}{2}mv^2 = \frac{1}{4\pi\varepsilon_0}\frac{Q\cdot q}{r} \Rightarrow r = \frac{1}{4\pi\varepsilon_0}\frac{Q\cdot q}{mv^2}$$

In next case, $\quad r' = \frac{1}{4\pi\varepsilon_0}\frac{Qq}{m(2v)^2}$

$$\Rightarrow \quad r' = \frac{1}{4}\left(\frac{1}{4\pi\varepsilon_0}\cdot\frac{Qq}{mv^2}\right) \Rightarrow r' = r/4$$

35. *(c)* The force causing the motion of A is frictional force between A and B,

So, acceleration of A

$$\mu M_B g = M_A a_A$$

$$\Rightarrow a_A = \mu\left(\frac{M_B}{M_A}\right)g = \frac{\mu g}{2} \text{ (towards right)}$$

Block B experiences frictions force toward left

$$M_B a_B = \mu M_B g \Rightarrow a_B = \mu g \text{ towards left}$$

36. *(b)* We know that in any medium except vacuum or air, the velocities of different colours are different. Therefore, both red and green colours are refracted at different angles of refraction. So, after emerging from glass slab through opposite parallel faces, they appear at two different points and move in two different parallel direction.

37. *(c)* When an object is placed in front of such a lens, the rays first of all refracted from the convex surface, then refract from the polished plane surface and again refracts from convex surface. If f_l and f_m be the focal lengths of lens (convex surface) and mirror (plane polished surface) respectively, then effective focal length F is given by

$$\frac{1}{F} = \frac{1}{f_l} + \frac{1}{f_m} + \frac{1}{f_l} = \frac{2}{f_l} + \frac{1}{f_m} = \frac{2}{f_l} \quad \left(\because f_m = \frac{R}{2} = \infty\right)$$

$$\frac{1}{f_l} = (\mu - 1)\left(\frac{1}{R}\right)$$

$$\therefore \frac{1}{F} = \frac{2(\mu - 1)}{R} \text{ or } F = \frac{R}{2(\mu - 1)} \text{ or } R = 2F = \frac{R}{(\mu - 1)}$$

38. *(b)* The condition of interference maxima is

$$d\sin\theta = n\lambda$$

$$\sin\theta = \frac{n\lambda}{d}$$

Given, $\quad d = 2\lambda$

$$\sin\theta = \frac{n\lambda}{2\lambda} = n/2$$

The magnitude of $\sin\theta$ lies between 0 and 1

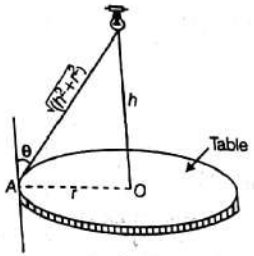
When $n = 0$, $\sin\theta = 0 \Rightarrow \theta = 0$

When $n = 1$, $\sin\theta = 1/2 \Rightarrow \theta = 30°$

When $n = 2$, $\sin\theta = 1 \Rightarrow \theta = 90°$

Thus, there is central maximum ($\theta = 0°$), on other side of it maxima lie at $\theta = 30°$ and $\theta = 90°$, so maximum number of possible interference maxima is 5.

39. *(c)* According to question, the situation is shown in the figure below



$$E_1 = \frac{I}{(LO)^2} = \frac{I}{h^2} \quad \ldots(i)$$

The illumination at the edge A is given by

$$E_2 = \frac{I\cos\theta}{(LA)^2} = \frac{I\cos\theta}{(h^2 + r^2)} \quad \ldots(ii)$$

From figure, $\cos\theta = \frac{h}{\sqrt{(h^2 + r^2)}}$

$$\therefore \quad E_2 = \frac{Ih}{(h^2 + r^2)^{3/2}}$$

Dividing Eq. (i) by Eq. (ii), we get

$$\frac{E_1}{E_2} = \frac{I/h^2}{Ih/(h^2 + r^2)^{3/2}} = \frac{(h^2 + r^2)^{3/2}}{h^3}$$

$$= \left(\frac{h^2 + r^2}{h^2}\right)^{3/2} = \left(1 + \frac{r^2}{h^2}\right)^{3/2}$$

40. *(c)* Magnetic field due to straight wire above O is zero

i.e. $B_1 = 0$ (since, $\theta = 0°$)

The magnetic field due to semi circular part

$$B_2 = \left(\frac{\mu_0 nI}{2r}\right) = \frac{\mu_0(1/2)I}{2r} = \frac{\mu_0 I}{4r}$$

The magnetic field due to lower straight portion

$$B_3 = \frac{1}{2}\frac{\mu_0 I}{2\pi r} \text{ (upward)}$$

Net magnetic field $B = B_1 + B_2 + B_3$

$$= 0 + \frac{\mu_0 I}{4r} + \frac{\mu_0 I}{4\pi r} \text{ (upwards)}$$

41. *(b)* Slope of adiabatic process of p-V diagram

$\left(\frac{dp}{dv}\right) = \gamma\frac{p}{V}$ i.e. slope $\propto\gamma$

From graph $(\text{slope})_2 > (\text{slope})_1$

$\Rightarrow \gamma_2 > \gamma_1$

γ for monoatomic gas (Ar, He) is greater than γ for diatomic gas (O_2, N_2)

42. *(c)* Half life of x = mean life of y

Let λ_x and λ_y be decay constants of x and y, then condition (1) implies

$$\frac{0.693}{\lambda_x} = \frac{1}{\lambda_y}$$

$$\lambda_y = \frac{\lambda_x}{0.693} \Rightarrow \lambda_y > \lambda_x$$

As rate of decay $\propto\lambda$; hence decay of y will be faster than that of x.

43. *(d)* We know that a phase change of π occurs when the reflection takes place at the boundary of denser medium. This is equivalent to a path difference of $\lambda/2$.

$\therefore$ Total phase difference $= \pi - \pi = 0$

Thus, the two waves superimpose in phase.

$$\text{Resultant amplitude} = \sqrt{I} + \sqrt{\left(\frac{I}{4}\right)} = \frac{3}{2}\sqrt{I}$$

$$\text{Resultant intensity} = \left(\frac{3}{2}\sqrt{I}\right)^2 = \frac{9}{4}I = \frac{9}{4} \text{ fold.}$$

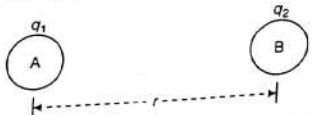
44. *(b)* Output of upper AND gate $= \bar{A}B$

Output of lower AND gate $= A\bar{B}$

Thus, output of OR gate $= \bar{A}B + A\bar{B}$

This is Boolean expression for XOR gate.

45. *(b)* According to coulomb's law, the force of repulsion between them is given by $F = \frac{q_1 q_2}{4\pi\varepsilon_0 r^2}$



When the charged spheres A and B are brought in contact, each sphere will attain equal charge q'

$$q' = \frac{q_1 + q_2}{2}$$

Now, the force of repulsion between them at the same distance r is

$$F' = \frac{q' \times q'}{4\pi\varepsilon_0 r^2} = \frac{1}{4\pi\varepsilon_0}\frac{\left(\frac{q_1+q_2}{2}\right)\left(\frac{q_1+q_2}{2}\right)}{r^2}$$

$$= \frac{\left(\frac{q_1+q_2}{2}\right)^2}{4\pi\varepsilon_0 r^2}$$

$$\text{As} \left(\frac{q_1+q_2}{2}\right)^2 > q_1 q_2$$

$$\therefore \quad F' > F$$

46. *(a)* Due to presence of test charge q_0 in front of positively charged ball, there would be a redistribution of charge on the ball. In the redistribution of charge, there will be less charge on front half surface and more charge on the back half surface. As a result, the net force F between ball and charge will decrease, i.e. the electric field is decreased. Thus, actual electric field will be greater than F / q_0.

47. *(b)* Here, V_0 and R in the two CR circuits are same, hence the currents in the two discharging circuits at $t = 0 (V_0 / R)$ will be same.

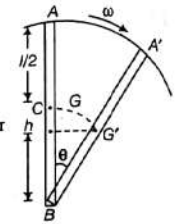
We know that, time constant of a resistance and capacitance circuit is CR. Here, time constant of first circuit (capacity $C_1 = 1\,\mu F$) is half of the time constant of second circuit (capacity $C_2 = 2\mu F$). Hence, C_1 loses 50% its initial charge sooner.

48. *(d)* The magnetic field will not apply any force on the electron. On the other hand, the electric field will apply a force on the electron in opposite direction of the motion. As a result, the velocity of the electron will decrease.

49. *(d)* When a resistance is connected in parallel, it reduces the resistance of combination but the range is not reduced. For the purpose of reducing the range the resistance in series with the galvanometer need to be reduced.

This cannot be achieved by connecting a resistance in parallel with voltmeter. It should be noted that the range of voltmeter can only be increased but cannot be decreased.

50. *(a)* When the rod rotates through an angle θ, the centre of gravity falls through a distance h. From $\Delta BCG'$



$$\cos\theta = \frac{(l/2) - h}{\mu_2} \quad \text{or} \quad h = \frac{l}{2}(1 - \cos\theta)$$

Decrease in PE

$$= mg\frac{l}{2}(1 - \cos\theta) \qquad \ldots (i)$$

The decrease in P.E. is equal to the kinetic energy of rotation $\left(\frac{1}{2} I\omega^2\right)$

$$(\text{KE})_{\text{rotational}} = \frac{1}{2}\left(\frac{ml^2}{3}\right)\omega^2 \qquad \ldots (ii)$$

From Eqs. (i) and (ii), we get

$$\frac{1}{2}\left(\frac{ml^2}{3}\right)\omega^2 = mg\frac{l}{2}(1 - \cos\theta)$$

$$\omega = \sqrt{\frac{6g}{l}}\sin\frac{\theta}{2}$$

51. *(d)* Applying the law of conservation of momentum

$$mV = MV \qquad \ldots (i)$$

By conservation of angular momentum

$$mV(L/2) = \left(\frac{ML^2}{12}\right)\omega \qquad \ldots (ii)$$

As the collision is elastic, we have

$$\frac{1}{2}mV^2 = \frac{1}{2}MV^2 + \frac{1}{2}Iw^2 \qquad \ldots (iii)$$

Substituting the values, we get

$$m = M/4$$

52. *(d)* $K = \frac{1}{2}mV^2$. In electric field,

$$Y = \frac{qEx^2}{2mV^2} = \frac{qEx^2}{4K}$$

The curvature of the trajectory is proportional to qE / K. Since q, E and K are same for both particles, hence the trajectories will have the same curvature.

53. *(c)* The two condensers in the circuit are in parallel order, hence $C' = C + \frac{C}{2} = \frac{3C}{2}$

The work done in charging the equivalent capacitor is stored in the form of potential energy

Hence, $W = U = \frac{1}{2}C'V^2 = \frac{1}{2}\left(\frac{3C}{2}\right)V^2 = \frac{3}{4}CV^2$

54. *(d)* In steady state, there will be no current in the capacitor branch. Net resistance of the circuit

$$R = 1 + 1 + 0.5 = 2.5\Omega$$

Current drawn from the cell

$$i = \frac{V}{R} = \frac{2.5}{2.5} = 1\text{A}$$

Potential drop across two parallel branches

$$V = E - ir = 2.5 - 1 \times 0.5$$
$$= 2.5 - 0.5 = 2.0\text{V}$$

So, charge on the capacitor plates

$$q = CV = 5 \times 2 = 10\mu\text{C}$$

55. *(d)* $I \propto \left(\frac{1}{d^2}\right)$

when source is placed 2 m away, then $I' = I / 4$. The number of electrons emitted is directly proportional to intensity. Hence, number of emitted electrons is reduced to one-fourth.

56. *(b)* The moment of inertia of a body about an axis depends not only on the mass of the body but also on the distribution of mass about the axis. For a given body mass is same, so it will depend only on the distribution of mass about the axis. The mass is farthest from axis BC, so I_2 is maximum mass is nearest to axis AC, so I_3 is minimum.

Hence, the correct sequence will be $I_2 > I_1 > I_3$

57. *(c)* Let the volume of ice-berg is V and its density is ρ. If this ice-berg floats in water with volume V_{in} inside it then $V_{\text{in}}\,\sigma g = V\rho g$

$$\Rightarrow \quad V_{\text{in}} = \left(\frac{\rho}{\sigma}\right)V$$

$$\Rightarrow \quad V_{\text{out}} = V - V_{\text{in}} = \left(\frac{\sigma - \rho}{\sigma}\right)V$$

$$= \left(\frac{1000 - 900}{1000}\right)V = \frac{V}{10}$$

$$\Rightarrow \quad \frac{V_{\text{out}}}{V} = 0 \cdot 1 = 10\%$$

58. *(a)* Given that, $V = V_0 \log_e (r / r_0)$

Field $E = -\frac{dV}{dr} = -V_0\left(\frac{r}{r_0}\right)$

$$eE = \frac{mV^2}{r} \quad \text{or} \quad \frac{eV_0 r_0}{r} = \frac{mV^2}{r}$$

$$V = \left(\frac{eV_0 r_0}{m}\right)^{1/2}$$

$$mV = (m_e V_0 r_0)^{1/2} = \text{constant}$$

$$\therefore \; mvr = \frac{nh}{2\pi}, \text{ Bohr's quantum condition}$$

or $r \propto n$

59. *(a)* Efficiency of heat engine is

$$\eta = 1 - \frac{T_2}{T_1} \text{ or } \eta = \frac{T_1 - T_2}{T_1}$$

Here, $T_1 = 273 + 127 = 400\text{K}$

$T_2 = 273 + 27 = 300\text{ K}$

$$\therefore \eta = \frac{400 - 300}{400} = \frac{100}{400} = 0 \cdot 25 = 25\%$$

Hence, 26% efficiency is impossible for a given heat engine.

60. *(c)* Let R be the resistance of the wire

(a) $H_1 = \frac{V^2 t}{R}$

(b) Resistance of each part will be $R / 2$. When they are connected in parallel, the resistance will be $R/4$.

Hence, $H_2 = \frac{4v^2 t}{R}$

(c) In case of four wires connected in parallel, the resistance will be $R / 8$

$$\therefore \quad H_3 = \frac{8V^2 t}{R}$$

(d) $H_4 = \frac{V^2 t}{[R/2]} = \frac{2V^2 \cdot t}{R}$

Hence, largest amount of heat will be generated in case of four parts connected in parallel.

Chemistry

61. *(b)* Since, compressibility $(Z) = \frac{pV}{nRT}$ for Z less than unity $\frac{pV}{nRT} < 1$ or, $pV < nRT$ [At STP, $p = 1$ atm, $T = 273$ K, $R = 0.0821$ L atm K^{-1}]

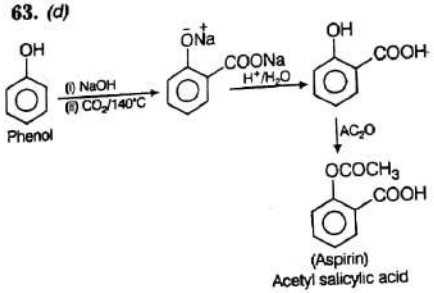
i.e $V < 1 \times 0.0821 \times 273$

Thus, $V < 22.4$ L

62. *(a)* For each value of n, $l = n - 1$ (max.) and for each value of l, $m = -l$ to $+l$.

Thus, for $l = 2$, $m = -2, -1, 0, 1, 2$ and $m \neq -3$.

63. *(d)*



64. *(c)* Normality $(N) \xrightarrow{\frac{W \times 1000}{XV\,(mL)}} = \frac{10 \times 1000}{60 \times 100}$

$= 1.66$

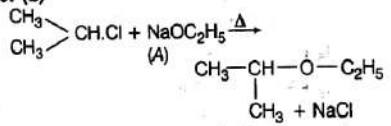
$\therefore \quad N = 1.66$ N

$N = 1.7$ N

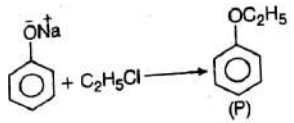
65. *(a)* Being non-polar, C_2H_6 is least soluble in water.

(as H_2O is polar in nature)

66. *(b)*



67. *(a)*



This is an example of Williamson's synthesis.

68. *(c)* $CH_3CH_2 \cdot C \equiv CH \xrightarrow{\text{Hot } KMnO_4\text{(alk)}} CH_3CH_2COOH + H \cdot COOH$

$CH_3CH_2COOH \downarrow + H \cdot COOH \rightarrow CH_3CH_2COOH + CO_2 + H_2O$

69. *(b)* Density $= \frac{Z \times M}{a^3 \times N_A}$

$Z = \frac{d \times N_A \times a^3}{M}$

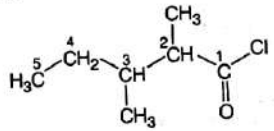
$= \frac{8.92 \times 6.023 \times 10^{23} \times (362 \times 10^{-10})^3}{63.55} = 4$

$\therefore$ The metal crystallises in fcc.

70. *(d)* $CH_3 - CH = CH_2 \xrightarrow{H\overset{\ominus}{O}\overset{\oplus}{Br}} CH_3 - \underset{OH}{CH} - \underset{Br}{CH_2}$

The reaction occurs through Markownikoff rule.

71. *(d)*



2, 3-dimethyl pentanoyl chloride

72. *(a)* Isotonic solutions have same molar concentration of solute particles in solution. Molar concentration of particles in solution are

(a) = 0.1 M in glucose

(b) = 2×0.05 M in NaCl

(c) = 3×0.05 M in $BaCl_2$

(d) = 4×0.1 M in $AlCl_3$

Hence, 0.1 M glucose and 0.05 M NaCl solutions are isotonic.

73. *(b)* $Na_2Cd\,Cl_4$ has no unpaired electron due to presence of d^{10} electrons. Hence, Cd^{2+} is a colourless compound.

74. *(b)* More be the positive oxidation state of a non-metallic oxide, more be its acidic nature.

$\therefore P_2O_5$ is most acidic.

75. *(c)* When CO_2 is passed through aqueous solution of BaO_2, $BaCO_3$ is precipitated and H_2O_2 is formed.

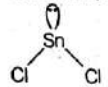
$BaO_2 + CO_2 + H_2O \longrightarrow BaCO_3 \downarrow + H_2O_2$

H_2O_2 can also be prepared by reaction of H_2SO_4 with hydrated barium peroxide.

$BaO_2 \cdot 8H_2O + H_2SO_4 \longrightarrow BaSO_4 + 8H_2O + H_2O_2$

76. *(a)* Due to lanthanide contraction, size of + 3 ions decreases from La^{3+} to Lu^{3+}.

77. *(c)* Gaseous $SnCl_2$ has sp^2-hybridisation with one lone pair of electrons. Thus, has angular shape.



78. *(b)* More be value of van't Hoff factor (i), more be the boiling point.

$\because i$ is maximum for Na_2SO_4 (= 3)

$\therefore$ It has maximum b.p.

79. *(d)* H_2SO_4 is consumed during discharging of lead storage battery as, Pb changes to $PbSO_4$, and PbO_2 changes to $PbSO_4$.

80. *(b)* Molar mass of $C_6H_{12}O_6 = 180$ g mol^{-1}

$\because$ 180 g of glucose require energy = 72 kcal

$\therefore$ 1.6 g of glucose require energy $= \frac{72 \times 1.6}{180}$

$= 0.64$ k cal

81. *(b)* For the reaction at constant pressure,

$\Delta H = -2.5 \times 10^3$ cal

$\Delta S = 7.4$ cal deg^{-1}

$\therefore \Delta G = \Delta H - T\Delta S = (-)\,2.5 \times 10^3 - 298 \times 7.4$

$= (-)\,2.5 \times 10^3 - 2205.2$

$\Delta G = -4705$ cal

$\therefore$ Reaction is spontaneous.

82. *(b)* $Ni(CO)_4$ due to absence of unpaired electrons does not show paramagnetic.

$Ni \rightarrow [Ar]_{18} 3d^8 4s^2$

83. *(d)* All have same oxidation number for sulphate, i.e + 6.

(i) Oxidation number of S is

$H_2SO_4 = + 2 + x - 8 = 0$

$\therefore \quad x = + 6$

(ii) Oxidation number of S in $SO_3 = x - 6 = 0$

$\therefore \quad x = + 6$

(iii) Oxidation number of S in $H_2S_2O_7$

$= 2 + 2x - 14 = 0$

$\therefore \quad 2x = + 12$

$x = + 6$

[where, x = Oxidation number sulphur (S)]

84. *(b)* As slowest step is the rate determining step. Hence, from slow reaction, $r = K[O]\,[O_3]$ ...(i)

From fast reaction, $K_C = \frac{[O_2]\,[O]}{[O_3]}$

$[O] = \frac{K_C \cdot [O_3]}{[O_2]}$, i.e.

$r = \frac{K_C[O_3]}{[O_2]} \cdot [O_3]$

$\Rightarrow \quad K_C \cdot [O_3]^2\,[O_2]^{-1}$

$\therefore$ Rate $(r) = K'\,[O_3]^2 \cdot [O_2]^{-1}$ $\quad (K' = K_C \cdot K)$

85. *(a)* With progressive increase in the size of alkali metal ions, the stability of superoxides increases because the size of superoxide ion is large and large cation can be stabilised more by large anion. Therefore, the order of stability is

$KO_2 < RbO_2 < CsO_2$

86. *(d)* PCl_5 on reaction with the given compounds produce $POCl_3$.

$2PCl_5 + SO_2 \longrightarrow POCl_3 + SOCl_2$

$PCl_5 + H_2O \longrightarrow POCl_3 + 2HCl$

$2PCl_5 + H_2SO_4 \longrightarrow SO_2Cl_2 + 2POCl_3 + 2HCl$

$6PCl_5 + P_4O_{10} \longrightarrow 10POCl_3$

87. *(c)* $\because \ln K = \ln A - \frac{E_a}{RT}$

$\ln K = \ln A - \frac{E_a}{R} \cdot \frac{1}{T}$

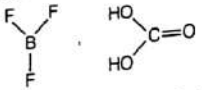
Thus, $\log_{10} K = \log A - \frac{E_a}{2.303\,RT}$

$\log K = \log A - \frac{E_a}{2.303} \cdot \frac{1}{T}$

88. *(a)* (i) SiF_4 and $HClO_3$ has sp^3- hybridisation.

(ii) BF_3 and H_2CO_3 has sp^2-hybridisation but BF_3 is non-polar.

∴ Correct answer is H_2CO_3



89. *(d)* Bithional is an antiseptic. It is mixed with soap to impart antiseptic property.

90. *(c)* $BrO_3^- + 6H^+ + 6e^- \longrightarrow Br^- + 3H_2O$

∴Number of Faraday's required = 6 F

91. *(d)* $C + O_2 \longrightarrow CO_2, \Delta H = -490\ J$ ...(i)

$H_2 + \frac{1}{2}O_2 \longrightarrow H_2O, \Delta H = -240\ J$ ...(ii)

$8C + 9H_2 \longrightarrow C_8H_{18}, \Delta H = +160\ J$ ...(iii)

On applying, 8 x Eq. (i) + 9 x Eq. (ii)–Eq. (iii), we get

$C_8H_{18} + \frac{25}{2}O_2 \longrightarrow 8CO_2 + 9H_2O$

$\Delta H_R^0 = [8 \times (-490)] + [9 \times (-240)] + 160$

$= -5920\ J\ mol^{-1}$

Hence, energy exchange when 6 moles of octane is burnt in air $= -5920 \times 6 = -35520\ J = -35.5$ kJ

92. *(a)* When I^- is oxidised by MnO_4^- in alkaline medium, I^- converts into IO_3^-. The reaction occurs as follows.

$2KMnO_4 + 2KOH \longrightarrow K_2MnO_4 + H_2O + [O]$

$K_2MnO_4 + 2H_2O \longrightarrow 2MnO_2 + 4KOH + 2[O]$

$2KMnO_4 + H_2O \xrightarrow{\text{Alkaline}} 2MnO_2 + 2KOH + 3[O]$

$KI + 3[O] \longrightarrow KIO_3$

i.e. IO_3^-—ion

93. *(d)* The cell reaction is

$Zn(s) \longrightarrow Zn^{2+}(0.01\ M) + 2e^-$

$[Ag^+(1.25\ M) + e^- \longrightarrow Ag(s)] \times 2$

$Zn(s) + 2Ag^+(1.25\ M) \longrightarrow Zn^{2+}(0.01\ M) + 2Ag(s)$

$\therefore Q = \frac{[Zn^{2+}]}{[Ag^+]^2} = \frac{0.01}{(1.25)^2} = 6.4 \times 10^{-3}$

∴Value of $Q = 6.4 \times 10^{-3}$

94. *(b)* $n_{HCl} = M_{HCl} \times V_{HCl}$ and $n_{NaOH} = M_{NaOH} \times V_{NaOH}$

where, n = number of moles

M = molarity, V = volume

$\therefore n_{HCl} = 0.5 \times 750 = 375$ milimoles.

$n_{NaOH} = 2.0 \times 250 = 500$ milimoles.

$\because n_{NaOH} > n_{HCl}$

The solution is basic and has pH > 7.

95. *(c)* Due to more possibility for delocalisation in $C_6H_5-\overset{+}{C}-C_6H_5$ (of π-electrons),

$C_6H_5-\overset{+}{C}-C_6H_5$ is the most stable ion.

96. *(d)* Due to adsorption, attractive forces increases, thus $\Delta H < 0$, i.e (–) ve.

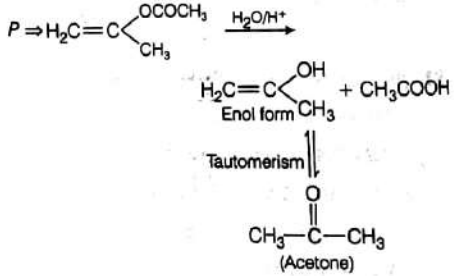
97. *(b)* The extraction of silver involves in cyanide process are

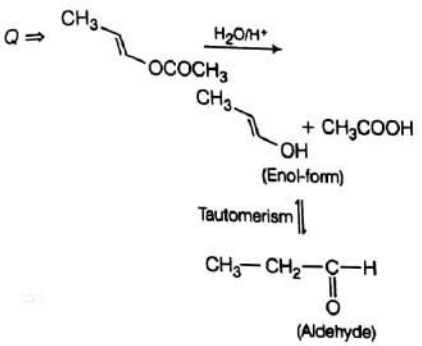
(i) $Ag_2S + 2CN^- + O_2 \longrightarrow 2[Ag(CN)_2]^- + SO_2$

(ii) $[Ag(CN)_2]^- + Zn \longrightarrow [Zn(CN)_4]^{2-} + Ag$

Thus, in (i) O_2-act as oxidising agent (oxidise sulphide to SO_2) and in (ii) Zn act as reducing agent (reduce Ag^+ to Ag).

98. *(c)* The product of (*P*) and (*Q*) are





∵ Fehling solution cannot reduced with acetone.

Thus, used to differentiate ketone (acetone) and aldehyde.

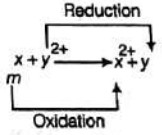
99. *(b)* Zn-Hg with HCl reduce ketone to respective alkane, i.e. C= O of ketone reduce to $>CH_2$ group. The reaction is called Clemmensen reduction.

100. *(d)* The reaction is spontaneous when $\Delta G < 0$ and $E^\circ_{cell} > 0$.

$\because \Delta G = -nFE^\circ$ and $E^\circ > 0$

Also $E^\circ_{cell} = E^\circ_{oxi} + E^\circ_{red}$ (or) $E^\circ_{cathode} - E^\circ_{anode}$

Here,



Thus, E°_{cell} for

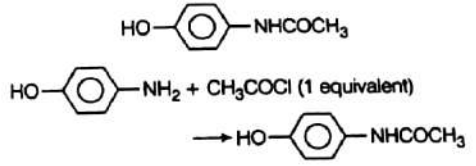
(a) – 0.21 V, i.e. $E^\circ_{cell} < 0$ (b) – 0.53 V, i.e. $E^\circ_{cell} < 0$

(c) – 0.32 V, i.e. $E^\circ_{cell} < 0$ (d) 0.53 V, i.e. $E^\circ > 0$

101. *(c)* The aldehyde/ketone, those do not contain α-H atom; show Cannizzaro reaction.

In CH_3CHO, carbonyl group is attached to C-atom having α-H; Hence, CH_3CHO do not show Cannizzaro reaction.

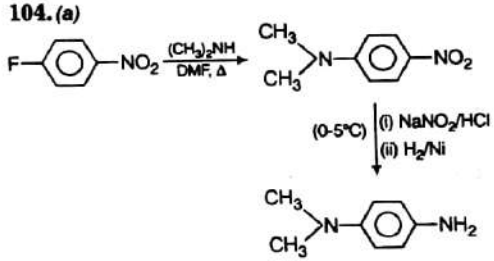
102. *(a)* As, $-NH_2$ group is more reactive than —OH group, CH_3COCl will attack on $-NH_2$ group and give as product.



103. *(d)* ∵ Electron releasing groups increases the basic nature while electron withdrawing group decreases the basis strength of amines.

Therefore, correct order is III > II > IV > I.

104. *(a)*



105. *(a)* Polymers are obtained by condensation reaction between monomers.

106. *(a)* The correct match is

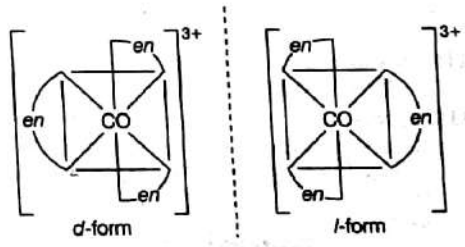
(A) → Lyman ultra violet → (1) Ultraviolet

(B) → Paschen → (2) → Near Infrared

(C) → Balmer → (4) → Visible

(D) → Pfund → (3) → Far infrared

107. *(b)* *Tris*-(ethylene diamine) cobalt (III) bromide, i.e. $[Cp(en)_3]Br_3$ exhibits optical isomerism.



108. *(a)* (i) ∵ More be the sum of $n + l \rightarrow$ more be the energy.

(ii) For same sum, the more value of n have higher energy.

∵ $n + l$ for →

(i) 4 + 1 = 5 (ii) 4 + 0 = 4

(iii) 3 + 2 = 5 (iv) 3 + 1 = 4

∴ Correct order is → (iv) < (ii) < (iii) < (i)

109. *(a)* Starch is a polymer of D-glucose units, thus on hydrolysis it only gives glucose.

110. *(b)* When organic compound containing both nitrogen and sulphur is fused with sodium, sodium-thiocyanate is formed as follows

$$Na + S + C + N \longrightarrow NaSCN$$

111. *(c)* *Meso*-sphere is the coldest region having about $-100°C$ temperature.

112. *(d)* For NaCl type structure $\frac{r_{A^+}}{r_{B^-}} = 0.414 - 0.737$

For maximum possible radius of B^-

$$\frac{r_{A^+}}{r_{B^-}} = 0.414, \frac{170}{r_{B^-}} = 0.414$$

$$r_{B^-} = \frac{170}{0.414} = 410.6 \text{ pm}$$

113. *(d)* k-for first order. $\frac{0.693}{t_{1/2}} = \frac{0.693}{1.26 \times 10^{14}}$ for 100% completion.

∵ $$t = \frac{2.303}{k} \log \frac{a}{a - x}$$

$$t = \frac{2.303 \times 1.26 \times 10^{14}}{0.693} \log \frac{100}{0}$$

∴ $t = \infty$

114. *(d)* Flux removes silica and undesirable metal oxides as silicates, etc.

115. *(a)* When sulphur reacts with chlorine in 1 : 2 ratio the SCl_4 is obtained which on hydrolysis gives H_2SO_4. Hence, the compound '*X*' is SCl_4 and '*Y*' is H_2SO_4

$$S + 2Cl_2 \longrightarrow \underset{\text{Sulphur tetrachloride}\ (X)}{SCl_4}$$

$$SCl_4 + 4H_2O \longrightarrow \underset{\text{Unstable}}{S(OH)_4} + 4HCl$$

$$S(OH)_4 \longrightarrow \underset{\text{Sulphurous acid}}{H_2SO_4} + H_2O$$

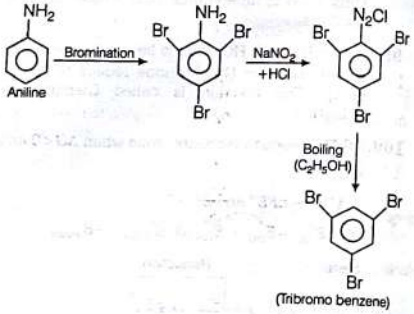
The hybridisation of sulphur in SO_3^{2-} is sp^3.

116. *(a)* $NaHCO_3$ is basic in nature so it is used in the identification of acid only. In the given compound only ester ($CH_3COOC_2H_5$) on hydrolysis gives acid as

$$\underset{\text{Ethyl acetate}}{CH_3COOC_2H_5} + H_2O \longrightarrow \underset{\text{Acetic acid}}{CH_3COOH} + \underset{\text{Ethyl alcohol}}{C_2H_5OH}$$

117. *(c)* Nylon is a polyamide, e.g. nylon-6,6, nylon-6, etc.

118. *(d)*



119. *(d)* ∵ $N_1V_1 = N_2V_2$

Given, $N_1 = 0.5$ N, $N_2 = 0.1$ N

$V_1 = 100 \text{ cm}^3$, $V_2 = ?$

$\therefore 0.5 \times 100 = 0.1 \times V_2$

$V_2 = 500 \text{ cm}^3$ (Total final volume)

∴ Volume to be added

$= 500 - 100 = 400 \text{ cm}^3$

120. *(a)* Oxidation of oxygen are as follows

$$\underset{(-1)}{BaO_2}, \underset{\left(-\frac{1}{2}\right)}{KO_2}, \underset{(\text{Zero})}{O_3}, \underset{(+2)}{OF_2}$$

Thus, correct order is

$BaO_2 < KO_2 < O_3 < OF_2$

Biology

121. *(c)* When breeding is done between animals of the same breed for 4-6 generations, it is called inbreeding. Inbreeding is necessary if we want to develop a pure line of any animal. It exposes harmful recessive genes that are eliminated by selection. It also helps in accumulation of superior genes and elimination of less desirable genes.

122. *(a)* DCMU is selective herbicide that acts as a potent inhibitor of PS-II. Paraquat inhibits PS-I by producing super oxides.

DCPIP is a dye used to measure rate of photosynthesis.

123. *(d)* Microtubules are found in both animal and plant cells and are formed of protein tubulin.

124. *(b)* Iron (Fe) is the concerned nutrient associated with the above given functions.

125. *(d)* Animals of class–Gastropoda of phylum–Mollusca undergo twisting or torsion of the visceral mass during development, leading to conversion of symmetrical embryo into an asymmetrical adult.

126. *(d)* In the process of photosynthesis

$$6CO_2 + 12H_2O \xrightarrow[\text{Chl}]{h\nu} \underset{\text{(Glucose)}}{C_6H_{12}O_6} + 6H_2O + 6O_2\uparrow$$

Plants manufacture glucose from H_2O and CO_2 and oxygen gas is released. So, due to isotopic carbon of CO_2, only glucose will be labelled, but oxygen will be normal.

127. *(c)* The correct matchings are

Sacral nerves	5 Pairs
Thoraic nerves	12 Pairs
Cocygeal nerves	1 Pair
Cervical nerves	8 Pairs

128. *(c)* Prolactin is secreted by pituitary gland, whereas the hCG, hPL and oestrogen are secreted by human placenta.

129. *(c)* 2ATP are required during conversion of PGA to 1, 3 diphosphoglyceric acid and 1 ATP during conversioin of glyceraldehyde phosphate to ribulose biphosphate. $2NADPH_2$ molecules are utilised for converting 1, 3 diphosphoglyceric acid to glyceraldehyde phosphate.

130. *(a)* Oxygen haemoglobin dissociation curve gives the relationship between the saturation of haemoglobin and oxygen tension.

The curve obtained by plotting the per cent saturation of Hb against time is sigmoid, at 38°C and pH 7.4. Dissociation of oxyhaemoglobin can be promoted by rise in the body temperature and low pH (high CO_2).

131. *(b)* Cholecystokinin Pancreozymin (CCK-PZ) is the hormone secreted from mucosa of small intestine. It stimulates pancreas to release enzymatic (Pancreatic) juice and gall bladder to eject bile.

132. *(a)* Cotyledons and testa are edible parts of ground nut and pomegranate respectively. The edible part of walnut is cotyledon, tamarind–mesocarp, french beans–seeds, coconut–endosperm testa, cotyledons and embryo, cashewnut-cotyledons and fleshy pedicels and of litchi is fleshy anl.

133. *(c)* Both intrinsic and extrinsic pathway of blood clotting are interlinked at the final common pathway of factor X, thrombin and fibrin.

134. *(c)* The correct matching are

A. Glycogen	5. *Agaricus*
B. Pyrenoids	4. *Spirogyra*
C. Laminarian and mannitol	1. *Sargassum*
D. Floridean starch	3. *Polysiphonia*

135. *(a)* Out of the given pairs in the option only antipodal is wrongly matched because antipodals are halploid cells (n) found within the mature embryo sac towards the chalazal end. Rest all three options are correctly matched.

136. *(c)* Globular head of myosin contains an ATPase enzyme that along with CO^{2+} and Mg^{2+} ions catalyses the breakdown of ATP during muscle contraction. It also has binding site for ATP and active sites for actin.

137. *(b)* Prabhani Kranti (example of mutation breeding) is a variety of bhindi which is made resistant to yellow mosaic, virus.

In this *Abelmoschus esculentus* was transferred from a wild species to produce this new variety.

138. *(c)* Transformation of the blastocyst into gastrula with primary germ layers by rearrangement of the cells is called gastrulation. In all the triploblastic animals three germ layers–ectoderm, mesoderm and endoderm are formed by characteristic morphogenetic movements.

139. *(a)* In dense regular connective tissue the collagen fibres are present in rows between many parallel bundles of fibres. Tendons which attach skeleton muscles to bones and ligaments which attach one bone to another are example of dense regular connective tissue.

140. *(a)* Minisatellites or Variable Number of Tandem Repeats (VNTR) are used in DNA fingerprinting technique. In VNTR, satellite DNA acts as a probe, that shows very high degree of polymorphism.

141. *(c)* Statements II, IV, VI are correct *Wuchereria bancrofti* commonly called filarial worm is a digenetic, dimorphic, pseudocoelomate, histozoic and pathogenic parasite. It is digenetic because it has two stages of multiplication in two different hosts, one sexual in the mature form, the other asexual in larval stages. It is a histozoic parasite as it lives in the tissue outside of a cell body.

142. *(d)* The process of addition of methyl GPT at the 5′ end of *hn*RNA is known as capping. Enzyme guanly transferase catalyses this process.

Cap is essential for the formation of *m*RNA-Ribosome complex. Translation is not possible if cap is lacking, because cap is identified by 18 SrRNA of ribosome unity.

143. *(b)* IgG is the most abundant antibody in foetus as it is the only one which can cross placental barrier from mother to reach child and provides immune protection to it.

144. *(b)* Full form of IUCN is International Union for Conservation of Nature.

145. *(c)* The first phase of human menstrual cycle is called proliferative phase (follicular phase), while second phase of human menstrual cycle is called as secretory phase or luteal phase and it lasts for about 13 days. Here, the LH is secreted by anterior lobe of pituitary leading to ovulation.

146. *(d)* Tapetum is innermost nutritive structure of anther wall which nourishes the developing pollen grain.

147. *(b)* Variation in gene frequencies within populations can occur by chance and is called as genetic drift.

148. *(b)* $N_2 \longrightarrow \underset{\text{Dimide}}{N_2H_2} \longrightarrow \underset{\text{Hydrazine}}{N_2H_4} \longrightarrow \underset{\text{Ammonia}}{2NH_3}$
(Nitrogen)

The fixation of atmospheric nitrogen to ammonia is given as

$$N_2 + 8e^- + 8H^+ + 16ATP \xrightarrow[\text{Nitrogenase}]{MO - Fe} 2NH_3 + H_2 + 16ADP + 16Pi$$

The process in which atmospheric nitrogen gets concerted into inorganic nitrogenon (nitrate, ammonia) compounds through microorganisms is called biological nitrogen fixing.

149. *(a)* AB blood group is characterised by the presence of both antigen A and B i.e. I^A and I^B over the surface of RBCs.

Phenotype AB
↓
Genotype I^AI^B
↓
Antigen A + Antigen B

'Here both alleles are able to express themselves forming antigens A and B. This is called as codominance.

150. *(d)* Palindromic sequence is the sequence of nucleotides whose reading is same when read from both 5′→ 3′ and 3′→ 5′ direction. It is the mirror image of the sequence in its first half

5′-AGC GCT-3′
⟶
3′-TCG CGA- 5′
⟵

151. *(d)* Pellagra is caused by the deficiency of Vitamin-B_3 (niacin), while vitamin-B_2(riboflavin) deficiency cause dermatitis.

152. *(d)* Plasma cells plays a key role in Humoral Imunity (HMI). It activates secretion of various antibodies (B-cells) against specific antigens entering the body.

153. *(c)* Lactose or *lac* operon of *E.coli* is an example of inducible operon. Lactose is known to be the inducer and substrate for the enzyme β-galactosidase.

It binds with the repressor protein and changes it into a non-DNA binding state thus activating the operon.

154. *(c)* Gibberellins and Abscisic Acid (ABA) are antagonistic to each other. Gibberllins promotes seed germination whereas ABA promotes seed dormacy.

155. *(b)* Ornithine cycle removes both ammonia and urea from the blood.

It converts ammonia into urea (in liver) and transport it to kidneys by the blood. Hence, it plays a key role in detoxification of our blood. This cycle occurs in the liver.

156. *(a)* Macromolecule chitin is an example complex structural hetero polysaccharide. It has nitrogen containing glucose derivatives such as N-acetyl glycosamine.

It is present as the structural component of fungal cell walls and exoskeleton of arthropods etc.

157. *(c)* Endocrine cells are present in different parts of the gastro-intestinal tract, e.g. gastrin, secretin, GIP. Atrial wall of our heart secretes a peptide hormone called ANF (Atrial Natriuretic Factor). RH/IH are produced by hypothalamus. Adenohypophysis is not directly under neural control, it is under the control of hypothalamic hormones, brought by portal system.

158. *(b)* The earliest organisms that appeared on earth were anaerobic chemoautotrophs.

Chemoautotrophs were the first autotrophic organisms. They were unable to perform photolysis of water and never released oxygen, e.g. sulphur bacteria.

159. *(b)* Taxonomic keys are tools that help in identification of organisms based on the description of specific characters.

e.g. flora (A resource providing information on the taxonomy, nomenclature and descriptive data of newly discovered plants).

Monographs (A comprehensive treatement of a taxon).

160. *(a)* The nutrition in given protozoans are as

Column I	Column II
Pinocytosis	*Amoeba proteus*
Holozoic	*Paramecium*
Parasitic	*Monocystis*
Mixotrophic	*Euglena gracilis*

161. *(b)* In the dicot stem the cortical cells gets differentiated to give rise to another meristematic tissue, which is called cork cambium or phellogen. On the other side, it forms phellem (cork) and in the inner region it forms secondary cortical cells (phelloderm).

162. *(a)* The historic convention on biological diversity (The earth summit) held in Rio de Janerio was the Rio Conevention, (in 1992). It called upon all nations to take appropriate measure for sustainable utilisation and conservation of biological diversity.

163. *(c)* Jacobson's organ is an axillary olfactory sense organ that is found in many animals. In mammals, the sensory neurons of Jacobson's organ detect specific chemical compounds contained within scents that are often but not always, large non-volatile molecules. It is well developed in snakes (and lizards).

164. *(d)* During favourable month sporangia are produced on the underside or margin of leaves in ferns. After development, it become dry and bursts to release spores. These spores germinate on the suitable substrate. Each spore absorb water, then ruptures and produce green filament which grow into prothallus (heart-shaped). Prothallus develops into young sporophyte, which in turn grows into an adult plant.

165. *(c)* Antibodies are produced by B-lymphocytes. Monoclonal and polyclonal antibodies are particularly produced by plasma cells of B-lymphocytes when combined with myleoma cells on specific medium. These cells play a key role in specific immunological reactions.

166. *(d)* All the given statements about monerans are correct.

167. *(a)*

Column I	Column II
Opuntia	Stem thorns
Asparagus	Phylloclades
Citrus	Cladodes

168. *(b)* In acrocentric chromosome, the centromere is situated close to one end of the chromosome.

169. *(b)* According sliding filament theory, during muscle contraction actin and myosin filaments shorter and slide pass each other.

170. *(c)* Statements I, II, IV and VI are correct.

Myasthemia gravis is an auto immune neuromuscular disease that is cogenital. It leads to muscle weakness. It is caused by circulating antibodies that block acetylcholine receptors at the post-synaptic neuromuscular junction inhibiting the excitatory effects of acetylcholine

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and nicotic receptors at neuromuscular junctions. First noticeable symptom is weakening of eye muscle leading to drooping of eyelids.
It is treated medically with acetylcholine esterase inhibitors or immuno suppressants.

171. *(b)* Most of the leaves have a swollen leaf base known as pulvinus. Its attachment on the stem is not strong. In guava opposite phyllotaxy is found. In this case all the pairs of leaves of a branch arise in same plane, so that two vertical rows are formed.

In Australian *Acacia*, petiole gets modified into leaf like structure and synthesise food. In *Eichhornia*, petiole becomes spongy and helps in floating.

172. *(c)* ICSI is intra cytoplasmic sperm injection. It is one of the techniques of Assisted Reproductive Technology (ART) that help couples to overcome their infertility. In ICSI, sperm is directly injected into ovum, *in vitro* to form zygote. The embryo, formed is later implanted through ZIFT into woman.

173. *(c)* When a bacterial population encounters a particular antibiotic, those sensitive to it die. But some bacteria having mutations become resistant to antibiotics. Such resistant bacteria survive and multiply quickly as the competing bacteria have died. Soon the resistance providing genes become wide spread and entire bacterial population become resistant.
Appearence of antibiotic resistant bacteria is example of pre-existing variation.

174. *(c)* Post mitotic gap phase is characterised by all except synthesis of histone proteins. Histone proteins are synthesised in S-phase. S-phase is called invisible phase of the cell cycle as replicated chromosomes are not visible at this stage.

175. *(b)* Munch hypothesis is based on the movement of phloem sap along a turgor pressure gradient. The mass flow of organic solutes takes place from the site of higher concentration, (source) to the site of lower concentration (sink).

176. *(a)* The correct matching

Molecular oxygen	Hydrogen acceptor
Electron acceptor	Cytochrome-C
Pyruvate dehydrogenase	Acetyl Co-A
Decarboxylation	α-ketoglutaric acid

177. *(b)* 'Roquefort cheese' is a sheep milk blue cheese, which comes from the South of France. It is ripened by growing a specific fungi, i.e. *Penicillium roqueforti* which gives them a particular flavour.

178. *(d)* *Marchantia* is a bryophyte belonging to the class-Hepaticopsida, the class of liverworts.

They have elasters which are hygroscopic structures that develops inside the capsule along with spores. Elasters help in dehiscence of capsule and liberation of spores.

179. *(a)* Foramen ovale is an opening in the interatrial septum of the foetal heart through which both the atria communicate with each other.

In adults, this aperture is closed and is represented by a small oval depression called fossa ovalis.

180. *(d)* Disruptive selection occurs when an environmental change may produce selection pressure that favours two extreme characteristics. Selection acts on the phenotype, physical, biochemical and behavioural traits of an organism. It indirectly adapts a population to its environment by selecting and maintaining favourable genotypes in their give pool.



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