AIPMT - 2006
(Physics, Chemistry and Biology)
Prelims

Time: 3 hrs **Total Marks: 600**

General Instructions:

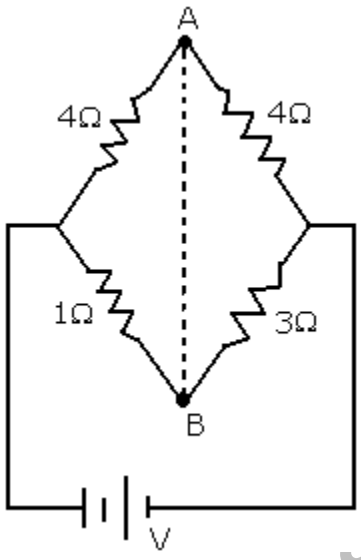
1. The Answer sheet is inside this Text booklet. When you are directed to open the text booklet, take out the Answer Sheet and fill in the particulars on side – 1 and side – 2 carefully with blue/black ball point pen only.
2. The test is of 3 hours duration and consists of 200 questions. Each question carries 3 marks. For each correct response the candidate will get 3 marks. For each incorrect response, one mark will be deducted. The maximum marks are 600.
3. Use Blue / Black ball point pen only for writing particulars on this page / marking responses.
4. Rough work is to be done on the space provided for this purpose in the text booklet only.
5. On completion of the test, the candidate must handover the answer sheet to the invigilator in the room/ Hall. The candidates are allowed to take away this text booklet with them.
6. The candidates should ensure that the Answer sheet is not folded. Do not make any stray marks on the Answer sheet. Do not write your roll no. anywhere else except in the specified space in the Test booklet / Answer Sheet.
7. Use of white fluid for correction is not permissible on the Answer Sheet.

Physics

1. In producing chlorine through electrolysis, 100 W power at 125 V is being consumed. How much chlorine per min is liberated? ECE of chlorine is 0.367×10^{-6} kg/C.

(1) 17.6 mg
(2) 21.3 mg
(3) 24.3 mg
(4) 13.6 mg

2. In the circuit shown, if a conducting wire is connected between points A and B, the current in this wire will



(1) flow from A to B
(2) flow in the direction which will be decided by the value of V
(3) be zero
(4) flow from B to A

3. A rectangular block of mass m and area of cross-section A floats in a liquid of density ρ. If it is given a small vertical displacement from equilibrium it undergoes oscillation with a time period T. Then

(1) $T \propto \sqrt{\rho}$

(2) $T \propto \frac{1}{\sqrt{A}}$

(3) $T \propto \frac{1}{\rho}$

(4) $T \propto \frac{1}{\sqrt{m}}$

4. A carnot engine whose sink is at 300 K has an efficiency of 40%. By how much should the temperature of source be increased so as to increase its efficiency by 50% of original efficiency?

(1) 275 K
(2) 325 K
(3) 250 K
(4) 380 K

5. 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:

(1) angle between $\vec{v}$ and $\vec{B}$ is necessarily 90°

(2) angle between $\vec{v}$ and $\vec{B}$ can have any value other than 90°

(3) angle between $\vec{v}$ and $\vec{B}$ can have any value other than zero and 180°

(4) angle between $\vec{v}$ and $\vec{B}$ is either zero or 180°

6. Two cells, having the same emf, are connected in series through an external resistance R. Cells have internal resistances r_1 and r_2 ($r_1 > r_2$) respectively. When the circuit is closed, the potential difference across the first cell is zero. The value of R is

(1) $r_1 - r_2$

(2) $\frac{r_1 + r_2}{2}$

(3) $\frac{r_1 - r_2}{2}$

(4) $r_1 + r_2$

7. A black body at 1227 °C emits radiations with maximum intensity at a wavelength of 5000 Å. If the temperature of the body is increased by 1000°C, the maximum intensity will be

(1) 4000 Å

(2) 5000 Å

(3) 6000 Å

(4) 3000 Å

8. Two circular coils 1 and 2 are made from the same wire but the radius of the 1st coil is twice that of the 2nd coil. What is the ratio of potential difference applied across them so that the magnetic field at their centres is the same?

(1) 3

(2) 4

(3) 6

(4) 2

9. A transistor-oscillator using a resonant circuit with an inductor L (of negligible resistance) and a capacitor C in series produce oscillations of frequency f. If L is doubled and C is changed to 4C, the frequency will be

(1) f/4

(2) 8f

(3) $\frac{f}{2\sqrt{2}}$

(4) f/2

10. The binding energy of deuteron is 2.2 MeV and that of $^4_2$He He is 28 MeV. If two deuterons are fused to form one $^4_2$He then the energy released is

(1) 25.8MeV
(2) 23.6 MeV
(3) 19.2 MeV
(4) 30.2 MeV

11. In a radioactive material the activity at time t_1 is R_1 and at a later time t_2, it is R_2. If the decay constant of the material is λ, then

(1) $R_1 = R_2\ e^{-\lambda(t_1 - t_2)}$
(2) $R_1 = R_2\ e^{\lambda(t_1 - t_2)}$
(3) $R_1 = R_2(t_1 / t_2)$
(4) $R_1 = R_2$

12. Ionization potential of hydrogen atoms is 13.6 eV. Hydrogen atoms in the ground state are excited by monochromatic radiation of photon energy 12.1 ev. According to Bohr's theory, the spectral lines emitted by hydrogen will be:

(1) two
(2) three
(3) four
(4) one

13. The potential energy of a long spring when stretched by 2 cm is U. If the spring is stretched by 8 cm the potential energy stored in it is

(1) 4U
(2) 8U
(3) 16U
(4) U/4

14. For angles of projection of a projectile at angles (45° - θ) and (45° + θ), the horizontal ranges described by the projectile are in the ratio of

(1) 1 : 1
(2) 2 : 3
(3) 1 : 2
(4) 2 : 1

15. A body of mass 3 kg is under a constant force which causes a displacement s in meters in it, given by the relation $s = \frac{1}{3}t^2$, where t is in s. Work done by the force in 2 s is

(1) $\frac{5}{19}$J

(2) $\frac{3}{8}$J

(3) $\frac{8}{3}$J

(4) $\frac{19}{5}$J

16. A particle moves along a straight line OX. At a time t (in seconds) the distance x (in metres) of the particle from O is given by $x = 40 + 12t - t^3$. How long would the particle travel before coming to rest?

(1) 24 m
(2) 40 m
(3) 56 m
(4) 16 m

17. The velocity v of a particle at time t is given by $v = at + \frac{b}{t+c}$, where a, b and c are constants. The dimensions of a, b and c are respectively:

(1) $[LT^{-2}]$, [L] and [T]
(2) $[L^2]$, [T] and $[LT^2]$
(3) $[LT^2]$, [LT] and [L]
(4) [L], [LT] and $[T^2]$

18. A microscope is focused on a mark on a piece of paper and then a slab of glass of thickness 3 cm and refractive index 1.5 is placed over the mark. How should the microscope be moved to get the mark in focus again?

(1) 1 cm upward
(2) 4.5 cm downward
(3) 1 cm downward
(4) 2 cm upward

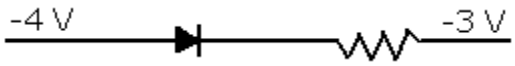
19. 300J of work is done in sliding a 2 kg block up an inclined plane of height 10 m. Taking g = 10 m/s^2, work done against friction is

(1) 200 J
(2) 100 J
(3) Zero
(4) 1000 J

20. A transistor is operated in common emitter configuration at constant collector voltage V_c = 1.5 V such that a change in the base current from 100 μA to 150 μA produces a change in the collector current from 5 mA to 10 mA. The current gain (β) is

(1) 67
(2) 75
(3) 100
(4) 50

21. A forward biased diode is

(1)


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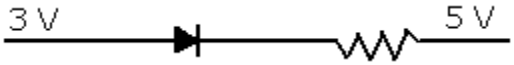

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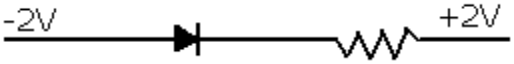


(4)


22. A photo-cell employs photoelectric effect to convert

(1) change in the frequency of light into a change in electric voltage
(2) change in the intensity of illumination into a change in photoelectric current
(3) change in the intensity of illumination into a change in the work function of the photocathode
(4) change in the frequency of light into a change in the electric current

23. The core of a transformer is laminated because

(1) energy losses due to eddy currents may be minimised
(2) the weight of the transformer may be reduced
(3) rusting of the core may be prevented
(4) ratio of voltage in primary and secondary may be increased

24. Two coils of self-inductances 2 mH and 8 mH are placed so close together that the effective flux in one coil is completely linked with other. The mutual inductance between these coils is

(1) 10 mH
(2) 6 mH
(3) 4 mH
(4) 16 mH

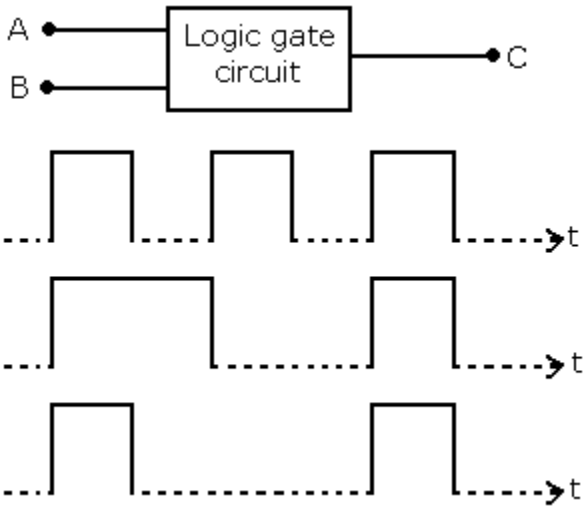
25. In a discharge tube ionization of enclosed gas is produced due to collisions between:

(1) positive ions and neutral atoms/molecules
(2) negative electrons and neutral atoms/molecules
(3) photons and neutral atoms/molecules
(4) neutral gas atoms/molecules

26. When photons of energy hν fall on an aluminium plate (of work function E_0) photoelectrons of maximum kinetic energy K are ejected. If the frequency of the radiation is doubled, the maximum kinetic energy of the ejected photoelectrons will be

(1) $K + E_0$
(2) 2K
(3) K
(4) $K + h\nu$

27. The following figure shows a logic gate circuit with two inputs A and B and the output C. The voltage waveforms of A, B and C are as shown below:



The logic circuit gate is

(1) AND gate
(2) NAND gate
(3) NOR gate
(4) OR gate

28. A coil of inductive reactance 31 Ω has a resistance of 8 Ω. It is placed in series with a condenser of capacitive reactance 25 Ω. The combination is connected to an A.C. source of 110 V. The power factor of the circuit is

(1) 0.56
(2) 0.64
(3) 0.80
(4) 0.33

29. A 0.5 kg ball moving with a speed of 12 m/s strikes a hard wall at an angle of 30° with the wall. It is reflected with the same speed and at the same angle. If the ball is in contact with the wall for 0.25 s, the average force acting on the wall is

(1) 48 N
(2) 24 N
(3) 12 N
(4) 96N

30. The moment of inertia of a uniform circular disc of radius R and mass M about an axis touching the disc at its diameter and normal to the disc is

(1) MR^2
(2) $\frac{2}{5}MR^2$
(3) $\frac{3}{2}MR^2$
(4) $\frac{1}{2}MR^2$

31. The momentum of a photon of energy 1 MeV in kg m/s, will be

(1) 0.33×10^{6}
(2) 7×10^{-24}
(3) 10^{-22}
(4) 5×10^{-22}

32. The radius of germanium (Ge) nucleus is measured to be twice the radius of ${}^{9}_{4}\text{Be}$. The numbers of nucleons in Ge are

(1) 73
(2) 74
(3) 75
(4) 72

33. The molar specific heat at constant pressure of an ideal gas is (7/2)R. The ratio of specific heat at constant pressure to that at constant volume is

(1) 7/5
(2) 8/7
(3) 5/7
(4) 9/7

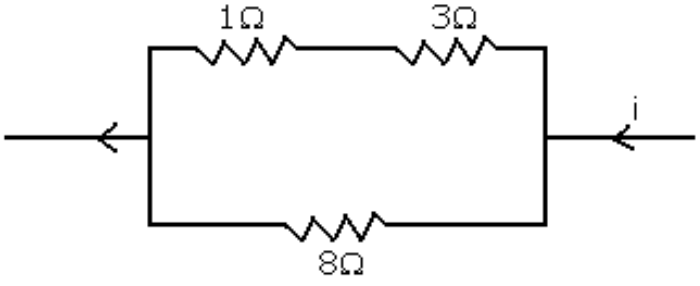
34. The earth is assumed to be a sphere of radius R. A platform is arranged at a height R from the surface of the earth. The escape velocity of a body from this platform is fv_e, where v_e is its escape velocity from the surface of the earth. The value of f is

(1) $\sqrt{2}$
(2) $\frac{1}{\sqrt{2}}$
(3) $\frac{1}{3}$
(4) $\frac{1}{2}$

35. Two sound waves with wavelengths 5.0 m and 5.5 m respectively each propagate in a gas with velocity 330 m/s. We expect the following number of beats per second:

(1) 12
(2) 0
(3) 1
(4) 6

36. Power dissipated across the 8 Ω resistor in the circuit shown here is 2 W. The power dissipated in watt units across the 3 Ω resistor is



(1) 2.0
(2) 1.0
(3) 0.5
(4) 3.0

37. Kirchhoff's first and second laws for electrical circuits are consequences of
(1) conservation of energy
(2) conservation of electric charge and energy respectively
(3) conservation of electric charge
(4) conservation of energy and electric charge respectively

38. A transverse wave propagating along x-axis is represented by

$$y(x,t)=8.0\sin\left(0.5\pi x-4\pi t-\frac{\pi}{4}\right)$$

where x is in metres and t is in seconds. The speed of the wave is
(1) 4π m/s
(2) 0.5π m/s
(3) $\frac{\pi}{4}$ m/s
(4) 8 m/s

39. 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?
(1) 2
(2) 4
(3) $\frac{1}{2}$
(4) 1

40. Which one of the following statements is true?
(1) Both light and sound waves in air are transverse
(2) The sound waves in air are longitudinal while the light waves are transverse
(3) Both light and sound waves in air are longitudinal
(4) Both light and sound waves can travel in vacuum

41. Above Curie temperature:
(1) a ferromagnetic substance becomes paramagnetic
(2) a paramagnetic substance becomes diamagnetic
(3) a diamagnetic substance becomes paramagnetic
(4) a paramagnetic substance becomes ferromagnetic.

42. A convex lens and a concave lens, each having same focal length of 25 cm, are put in contact to form a combination of lenses. The power in dioptres of the combination is

(1) 25
(2) 50
(3) infinite
(4) zero

43. An electric dipole of moment $\vec{p}$ is lying along a uniform electric field $\vec{E}$. The work done in rotating the dipole by 90° is

(1) $\sqrt{2}pE$
(2) $\frac{pE}{2}$
(3) 2pE
(4) pE

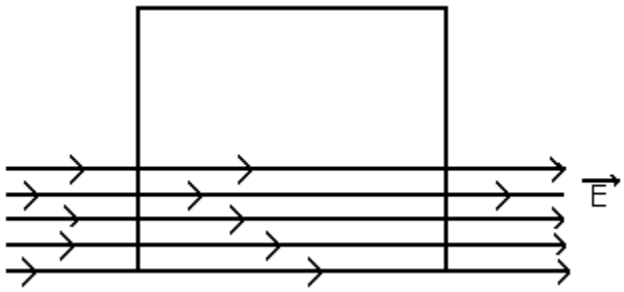
44. A parallel plate air capacitor is charged to a potential difference of V volts. After disconnecting the charging battery the distance between the plates of the capacitor is increased using an insulating handle. As a result, the potential difference between the plates

(1) decreases
(2) does not change
(3) becomes zero
(4) increases

45. A car runs at a constant speed on a circular track of radius 100 m, taking 62.8 s for every circular lap. The average velocity and average speed for each circular lap respectively is

(1) 0, 0
(2) 0, 10 m/s
(3) 10 m/s, 10 m/s
(4) 10 m/s, 0

46. A square surface of side L m is in the plane of the paper. A uniform electric field ($\vec{E}$ V/m), also in the plane of the paper, is limited only to the lower half of the square surface, (see figure). The electric flux in SI units associated with the surface is:

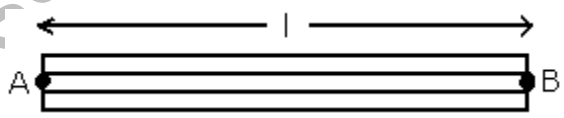


(1) $EL^2/(2\varepsilon_0)$
(2) $EL^2/2$
(3) zero
(4) EL^2

47. A tube of length L is filled completely with an incompressible liquid of mass M and closed at both the ends. The tube is then rotated in a horizontal plane about one of its ends with a uniform angular velocity ω. The force exerted by the liquid at the other end is:

(1) $\frac{ML\omega^2}{2}$
(2) $\frac{ML^2\omega}{2}$
(3) $ML\omega^2$
(4) $\frac{ML^2\omega^2}{2}$

48. A uniform rod of length l and mass m is free to rotate in vertical plane about A. The rod initially in horizontal position is released. The initial angular acceleration of the rod is: (Moment of inertia of rod about A is $\frac{ml^2}{3}$)



(1) $\frac{3g}{2l}$
(1) $\frac{2l}{3g}$
(2) $\frac{3g}{2l^2}$
(3) $mg\frac{l}{2}$

49. The vectors $\vec{A}$ and $\vec{B}$ are such that

$$\left|\vec{A}+\vec{B}\right| = \left|\vec{A}-\vec{B}\right|$$

The angle between the two vectors is

(1) 90°
(2) 60°
(3) 75°
(4) 45°

50. Two bodies, A (of mass 1 kg) and B (of mass 3 kg) are dropped from heights of 16 m and 25 m, respectively. The ratio of the time taken by them to reach the ground is

(1) 5/4
(2) 12/5
(3) 5/12
(4) 4/5

Chemistry

51. Identify the correct statement for change of Gibbs energy for a system (ΔG_{system}) at constant temperature and pressure:

(1) If $\Delta G_{system} > 0$, the process is spontaneous

(2) If $\Delta G_{system} = 0$, the system has attained equilibrium

(3) If $\Delta G_{system} = 0$, the system is still moving in a particular direction

(4) If $\Delta G_{system} < 0$, the process is not spontaneous

52. A solution containing 10g per dm^3 of urea (molecular mass = 60 $g\,mol^{-1}$) is isotonic with a 5% solution of a non-volatile solute. The molecular mass of this non-volatile solute is:

(1) 250 $g\,mol^{-1}$

(2) 300 $g\,mol^{-1}$

(3) 350 $g\,mol^{-1}$

(4) 200 $g\,mol^{-1}$

53. A plot of log (x/m) versus log p for the adsorption of a gas on a solid gives a straight line with slope equal to:

(1) –log k

(2) n

(3) $\frac{1}{n}$

(4) log k

54. Assume each reaction is carried out in an open container. For which reaction will $\Delta H = \Delta E$?

(1) $H_{2(g)} + Br_{2(g)} \rightarrow 2HBr_{(g)}$

(2) $C_{(s)} + 2H_2O_{(g)} \rightarrow 2H_{2(g)} + CO_{2(g)}$

(3) $PCl_{5(g)} \rightarrow PCl_{3(g)} + Cl_{2(g)}$

(4) $2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{2(g)}$

55. In a set of reactions propanoic acid yielded a compound D

$$CH_3CH_2COOH \xrightarrow{SOCl_2} B \xrightarrow{NH_3} C \xrightarrow[Br_2]{KOH} D$$

The structure of D would be:

(1) $CH_3CH_2CH_2NH_2$

(2) $CH_3CH_2CONH_2$

(3) $CH_3CH_2NHCH_3$

(4) $CH_3CH_2NH_2$

56. During the process of digestion, the proteins present in food materials are hydrolysed to amino acids. The two enzymes involved in the process

Proteins $\xrightarrow{\text{Enzyme(A)}}$ Polypeptides

$\xrightarrow{\text{Enzyme(B)}}$ Amino acids,

are respectively:

(1) amylase and maltase
(2) diastase and lipase
(3) pepsin and trypsin
(4) invertase and zymase

57. The human body does not produce:

(1) DNA
(2) vitamins
(3) hormones
(4) enzymes

58. CsBr crystallises in a body centred cubic lattice. The unit cell length is 436.6 pm. Given that the atomic mass of Cs = 133 and that of Br = 80 amu and Avogadro number being 6.02×10^{23} mol^{-1}, the density of CsBr is:

(1) 42.5 g/cm^3
(2) 0.425 g/cm^3
(3) 8.25 g/cm^3
(4) 4.25 g/cm^3

59. More number of oxidation states are exhibited by the actinides than by the lanthanides. The main reason for this is:

(1) more energy difference between 5f and 6d orbitals than that between 4f and 5d orbitals
(2) lesser energy difference between 5f and 6d orbitals than that between 4f and 5d orbitals
(3) greater metallic character of the lanthanides than that of the corresponding actinides
(4) more active nature of the actinides

60. Given : The mass of electron is 9.11×10^{-31}kg
Planck's constant is 6.626×10^{-34} Js, the uncertainty involved in the Measurement of velocity within a distance of 0.1 Å is:

(1) 5.79×10^6 ms^{-1}
(2) 5.79×10^7 ms^{-1}
(3) 5.79×10^8 ms^{-1}
(4) 5.79×10^5 ms^{-1}

61. Copper sulphate dissolves in excess of KCN to give:
(1) CuCN
(2) $[Cu(CN)_4]^{3-}$
(3) $[Cu(CN)_4]^{2-}$
(4) $Cu(CN)_2$

62. In which of the following pairs are both the ions coloured in aqueous solution?
(1) Ni^{2+}, Ti^{3+}
(2) Sc^{3+}, Ti^{3+}
(3) Sc^{3+}, Co^{2+}
(4) Ni^{2+}, Cu^{+}

63. Al_2O_3 can be converted to anhydrous $AlCl_3$ by heating:
(1) Al_2O_3 with HCl gas
(2) Al_2O_3 with NaCl in solid state
(3) a mixture of Al_2O_3 and carbon in dry Cl_2
(4) Al_2O_3 with Cl_2 gas

64. The enthalpy and entropy change for the reaction:
$Br_{2(l)} + Cl_{2(g)} \rightarrow 2BrCl_{(g)}$
are 30 kJ mol^{-1} and 105 JK^{-1} mol^{-1} respectively. The temperature at which the reaction will be in equilibrium is:
(1) 285.7 K
(2) 273 K
(3) 450 K
(4) 300 K

65. The appearance of colour in solid alkali metal halides is generally due to:
(1) F-centres
(2) Schottky defect
(3) Frenkel defect
(4) Interstitial positions

66. The general molecular formula, which represents the homologous series of alkanols is:
(1) $C_nH_{2n}O_2$
(2) $C_nH_{2n}O$
(3) $C_nH_{2n+1}O$
(4) $C_nH_{2n+2}O$

67. If $E^{\circ}_{Fe^{2+}/Fe}$ = -0.441 V and $E^{\circ}_{Fe^{3+}/Fe^{2+}}$ = 0.771 V, the standard emf of the reaction:
$Fe + 2Fe^{3+} \rightarrow 3Fe^{2+}$ will be:

(1) 0.330 V
(2) 1.653 V
(3) 1.212 V
(4) 0.111 V

68. For the reaction
$2A + B \rightarrow 3C + D$
which of the following does not express the reaction rate ?

(1) $-\frac{d[C]}{3dt}$
(2) $-\frac{d[B]}{dt}$
(3) $\frac{d[D]}{dt}$
(4) $-\frac{d[A]}{2dt}$

69. For the reaction,
$CH_{4(g)} + 2O_{2(g)} \rightleftharpoons CO_{2(g)} + 2H_2O_{(l)}$, ΔH_r = -170.8 kJ mol^{-1}
Which of the following statements is not true?

(1) At equilibrium, the concentrations of $CO_{2(g)}$ and $H_2O_{(l)}$ are not equal
(2) The equilibrium constant for the reaction is given by $K_p = \frac{[CO_2]}{[CH_4][O_2]}$
(3) Addition of $CH_{4(g)}$ or $O_{2(g)}$ at equilibrium will cause a shift to the right
(4) The reaction is exothermic

70. $[NH(CH_2)_2 NHCO(CH_2)_4CO]_n$— is a:

(1) co-polymer
(2) addition polymer
(3) thermo-setting polymer
(4) homopolymer

71. A carbonyl compound reacts with hydrogen cyanide to form cyanohydrin which on hydrolysis forms a racemic mixture of α-hydroxy acid. The carbonyl compound is:

(1) acetaldehyde
(2) acetone
(3) diethyl ketone
(4) formaldehyde

72. Which one of the following is a peptide hormone?

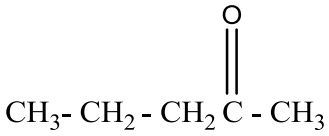
(1) Glucagon
(2) Testosterone
(3) Thyroxin
(4) Adrenaline

73. The major organic product in the reaction, $CH_3—O—CH(CH_3)_2 + HI \rightarrow$ Product is:

(1) $CH_3OH + (CH_3)_2CHI$
(2) $ICH_2OCH(CH_3)_2$
(3) $CH_3OCI(CH_3)_2$
(4) $CH_3I + (CH_3)_2CHOH$

74. Nucleophilic addition reaction will be most favoured in:

(1)



(2) $(CH_3)_2C=O$
(3) CH_3CH_2CHO
(4) CH_3CHO

75. The enthalpy of hydrogenation of cyclohexene is –119.5 kJ mol–1. If resonance energy of benzene is –150.4 kmol–1, its enthalpy of hydrogenation would be:-

(1) -508 kJ per mol
(2) -208kJ per mol
(3) -269.9 kJ per mol
(4) -358.5 kJ per mol

76. Self condensation of two moles of ethyl acetate in presence of sodium ethoxide yields:

(1) ethyl butyrate
(2) ethyl acetoacetate (ester)
(3) methyl acetoacetate
(4) ethyl propanoate

77. Consider the reaction

$N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$

The equality relationship between $\frac{d[NH_3]}{dt}$ and $-\frac{d[H_2]}{dt}$ is:

(1) $\frac{d[NH_3]}{dt} = -\frac{1}{3}\frac{d[H_2]}{dt}$

(2) $+\frac{d[NH_3]}{dt} = -\frac{2}{3}\frac{d[H_2]}{dt}$

(3) $+\frac{d[NH_3]}{dt} = -\frac{3}{2}\frac{d[H_2]}{dt}$

(4) $\frac{d[NH_3]}{dt} = -\frac{d[H_2]}{dt}$

78. Which of the following is not chiral?

(1) 2-butanol
(2) 2,3-dibromopentane
(3) 3-bromopentane
(4) 2-hydroxypropanoic acid

79. $[Co(NH_3)_4(NO_2)_2]Cl$ exhibits:

(1) linkage isomerism, ionization isomerism and optical isomerism
(2) linkage isomerism, ionization isomerism and geometrical isomerism
(3) ionization isomerism, geometrical isomerism and optical isomerism
(4) linkage isomerism, geometrical isomerism and optical isomerism

80. $[Cr(H_2O)_6]Cl_3$ (at. no. of Cr = 24) has a magnetic moment of 3.83 B.M.The correct distribution of 3d electrons in the chromium of the complex is:

(1) $(3d_{x^2-y^2})^1, 3d_{z^2}, 3d_{xz^1}$

(2) $3d_{xy^1}, (3d_{x^2-y^2})^1, 3d_{yz^1}$

(3) $3d_{xy^1}, 3d_{yz^1}, 3d_{xz^1}$

(4) $3d_{xy}{}^1, 3d_{yz^1}, 3d_{z^2}$

81. 1.00 g of a non-electrolyte solute (molar mass 250g mol^{-1}) was dissolved in 51.2 g of benzene. If the freezing point depression constant, k_f of benzene is 5.12 K $kg\ mol^{-1}$, the freezing point of benzene will be lowered by:

(1) 0.4 K
(2) 0.3 K
(3) 0.5 K
(4) 0.2 K

82. Which of the following pairs constitutes a buffer?

(1) HNO_2 and $NaNO_2$
(2) NaOH and NaCl
(3) HNO_3 and NH_4NO_3
(4) HCl and KCl

83. The hydrogen ion concentration of a 10^{-8} M HCl aqueous solution at 298 K ($K_w = 10^{-14}$) is:

(1) 1.0×10^{-6} M
(2) 1.0525×10^{-7} M
(3) 9.525×10^{-8} M
(4) 1.0×10^{-8} M

84. A solution of acetone in ethanol:

(1) shows a negative deviation from Raoult's law
(2) shows a positive deviation from Raoult's law
(3) behaves like a near ideal solution
(4) obeys Raoult's law

85. A hypothetical electrochemical cell is shown below :

$A^- \left| A^+(xM) \right| \left| B^+(yM) \right| B^+$

The emf measured is + 0.20V. The cell reaction is:

(1) $A^+ + B \rightarrow A + B^+$
(2) $A^+ + e^- \rightarrow A$; $B^+ + e^- \rightarrow B$
(3) the cell reaction cannot be predicted
(4) $A + B^+ \rightarrow A^+ + B$

86. Ethylene oxide when treated with Grignard reagent yields:

(1) secondary alcohol
(2) tertiary alcohol
(3) cyclopropyl alcohol
(4) primary alcohol

87. During osmosis, flow of water through a semi-permeable membrane is:

(1) from solution having higher concentration only
(2) from both sides of semi-permeable membrane with equal flow rates
(3) from both sides of semi-permeable membrane with unequal flow rates
(4) from solution having lower concentration only

88. Which of the following is more basic than aniline?

(1) Diphenylamine
(2) Triphenylamine
(3) p-nitroaniline
(4) Benzylamine

89. In which of the following molecules are all the bonds not equal?

(1) ClF_3
(2) BF_3
(3) AlF_3
(4) NF_3

90. The electro negativity difference between N and F is greater than that between N and H, yet the dipole moment of NH_3 (1.5 D) is larger than that of NF_3 (0.2 D). This is because:

(1) in NH_3 as well as in NF_3 ,the atomic dipole and bond dipole are in the same direction
(2) in NH_3 ,the atomic dipole and bond dipole are in the same direction whereas in NF_3 they are in opposite directions
(3) in NH_3 as well as NF_3 ,the atomic dipole and bond dipole are in opposite directions
(4) in NH_3 ,the atomic dipole and bond dipole are in the opposite directions; whereas in NF_3 these are in the same direction

91. The correct order of the mobility of the alkali metal ions in aqueous solutions is:

(1) $Li^+ > Na^+ > K^+ > Rb^+$
(2) $Na^+ > K^+ > Rb^+ > Li^+$
(3) $K^+ > Rb^+ > Na^+ > Li^+$
(4) $Rb^+ > K^+ > Na^+ > Li^+$

92. The correct order regarding the electronegativity of hybrid orbitals of carbon is:

(1) $sp > sp^2 < sp^3$
(2) $sp > sp^2 > sp^3$
(3) $sp < sp^2 > sp^3$
(4) $sp < sp^2 < sp^3$

93. Which of the following species has a linear shape?

(1) NO_2
(2) SO_2
(3) NO_2^+
(4) O_3

94. Which of the following is the most basic oxide?

(1) Al_2O_3
(2) Sb_2O_3
(3) Bi_2O_3
(4) SeO_2

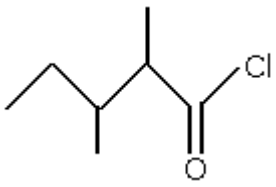
95. The orientation of an atomic orbital is governed by:
(1) azimuthal quantum number
(2) spin quantum number
(3) magnetic quantum number
(4) principal quantum number

96. Which of the following is not a correct statement?
(1) The electron-deficient molecules can act as Lewis acids
(2) The canonical structures have no real existence
(3) Every AB_5 molecule does in fact have square pyramidal structure
(4) Multiple bonds are always shorter than corresponding single bonds

97. The number of unpaired electrons in a paramagnetic diatomic molecule of an element with atomic number 16 is:
(1) 2
(2) 3
(3) 4
(4) 1

98. Which one of the following orders is not in accordance with the property stated against it?
(1) $F_2 > Cl_2 > Br_2 > I_2$; Oxidising power
(2) HI > HBr > HCl > HF ; Acidic property in water
(3) $F_2 > Cl_2 > Br_2 > I_2$; Electronegativity
(4) $F_2 > Cl_2 > Br_2 > I_2$; Bond dissociation energy

99. Which of the following is not isostructural with $SiCl_4$?
(1) SCl_4
(2) SO_4^{2-}
(3) PO_4^{3-}
(4) NH_4^+

100. The IUPAC name of 

is:
(1) 3, 4-dimethylpentanoyl chloride
(2) 1-chloro-1-oxo-2, 3-dimethylpentane
(3) 2-ethyl-3-methylbutanoyl chloride
(4) 2,3-dimethylpentanoyl chloride

Biology

101. What would be the number of chromosomes in the cells of the aleurone layer in a plant species with 8 chromosomes in its synergids?
(1) 16
(2) 24
(3) 32
(4) 8

102. Pineapple (annanas) fruit develops from :
(1) a unilocular polycarpillary flower
(2) a multipistillate syncarpous flower
(3) a cluster of compactly borne flowers on a common axis
(4) a multilocular monocarpillary flower

103. Golden rice is a promising transgenic crop. when released for cultivation, it will help in :
(1) alleviation of vitamin- A deficiency
(2) pest resistance
(3) herbicide tolerance
(4) producing a petol-like fuel from rice

104. Parthenocarpic tomato fruits can be produced by:
(1) removing androecium of flowers before pollen grains are released
(2) treating the plants with low concentrations of gibberellic acid and auxins
(3) raising the plants from vernalized seeds
(4) treating the plants with phenylmercuric acetate

105. How does pruning help in making the hedge dense?
(1) it induces the differentiation of new shoots from the rootstock
(2) It frees axillary buds from apical dominance
(3) The apical shoot grows faster after pruning
(4) It releases wound hormones

106. The 'blue baby' syndrome results from:
(1) excess of chloride
(2) methaemoglobin
(3) excess of dissolved
(4) excess of TDS (Total Dissolved Solids)

107. Praying mantis is a good example of :
(1) mullerian mimicry
(2) warning colouration
(3) social insects
(4) camouflage

108. Which one of the following statements is correct?
(1) Neurons regulate endocrine activity, but not vice versa
(2) Endocrine glands regulate neural activity and nervous system regulates endocrine glands
(3) Neither hormones control neural activity nor the neurons control endocrine activity
(4) Endocrine glands regulate neural activity, but not vice versa.

109. Examination of blood of a person suspected of having anaemia, shows large, immature, and nucleated erythrocytes without haemoglobin. Supplementing his diet with which of the following, is likely to alleviate his symptoms?
(1) Thiamine
(2) Folic acid and cobalamine
(3) Riboflavin
(4) Iron compounds

110. Farmers in a particular region were concerned that per-mature yellowing of leaves of a pulse crop might cause decrease in the yield. Which treatment could be most beneficial to obtain maximum seed yield?
(1) Frequent irrigation of the crop
(2) Treatment of the plants with cytokines along with a small dose of nitrogenous fertilizer
(3) Removal of all yellow leaves and spraying the remaining green leaves with 2, 4, 8-trichlorophenoxy acetic acid
(4) Application of iron and magnesium to promote synthesis of chlorolphyll

111. In which of the following fruits is the edible part the aril?
(1) Custard apple
(2) Pomegranate
(3) Orange
(4) Litchi

112. Which of the following amino acids was not found to be synthesized in Miller's experiment?
(1) Glycine
(2) Aspartic acid
(3) Glutamic acid
(4) Alanine

113. Crop plants grown in monoculture are:
(1) low in yield
(2) free from intraspecific competition
(3) characterised by poor root system,
(4) highly prone to pests

114. Montreal protocol which calls for appropriate action to protect the ozone layer from human activities was passed in the year:
(1) 1986
(2) 1987
(3) 1988
(4) 1985

115. The formula for exponential population growth is:
(1) dt/dN = rN
(2) dN/rN = dt
(3) rN/dN = dt
(4) dN/dt = rN

116. Which one of the following is not used for construction of ecological pyramids?
(1) Dry weight
(2) Number of individuals
(3) Rate of energy flopw
(4) Fresh weight

117. Niche overlap indicates:
(1) active co-operation between two species
(2) two different parasites on the same host
(3) sharing of one or more resources between the two species
(4) mutualism between two species

118. In photosystem-I, the first electron acceptor is:
(1) ferredoxin
(2) cytochrome
(3) plastocyanin
(4) an iron-sulphur protein

119. Treatment of seed at low temperature under moist conditions to break its dormancy is called:
(1) scarification
(2) vernalization
(3) chelation
(4) stratification

120. Which one of the following is the most suitable, medium for culture of *Drosophila melanogaster*?
(1) Moist bread
(2) Agar agar
(3) Ripe banana
(4) Cow dung

121. Which one of the following is not included under *in situ* conservation?
(1) Sanctuary
(2) Botanical garden
(3) Biosphere reserve
(4) National park

122. Which antibiotic inhibits interaction between t-RNA and m-RNA during bacterial protein synthesis?
(1) Erythromycin
(2) Neomycin
(3) Streptomycin
(4) Tetracycline

123. Phenotype of an organism is the result of:
(1) mutations and linkages
(2) cytoplasmic effects and nutrition
(3) environmental changes and sexual dimorphism
(4) genotype and environment interactions

124. Photochemical smog pollution does not contain:
(1) ozone
(2) nitrogen dioxide
(3) carbon dioxide
(4) PAN (Peroxy Acyl Nitrate)

125. Moss peat is used as a packing material for sending flowers and live plants to distant places because:
(1) it is easily available
(2) it is hygroscopic
(3) it is reduces transpiration
(4) It serves as a disinfectant

126. A common structural feature of vessel elements and sieve tube elements is:
(1) thick secondary walls
(2) pores on lateral walls
(3) presence of P-protein
(4) enucleate condition

127. The thalloid body of a slime mould (Myxomycetes) is known as:
(1) protonema
(2) plasmodium
(3) fruiting body
(4) mycelium

128. In which made of inheritance do you expect more maternal influence among the offspring?
(1) Autosomal
(2) Cytoplasmic
(3) Y-linked
(4) X-linked

129. What type of placentation is seen in sweet pea?
(1) Basal
(2) Axile
(3) Free central
(4) Marginal

130. Long filamentous threads protruding at the end of a young cob of maize are:
(1) anthers
(2) styles
(3) ovaries
(4) hairs

131. Conifers differ from grasses in the:
(1) production of seeds from ovules
(2) lack of xylem tracheids
(3) absence of pollen tubes
(4) formation of endosperm before fertilization

132. How many different kinds of gametes will be produced by a plant having the genotype AABbCC?
(1) Three
(2) Four
(3) Nine
(4) Two

133. In maize, hybrid vigour is exploited by:
(1) bombarding the protoplast with DNA
(2) crossing of two inbreed parental lines
(3) harvesting seeds from the most productive plants
(4) inducing mutation

134. Which of the following statements regarding mitochondrial membrane is not correct?
(1) The outer membrane is permeable to all kinds of molecules
(2) The enzymes of the electron transfer chain are embedded in the outer membrane
(3) The inner membrane is highly convoluted forming a series of infoldings
(4) The outer membrane resembles a sieve

135. Amino acid sequence, in protein synthesis is decided by the sequence of:
(1) t-RNA
(2) m-RNA
(3) c-DNA
(4) r-RNA

136. How many ATP molecules could maximally be generated from one molecule of glucose, if the complete oxidation of one mole of glucose to CO_2 and H_2O yields 686 kcal and the useful chemical energy available in the high energy phosphate bond of one mole of ATP is 12 kcal?
(1) Two
(2) Thirty
(3) Fifty seven
(4) One

137. An organic substance bound to an enzyme and essential for its cavity is called:
(1) coenzyme
(2) holoenzyme
(3) apoenzyme
(4) isoenzyme

138. Bowman's glands are found in:
(1) n olfactory epithelium
(2) external auditory canal
(3) cortical nephrons only
(4) juxtamedullary nephrons

139. The bacterium (*Clostridium botulinum*) that causes botulism is:
(1) a facultative anaerobe
(2) an obligate anaerobe
(3) a facultative aerobe
(4) an obligate aerobe

140. Which one of the following is the correctly matched pair of an endangered animal and National Park?
(1) Lion - Corbett National Park
(2) Rhinoceros - Kaziranga National Park
(3) Wild ass - Dudhwa national Park
(4) Great Indian bustard - Keoladeo National Park

141. A person showing unpredictable moods, outbursts of emotion, quarrelsome behaviour and conflicts with others is suffering from:
(1) schizophrenia
(2) borderline personality disorder (BPD)
(3) mode disorders
(4) addictive disorders

142. Sulphur is an important nutrient for optimum growth and productivity in:
(1) pulse crops
(2) cereals
(3) fibre crops
(4) oilseed crops

143. Pentamerous, actinomorphic flowers, bicarpillary ovary with oblique septa, and fruit a capsule or berry, are characteristic features of
(1) Asteraceae
(2) Brassicaceae
(3) Solanaceae
(4) Liliaceae

144. In a moss the sporophyte:
(1) is partially parasitic on the gametophyte
(2) produces gametes that give rise to the gametophyte
(3) arises from a spore produced from the gametophyte
(4) manufactures food for itself, as well as for the gametophyte

145. Curing of tea leaves is brought about by the activity of:
(1) bacteria
(2) mycorrhiza
(3) viruses
(4) fungi

146. People living at seal level have around 5million RBc per cubic millimeter of the their blood whereas those living at an altitude of 5400 metres have around 8million. This is because at high altitude:
(1) people get pollution-free air to breathe and more oxygen is available
(2) atmospheric O_2 level is less and hence required amount of O_2 to survive
(3) there is more UV radiation which enhances RBC production
(4) people eat more nutritive food, therefore more RBCs are formed

147. An important evidence in favour of organic evolution is the occurrence of :
(1) homologous and vestigial organs
(2) analogous and vestigial organs
(3) homologous organs only
(4) homologous and analogous organs

148. Which one of the following is not a living fossil?
(1) King crab
(2) Sphenodon
(3) Archaeopteryx
(4) Peripatus

149. Annual migration does not occur in the case of:
(1) salmon
(2) siberian crane
(3) salamander
(4) arctic tern

150. A major breakthrough in the studies of cells came with the development of electron microscope. This is because:
(1) the resolution power of the electron microscope is much higher than that of the light microscope
(2) the resolving power of the electron microscope is 200-350 nm as compared to 0.1 - 0.2 nm for the light microscope
(3) electron beam can pass through thick materials, whereas light microscopy requires thin sections
(4) the electron microscope is more powerful than the light microscope as it uses a beam of electrons which has wavelength much longer than that of photons

151. Which one of the following is a matching set of a phylum and its three examples?
(1) Cnidaria - Bonellia, Physalia, Aurelia
(2) Platyhelminthes - Planaria, Schistosomea, Enterobius
(3) Mollusca - Loligo, Teredo, Octopus
(4) Porifera - Spongilla, Euplectella, Pennatula

152. Metameric segmentation is the characteristic of:
(1) Platyhelminthes and Arthropoda
(2) Echinodermata and Annelida
(3) Annelida and Arthropoda
(4) Mollusca and Chordata

153. Which of the following pairs of an animal and a plant represents endangered organisms isn India?
(1) *Bentinckia nicobarica* and red panda
(2) Tamarind and rhesus monkey
(3) Cinchona and leopard
(4) Banyan and black buck

154. Jurassic period of the Mesozoic era is characterised by:
(1) gymnosperms are dominant plants and first birds appear
(2) radiation of reptiles and origin of mammal like reptiles
(3) dinosaurs become extinct and angiosperms appear
(4) flowering plants and first dinosaurs appear

155. What is common about *Trypanosoma, Noctiluca, Monocystis and Giardia*?
(1) These are all unicellular protists
(2) They have flagella
(3) They produce spores
(4) These are all parasites

156. Which of the following statements regarding cilia is not correct?
(1) The organized beating of cilia is controlled by fluxes of Ca^{2+} across the membrane
(2) Cilia are hair-like cellular appendages
(3) Microtubules of cilia are composed of tubulin
(4) Cilia contain an outer ring of nine doublet microtubules surrounding two single microtubules

157. Microbes found to be very useful in genetic engineering are:
(1) Escherichia coli and Agrobacterium tumefaciens
(2) Vibrio cholerae and a tailed bacteriophage
(3) Diplococcus sp. and Pseudomanas sp.
(4) Crown gall bacterium and Caenorhabditis elegans

158. Which of the following environmental conditions are essential for optimum growth of *mucor* on a piece of bread?
(1) Temperature of about 25° C
(2) Temperature of about 5° C
(3) Relative humidity of about 5%
(4) Relative humidity of about 95%
(5) A shady place
(6) A brightly illuminated place

159. Evolutionary history of an organism is known as:
(1) Phylogeny
(2) Ancestry
(3) paleontology
(4) Ontogeny

160. Which of the following is considered a hot-spot of biodiversity in India?
(1) Western ghats
(2) Indo-Gangetic plain
(3) Eastern ghats
(4) Aravalli hills

161. During photorespiration, the oxygen consuming reaction(s) occur in:
(1) stroma of chloroplasts and mitochondria
(2) Stroma of chloroplasts and peroxisomes
(3) grana of chloroplasts and peroxisomes
(4) stroma of chloroplasts

162. Which one of the following is an example of polygenic inheritance?
(1) Flower colour in *Mirabilis jalapa*
(2) Production of male honey bee
(3) Pod shape in garden pea
(4) Skin colour in humans

163. Which one of the following not act as a neurotransmitter?
(1) Acetylcholine
(2) Epinephrine
(3) Nor epinephrine
(4) Cortisone

164. Sertoli cells are regulated by the pituitary hormone known as:
(1) FSH
(2) GH
(3) prolactin
(4) LH

165. A steroid hormone which regulates glucose metabolism is:
(1) cortisol
(2) corticosterone
(3) 11-deoxycorticosterone
(4) cortisone

166. The contractile protein of skeletal muscle involving ATPase activity is:
(1) tropomyosin
(2) myosin
(3) α-actinin
(4) troponin

167. Which one of the following is not a second messenger in hormone action?
(1) cGMP
(2) Calcium
(3) Sodium
(4) cAMP

168. In Mendel's experiments with garden pea, round seed shape (RR) was dominant over wrinkled seeds (rr), yellow cotyledon (YY) was dominant over green cotyledon (yy). What are the expected phenotypes in the F_2 generation of the cross RRYY × rryy

(1) Only round seed with green cotyledons
(2) Only wrinkled seeds with yellow cotyledons
(3) Only wrinkled sees with green cotyledons
(4) Round seeds with yellow cotyledons and wrinkled seeds with yellow cotyledons

169. One gene — one enzyme hypothesis was postulated by:

(1) R.Franklin
(2) Hershey and Chase
(3) A. Garrod
(4) Beadle and Tatum

170. One turn of the helix in a B-form DNA is approximately:

(1) 20 nm
(2) 0.34 nm
(3) 3.4 nm
(4) 2 nm

171. Test cross involves:

(1) crossing between two genotypes with recessive trait
(2) crossing between two F_1 hybrid
(3) crossing the F1 hybrid with a double recessive genotype
(4) crossing between two genotypes with dominant trait

172. Antiparallel strands of a DNA molecule means that;

(1) one strand turns anti-clockwise
(2) the phosphate groups of two DNA strands, at their ends, share the same position
(3) the phosphate groups at the start of two DNA strands are in opposite position (pole)
(4) one strand turns clockwise

173. Areolar connective tissue joins:

(1) fat body with muscles
(2) integument with muscles
(3) bones with muscles
(4) bones with bones

174. Mast cells secrete:
(1) hippurin
(2) myoglobin
(3) histamine
(4) haemoglobin

175. If a colourblind woman marries a normal visioned man, their sons will be:
(1) all normal visioned
(2) one-half colourblind and one-half normal
(3) three-fourths colourblind and one-fourth normal
(4) all colourblind

176. Cri-du-chat syndrome in humans is caused by the:
(1) fertilization of an XX egg by a normal Y-bearing sperm
(2) loss of half of the short arm of chromosome 5
(3) loss half of the long arm of chromosome 5
(4) trisomy of 21st chromosome

177. Restriction endonuclease:
(1) cuts the DNA molecule randomly
(2) cuts the DNA molecule at specific sites
(3) restricts the synthesis of DNA inside the nucleus
(4) synthesizes DNA

178. Antibodies in our body are complex:
(1) lipoproteins
(2) steroids
(3) prostaglandins
(4) glycoproteins

179. Limit of BOD prescribed by Central pollution Control Board for the discharge of industrial and municipal waste water into natural surface water, is:
(1) < 3.0 ppm
(2) < 10 ppm
(3) < 100 ppm
(4) < 30 ppm

180. Earth worms are:
(1) ureotelic when plenty of water is available
(2) uriocotelic when plenty of water is a available
(3) uricotelic under conditions of water scarcity
(4) ammonotelic when plenty of water is available

181. Which of the following is an accumulation and release centre of neurohormones?
(1) posterior pituitary lobe
(2) Intermediate lobe of the pituitary
(3) Hypothalamus
(4) Anterior pituitary lobe

182. Withdrawal of which of the following hormones is the immediate cause of menstruation?
(1) Eastrogens
(2) FSH
(3) FSH-RH
(4) Progesterone

183. Which one of the following statements is incorrect?
(1) The residual air in lungs slightly decreases the efficiency of respiration in mammals
(2) The presence of non-respiratory air sacs, increases the efficiency of respiration in birds
(3) In insects, circulating body fluids serve to distribute oxygen to tissues
(4) The principle of countercurrent flow facilitates efficient respiration in gills of fishes

184. Which one of the following has an open circulatory system?
(1) Pheretima
(2) Periplaneta
(3) Hirudinaria
(4) Octopus

185. Which hormone causes dilation of blood vessels, increases oxygen consumption and glycogenolysis?
(1) ACTH
(2) Insulin
(3) Adrenalin
(4) Glucagon

186. The causative agent of mad-cow disease is a:
(1) bacterium
(2) prion
(3) work
(4) virus

187. The translocation of organic solutes in sieve tube members is supported by:
(1) root pressure and transpiration pull
(2) P-proteins
(3) mass flow involving a carrier and ATP
(4) cytoplasmic streaming

188. Biradial symmetry and lack of cnidoblasts are the characteristics of:
(1) Starfish and sea anemone
(2) Ctenoplana and Beroe
(3) Aurelia and paramecium
(4) Hydra and starfish

189. The arrangement of the nuclei in a normal embryo sac in the dicot plants is:
(1) 2+4+2
(2) 3+2+3
(3) 2+3+3
(4) 3+3+2

190. An enzyme that can stimulate germination of barley seeds is:
(1) α-amylase
(2) lipase
(3) protease
(4) invertase

191. In a cereal grain the single cotyledon of embryo is represented by:
(1) coleorhizae
(2) scutellum
(3) prophyll
(4) coleoptile

192. The majority of carbon dioxide produced by our body cells is transported to the lungs:
(1) dissolved in the blood
(2) as bircarbonates
(3) as carbonates
(4) attached to haemoglobin

193. *Triticale*, the first man-made cereal crop, has been obtained by crossing wheat with:
(1) rye
(2) pearl millet
(3) sugarcane
(4) barley

194. In order to obtain virus-free plants through tissue culture the best method is:
(1) protoplast culture
(2) embryo 4rescue
(3) anther culture
(4) meristem culture

195. HIV that causes AIDS, first starts destroying:
(1) B-lymphocytes
(2) leucocytes
(3) thrombocytes
(4) helper T-lymphocytes

196. In which one of the following of animals do all the four give birth to young ones?
(1) Lion, bat, whale, ostrich
(2) Platypus, penguin, bat, hippopotamus
(3) Shrew, bat, cat, kiwi
(4) Kangaroo, hedgehog, dolphin, loris

197. Sickle cell anaemia has not been eliminated from the African population because:
(1) it is controlled by recessive genes
(2) it is not a fatal disease
(3) it provides immunity against malaria
(4) it is controlled by dominant genes

198. Two common characters found in centipede, cockroach and crab are:
(1) compound eyes and anal cerci
(2) jointed legs and chitinous exoskeleton
(3) green gland and tracheae
(4) book lungs and antennae

199. Both sickle cell anaemia and Huntington's chorea are:
(1) bacteria-related diseases
(2) congenital disorders
(3) pollutant-induced disorders
(4) virus-related diseases

200. Angiotensinogen is a protein produce and secreted by:
(1) macula densa cells
(2) endothelial cells (cells lining the blood vessels)
(3) liver cells
(4) juxtaglomerular (JG) cells

AIPMT - 2006
(Physics, Chemistry and Biology)
Prelims Answer Key and Solution

Answers

1	(1)	2	(4)	3	(2)	4	(3)	5	(3)	6	(1)	7	(4)	8	(2)	9	(3)	10	(2)
11	(1)	12	(2)	13	(3)	14	(1)	15	(3)	16	(3)	17	(1)	18	(1)	19	(2)	20	(3)
21	(4)	22	(2)	23	(1)	24	(3)	25	(1)	26	(4)	27	(1)	28	(3)	29	(2)	30	(3)
31	(4)	32	(4)	33	(1)	34	(2)	35	(4)	36	(4)	37	(2)	38	(4)	39	(1)	40	(2)
41	(1)	42	(4)	43	(4)	44	(4)	45	(2)	46	(3)	47	(1)	48	(1)	49	(1)	50	(4)
51	(2)	52	(2)	53	(3)	54	(1)	55	(4)	56	(3)	57	(2)	58	(4)	59	(2)	60	(4)
61	(2)	62	(1)	63	(3)	64	(1)	65	(1)	66	(4)	67	(3)	68	(1)	69	(2)	70	(1)
71	(1)	72	(4)	73	(4)	74	(4)	75	(2)	76	(2)	77	(2)	78	(3)	79	(2)	80	(3)
81	(1)	82	(1)	83	(2)	84	(2)	85	(4)	86	(4)	87	(4)	88	(4)	89	(1)	90	(2)
91	(2)	92	(2)	93	(1)	94	(3)	95	(3)	96	(3)	97	(1)	98	(4)	99	(1)	100	(4)
101	(2)	102	(2)	103	(3)	104	(1)	105	(2)	106	(1)	107	(4)	108	(2)	109	(2)	110	(3)
111	(2)	112	(2)	113	(4)	114	(1)	115	(2)	116	(3)	117	(1)	118	(4)	119	(4)	120	(2)
121	(3)	122	(4)	123	(1)	124	(4)	125	(1)	126	(4)	127	(2)	128	(4)	129	(2)	130	(3)
131	(2)	132	(1)	133	(1)	134	(3)	135	(1)	136	(2)	137	(3)	138	(4)	139	(1)	140	(3)
141	(1)	142	(3)	143	(2)	144	(4)	145	(2)	146	(1)	147	(4)	148	(2)	149	(1)	150	(2)
151	(3)	152	(3)	153	(4)	154	(1)	155	(2)	156	(1)	157	(4)	158	(3)	159	(4)	160	(3)
161	(3)	162	(1)	163	(3)	164	(2)	165	(4)	166	(3)	167	(3)	168	(1)	169	(3)	170	(2)
171	(2)	172	(3)	173	(1)	174	(2)	175	(1)	176	(2)	177	(3)	178	(1)	179	(1)	180	(1)
181	(3)	182	(1)	183	(1)	184	(3)	185	(1)	186	(1)	187	(3)	188	(4)	189	(3)	190	(2)
191	(1)	192	(3)	193	(3)	194	(1)	195	(2)	196	(2)	197	(2)	198	(1)	199	(3)	200	(4)

Physics

1. According to the question,
Power consumed in electrolysis P = 100 W
Voltage applied V = 125 V

So, current in the solution

$$i = \frac{P}{V} = \frac{100}{125} = 0.8 \text{ A}$$

According to Faraday's first law of electrolysis, we get

$$m \propto Q$$

$$\Rightarrow m = zQ$$

Where z = electrochemical equivalent (ECE)
Also Q = it

$$\therefore m = zit$$

Given, $z = 0.367 \times 10^{-6} \text{ kg/C}, i = 0.8\text{A}, t = 60\text{s}$

Hence, $m = 0.367 \times 10^{-6} \times 0.8 \times 60$
$= 17.6 \times 10^{-6}$ kg
= 17.6 mg

2. Resistors of 4 Ω and 4 Ω are connected in series, so the effective resistance is R′ = 4 + 4 = 8Ω.
Similarly, resistors of 1Ω and 3Ω are connected in series.
So, R′′ = 1 + 3 = 4 Ω

Now, R′ and R′′ will be in parallel, and hence, the effective resistance is

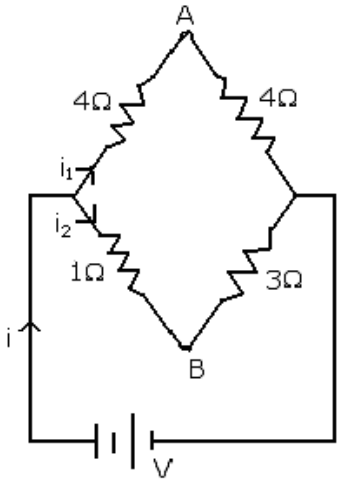
$$R = \frac{R' \times R''}{R' + R''}$$

$$= \frac{8 \times 4}{8 + 4} = \frac{32}{12} = \frac{8}{3}\Omega$$

Therefore, the current through the circuit is given from Ohm's law as

$$i = \frac{V}{R} = \frac{3V}{8} \text{A}$$

Let currents i_1 and i_2 flow in the branches as shown.



$\therefore\ 8i_1 = 4i_2$

$\Rightarrow i_2 = 2i_1$

Also, $i = i_1 + i_2$

$\Rightarrow \frac{3V}{8} = i_1 + 2i_1$

$\Rightarrow\ i_1 = \frac{V}{8}A$

and $i_2 = \frac{V}{4}A$

Potential drop at A $V_A = 4 \times i_1 = \frac{4V}{8} = \frac{V}{2}$

Potential drop at B $V_B = 1 \times i_2 = 1 \times \frac{V}{4} = \frac{V}{4}$

Since the drop of potential is greater in the 4 Ω resistor, the current will flow from B to A.

3. Let the block be displaced through 'x' m.
Then the upthrust (upwards) = $-Ax\rho g$
where A = area of cross-section of the block and ρ = density
The upthrust must be equal to force (=ma) applied, where m is the mass of the block and a is the acceleration.

$\therefore\ ma = -Ax\rho g$

$\therefore a = -\frac{A\rho g}{m}x = -\omega^2 x$

This is the equation of simple harmonic motion.
Hence, the time period of oscillation is

$T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{m}{A\rho g}}$

$\Rightarrow\ T \propto \frac{1}{\sqrt{A}}$

4. The efficiency of the Carnot engine is given as

$$\eta = \frac{\text{Work done}}{\text{Heat supplied}} = \frac{W}{Q_1} = \frac{Q_1 - Q_2}{Q_1}$$

$$= 1 - \frac{Q_2}{Q_1} = 1 - \frac{T_2}{T_1}$$

Here, T_1 = temperature of source

T_2 = temperature of sink

As given, $\eta = 40\% = \frac{40}{100} = 0.4$

And $T_2 = 300K$

So, $0.4 = 1 - \frac{300}{T_1}$

$$\Rightarrow T_1 = \frac{300}{1-0.4} = \frac{300}{0.6} = 500K$$

Let the temperature of the source be increased by x K. Then the efficiency becomes

$\eta = 40\% + 50\%$ of η

$$= \frac{40}{100} + \frac{50}{100} \times 0.4$$

$$= 0.4 + 0.5 \times 0.4$$

$$= 0.6$$

Hence, we get

$$0.6 = 1 - \frac{300}{500 + x}$$

$$\Rightarrow \frac{300}{500 + x} = 0.4$$

$$\Rightarrow 500 + x = \frac{300}{0.4} = 750$$

$$\therefore x = 750 - 500 = 250K$$

5. When a charged particle q is moving in a uniform magnetic field $\vec{B}$ with velocity $\vec{v}$ with angle between $\vec{v}$ and $\vec{B}$ as θ, then due to interaction between the magnetic field produced because of moving charge and magnetic field applied, the charge q experiences a force which is given by

$F = qvB \sin\theta$

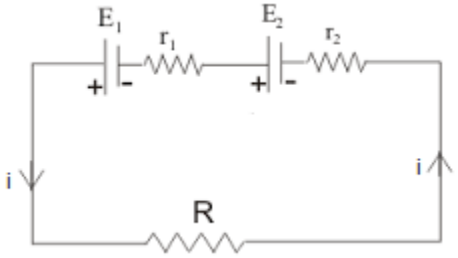
If $\theta = 0°$ or 180°, then $\sin\theta = 0$

$\therefore F = qvB \sin\theta = 0$

Since force on a charged particle is non-zero, the angle between $\vec{v}$ and $\vec{B}$ can have any value other than zero and 180°.

6. Net resistance of the circuit = $r_1 + r_2 + R$

Net *emf* in series = E + E = 2E



Therefore, from Ohm's law, current in the circuit is

$$i = \frac{\text{Net emf}}{\text{Net resistance}}$$

$$\Rightarrow i = \frac{2E}{r_1 + r_2 + R} \quad \text{....(i)}$$

It is given that the circuit is closed and the potential difference across the first cell is zero. That is,

$$V = E - ir_1 = 0$$

$$\Rightarrow \ i = \frac{E}{r_1} \quad \text{....(ii)}$$

Equating equations (i) and (ii), we get

$$\frac{E}{r_1} = \frac{2E}{r_1 + r_2 + R}$$

$$\Rightarrow \ 2r_1 = r_1 + r_2 + R$$

$\therefore$ R = external resistance = $r_1 - r_2$

7. It is given that

$$T = 1227 + 273 = 1500K,$$

$$T' = 1227 + 1000 + 273 = 2500K$$

$$\lambda_m = 5000\,\text{Å}$$

According to Wien's law, we have

$$\frac{\lambda_{m'}}{\lambda_m} = \frac{T}{T'}$$

Hence, $\lambda_{m'} = \frac{1500}{2500} \times 5000 = 3000\,\text{Å}$

8. Magnetic field at the centre of a circular coil-1 is calculated by the expression

$$B_1 = \frac{\mu_0}{4\pi} \times \frac{2\pi i_1}{r_1}$$

At the centre of coil-2,

$$B_2 = \frac{\mu_0}{4\pi} \times \frac{2\pi i_2}{r_2}$$

but $B_1 = B_2$

$$\therefore \quad \frac{\mu_0}{4\pi}\frac{2\pi i_1}{r_1} = \frac{\mu_0}{4\pi}\frac{2\pi i_2}{r_2}$$

$$\frac{i_1}{r_1} = \frac{i_2}{r_2}$$

As $r_1 = 2r_2$

$$\therefore \quad \frac{i_1}{2r_2} = \frac{i_2}{r_2}$$

Hence, $i_1 = 2i_2$

Now, the ratio of potential differences is

$$\frac{V_2}{V_1} = \frac{i_2 \times r_2}{i_1 \times r_1} = \frac{i_2 \times r_2}{2i_2 \times 2r_2} = \frac{1}{4}$$

$$\therefore \quad \frac{V_1}{V_2} = \frac{4}{1}$$

9. Given, $L_1 = L$, $C_1 = C$, $L_2 = 2L$, $C_2 = 4C$, $f_1 = f$

We know that in a series LC circuit, the frequency of LC oscillations is given by the expression

$$f = \frac{1}{2\pi\sqrt{LC}}$$

$$f \propto \frac{1}{\sqrt{LC}}$$

$$\Rightarrow \frac{f_1}{f_2} = \sqrt{\frac{L_2C_2}{L_1C_1}}$$

Substituting the values, we get

$$\frac{f}{f_2} = \sqrt{\frac{2L \times 4C}{LC}} = \sqrt{8}$$

$$\therefore f_2 = \frac{f}{2\sqrt{2}}$$

10. The reaction can be written as

$_1H^2 + {}_1H^2 \rightarrow {}_2He^4 + \text{Energy}$

$\text{Energy released} = \text{Binding energy of } {}_2He^4 - 2 \times \text{Binding energy of } {}_1H^2$

$= 28 - 2 \times 2.2$

$= 23.6 \text{ MeV}$

11. We know from the radioactive decay law that

$$-\frac{dN}{dt} \propto N \text{ or } -\frac{dN}{dt} = \lambda N$$

$$\text{Thus, } R = -\frac{dN}{dt}$$

$$\Rightarrow R \propto N$$

$$R = \lambda N$$

$$\Rightarrow R = \lambda N_0 e^{-\lambda t} \quad \ldots\ldots \text{(i)}$$

where $R_0 = \lambda N_0$ is the activity of the radioactive material at time t = 0.

At time t_1, $R_1 = R_0 e^{-\lambda t_1}$ ..... (ii)

At time t_2, $R_2 = R_0 e^{-\lambda t_2}$ ..... (iii)

Dividing equation (ii) by (iii), we get

$$\frac{R_1}{R_2} = \frac{e^{-\lambda t_1}}{e^{-\lambda t_2}} = e^{-\lambda(t_1 - t_2)}$$

$R_1 = R_2 \ e^{-\lambda(t_1 - t_2)}$

12. Ionisation energy corresponding to ionisation potential = −13.6 eV

Photon energy incident = 12.1 eV

So, the energy of electrons in the excited state is −13.6 + 12.1 = −1.5 eV

$$\text{i.e. } E_n = -\frac{13.6}{n^2} \text{eV}$$

$$-1.5 = \frac{-13.6}{n^2}$$

$$\Rightarrow n^2 = \frac{-13.6}{-1.5} \approx 9$$

$\therefore n = 3$

Thus, 3 spectral lines are emitted.

13. Let extension produced in a spring be x initially. In the stretched condition, the spring will have potential energy

$$U = \frac{1}{2} k x^2$$

where k is the spring constant or force constant.

$$\therefore \frac{U_1}{U_2} = \frac{x_1^2}{x_2^2} \quad \text{....(i)}$$

Given, $U_1 = U$, $x_1 = 2$ cm, $x_2 = 8$ cm
Putting these values in equation (i), we get

$$\frac{U}{U_2} = \frac{(2)^2}{(8)^2} = \frac{4}{64} = \frac{1}{16}$$

$$\therefore U_2 = 16U$$

14. Horizontal range of projectile = horizontal component of velocity (U_x) × Time of flight (T)

$$R = u\cos\alpha \times \frac{2u\sin\alpha}{g}$$

$$R = \frac{u^2 \sin 2\alpha}{g}$$

For $\alpha = (45° - \theta)$, we get

$$R_1 = \frac{u^2 \sin 2(45° - \theta)}{g}$$

$$= \frac{u^2 \sin(90° - 2\theta)}{g}$$

$$= \frac{u^2 \cos 2\theta}{g}$$

For $\alpha = (45° + \theta)$, we get

$$R_2 = \frac{u^2 \sin 2(45° + \theta)}{g}$$

$$= \frac{u^2 \sin(90° + 2\theta)}{g}$$

$$= \frac{u^2 \cos 2\theta}{g}$$

Hence, $\frac{R_1}{R_2} = \frac{1}{1}$

$R_1 : R_2 = 1 : 1$

15. Work done $W = F \times s$ ..... (i)
But from Newton's 2nd law, we have
$F = ma$ ..... (ii)
Hence, from equations (i) and (ii), we get

$$W = mas = m\left(\frac{d^2s}{dt^2}\right)s \quad \text{(iii)} \quad \left(\because a = \frac{d^2s}{dt^2}\right)$$

Now, we have $s = \frac{1}{3}t^2$

$$\frac{d^2s}{dt^2} = \frac{d}{dt}\left[\frac{d}{dt}\left(\frac{1}{3}t^2\right)\right]$$

$$\therefore \quad = \frac{d}{dt} \times \left(\frac{2}{3}t\right)$$

$$= \frac{2}{3}$$

Hence, equation (iii) becomes

$$W = \frac{2}{3}ms = \frac{2}{3}m \times \frac{1}{3}t^2 = \frac{2}{9}mt^2$$

$$W = \frac{2}{9} \times 3 \times (2)^2 = \frac{8}{3}J$$

16. Distance travelled by the particle is

$x = 40 + 12t - t^3$ ---- (i)

We know that velocity is the rate of change of distance

i.e. $v = \frac{dx}{dt}$.

$$\therefore v = \frac{d}{dt}(40 + 12t - t^3)$$

$= 0 + 12 - 3t^2$

$\therefore 0 = 12 - 3t^2$ (Since final velocity v = 0)

$$t^2 = \frac{12}{3} = 4$$

$t = 2$ s

Substitute the value of t in equation (i)

$x = 40 + 12(2) - (2)^3$

$= 40 + 24 - 8 = 64 - 8$

$= 56$ m

17. The given expression is

$$v = at + \frac{b}{t + c}$$

From the principle of homogeneity, we get

$[a][t] = [v]$

$$[a] = \frac{[v]}{[t]} = \frac{[LT^{-1}]}{[T]} = [LT^{-2}]$$

Similarly, $[c] = [t] = [T]$

Further, $\frac{[b]}{[t + c]} = [v]$

$[b] = [v][t + c] = [LT^{-1}][T] = [L]$

18. Apparent depth of the mark as seen through a glass slab of thickness x and refractive index μ is

$$\text{Apparent depth} = \frac{\text{Real depth}}{\text{Refractive index}}$$

$$x' = \frac{x}{\mu} = \frac{3}{1.5} = 2\text{cm}$$

The image appears to be raised by 1 cm; therefore, the microscope must be moved upwards by 1 cm.

19. Net work done in sliding a body up to a height 'h' on the inclined plane,

$W = W_g + W_f$ ..... (i)

where W_g = work done against gravitational force

W_f = work done against frictional force

But W = 300 J

$W_g = mgh = 2 \times 10 \times 10 = 200$ J

Substituting the values in equation (i), we get

$300 = 200 + W_f$

$\Rightarrow W_f = 300 - 200 = 100$ J

20. AC gain β is the ratio of the collector to the base current at constant collector voltage as

$$\beta = \left(\frac{\Delta i_c}{\Delta i_B}\right)_{V_e}$$

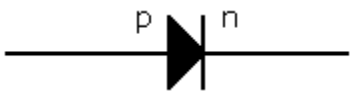
Given,

$\Delta i_c = 10\text{mA} - 5\text{mA} = 5\text{mA}$

$\Delta i_B = 150\mu\text{A} - 100\mu\text{A} = 50\mu\text{A}$

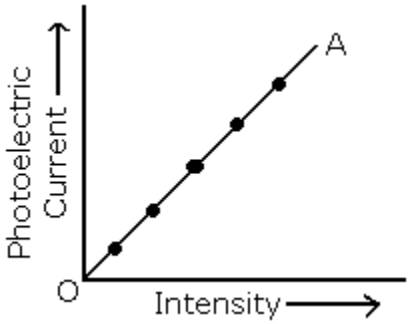
$$\therefore \beta = \frac{5\text{mA}}{50 \times 10^{-3}\text{mA}} = 100$$

21. The p–n junction diode can be shown as



If the p-side of the p–n junction diode is given more positive potential than the n-side, then it is forward biased. In option (4), the p-side is at 0 V and the n-side is at –2V, so p is at a higher potential. Hence, it is forward biased.

22. In a photoelectric effect when monochromatic radiations of suitable frequency fall on the photo-sensitive plate called the cathode, photoelectrons are emitted which get accelerated towards the anode. These electrons flow in the outer circuit resulting in photoelectric current.
Using the incident radiations of a fixed frequency, it is found that the photoelectric current increases linearly with the intensity of incident light as shown in the figure.



Hence, a photocell employs the photoelectric effect to convert change in the intensity of illumination into a change in photoelectric current.

23. When magnetic flux linked with a coil changes, induced emf is produced in it and the induced current flows through the wire. In 1895, Foucault experimentally found that these induced currents are set up in the conductor in the form of closed loops. These currents look like eddies or whirlpools and likewise are known as eddy currents. They are also known as Foucault's currents. These currents oppose the cause of their origin. Therefore, because of eddy currents, a great amount of energy is wasted in the form of heat energy. If the core of the transformer is laminated, then the effect produced because of eddy currents can be minimised.

24. When the total flux associated with one coil links with the other, i.e. a case of maximum flux linkage, then

$$M_{12} = \frac{N_2\phi_{B_2}}{i_1} \text{ and } M_{21} = \frac{N_1\phi_{B_1}}{i_2}$$

Similarly, $L_1 = \frac{N_1\phi_{B_1}}{i_1}$ and $L_2 = \frac{N_2\phi_{B_2}}{i_2}$

If all the flux of coil 2 links coil 1 and *vice versa*, then we get

$\phi_{B_2} = \phi_{B_1}$

Since $M_{12} = M_{21} = M$; hence, we have

$$M_{12} \times M_{21} = M^2 = \frac{N_1N_2\phi_{B_2}\phi_{B_1}}{i_1i_2} = L_1L_2$$

$$\therefore M_{max} = \sqrt{L_1L_2}$$

Given, $L_1 = 2$ mH, $L_2 = 8$ mH

$$\therefore M_{max} = \sqrt{2 \times 8} = \sqrt{16} = 4\,\text{mH}$$

25. In a discharge tube, after being accelerated through a high potential difference, the ions in the gas strike the cathode with huge kinetic energy. This collision liberates electrons from the cathode. These free electrons can further liberate ions from gas molecules through collisions. The positive ions are attracted towards the cathode and the negative ions move towards the anode. Thus, ionisation of gas results.

26. According to Einstein's photoelectric effect energy of photon = KE of photoelectron + work function of metal

$$h\nu = \frac{1}{2}mv^2 + E_0$$

$$h\nu = K_{max} + E_0 \quad ....(i)$$

Now, we are given

$$v' = 2v$$

Therefore, we get

$$K'_{max} = 2h\nu - E_0$$

$$K'_{max} = 2h\nu - E_0 \quad ....(ii)$$

From equations (i) and (ii), we have

$$K'_{max} = 2(K_{max} + E_0) - E_0$$

$$= 2K_{max} + E_0$$

$$= K_{max} + (K_{max} + E_0)$$

$$= K_{max} + h\nu \quad [\text{From Eq. (i)}]$$

Substituting $K_{max} = K$

$$K'_{max} = K + h\nu$$

27. From the figure, voltage waveforms A, B and C can be represented in the form of a truth table as

A	B	C
0	0	0
1	1	1
0	1	0
1	0	0

The Boolean expression which satisfies the output of this logic gate is $C = A \cdot B$, which is for the AND gate.

28. Power factor of the AC circuit is given by

$$\cos\phi = \frac{R}{Z} \quad ....(i)$$

where R is the resistance employed and Z is the impedance of the circuit.

$$Z = \sqrt{R^2 + (X_L - X_C)^2} \quad ....(ii)$$

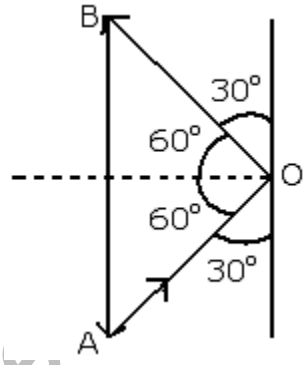
Equations (i) and (ii) give

$$\cos\phi = \frac{R}{\sqrt{R^2 + (X_L - X_C)^2}} \quad \ldots.(iii)$$

Given, $R = 8\Omega$, $X_L = 31\Omega$, $X_C = 25\Omega$

$$\therefore \cos\phi = \frac{8}{\sqrt{(8)^2 + (31-25)^2}} = \frac{8}{\sqrt{64+36}} = 0.80$$

29. The vector $\overrightarrow{OA}$ represents the momentum of the object before the collision, and the vector $\overrightarrow{OB}$ after the collision. The vector $\overrightarrow{AB}$ represents the change in the momentum of the object Δp. As the magnitudes of $\overrightarrow{OA}$ and $\overrightarrow{OB}$ are equal, the components of $\overrightarrow{OA}$ and $\overrightarrow{OB}$ are equal. The components of $\overrightarrow{OA}$ and $\overrightarrow{OB}$ along the wall are equal and in the same direction, while those perpendicular to the wall are equal and opposite. Thus, the change in momentum is only due to the change in the direction of the perpendicular components.



Hence, $\Delta p = OB \sin 30° - (-OA \sin 30°)$

$= mv \sin 30° - (-mv \sin 30°)$

$= 2mv \sin 30°$

Its time rate will appear in the form of average force acting on the wall.

$\therefore F \times t = 2mv \sin 30°$

$$F = \frac{2mv\sin 30°}{t}$$

Given, m = 0.5 kg, v = 12 m/s, t = 0.25 s

$\theta = 30°$

$$\text{Hence, } F = \frac{2\times 0.5\times 12\sin 30°}{0.25} = 24N$$

30. The moment of inertia about an axis passing through the centre of mass of the disc and perpendicular to its plane is

$$I_{CM} = \frac{1}{2}MR^2$$

where M is the mass of the disc and R its radius.

According to the theorem of parallel axis, the moment of inertia of a circular disc about an axis touching the disc at its diameter and normal to the disc is

$$I = I_{CM} + MR^2$$

$$= \frac{1}{2}MR^2 + MR^2$$

$$= \frac{3}{2}MR^2$$

31. Energy of photon is given by

$$E = \frac{hc}{\lambda} \qquad \ldots\ldots (i)$$

where h is the Planck's constant, c is the velocity of light and λ is its wavelength.
The de Broglie wavelength is given by

$$\lambda = \frac{h}{p} \qquad \ldots\ldots (ii)$$

p being the momentum of photon.
From equations (i) and (ii), we can have

$$E = \frac{hc}{h/p} = pc$$

Hence, we get p = E/c
Given, $E = 1MeV = 1 \times 10^6 \times 1.6 \times 10^{-19} J$ c = 3 × 10^8 m/s
Hence, after substituting the values, we get

$$p = \frac{1 \times 10^6 \times 1.6 \times 10^{-19}}{3 \times 10^8} kgm/s$$

$$= 5 \times 10^{-22} kgm/s$$

32. Let the radius of $^{9}_{4}Be$ nucleus be r. Then the radius of germanium (Ge) nucleus will be 2r.
Radius of a nucleus is given by

$$R = R_0 A^{1/3}$$

$$\frac{R_1}{R_2} = \left(\frac{A_1}{A_2}\right)^{1/3}$$

$$\therefore \frac{r}{2r} = \left(\frac{9}{A_2}\right)^{1/3} \qquad (\because A_1 = 9)$$

$$\Rightarrow \left(\frac{1}{2}\right)^3 = \frac{9}{A_2}$$

Hence, $A_2 = 9 \times (2)^3 = 9 \times 8 = 72$

Thus, in the germanium (Ge) nucleus, the number of nucleons is 72.

33. It is given that the molar specific heat at constant pressure is

$$C_p = \frac{7}{2}R$$

We know that $C_p - C_v = R$

$$\Rightarrow C_v = C_p - R$$

$$= \frac{7}{2}R - R = \frac{5}{2}R$$

Hence, the required ratio is

$$\gamma = \frac{C_p}{C_v} = \frac{(7/2)R}{(5/2)R} = \frac{7}{5}$$

34. At a platform at a height h, we have

Escape energy = binding energy of the Earth

$$\frac{1}{2}mv_e'^2 = \frac{GMm}{R+h}$$

$$v_e' = \sqrt{\frac{2GM}{R+h}} = \sqrt{\frac{2GM}{2R}} \quad (\because h = R)$$

But at the surface of the Earth, we have

$$v_e = \sqrt{\frac{2GM}{R}}$$

It is given that $v_e' = fv_e$

Hence,

$$\sqrt{\frac{2GM}{2R}} = f\sqrt{\frac{2GM}{R}}$$

$$\frac{1}{2R} = \frac{f^2}{R}$$

$$f = \frac{1}{\sqrt{2}}$$

35. Let $\lambda_1 = 5.0$ m, $v = 330$ m/s and $\lambda_2 = 5.5$ m

The relation between frequency, wavelength and velocity is given by

$v = n\lambda$

$$\Rightarrow n = \frac{v}{\lambda}$$

The frequency corresponding to wavelength λ_1

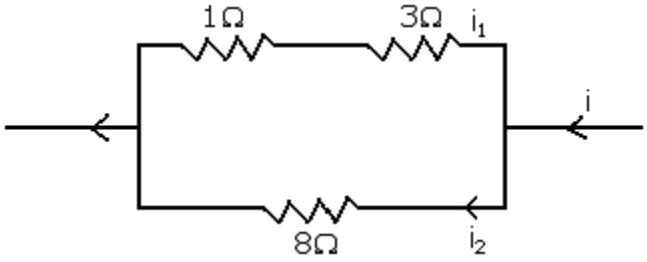
$$n_1 = \frac{v}{\lambda_1} = \frac{330}{5.0} = 66\text{Hz}$$

The frequency corresponding to wavelength λ_2

$$n_2 = \frac{v}{\lambda_2} = \frac{330}{5.5} = 60\text{Hz}$$

Hence, the number of beats per second = $n_1 - n_2 = 66 - 60 = 6$

36. Resistors 1 Ω and 3 Ω are connected in series. So, the effective resistance is
$R' = 1 + 3 = 4\ \Omega$
Now, R′ and 8 Ω are in parallel. We know that the potential difference across resistances in parallel is the same.



Hence, $R' \times i_1 = 8i_2$

$4 \times i_1 = 8i_2$

$$i_1 = \frac{8}{4} i_2 = 2i_2$$

$i_1 = 2i_2$ ..... (i)

The power dissipated across the 8 Ω resistor is

$i_2^2(8)t = 2W$

$$i_2^2 t = \frac{2}{8} = 0.25W \quad \text{..... (ii)}$$

The power dissipated across the 3 Ω resistor is

$H = i_1^2(3)t$

$= (2i_2)^2 (3)t$

$= 12i_2^2 t$

But $i_2^2 t = 0.25W$

$\therefore$ H = 12 × 0.25 = 3 W

37. Kirchhoff's first law is the junction rule, according to which the algebraic sum of the currents into any junction is zero. The junction rule is based on the conservation of the electric charge. No charge can accumulate at a junction, so the total charge entering the junction per unit time must be equal to the charge leaving per unit time.

Kirchhoff's second law is the loop rule according to which the algebraic sum of the potential differences in any loop including the associated emfs and the resistive elements must equal zero. This law is basically the law of conservation of energy.

38. The given equation is

$$y(x,t) = 8.0\sin\left(0.5\pi x - 4\pi t - \frac{\pi}{4}\right) \quad \ldots.(i)$$

The standard wave equation can be written as

$$y = \alpha\sin(kx - \omega t + \phi) \quad \ldots.(ii)$$

where α is the amplitude, k is the propagation constant and ω is the angular frequency.

Comparing equations (i) and (ii), we get

$k = 0.5\pi, \omega = 4\pi$

$\therefore$ Speed of the transverse wave is

$$v = \frac{\omega}{k} = \frac{4\pi}{0.5\pi} = 8 \text{ m/s}$$

39. Sabine's formula for reverberation time is

$$T = \frac{0.16V}{\Sigma as}$$

where V is the volume of the hall in m^3.

$\Sigma as = \alpha_1 s_1 + \alpha_1 s_2 + \ldots$ = total absorption of the hall (room)

Here, $s_1, s_2, s_3, \ldots$ are surface areas of the absorbers and $\alpha_1, \alpha_2, \alpha_3, \ldots$ are their respective absorption coefficients.

$$\therefore \frac{T'}{T} = \frac{V'}{s'} \times \frac{s}{V} = \frac{(2)^3}{(2)^2} = \frac{8}{4} = 2$$

Hence, $T' = 2T = 2 \times 1 = 2$ s

40. 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 a transverse wave, the particles of the medium oscillate about their mean or equilibrium position at right angles to the direction of propagation of the wave itself. Light waves being electromagnetic are transverse waves.

41. Ferromagnetism decreases with rise in temperature. If we heat a ferromagnetic substance, then the ferromagnetic property of the substance suddenly disappears at a definite temperature and the substance becomes paramagnetic. The temperature above which a ferromagnetic substance becomes paramagnetic is called the Curie temperature of the substance.

42. Focal length of combination of lenses placed in contact is

$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$$

For convex lens $f_1 = 25$ cm

For concave lens $f_2 = -25$ cm

Hence, $\frac{1}{F} = \frac{1}{25} + \frac{1}{-25} = \frac{1}{25} - \frac{1}{25} = 0$

$\therefore F = \frac{1}{0} = \infty$

Hence, the power of the combination is

$P = \frac{1}{F} = 0$

43. When an electric dipole is placed in an electric field $\vec{E}$, a torque $\vec{\tau} = \vec{p} \times \vec{E}$ acts on it.

This torque tries to rotate the dipole through an angle.

If the dipole is rotated from an angle θ_1 to θ_2, then work done by the external force is given by

$W = pE (\cos\theta_1 - \cos\theta_2)$ ..... (i)

Substituting $\theta_1 = 0°$, $\theta_2 = 90°$ in the equation (i), we get

$W = pE (\cos 0° - \cos 90°)$

$= pE (1 - 0)$

$= pE$

44. If the battery is removed after charging, then the charge stored in the capacitor remains constant.

Q = constant

The capacitance of a capacitor is given as

$$C' = \frac{\varepsilon_0 A}{d'}$$

As $d' > d$, we get $C' < C$.

Hence, the potential difference between the plates is

$$V' = \frac{Q}{C'}$$

$$V' \propto \frac{1}{C'}$$

As capacitance decreases, the potential difference increases.

45. Average velocity is the ratio of displacement to time taken while the average speed of a particle in a given interval of time is the ratio of distance travelled to the time taken.

On a circular path in completing one turn, the distance travelled is $2\pi r$, while displacement is zero.

Hence, average velocity $= \dfrac{\text{displacement}}{\text{time} - \text{interval}}$

Average speed $= \dfrac{\text{Distance}}{\text{Time} - \text{interval}}$

$$= \frac{2\pi r}{t} = \frac{2 \times 3.14 \times 100}{62.8} = 10 \text{ m/s}$$

46. Electric flux (ϕ_e) is a measure of the number of field lines crossing a surface. The number of field lines passing through unit area (N/S) will be proportional to the electric field.

$$\frac{N}{S} \propto E \Rightarrow N \propto ES$$

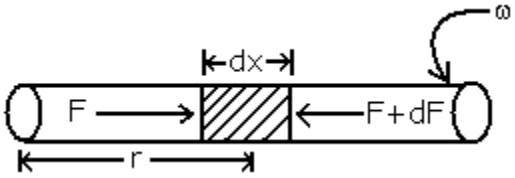
The quantity ES is the electric flux through surface S.

We know that the lines of force which enter the closed surface leave the surface immediately. So, the electric flux is zero.

47. Let the length of a small element of tube be dx.

Mass of this element is

$$dm = \frac{M}{L}dx$$



where M is the mass of filled liquid and L is the length of the tube.

Force on this element is given as

$dF = dm \times x\omega^2$

$$\int_0^F dF = \frac{M}{L}\omega^2 \int_0^L x\,dx$$

$$F = \frac{M}{L}\omega^2\left[\frac{L^2}{2}\right] = \frac{ML\omega^2}{2}$$

$$F = \frac{1}{2}ML\omega^2$$

48. The moment of inertia of the uniform rod about an axis through one end and perpendicular to the length is

$$I = \frac{ml^2}{3}$$

where m is the mass of the rod and l is its length.

Torque $(\tau = I\alpha)$ acting on the centre of gravity of the rod is given by

$$\tau = mg\frac{l}{2}$$

$$I\alpha = mg\frac{l}{2}$$

$$\frac{ml^2}{3}\alpha = mg\frac{l}{2}$$

$$\therefore \alpha = \frac{3g}{2l}$$

49. It is given that

$$\left|\vec{A} + \vec{B}\right| = \left|\vec{A} - \vec{B}\right|$$

$$\sqrt{A^2 + B^2 + 2AB\cos\theta} = \sqrt{A^2 + B^2 - 2AB\cos\theta}$$

where θ is the angle between $\vec{A}$ and $\vec{B}$.

Squaring both sides, we have

$A^2 + B^2 + 2AB\cos\theta = A^2 + B^2 - 2AB\cos\theta$

$4AB\cos\theta = 0$

As $AB \neq 0$

$\therefore \cos\theta = 0 = \cos 90°$

$\therefore \theta = 90°$

Hence, the angle between $\vec{A}$ and $\vec{B}$ is 90°.

50. For free fall from a height h, u = 0 (initial velocity).

From the second equation of motion, we have

$$h = ut + \frac{1}{2}gt^2$$

$$h = 0 + \frac{1}{2}gt^2$$

$$\frac{h_1}{h_2} = \left(\frac{t_1}{t_2}\right)^2$$

Given, $h_1 = 16$ m, $h_2 = 25$ m

$$\therefore \frac{t_1}{t_2} = \sqrt{\frac{h_1}{h_2}} = \sqrt{\frac{16}{25}} = \frac{4}{5}$$

Chemistry

51. If the Gibbs free energy for a system (ΔG_{system}) is equal to zero, then the system is in equilibrium at constant temperature and pressure.

52. 10 g per dm^3 of urea is isotonic with 5% solution of a non-volatile solute. Hence, osmosis is not possible between these solutions. So, their molar concentrations are equal to each other.

Thus, the molar concentration of urea solution

$$= \frac{10 g / dm^3}{\text{Mol. wt. of urea}}$$

$$= \frac{10}{60} M$$

$$= \frac{1}{6} M$$

Molar concentration of 5% non-volatile solute

$$= \frac{50 g / dm^3}{\text{mol. wt. of non - volatile solute}}$$

$$= \frac{50}{m} M$$

Both solutions are isotonic to each other; therefore,

$$\frac{1}{6} = \frac{50}{m}$$

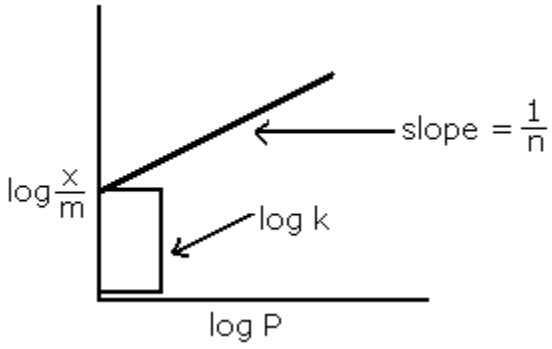
$$m = 50 \times 6$$

$$= 300 \text{ g mol}^{-1}$$

53. The empirical relation $\frac{x}{m} = k\ p^{\frac{1}{n}}$, put forward by Freundlich is known as the Freundlich adsorption isotherm. Taking the logarithm on both sides,

$$\log \frac{x}{m} = \log k + \frac{1}{n} \log p$$

If a following curve is plotted



54. As we know that,

$\Delta H = \Delta E + P\Delta V$

$\Delta H = \Delta E + \Delta nRT$

where

$\Delta H \rightarrow$ Change in enthalpy of the system (standard heat at constant pressure)

$\Delta E \rightarrow$Change in internal energy of the system (standard heat at constant volume)

$\Delta n \rightarrow$ No. of gaseous moles of product – No. of gaseous moles of reactant

$R \rightarrow$ Gas constant

$T \rightarrow$ Absolute temperature

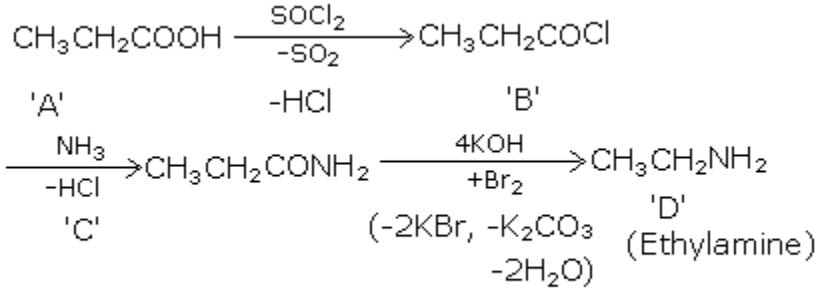
If $\Delta n = 0$ for reactions which are carried out in an open container; therefore,

$\Delta H = \Delta E$

So, for reaction (1) $\Delta n = 2 - 2 = 0$

Hence, for reaction (1), $\Delta H = \Delta E$

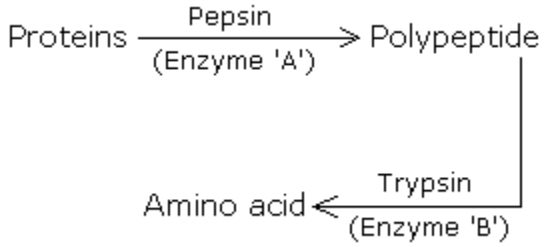
55. For reaction,



(Hofmann–Bromamide reaction)

Hence, compound 'D' is $CH_3—CH_2—NH_2$.

56. In the process of digestion, the proteins present in food material are hydrolysed to amino acids. In this process, two enzymes pepsin and trypsin are involved as follows:



57. The organic compounds other than carbohydrates and proteins which maintain normal growth and nutrition in the human body (but not produced in human body) are called vitamins.

58. Density of CsBr $= \dfrac{Z \times M}{\alpha^3 \times N_0}$

$Z \rightarrow$ No. of atoms in the bcc unit cell = 2

$M \rightarrow$ Molar mass of CsBr = 133 + 80 = 213

$\alpha \rightarrow$ Edge length of unit cell = 436.6 pm = 436.6×10^{-10} cm

N_0 is Avogadro number

$$\therefore \text{Density} = \frac{2 \times 213}{(436.6 \times 10^{-10})^3 \times 6.02 \times 10^{23}}$$

$$= 8.50 \text{ g/cm}^3$$

For a unit cell $= \dfrac{8.50}{2} = 4.25 \text{g / cm}^3$

59. More number of oxidation states are exhibited by the actinides than by the lanthanides because of lesser energy difference between the 5f and 6d orbitals than that between the 4f and 5d orbitals.

60. By Heisenberg's uncertainty principle,

$$\Delta p \times \Delta x \geq \frac{h}{4\pi}$$

or

$$\Delta v \times \Delta x > \frac{h}{4\pi m}$$

$\Delta p \rightarrow$ Uncertainty in momentum

$\Delta x \rightarrow$ Uncertainty in position

$\Delta v \rightarrow$ Uncertainty in velocity

$m \rightarrow$ Mass of particle

Given that

$\Delta x = 0.1 \text{ Å} = 0.1 \times 10^{-10}$ m

$m = 9.11 \times 10^{-31}$ kg

h = Planck's constant = 6.626×10^{-34} Js

In uncertain position,

$$\Delta v \times \Delta x = \frac{h}{4\pi m}$$

$$\Delta v \times 0.1 \times 10^{-10} = \frac{6.626 \times 10^{-34}}{4 \times 3.14 \times 9.11 \times 10^{-31}}$$

$$\Delta v = \frac{6.626 \times 10^{-34}}{4 \times 3.14 \times 9.11 \times 10^{-31} \times 0.1 \times 10^{-10}} \text{ms}^{-1}$$

$$= 5.785 \times 10^6 \text{ms}^{-1}$$

$$= 5.79 \times 10^6 \text{ms}^{-1}$$

61.

$$CuSO_4 + 2KCN \rightarrow Cu(CN)_2 + K_2SO_4$$

Cupric cyanide

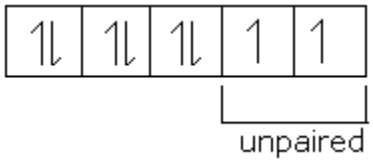
$$2Cu(CN)_2 \rightarrow 2Cu(CN) + NC-CN$$

Cyanogen

$$Cu(CN) + 3KCN \rightarrow K_3[Cu(CN)_4]$$

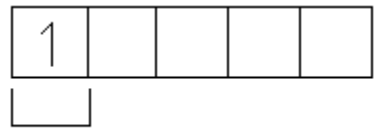
Soluble complex salt

62. $_{28}Ni = 1s^2, 2s^2\ 2p^6, 3s^2\ 3p^6\ 3d^8, 4s^2$



$Ni^{2+} = 1s^2, 2s^2\ 2p^6, 3s^2\ 3p^6\ 3d^8$

$_{22}Ti = 1s^2, 2s^2\ 2p^6, 3s^2\ 3p^6\ 3d^2, 4s^2$



$Ti^{3+} = 1s^2, 2s^2\ 2p^6, 3s^2\ 3p^6\ 3d^1$

$_{21}Sc = 1s^2, 2s^2\ 2p^6, 3s^2\ 3p^6\ 3d^1, 4s^2$

$Sc^{3+} = 1s^2, 2s^2\ 2p^6, 3s^2\ 3p^6$

(Unpaired electron in d-orbital is not possible)

$_{29}Cu = 1s^2, 2s^2\ 2p^6, 3s^2\ 3p^6\ 3d^{10}, 4s^1$

$Cu^+ = 1s^2, 2s^2\ 2p^6, 3s^2\ 3p^6\ 3d^{10}$

Thus, Cu^+ has completely occupied d-orbital.

Hence, in the above ions, Ni^{2+} and Ti^{3+} ions are coloured ions in the aqueous solution because of the presence of unpaired electrons in the d-subshell.

63. Al_2O_3 may be converted to anhydrous $AlCl_3$ by heating a mixture of Al_2O_3 and carbon in dry chlorine.

$$Al_2O_3 + 3C + 3Cl_2 \rightarrow Al_2Cl_6$$

Hot and dry (anhydrous $AlCl_3$)

64. At equilibrium, Gibbs free energy change ($\Delta G°$) is equal to zero. The following thermodynamic relation is used to show the relation of $\Delta G°$ with enthalpy change ($\Delta H°$) and entropy change ($\Delta S°$).

$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$

$0 = 30 \times 10^3 \left(J\ mol^{-1}\right) - T \times 105 \left(J\ K^{-1} mol^{-1}\right)$

$\therefore \quad T = \frac{30 \times 10^3}{105} K$

$= 285.71 K$

65. The appearance of colour in solid alkali metal halides is generally due to F-centres.

66. Alkanols are the derivatives of alkanes which are derived by the replacement of the –H of alkanes with the –OH (hydroxyl) group.

$C_nH_{2n+2} \xrightarrow[+OH]{-H} C_nH_{2n+1}OH$ or $C_nH_{2n+2}O$

Alkanes

67. $E^\circ_{Fe2+/Fe} = -0.441$ V

$E^\circ_{Fe3+/Fe2+} = 0.771$ V

If $E^\circ_{cell} = E^\circ_{OP\ Fe/Fe+2} + E^\circ_{RP\ Fe+3/Fe+2}$

$= +0.441 + 0.771 = 1.212$ V

68. For the reaction $2A + B \rightarrow 3C + D$,

The reaction rate is written as follows:

The reaction rate w.r.t. $A = -\frac{1}{2}\frac{d[A]}{dt}$

The reaction rate w.r.t. $B = -\frac{d[B]}{dt}$

The reaction rate w.r.t. $C = +\frac{1}{3}\frac{d[C]}{dt}$

The reaction rate w.r.t. $D = \frac{d[D]}{dt}$.

The products have a + sign because the concentration of the products increases with time.

Hence, the answer (1) is not the correct expression to represent the rate of reaction.

69. For the reaction,

$CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(l)}$

$\Delta H_r = -170.8\ kJ\ mol^{-1}$

From the above reaction,

$$K_c = \frac{[CO_2]}{[CH_4][O_2]^2}$$

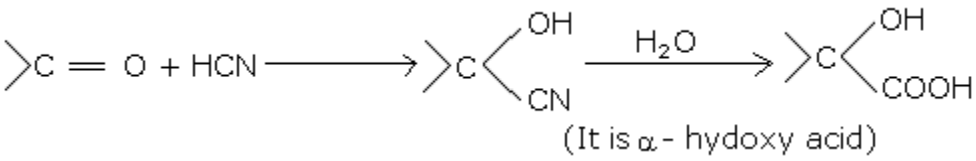
$$K_p = \frac{P_{CO_2}}{P_{CH_4} \times P_{O_2}^2}$$

$$So, K_p = \frac{[CO_2]}{[CH_4][O_2]^2} \text{ is incorrect.}$$

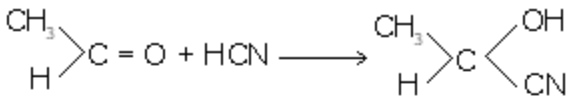
Hence, the correct option is B.

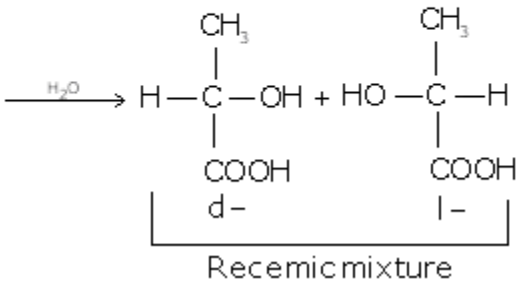
70. $—[NH(CH)_2\ NHCO(CH_2)_4CO]—_n$ is a copolymer because polymers whose repeating structural units are derived from two or more types of monomer units are called copolymers.

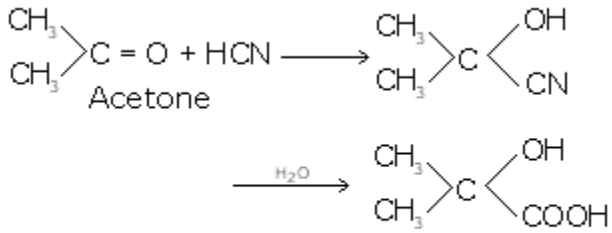
71.



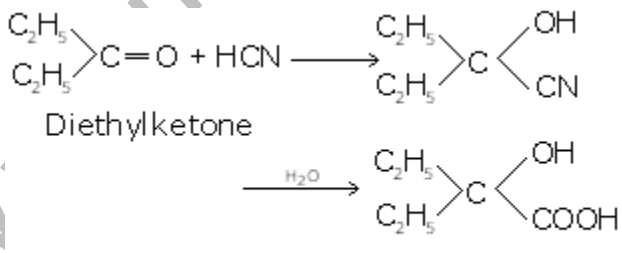
If it is a racemic mixture, then such 'C' atoms must be asymmetric carbon atoms.



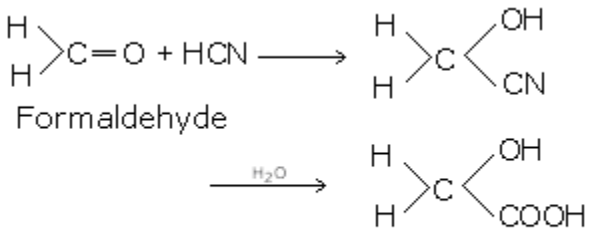




It is not optically active.



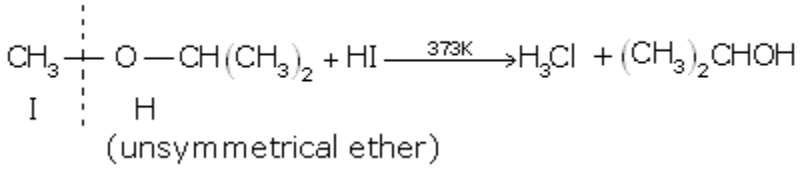
It is not optically active.



It is not optically active.

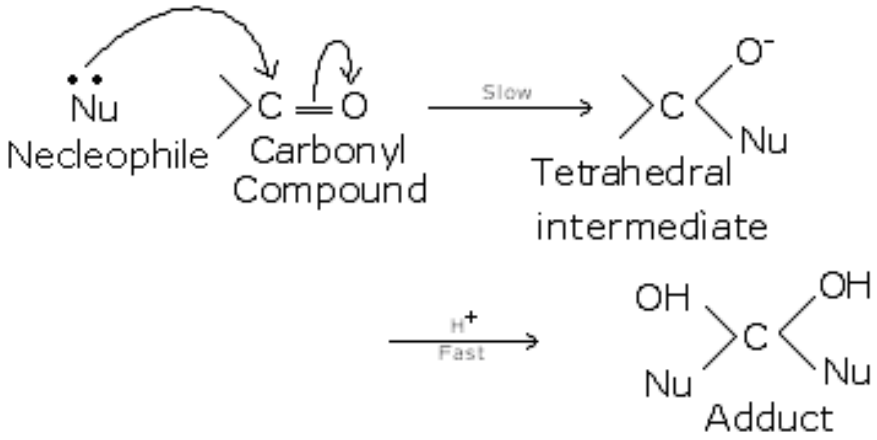
72. Glucagon is a peptide hormone because in it the peptide linkage is present.

73.



In the case of an unsymmetrical ether, the alkyl halide is always formed from the smaller alkyl group. This happens because the I^- ion being larger in size approaches the smaller alkyl group to avoid steric hindrance.

74.

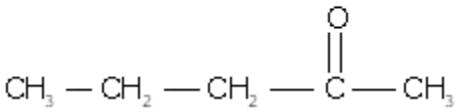


The carbonyl compounds undergo a nucleophilic addition reaction because oxygen is more electronegative than carbon. As such, it withdraws the shared π electron pair towards itself and gets a partial negative charge; therefore, carbon gets a partial positive charge and becomes susceptible to a nucleophilic attack.
Aldehydes are more reactive than ketones towards nucleophiles. This can be explained on the basis of the inductive effect and the steric effect. The addition of nucleophiles is based on the positive charge present on the carbon atom.

In aldehydes, $>C=O$ has the presence of at least one alkyl group (except formaldehyde) which has the +I effect (electron-donating effect) and which

decreases the positive charge of carbon, thereby making the attack of nucleophiles difficult. The nucleophilic attack becomes more difficult in ketones having a minimum of two alkyl groups. Hence, by attachment of the alkyl groups (due to the +I effect), the rate of nucleophilic addition decreases.
The order of nucleophilic addition in the given carbonyl compound is

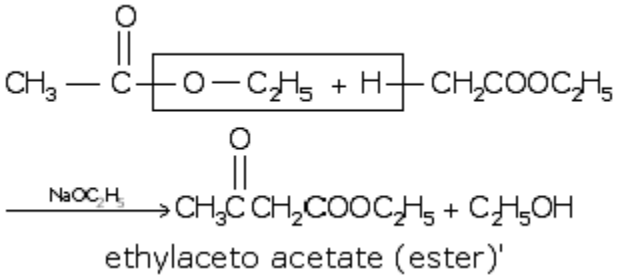
$$CH_3CHO > CH_3-CH_2-CHO > (CH_3)_2CO >$$



75. Heat of hydrogenation of cyclohexene = -119.5 k J mol^{-1}
Heat of hydrogenation of benzene = $3x - 119.5$ k J $mol^{-1} = -358.5$ k J mol^{-1}

$$\text{Resonance energy} = \text{Observed}\,\Delta H - \text{Calculated}\,\Delta H$$
$$-150.4 = -358.5 - x$$
$$x = -358.5 + 150.4$$
$$= -208.1 \text{ k J mol}^{-1}$$

76. Condensation of two moles of ethyl acetate in the presence of sodium ethoxide gives ethyl aceto-acetate (ester). This condensation is an example of Claisen condensation because it is possible in esters which have an α-hydrogen atom.



77. For the reaction,
$N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$

The rate of reaction w.r.t. $N_2 = -\frac{d[N_2]}{dt}$

The rate of reaction w.r.t. $H_2 = -\frac{1}{3}\frac{d[H_2]}{dt}$

The rate of reaction w.r.t. $NH_3 = +\frac{1}{2}\frac{d[NH_3]}{dt}$

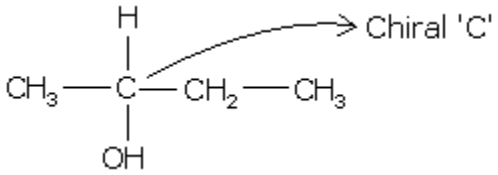
Hence, at a fixed time

$$-\frac{d[N_2]}{dt} = -\frac{1}{3}\frac{d[H_2]}{dt} = +\frac{1}{2}\frac{d[NH_3]}{dt}$$

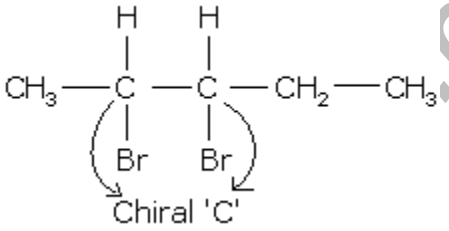
$$\Rightarrow +\frac{d[NH_3]}{dt} = -\frac{2}{3}\frac{d[H_2]}{dt}$$

78.

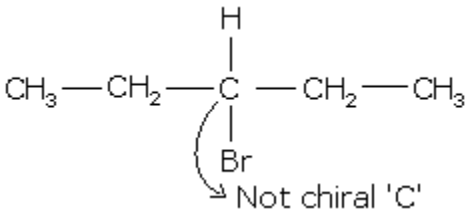
(1) 2-butanol



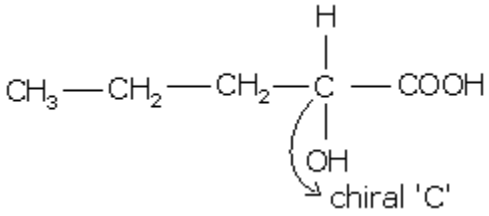
(2) 2, 3-dibromopentane



(3) 3-bromopentane



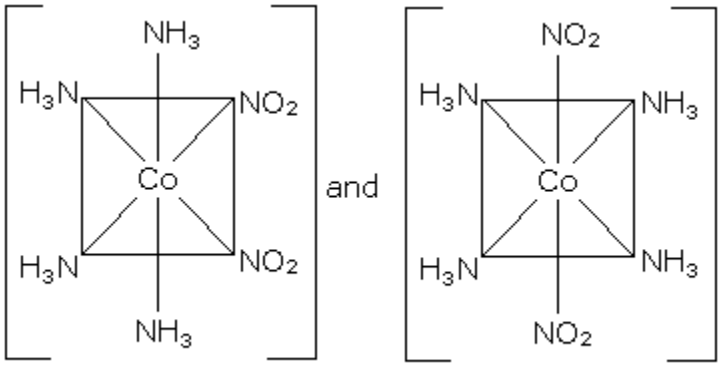
(4) 2-hydroxy propanoic acid



Hence, in these, 3-bromopentane is not a chiral molecule because of the absence of a chiral 'C' atom.

79. The compound $[Co(NH_3)_4(NO_2)_2]Cl$ exhibits linkage, ionisation and geometrical isomerism.
Hence,

(i) Its linkage isomers are $[Co(NH_3)_4(NO_2)_2]Cl$ and $[Co(NH_3)_4(ONO)_2]Cl$
(ii) Its ionisation isomers are $[Co(NH_3)_4(NO_2)_2Cl]$ and $[Co(NH_3)_4(NO_2)Cl)]NO_2$
(iii) Its geometrical isomers are



Cis-isomer Trans-isomer

80.

$$\text{Magnetic moment}(\mu) = \sqrt{n(n+2)}\,BM$$

$$3.83 = \sqrt{n(n+2)}$$

$$3.83 \times 3.83 = n^2 + 2n$$

$$14.6689 = n^2 + 2n$$

On solving this, we get n = 3.
Hence, the number of unpaired electrons in the d-subshell of the penultimate shell of chromium (Cr = 24) is 3.
So, the configuration of chromium ion is
$Cr^{3+} = 1s^2, 2s^2\ 2p^6, 3s^2\ 3p^2\ 3d^3$
In $[Cr(H_2O)_6]Cl_3$, the oxidation state of Cr is +3.
Hence, in $3d^3$, the distribution of electrons is $3d^1_{xy}, 3d^1_{yz}, 3d^1_{zx}$.

81. Molality of a non-electrolyte solute

$$= \frac{\text{weight of solute in gram}}{\text{molecular weight of solute}} \Big/ \text{weight of solvent in kg}$$

$$= \frac{\frac{1}{250}}{0.0512}$$

$$= \frac{1}{250 \times 0.0512}$$

$$= 0.0781\,m$$

$$\Delta T_f = k_f \times \text{molality of solution}$$

$$= 5.12 \times 0.0781$$

$$= 0.4\ K$$

82. The pair HNO_2 and $NaNO_2$ constitutes a buffer because HNO_2 is a weak acid and $NaNO_2$ is a salt of a weak acid (HNO_2) with a strong base (NaOH). Hence, it is an example of an acidic buffer solution.

83. In an aqueous solution of 10^{-8} M HCl, $[H^+]$ is based on the concentration of H^+ ions of 10^{-8} M HCl and the concentration of H^+ ions of water.

K_w of $H_2O = 10^{-14} = [H^+][OH^-]$

Or $[H^+] = 10^{-7}$ M (because of its neutral behaviour)

So, in the aqueous solution of 10^{-8} M HCl,

$$\left[H^+\right] = \left[H^+\right] \text{of HCl} + \left[H^+\right] \text{of water}$$

$$= 10^{-8} + 10^{-7}$$

$$= 11 \times 10^{-8} \text{M}$$

$$\approx 1.10 \times 10^{-7} \text{M}$$

Hence, the answer is nearer to (2).

84. A solution of acetone in ethanol shows a positive deviation from Raoult's law because of the miscibility of these two liquids with a difference of polarity and the length of a hydrocarbon chain.

85. Electrochemical cell

$$A^- \left|A^+ \ (xM)\right|\left|B^+ \ (yM)\right| B \ A \left|A^+ \ (xM)\right|\left|B^+ \ (yM\right|B^+$$

The emf of a cell is +0.20 V. So, the cell reaction is possible. The half-cell reaction is given as follows:

(i) At the negative pole:

$A \rightarrow A^+ + e^-$ (oxidation)

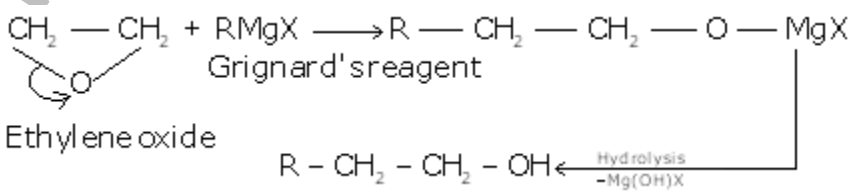
(ii) At the positive pole:

$B^+ + e^- \rightarrow B$ (reduction)

Hence, the cell reaction is

$A + B^+ \rightarrow A^+ + B$, $E^\circ_{cell} = +0.20$ V

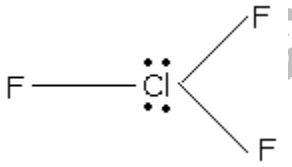
86. Ethylene oxide on treatment with Grignard reagent gives an additive product which on hydrolysis gives primary alcohol as the final product.



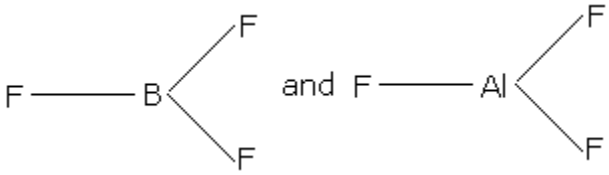
87. During osmosis, the flow of water through a semi-permeable membrane is from a solution with lower concentration only.

88. Benzyl amine $C_6H_5CH_2 \rightarrow -\ddot{N}H_2$ is more basic than aniline because the benzyl group $C_6H_5CH_2$ is an electron-donating group on account of the +I effect. So, it is capable of increasing the electron density of N of the $-NH_2$ group. Thus, because of the higher electron density, the rate of donation of a free pair of electrons is increased, i.e. the basic character is higher. Phenyl and nitro groups are electron attractive groups, so they are able to decrease the electron density of N of the $-\ddot{N}H_2$ group. Hence, they are less basic with aniline.

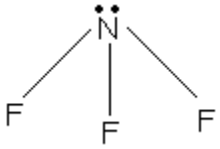
89. In ClF_3, the chlorine atom is sp^3d-hybridised. So, the bonds are not equal and have trigonal-bipyramidal geometry.



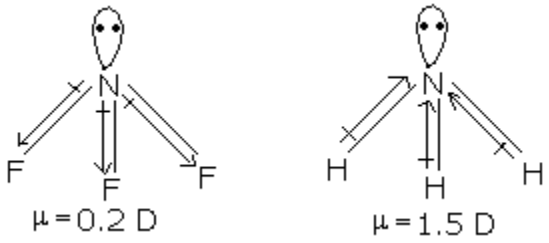
BF_3 and AlF_3 show a trigonal symmetric structure because of sp^2-hybridisation.



NF_3 shows pyramidal geometry because of sp^3 hybridisation.



90. The electronegativity of N is greater than that of H in NH_3, but in NF_3, the electronegativity of F is greater than that of N. In NH_3, the atomic dipole and bond dipole are in the same direction, whereas in NF_3, these are in opposite directions.



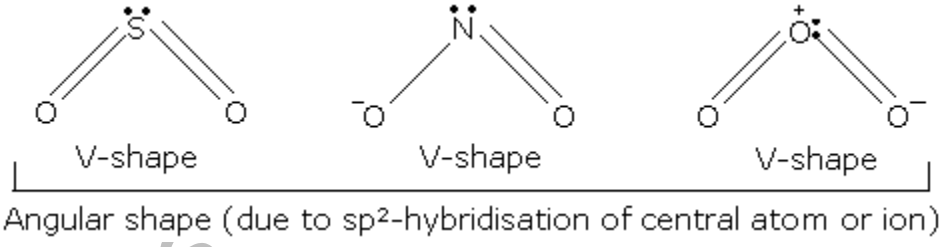
91. The mobility of ions and conductivity in aqueous solution are inversely proportional to the size of hydrated ions.
So, among alkali metal ions, lithium has the lowest mobility.
The mobility of ions decreases in the order given below:
$Rb^+ > K^+ > Na^+ > Li^+$

92. The correct order regarding the electronegativity of hybrid orbitals of carbon is sp > sp^2 > sp^3, because in sp, sp^2 and sp^3 hybrid orbitals, the s-orbital character is 50%, 33.3% and 25%, respectively, and because of the higher s-orbital character, the electron attraction tendency, i.e. electronegativity, increases.

93. NO_2^+ has a linear shape because of sp-hybridisation of N in $\overset{+}{N}O_2$

$$O = \overset{+}{N} = O$$

while SO_2, NO_2^- and O_3 have an angular shape.

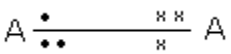


94. In Al_2O_3, Sb_2O_3, Bi_2O_3 and SeO_2, Bi_2O_3 is the most basic oxide because of higher reactivity with acid.
$Bi_2O_3 + 6HCl \rightarrow 2BiCl_3 + 3H_2O$

95. The orientation of an atomic orbital is governed by the magnetic quantum number.

96. The AB_5 molecule does not have a square pyramidal structure but has a trigonal bipyramidal structure because of sp^3d hybridisation.

97.



(Because of the presence of two unpaired electrons, it shows paramagnetic character.)

98. The incorrect order of bond dissociation energy is $F_2 > Cl_2 > Br_2 > I_2$ because of the following order of size I > Br > Cl > F.

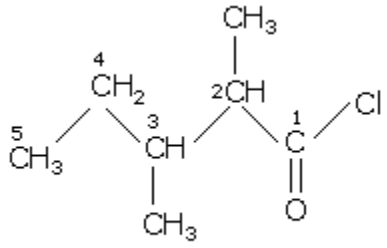
99. SCl_4 is not isostructural with $SiCl_4$ because it shows a square planar structure due to the repulsion between lone pair and bond pair of electrons.

SO_4^{2-} shows tetrahedral structure because of sp^3 hybridisation.

PO_4^{3-} shows tetrahedral structure because of sp^3 hybridisation.

NH_4^+ shows tetrahedral structure because of sp^3 hybridisation.

100. The IUPAC name of



2, 3 - dimethyl pentanoyl chloride

Biology

101. Synergids are haploid (n) cells, whereas the endosperm or aleurone layer is a triploid (3n) tissue. Thus, if the synergids have 8 chromosomes, the aleurone layer will contain 24 chromosomes.

102. Pineapple is a sorosis which is a type of multiple fruit. Here, the whole inflorescence turns into a compact fruit.

103. Golden rice is a promising transgenic crop which is prepared by genetic engineering. It is rich in vitamin A.

104. Seedless fruits are produced by parthenocarpy. It can be artificially induced by the application of plant hormones such as auxin and GA.

105. The apical portion of the plant axis (e.g. shoot apex) has the highest concentration of auxin which suppresses the axillary buds while promotes the growth of the apical bud. Pruning helps in making the hedge dense as it frees the axillary buds from apical dominance.

106. Blue baby syndrome occurs because of nitrate pollution. The main cause of this disease is the nitrate fertilisers in soil which enter the human body through water and are converted to nitrites by microbial flora of the intestine. The nitrites combine with haemoglobin to form methaemoglobin causing methaemoglobinaemia in adults and blue baby syndrome in newborns.

107. Praying mantis (*Mantis religiosa*) is a large social insect. It usually inhabits plantation areas and destroys certain harmful insects, so it is useful.

108. The autonomous nervous system regulates the secretion of glands, whereas the glands do not regulate the nervous system.

109. Anaemia is marked by an abnormally low haemoglobin concentration. The most common cause is deficiency of iron which is an essential element of the haemoglobin molecule. Thus, the iron compounds in the diet will help to alleviate the symptoms of anaemia.

110. Premature yellowing of leaves in pulse crops occurs because of degradation of chlorophyll. Mg and Fe are required for the biosynthesis of chlorophyll. Hence, Mg and Fe supplements will increase the yield of pulse crops.

111. Aril is the edible part in the fruit of litchi. The aril is an accessory seed covering often formed from an outgrowth at the base of the ovule.

112. Miller and Urey through their experiment abiotically synthesised amino acids and bases. They synthesised glycine, aspartic acid and alanine in abundant quantities. However, glutamic acid could not be synthesised in their experiment.

113. Monoculture involves the exclusive cultivation of a single crop over wide areas. It carries the risk of an entire crop being destroyed with the appearance of a single pest species or disease.

114. Montreal Protocol was passed in 1987. It was attended by 27 industrialised countries for reduction in production and release of CFCs.

115. In the J-shaped form of population growth, the density increases in an exponential manner and then the increase stops abruptly as environmental resistance becomes effective. This is mathematically described by an equation of exponential or geometric increase which is as follows:

$$\frac{dN}{dt} = rN$$

where d = rate of change
t = time
N = total population
r = biotic potential of each female

116. Ecological pyramids are the graphical representation of the trophic structure and function at successive trophic levels. Ecological pyramids are of the three following types:

(i) Pyramid of numbers, showing the number of organisms at each level.
(ii) Pyramid of biomass, showing the total dry weight of living matter.
(iii) Pyramid of energy, showing the rate of energy flow/productivity at successive trophic levels.

117. Niche overlap is a measure of the association of two or more species. This indicates their similar habitat requirement and may also indicate competition niche is the same and food/space is limited, e.g. two different parasites on the same host.

118. In photosystem I, the primary electron acceptor is probably a Fe–S protein. The reduced primary acceptor transfers the electrons to the secondary electron acceptor P_{430}. The reduced P_{430} passes its electrons to ferredoxin (Fd) present at the outer surface of the thylakoid membrane.

119. Stratification is the process of breaking of dormancy. It involves the treatment of seeds at low temperature (5–10°C) under sufficiently moist conditions to break its dormancy and induce germination.

120. *Drosophila melanogaster* is commonly called fruit fly and is often used in genetic and developmental biology research. Ripe bananas are ideal for the culture of this fly.

121. *In situ* conservation involves the conservation of genetic resources through their maintenance within natural ecosystems in which they occur. It includes national parks, sanctuaries, biosphere reserves, nature reserves, natural monuments and cultural landscapes. Botanical gardens, on the other hand, are the means of *ex situ* conservation where conservation is outside natural habitats.

122. Tetracycline interferes with the attachment of t-RNA carrying the amino acid to the m-RNA–ribosome complex preventing translation by inhibiting the addition of amino acids to the growing polypeptide chain. Streptomycin, on the other hand, interferes with the initial steps of protein synthesis by changing the shape of the 30S portion of the 70S prokaryotic ribosome.

123. Phenotype is the observable characteristics or the total appearance of an organism. It is determined by its genes, the relationships between the alleles and by the interaction during development between its genetic constitution (genotype) and the environment.

124. Photochemical smog due to NOx. It is highly oxidising and largely consists of ozone (O_3), oxides of nitrogen (NO_x), hydrogen peroxide (H_2O_2), organic peroxide, peroxy acetyl nitrate (PAN) and peroxy benzyl nitrate (PB_zN). Some sulphates and nitrates can also be formed in photochemical smog because of oxidation of sulphur-containing components (SO_2, H_2S) and NO_x (N_2O_5, NO_2), but it does not contain CO_2.

125. Sphagnum is a bryophyte, commonly called bog moss or peat moss. It is hygroscopic and possesses remarkable water-holding capacity. Hence, it is used as a packaging material in the transport of flowers, live plants, tubers, bulbs and seedlings. It is also used in seedbeds and in moss sticks.

126. Both vessels and sieve tubes are known for conduction. Therefore, the walls of both vessels and sieve tubes are perforated with large openings. Because of these adaptations, cell to cell contact is possible.

127. The thalloid body of Myxomycetes is called plasmodium. It is a multinucleate diploid body which propagates through fission or thick-walled cysts or sclerotium-like structures.

128. Cytoplasmic inheritance occurs in the maternal line. This is because the female reproductive cell or the egg has a large amount of cytoplasm containing many organelles such as chloroplasts and mitochondria which contain their own genes and can reproduce independently. Because these organelles are contributed by the female, cytoplasmic inheritance occurs in the maternal line.

129. In sweet pea (*Pisum sativum*), the placentation is marginal, in which the placenta develops along the junction of two carpels in a unilocular ovary.

130. In a cob of maize, each ovary has a long silky (hair) style, called corn silk. Collectively, these styles protrude at the end of a young cob. The grains are formed on the cob which remains covered by leafy bracts.

131. The conifers (gymnosperm) differ from the grasses (angiosperm) in the formation of endosperm before fertilisation. The endosperm in gymnosperms is a haploid structure, whereas it is a triploid structure in angiosperms.

132. Number of types of gametes = 2^n
n = number of heterozygous pair
$2^1 = 2$
The gametes are ABC and Abc.

133. G. H. Shull (1909) has shown that the hybrid vigour in maize is exploited by crossing of an inbred parental line.

134. In mitochondria, the outer membrane resembles a sieve which is permeable to all molecules of 10,000 Daltons. The inner membrane is impermeable and highly convoluted, forming a series of infoldings known as cristae. The enzymes of the electron transport chain are found in the inner membrane, while the outer membrane contains enzymes involved in mitochondrial lipid synthesis.

135. In the process of protein synthesis, m-RNA is responsible for carrying the genetic code transcribed from DNA. The process is known as translation and it occurs in ribosomes. The sequence of amino acids in a particular protein is determined by the sequence of nucleotides in m-RNA.

136. 30 ATP molecules could be generated from 686 Kcal energy.

137. Coenzyme is an organic non-protein molecule which associates with an enzyme molecule in catalysing biochemical reactions. It usually participates in the substrate–enzyme interaction by donating or accepting certain chemical groups.

138. Bowman's glands are tubular mucus glands (olfactory glands) which occur below the olfactory epithelia. Their ducts open on the olfactory epithelial surface. These glands secrete watery mucus to protect and keep the epithelium moist.

139. The bacterium *Clostridium botulinum* is an obligate anaerobic, endospore-forming, gram positive, rod-shaped bacterium found in soil and in many freshwater sediments.
This bacterium is known for causing food poisoning by producing a toxin called botulinum.

140. Rhinoceros (*Rhinoceros unicornis*) is an endangered animal. It is conserved in Kaziranga National Park.

141. Schizophrenia is any of a group of severe mental disorders which have in common symptoms such as hallucinations, delusions, blunted emotions, disordered thinking and a withdrawal from reality.

142. Sulphur is a constituent of certain amino acids. The amino acids form the protein by polymerisation. Because pulses are rich in protein, sulphur is required for the proper growth of pulses.

143. Pentamerous, actinomorphic flowers, bicarpellary ovary with oblique septa and a fruit capsule or berry are characteristic features of Family Solanaceae.

144. In mosses, the sporophyte developing from the embryo partially depends on the gametophyte. It contains chlorophyll and hence is capable of making its own food.

145. Curing of tea leaves is brought about by the activity of bacteria. It is essentially an oxidation dry fermentation process during which water is driven off, the green colour is lost and the leaves assume a tougher texture and undergo chemical changes.

146. At high altitudes, the atmospheric O_2 level is less, and hence, more RBCs are needed to absorb the required amount of O_2 to survive. That is why the people living at the sea level have about 5 million RBC/mm^3 in their blood, whereas those living at an altitude of 5,400 metres have about 8 million RBC/mm^3 in their blood.

147. An important evidence in favour of organic evolution is the occurrence of homologous and vestigial organs. Homologous organs have a common origin and are built on the same fundamental pattern, but they perform different functions and have different appearances.
Vestigial organs in animals have no function now, but they had important functions in ancestors.

148. Archaeopteryx is not a living fossil. It is a fossil bird which lived in the Jurassic period and is considered a connecting link between birds and reptiles. King crab, Sphenodon and Peripatus are living fossils.

149. Salamander is a semi-terrestrial lizard-like tailed amphibian which lives under stones, logs and inside crevices. They show hibernation.
Salmon is anadromous, i.e. they spend their adult lives at sea but return to freshwater to spawn. Migration is a characteristic feature of birds.

150. A major breakthrough in the studies on cell came with the development of the electron microscope because the resolution power of the electron microscope is much higher than that of the light microscope.
On an average, the resolving power of a light microscope is 0.25–0.3 μm, while that of an electron microscope is 2–10 Å . The magnification range of the light microscope is 2000–4000, while that of an electron microscope is 1,00,000–3,00,000.

151. Loligo, Teredo and Octopus are members of Phylum Mollusca.

152. Metameric segmentation is a characteristic of Annelida (e.g. earthworm) and Arthropoda (e.g. cockroach).
Earthworm shows true segmentation, i.e. external segmentation corresponds with internal segmentation.
Cockroach also shows metameric segmentation. Its anterior few segments are specialised to form a head. Such metamerism is called heteronomous metamerism.

153. An endangered species is a plant or animal species defined by IUCN as being in immediate danger of extinction because its members have reached a critical level or their habitats have been drastically reduced.
Bentinckia condapanna/*nicobarica* (member of Family Arecaceae) and the red panda are declared as endangered in India.

154. The Jurassic period is the second geological period of the Mesozoic era. In this period, the gymnosperms were dominant and the plants included ferns, cycads, Ginkgo, rushes and conifers; among animals, important invertebrates included ammonites, corals, brachiopods, bivalves and echinoids. Reptiles dominated the vertebrates and the first flying reptile—the pterosaurs—appeared.
The first primitive bird Archaeopteryx also made its appearance.

155. *Trypanosoma*, *Noctiluca*, *Monocystis* and *Giardia* are unicellular protists.

156. Cilia are minute, hair-like processes on the surface of protozoans or on metazoan cells. Each cilium contains a peripheral circle of nine doubled microtubules arranged around two single microtubules. Each microtubule is composed of tubulin proteins.
The mechanism of ciliary movement is not completely understood. The fluxes of Ca^{2+} across the membrane are not responsible for controlling the organised beating of cilia.

157. *Escherichia coli* and *Agrobacterium tumefaciens* are the microbes found to be very useful in genetic engineering.
E. coli is the most extensively used in bacterial genetic and molecular biology.
Agrobacterium tumefaciens is a soil bacterium with Ti plasmid (tumour-inducing plasmid). It can be used for the transfer of a desired gene in dicot plants.

158. *Mucor* is a saprophytic fungus. It grows on decaying dung and on some food stuffs. It shows the best growth on a piece of bread at about 25°C with relative humidity of about 95% in moist and shady places.

159. Phylogeny is the origin and diversification of any taxon or the evolutionary history of its origin and diversification. It is usually represented as a diagrammatic phylogenetic tree.

160. Hotspots are areas with high density of diversity which are also the most threatened ones. Ecologists have identified 25 hotspots in the world, of which two hotspots are present in India, i.e. Western Ghats and Eastern Himalayas.

161. The first reaction of photorespiration occurs in the stroma of chloroplasts. In this reaction, RuBisCO in the presence of oxygen shows oxygenase activity. In peroxisomes, the glycolate transferred from chloroplasts takes up O_2 and forms the glyoxylate, whereas H_2O_2 is released as a by-product.

162. In polygenic inheritance, more than one gene together determines the phenotypic expression. Skin colour in human is a polygenic trait and it is controlled by three pairs of polygenes.

163. Cortisone is a corticosteroid which is itself biologically inactive and is formed naturally in the adrenal gland from the active hormone cortisol. Cortisol promotes the synthesis and storage of glucose and is important in the normal response to stress, suppresses inflammation and regulates deposition of fat in the body. Acetylcholine, epinephrine and nor-epinephrine are neurotransmitters.

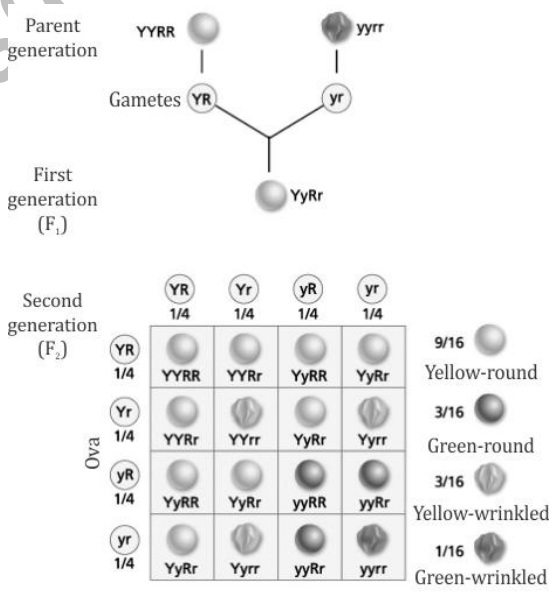
164. Sertoli cells line the seminiferous tubules in the testes. These cells protect the spermatids and convey nutrients to both developing and mature spermatozoa. Sertoli cells are regulated by follicle-stimulating hormone (FSH).

165. Cortisol or hydrocortisone is the principal glucocorticoid hormone of many mammals including humans. It regulates the glucose metabolism and promotes gluconeogenesis, especially during starvation, and raises blood pressure. Cortisone is an inactive form of cortisol.

166. The kinesin, myosin and dynein proteins of skeletal muscles involve ATPase activity, which causes the contraction of skeletal muscles, propelling action of cilia and flagella and the intracellular transport of organelles.

167. Second messengers are the organic molecules whose production or release usually amplifies a signal such as a hormone and are received at the cell surface.
Sodium (Na) is not a second messenger in hormone action.
Cyclic adenosine monophosphate (cAMP) and cyclic guanosine monophosphate (cGMP) function as second messengers. Calcium ions (Ca^{2+}) also function as second messenger in the phospholipase C–Ca^{+} second messenger system.

168. When a cross (dihybrid) is made between plants bearing round yellow (RRYY) and wrinkled green (rryy) seeds, all the plants in F_1



168. 'One gene–one enzyme' hypothesis was given by Beadle and Tatum (1948) which states that a particular gene controls the synthesis of a specific enzyme.

169. B-DNA is a helical structure with a diameter of 20 $\mathring{A}$ and the distance between the two base pairs is 3.4 $\mathring{A}$. There are 10 base pairs in each turn; hence, one turn of the helix is approximately 34 $\mathring{A}$ or 3.4 nm (10 $\mathring{A}$ = 1.0 nm).

170. A test cross involves the crossing of the F_1 hybrid with a double recessive genotypic parent. By a test cross, the heterozygosity and homozygosity of the organism can be tested. For a typical Mendelian population, the test cross produces similar genotypic and phenotypic ratios.

171. J. D. Watson and F. H. C. Crick (1953) showed that DNA has a double helical structure with two polynucleotide chains connected by hydrogen bonds and running in opposite directions (antiparallel).

172. The antiparallel strands of a DNA molecule means that the phosphate groups at the start of two DNA strands are in the opposite directions. One polynucleotide chain grows in the 5′–3′-direction and the other chain grows in the 3′–5′ direction.

173. Loose or areolar connective tissue is the most generalised connective tissue which is spread extensively throughout the body—under the skin and epithelia, around and in between the muscles. It functions mainly for binding the parts together.

174. Histamine is a protein acting as a vasodilator (widening of blood vessels) in inflammatory and allergic reactions and increases the permeability of small vessels. It is secreted from the mast cells which widely occur in the areolar connective tissue. Two other active substances secreted by mast cells are heparin, a proteoglycan, which prevents the coagulation of blood vessels, and serotonin, a protein which acts as a vasoconstrictor to stop bleeding and to increase blood pressure.

175. Colourblindness is a hereditary disease in which the gene for this disease is located on the X-chromosome. So, if a colourblind woman marries a normal man, then it will produce all colourblind (X^cY) sons. In the case of a carrier woman, the probability of a colourblind son and a normal son is 50:50.

176. Cri du chat (cat cry) syndrome in human is caused by the deletion of the short arm of chromosome 5. The affected newborn cries like the mewing of a cat.

177. Restriction endonuclease is a type of enzyme which can cleave molecules of DNA at a particular site called the restriction site with a palindromic sequence. These enzymes are widely used in the techniques of genetic engineering.

178. Antibodies are glycoproteins called immunoglobulins. These are produced by the lymphocytes in response to the entry of a foreign substance or antigen into the body.

179. The central pollution control board prescribed the BOD limit for the discharge of industrial and municipal waste water as >10 ppm.

180. Class Oligochaeta includes terrestrial earthworms and some other species which live in freshwater. Aquatic oligochaetes excrete ammonia, while terrestrial oligochaetes excrete urea, but *Lumbricus* produces both ammonia and urea.

181. Almost all secretions by the pituitary gland are controlled by hormonal signal form hypothalamus. The neurohormones are secreted and accumulated by the hypothalamus.

182. Menstruation is caused by the reduction of oestrogen and progesterone, especially progesterone, at the end of the monthly ovarian cycle. The first effect is decreased stimulation of the endometrial cells by these two hormones, followed rapidly by involution of the endometrium.

183. Residual air is the air which remains in the lungs after the most forceful expiration. It is about 1200 ml. As the residual air remains in the lungs, it has no effect on respiration efficiency.

184. In the open circulatory system, the blood flows in open spaces such as lacunae and sinuses and it bathes the cells directly. Such a circulatory system occurs in arthropods. Cephalopods and annelids have a closed circulatory system.

185. Adrenaline (epinephrine) is a hormone produced by the adrenal medulla and is secreted in great amounts during emotional stress. It elevates the glucose level in the blood stream (by glycogenolysis) which is accompanied by an increase in oxygen consumption, body temperature and heat production. Adrenaline also causes an increase in the flow of blood by dilating the blood vessels. Insulin regulates the glucose level in blood.

186. 'Prions' are infective proteinaceous particles. They cause some neurological diseases in animals (including humans). Example: Mad cow disease

187. According to the mass flow hypothesis, the transport of organic solutes occurs from the source to the sink. This transport also depends on metabolic energy in the form of ATP.

188. Ctenoplana and Beroe lack cnidoblasts and have biradial symmetry. These belong to Phylum Ctenophora. Hydra, sea anemone and Aurelia are coelenterates which have cnidoblasts.

189. In angiosperms (dicots), the Polygonum type of embryo sac is most common. In this embryo sac, the arrangement of the nuclei is 3 + 2 + 3, i.e. 3 in antipodal cells, 2 as polar nuclei and 3 in the egg apparatus (2 in synergids and 1 in egg cell).

190. Barley seeds are rich in carbohydrate (starch). The starch is hydrolysed by α-amylase to monosaccharides at the time of seed germination.

191. In a cereal grain (e.g. wheat), a single cotyledon of the embryo is represented by the scutellum. The scutellum is specialised for nutrient absorption from the endosperm.

192. In our body, the blood transports CO_2 in three ways:

(i) Majority of CO_2 produced (70%) in our cells is transported in the form of bicarbonates. In this way, CO_2 which dissolves in blood plasma reacts with water forming carbonic acid which dissociates into hydrogen and bicarbonate ions.

$CO_2 + H_2O \rightarrow H_2CO_3$

(Carbonic acid)

$H_2CO_3 \rightarrow H^+ + HCO_3^-$

(ii) About 7% of all the CO_2 transported by blood from the tissues to the lungs is in the dissolved state in the plasma.

(iii) About 23% of CO_2 collected from cells through tissue fluids is transported by blood in the form of carbamino compound, carbamino-haemoglobin (CO_2HHb).

193. *Triticale* is the first man-made cereal crop. It has been obtained by crossing wheat (*Triticum* sp.) with rye (*Secale cereale*).

194. In meristem culture, the shoot apical meristem along with some surrounding tissue is grown *in vitro*. It is used for clonal propagation and recovery of virus-free plants. It is also potentially useful in germ plasma exchange and long-term storage of germ plasma through freeze preservation.

195. Acquired immunodeficiency syndrome (AIDS) is caused by human immunodeficiency virus (HIV). T_4 lymphocytes are the principal target cells of HIV.

196. Kangaroo, hedge hog, dolphin and loris are mammals. These give birth to young ones.

197. Sickle cell anaemia in which RBCs become sickle-shaped and stiff is a genetic disorder which is autosomal and linked to a recessive allele. It has not been eliminated from the African population because it provides immunity against malaria. People who are heterozygous for the sickle cell allele are much less susceptible to falciparum malaria—one of the main causes of illness and death.

198. Crab, centipede and cockroach belong to Phylum Arthropoda. These have jointed appendages and a chitinous exoskeleton.

199. Both sickle cell anaemia and Huntington's chorea are congenital genetic disorders.

200. Angiotensinogen is a plasma protein produced and secreted by the liver cells. Renin secreted from juxtaglomerular cells enzymatically on angiotensinogen to release the 10- amino acid peptide, angiotensin.

AIPMT - 2007
(Physics, Chemistry and Biology)
Prelims

Time: 3 hrs **Total Marks: 600**

General Instructions:

1. The Answer sheet is inside this Text booklet. When you are directed to open the text booklet, take out the Answer Sheet and fill in the particulars on side – 1 and side – 2 carefully with blue/black ball point pen only.
2. The test is of 3 hours duration and consists of 200 questions. Each question carries 3 marks. For each correct response the candidate will get 3 marks. For each incorrect response, one mark will be deducted. The maximum marks are 600.
3. Use Blue / Black ball point pen only for writing particulars on this page / marking responses.
4. Rough work is to be done on the space provided for this purpose in the text booklet only.
5. On completion of the test, the candidate must handover the answer sheet to the invigilator in the room/ Hall. The candidates are allowed to take away this text booklet with them.
6. Make sure that the CODE printed on side – 2 of the answer sheet is the same as that on this booklet, In case of discrepancy, the candidate should immediately report the matter to the invigilator for the replacement of both the test Booklet and the Answer Sheet.
7. The candidates should ensure that the Answer sheet is not folded. Do not make any stray marks on the Answer sheet. Do not write your roll no. anywhere else except in the specified space in the Test booklet / Answer Sheet.
8. Use of white fluid for correction is not permissible on the Answer Sheet.

Physics

1. If the cold junction of a thermo-couple is kept at 0°C and the hot junction is kept at T° C, then the relation between neutral temperature (T_n) and temperature of inversion (T_i) is:

(1) $T_n = \frac{T_i}{2}$

(2) $T_n = 2T_i$

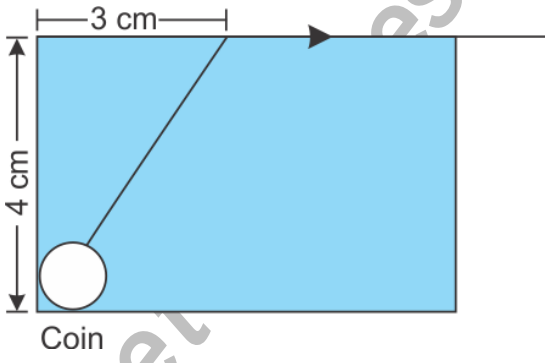
(3) $T_n = T_i - T$

(4) $T_n = T_i + T$

2. Nickel shows ferromagnetic property at room temperature. If the temperature is increased beyond Curie temperature, then it will show:
(1) paramagnetism
(2) anti-ferromagnetism
(3) no magnetic property
(4) diamagnetism

3. In radioactive decay process, the negatively charged emitted β-particles are:
(1) the electrons present inside the nucleus
(2) the electrons produced as a result of the decay of neutrons inside the nucleus
(3) the electrons produced as a result of collisions between atoms
(4) the electrons orbiting around the nucleus

4. A small coin is resting on the bottom of a beaker filled with a liquid. A ray of light from the coin travels up to the surface of the liquid and moves along its surface (see figure).



How fast is the light travelling in the liquid?
(1) 1.8×10^8 m/s
(2) 2.4×10^8 m/s
(3) 3.0×10^8 m/s
(4) 1.2×10^8 m/s

5. What is the value of inductance L for which the current is maximum in a series LCR circuit with C = 10 μF and ω= 1000 S^{-1}?
(1) 100 mH
(2) 1mH
(3) Cannot be calculated unless R is known
(4) 10 mH

6. Three point 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:

(1) $\sqrt{2}$ qa along +y direction

(2) $\sqrt{2}$ qa along the line joining points
(x = 0, y = 0, z = 0)
and (x = a, y = a, z = 0)

(3) qa along the line joining points
(x = 0, y = 0, z = 0)
and (x = a, y = a, z = 0)

(4) $\sqrt{2}$qa along +x direction

7. 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:

(1) BE = $[M(A, Z) - ZM_p - (A - Z)M_n]c^2$

(2) BE = $[ZM_p + (A - Z)M_n - M(A, Z)]c^2$

(3) BE = $[ZM_p + AM_n - M(A, Z)]c^2$

(4) BE = $M(A, Z) - ZM_p - (A - Z)M_n$

8. The position x of a particle with respect to time t along x-axis is given by $x = 9t^2 - t^3$ where x is in metre and t in seconds. What will be the position of this particle when it achieves maximum speed along the +x direction?

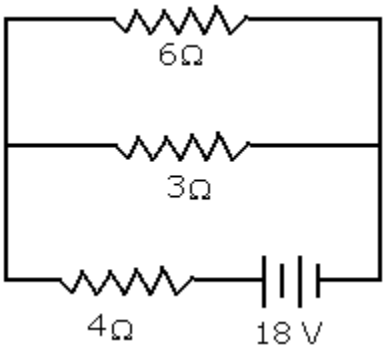
(1) 32 m

(2) 54 m

(3) 81 m

(4) 24m

9. The total power dissipated in watts in the circuit shown here is:



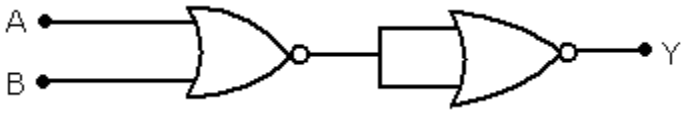
(1) 16

(2) 40

(3) 54

(4) 4

10. In the following circuit, the output Y for all possible inputs A and b is expressed by the truth table:



(1)

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

(2)

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

(3)

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0

(4)

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

11. Assuming the Sun to have a spherical outer surface of radius r, radiating like a black body at temperature t°C, the power received by a unit surface, (normal to the incident rays) at a distance R from the centre of the Sun is:

(1) $\frac{4\pi^2\sigma t^4}{R^2}$

(2) $\frac{r^2\sigma(t+273)^4}{4\pi R^2}$

(3) $\frac{16\pi^2r^2\sigma t^4}{R^2}$

(4) $\frac{r^2\sigma(t+273)^4}{R^2}$

12. 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:

(1) 30°
(2) 45°
(3) 60°
(4) 0°

13. If the nucleus $^{27}_{13}Al$ has a nuclear radius of about 3.6 fm, then $^{125}_{52}Te$ would have its radius approximately as:

(1) 6.0 fm
(2) 9.6 fm
(3) 12.0 fm
(4) 4.8 fm

14. 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:

(1) 6
(2) 10
(3) 12
(4) 4

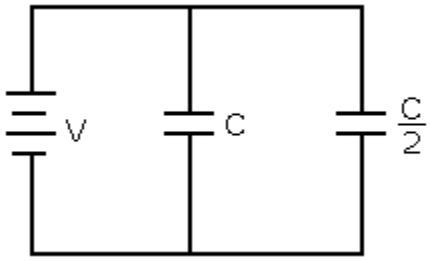
15. The resistance of an ammeter is 13 Ω and its scale is graduated for a current up to 100 A. After an additional shunt has been connected to this ammeter it becomes possible to measure current up to 750 A. The value of shunt resistance is:

(1) 20 Ω
(2) 2 Ω
(3) 0.2 Ω
(4) 2 kΩ

16. 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:
(1) depends on v and not on R
(2) depends on both R and v
(3) is independent of both R and v
(4) depends on R and not on v

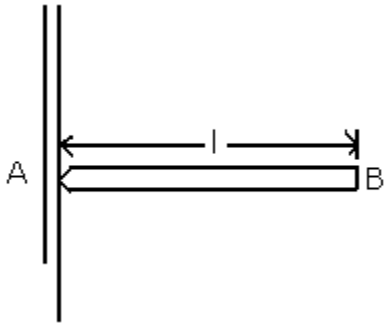
17. The primary and secondary coils of a transformer have 50 and 1500 turns respectively. If the magnetic flux $\phi = \phi_0 + 4t$, where ϕ is in weber, t is time in seconds and ϕ_0 is a constant, the output voltage across the secondary coil is:
(1) 90V
(2) 120V
(3) 220V
(4) 3V

18. Two condensers, one of capacity C and the other of capacity C/2, are connected to a V volt battery, as shown.



The work done in charging fully both the condensers is:
(1) $2CV^2$
(2) $\frac{1}{4}CV^2$
(3) $\frac{3}{4}CV^2$
(4) $\frac{1}{2}CV^2$

19. Uniform rod AB of length l and mass m is free to rotate about point A. The rod is released from rest in the horizontal position. Given that the moment of inertia of the rod about A is $\frac{ml^2}{3}$, the initial angular acceleration of the rod will be:



(1) $\frac{2g}{3l}$

(2) $mg\frac{l}{2}$

(3) $\frac{3}{2}gl$

(4) $\frac{3g}{2l}$

20. 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:

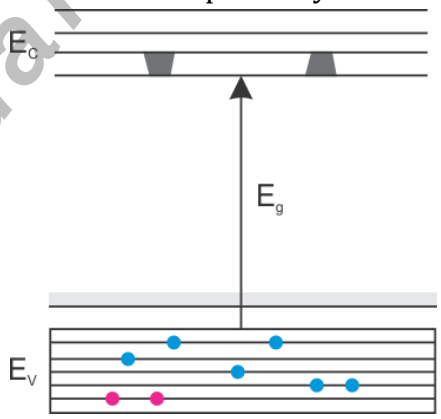
(1) 1.40

(2) 1.50

(3) 3.00

(4) 1.33

21. In the energy band diagram of a material shown below, the open circles and filled circles denote holes and electrons respectively. The material is a/an:



(1) p-type semiconductor

(2) insulator

(3) metal

(4) n-type semiconductor

22. 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:

(1) $\frac{2v_d v_u}{v_d + v_u}$

(2) $\sqrt{v_u v_d}$

(3) $\frac{v_d v_u}{v_d + v_u}$

(4) $\frac{v_u + v_d}{2}$

23. 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:

(1) $\frac{T}{4}$

(2) $\frac{T}{8}$

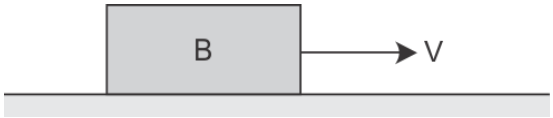
(3) $\frac{T}{12}$

(4) $\frac{T}{2}$

24. A 5 W source emits monochromatic light of wavelength 5000 Å. When placed 0.5 m away, it liberates photoelectrons from a photosensitive metallic surface. When the source is moved to a distance of 1.0 m, the number of photoelectrons liberated will be reduced by a factor of:

(1) 4
(2) 8
(3) 16
(4) 2

25. 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:



(1) $\frac{v}{g\mu}$

(2) $\frac{g\mu}{v}$

(3) $\frac{g}{v}$

(4) $\frac{v}{g}$

26. 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

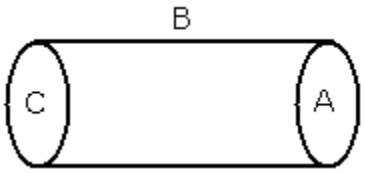
(1) $\frac{1}{4\lambda}$

(2) 4λ

(3) 2λ

(4) $\frac{1}{2\lambda}$

27. A hollow cylinder has a charge q coulomb within it. If ϕ is the electric flux in unit of voltmeter associated with the curved surface B, the flux linked with the plane surface A in unit of voltmeter will be:



(1) $\frac{1}{2}\left(\frac{q}{\varepsilon_0}-\phi\right)$

(2) $\frac{q}{2\varepsilon_0}$

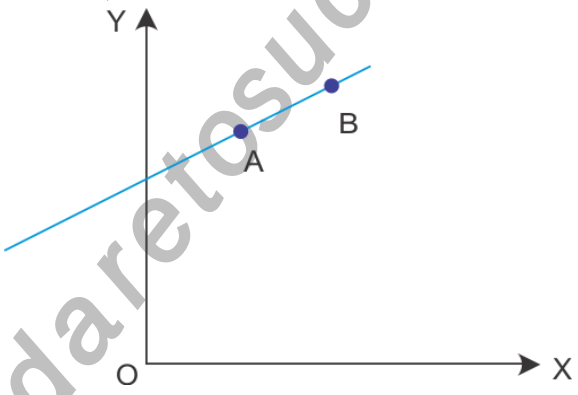
(3) $\frac{\phi}{3}$

(4) $\frac{q}{\varepsilon_0}-\phi$

28. 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:
(1) 30%
(2) 50%
(3) 90%
(4) 10%

29. A charged particle (charge q) is moving in a circle of a radius R with uniform speed v. The associated magnetic moment μ given by:
(1) $\frac{qvR}{2}$
(2) qvR^2
(3) $\frac{qvR^2}{2}$
(4) qvR

30. A particle of mass m moves in the XY plane with a velocity v along the straight line AB. If the angular momentum of the particle with respect to origin O is L_A when it is at A and L_B when it is at B, then:



(1) $L_A > L_B$
(2) $L_A = L_B$
(3) the relationship between L_A and L_B depends upon the slope of the line AB
(4) $L_A < L_B$

31. The total energy of electron in the ground state of hydrogen atom is -13.6 eV. The kinetic energy of an electron in the first excited state is:
(1) 3.4 eV
(2) 6.8 eV
(3) 13.6 eV
(4) 1.7 eV

32. 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:
(1) 0.40g
(2) 0.50 g
(3) 0.67 g
(4) 0.27 g

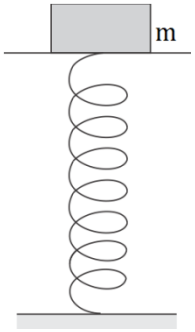
33. In a mass spectrometer used for measuring the masses of ions, the ions are initially accelerated by an electric potential V and then made to describe semicircular paths of radius R using a magnetic field B. If V and B are kept constant, the ratio $\left(\frac{\text{charge on the ion}}{\text{mass of the ion}}\right)$ will be proportional to:
(1) $\frac{1}{R}$
(2) $\frac{1}{R^2}$
(3) R^2
(4) R

34. Three resistances P, Q, R each of 2 Ω and an unknown resistance S form the four arms of a Wheatstone's bridge circuit. When a resistance of 6 Ω is connected in parallel to S the bridge gets balanced. What is the value of S?
(1) 2 Ω
(2) 3 Ω
(3) 6 Ω
(4) 1 Ω

35. The particle executing simple harmonic motion has a kinetic energy $K_0 \cos^2 \omega t$. The maximum values of the potential energy and the total energy are respectively:
(1) 0 and $2K_0$
(2) $\frac{K_0}{2}$ and K_0
(3) K_0 and $2K_0$
(4) K_0 and K_0

36. The electric and magnetic fields of an electromagnetic wave are:
(1) in phase and parallel to each other
(2) in opposite phase and perpendicular to each other.
(3) in opposite phase and parallel to each other
(4) in phase and perpendicular to each other

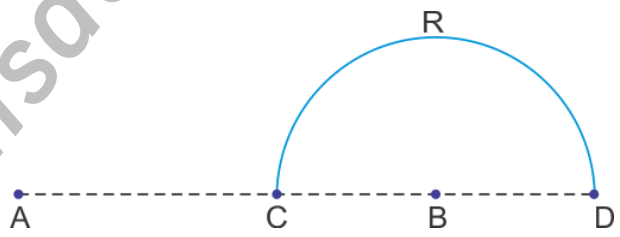
37. A mass of 2.0 kg is put on a flat pan attached to a vertical spring fixed on the ground as shown in the figure. The mass of the spring and the pan is negligible. When pressed slightly and released the mass executes a simple harmonic motion. The spring constant is 200 N/m. What should be the minimum amplitude of the motion, so that the mass gets detached from the pan? (Take g = 10 m/s^2)



(1) 8.0 cm
(2) 10.0 cm
(3) any value less than 12.0 cm
(4) 4.0 cm

38. 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?
(1) The time period of S_1 is four times that of S_2
(2) The potential energies of earth and satellite in the two cases are equal
(3) S_1 and S_2 are moving with the same speed
(4) The kinetic energies of the two satellites are equal

39. Charges +q and –q are placed at points A and B respectively which are at a distance 2L apart, C is the midpoint between A and B. The work done in moving a charge + Q along the semicircle CRD is:



(1) $\frac{qQ}{4\pi\varepsilon_0 L}$
(2) $\frac{qQ}{2\pi\varepsilon_0 L}$
(3) $\frac{qQ}{6\pi\varepsilon_0 L}$
(4) $-\frac{qQ}{6\pi\varepsilon_0 L}$

40. A beam of electrons passes undeflected through mutually perpendicular electric and magnetic fields. If the electric field is switched off, and the same magnetic field is maintained, the electrons move:
(1) in an elliptical orbit
(2) in a circular orbit
(3) along a parabolic path
(4) along a straight line

41. A black body is at 727°C. It emits energy at a rate which is proportional to:
(1) $(727)^2$
(2) $(1000)^4$
(3) $(1000)^2$
(4) $(727)^4$

42. An engine has an efficiency of 1/6. When the temperature of sink is reduced by 62 °C, its efficiency is doubled. Temperature or the source is:
(1) 124 °C
(2) 37 °C
(3) 62 °C
(4) 99 °C

43. Monochromatic light of frequency 6.0×10^{14} Hz is produced by a laser. The power emitted is 2×10^{-3} W. The number of photons emitted, on the average, by the source per second is:
(1) 5×10^{15}
(2) 5×10^{16}
(3) 5×10^{17}
(4) 5×10^{14}

44. For a cubic crystal structure which one of the following relations indicating the cell characteristic is correct?
(1) $a \neq b \neq c$ and $\alpha \neq \beta$ and $\gamma \neq 90°$
(2) $a \neq b \neq c$ and $\alpha = \beta = \gamma = 90°$
(3) $a = b = c$ and $\alpha \neq \beta \neq \gamma = 90°$
(4) $a = b = c$ and $\alpha = \beta = \gamma = 90°$

45. A common emitter amplifier has a voltage gain of 50, an input impedance of 100 Ω and an output impedance of 200 Ω. The power gain of the amplifier is:
(1) 500
(2) 1000
(3) 1250
(4) 100

46. The phase difference between the instantaneous velocity and acceleration of a particle executing simple harmonic motion is:

(1) 0.5π

(2) π

(3) 0.707π

(4) Zero

47. A vertical spring with force constant k is fixed on a table. A ball of mass m at a height h above the free upper end of the spring falls vertically on the spring, so that the spring is compressed by a distance d. The new work done in the process is:

(1) $mg(h+d)+\frac{1}{2}kd^2$

(2) $mg(h+d)-\frac{1}{2}kd^2$

(3) $mg(h-d)-\frac{1}{2}kd^2$

(4) $mg(h-d)+\frac{1}{2}kd^2$

48. $\vec{A}$ and $\vec{B}$ are two vectors and θ is the angle between them, if $\left|\vec{A}\times\vec{B}\right|=\sqrt{3}(\vec{A}\cdot\vec{B})$ the value of θ is:

(1) 60°

(2) 45°

(3) 30°

(4) 90°

49. Dimensions of resistance in an electrical circuit, in terms of dimensions of mass M, of length L, of time T and of current I, would be:

(1) $[ML^2T^{-3}I^{-1}]$

(2) $[ML^2T^{-2}]$

(3) $[ML^2T^{-1}I^{-1}]$

(4) $[ML^2T^{-3}I^2]$

50. A particle moving along x-axis has acceleration f, at time t, given by $f = f_0\left(1 - \frac{t}{T}\right)$, where f_0 and T are constants. The particle at t = 0 and the instant when f = 0, the particle's velocity (v_x) is:

(1) f_0T

(2) $\frac{1}{2}f_0T^2$

(3) f_0T^2

(4) $\frac{1}{2}f_0T$

Chemistry

51. Calculate the pOH of a solution at 25°C that contains 1×10^{-10} M of hydronium ions.
(1) 7.00
(2) 4.00
(3) 9.00
(4) 1.00

52. Which of the following will give a pair of enantiomorphs?
(1) $[Co(NH_3)_4Cl_2]NO_2$
(2) $[Cr(NH_3)_6][Co(CN)_6]$
(3) $[Co(en)_2Cl_2]Cl$
(4) $[Pt(NH_3)_4[PtCl_6]$

53. The correct order of increasing thermal stability of K_2CO_3, $MgCO_3$, $CaCO_3$ and $BeCO_3$ is:
(1) $BeCO_3 < MgCO_3 < K_2CO_3 < CaCO_3$
(2) $BeCO_3 < MgCO_3 < CaCO_3 < K_2CO_3$
(3) $MgCO_3 < BeCO_3 < CaCO_3 < K_2CO_3$
(4) $K_2CO_3 < CaCO_3 < MgCO_3 < BeCO_3$

54. A weak acid, HA has a K_a of 1.00×10^{-5}. If 0.100 mole of this acid is dissolved in one litre of water, the percentage of acid dissociated at equilibrium is closest to:
(1) 99.0%
(2) 1.00%
(3) 99.9%
(4) 0.100%

55. The number of moles of $KMnO_4$ that will be needed to react with one mole of sulphite ion in acidic solution is:
(1) $\frac{3}{5}$
(2) $\frac{4}{5}$
(3) $\frac{2}{5}$
(4) 1

56. Identify the incorrect statement among the following:
(1) There is a decrease in the radii of the atoms or ions as one proceeds from

La to Lu.
(2) Lanthanide contraction is the accumulation of successive shrinkages.
(3) As a result of lanthanide contraction, the properties of 4d series of the transition elements have no similarities with the 5d series of elements.
(4) Shielding power of 4f electrons is quite weak.

57. Which of the following oxidation states are the most characteristics for lead and tin respectively?
(1) +4, +2
(2) +2, +4
(3) +4, +4
(4) +2, +2

58. The correct order of C—O bond length among CO, CO_3^{2-}, CO_2 is:
(1) $CO_2 < CO_3^{2-} < CO$
(2) $CO < CO_3^{2-} < CO_2$
(3) $CO_3^{2-} < CO_2 < CO$
(4) $CO < CO_2 < CO_3^{2-}$

59. Which of the following represents the correct order of the acidity in the given compounds?
(1) $CH_3COOH > BrCH_2COOH > ClCH_2COOH > FCH_2COOH$
(2) $FCH_2COOH > CH_3COOH > BrCH_2COOH > ClCH_2COOH$
(3) $BrCH_2COOH > ClCH_2COOH > FCH_2COOH > CH_3COOH$
(4) $FCH_2COOH > ClCH_2COOH > BrCH_2COOH > CH_3COOH$

60. The following equilibrium constants are given:
$N_2 + 3H_2 \rightleftharpoons 2NH_3$; K_1
$N_2 + O_2 \rightleftharpoons 2NO$; K_2
$H_2 + \frac{1}{2}O_2 \rightleftharpoons H_2O$; K_3
The equilibrium constant for the oxidation of NH_3 by oxygen to give NO is:
(1) $\frac{K_2K_3^3}{K_1}$
(2) $\frac{K_2K_3^2}{K_1}$
(3) $\frac{K_2^2K_3}{K_1}$

(4) $\frac{K_1K_2}{K_3}$

61. Which one of the following vitamins is water-soluble?
(1) Vitamin-B
(2) Vitamin-E
(3) Vitamin-K
(4) Vitamin-A

62. If there is no rotation of plane polarized light by a compound in a specific solvent, thought to be chiral, it may mean that:
(1) the compound is certainly a chiral
(2) the compound is certainly meso
(3) there is no compound in the solvent
(4) the compound may be a racemic mixture

63. Consider the following sets of quantum numbers:

	n	l	m	s
(i)	3	0	0	+1/2
(ii)	2	2	1	+1/2
(iii)	4	3	-2	-1/2
(iv)	1	0	-1	-1/2
(v)	3	2	3	+1/2

Which of the following sets of quantum number is not possible?
(1) ii, iii and iv
(2) i, ii, iii and iv
(3) ii, iv and v
(4) i and iii

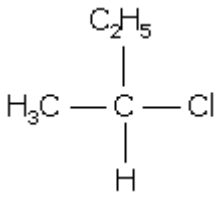
64. Which one of the following ions is the most stable in aqueous solution?
(1) Cr^{3+}
(2) V^{3+}
(3) Ti^{3+}
(4) Mn^{3+}
(At. no. Ti = 22, V = 23, Cr = 24, Mn = 25)

65. Concentrated aqueous sulphuric acid is 98% H_2SO_4 by mass and has a density of 1.80 g ml^{-1}. Volume of acid required to make one litre of 0.1 M H_2SO_4 solution is :
(1) 11.10 ml
(2) 16.65 ml

(3) 22.20 ml
(4) 5.55 ml

66. Which one of the following ionic species has the greatest proton affinity to form stable compound?
(1) HS^-
(2) NH_2^-
(3) F^-
(4) I^-

67. $CH_3—CHCl—CH_2—CH_3$ has a chiral centre. Which one of the following represents its R configuration?
(1)



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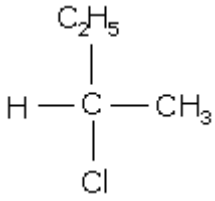

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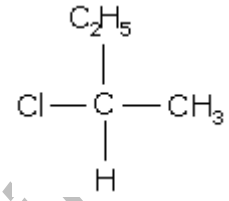

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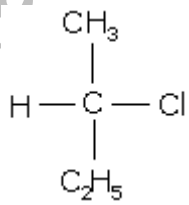


68. 0.5 molal aqueous solution of a weak acid (HX) is 20% ionised. If K_f for water is 1.86 K kg mol^{-1}, the lowering in freezing point of the solution is:
(1) –1.12 K
(2) 0.56 K

(3) 1.12 K
(4) –0.56 K

69. Which one of the following polymers is prepared by condensation polymerization?
(1) Nylon-66
(2) Teflon
(3) Rubber
(4) Styrene

70. The Langmuir adsorption isotherm is deduced using the assumption:
(1) The adsorption takes place in multilayers
(2) The adsorption sites are equivalent in their ability to adsorb the particles
(3) The heat of adsorption varies with coverage
(4) The adsorbed molecules interact with each other

71. The reaction of hydrogen and iodine monochloride is given as:
$H_{2\,(g)} + 2ICl_{\,(g)} \rightarrow 2HCl_{\,(g)} + I_{2\,(g)}$
This reaction is of first order with respect to $H_{2(g)}$ and $ICl_{(g)}$, following mechanisms were proposed:

- Mechanism A:
  $H_{2\,(g)} + 2ICl_{\,(g)} \rightarrow 2HCl_{\,(g)} + I_{2\,(g)}$
- Mechanism B:
  $H_{2(g)} + ICl_{(g)} \rightarrow HCl_{(g)} + HI_{(g)}$; slow
  $HI_{(g)} + ICl_{(g)} \rightarrow HCl_{(g)} + I_{2(g)}$; fast

Which of the above mechanism (s) can be consistent with the given information about the reaction?
(1) B only
(2) A and B both
(3) neither A nor B
(4) A only

72. RNA and DNA are chiral molecules, their chirality is due to:
(1) L-sugar component
(2) Chiral bases
(3) Chiral phosphate ester units
(4) D-sugar component

73. In which of the following the hydration energy is higher than the lattice energy?
(1) $BaSO_4$
(2) $MgSO_4$
(3) $RaSO_4$
(4) $SrSO_4$

74. Which one of the following on reduction with lithium aluminium hydride yields a secondary amine?
(1) Nitroethane
(2) Methylisocyanide
(3) Acetamide
(4) Methyl cyanide

75. Consider the following reactions:
(i) $H^+_{(aq)} + OH^-_{(aq)} = H_2O_{(l)}$ $\Delta H = -x_1$ kJ mol^{-1}
(ii) $H_{2(g)} + \frac{1}{2} O_{2(g)} = H_2O_{(l)}$ $\Delta H = -x_2$ kJ mol^{-1}
(iii) $CO_{2(g)} + H_{2(g)} = CO_{(g)} + H_2O_{(l)} - x_3$ kJ mol^{-1}
(iv) $C_2H_{2(g)} + \frac{5}{2} O_{2(g)} = 2CO_{2(g)} + H_2O_{(l)} + x_4$ kJ mol^{-1}
Enthalpy of formation of $H_2O_{(l)}$ is:
(1) $-x_2$ kJ mol^{-1}
(2) $+x_3$ kJ mol^{-1}
(3) $-x_4$ kJ mol^{-1}
(4) $+x_1$ kJ mol^{-1}

76. Given that bond energies of H — H and Cl — Cl are 430 kJ mol^{-1} and 240 kJ mol^{-1} respectively and ΔH_f for HCl is -90 kJ mol^{-1}. Bond enthalpy of HCl is :
(1) 290 kJ mol^{-1}
(2) 380 kJ mol^{-1}
(3) 425 kJ mol^{-1}
(4) 245 kJ mol^{-1}

77. Reduction of aldehydes and ketones into hydrocarbons using zinc amalgam and conc. HCl is called:
(1) Clemmensen reduction
(2) Cope reduction
(3) Dow reduction
(4) Wolff-Kishner reduction

78. Which one of the following anions is present in the chain structure silicates?
(1) $Si_2O_7^{6-}$
(2) $(Si_2O_5^{2-})_n$
(3) $(SiO_3^{2-})_n$
(4) SiO_4^{4-}

79. The fraction of total volume occupied by the atoms present in a simple cube is:
(1) $\frac{\pi}{6}$
(2) $\frac{\pi}{3\sqrt{2}}$
(3) $\frac{\pi}{4\sqrt{2}}$
(4) $\frac{\pi}{4}$

80. For the following:
(i) I^- (ii) Cl^- (iii) Br^-
the increasing order of nucleophilicity would be:
(1) $I^- > Br^- < Cl^-$
(2) $Cl^- < Br^- < I^-$
(3) $I^- < Cl^- < Br^-$
(4) $Br^- < Cl^- < I^-$

81. Which one of the following orders correctly represents the increasing acid strengths of the given acids?

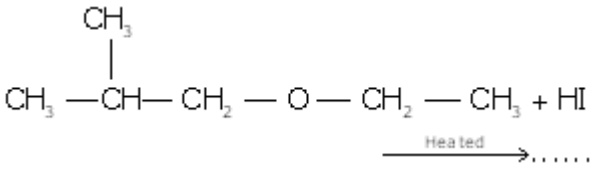
(1) $HOCl < HOClO < HOClO_2 < HOClO_3$

(2) $HOClO_3 < HOCl < HOClO_3 < HOClO_2$

(3) $HOClO_2 < HOClO_3 < HOClO < HOCl$

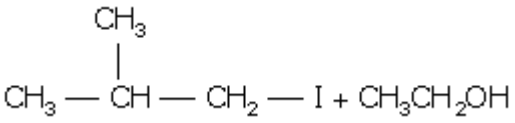
(4) $HOClO_3 < HOClO_2 < HOClO < HOCl$

82. The reaction :



Which of the following compounds will be formed?

(1)



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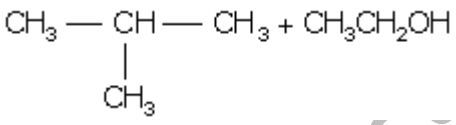

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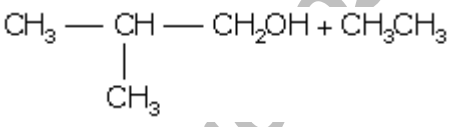

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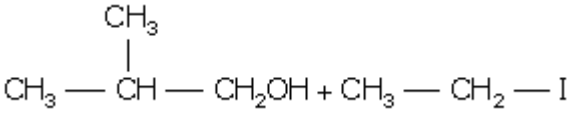


83. With which of the following electronic configuration an atom has the lowest ionisation energy?

(1) $1s^2\ 2s^2\ 2p^5$

(2) $1s^2\ 2s^2\ 2p^3$

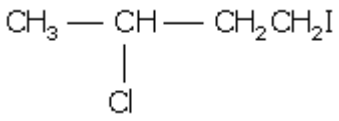
(3) $1s^2\ 2s^2\ 2p^6\ 3s^1$

(4) $1s^2\ 2s^2\ 2p^6$

84. Predict the product C obtained in the following reaction of 1-butyne.

$$CH_3CH_2 - C \equiv CH + HCl \rightarrow B \xrightarrow{HI} C$$

(1)



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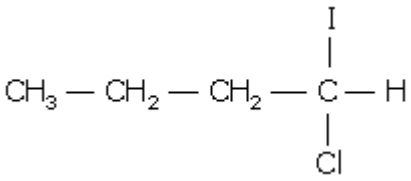

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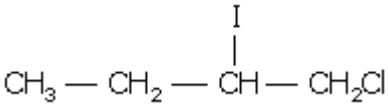

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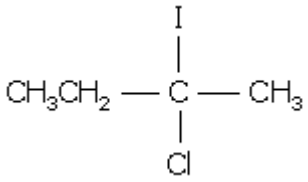


85. An element, X has the following isotopic composition:

^{200}X : 90%

^{199}X: 8.0%

^{202}X: 2.0%

The weighted average atomic mass of the naturally-occurring element X is closest to:

(1) 200 amu

(2) 201amu

(3) 202 amu

(4) 199 amu

86. In a first order reaction A → B, if k is rate constant and initial concentration of the reactant A is 0.5 M then the half-life is:

(1) $\frac{0.693}{0.5k}$

(2) $\frac{\log 2}{k}$

(3) $\frac{\log 2}{k\sqrt{0.5}}$

(4) $\frac{\ln 2}{k}$

87. Which of the following statements, about the advantage of roasting of sulphide ore before reduction is not true?
(1) Carbon and hydrogen are suitable reducing agents for metal sulphides
(2) The $\Delta_f G°$ of the sulphide is greater than those for CS_2 and H_2S
(3) The $\Delta_f G°$ is negative for roasting of sulphide ore to oxide
(4) Roasting of the sulphide to the oxide is thermodynamically feasible

88. If 60% of a first order reaction was completed in 60 min, 50% of the same reaction would be completed in approximately:
(1) 50 min
(2) 45 min
(3) 60 min
(4) 40 min
(log 4 = 0.60, log 5 = 0.69)

89. The equilibrium constant of the reaction:
$Cu_{(s)} + 2Ag^+_{(aq)} \rightarrow Cu^{2+}_{(aq)} + 2Ag_{(s)}$;
E° = 0.46V at 298 K is:
(1) 2.4×10^{10}
(2) 2.0×10^{10}
(3) 4.0×10^{10}
(4) 4.0×10^{15}

90. Which of the compounds with molecular formula C_5H_{10} yields acetone on ozonolysis?
(1) 2-methyl-2-butene
(2) 3-methyl-1-butene
(3) Cyclopentane
(4) 2-methyl-1-butene

91. Sulphide ores of metals are usually concentrated by Froth flotation process. Which one of the following sulphide ores offers an exception and is concentrated by chemical leaching?
(1) Argentite
(2) Galena
(3) Copper pyrite
(4) Sphalerite

92. The efficiency of a fuel cell is given by :

(1) $\frac{\Delta H}{\Delta G}$

(2) $\frac{\Delta G}{\Delta S}$

(3) $\frac{\Delta G}{\Delta H}$

(4) $\frac{\Delta S}{\Delta G}$

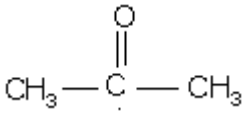
93. Which one of the following on treatment with 50% aqueous sodium hydroxide yields the corresponding alcohol and acid?

(1) $C_6H_5CH_2CHO$

(2) C_6H_5CHO

(3) $CH_3CH_2CH_2CHO$

(4)



94. Identify the correct order of the size of the following:

(1) $Ca^{2+} < K^+ < Ar < S^{2-} < Cl^-$

(2) $Ca^{2+} < K^+ < Ar < Cl^- < S^{2-}$

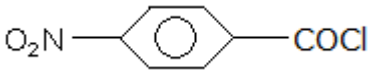
(3) $Ar < Ca^{2+} < K^+ < Cl^- < S^{2-}$

(4) $Ca^{2+} < Ar < K^+ < Cl^- < S^{2-}$

95. Consider the following compounds :

(i) C_6H_5COCl

(ii)



(iii)

(iv)

The correct decreasing order of their reactivity towards hydrolysis is:

(1) (ii) > (iv) > (iii) > (i)

(2) (i) > (ii) > (iii) > (iv)

(3) (iv) > (ii) > (i) > (iii)

(4) (ii) > (iv) > (i) > (iii)

96. The product formed in aldol condensation is :
(1) a beta-hydroxy acid
(2) a beta-hydroxy aldehyde or a beta-hydroxy ketone
(3) an alpha-hydroxy aldehyde or ketone
(4) an alpha, beta unsaturated ester

97. If NaCl is doped with 10^{-4} mol % of $SrCl_2$, the concentration of cation vacancies will be ($N_A = 6.02 \times 10^{23} mol^{-1}$)
(1) $6.02 \times 10^{15}\ mol^{-1}$
(2) $6.02 \times 10^{16}\ mol^{-1}$
(3) $6.02 \times 10^{17}\ mol^{-1}$
(4) $6.02 \times 10^{14}\ mol^{-1}$

98. The d-electron configurations of Cr^{2+}, Mn^{2+}, Fe^{2+} and Ni^{2+} are $3d^4$, $3d^5$, $3d^6$ and $3d^8$ respectively. Which one of the following aqua complexes will exhibit the minimum paramagnetic behaviour?
(1) $[Mn(H_2O)_6]^{2+}$
(2) $[Fe(H_2O)_6]^{2+}$
(3) $[Ni(H_2O)_6]^{2+}$
(4) $Cr(H_2O)_6]^{2+}$

99. The order of decreasing reactivity towards an electrophilic reagent, for the following :
(i) Benzene (ii) Toluene (iii) Chlorobenzene and (iv) Phenol
would be:
(1) (i) > (ii) > (iii) > (iv)
(2) (ii) > (v) > (i) > (iii)
(3) (iv) > (iii) > (ii) > (i)
(4) (iv) > (ii) > (i) > (iii)

100. In which of the following pairs, the two species are iso-structural?
(1) SF_4 and XeF_4
(2) SO_3^{2-} and NO_3^-
(3) BF_3 and NF_3
(4) BrO_3^- and XeO_3

Biology

101. Passage cell are thin-walled cells found in:
(1) endodermis of roots facilitating rapid transport of water from cortex to pericycle
(2) phloem elements that serve as entry points for substances for transport to other plant parts
(3) testa of seeds to enable emergency of growing embryonic axis during seed germination
(4) central region of style through which the pollen tube grows towards the ovary

102. Opening of floral buds into flowers is a type of:
(1) autonomic movement of locomotion
(2) autonomic movement of variation
(3) paratonic movement of growth
(4) autonomic movement of growth

103. Telomere repetitive DNA sequences control the function of eukaryotic chromosomes because they:
(1) act as replicons
(2) are RNA transcription initiator
(3) help in chromosome pairing
(4) prevent chromosome loss

104. Identify the odd combination of the habitat and the particular animal concerned:
(1) Dachigam National Park— Snow Leopard
(2) Sunderbans — Bengal Tiger
(3) Periyar — Elephant
(4) Rann of kutch—Wild Ass

105. In the leaves of C_4 plants, malic acid formation during CO_2 fixation occurs in the cells of:
(1) mesophyll
(2) bundle sheath
(3) phloem
(4) epidermis

106. A human male produces sperms with the genotypes AB, Ab, aB and ab pertaining to two diallelic characters in equal proportions. What is the corresponding genotype of this person?
(1) AaBb
(2) AaBB
(3) AABb
(4) AABB

107. Which of the following ecosystem types has the highest annual net primary productivity?
(1) Tropical rain forest
(2) Tropical deciduous forest
(3) Temperate evergreen forest
(4) Temperate deciduous forest

108. In human body, which one of the following is anatomically correct?
(1) Floating ribs—2 pairs
(2) Collar bones—3 pairs
(3) Salivary glands—1 pair
(4) Cranial nerves—10 pairs

109. Which of the following is a flowering plant with nodules containing filamentous nitrogen fixing microorganism?
(1) *Casuarina equisetifolia*
(2) *Crotolaria juncea*
(3) *Cycas revoluta*
(4) *Cicer arietinum*

110. The population of an insect species shows an explosive increase in numbers during rainy season followed by its disappearance at the end of the season. What does this show?
(1) S-shaped or sigmoid growth of this insect
(2) The food plants mature and die at the end of the rainy season
(3) Its population growth curve is of J-type
(4) The population of its predators increases enormously

111. One of endangered species of Indian medicinal plants is that of:
(1) *Podophyllum*
(2) *Ocimum*
(3) Garlic
(4) *Nepenthes*

112. In the hexaploid wheat, the haploid (n) and basic (x) numbers of chromosomes are:
(1) n = 7 and x = 21
(2) n = 21 and x = 21
(3) n = 21 and x = 14
(4) n = 21 and x = 7

113. In cloning of cattle a fertilized egg is taken out of the mother's womb and:
(1) the egg is divided into 4 pairs of cells which are implanted into the womb of other cows
(2) in the eight cell stage, cells are separated and cultured until small embryos are formed which are implanted into the womb of other cows
(3) in the eight cell stage the individual cells are separated under electrical field for further development in culture media
(4) from this upto eight identical twins can be produced

114. Which one of the following statements is correct?
(1) Extensive use of chemical fertilizers may lead to eutrophication of nearby water bodies
(2) Both *Azotobacter* and *Rhizobium* fix atmospheric nitrogen in root nodules of plants
(3) Cyanobacteria such as *Anabaena* and *Nostoc* are important mobilizers of phosphates and potassium for plant nutrition in soil
(4) At present it is not possible to grow maize without chemical fertilizers

115. One of the important consequences of geographical isolation is:
(1) no change in the isolated fauna
(2) preventing speciation
(3) speciation through reproductive isolation
(4) random creation of new species

116. Flagellated male gametes are present in all the three of which one of the following sets?
(1) *Anthoceros, Funaria* and *Spirogyra*
(2) *Zygnema, Saprolegnia* and *Hydrilla*
(3) *Fucus, Marsilea* and *Calotropis*
(4) *Riccia, Dryopteris* and *Cycas*

117. Molecular basis of organ differentiation depends on the modulation in transcription by:
(1) RNA polymerase
(2) ribosome
(3) transcription factor
(4) anticodon

118. Increased asthmatic attacks in certain seasons are related to:
(1) hot and humid environment
(2) eating fruits preserved in tin containers
(3) inhalation of seasonal pollen
(4) low temperature

119. Which of the following is a slime mould?
(1) *Rhizopus*
(2) *Physarum*
(3) *Thiobacillus*
(4) *Anabaena*

120. Which one of the following is an example of negative feedback loop in humans?
(1) Constriction of skin blood vessels and contraction of skeletal muscles when it is too cold
(2) Secretion of tears after falling of sand particles into the eye
(3) Salivation of mouth at the sight of delicious food
(4) Secretion of sweat glands and constriction of skin blood vessels when it is too hot

121. Ergot of rye is caused by a species of:
(1) *Phytophthora*
(2) *Uncinula*
(3) *Ustilago*
(4) *Claviceps*

122. Geometric representation of age structure is a characteristic of:
(1) Biotic community
(2) Population
(3) Landscape
(4) Ecosystem

123. Which one of the following mammalian cells is not capable of metabolizing glucose to carbon-dioxide aerobically?
(1) White blood cells
(2) Unstriated muscle cells
(3) Liver cells
(4) Red blood cells

124. Feeling the tremors of an earthquake, a scared resident of seventh floor of a multistoried building starts climbing down the stairs rapidly. Which hormone initiated this action?
(1) Thyroxine
(2) Adrenaline
(3) Glucagon
(4) Gastrin

125. Among the human ancestors the brain size was more the 1000 CC in:
(1) *Homo neanderthalensis*
(2) *Homo erectus*
(3) *Ramapithecus*
(4) *Homo habilis*

126. The length of DNA molecule greatly exceeds the dimensions of the nucleus in eukaryotic cells. How is this DNA accommodated?
(1) Deletion of non-essential genes
(2) Super-coiling in nucleosomes
(3) DNAse digestion
(4) Through elimination of repetitive DNA

127. The wavelength of light absorbed by P_r from of phytochrome is:
(1) 640 nm
(2) 680 nm
(3) 720 nm
(4) 620 nm

128. Which part of ovary in mammals acts as an endocrine gland after ovulation?
(1) Graaffian follicle
(2) Stroma
(3) Germinal epithelium
(4) Vitelline membrane

129. Which one of the following is not a constituent of cell membrane?
(1) Cholesterol
(2) Glycolipids
(3) Proline
(4) Phospholipids

130. The concept of chemical evolution is based on:
(1) crystallization of chemicals
(2) interaction of water, air and clay under intense heat
(3) effect of solar radiation on chemicals
(4) possible origin of life by combination of chemicals under suitable environmental conditions

131. In maize, hybrid vigour is exploited by:
(1) bombarding the seeds with DNA
(2) crossing of two inbred parental lines
(3) harvesting seeds from the most productive plants
(4) inducing mutations

132. In gymnosperms, the pollen chamber represents:
(1) a cell in the pollen grain in which the sperms are formed
(2) a cavity in the ovule in which pollen grains are stored after pollination
(3) an opening in the megagametophyte through which the pollen tube approaches the egg
(4) the microsporangium in which pollen grains develop

133. During transcription, RNA polymerase holoenzyme binds to a gene promoter and assumes a saddle-like structure. What is its DNA-binding sequence?
(1) TTAA
(2) AATT
(3) CACC
(4) TATA

134. In the prothallus of a vascular cryptogam, the antherozoids and eggs mature at different times. As a result:
(1) there is no change in success rate of fertilization
(2) there is high degree of sterility
(3) one can conclude that the plant is apomictic
(4) self fertilization is prevented

135. Industrial melanism as observed in peppered moth proves that:
(1) The true black melanic forms arise by a recurring random mutation
(2) The melanic form of the moth has no selective advantage over lighter form in industrial area
(3) The lighter-from moth has no selective advantage either in polluted industrial area or non-polluted area
(4) Melanism is a pollution-generated feature

136. "Foolish seedling" disease of rice led to the discovery of:
(1) GA
(2) ABA
(3) 2, 4-D
(4) IAA

137. Differentiation of organs and tissues in a developing organism, is associated with:
(1) developmental mutations
(2) differential expression of genes
(3) lethal mutations
(4) deletion of gens

138. The first acceptor of electrons from an excited chlorophyll molecule of photosystem II is:
(1) cytochrome
(2) iron-sulphur
(3) ferrodoxin
(4) quinine

139. Lysozyme that is present in perspiration, saliva and tears, destroys:
(1) certain fungi
(2) certain types of bacteria
(3) all viruses
(4) most virus-infected cells

140. During the transmission of nerve impulse through a nerve fibre, the potential on the inner side of the plasma membrane has which type of electric charge?
(1) First negative, then positive and again back to negative
(2) First positive, then negative and continue to be negative
(3) First negative, then positive and continue to be positive
(4) First positive, then negative and again back to positive

141. The Okazaki fragments in DNA Chain growth:
(1) result in transcription
(2) polymerize in the 3' to 5' direction and forms replication fork
(3) prove semi-conservative nature of DNA replication
(4) polymerize in the 5' to 3' direction and explain 3' to 5' DNA replication

142. The two polynucleotide chains in DNA are:
(1) parallel
(2) discontinuous
(3) antiparallel
(4) semi-conservative

143. Which one of the following is a viral disease of poultry?
(1) Salmonellosis
(2) Coryza
(3) New castle disease
(4) Pasteurellosis

144. Inheritance of skin colour in humans is an example of:
(1) chromosomal aberration
(2) point mutation
(3) polygenic inheritance
(4) codominance

145. One gene-one enzyme relationship was established for the first time in:
(1) *Neurospora crassa*
(2) *Salmonella typhimurium*
(3) *Escherichia coli*
(4) *Diplococcus penumoniae*

146. A genetically engineered micro-organism use successfully in bioremediation of oil spills is a species of:
(1) *Pseudomonas*
(2) *Trichoderma*
(3) *Xanthomonas*
(4) *Bacillus*

147. In which one of the following preparations are you likely to come across cell junctions most frequently?
(1) Ciliated epithelium
(2) Thrombocytes
(3) Tendon
(4) Hyaline cartilage

148. Which one of the following pairs is mismatched?
(1) *Pila globosa* — pearl
(2) *Apis indica* — honey
(3) *Kenia lacca* — lac
(4) *Bombyx mori* — silk

149. About 98 percent of the mass of every living organism is composed of just six elements including carbon, hydrogen, nitrogen, oxygen and:
(1) phosphorus and sulphur
(2) sulphur and magnesium
(3) magnesium and sodium
(4) calcium and phosphorus

150. Two genes R and Y are located very close on the chromosomal linkage map of maize plant. When RRYY and rryy genotypes are hybridized, then F_2 segregation will show:
(1) higher number of the recombinant types
(2) segregation in the expected 9 : 3 : 3 : 1 ratio
(3) segregation in 3 : 1 ratio
(4) higher number of the parental types

151. What is common between parrot, platypus and kangaroo?
(1) Homeothermy
(2) Toothless jaws
(3) Functional post-anal tail
(4) Ovoparity

152. Which one of the following is being utilized as a source of bio-diesel in the Indian countryside?
(1) *Euphorbia*
(2) Beetroot
(3) Sugarcane
(4) *Pongamia*

153. In which one of the following the BOD (Biochemical Oxygen Demand) of sewage(S), distillery effluent (DE), paper mill effluent (PE) and sugar mill effluent (SE) have been arranged in ascending order?
(1) SE < S < PE < DE
(2) SE < PE < S < DE
(3) PE < S < SE < DE
(4) S < DE < PE < SE

154. In the human female, menstruation can be deferred by the administration of:
(1) LH only
(2) Combination of FSH and LH
(3) Combination of estrogen and progesterone
(4) FSH only

155. Select the correct statement from the following:
(1) Darwinian variations are small and directionless
(2) Fitness is the end result of the ability to adapt and gets selected by nature
(3) all mammals except whales and camels have seven cervical vertebrae
(4) mutations are random and directional

156. Two plants can be conclusively said to belong to the same species if they
(1) can reproduce freely with each other and form seeds
(2) have more than 90 per cent similar genes
(3) look similar and possess identical secondary metabolites
(4) have same number of chromosomes

157. A sequential expression of a set of human genes occurs when a steroid molecule binds to the:
(1) transfer RNA
(2) messenger RNA
(3) DNA sequence
(4) Ribosome

158. In a coal fired power plant electrostatic precipitators are installed to control emission of:
(1) SO_2
(2) NO_x
(3) SPM
(4) CO

159. Probiotics are:
(1) safe antibiotics
(2) cancer inducing microbes
(3) new kind of food allergens
(4) live microbial food supplement

160. Which pair of the following belongs to Basidiomycetes?
(1) Birds nest fungi and Puffballs
(2) Puffballs and Claviceps
(3) Peziza and Stink horns
(4) Morchella and Mushrooms

161. Spore dissemination in some liverworts is aided by:
(1) elaters
(2) indusium
(3) calyptra
(4) peristome teeth

162. A person who is on a long hunger strike and is surviving only on water, will have:
(1) more sodium in his urine
(2) less amino acids in his urine
(3) more glucose in his blood
(4) less urea in his urine.

163. Which one of the following pairs, is not correctly matched?
(1) Abscisic acid — Stomatal closure
(2) Gibberellic acid — Leaf fall
(3) Cytokinin — Cell division
(4) IAA — Cell wall elongation

164. A common test to find the genotype of a hybrid is by:
(1) crossing of one F_2 progeny with male parent
(2) crossing of one F_2 progeny with female parent
(3) studying the sexual behaviour of F_1 progenies
(4) crossing of one F_1 progeny with male parent

165. Which one of the following is a matching pair of a body feature and the animal possessing it?
(1) Post-anal tail — Octopus
(2) Ventral Central nervous system — Leech
(3) Pharyngeal gills slits absent in embryo —Chameleon
(4) Ventral heart — Scorpion

166. Which of the following pairs are correctly matched?

Animals		Morphological features
(A) Crocodile	—	4-chambered heart
(B) Sea urchin	—	Parapodia
(C) Obelia	—	Metagenesis
(D) Lemur	—	Thecodont

(1) A, C and D
(2) B, C and D
(3) Only A and D
(4) Only A and B

167. If you suspect major deficiency of antibodies in a person, to which of the following would you look confirmatory evidence?
(1) Serum albumins
(2) Serum globulins
(3) Fibrinogen in the plasma
(4) Hemocytes

168. A person is having problems with calcium and phosphorus metabolism in his body. Which one of the following glands may not be functioning properly?
(1) Parathyroid
(2) Parotid
(3) Pancreas
(4) Thyroid

169. What is true about Nereis, Scorpion, Cockroach and Silver fish?
(1) They all have jointed paired appendages
(2) They all possess dorsal heart
(3) None of them is aquatic
(4) They all belong to the same phylum

170. The finches of Galapagos islands provide an evidence in favour of:
(1) special creation
(2) evolution due to mutation
(3) retrogressive evolution
(4) biogeographical evolution

171. Two cells A and B are contiguous. 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:
(1) Movement of water from cell B to A
(2) No movement of water
(3) Equilibrium between the two
(4) Movement of water from cell A to B

172. Which one of the following elements is not an essential micronutrient for plant growth?
(1) Mn
(2) Zn
(3) Cu
(4) Ca

173. Male gametes in angiosperms are formed by the division of
(1) microspore
(2) generative cell
(3) vegetative cell
(4) microspore mother cell

174. Which one of the following is surrounded by a callose wall?
(1) Microspore mother cell
(2) Male gamete
(3) Egg
(4) Pollen grain

175. Which one of the following statements about Mycoplasma is wrong?
(1) They are also called PPLO
(2) They are pleomorphic
(3) They are sensitive to penicillin
(4) They cause disease in plants

176. Which of the following is not a bio-indicator of water pollution?
(1) Sludge-worms
(2) Blood-worms
(3) Stone files
(4) Sewage fungus

177. Select the wrong statement from the following:
(1) both chloroplasts and mitochondria contain an inner and an outer membrane
(2) both chloroplasts and mitochondria have an internal compartment, the thylakoid space bounded by the thylakoid membrane
(3) both chloroplasts and mitochondria contain DNA
(4) the chloroplasts are generally much larger than mitochondria

178. Which one of the following pairs of organisms are exotic species introduced in India?
(1) *Ficus religiosa*, *Lantana camara*
(2) *Lantana camara*, Water hyacinth
(3) Water hyacinth, *Prosopis cinereria*
(4) Nile perch, *Ficus religiosa*

179. Which one of the following statement is correct?
(1) Stem cells are specialized cells
(2) There is no evidence of the existence of gills during embryogenesis of mammals
(3) All plant and animal cells are totipotent
(4) Ontogeny repeats phylogeny

180. Bowman's glands are located in the:
(1) proximal end of uriniferous tubules
(2) anterior pituitary
(3) female reproductive system of cockroach
(4) olfactory epithelium of our nose

181. The living organisms can be unexceptionally distinguished from the non-living things on the basis of their ability for:
(1) responsiveness to touch
(2) interaction with the environment and progressive evolution
(3) reproduction
(4) growth and movement

182. Compared to a bull a bullock is docile because of:
(1) higher levels of thyroxin
(2) higher levels of cortisone
(3) lower levels of blood testosterone
(4) lower levels of adrenalin / noradrenalin in its blood

183. What is common to whale, seal and shark?
(1) Seasonal migration
(2) Thick subcutaneous fat
(3) Convergent evolution
(4) Homeothermy

184. All enzymes of TCA cycle are located in the mitochondrial matrix except one which is located in inner mitochondrial membranes in eukaryotes and in cytosol in prokaryotes. This enzyme is:
(1) lactate dehydrogenase
(2) isocitrate dehydrogenase
(3) malate dehydrogenase
(4) succinate dehydrogenase

185. Which one of the following pairs of structures distinguishes a nerve cell from other types of cell?
(1) Perikaryon and dendrites
(2) Vacuoles and fibres
(3) Flagellum and medullary
(4) Nucleus and mitochondria

186. Ultrasound of how much frequency is beamed into human body for sonography?
(1) 30-45 MHz
(2) 15-30 MHz
(3) 1-15 MHz
(4) 45-70 MHz

187. Biological organization starts with:
(1) Submicrosocpic molecular level
(2) Cellular level
(3) Organismic level
(4) Atomic level

188. Which one of the following pairs is wrongly matched?
(1) Methanogens — Gobar gas
(2) Yeast — Ethanol
(3) Streptomycetes — Antibiotic
(4) Coliforms — Vinegar

189. 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 would you expect in F_1 generation?
(1) 50 : 50
(2) 9 : 1
(3) 1 : 3
(4) 3 : 1

190. Adaptive radiation refers to:
(1) adaptations due to geographical isolation
(2) evolution of different species from a common ancestor
(3) migration of members of a species to different geographical areas
(4) power of adaptation in an individual to a variety of environments

191. If the mean and the median pertaining to a certain character of a population are of the same value, the following is most likely to occur:
(1) a normal distribution
(2) a bi-modal distribution
(3) a T-shaped curve
(4) a skewed curve

192. When two species of different genealogy come to resemble each other as a result of adaptation, the phenomenon is termed:
(1) divergent evolution
(2) microevolution
(3) co-evolution
(4) convergent evolution

193. Which one of the following is a fat-soluble vitamin and its related deficiency disease?
(1) Ascorbic acid — Scurvy
(2) Retinol — Xerophthalmia
(3) Cobalamine — Beri-beri
(4) Calciferol — Pellagra

194. ICBN stands for:
(1) Indian Congress of Biological Names
(2) International Code of Botanical nomenclature
(3) International Congress of Biological Names
(4) Indian Code of Botanical Nomenclature

195. If you are asked to classify the various algae into distinct groups, which of the following characters you should choose?
(1) Types of pigments present in the cell
(2) Nature of stored food materials in the cell
(3) Structural organization of thallus
(4) Chemical composition of the cell wall

196. A plant requires magnesium for:
(1) holding cells together
(2) protein synthesis
(3) chlorophyll synthesis
(4) cell wall development

197. The overall goal of glycolysis, Krebs cycle and the electron transport system is the formation of:
(1) ATP in small stepwise units
(2) ATP in one large oxidation reaction
(3) Sugars
(4) Nucleic acids

198. A high density of elephant population in an area can result in:
(1) Mutualism
(2) Intraspecific competition
(3) Inter-specific competition
(4) Predation on one another

199. A drop of each of the following is placed separately on for slides. Which of them will not coagulate?
(1) Blood plasma
(2) Blood serum
(3) Sample from the thoracic duct of lymphatic system
(4) Whole blood from pulmonary vein

200. For a critical study of secondary growth in plants, which one of the following pairs is suitable?
(1) Sugarcane and sunflower
(2) Teak and pine
(3) Deodar and fern
(4) Wheat and maiden hair fern

AIPMT - 2007
(Physics, Chemistry and Biology)
Prelims Answer Key and Solution

Answers

1	(1)	2	(1)	3	(2)	4	(1)	5	(1)	6	(2)	7	(2)	8	(2)	9	(3)	10	(4)
11	(4)	12	(3)	13	(1)	14	(2)	15	(2)	16	(3)	17	(2)	18	(3)	19	(4)	20	(3)
21	(1)	22	(1)	23	(3)	24	(1)	25	(1)	26	(4)	27	(1)	28	(3)	29	(1)	30	(2)
31	(1)	32	(4)	33	(2)	34	(2)	35	(4)	36	(4)	37	(2)	38	(3)	39	(4)	40	(2)
41	(2)	42	(4)	43	(1)	44	(4)	45	(3)	46	(1)	47	(2)	48	(1)	49	(4)	50	(4)
51	(2)	52	(3)	53	(2)	54	(2)	55	(3)	56	(3)	57	(2)	58	(4)	59	(4)	60	(1)
61	(1)	62	(2)	63	(3)	64	(1)	65	(4)	66	(2)	67	(3)	68	(3)	69	(1)	70	(2)
71	(1)	72	(4)	73	(2)	74	(2)	75	(1)	76	(2)	77	(1)	78	(3)	79	(1)	80	(2)
81	(1)	82	(4)	83	(3)	84	(4)	85	(1)	86	(4)	87	(1)	88	(2)	89	(4)	90	(1)
91	(4)	92	(3)	93	(2)	94	(2)	95	(4)	96	(2)	97	(3)	98	(3)	99	(4)	100	(4)
101	(1)	102	(4)	103	(4)	104	(1)	105	(1)	106	(1)	107	(1)	108	(2)	109	(1)	110	(3)
111	(1)	112	(4)	113	(2)	114	(1)	115	(3)	116	(4)	117	(3)	118	(3)	119	(2)	120	(1)
121	(4)	122	(2)	123	(4)	124	(2)	125	(1)	126	(2)	127	(2)	128	(1)	129	(3)	130	(4)
131	(2)	132	(2)	133	(4)	134	(4)	135	(1)	136	(1)	137	(2)	138	(4)	139	(2)	140	(1)
141	(4)	142	(3)	143	(3)	144	(3)	145	(1)	146	(1)	147	(1)	148	(1)	149	(1)	150	(4)
151	(1)	152	(1)	153	(4)	154	(3)	155	(2)	156	(1)	157	(3)	158	(3)	159	(4)	160	(1)
161	(1)	162	(1)	163	(2)	164	(4)	165	(2)	166	(1)	167	(2)	168	(1)	169	(3)	170	(4)
171	(4)	172	(4)	173	(2)	174	(1)	175	(3)	176	(3)	177	(2)	178	(3)	179	(4)	180	(4)
181	(3)	182	(3)	183	(3)	184	(4)	185	(1)	186	(3)	187	(1)	188	(4)	189	(1)	190	(2)
191	(1)	192	(4)	193	(2)	194	(2)	195	(1)	196	(3)	197	(1)	198	(2)	199	(2)	200	(2)

Physics

1. It is found that temperature of inversion (T_i) is as much above the neutral temperature (T_n) as the neutral temperature is above the temperature of the cold junction (T), i.e.

$T_i - T_n = T_n - T$

$\Rightarrow T_i = 2T_n - T$

But here the cold junction is kept at 0°C.

Hence, T = 0

Thus, $T_i = 2T_n$

$\Rightarrow T_n = \frac{T_i}{2}$

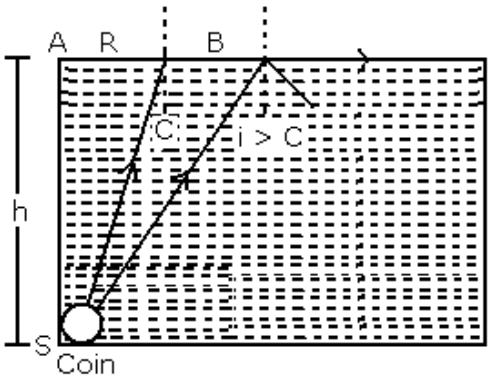
2. Nickel exhibits ferromagnetism because of a quantum physical effect called exchange coupling in which the electron spins of one atom interact with those of neighbouring atoms. The result is alignment of the magnetic dipole moments of the atoms. This alignment is what gives ferromagnetic materials their permanent magnetism.

If the temperature of a ferromagnetic material is raised above a certain critical value, called the Curie temperature, the exchange coupling ceases to be effective. Most such materials then become simply paramagnetic.

3. Beta decay can involve the emission of either electrons or positrons. The electrons or positrons emitted in a β-decay do not exist in the nucleus. They are only created at the time of emission, just as photons are created when an atom makes a transition from a 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 the radioactive decay process, the negatively charged emitted β-particles are the electrons produced as a result of the decay of neutrons present in the nucleus.

4. As shown in the figure, a light ray from the coin will not emerge out of liquid if i > C.



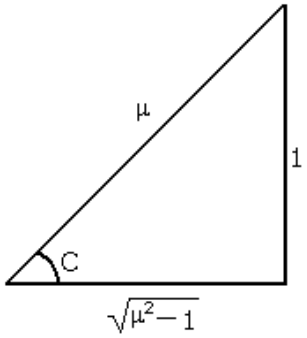
Therefore, the minimum radius R corresponds to i = C. In ΔSAB

$\frac{R}{h} = \tan C$

$\Rightarrow R = h\tan C$

$\Rightarrow R = \frac{h}{\sqrt{\mu^2 - 1}}$

Given, R = 3 cm, h = 4 cm



Hence, $\frac{3}{4} = \frac{1}{\sqrt{\mu^2 - 1}}$

$\Rightarrow \mu^2 = \frac{25}{9}$

$\Rightarrow \mu = \frac{5}{3}$

But $\mu = \frac{c}{v}$ or $v = \frac{c}{\mu}$, where c is the velocity of light in air/vacuum

$\therefore v = \frac{3 \times 10^8}{5/3} = 1.8 \times 10^8$ m/s

5. Current in LCR series circuit is

$i = \frac{V}{\sqrt{R^2 + (X_L - X_C)^2}}$

where V is the rms value of current, R is the resistance, X_L is the inductive reactance and X_C is the capacitive reactance.

For current to be maximum, the denominator should be minimum which can be done if $X_L = X_C$.

This happens in the resonance state of the circuit, i.e.

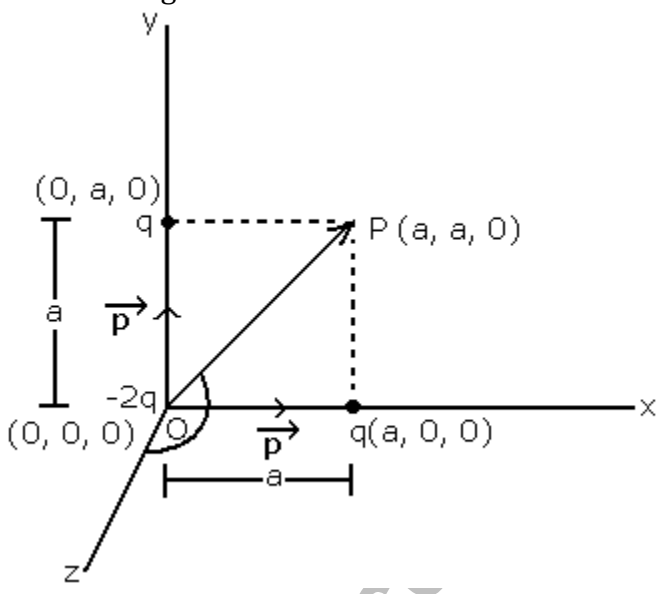
$\omega L = \frac{1}{\omega C}$

$\Rightarrow L = \frac{1}{\omega^2 C}$

Given, $\omega = 1000\ s^{-1}$, $C = 10\mu F = 10 \times 10^{-6}$ F

Hence, $L = \frac{1}{(1000)^2 \times 10 \times 10^{-6}} = 0.1$ H = 100 mH

6. Choose the three coordinate axes as x, y and z and plot the charges with the given coordinates as shown.
O is the origin at which the −2q charge is placed. The system is equivalent to two dipoles along the x and y directions, respectively. The dipole moments of two dipoles are shown in the figure.



The resultant dipole moment will be directed along OP, where P ≡ (a, a, 0). The magnitude of the resultant dipole moment is

$$p' = \sqrt{p^2 + p^2}$$
$$= \sqrt{(qa)^2 + (qa)^2}$$
$$= \sqrt{2}qa$$

7. For the formation of a nucleus, the evolution of energy equals to the binding energy of the nucleus because of disappearance of a fraction of the total mass. If the quantity of mass disappearing is ΔM, then the binding energy is
$BE = \Delta Mc^2$
Hence, 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 and atomic number Z.
Hence, the binding energy of the nucleus is
$BE = [ZM_p + NM_n - M(A, Z)]c^2$
$BE = [ZM_p + (A - Z)M_n - M(A, Z)]c^2$
where N = A − Z = number of neutrons

8. Given, the position x of a particle with respect to time t along the x-axis

$x = 9t^2 - t^3$ ..... (i)

Differentiating equation (i) with respect to time, we get speed, i.e.

$$v = \frac{dx}{dt} = \frac{d}{dt}(9t^2 - t^3)$$

$v = 18t - 3t^2$ ..... (ii)

Again differentiating equation (ii) with respect to time, we get acceleration, i.e.

$$a = \frac{dv}{dt} = \frac{d}{dt}(18t - 3t^2)$$

$\Rightarrow a = 18 - 6t$ ..... (iii)

Now, when the speed of a particle is maximum, its acceleration is zero, i.e.

$a = 0$

i.e. $18 - 6t = 0$

$\Rightarrow t = 3s$

Substituting the above value in equation (i), we obtain the position of a particle at that time as

$x = 9(3)^2 - (3)^3 = 9(9) - 27$

$= 81 - 27 = 54$ m

9. The resistors of 6Ω and 3Ω are in parallel in the given circuit. Hence, their equivalent resistance is

$$\frac{1}{R_1} = \frac{1}{6} + \frac{1}{3} = \frac{1+2}{6} = \frac{1}{2}$$

$\therefore R_1 = 2\Omega$

Now, R_1 is in series with the 4Ω resistor. Hence, we get

$R = R_1 + 4 = 2 + 4 = 6\Omega$

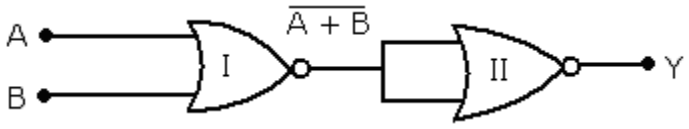
Thus, the total power dissipated in the circuit is

$$P = \frac{V^2}{R}$$

Here, V = 18 V, R = 6 Ω

Thus, $P = \frac{(18)^2}{6} = 54$ W

10. We can simplify the gate circuit as



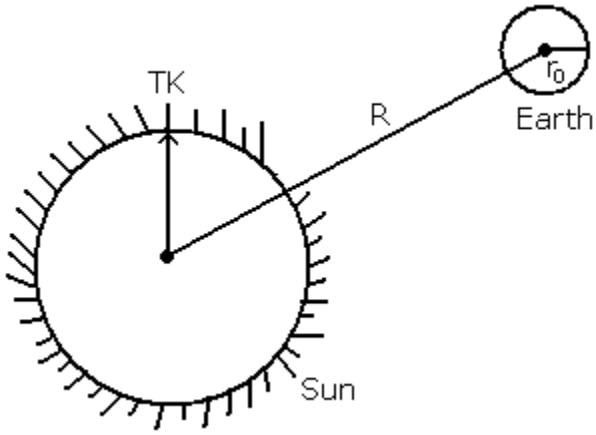
Here, gates-I and II are NOR gates. The output of gate-I will be appeared as the input of gate-II. The final output is

$Y = \overline{\overline{(A+B)}} = A + B$

This is the Boolean expression of the OR gate whose truth table is given below:

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

11. From Stefan's law, the rate at which energy is radiated by the Sun at its surface is $P = \sigma \times 4\pi r^2 T^4$



[The Sun is a perfectly black body as it emits radiations of all wavelengths and so for it e = 1.]

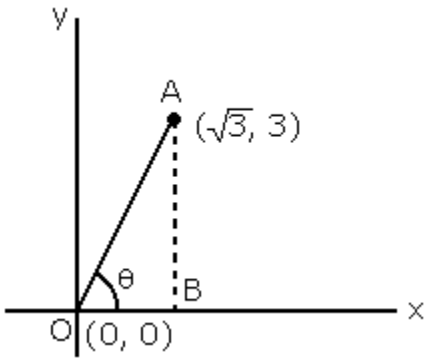
The intensity of this power at the Earth's surface (under the assumption $R >> r_0$) is

$$I = \frac{P}{4\pi R^2}$$
$$= \frac{\sigma \times 4\pi r^2 T^4}{4\pi R^2}$$
$$= \frac{\sigma r^2 T^4}{R^2}$$
$$= \frac{\sigma r^2 (t+273)^4}{R^2}$$

12. Draw the path as shown below. OA represents the path of the particle starting from origin O (0, 0).

Draw a perpendicular from point A to the x-axis.

Let the path of the particle make an angle θ with the x-axis.



From the geometry of the figure, we get

$\tan\theta$ = slope of line OA = $\frac{AB}{OB} = \frac{3}{\sqrt{3}} = \sqrt{3}$

$\therefore \theta = 60°$

13. If R is the radius of the nucleus, the corresponding volume $\frac{4}{3}\pi R^3$ has been found to be proportional to A.

This relationship is expressed as

$R = R_0 A^{1/3}$

The value of R_0 is 1.2×10^{-15} m, i.e. 1.2 fm

Therefore, $\frac{R_{Al}}{R_{Te}} = \frac{R_0 (A_{Al})^{1/3}}{R_0 (A_{Te})^{1/3}}$

$$\frac{R_{Al}}{R_{Te}} = \frac{(A_{Al})^{1/3}}{(A_{Te})^{1/3}} = \frac{(27)^{1/3}}{(125)^{1/3}} = \frac{3}{5}$$

$$\Rightarrow R_{Te} = \frac{5}{3} \times R_{Al} = \frac{5}{3} \times 3.6$$

$\Rightarrow R_{Te} = 6$ fm

14. By definition of angular acceleration, we have $\alpha = \frac{d\omega}{dt}$

i.e. $d\omega = \alpha dt$

So, in time t, the angular speed of a body changes from ω_0 to ω

$$\int_{\omega_0}^{\omega} d\omega = \int_0^t \alpha dt$$

If α is constant, then we get

$\omega - \omega_0 = \alpha t$

$\omega = \omega_0 + \alpha t$ ..... (i)

Now, by definition of angular speed, we have $\omega = \frac{d\theta}{dt}$

So, equation (i) becomes

$\frac{d\theta}{dt} = \omega_0 + \alpha t$

$d\theta = (\omega_0 + \alpha t)dt$

So, in time t, angular displacement is θ.

$\int_0^\theta d\theta = \int_0^t (\omega_0 = \alpha t)dt$

$\theta = \omega_0 t + \frac{1}{2}\alpha t^2$ ..... (ii)

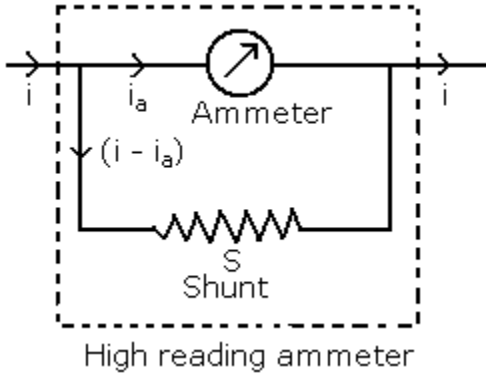
Given, $\alpha = 3.0$ rad/s^2, $\omega_0 = 2.0$ rad/s, t = 2 s

Hence, substituting the values in equation (ii), we get

$\theta = 2\times 2 + \frac{1}{2}\times 3\times (2)^2$

θ = 4 + 6 = 10 radians

15. Let i_a be the current flowing through the ammeter and i be the total current. So, a current $i - i_a$ will flow through the shunt resistance.



Potential difference across the ammeter and shunt resistance is the same.

i.e. $i_a \times R = (i - i_a) \times S$

$S = \frac{i_a R}{i - i_a}$

Given, $i_a = 100$ A, i = 750 A, R = 13Ω

Hence, $S = \frac{100\times 13}{750 - 100} = 2\Omega$

16. When magnetic field is perpendicular to the motion of the charged particle, then Centripetal force = Magnetic force

i.e. $\frac{mv^2}{R} = Bqv$

$\therefore R = \frac{mv}{Bq}$

Now, the time period of the motion is

$$T = \frac{2\pi R}{v} = \frac{2\pi\left(\frac{mv}{Bq}\right)}{v}$$

$$\therefore T = \frac{2\pi m}{Bq}$$

Hence, it is independent of both R and v.

17. The magnetic flux linked with the primary coil is given by

$\phi = \phi_0 + 4t$

So, the voltage across the primary coil is

$$V_p = \frac{d\phi}{dt} = \frac{d}{dt}(\phi_0 + 4t)$$

V_p = 4 volt (as ϕ_0 = constant)

Also, we have

N_p = 50 and N_s = 1500

From the transformer relation, we get

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

$$V_s = V_p \frac{N_s}{N_p}$$

$$= 4\left(\frac{1500}{50}\right)$$

$$= 120 \text{ V}$$

18. The two condensers in the circuit are in the 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, $W = U = \frac{1}{2}C'V^2$

$$= \frac{1}{2}\left(\frac{3C}{2}\right)V^2 = \frac{3}{4}CV^2$$

19. The moment of inertia of the uniform rod about an axis through one end and perpendicular to its length is

$$I = \frac{ml^2}{3}$$

where m is the mass of the rod and l is its length.

Now, the torque $(\tau = I\alpha)$ acting on the centre of gravity of the rod is

$$\tau = mg\frac{l}{2}$$

$$I\alpha = mg\frac{l}{2}$$

$$\frac{ml^2}{3}\alpha = mg\frac{l}{2}$$

$$\alpha = \frac{3g}{2l}$$

20. Velocity of light waves in material is

$V = V\lambda$ ..... (i)

Refractive index of material is

$$\mu = \frac{c}{v}$$ ..... (ii)

where c is the speed of light in vacuum or air.

$$\mu = \frac{c}{v\lambda}$$ ..... (iii)

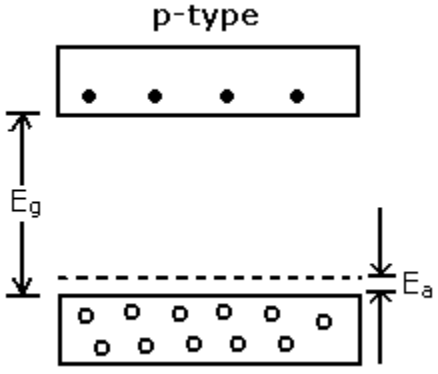
Given, $v = 2 \times 10^{14}$ Hz, $\lambda = 5000\,\text{Å} = 5000 \times 10^{-10}\text{m}$, $c = 3 \times 10^{8}\text{m/s}$

Hence, from equation (iii), we get

$$\mu = \frac{3 \times 10^{8}}{2 \times 10^{14} \times 5000 \times 10^{-10}} = 3.00$$

21. The given figure represents the p-type semiconductor as described below:

When one of the silicon atoms (valence = 4) has been replaced by an atom of aluminium (valence = 3), the aluminium atom can bond covalently with only three silicon atoms, so there is now a 'missing' electron (a hole) in one aluminium–silicon bond. With a small expenditure of energy, an electron can be drawn from a neighbouring silicon–silicon bond to fill this hole, thereby creating a hole in that bond. Similarly, an electron from some other bond can be moved to fill the second hole. In this way, the hole can migrate through the lattice.



22. Average speed = $\frac{\text{Distance travelled}}{\text{Time taken}}$

Let t_1 and t_2 be the 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, the average speed of the car for this round trip is

$$v_{avg} = \frac{2XY}{XY\left(\frac{v_u + v_d}{v_u v_d}\right)}$$

$$\Rightarrow v_{avg} = \frac{2v_u v_d}{v_u + v_d}$$

23. Let the displacement equation of particle executing SHM be

$y = a\sin\omega t$

As the particle travels half of the amplitude from the equilibrium position, so

$y = \frac{a}{2}$

Therefore, $\frac{a}{2} = a\sin\omega t$

$\Rightarrow \sin\omega t = \frac{1}{2} = \sin\frac{\pi}{6}$

$\Rightarrow \omega t = \frac{\pi}{6}$

$\Rightarrow t = \frac{\pi}{6\omega}$

$\Rightarrow t = \frac{\pi}{6\left(\frac{2\pi}{T}\right)}$ $\left(\text{as } \omega = \frac{2\pi}{T}\right)$

$\Rightarrow t = \frac{T}{12}$

Hence, the particle travels half of the amplitude from the equilibrium in $\frac{T}{12}$ sec.

24. Intensity of light is inversely proportional to the square of the distance.

$$I \propto \frac{1}{r^2}$$

$$\Rightarrow \frac{I_2}{I_1} = \frac{(r_1)^2}{(r_2)^2}$$

Given, $r_1 = 0.5$ m, $r_2 = 1.0$ m

Therefore, $\frac{I_2}{I_1} = \frac{(0.5)^2}{(1)^2} = \frac{1}{4}$

Now, because the number of photoelectrons emitted per second is directly proportional to intensity, the number of electrons emitted would also decrease by a factor of 4.

25. Block B will come to rest if the force applied to it will vanish because of frictional force acting between block B and the surface, i.e.

Force applied = Frictional force

i.e. $ma = \mu mg$

$$\Rightarrow m\left(\frac{v}{t}\right) = \mu mg$$

$$\Rightarrow t = \frac{v}{\mu g}$$

26. Number of nuclei remaining after time t can be written as

$$N = N_0 e^{-\lambda t}$$

where N_0 is the initial number of nuclei of both substances.

$N_1 = N_0 e^{-5\lambda t}$ ..... (i)

and $N_2 = N_0 e^{-\lambda t}$ ..... (ii)

Dividing equation (i) by equation (ii), we get

$$\frac{N_1}{N_2} = e^{(-5\lambda+\lambda)t} = e^{-4\lambda t} = \frac{1}{e^{4\lambda t}}$$

But it is given that

$$\frac{N_1}{N_2} = \left(\frac{1}{e}\right)^2 = \frac{1}{e^2}$$

$$\therefore \frac{1}{e^2} = \frac{1}{e^{4\lambda t}}$$

Comparing the powers, we get

$$2 = 4\lambda t$$

$$t = \frac{2}{4\lambda} = \frac{1}{2\lambda}$$

27. Gauss's law states that the net electric flux through any closed surface is equal to the net charge inside the surface divided by ε_0. That is

$$\phi_{total} = \frac{q}{\varepsilon_0}$$

Let the electric flux linked with surfaces A, B and C be ϕ_A, ϕ_B and ϕ_C, respectively. That is $\phi_{total} = \phi_A + \phi_B + \phi_C$

Since we know that $\phi_C = \phi_A$

$$\therefore 2\phi_A + \phi_B = \phi_{total} = \frac{q}{\varepsilon_0}$$

$$\Rightarrow \phi_A = \frac{1}{2}\left(\frac{q}{\varepsilon_0} - \phi_B\right)$$

But, we have

$\phi_B = \phi(\text{given})$

$$\therefore \phi_A = \frac{1}{2}\left(\frac{q}{\varepsilon_0} - \phi\right)$$

28. The efficiency of transformer is

$$\eta = \frac{\text{Energy obtained from the secondary coil}}{\text{Energy given to the primary coil}}$$

$$\eta = \frac{\text{Output power}}{\text{Input power}}$$

$$\eta = \frac{V_s I_s}{V_p I_p}$$

Given, $V_s I_s = 100\text{W}, V_p = 220\text{V}, I_p = 0.5\text{A}$

Hence, $\eta = \frac{100}{220 \times 0.5} = 0.90 = 90\%$

29. A charge in motion is equivalent to current, so we have

$$I = \frac{q}{t} = qf = q \times \frac{\omega}{2\pi}$$

But $\omega = \frac{v}{R}$

where R is the radius of the circle and v is the uniform speed of the charged particle.

Therefore, $I = \frac{qv}{2\pi R}$

Now, the magnetic moment associated with the charged particle is given by

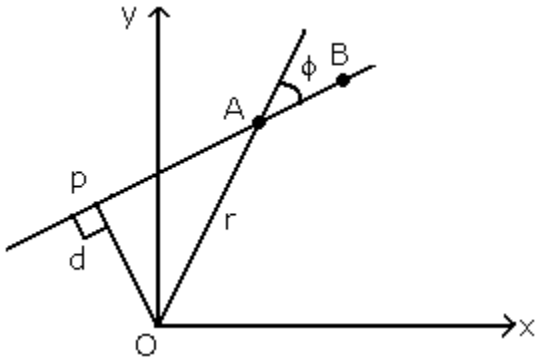
$$\mu = IA = I \times \pi R^2$$

$$\mu = \frac{qv}{2\pi R} \times \pi R^2$$

$$\mu = \frac{1}{2} qvR$$

30. From the definition of angular momentum, we have

$\vec{L} = \vec{r} \times \vec{p} = rmv \sin\phi$



Therefore, the magnitude of L is

$L = mvr \sin\phi = mvd$

where $d = r \sin\phi$ is the distance of closest approach of the particle to the origin.

d is the same for both particles; hence, $L_A = L_B$.

31. The energy of the hydrogen atom when the electron revolves in the nth orbit is

$$E = \frac{-13.6}{n^2} eV$$

In the ground state, n = 1

$$\therefore E = \frac{-13.6}{1^2} = -13.6eV$$

$$\text{For } n = 2, E = \frac{-13.6}{2^2} = -3.4eV$$

So, the kinetic energy of the electron in the first excited state (i.e. for n = 2) is

$K = -E = -(-3.4) = 3.4$ eV

32. If m is the mass of a substance deposited or liberated at an electrode during electrolysis when a charge q passes through the electrolyte, then according to Faraday's first law of electrolysis, we have

$m \propto q$

$m = zq$

where z is a constant of proportionality and is called the electrochemical equivalent (ECE) of 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 × 60 s
$z = 30 \times 10^{-5}\ gC^{-1}$
Hence, the mass of copper deposited on the electrode is
$m = 30 \times 10^{-5} \times 1.5 \times 10 \times 60$
$= 27 \times 10^{-2} = 0.27\ g$

33. The radius of the orbit in which ions are moving is determined by the relation

$$\frac{mv^2}{R} = qvB \Rightarrow v = \frac{RqB}{m}$$

where m is the mass, v is the velocity, q is the charge of the ion and B is the flux density of the magnetic field.

Hence, 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 ions about the vertical field B is given by

$$\omega = \frac{v}{R} = \frac{qB}{m} = 2\pi\nu$$

where ν is the frequency.

Therefore, the energy of the ion is given by

$$E = \frac{1}{2}mv^2 = \frac{1}{2}m(R\omega)^2$$

$$= \frac{1}{2}mR^2B^2\frac{q^2}{m^2}$$

$$E = \frac{1}{2}\frac{R^2B^2q^2}{m} \quad \text{....(i)}$$

If the ions are accelerated by an electric potential V, the energy attained by the ions is

$$E = qV \quad \text{....(ii)}$$

From equations (i) and (ii), we get

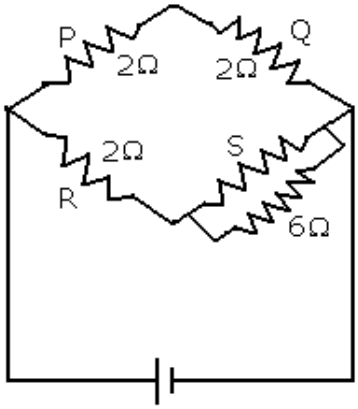
$$qV = \frac{1}{2}\frac{R^2B^2q^2}{m}$$

$$\frac{q}{m} = \frac{2V}{R^2B^2}$$

If V and B are kept constant, then

$$\frac{q}{m} \propto \frac{1}{R^2}$$

34. The situation can be depicted as shown in the figure below.



As the resistors S and 6Ω are in parallel, their effective resistance is

$\frac{6S}{6+S}\Omega$

As the bridge is balanced, it is a balanced Wheatstone's bridge.

For the balancing condition, we have

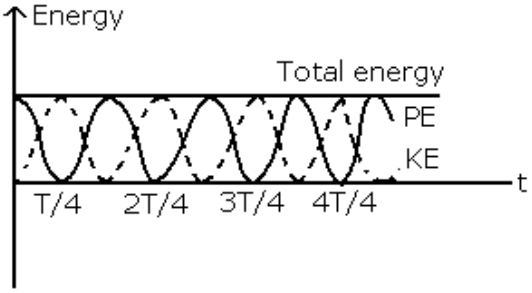
$\frac{P}{Q} = \frac{R}{\left(\frac{6S}{6+S}\right)}$

$\frac{2}{2} = \frac{2(6+S)}{6S}$

$3S = 6 + S$

$S = 3\Omega$

35. In simple harmonic motion, the total energy of the particle is constant at all instants. This energy is totally kinetic when the particle is passing through the mean position and is totally potential when the particle is passing through the extreme positions.



The variations of PE and KE with time are shown in the figure above by the dotted parabolic curve and the solid parabolic curve, respectively.

The figure indicates that maximum values of total energy, KE and PE of SHM are equal.

Now, $E_k = K_0 \cos^2 \omega t$

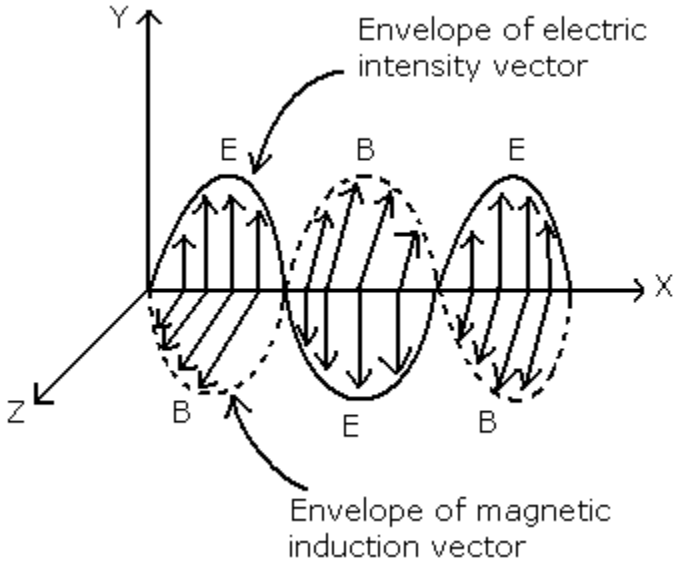
$\therefore (E_K)_{max} = K_0$

$\Rightarrow (E_P)_{max} = K_0$

And $(E)_{Total} = K_0$

36. The sinusoidal variation of both electric and magnetic field vectors ($\vec{E}$ and $\vec{B}$) occurs simultaneously. As a result, they attain the maxima and minima at the same place and at the same time. The amplitudes of the electric and magnetic fields in free space are related by

$$\frac{E_0}{B_0} = c$$



In the above figure, we can see that the electric field vector ($\vec{E}$) and the magnetic field vector ($\vec{B}$) are vibrating along the Y and Z directions and the propagation of the electromagnetic wave is along the X-direction.
Hence, the electric and magnetic fields are in phase and perpendicular to each other.

37. Let the minimum amplitude of SHM be a.
The restoring force on the spring is
F = ka
Restoring force is balanced by the weight mg of the block for a mass to execute simple harmonic motion of amplitude a.

$\therefore$ ka = mg

$$\Rightarrow a = \frac{mg}{k}$$

m = 2 kg, k = 200 N/m, g = 10 m/s^2

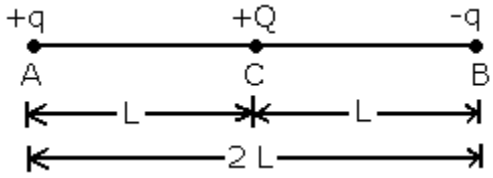
$$\therefore a = \frac{2 \times 10}{200} = \frac{10}{100}\,m$$

$$= \frac{10}{100} \times 100cm = 10cm$$

Hence, the minimum amplitude of the motion should be 10 cm so that mass detaches from the pan.

38. When two satellites of the Earth are moving in the same orbit, then the time period of both of them are equal.
From Kepler's third law, we have
$T^2 \propto r^3$
Time period is independent of mass, and 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 the same orbit, then they have equal orbital speed.

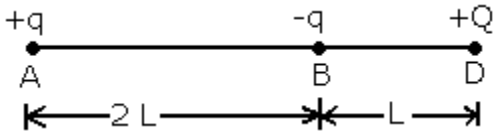
39. In the first case, when charge +Q is situated at C:



Electric potential energy of the system

$$U_1 = \frac{1}{4\pi\varepsilon_0}\frac{(q)(-q)}{2L} + \frac{1}{4\pi\varepsilon_0}\frac{(-q)Q}{L} + \frac{1}{4\pi\varepsilon_0}\cdot\frac{qQ}{L}$$

In the second case, when charge +Q is moved from C to D:



Electric potential energy of the system

$$U_2 = \frac{1}{4\pi\varepsilon_0}\cdot\frac{(q)(-q)}{2L} + \frac{1}{4\pi\varepsilon_0}\cdot\frac{qQ}{3L} + \frac{1}{4\pi\varepsilon_0}\frac{(-q)(Q)}{L}$$

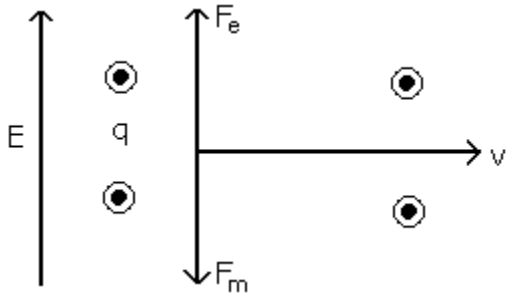
$\therefore$ Work done = $\Delta U = U_2 - U_1$

$$\Delta U = \left(-\frac{1}{4\pi\varepsilon_0}\frac{q^2}{2L} + \frac{1}{4\pi\varepsilon_0}\frac{qQ}{3L} - \frac{1}{4\pi\varepsilon_0}\frac{qQ}{L}\right) - \left(-\frac{1}{4\pi\varepsilon_0}\frac{q^2}{2L} - \frac{1}{4\pi\varepsilon_0}\frac{qQ}{L} + \frac{1}{4\pi\varepsilon_0}\frac{qQ}{L}\right)$$

$$= \frac{qQ}{4\pi\varepsilon_0}\cdot\left[\frac{1}{3L} - \frac{1}{L}\right] = \frac{qQ}{4\pi\varepsilon_0}\frac{(1-3)}{3L}$$

$$= \frac{-2qQ}{12\pi\varepsilon_0 L} = -\frac{qQ}{6\pi\varepsilon_0 L}$$

40. If both electric and magnetic fields are present and perpendicular to each other and the particle is moving perpendicular to both of them, then the particle passes undeflected.



Here, $F_e = F_m$ and in this situation $\vec{E} \neq 0$ and $\vec{B} \neq 0$.

But if the electric field becomes zero, then only the force because of the magnetic field exists. Under this force, the charge moves along a circle.

41. According to Stefan's law, we have

$E \propto T^4$

$E = \sigma T^4$

where σ is the constant of proportionality and is called Stefan's constant.

Its value is $5.67 \times 10^{-8}\ Wm^{-2}\ K^{-4}$

The temperature has to be in Kelvin.

Hence, $E \propto (727 + 273)^4$

$\Rightarrow E \propto (1000)^4$

42. Efficiency of an engine is given by

$$\eta = 1 - \frac{T_2}{T_1}$$

$$\therefore \frac{T_2}{T_1} = 1 - \eta = 1 - \frac{1}{6} = \frac{5}{6} \quad \text{..... (i)}$$

In the other case, we have

$$\frac{T_2 - 62}{T_1} = 1 - \eta = 1 - \frac{2}{6} = \frac{2}{3} \quad \text{..... (ii)}$$

Using equation (i), we get

$$T_2 - 62 = \frac{2}{3}T_1 = \frac{2}{3} \times \frac{6}{5}T_2$$

$$\frac{1}{5}T_2 = 62$$

$$\therefore T_2 = 310\text{K} = 310 - 273°\text{C} = 37°\text{C}$$

Hence, $T_1 = \frac{6}{5}T_2 = \frac{6}{5} \times 310 = 372\ \text{K} = 372 - 273 = 99\ °\text{C}$

Hence, the temperature of the source is 99 °C.

43. Power emitted by the laser is

$P = 2 \times 10^{-3}$ W

Energy of photon is

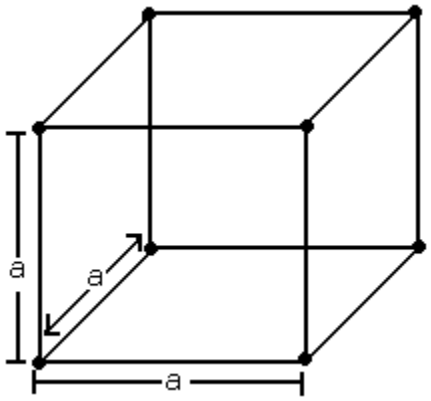
$E = hv = 6.6 \times 10^{-34} \times 6 \times 10^{14}$ J

where h is the Planck's constant.

Number of photons emitted per second is

$$n = \frac{P}{E} = \frac{2\times10^{-3}}{6.6\times10^{-34}\times6\times10^{14}} = 5\times10^{15}$$

44. In cubic crystals, the crystal axes are perpendicular to one another ($\alpha = \beta = \gamma = 90°$) and the repetitive interval is the same along the three axes (a = b = c).



45. AC power gain is

$$= \frac{\text{Change in output power}}{\text{Change in input power}}$$

$$= \frac{\Delta V_c \times \Delta i_c}{\Delta V_i \times \Delta i_b}$$

$$= \left(\frac{\Delta V_c}{\Delta V_i}\right) \times \left(\frac{\Delta i_c}{\Delta i_b}\right)$$

$= A_v \times \beta_{AC}$

where A_v is the voltage gain and $(\beta)_{AC}$ is AC gain.

Also, $A_v = \beta_{AC} \times$ resistance gain $\left(= \frac{R_o}{R_i}\right)$

Given, $A_v = 50$, $R_o = 200\Omega$, $R_i = 100\Omega$

Hence, $50 = \beta_{AC} \times \frac{200}{100}$

$\therefore \beta_{AC} = 25$

Now, AC power gain = $A_V \times \beta_{AC}$

$= 50 \times 25$

$= 1250$

46. The displacement equation of a particle executing SHM is

$x = a\cos(\omega t + \phi)$ ..... (i)

Velocity $v = \frac{dx}{dt} = -a\omega\sin(\omega t + \phi)$ ..... (ii)

and acceleration is

$A = \frac{dv}{dt} = -a\omega^2\cos(\omega t + \phi)$ ..... (iii)

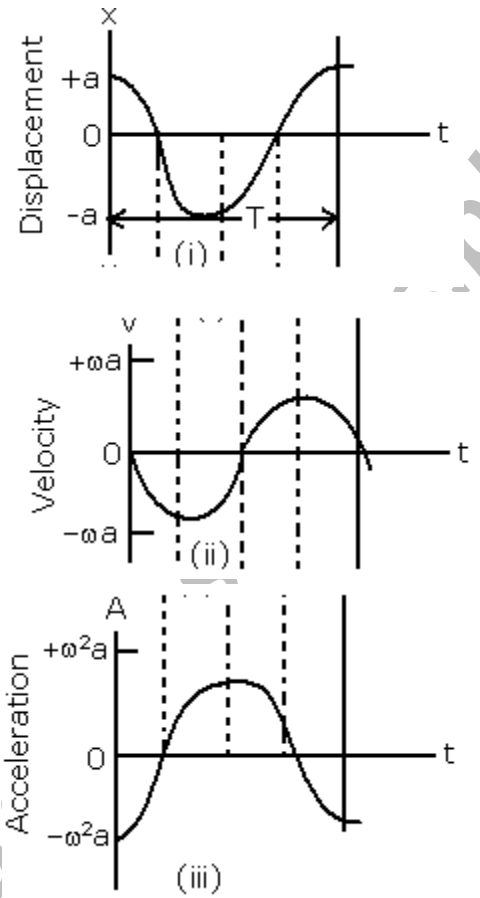
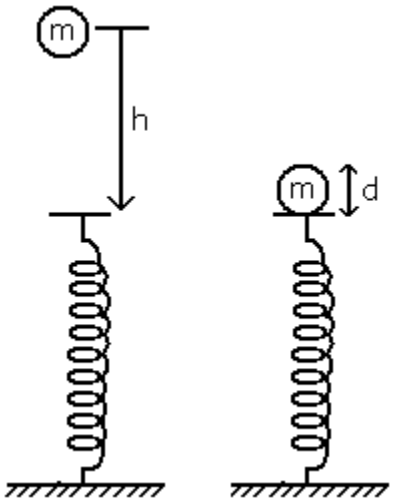


Figure (i) is a plot of equation (i) with $\phi = 0$.
Figure (ii) shows equation (ii) also with $\phi = 0$.
Figure (iii) is a plot of equation (iii).

It should be noted that in the figures the curve of v is shifted (to the left) from the curve of x by one-quarter period $\left(\frac{1}{4}T\right)$. Similarly, the acceleration curve of A is shifted (to the left) by $\frac{1}{4}T$ relative to the velocity curve of v. This implies that acceleration is 90° (0.5π) out of phase with the velocity but 180° (π) out of phase with displacement.

47. When mass m falls vertically on a spring, the spring is compressed by distance d.



Hence, net work done in the process is

W = Potential energy stored in the spring + Loss of potential energy of mass

$= mg(h + d) - \frac{1}{2}kd^2$

48. Given, $\left|\vec{A} \times \vec{B}\right| = \sqrt{3}(\vec{A} \cdot \vec{B})$

$\Rightarrow AB\sin\theta = \sqrt{3}\,AB\cos\theta$

$\Rightarrow \tan\theta = \sqrt{3}$

$\therefore \theta = 60°$

49. Resistance is given from Ohm's law as

$$R = \frac{\text{potential difference}}{\text{current}} = \frac{V}{i} = \frac{W}{qi}$$

(Potential difference is equal to work done per unit charge)

So, the dimensions of R are

$$[R] = \frac{[\text{Dimensions of work}]}{[\text{Dimensions of charge}][\text{Dimension of current}]}$$

$$[R] = \frac{[ML^2T^{-2}]}{[IT][I]} = [ML^2T^{-3}I^{-2}]$$

50. Acceleration is

$$f = f_0\left(1 - \frac{t}{T}\right)$$

$$f = \frac{dv}{dt} = f_0\left(1 - \frac{t}{T}\right) \qquad \left[\because f = \frac{dv}{dt}\right]$$

$$dv = f_0\left(1 - \frac{t}{T}\right)dt \qquad \text{..... (i)}$$

Integrating equation (i) on both sides, we get

$$\int dv = \int f_0\left(1 - \frac{t}{T}\right)dt$$

$$\therefore v = f_0 t - \frac{f_0}{T}\cdot\frac{t^2}{2} + C \qquad \text{..... (ii)}$$

where C is the constant of integration.

Now, when t = 0, v = 0.

So, from equation (ii), we get C = 0

$$\therefore v = f_0 t - \frac{f_0}{T}\cdot\frac{t^2}{2} \qquad \text{..... (iii)}$$

$$\text{As } f = f_0\left(1 - \frac{t}{T}\right)$$

$$\text{When } f = 0,\ 0 = f_0\left(1 - \frac{t}{T}\right)$$

$$\text{As } f_0 \neq 0,\ \text{so}, 1 - \frac{t}{T} = 0 \ \therefore t = T$$

Substituting, t = T in equation (iii), we get velocity as

$$v_x = f_0 T - \frac{f_0}{T}\cdot\frac{T^2}{2} = f_0 T - \frac{f_0 T}{2} = \frac{1}{2} f_0 T$$

Chemistry

51. $[H_3O^+] = [H^+] = 10^{-10}$
pH + pOH = 14
$pH = -\log[H^+]$
$pH = -\log[10^{-10}]$
pH = 10
pOH + 10 = 14
pOH = 14 – 10 = 4

52. The complex ion $[Co(en)_2Cl_2]^+$ can show optical isomerism in its cis-isomer and will form a pair of enantiomers. The trans-isomer will be optically inactive.

53. Thermal stability of carbonates increases in a group as we move from top to bottom and decreases in a period as we move from left to right. So, the correct order of thermal stability of given carbonates is
$BeCO_3 < MgCO_3 < CaCO_3 < K_2CO_3$
Be, Mg and Ca are present in the second group and K is present in the first group.

54.

$$HA \rightleftharpoons H^+ + A^-$$

$$K_a = \frac{[H^+][A^-]}{[HA]} = \frac{[H^+]^2}{[HA]}$$

$$[H^+] = \sqrt{K_a[HA]}$$

$$= \sqrt{1\times10^{-5}\times0.1}$$

$$= \sqrt{1\times10^{-6}}$$

$$= 1\times10^{-3}$$

$$\alpha = \frac{\text{actual ionization}}{\text{molar concentration}} = \frac{10^{-3}}{0.1} = 10^{-2}$$

$$\%\text{ of acid dissociated} = 10^{-2}\times 100$$

$$= 1\%$$

55. $2KMnO_4 + 3H_2SO_4 \rightarrow K_2SO_4 + 2MnSO_4 + 3H_2O + 5[O]$

$$\left(MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O\right) \times 2$$

$$\left(SO_3^{2-} + H_2O \rightarrow SO_4^{2-} + 2H^+ + 2e^-\right) \times 5$$

$$2MnO_4^- + 6H^+ + 5SO_3^{2-} \rightarrow 2Mn^{2+} + 5SO_4^{2-} + 3H_2O$$

5 moles of sulphite ion react with = 2 moles of MnO_4^-

So, 1 mole of sulphite ion reacts with $\frac{2}{5}$ moles of MnO_4^-.

56. The atomic radii of 4d and 5d elements down the group become quite similar because of lanthanide contraction.

57. The tendency to form +2 ionic state increases on moving down the group because of the inert pair effect.
The most characteristic oxidation states for lead and tin are +2 and + 4, respectively.

58. Bond length is inversely proportional to bond order.
The correct order of C–O bond length is $CO < CO_2 < CO_3^{2-}$.
Bond order of CO, CO_2 and CO_3^{2-} is 3, 2 and 1.33, respectively.

59. The acidity of halogenated acid increases almost proportionately with the increase in electronegativity of the halogen present.
So, the correct order is
$FCH_2COOH > ClCH_2COOH > BrCH_2COOH > CH_3COOH$

60.

$$2NH_3 \rightarrow N_2 + 3H_2 \qquad \frac{1}{K_1}$$

$$3H_2 + 3/2O_2 \rightarrow 3H_2O \qquad K_3^3$$

$$N_2 + O_2 \rightarrow 2NO \qquad K_2$$

$$2NH_3 + 5O_2 \rightarrow 2NO + 3H_2O \qquad K^* = K_2K^3{}_3/K_1$$

61. Vitamins are classified as
(i) Fat-soluble vitamins: A, D, E, K
(ii) Water-soluble vitamins: Vitamin B complex and C, so vitamin B is water-soluble.

62. Because there is no optical activity, the compound must be meso.

63. The value of l varies from 0 to n − 1, and the value of m varies from −1 to +1 through zero. The value of 's' $\pm \frac{1}{2}$ signifies the spin of electron. The correct sets of quantum numbers are

	n	l	m	s
(ii)	2	1	1	+1/2
(iv)	1	0	0	−1/2
(v)	3	2	2	+1/2

64. Cr^{3+} is the most stable in aqueous solution because its hydration energy is the highest.

65.

$$\text{Normality} = \frac{\text{wt}\% \times \text{density} \times 10}{\text{eq.wt.}}$$

$$= \frac{98 \times 1.8 \times 10}{49}$$

$$= 36\text{N}$$

$$N_1V_1 = N_2V_2$$

$$36 \times V = 0.2 \times 1000$$

$$V = \frac{0.2 \times 1000}{36}$$

$$= 5.55\text{mL}$$

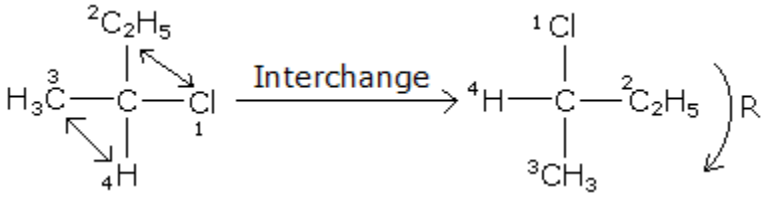
66. NH_2^- is the strongest base, so it has the strongest affinity for proton.

67. $CH_3—CHCl—CH_2—CH_3$

Priority order is

$-Cl > -C_2H_5 > -CH_3 > -H$

(1)



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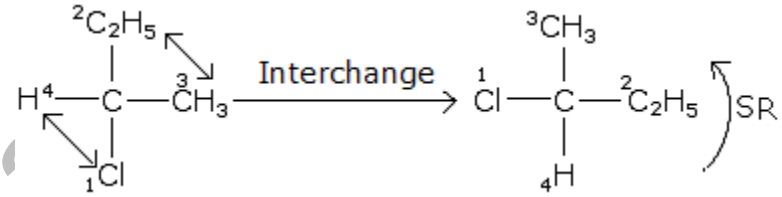

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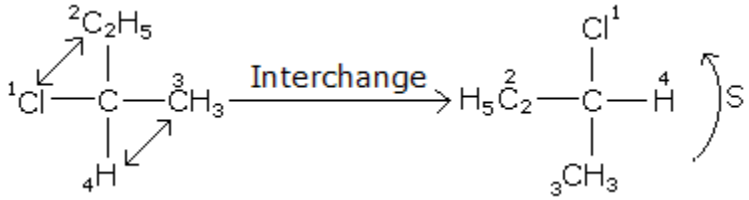

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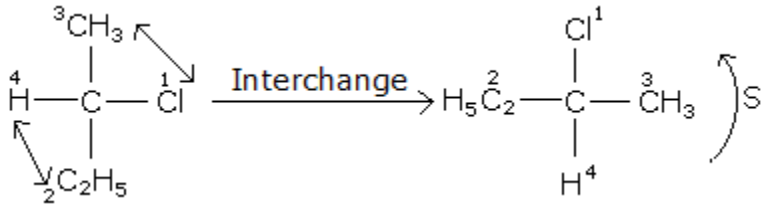


68.

$$HX \rightleftharpoons H^+ + X^-$$

weak acid 0 0

$1-\alpha$ α α (at equlibrium)

$\alpha =$ 20% dissociation, i.e. $\alpha = 0.2$

$i = 1 - \alpha + \alpha + \alpha$

$= 1 + \alpha$

$= 1 + 0.2$

$= 1.2$

$\Delta T_f = i \times K_f \times m$

$= 1.2 \times 1.86\ K\ kg\ mol^{-1} \times 0.5$

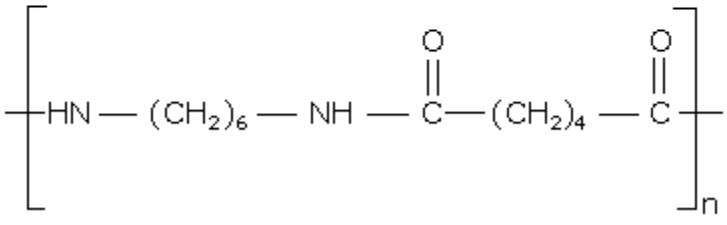
$= 1.12\ K$

69. Polymers formed by the polymerisation of monomers with the elimination of small molecules such as NH_3, H_2O, HCl and CH_3OH are known as condensation polymers. Nylon-66 is prepared by condensation polymerisation.

$nH_2N-(CH_2)_6-NH_2$ + $nHOOC-(CH_2)_4-COOH$

hexa methylene diamine adipic acid

$\downarrow -nH_2O$



70. The Langmuir adsorption isotherm is based on the assumption that every adsorption site is equivalent and the adsorption at a site is unaffected by adsorption at neighbouring sites.

71. Rate of reaction always depends on slow reaction.
So, the mechanism B is consistent with the given information about the reaction.

72. RNA and DNA molecules have ribose and deoxyribose sugar, respectively. Both are chiral, and their chirality is due to D-ribose or deoxyribose sugar components.

73. Hydration energy of sulphate decreases from top to bottom in the II group. Mg^{2+} is smaller than other ions of that group, so Mg^{2+} is readily hydrated. $MgSO_4$ has higher hydration energy than lattice energy.

74. On catalytic reduction or with nascent hydrogen or with lithium aluminium hydride ($LiAlH_4$), alkyl isocyanide yields secondary amine.

$$CH_3-N\rightleftharpoons C + 4[H] \longrightarrow CH_3-NH-CH_3$$

methylisocyanide

75. Enthalpy of formation: The amount of heat evolved or absorbed during the formation of 1 mole of a compound from its constituent elements is known as heat of formation. So, the correct answer is

$$H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(l)},\ \Delta H = -x_2 \text{ kJ mol}^{-1}$$

76.

$$\Delta H_{reaction} = \Delta H_{H-H} + \Delta H_{Cl-Cl} - 2\Delta H_{H-Cl} = -90\text{kJ}$$

$$\Rightarrow \Delta H_{H-Cl} = \frac{430 + 240 - (-90)}{2}$$

$$= \frac{760}{2}$$

$$= 380\text{kJ mol}^{-1}$$

77. Clemmensen reduction: Aldehydes and ketones are reduced to the corresponding alkanes by amalgamated zinc and HCl.

$> C = O + 4[H] \rightarrow > CH_2 + H_2O$

78. $\left[SiO_3^{2-}\right]_n$ and $\left[Si_4O_{11}\right]^{6-}$ have the chain structure of silicates.

79. For simple cubic

Radius (r) = $\frac{a}{2}$

$$\text{Volume of the atom} = \frac{4}{3}\pi\left(\frac{a}{2}\right)^3$$

$$\text{Packing fraction} = \frac{\frac{4}{3}\pi\left(\frac{a}{2}\right)^3}{a^3}$$

$$= \frac{\pi}{6}$$

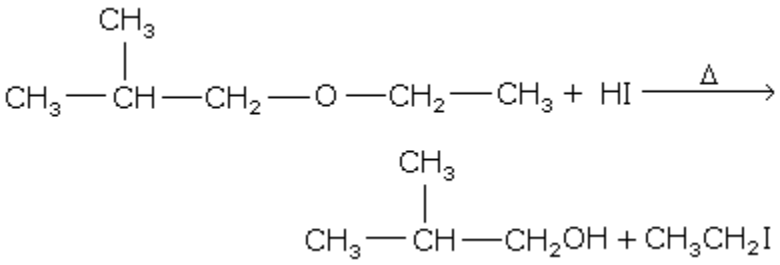
80. Nucleophilicity of halide ions increases as we move down the group. So, the correct order of nucleophilicity is

$Cl^- < Br^- < I^-$

81. The acidic character of oxyacids increases with increase in oxidation number. Acidity of oxyacids of chlorine increases in the following order:

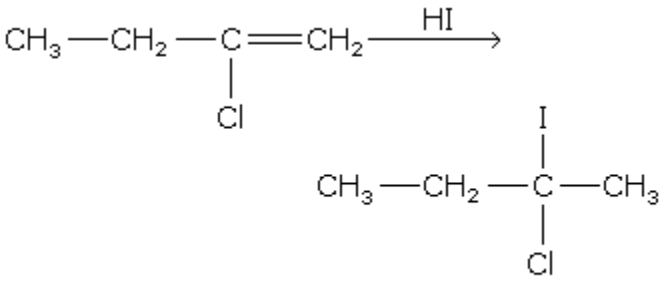
$$H\overset{+1}{C}lO < H\overset{+3}{C}lO_2 < H\overset{+5}{C}lO_3 < H\overset{+7}{C}lO_4$$

82. When conc. HI or HBr react with ether, the corresponding alcohol and iodide are formed. When there is a case of mixed ethers, the halogen atom attaches to the smaller alkyl group because of steric effect.



83. The electronic configuration $1s^2\ 2s^2\ 2p^6\ 3s^1$ shows lowest ionisation energy because this configuration is unstable because of the presence of one electron in the s-orbital. Hence, less energy is required to remove the electron.

84. $CH_3—CH_2—C \equiv CH + HCl \rightarrow$



2-chloro, 2-iodo butane

85. Weight of $^{200}X = 0.90 \times 200 = 180.00$ amu
Weight of $^{199}X = 0.08 \times 199 = 15.92$ amu
Weight of $^{202}X = 0.02 \times 202 = 4.04$ amu
Total weight = 199.06 ≈ 200 amu

86. For the first order reaction:

$$k = \frac{2.303}{t}\log\frac{a}{(a-x)}$$

$$t_{1/2} = \frac{2.303}{k}\log\frac{a}{a-\frac{a}{2}}$$

$$= \frac{2.303}{k}\log 2$$

$$= \frac{\ln 2}{k}$$

87. Carbon and hydrogen are not suitable reducing agents for metal sulphides.

88.

$$k = \frac{2.303}{t}\log_{10}\frac{a}{a-x}$$

$$k_1 = \frac{2.303}{t_1}\log\frac{a_1}{a_1 - x_1}$$

$$k_2 = \frac{2.303}{t_2}\log\frac{a_2}{a_2 - x_2}$$

$$x_1 = \frac{60}{100}a_1,\ t_1 = 60$$

$$x_2 = \frac{50}{100}a_2, t_2 = ?$$

$$\frac{2.303}{t_1}\log\frac{a_1}{a_1 - x_1} = \frac{2.303}{t_2}\log\frac{a_2}{a_2 - x_2}$$

$$\frac{2.303}{60}\log\frac{a}{\left(a_1 - \frac{60}{100}a_1\right)} = \frac{2.303}{t_2}\log\frac{a_2}{\left(a_2 - \frac{50}{100}a_2\right)}$$

$$\frac{2.303}{60}\log\frac{100a_1}{40a_1} = \frac{2.303}{t_2}\log\frac{100a_2}{50a_2}$$

$$\frac{1}{60}\log\frac{100}{40} = \frac{1}{t_2}\log\frac{100}{50}$$

$$t_2 = \frac{60\log(100/50)}{\log(100/40)}$$

$$= \frac{60(\log 10 - \log 5)}{(\log 10 - \log 4)}$$

$$= \frac{60(1 - 0.69)}{(1 - 0.60)}$$

$$= \frac{60 \times 0.31}{0.40}$$

$$= 1.5 \times 31$$

$$= 46.5 \approx 45\,\text{min}$$

89. $Cu_{(s)} + 2Ag^{+}{}_{(aq)} \rightarrow Cu^{2+}{}_{(aq)} + 2Ag_{(s)}$

$E^\circ = 0.46V$ at 298 K

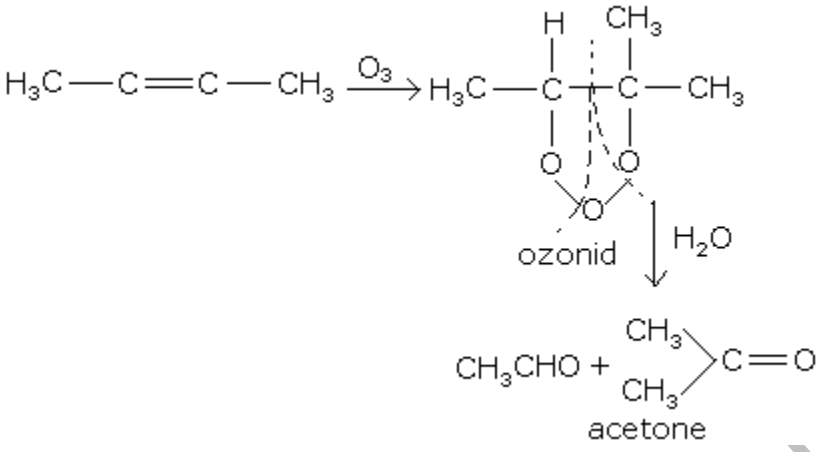
$RT \ln K = nFE^\circ$

$$\ln K = \frac{nFE^\circ}{RT}$$

$$= \frac{2 \times 0.46}{0.0591}$$

$$K = 4 \times 10^{15}$$

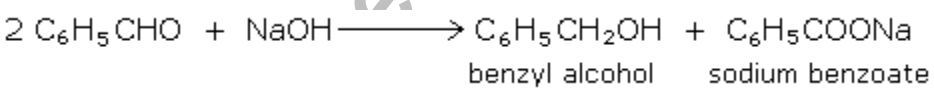
90. 2-methyl-2-butene (molecular formula C_5H_{10}) yields acetone on ozonolysis.



91. Galena (PbS), copper pyrite ($CuFeS_2$) and argentite (Ag_2S) are concentrated by the froth flotation process, but sphalerite (ZnS) is concentrated by chemical leaching.

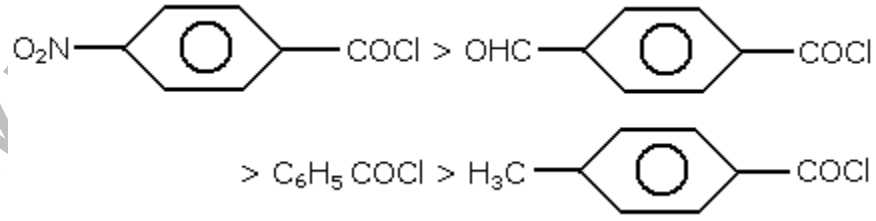
92. Efficiency of fuel cell = $\frac{\Delta G}{\Delta H}$.

93. Aldehydes which do not have any α-hydrogen atom when heated with a conc. solution of NaOH undergo simultaneous oxidation and reduction (disproportionation) forming a salt of carboxylic acid and alcohol called Cannizzaro reaction.

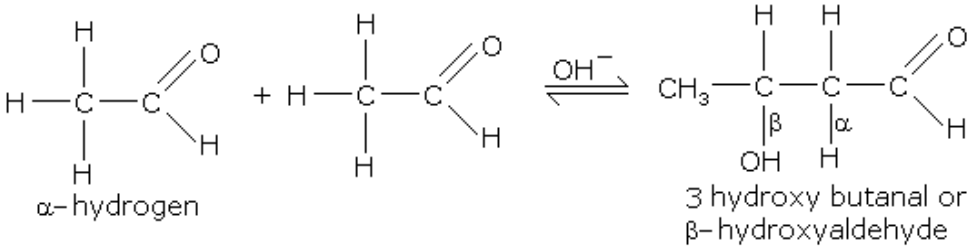


94. A cation always has lesser ionic size than a metal atom because of loss of electrons, and an anion always has greater size than a metal atom because of gain of electrons. So, the correct order of size is as
$Ca^{2+} < K^+ < Ar < Cl^- < S^{2-}$

95. Decreasing order of their reactivity towards hydrolysis is



96. Condensation between two molecules of an aldehyde or a ketone having at least one α-hydrogen atom in the presence of a base to form a β-hydroxy ketone is known as aldol condensation.



97. Number of moles of cationic vacancies

$$\frac{10^{-4}}{10^{2}} = 10^{-6} \text{ mole}$$

Number of cationic vacancies = $10^{-6} \times 6.02 \times 10^{23} = 6.023 \times 10^{17}$

98. As the number of unpaired electrons increases, the magnetic moment increases, and hence, the paramagnetic behaviour increases.

So, Cr^{2+} (22) = $3d^4$ – 4 unpaired electrons

Mn^{2+} (23) = $3d^5$ – 5 unpaired electrons

Fe^{2+} (24) = $3d^6$ – 4 unpaired electrons

Ni^{2+} (26) = $3d^8$ – 2 unpaired electrons

So, $[Ni(H_2O)_6]^{2+}$ exhibits minimum paramagnetic behaviour.

99. Benzene having any activating group, i.e. OH, R etc., undergoes electrophilic substitution very easily as compared to benzene itself. Thus, toluene ($C_6H_5CH_3$) and phenol (C_6H_5OH) undergo electrophilic substitution very readily than benzene. Chlorine with +E and +M effect deactivates the ring because of strong –I effect. So, it is difficult to carry out the substitution in chlorobenzene than in benzene, so the correct order is

Phenol > Toluene > Benzene > Chlorobenzene

(iv) (ii) (i) (iii)

100.

(1) SF_4 = irregular tetrahedron (sp^3d, one lone pair)

XeF_4 = square planar ($sp^3 d^2$, two lone pairs)

(2) SO_3^{2-} = pyramidal (sp^3 one lone pair)

NO_3^- = trigonal planar (sp^2)

(3) BF_3 = trigonal planar (sp^2)

NF_3 = pyramidal (sp^3)

(4) BrO_3^- = pyramidal (sp^3, one lone pair)

XeO_3 = pyramidal (sp^3, one lone pair)

Hence, BrO_3^- and XeO_3 are isostructural.

Biology

101. The endodermis is the innermost layer of the cortex in roots. Some endodermal cells present opposite to the xylem patches are thin-walled and are called passage cells or transfusion cells. Passage cells help in the transfer of water and dissolved salts from the cortex directly into the xylem and ultimately to the pericycle.

102. The opening of floral buds and the change into a flower is a nastic movement. It is a type of autonomic movement of growth in which the direction of the movement is independent of the direction of the stimulus. In fact, the response is determined by the structure of the responsive organ and not by the opposite side.

103. The terminal end of the chromosome is known as a telomere. It consists of repetitive DNA sequences. These are stable and resistant to exonuclease digestion and hence essential for chromosome stability.

104. Dachigam National Park is situated near Dal Lake in Jammu and Kashmir which is known for the conservation of the most endangered Hangul or Kashmir stag.

105. C_4 plants have Kranz anatomy consisting of mesophyll and bundle sheath cells. In mesophyll cells, PEP functions as CO_2 acceptor and forms oxalic acid. Later, oxalic acid is reduced to malic acid. Finally, malic acid is transferred to bundle sheath cells.

106. The corresponding genotype of the person will be AaBb.

	A	a
B	AB	aB
b	Ab	ab

107. Productivity of tropical rainforests is the highest. The tropical rainforests covering an area of 3,00,000 km^2 contain more than 50% of the total flora and fauna of the world.

108. (1) Floating ribs—3 pairs
(2) Collar bones—3 pairs
(3) Salivary glands—2 pairs
(4) Cranial nerves—12 pairs

109. Nitrogen-fixing organisms are found associated with *Casuarina equisetifolia*. It harbours a N_2-fixing organism *Frankia* in their roots in the form of nodules.

110. The population of an insect species shows an explosive increase in numbers during the rainy season followed by almost sudden disappearance at the end of the season. Population growth curves in such cases are J-shaped. The exponential growth stops abruptly as the environmental resistance or another limiting factor becomes effective.

111. *Podophyllum* is an Indian endangered flora. Its dried roots and rhizomes have medicinal significance.

112. The basic chromosome number (x) of hexaploid wheat is 7 and the haploid (n) number is 21.

113. In the cloning of cattle, a fertilised egg is taken out of the mother's womb. In the eight-cell stage, cells are separated and cultured until small embryos are formed. Later, these are implanted in the womb of a different cow—the host mother.

114. Eutrophication is the phenomenon of nutrient enrichment of aquatic bodies. It is caused by runoff water from fertilised fields and through detergent-rich sewage.

115. Speciation is the evolutionary process for the formation of new species. The species diversity occurs when gene flow within the common pool is interrupted by an isolating mechanism. The isolation can occur through geographical separation of population known as allopatric speciation.

116. Flagellated male gametes are present in *Riccia, Dryopteris* and *Cycas*.

117. Transcription factor is the molecular basis of organ differentiation.

118. Asthma is a respiratory disorder. It is caused by foreign allergens and dust particles present in the air. Sometimes the pollen grains also act as allergens and cause asthmatic attacks in certain seasons.

119. The genus *Physarum* with about 100 species is the largest and best-studied slime mould in Class Myxomycetes.

120. Constriction of blood vessels and contraction of skeletal muscles because of cold is an example of negative feedback mechanism of homeostasis.

121. The fungus *Claviceps purpurea* is responsible for Ergot disease of rye.

122. Geometric representation of age structure is a characteristic of population. In most-populations, individuals are of different ages. The proportion of individuals in each age group is called the age structure of the population.

123. Mature red blood cells lack cell organelles and a nucleus; hence, aerobic respiration does not take place.

124. Adrenaline is responsible for this action as it is known as the 3F hormone—fright, flight and fight hormone.

125. The cranial capacity of *Homo neanderthalensis* was about 1450 cc, roughly equal to that of modern man.

126. DNA in eukaryotic cells are accommodated by super-coiling in the form of nucleosomes. It consists of an octamer consisting of histone proteins and DNA.

127. Phytochrome occurs in leaves and is responsible for photoperiodic responses. When P_r absorbs red light (660–665nm), it is converted to the P_{fr} form and when P_{fr} absorbs far red light (730–735 nm), it is converted to the P_r form.

128. The mature follicle or Graafian follicle under the influence of hormone bursts and the ovum is released. After ovulation, the granulosa cells and the interstitial cells are transformed into the corpus luteum. It serves as a temporary endocrine gland by releasing progesterone and oestrogen.

129. Cell membrane is chemically made of lipoprotein (60%) and carbohydrates (2–10%). The lipids of cells membrane are of three types—phospholipids, glycolipids and sterols. Proline, on the other hand, is an amino acid which is not a constituent of the plasma membrane.

130. The concept of chemical evolution is based on the possible origin of life by the combination of chemicals under suitable environmental conditions. Urey and Miller through their experiment proved the existence of chemical evolution.

131. Hybrid vigour or heterosis is exploited by crossing of two inbred parental lines. The very objective of getting homozygous inbred parental lines is so that a perfect heterozygous can be formed.

132. In gymnosperms, there is a gap between pollination and fertilisation. Therefore, the pollen chamber is a cavity in the ovule in which pollen grains are stored after pollination.

133. The TATA box is present in the eukaryotic promoter region. 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 the TATA box because of which DNA assumes a saddle-like structure at this place.

134. In the prothallus of a vascular cryptogam, the antherozoids and eggs mature at different times. As a result, self-fertilisation is prevented.

135. Industrial melanism is a term used to describe the evolutionary process in which darker individuals came to predominate over lighter individuals because of the Industrial Revolution. This occurred as a result of natural selection in which a black 'melanic' form arose by a recurring random mutation, but its phenotypic appearance had a strong selective advantage in industrial areas.

136. Gibberellins (GA) were first isolated from the fungus *Gibberella fujikuroi*, the causal organism of foolish seedling disease of rice plants, by Kurasawa in Japan in 1926.

137. Differentiation of organs and tissues in a developing organism is associated with differential expression of genes. Differential expression of genes depends on several factors.

138. Pheophytin is the first acceptor in PSII. Later from phaeophytin, electrons are passed to plastoquinone. It functions as the first acceptor for excited electrons outside PSII.

139. Lysozyme is an enzyme which acts on bacterial cell walls and provides protection against bacterial invasion in the skin, mucous membranes and many body fluids. It is found in tears, sweat and saliva.

140. Transmission of a nerve impulse occurs through polarisation–repolarisation of the nerve fibre. At first, in the nerve fibre, the potential on the inner side of the plasma membrane has first negative charge. Later during the transmission, it becomes positive and finally again negative by repolarisation. The change occurs because of the Na^+/K^+ pump.

141. The Okazaki fragments are small fragments of DNA synthesised on the lagging strand. It shows that the DNA chain polymerises in the 5′–3′ direction.

142. Watson and Crick through their DNA model has shown that the two strands of DNA are antiparallel. One chain grows in 5′–3′ direction and the other chain grows in the 3′–5′ direction.

143. New Castle disease or Ranikhet disease is a very dangerous viral disease of poultry. It is a contagious disease affecting many domestic and wild avian species.

144. Inheritance of skin colour in humans is the result of polygenic inheritance. The inheritance of human skin colour was studied by C. B. Davenport in 1913. Three pairs of genes control the colour of human skin.

145. The one gene–one enzyme relationship was initially proposed by Beadle and Tatum and based on the experiments conducted on *Neurospora crassa*. They were awarded the Nobel Prize in 1958.

146. A genetically engineered microorganism called *Pseudomonas putida* is used in the bioremediation of oil spills. It is also known as super bug and was discovered by India-born American scientist Ananda Mohan Chakrabarty.

147. Specialised cell junctions occur at many points of cell–cell and cell–matrix contact in all tissues, but they are particularly important and plentiful in the epithelium.

148. Pearl is obtained from pearl oyster (*Pinctada vulgaris*), honey from *Apis indica*, lac from *Kenia lacca* and silk from *Bombyx mori*.

149. About 98% of the mass of every living organism is composed of just six elements, i.e. Carbon (C), Hydrogen (H), Nitrogen (N), Oxygen (O), Phosphorus (P) and Sulphur (S).

150. The law of independent assortment fails in the case of linkage. Hence, in the given cross, the parental combination will be more and recombinants will be very few.

151. Parrot (birds), platypus and kangaroo (both mammals) are homeothermic animals.

152. *Euphorbia*, *Asclepias* and *Copaifera* are some plants which accumulate hydrocarbons in the form of latex. These are even cultivated as petro-crops.

153. BOD depends on the organic matter present in the effluent. The ascending order of BOD in the given effluents is as follows:
Sugar mill effluent > Paper mill effluent > Distillery effluent > Sewage

154. Shedding off the lying of uterine endometrium is triggered when the production of progesterone and oestrogen hormone stops in blood. Hence, menstruation can be deferred by supply of oestrogen and progesterone.

155. Survival of the fittest is a result of selection and proliferation of only those organisms which were most suitably adapted to the environment and get selected by nature.

156. A group of organisms capable of interbreeding and producing fertile offspring is called species. A species is reproductively isolated from other such groups or organisms.

157. The steroid hormone receptor–protein complex activates the transcription of the target gene by binding to a specific DNA sequence.

158. Electrostatic precipitators are widely used in power plants to remove particulate matter.

159. A probiotic is a microbial preparation which helps to establish a population of beneficial microorganisms in the body in order to maintain health and has the potential to prevent disease.

160. Common examples of Class Basidiomycetes are smut, rusts and mushrooms.

161. Elaters are hygroscopic and help in the dispersal of spores by bursting the sporophyte.

162. A person who is on a long hunger strike and is surviving only on water will have more sodium in urine. The normal concentration of sodium in the blood plasma is 150 mEq/L. Excess water intake will cause excess urination. Because nutritional Na is absent on account of hunger, the amount of Na in the blood will decrease.

163. GA (Gibberelic acid) is a plant hormone, and it helps in cell growth of the stem, leaves and other aerial parts.

164. A common test to find the genotype of a hybrid is a test cross. Here, F_1 hybrids are crossed with the recessive parent. Phenotypic ratios of 1:1 confirm that the F_1 hybrid is heterozygous.

165. The nervous system of leech consists of the ventral central nervous system, peripheral nervous system and sympathetic nervous system.

166. Crocodile has a 4-chambered heart. Alternation of generations occurs in Obelia and it is known as metagenesis. Thecodont dentition is a characteristic feature of mammals.

167. Antibodies, also called immunoglobulins, constitute the gamma globulin part of blood proteins. These are secreted by activated B-cells or plasma cells.

168. Ca and P metabolism is controlled by the hormone parathormone secreted by the parathyroid gland.

169. Nereis lives in burrows, in sand or mud often with clams. Scorpions are abundant in deserts. Cockroaches are found in warm, damp places with plenty of organic food to devour. Silverfish are found in damp cold places, and they feed on starchy matter.

170. Darwin's finches of Galapagos Islands had common ancestors. Later on, their beaks modified according to their feeding habit. These provide evidence of geographical distribution.

171. The water moves from a lower diffusion pressure deficit to a higher diffusion pressure deficit.

172. Ca is an essential macronutrient for plant growth. It is a constituent of the middle lamella (in the form of calcium pectate), an activator of enzymes and catalyses many vital metabolic reactions.

173. Pollen grains in angiosperms are released at the 2-celled stage—generative cell and vegetative cell. The generative cell divides to form two male gametes.

174. The wall of the pollen mother cell (microspore mother cell) is surrounded by callose (β-1, 3-glucan).

175. Penicillin acts on the cell wall. Moreover, mycoplasma lacks a cell wall; hence, they are not sensitive to penicillin.

176. Stoneflies belong to Order Plecoptera of Class Insecta which has terrestrial mandibulates.

177. Thylakoid space is present only in chloroplasts. The inner space in mitochondria is known as matrix. Here, the inner membrane is folded to form cristae.

178. A species of organisms (water hyacinth and *Prosopis cineraria*) which is not native to a locality and has been moved there from its natural range by humans or other agents is called an exotic species.

179. Biogenetic law states that ontogeny (development of embryo) is the recapitulation of phylogeny (ancestral sequence).

180. Many olfactory glands (Bowman's glands) occur below the olfactory epithelium which secretes mucus over the epithelium to keep it moist.

181. Living organisms can be unexceptionally distinguished from non-living things on the basis of their ability of reproduction. All living things reproduce passing on traits from one generation to the next. Non-living things cannot reproduce.

182. Testis is degenerated in bullock because of which the testosterone level in blood is reduced. This hormone promotes the growth of many body tissues such as muscles. However, in bull, it is active, thereby adding greater musculature; bulls are not docile like bullocks.

183. Distantly related animals (whale, seal and shark) inhabiting similar habitats often develop similar morphological features which make them look similar. This is termed adaptive convergence or convergent evolution.

184. Succinate dehydrogenase is a membrane-bound enzyme. It is present on the inner membrane of the mitochondria and catalyses the oxidation of succinate to fumarate.

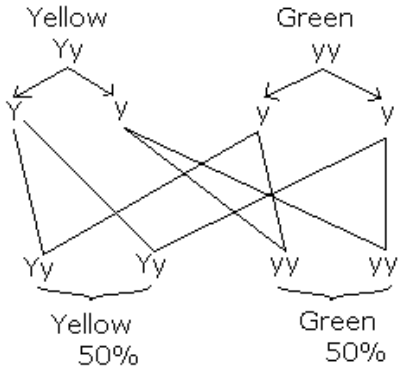
185. A nerve cell consists of cell body (perikaryon) containing the nucleus, Nissl granules, dendrites and an axon. These are specialised cells meant for the transmission of the nerve.

186. In sonography (ultrasound imaging), inaudible high frequency of sound waves in the range of 1–5 MHz are used.

187. Biological organisation starts at the sub-microscopic molecular level. Different elements combine to form four basic types of molecules—carbohydrates, lipids, proteins and nucleic acids. Later these are organised into organelles of the cell.

188. *Coliforms* are aerobic or facultative anaerobic gram negative, non-endospore forming rod-shaped bacteria which ferment lactose to form gas.

189. It is a test cross in which F1 hybrids are crossed with recessive parents forming genotypic and phenotypic ratio of 1:1.



190. Adaptive radiation is the development of different functional structures from a common ancestral form.

191. For a normal distribution, the mean, median and mode are actually equivalent.

192. When two species of different genealogy come to resemble each other as a result of adaptation, the phenomenon is termed convergent evolution. Here, lineages show similar morphology under the influence of similar environmental factors.

193. The disease xerophthalmia is caused by deficiency of vitamin-A (retinol).

194. ICBN = International Code of Botanical Nomenclature

195. Types of pigments present in the cell of algae are the most important character for classification. In fact, 11 algal divisions are recognised on the basis of their pigmentation.

196. Magnesium is an important constituent of the chlorophyll molecule.

197. Glycolysis, Krebs cycle and the electron transport system are part of aerobic respiration. The objective of respiration is the step-wise oxidation of food to form ATP.

198. A high density of elephant population in an area can result in intraspecific competition. Intraspecific competition occurs between the members of the same population. It is an important density dependent factor regulating populations.

199. Serum (plasma-clotting proteins) will not coagulate.

200. Secondary growth is characteristic of dicot stem and root. It occurs because of the activity of secondary tissues such as vascular cambium and cork cambium.

AIPMT - 2008
(Physics, Chemistry and Biology)
Prelims

Time: 3 hrs **Total Marks: 600**

General Instructions:

1. The Answer sheet is inside this Text booklet. When you are directed to open the text booklet, take out the Answer Sheet and fill in the particulars on side – 1 and side – 2 carefully with blue/black ball point pen only.
2. The test is of 3 hours duration and consists of 200 questions. Each question carries 3 marks. For each correct response the candidate will get 3 marks. For each incorrect response, one mark will be deducted. The maximum marks are 600.
3. Use Blue / Black ball point pen only for writing particulars on this page / marking responses.
4. Rough work is to be done on the space provided for this purpose in the text booklet only.
5. On completion of the test, the candidate must handover the answer sheet to the invigilator in the room/ Hall. The candidates are allowed to take away this text booklet with them.
6. Make sure that the CODE printed on side – 2 of the answer sheet is the same as that on this booklet, In case of discrepancy, the candidate should immediately report the matter to the invigilator for the replacement of both the test Booklet and the Answer Sheet.
7. The candidates should ensure that the Answer sheet is not folded. Do not make any stray marks on the Answer sheet. Do not write your roll no. anywhere else except in the specified space in the Test booklet / Answer Sheet.
8. Use of white fluid for correction is not permissible on the Answer Sheet.

Physics

1. If the lattice parameter for a crystalline structure is 3.6 Å, then the atomic radius of fcc crystal is
(1) 1.81 Å
(2) 2.10 Å
(3) 2.92 Å
(4) 1.27 Å

2. If the error in the measurement of radius of a sphere is 2%, then the error in the determination of volume of the sphere will be
(1) 4%
(2) 6%
(3) 8%
(4) 2%

3. The electric potential at a point in free space due to a charge Q coulomb is $Q \times 10^{11}$ V. The electric field at that point is
(1) $4\pi\varepsilon_0 Q \times 10^{22}$ V/m
(2) $12\pi\varepsilon_0 Q \times 10^{20}$ V/m
(3) $4\pi\varepsilon_0 Q \times 10^{20}$ V/m
(4) $12\pi\varepsilon_0 Q \times 10^{22}$ V/m

4. The voltage gain of an amplifier with 9% negative feedback is 10. The voltage gain without feedback will be
(1) 90
(2) 10
(3) 1.25
(4) 100

5. The energy required to charge a parallel plate condenser of plate separation d and plate area of cross-section A such that the uniform electric field between the plates is E, is
(1) $\frac{\frac{1}{2}\varepsilon_0 E^2}{Ad}$
(2) $\frac{\varepsilon_0 E^2}{Ad}$
(3) $\varepsilon_0 E^2 Ad$
(4) $\frac{1}{2}\varepsilon_0 E^2 Ad$

6. A roller coaster is designed such that riders experience "weightlessness" as they go round the top of a hill whose radius of curvature is 20 m. The speed of the car at the top of the hill is between
(1) 14 m/s and 15 m/s
(2) 15 m/s and 16 m/s
(3) 16 m/s and 17 m/s
(4) 13 m/s and 14 m/s

7. The ratio of the radii of gyration of a circular disc to that of a circular ring, each of same mass and radius, around their respective axes is

(1) $\sqrt{3}:\sqrt{2}$

(2) $1:\sqrt{2}$

(3) $\sqrt{2}:1$

(4) $\sqrt{2}:\sqrt{3}$

8. The work function of a surface of a photosensitive material is 6.2 eV. The wavelength of the incident radiation for which the stopping potential is 5 V lies in the

(1) ultraviolet region

(2) visible region

(3) infrared region

(4) X-ray region

9. The ground state energy of hydrogen atom is -13.6 eV. When its electron is in the first excited state, its excitation energy is

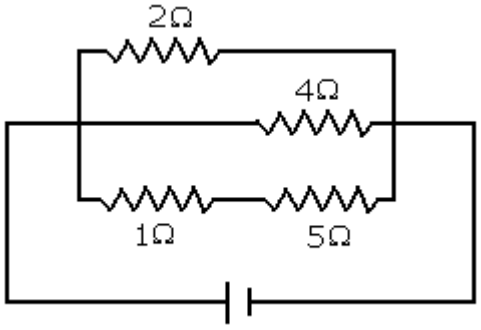
(1) 3.4 eV

(2) 6.8 eV

(3) 10.2 eV

(4) zero

10. A current of 3 A flows through the 2 Ω resistor shown in the circuit. The power dissipated in the 5 Ω resistor is



(1) 4 W

(2) 2 W

(3) 1 W

(4) 5 W

11. A p-n photodiode is made of a material with a band gap of 2.0 eV. The minimum frequency of the radiation that can be absorbed by the material is nearly
(1) 10×10^{14} Hz
(2) 5×10^{14} Hz
(3) 1×10^{14} Hz
(4) 20×10^{14} Hz

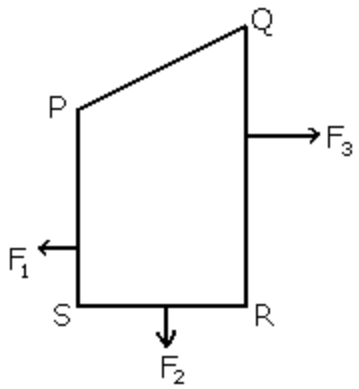
12. Water falls from a height of 60 m at the rate of 15 kg/s to operate a turbine. The loss due to frictional forces are 10% of energy. How much power is generated by the turbine? ($g = 10\ m/s^2$)
(1) 8.1 kW
(2) 10.2 kW
(3) 12.3 kW
(4) 7.0 kW

13. On a new scale of temperature (which is linear) and called the W scale, the freezing and boiling points of water are 39°W and 239°W respectively. What will be the temperature on the new scale, corresponding to a temperature of 39°C on the Celsius scale?
(1) 78°W
(2) 117°W
(3) 200°W
(4) 139°W

14. If Q, E and W denote respectively the heat added, change in internal energy and the work done in a closed cyclic process, then
(1) W = 0
(2) Q = W = 0
(3) E = 0
(4) Q = 0

15. Two simple harmonic motions of angular frequency 100 and 1000 rad s^{-1} have the same displacement and amplitude. The ratio of their maximum acceleration is
(1) 1 : 10
(2) $1 : 10^2$
(3) $1 : 10^3$
(4) $1 : 10^4$

16. A closed loop PQRS carrying a current is placed in a uniform magnetic field. If the magnetic forces on segments PS, SR and RQ are F_1, F_2 and F_3 respectively and are in the plane of the paper and along the directions shown, the force on the segment QP is



(1) $F_3 - F_1 - F_2$

(2) $\sqrt{(F_3 - F_1)^2 + F_2^2}$

(3) $\sqrt{(F_3 - F_1)^2 - F_2^2}$

(4) $F_3 - F_1 + F_2$

17. Two radioactive materials X_1 and X_2 have decay constants 5λ and λ respectively. If initially they have the same number of nuclei, then the ratio of the number of nuclei of X_1 to that of X_2 will be $1/e$ after a time

(1) λ

(2) $\frac{1}{2}\lambda$

(3) $\frac{1}{4\lambda}$

(4) $\frac{e}{\lambda}$

18. Two thin lenses of focal lengths f_1 and f_2 are in contact and coaxial. The power of the combination is

(1) $\sqrt{\frac{f_1}{f_2}}$

(2) $\sqrt{\frac{f_2}{f_1}}$

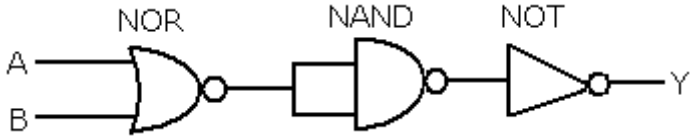
(3) $\frac{f_1 f_2}{f_1 + f_2}$

(4) $\frac{f_1 + f_2}{f_1 f_2}$

19. The distance traveled by a particle starting from rest and moving with acceleration $\frac{4}{3}ms^{-2}$, in the third second is

(1) 6 m
(2) 4 m
(3) $\frac{10}{3}$ m
(4) $\frac{19}{3}$m

20. The circuit is equivalent to



(1) AND gate
(2) NAND gate
(3) NOR gate
(4) OR gate

21. A particle of mass m, charge Q and kinetic energy T enters a transverse uniform magnetic field of induction $\vec{B}$. After 3 s the kinetic energy of the particle will be

(1) 3T
(2) 2T
(3) T
(4) 4T

22. A wire of a certain material is stretched slowly by ten per cent. Its new resistance and specific resistance become respectively

(1) 1.2 times, 1.1 times
(2) 1.21 times, same
(3) both remain the same
(4) 1.1 times, 1.1 times

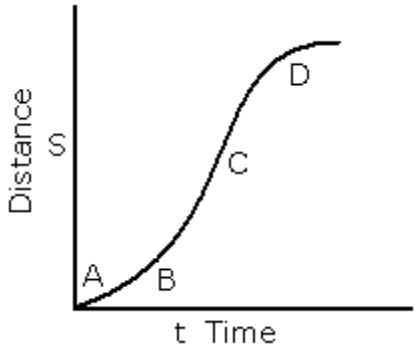
23. An electric kettle takes 4 A current at 220 V. How much time will it take to boil 1 kg of water from temperature 20°C? The temperature of boiling water is 100°C

(1) 6.3 min
(2) 8.4 min
(3) 12.6 min
(4) 4.2 min

24. In the phenomenon of electric discharge through gases at low pressure, the coloured glow in the tube appears as a result of
(1) excitation of electrons in the atoms
(2) collision between the atoms of the gas
(3) collision between the charged particles emitted from the cathode and the atoms of the gas
(4) collision between different electrons of the atoms of the gas

25. A particle of mass 1 mg has the same wavelength as an electron moving with a velocity of 3×10^6 ms^{-1}. The velocity of the particle is
(1) 2.7×10^{-18} ms^{-1}
(2) 9×10^{-2} ms^{-1}
(3) 3×10^{-31} ms^{-1}
(4) 2.7×10^{-21} ms^{-1}
(Mass of electron = 9.1×10^{-31} kg)

26. A particle shows distance-time curve as given in this figure. The maximum instantaneous velocity of the particle is around the point



(1) B
(2) C
(3) D
(4) A

27. A cell can be balanced against 110 cm and 100 cm of potentiometer wire, respectively with and without being short circuited through a resistance of 10Ω. Its internal resistance is
(1) 1.0 Ω
(2) 0.5 Ω
(3) 2.0 Ω
(4) zero

28. If M (A, Z), M_p and M_n denote the masses of the nucleus ${}^{A}_{Z}X$, proton and neutron respectively in units of u (1 u = 931.5 MeV/c^2) and BE represent its binding energy in MeV, then

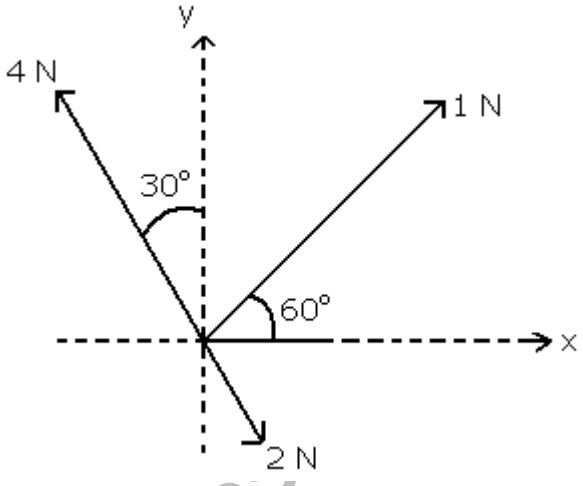
(4) $M(A, Z) = ZM_p + (A - Z)M_n - BE/c^2$

(5) $M(A, Z) = ZM_p + (A - Z)M_n + BE$

(6) $M(A, Z) = ZM_p + (A - Z)M_n - BE$

(7) $M(A, Z) = ZM_p + (A - Z)M_n + BE/c^2$

29. Three forces acting on a body are shown in the figure. To have the resultant force only along the y-direction, the magnitude of the minimum additional force needed is



(1) 0.5 N

(2) 1.5 N

(3) $\frac{\sqrt{3}}{4}$ N

(4) $\sqrt{3}$ N

30. Two periodic waves of intensities I_1 and I_2 pass through a region at the same time in the same direction. The sum of the maximum and minimum intensities is

(1) $I_1 + I_2$

(2) $(\sqrt{I_1} + \sqrt{I_2})^2$

(3) $(\sqrt{I_1} - \sqrt{I_2})^2$

(4) $2(I_1 + I_2)$

31. A shell of mass 200 g is ejected from a gun of mass 4 kg by an explosion that generates 1.05 kJ of energy. The initial velocity of the shell is

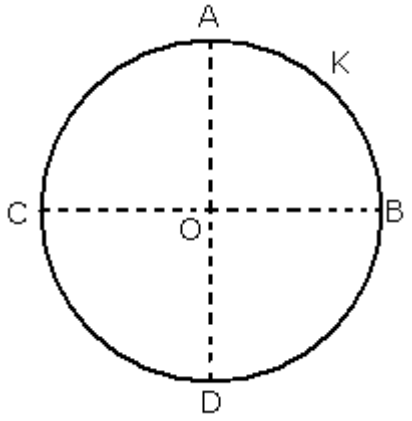
(1) $100ms^{-1}$

(2) $80ms^{-1}$

(3) $40ms^{-1}$

(4) $120ms^{-1}$

32. A thin conducting ring of radius R is given a charge +Q. The electric field at the centre O of the ring due to the charge on the part AKB of the ring is E. The electric field at the centre due to the charge on the part ACDB of the ring is



(1) 3E along KO

(2) E along OK

(3) E along KO

(4) 3E along OK

33. The velocity of electromagnetic radiation in a medium of permittivity ε_0 and permeability μ_0 is given by

(1) $\sqrt{\frac{\varepsilon_0}{\mu_0}}$

(2) $\sqrt{\mu_0\varepsilon_0}$

(3) $\frac{1}{\sqrt{\mu_0\varepsilon_0}}$

(4) $\sqrt{\frac{\mu_0}{\varepsilon_0}}$

34. A point performs simple harmonic oscillation of period T and the equation of motion is given by $x = a \sin(\omega t + \pi/6)$. After the elapse of what fraction of the time period the velocity of the point will be equal to half of its maximum velocity?

(1) $\frac{T}{8}$

(2) $\frac{T}{6}$

(3) $\frac{T}{3}$

(4) $\frac{T}{14}$

35. A long solenoid has 500 turns. When a current of 2 A is passed through it, the resulting magnetic flux linked with each turn of the solenoid is 4×10^{-3} Wb. The self-inductance of the solenoid is

(1) 2.5 H

(2) 2.0 H

(3) 1.0 H

(4) 4.0 H

36. A boy is trying to start a fire by focusing sunlight on a piece of paper using an equiconvex lens of focal length 10 cm. The diameter of the sun is 1.39×10^9 m. What is the diameter of the sun's image on the paper?

(1) 9.2×10^{-4} m

(2) 6.5×10^{-4} m

(3) 6.5×10^{-5} m

(4) 12.4×10^{-4} m

37. In an AC circuit the emf (e) and the current (i) at any instant are given respectively by $E = E_0 \sin \omega t$ and $I = I_0 \sin(\omega t - \phi)$

The average power in the circuit over one cycle of AC is

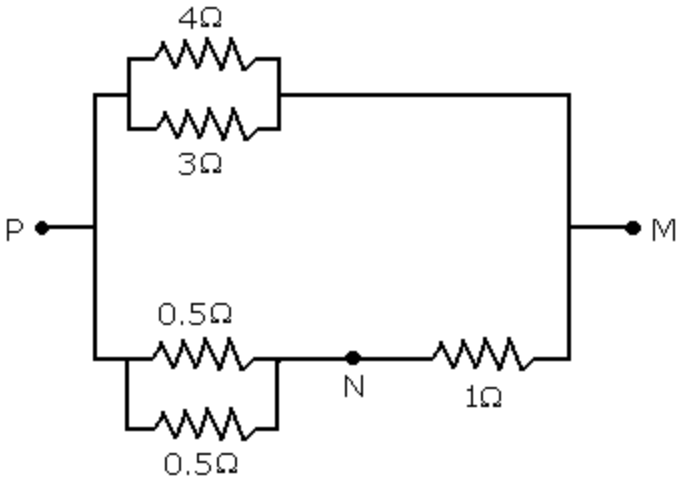
(1) $\frac{E_0 I_0}{2}$

(2) $\frac{E_0 I_0}{2} \sin\phi$

(3) $\frac{E_0 I_0}{2} \cos\phi$

(4) $E_0 I_0$

38. In the circuit shown, the current through the 4 Ω resistor is 1 A when the points P and M are connected to a DC voltage source. The potential difference between the points M and N is



(1) 1.5 V
(2) 1.0 V
(3) 0.5 V
(4) 3.2 V

39. A particle moves in a straight line with a constant acceleration. It changes its velocity from 10 ms^{-1} to 20 ms^{-1} while passing through a distance 135 m in t second. The value of t is
(1) 10
(2) 1.8
(3) 12
(4) 9

40. A thin rod of length L and mass M is bent at its midpoint into two halves so that the angle between them is 90°. The moment of inertia of the bent rod about an axis passing through the bending point and perpendicular to the plane defined by the two halves of the rod is

(1) $\frac{ML^2}{24}$

(2) $\frac{ML^2}{12}$

(3) $\frac{ML^2}{6}$

(4) $\frac{\sqrt{2}ML^2}{24}$

41. A circular disc of radius 0.2 m is placed in a uniform magnetic field of induction $\frac{1}{\pi}\left(\frac{Wb}{m^2}\right)$ in such a way that its axis makes an angle of 60° with $\vec{B}$. The magnetic flux linked with the disc is
(1) 0.02 Wb
(2) 0.06 Wb
(3) 0.08 Wb
(4) 0.01 Wb

42. A particle of mass m is projected with velocity v making an angle of 45° with the horizontal. When the particle lands on the level ground the magnitude of the change in its momentum will be
(1) 2 mv
(2) $\frac{mv}{\sqrt{2}}$
(3) $\sqrt{2}mv$
(4) zero

43. Two points are located at a distance of 10 m and 15 m from the source of oscillation. The period of oscillation is 0.05s and the velocity of the wave is 300 m/s. What is the phase difference between the oscillations of two points?
(1) $\frac{\pi}{3}$
(2) $\frac{2\pi}{3}$
(3) π
(4) $\frac{\pi}{6}$

44. Two nuclei have their mass numbers in the ratio of 1 : 3. The ratio of the nuclear densities would be
(1) 1 : 3
(2) 3 : 1
(3) 1/3 : 1
(4) 1 : 1

45. Sand is being dropped on a conveyor belt at the rate of M kg/s. The force necessary to keep the belt moving with a constant velocity of v m/s will be
(1) Mv newton
(2) 2 Mv newton
(3) $\frac{Mv}{2}$ newton
(4) zero

46. The wave described by y = 0.25 sin (10πx – 2πt), where x and y are in metre and t in seconds, is a wave traveling along the
(8) –ve x direction with frequency 1 Hz
(9) +ve x direction with frequency π Hz and wavelength λ = 0.2 m
(10) +ve x direction with frequency 1 Hz and wavelength λ = 0.2 m
(11) –ve x direction with amplitude 0.25 m and wavelength λ = 0.2 m

47. Curie temperature is the temperature above which
(12) ferromagnetic material becomes paramagnetic material
(13) paramagnetic material becomes diamagnetic material
(14) paramagnetic material becomes ferromagnetic material
(15) ferromagnetic material becomes diamagnetic material

48. At 10 °C the value of the density of a fixed mass of an ideal gas divided by its pressure is x. At 110 °C this ratio is
(1) x
(2) $\frac{383}{283}$ x
(3) $\frac{10}{110}$ x
(4) $\frac{283}{383}$ x

49. Which two of the following five physical parameters have the same dimensions?
(A) energy density
(B) refractive index
(C) dielectric constant
(D) Young's modulus
(E) magnetic field

(1) B and D
(2) C and E
(3) A and D
(4) A and E

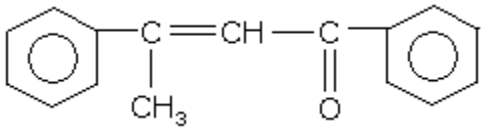
50. A galvanometer of resistance 50 Ω is connected to a battery of 3 V along with a resistance of 2950 Ω in series. A full scale deflection of 30 divisions is obtained in the galvanometer. In order to reduce this deflection to 20 divisions, the resistance in series should be

(1) 5050 Ω
(2) 5550 Ω
(3) 6050 Ω
(4) 4450 Ω

Chemistry

51. Equal volumes of three acid solutions of pH 3, 4 and 5 are mixed in a vessel. What will be the H^+ ion concentration in the mixture?
(1) 1.11×10^{-4} M
(2) 3.7×10^{-4} M
(3) 3.7×10^{-3} M
(4) 1.11×10^{-3} M

52. Acetophenone when reacted with a base, C_2H_5ONa, yields a stable compound which has the structure
(1)



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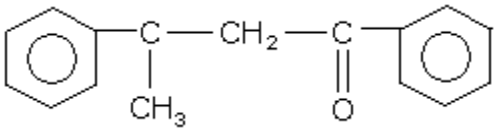

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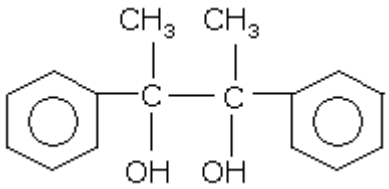

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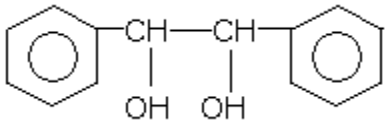


53. The angular shape of ozone molecule (O_3) consists of
(1) 1 sigma and 2 pi bonds
(2) 2 sigma and 2 pi bonds
(3) 1 sigma and 11 pi bonds
(4) 2 sigma and 1 pi bonds

54. On the basis of the following E° values, the strongest oxidizing agent is
$[Fe(CN)_6]^{4-} \rightarrow [Fe(CN)_6]^{3-} + e^-$; E° = – 0.35 V
$Fe^{2+} \rightarrow Fe^{3+} + e^-$; E° = – 0.77 V

(1) $[Fe(CN)_6]^{4-}$
(2) Fe^{2+}
(3) Fe^{3+}
(4) $[Fe(CN)_6]^{3-}$

55. Green chemistry means such reactions which
(1) produce colour during reactions
(2) reduce the use and production of hazardous chemicals
(3) are related to the depletion of ozone layer
(4) study the reactions in plants

56. Which of the following are not state functions?
(I) q +W (II) q (III) W (IV) H — TS

(1) (I) and (IV)
(2) (II), (III) and (IV)
(3) (II) and (III)
(4) (I),(II) and (III)

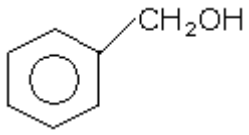
57. If uncertainty in position and momentum are equal, then uncertainty in velocity is
(1) $\frac{1}{2m}\sqrt{\frac{h}{\pi}}$
(2) $\sqrt{\frac{h}{2\pi}}$
(3) $\frac{1}{m}\sqrt{\frac{h}{\pi}}$
(4) $\sqrt{\frac{h}{\pi}}$

58. The correct order of decreasing second ionization enthalpy of Ti(22), V (23), Cr (24) and Mn(25) is
(1) Cr > Mn > V > Ti
(2) V > Mn > Cr > Ti
(3) Mn > Cr > Ti > V
(4) Ti > V > Cr > Mn

59. The relative reactivities of acyl compounds towards nucleophilic substitution are in the order of
(1) Acyl chloride > Acid anhydride > Ester > amide
(2) Ester > Acyl chloride > Amide > Acid anhydride
(3) Acid anhydride > Amide > Ester > Acyl chloride
(4) Acyl chloride > Ester > Acid anhydride > Amide

60. Kohlrausch's law states that at
(1) finite dilution, each ion makes definite contribution to equivalent conductance of an electrolyte, whatever be the nature of the other ion of the electrolyte.
(2) infinite dilution, each ion makes definite contribution to equivalent conductance of an electrolyte depending on the nature of the other ion of the electrolyte.
(3) infinite dilution, each ion makes definite contribution to conductance of an electrolyte whatever be the nature of the other ion of the electrolyte.
(4) infinite dilution, each ion makes definite contribution to equivalent conductance of an electrolyte, whatever be the nature of the other ion of the electrolyte.

61. Which one of the following is most reactive towards electrophilic attack?
(1)



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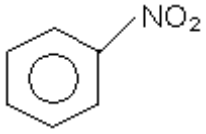

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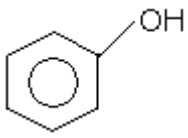

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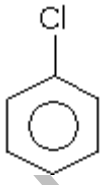


62. Volume occupied by one molecule of water (density = 1g cm^{-3}) is
(1) 9.0×10^{-23} cm^3
(2) 6.023×10^{-23} cm^3
(3) 3.0×10^{-23} cm^3
(4) 5.5×10^{-23} cm^3

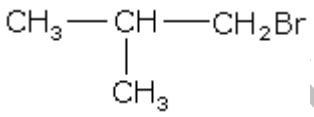
63. Which of the following complexes exhibit the highest paramagnetic behaviour?
Where gly = glycine, en = ethylenediamine and bpy = bipyridyl moieties
(At no : Ti = 22, V = 23, Fe = 26, Co = 27)
(1) $[V(gly)_2 (OH)_2(NH_3)_2]^+$

(2) $[Fe\ (en)\ (bpy)(NH_3)_2]^{2+}$
(3) $[Co(OX)_2(OH)_2]^-$
(4) $[Ti(NH_3)_6]^{3+}$

64. If a gas expands at constant temperature, it indicates that
(1) kinetic energy of molecules decreases
(2) pressure of the gas increases
(3) kinetic energy of molecules remains the same
(4) number of the molecules of gas increases

65. For the gas phase reaction
$PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$
Which of the following conditions are correct?
(1) $\Delta H = 0$ and $\Delta S < 0$
(2) $\Delta H > 0$ and $\Delta S > 0$
(3) $\Delta H < 0$ and $\Delta S < 0$
(4) $\Delta H > 0$ and $\Delta S < 0$

66. In a S_N2 substitution reaction of the type $R—Br + Cl^- \xrightarrow{DMF} R—Cl + Br^-$,
Which one of the following has the highest relative rate?
(1) $CH_3—CH_2—CH_2Br$
(2)



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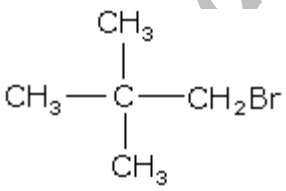


(4) CH_3CH_2Br

67. Number of moles of MnO_4^- required to oxidize one mole of ferrous oxalate completely in acidic medium will be
(1) 0.6 mole
(2) 0.4 mole
(3) 7.5 mole
(4) 0.2 mole

68. If the concentration of OH^- ions in the reaction

$Fe(OH)_{3(s)} \rightleftharpoons Fe^{3+}_{(aq)} + 3OH^-_{(aq)}$ is decreased by $\frac{1}{4}$ times, then equilibrium concentration of Fe^{3+} will increase by

(1) 8 times
(2) 16 times
(3) 64 times
(4) 4 times

69. The sequence of ionic mobility in aqueous solution is

(1) $K^+ > Na^+ > Rb^+ > Cs^+$
(2) $Cs^+ > Rb^+ > K^+ > Na^+$
(3) $Rb^+ > K^+ > Cs^+ > Na^+$
(4) $Na^+ > K^+ > Rb^+ > Cs^+$

70. The alkali metals form salt-like hydrides by the direct synthesis at elevated temperature. The thermal stability of these hydrides decreases in which of the following orders?

(1) CsH > RbH > KH > NaH > LiH
(2) KH > NaH > LiH > CsH > RbH
(3) NaH > LiH > KH > RbH > CsH
(4) LiH > NaH > KH > RbH > CsH

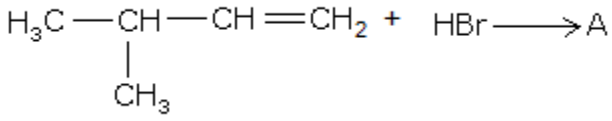
71. Which one of the following arrangements does not give the correct picture of the trends indicated against it?

(1) $F_2 > Cl_2 > Br_2 > I_2$: oxidizing power
(2) $F_2 > Cl_2 > Br_2 > I_2$: Electron gain enthalpy
(3) $F_2 > Cl_2 > Br_2 > I_2$: Bond dissociation energy
(4) $F_2 > Cl_2 > Br_2 > I_2$: Electronegativity

72. Standard free energies of formation (in kJ/mol) at 298 K are -237.2, -394.4 and -8.2 for $H_2O_{(l)}$, $CO_{2\ (g)}$ and pentane$_{(g)}$, respectively. The value of E^0_{cell} for the pentane-oxygen fuel cell is

(1) 1.968 V
(2) 2.0968 V
(3) 1.0968 V
(4) 0.0968 V

73. A (Predominantly) is



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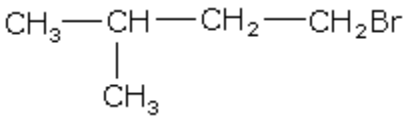

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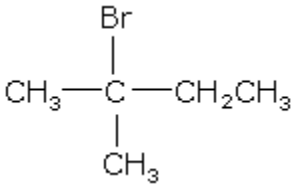

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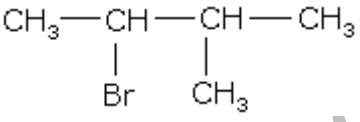

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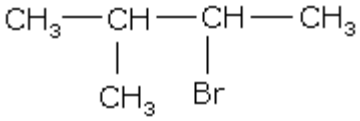


74. Base strength of

(A) $H_3C\bar{C}H_2$ (B) $H_2C=\bar{C}H$ and (C) $H-C\equiv\bar{C}$ is in the order of

(1) (B) > (A) > (C)
(2) (C) > (B) > (A)
(3) (A) > (C) > (B)
(4) (A) > (B) > (C)

75. Which of the following statements is not correct?

(1) The fraction of the total volume occupied by the atoms in a primitive cell is 0.48
(2) Molecular solids are generally volatile
(3) The number of carbon atoms in an unit cell of diamond is 4
(4) The number of Bravais lattices in which a crystal can be categorized is 14

76. If 'a' stands for the edge length of the cubic systems: simple cubic, body centered cubic and face centered cubic, then the ratio of radii of the spheres in these systems will be respectively,

(1) $\frac{1}{2}a : \frac{\sqrt{3}}{4}a : \frac{1}{2\sqrt{2}}a$

(2) (2) $\frac{1}{2}a : \sqrt{3}a : \frac{1}{\sqrt{2}}a$

(3) $\frac{1}{2}a : \frac{\sqrt{3}}{2}a : \frac{\sqrt{2}}{2}a$

(4) $1a : \sqrt{3}a : \sqrt{2}a$

77. The rate constants k_1 and k_2 for two different reactions are $10^{16} \times e^{-2000/T}$ and $10^{15} \times e^{-1000/T}$, respectively. The temperature at which $k_1 = k_2$ is

(1) 1000 K

(2) $\frac{2000}{2.303}$ K

(3) 2000 K

(4) $\frac{1000}{2.303}$ K

78. What volume of oxygen gas (O_2) measured at 0°C and 1 atm, is needed to burn completely 1 L of propane gas (C_3H_8) measured under the same conditions?

(1) 7 L

(2) 6 L

(3) 5 L

(4) 10 L

79. The correct order of increasing bond angles in the following triatomic species is

(1) $NO_2^- < NO_2^+ < NO_2$

(2) $NO_2^- < NO_2 < NO_2^+$

(3) $NO_2^+ < NO_2 < NO_2^-$

(4) $NO_2^+ < NO_2^- < NO_2$

80. How many stereoisomers does this molecule have?

$CH_3CH = CHCH_2\overset{*}{C}HBrCH_3$

(1) 4

(2) 6

(3) 8

(4) 2

81. Equimolar solutions of the following were prepared in water separately. Which one of the solutions will record the highest pH?
(1) $SrCl_2$
(2) $BaCl_2$
(3) $MgCl_2$
(4) $CaCl_2$

82. Four diatomic species are listed below in different sequences. Which of these presents the correct order of their increasing bond order?
(1) $O_2^- < NO < C_2^{2-} < He_2^+$
(2) $NO < C_2^{2-} < O_2^- < He_2^+$
(3) $C_2^{2-} < He_2^+ < NO < O_2^-$
(4) $He_2^+ < O_2^- < NO < C_2^{2-}$

83. Percentage of free space in a body centered cubic unit cell is
(1) 30%
(2) 32%
(3) 34%
(4) 28%

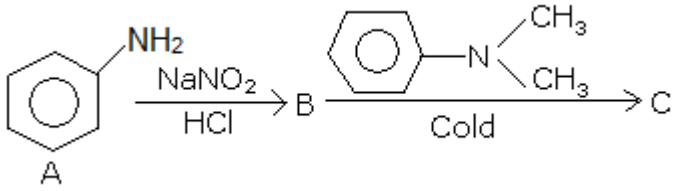
84. With which one of the following element silicon should be doped so as to give p-type of semiconductor?
(1) Germanium
(2) Arsenic
(3) Selenium
(4) Boron

85. An organic compound contains carbon, hydrogen and oxygen. Its elemental analysis gave C, 38.71% and H, 9.67%. The empirical formula of the compound would be
(1) CH_3O
(2) CH_2O
(3) CHO
(4) CH_4O

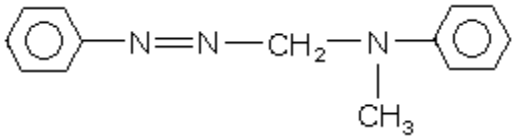
86. The measurement of the electron position is associated with an uncertainty in momentum, which is equal to 1×10^{-18} g cm s^{-1}. The uncertainty in electron velocity is,(mass of an electron is 9×10^{-28}g)
(1) 1×10^9 cm s^{-1}
(2) 1×10^6 cm s^{-1}
(3) 1×10^5 cm s^{-1}
(4) 1×10^{11} cm s^{-1}

87. How many moles of lead (II) chloride will be formed from a reaction between 6.5 g of PbO and 3.2 g of HCl?
(1) 0.044
(2) 0.333
(3) 0.011
(4) 0.029

88. In a reaction of aniline a colored product C was obtained.



The structure of C would be
(1)



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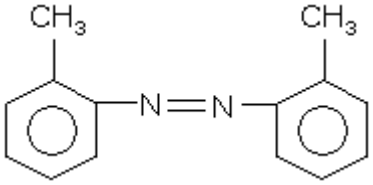

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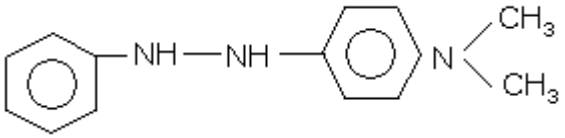
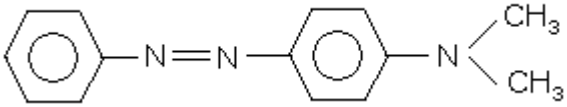


(4)

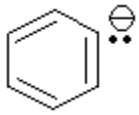


89. A strong base can abstract an α-hydrogen from
(1) alkene
(2) amine
(3) ketone
(4) alkane

90. The stability of carbanions in the following

(i) $RC \equiv \overset{\Theta}{C}$

(ii)



(iii) $R_2C = \overset{\Theta}{C}H$

(iv) $R_3C - \overset{\Theta}{C}H_2$

(1) (i) > (ii) > (iii) > (iv)
(2) (ii) > (iii) > (iv) > (i)
(3) (iv) > (ii) > (iii) > (i)
(4) (i) > (iii) > (ii) > (iv)

91. Bond dissociation enthalpy of H_2, Cl_2 and HCl are 434, 242, and 431 kJ mol^{-1} respectively. Enthalpy of formation of HCl is
(1) 93 kJ mol^{-1}
(2) -245 kJ mol^{-1}
(3) -93 kJ mol^{-1}
(4) 245 kJ mol^{-1}

92. 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
(1) $(2K_p/p)$
(2) $(2K_p/p^2)^{1/3}$
(3) $(2K_p/p)^{1/2}$
(4) (K_p/p)

93. Which one of the following is an amine hormone?
(1) Thyroxine
(2) Oxypurin
(3) Insulin
(4) Progesterone

94. Which one of the following statements is not true?
(1) In vulcanization, the formation of sulphur bridges between different chains makes rubber harder and stronger
(2) Natural rubber has the trans-configuration at every double bond
(3) Buna-S is a copolymer of butadiene and styrene
(4) Natural rubber is a 1,4-polymer of isoprene

95. In the hydrocarbon

$$\underset{6}{CH_3}-\underset{5}{CH}=\underset{4}{CH}-\underset{3}{CH_2}-\underset{2}{C}\equiv\underset{1}{CH}$$

The state of hybridization of carbons 1, 3 and 5 are in the following sequence
(1) sp^2, sp, sp^3
(2) sp, sp^3, sp^2
(3) sp, sp^2, sp^3
(4) sp^3, sp^2, sp

96. The values of K_{p_1} and K_{p_2} for the reactions

$X \rightleftharpoons Y+Z$ ....(i)

and $A \rightleftharpoons 2B$ ....(ii)

are in ratio of 9 : 1. If degree of dissociation of X and A be equal, then total pressure at equilibrium (i) and (ii) are in the ratio
(1) 3 : 1
(2) 1 : 9
(3) 36 : 1
(4) 1 : 1

97. In DNA, the complimentary bases are
(1) Adenine and thymine; guanine and cytosine
(2) Adenine and thymine; guanine and uracil
(3) Adenine and guanine, thymine and cytosine
(4) Uracil and adenine; cytosine and guanine

98. The bromination of acetone that occurs in acid solution is represented by this equation.

$CH_3COCH_{3(aq)} + Br_{2(aq)} \rightarrow CH_3COCH_2\,Br_{(aq)} + H^+_{(aq)} + Br^-_{(aq)}$

These kinetic data were obtained for given reaction concentrations.

Initial concentrations, M		
$[CH_3COCH_3]$	$[Br_2]$	$[H^+]$
0.30	0.05	0.05
0.30	0.10	0.05
0.30	0.10	0.10

0.40	0.05	0.20

Initial rate, disappearance of Br_2, Ms^{-1}

5.7×10^{-5}

5.7×10^{-5}

1.2×10^{-4}

3.1×10^{-4}

Based on these data, the rate equation is

(1) Rate = k $[CH_3COCH_3][H^+]$

(2) Rate = k $[CH{=}COCH_3][Br_2]$

(3) Rate = k $[CH_3COCH_3][Br_2][H^+]^2$

(4) Rate = k $[CH_3COCH_3][Br_2][H^+]$

99. The value of equilibrium constant of the reaction $HI_{(g)} \rightleftharpoons \frac{1}{2}H_{2(g)} + \frac{1}{2}I_{2(g)}$ is 8.0 the equilibrium constant of the reaction

$H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$ will be

(1) $\frac{1}{16}$

(2) $\frac{1}{64}$

(3) 16

(4) $\frac{1}{8}$

100. In which of the following coordination entities the magnitude of Δ_0 (CFSE in octahedral field) will be maximum?

(Atomic number Cu = 27)

(1) $[Co(H_2O_6)]^{3+}$

(2) $[Co(NH_3)_6]^{3+}$

(3) $[Co(CN)_6]^{3-}$

(4) $[Co(C_2O_4)]^{3-}$

Biology

101. Keeping in view the 'fluid mosaic model' for the structure of cell membrane, which one of the following statements is correct with respect to the movement of lipids and proteins from one lipid monolayer to the other (described as flip-flop movement)?
(1) Both lipids and proteins can flip-flop
(2) While lipids can rarely flip-flop, proteins cannot
(3) While proteins can flip-flop, lipids cannot
(4) Neither lipids, nor proteins can flip-flop

102. Which one of the following pairs of plant structures has haploid number of chromosomes?
(1) Megaspore mother cell and antipodal cells
(2) Egg cell and antipodal cells
(3) Nucellus and antipodal cells
(4) Egg nucleus and secondary nucleus

103. The C_4-plants are photosynthetically more efficient than C_3-plants because
(1) the CO_2 compensation point is more
(2) CO_2 generated during photorespiration is trapped and recycled through PEP carboxylase
(3) the CO_2 efflux is not prevented
(4) they have more chloroplasts

104. In human adult females, oxytocin
(1) is secreted by anterior pituitary
(2) stimulates growth of mammary glands
(3) stimulates pituitary to secrete vasopressin
(4) causes strong uterine contractions during parturition

105. Gel electrophoresis is used for
(1) cutting of DNA into fragments according to their size
(2) separation of DNA fragments according to their size
(3) construction of recombinant DNA by joining with cloning vectors
(4) isolation of DNA molecule

106. Polysome is formed by
(1) several ribosomes attached to a single mRNA
(2) many ribosomes attached to a strand of endoplasmic reticulum
(3) a ribosome with several subunits
(4) ribosomes attached to each other in a linear arrangement

107. Given below are four methods (A—D) and their modes of action (1—4) in achieving contraception. Select their correct matching from the four options that follow

Method	Mode of action
A. The pill	1. Prevents sperms reaching cervix
B. Condom	2. Prevents implantation
C. Vasectomy	3. Prevents ovulation
D. Copper-T	4. Semen contains no sperms

	A	B	C	D
(1)	3	1	4	2
(2)	4	1	2	3
(3)	3	4	1	2
(4)	2	3	1	4

108. What is vital capacity of our lungs?

(1) Inspiratory reserve volume plus tidal volume
(2) Total lung capacity minus expiratory reserve volume
(3) Inspiratory reserve volume plus expiratory reserve volume
(4) Total lung capacity minus residual volume

109. In which one of the following, the male and female gametophytes don't have free-living independent existence?

(1) *Pteris*
(2) *Funaria*
(3) *Polytrichum*
(4) *Cedrus*

110. A transgenic food crop, which may help in solving the problem of night blindness in developing countries is

(1) Flaver Savr tomatoes
(2) Starlink maze
(3) Bt Soybean
(4) Golden rice

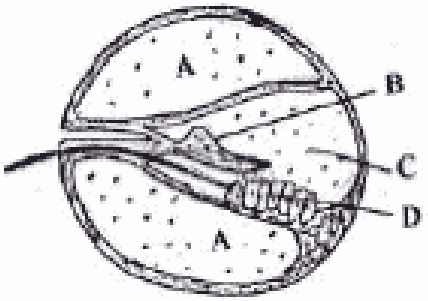
111. A lake near a village suffered heavy mortality of fishes within a few days. Consider the following reasons for this

(a) Lots of urea and phosphate fertilizer were used in the crops in the vicinity.
(b) The area was sprayed with DDT by an aircraft.
(c) The lake water turned green and stinky.
(d) Phytoplankton populations in the lake declined initially thereby greatly reducing photosynthesis.

Which two of above were the main causes of fish mortality in the lake?

(1) b, c
(2) c, d
(3) a, c
(4) a, b

112. Given below is a diagrammatic cross section of a single loop of human cochlea.



Which one of the following options correctly represents the names of three different parts?

(1) B : Tectorial membbrane
C: perilymph
D: Secretory cells
(2) C : Endolymph
D: Sensory hair cells
A: Serum
(3) D : Sensory hair cells
A: Endolymph
B: Tectorial membrane
(4) A : perilymph
B: Tectorial membrane
C: Endolymph

113. Senescence as an active developmental cellular process in the growth and functioning of a flowering plant, is indicated in
(1) vessels and tracheid differentiation
(2) leaf abscission
(3) annual plants
(4) floral parts

114. Vascular tissues in flowering plants develop from
(1) Phellogen
(2) Plerome
(3) Periblem
(4) Dermatogen

115. Nitrogen-fixation in root nodules of *Alnus* is brought about by
(1) *Bradyrhizobium*
(2) *Clostridium*
(3) *Frankia*
(4) *Azorhizobium*

116. What will happen if the secretion of parietal cell of gastric glands is blocked with an inhibitor?
(1) Gastric juice will be deficient in chymosin
(2) Gastric juice will be deficient in pepsinogen
(3) In the absence of HCl secretion, inactive pepsinogen is not converted into the active enzyme pepsin
(4) Enterokinase will not be released from the duodenal mucosa and so trypsinogen is not converted to trypsin

117. Electrons from excited chlorophyll molecule of photosystem-II are accepted first by
(1) cytochrome-b
(2) cytochrome-f
(3) quinine
(4) ferredoxin

118. *Trichoderma harzianum* has proved a useful micro-organism for
(1) bioremediation of contaminated soils
(2) reclamation of wastelands
(3) gene transfer in higher plants
(4) biological control of soil-borne plant pathogens

119. Which type of white blood cells are concerned with the release of histamine and the natural anticoagulant heparin?
(1) Neutrophils
(2) Basophils
(3) Eosinophils
(4) Monocytes

120. Which one of the following in birds indicates their reptilian ancestry?
(1) Scales on their hind limbs
(2) Four chambered heart
(3) Two special chambers crop and gizzard in their digestive tract
(4) Eggs with a calcareous shell

121. Endosperm is consumed by developing embryo in the seed of
(1) Coconut
(2) Castor
(3) Pea
(4) Maize

122. In humans, at the end of the first meiotic division, the male germ cells differentiate into the
(1) primary spermatocytes
(2) secondary spermatocytes
(3) spermatids
(4) spermatogonia

123. In the DNA molecule
(1) the total amount of purine nucleotides and pyrimidine nucleotides is not always equal
(2) there are two strands, which run parallel in the 5'→3' direction
(3) the proportion of adenine in relation to thymine varies with the organism
(4) there are two strands, which run antiparallel - one in 5'→3' direction and other in 3'→5'

124. Consider the following for measures (A—D) that could be taken to successfully grow chick pea in an area where bacterial blight disease is common
(A) spray with Bordeaux mixture
(B) control of the insect vector of the disease pathogen
(C) use of only disease-free seeds
(D) use of varieties resistant to the disease
Which two of the above measures can control the disease?
(1) B and C
(2) A and B
(3) C and D
(4) A and D

125. The rupture and fractionation do not usually occur in the water column in vessel/tracheids during the accent of sap because of
(1) lignified thick walls
(2) cohesion and adhesion
(3) weak gravitational pull
(4) transpiration pull

126. The blood calcium level is lowered by the deficiency of
(1) parathormone
(2) thyroxine
(3) calcitonin
(4) Both (1) and (3)

127. About 70% of total global carbon is found in
(1) Grasslands
(2) agro-ecosystems
(3) oceans
(4) forestes

128. Which one of the following is heterosporous?
(1) *Dryopteris*
(2) *Salvinia*
(3) *Adiantum*
(4) *Equisetum*

129. Dry indehiscent single-seeded fruit formed from bicarpellary syncarpous inferior ovary is
(1) Caryopsis
(2) Cypsela
(3) Berry
(4) cremocarp

130. Which extra embryonic membrane in humans prevents desiccation of the embryo inside the uterus?
(1) Chorion
(2) Allantois
(3) Yolk sac
(4) Amnion

131. The fleshy receptacle of syconous of fig encloses a number of
(1) Achenes
(2) Samaras
(3) Berries
(4) mericarps

132. Which one of the following is linked to the discovery of Bordeaux mixture as a popular fungicide?
(1) Bacterial leaf blight of rice
(2) Downy mildew of grapes
(3) Loose smut of wheat
(4) Black rust of wheat

133. Unisexuality of flowers prevents
(1) autogamy but not geitonogamy
(2) both geitonogamy and xenogamy
(3) geitonogamy, but not xenogamy
(4) autogamy and geitonogamy

134. The length of different internodes in a culm of sugarcane is variable because of
(1) shoot apical meristem
(2) position of axillary buds
(3) size of leaf lamina at the node below each internode
(4) intercalary meristem

135. Which one of the following is the correct difference between rod cells and cone cells of our retina?

Features	Rod Cells	Cone Cells
(1) Visual acuity	High	Low
(2) Visual pigment contained	Iodopsin	Rhodopsin
(3) Overall function	Vision in poor light	Colour vision and detailed Vision in bright light
(4) Distribution	More concentrated in centre of retina	Distributed all over retina

136. In leaes of C_4-plants malic acid synthesis during CO_2-fixation occurs in
(1) epidermal cells
(2) mesophyll cells
(3) bundle sheath
(4) guard cells

137. Which one of the following pairs of codons is correctly matched with their function or the signal for the particular amino acid
(1) GUU, GCU — Alanine
(2) UAG, UGA — Stop
(3) AUG, ACG — Start/methionine
(4) UUA, UCA — Leucine

138. The Cellulose is the major component of cell walls of
(1) *Pythium*
(2) *Xanthomonas*
(3) *Pseudomonas*
(4) *Saccharomyces*

139. The slow rate of decomposition of fallen logs in nature is due to their
(1) low moisture content
(2) poor nitrogen content
(3) anaerobic environment around them
(4) low cellulose content

140. Carbohydrates are commonly found as starch in plant storage organs. Which of the following five properties of starch (A-E) make it useful as a storage material?
(A) Easily translocated (B) Chemically non-reactive
(C) Easily digested by animals (D) Osmotically inactive
(E) Synthesized during photosynthesis

(1) (B) and (C)
(2) (B) and (D)
(3) (A), (C) and (E)
(4) (A) and (E)

141. Which one of the following pairs of organs includes only the endocrine glands?
(1) Parathyroid and adrenal
(2) Pancreas and parathyroid
(3) Thymus and testes
(4) Adrenal and ovary

142. Match the disease in Column-1 with the appropriate items (pathogen/prevention/treatment) in Column-II

Column-I		Column-II
A. Amoebiasis	1.	*Treponema pallidum*
B. Diphtheria	2.	Use only sterilized food and water
C. Cholera	3.	DPT vaccine
D. Syphilis	4.	Use oral rehydration therapy

	A	B	C	D
(1)	1	2	3	4
(2)	2	4	1	3
(3)	2	1	3	4
(4)	2	3	4	1

143. Replum is present in the ovary of flower of
(1) Lemon
(2) Mustard
(3) Sunflower
(4) Pea

144. Which one of the following is the correct matching of the site of action on the given substrate, the enzyme acting upon it and the end product?
(1) Duodenum : Triglycerides $\xrightarrow{\text{Trypsin}}$ Monoglycerides
(2) Small intestine : Starch $\alpha \xrightarrow{\text{Amylase}}$ Disaccharide (maltose)
(3) Small intestine : proteins $\xrightarrow{\text{Pepsin}}$ Amino acids
(4) Stomach : Proteins $\xrightarrow{\text{Lipase}}$ Micelles

145. Modern detergents contain enzyme preparations of
(1) Acidophiles
(2) Alkaliphiles
(3) Thermoacidophiles
(4) Thermophiles

146. The haemoglobin of a human foetus
(1) has a lower affinity for oxygen than that of the adult
(2) its affinity for oxygen is the same as that of an adult
(3) has only 2 protein subunits instead of 4
(4) has a higher affinity for oxygen than that of an adult

147. Which one of the following scientist's names is correctly matched with the theory put forth by him?
(1) Weismann — Theory of continuity of germplasm
(2) Pasteur — Inheritance of acquired characters
(3) de Vries — natural selection
(4) Mendel — Theory of pangenesis

148. The most active phagocytic white blood cells are
(1) neutrophils and eosinophils
(2) lymphocytes and macrophages
(3) eosinophils and lymphocytes
(4) neutrophils and monocytes

149. According to Central Pollution Control Board (CPCB), which particulate size in diameter (in micrometres) of the air pollutants is responsible for greatest harm to human health?
(1) 2.5 or less
(2) 1.5 or less
(3) 1.0 or less
(4) 5.2 or 5.2

150. Which one of the following is the correct statement regarding the particular psychotropic drug specified?
(1) Hashish causes after thought perceptions and hallucinations
(2) Opium stimulates nervous system and causes hallucinations
(3) Morphine leads to delusions and disturbed emotions
(4) Barbiturates cause relaxation and temporary euphoria

151. The two subunits of ribosome remain united at a critical ion level of
(1) copper
(2) manganese
(3) magnesium
(4) calcium

152. During the propagation of a nerve impulse, the action potential results from the movement of
(1) K^+ ions from extracellular fluid to intracellular fluid
(2) Na^+ ions from intracellular fluid to extracellular fluid
(3) K^+ ions from intracellular fluid to extracellular fluid
(4) Na^+ ions from extracellular fluid to intracellular fluid

153. Bacterial leaf blight of rice is caused by a species of
(1) *Xanthomonas*
(2) *Pseudomonas*
(3) *Alternaria*
(4) *Erwinia*

154. Darwin's finches are an excellent example of
(1) adaptive radiation
(2) seasonal migration
(3) brood parasitism
(4) connecting links

155. Earthworms have no skeleton but during burrowing, the anterior end becomes turgid and acts as a hydraulic skeleton. It is due to
(1) coelomic fluid
(2) blood
(3) gut peristalsis
(4) setae

156. Which one of the following pair of nitrogenous bases of nucleic acids, is wrongly matched with the category mentioned against it?
(1) Thymine, Uracil — Pyrimidines
(2) Uracil, Cytosine — Pyrimidines
(3) Guanine, Adenine — Purines
(4) Adenine, Thymine — Purines

157. Main objective of production /use of herbicide resistant GM crops is to
(1) eliminate weeds from the field without the use of manual labour
(2) eliminate weeds from the field without the use of herbicides
(3) encourage eco-friendly herbicides
(4) reduce herbicide accumulation in food particles for health safety

158. The table below gives the populations (in thousands) of ten species (A-J) in four areas (a-b) consisting of the number of habitats given within brackets against each. Study the table and answer the question which follows:

Area and number of habitats	Species and their populations (in thousands) in the areas									
	A	B	C	D	E	F	G	H	I	J
a (11)	23	1.2	0.52	6.0	—	3.1	1.1	9.0	—	10.3
b (11)	10.2	—	0.62	—	1.5	3.0	—	8.2	1.1	11.2
c (13)	11.3	0.9	0.48	2.4	1.4	4.2	0.8	8.4	2.2	4.1
d (12)	3.2	10.2	11.1	4.8	0.4	3.3	0.8	7.3	11.3	2.1

Which area out of a to d shows maximum species diversity?

(1) b
(2) c
(3) d
(4) a

159. To which type of barriers under innate immunity, do the saliva in the mouth and the tears from the eyes, belong?
(1) Cytokine barriers
(2) Cellular barriers
(3) Physiological barriers
(4) Physical barriers

160. Cornea transplant in humans is almost never rejected. This is because
(1) its cells are least penetrable by bacteria
(2) it has no blood supply
(3) it is composed of enucleated cells
(4) it is a non-living layer

161. The energy-releasing process in which the substrate is oxidized without an external electron acceptor is called
(1) fermentation
(2) photorespiration
(3) aerobic respiration
(4) glycolysis

162. Select one of the following pairs of important features distinguishing *Gnetum* from *Cycas* and *Pinus* and showing affinities with angiosperms
(1) absence of resin duct and leaf venation
(2) presence of vessel elements and absence of archegonia
(3) perianth and two integuments
(4) embryo development and apical meristem

163. Thorn of Bougainvillea and tendril of Cucurbita are examples of
(1) analogous organs
(2) homologous organs
(3) vestigial organs
(4) retrogressive evolution

164. What is true about the isolated small tribal populations?
(1) There is a decline in population as boys marry girls only from their own tribe
(2) Hereditary diseases like colour blindness do not spread in the isolated population
(3) Wrestlers who develop strong body muscles in their life time pass this character on to their progeny
(4) There is no change in population size as they have a large gene pool

165. Human insulin is being commercially produced from a transgenic species of
(1) *Escherichia*
(2) *Mycobacterium*
(3) *Rhizobium*
(4) *Saccharomyces*

166. In the light of recent classification of living organisms into three domains of life (bacteria, archaea and eukarya), which one of the following statement is true about archaea?
(1) Archaea resemble eukarya in all respects
(2) Archaea have some novel features that are absent in other prokaryotes and eukaryotes
(3) Archaea completely differ from both prokaryotes and eukaryotes
(4) Archaea completely differ from prokaryotes

167. Thermococcus, Methanococcus and Methanobacterium exemplify
(1) archaebacteria that contain protein homologous to eukaryotic core Histones
(2) archaebacteria that lack any histones resembling those found in eukaryotes but whose DNA is negatively super coiled
(3) bacteria whose DNA is relaxed or positively super coiled but which have a cytoskeleton as well as mitochondria
(4) bacteria that contain a cytoskeleton and ribosome

168. A competitive inhibitor of succinic dehydrogenase is
(1) malonate
(2) oxloacetate
(3) α-ketoglutarate
(4) malate

169. Cry-I endotoxins obtained from *Bacillus thuringiensis* are effective against
(1) mosquitoes
(2) flies
(3) nematodes
(4) boll worms

170. Vacuole in a plant cell
(1) is membrane-bound and contains storage proteins and lipids
(2) is membrane-bound and contains water and excretory substances
(3) lacks membrane and contains air
(4) lacks membrane and contains water and excretory substances

171. Which one of the following is not observed in biodiversity hot spots?
(1) Endemism
(2) Accelerated species loss
(3) Lesser interspecific competition
(4) Species richness

172. Consider the statements given below regarding contraception and answer as directed thereafter.
(a) Medical Termination of Pregnancy (MTP) during first trimester is generally safe
(b) Generally chances of conception are nil until mother breast-feeds the infant upto two years
(c) Intrauterine devices like copper-T are effective contraceptives
(d) Contraception pills may be taken upto one week after coitus to prevent Conception
Which two of the above statements are correct?

(1) b and c
(2) c and d
(3) a and c
(4) a and b

173. Which one of the following proved effective for biological control of nematodal diseases in plants?
(1) *Pisolithus tinctorius*
(2) *Pseudomonas cepacin*
(3) *Gliocladium virens*
(4) *Paecilomyces lilacinus*

174. Which one of the following condition in humans is correctly match with its chromosomal abnormality/linkage?
(1) Klinefelter's syndrome — 44 autosomes + XXY
(2) Colourblindness — Y-linked
(3) Erythroblastosis foetalis — X-linked
(4) Down syndrome — 44 autosomes + XO

175. Which one of the following item gives its correct total number?
(1) Floating ribs in humans — 4
(2) Amino acids found in proteins — 16
(3) Types of diabetes — 3
(4) Cervical vertebrae in humans — 8

176. In germinating seeds fatty acids are degraded exclusively in the
(1) proplastids
(2) glyoxysomes
(3) peroxisomes
(4) mitochondria

177. What does the filiform apparatus do at the entrance into ovule?
(1) It helps in the entry of pollen tube into a synergid
(2) It prevents entry of more than one pollen tube into the embryo sac
(3) It brings about opening of the pollen tube
(4) It guides pollen tube from a synergid to egg

178. Which one of the following is being tried in India as a biofuel substitute for fossil fuels?
(1) *Jatropha*
(2) *Azadirachta*
(3) *Musa*
(4) *Aegilops*

179. Which one of the following is resistant to enzyme action?
(1) Cork
(2) Wood fibre
(3) Pollen exine
(4) Leaf cuticle

180. What is antisense technology?
(1) A cell disk playing a foreign antigen used for synthesis of antigens.
(2) Production of somaclonal variants in tissue cultures.
(3) When a piece of RNA that is complementary in sequence is used to stop expression of a specific gene.
(4) RNA polymerase producing DNA

181. Haploids are more suitable for mutation studies than the diploids. This is because
(1) haploids are reproductively more stable than diploids
(2) mutagens penetrate in haploids more stable than diploids
(3) haploids are more abundant in nature than diploids
(4) all mutations, whether dominant or recessive are expressed in haploids

182. Which one of the following is not a characteristic of phylum—Annelida?
(1) Closed circulatory system
(2) Segmentation
(3) Pseudocoelom
(4) Ventral nerve cord

183. Importance of day length in flowering of plants was first shown in
(1) *Lemna*
(2) *Tobacco*
(3) *Cotton*
(4) *Petunia*

184. In human blood passes from the post caval to the diastolic right atrium of heart due to
(1) pushing open of the venous valves
(2) suction pull
(3) stimulation of the sino auricular node
(4) pressure difference between the caval and atrium

185. Which one of the following is the true description about an animal concerned?
(1) Earthworm — The alimentary canal consists of a sequence of pharynx, oesophagus, stomach, gizzard and intestine
(2) Frog — Body divisible into three regions—head, neck and trunk
(3) Rat — Left kidney is slightly higher in position than the right one
(4) Cockroach — 10 pairs of spiracles (2 pairs on thorax and 8 pairs on abdomen)

186. The linking of antibiotic resistance gene with the plasmid vector became possible with
(1) DNA ligase
(2) Endonucleases
(3) dNA polymerase
(4) exonucleases

187. Which one of the following statement is incorrect about menstruation?
(1) During normal menstruation about 40 ml. blood is lost
(2) The menstrual fluid can easily clot
(3) At menopause in the female, there is especially abrupt increase in gonadotropic hormones
(4) The beginning of the cycle of menstruation is called menarche

188. Which one of the following phyla is correctly matched with its two general characteristics?
(1) Arthropoda — Body divided into head, thorax and abdomen and respiration by tracheae
(2) Chordata — Notochord at some stage and separate anal and urinary openings to the outside
(3) Echinodermata — Pentamerous radial symmetry an mostly internal fertilization
(4) Mollusca — Normally oviparous and development through a trochophore or veliger larva

189. Which one of the following pair of items correctly belongs to the category of organs mentioned against it?
(1) Thorn of Bougainvillea and tendrils — Analogous organs of *Curcurbita*
(2) Nictitating membrane and blind spot— Vestigial organs in human eye
(3) Nephridia of earthworm and Malpighian—Excretory organs tubules of cockroach
(4) Wings of honey bee and wings of crow — Homologous organs

190. The chemiosmotic coupling hypothesis of oxidative phosphorylation proposes that Adenosine Triphosphate (ATP) is formed because
(1) high energy bonds are formed in mitochondrial proteins
(2) ADP is pumped out of the matrix into the intermembrane space
(3) a proton gradient forms across the inner membrane there is a change in the permeability of the inner mitochondrial
(4) membrane toward Adenosine Diphosphate (ADP)

191. Consider the following statements about biomedical technologies
(A) During open heart surgery blood is circulated in the heart lung machine.
(B) Blockage in coronary arteries is removed by angiography.
(C) Computerised Axial Tomography (CAT) shows detailed internal structure as seen in a section of body.
(D) X-ray provides clear and detailed images of organs like prostate glands and lungs.
Which of the above statements are correct?

(1) B and D
(2) C and D
(3) A and C
(4) A and B

192. Consider the following statements concerning food chains
(A) Removal of 80% tigers from an area resulted in greatly increased growth of vegetation
(B) Removal of most of the carnivores resulted in an increased population of deers
(C) The length of food chains is generally limited to 3-4 trophic levels due to energy loss
(D) The length of food chains may vary from 2 to 8 trophic levels.
Which two of the above statements are correct?

(1) B and C
(2) C and D
(3) A and D
(4) A and B

193. *Ascaris* is characterized by
(1) absence of true coelom but presence of metamerism
(2) presence of neither true coelom nor metamerism
(3) presence of true coelom but absence of metamerism
(4) presence of true coelom and metamerism (metamerisation)

194. Consider the following four statements (A—D) about certain desert animals such as kangaroo rat
(A) They have dark colour and high rate of reproduction and excrete solid urine.
(B) They do not drink water, breathe at a slow rate to conserve water and have their body covered with thick hairs.
(C) They feed on dry seeds and do not require drinking water
(D) They excrete very concentrated urine and do not use water to regulate body temperature.
Which two of the above statements for such animals are true?

(1) C and D
(2) B and C
(3) C and A
(4) A and B

195. Which one of the following is incorrect about the characteristics of protobionts (coacervates and microspheres) as envisaged in the abiogenic origin of life?
(1) They were able to reproduce
(2) They could separate combinations of molecules from the surroundings
(3) They were partially isolated from the surroundings
(4) They could maintain an internal environment

196. Which one of the following groups of three animals each is correctly matched with their one characteristic morphological feature?
(1) Liver fluke, sea anemone, sea cucumber — Bilateral symmetry
(2) Centipede, prawn, sea urchin — Jointed appendages
(3) Scorpion, spider, cockroach — Ventral solid central nervous system
(4) Cockroach, locust, Taenia — Metameric segmentation

197. The fruit is chambered, developed from inferior ovary and has seeds with succulent testa in
(1) pomegranate
(2) orange
(3) guava
(4) cucumber

198. Which one of the following is the correct percentage of the two (out of the total of 4) green-house gases that contribute to the total global warming?
(1) CFCs 14%, CH_4 20%
(2) CO_2 40%, CFCs 30%
(3) N_2O 6%, CO_2 86%
(4) CH_4 20%, N_2O 118%

199. World Summit on Sustainable Development (2002) was held in
(1) Brazil
(2) Sweden
(3) Argentina
(4) South Africa

200. *Quercus* species are the dominant component in
(1) temperate deciduous forests
(2) alpine forests
(3) scrub forests
(4) tropical rain forests

AIPMT - 2008
(Physics, Chemistry and Biology)
Prelims Answer Key and Solution

Answers

1	(4)	2	(2)	3	(1)	4	(4)	5	(3)	6	(1)	7	(2)	8	(1)	9	(3)	10	(4)
11	(2)	12	(1)	13	(2)	14	(3)	15	(2)	16	(2)	17	(3)	18	(4)	19	(3)	20	(3)
21	(3)	22	(2)	23	(1)	24	(3)	25	(1)	26	(2)	27	(1)	28	(1)	29	(1)	30	(4)
31	(1)	32	(2)	33	(3)	34	(2)	35	(3)	36	(1)	37	(3)	38	(4)	39	(4)	40	(2)
41	(1)	42	(3)	43	(2)	44	(4)	45	(1)	46	(3)	47	(1)	48	(4)	49	(3)	50	(4)
51	(2)	52	(1)	53	(4)	54	(3)	55	(2)	56	(3)	57	(1)	58	(1)	59	(1)	60	(3)
61	(3)	62	(3)	63	(3)	64	(3)	65	(2)	66	(4)	67	(1)	68	(3)	69	(2)	70	(4)
71	(3)	72	(3)	73	(2)	74	(4)	75	(3)	76	(1)	77	(4)	78	(3)	79	(2)	80	(1)
81	(2)	82	(4)	83	(2)	84	(4)	85	(1)	86	(1)	87	(4)	88	(4)	89	(3)	90	(1)
91	(3)	92	(2)	93	(1)	94	(2)	95	(2)	96	(3)	97	(1)	98	(1)	99	(2)	100	(3)
101	(2)	102	(2)	103	(4)	104	(4)	105	(2)	106	(2)	107	(1)	108	(2)	109	(4)	110	(4)
111	(3)	112	(4)	113	(2)	114	(2)	115	(3)	116	(3)	117	(3)	118	(4)	119	(2)	120	(1)
121	(3)	122	(2)	123	(4)	124	(3)	125	(2)	126	(1)	127	(3)	128	(2)	129	(2)	130	(4)
131	(1)	132	(2)	133	(1)	134	(4)	135	(3)	136	(2)	137	(2)	138	(1)	139	(4)	140	(2)
141	(1)	142	(4)	143	(2)	144	(3)	145	(2)	146	(4)	147	(1)	148	(4)	149	(1)	150	(1)
151	(3)	152	(4)	153	(1)	154	(1)	155	(1)	156	(4)	157	(4)	158	(3)	159	(3)	160	(2)
161	(1)	162	(2)	163	(2)	164	(1)	165	(1)	166	(2)	167	(2)	168	(1)	169	(4)	170	(2)
171	(3)	172	(3)	173	(4)	174	(1)	175	(1)	176	(2)	177	(1)	178	(1)	179	(3)	180	(3)
181	(4)	182	(3)	183	(2)	184	(4)	185	(4)	186	(1)	187	(2)	188	(4)	189	(3)	190	(3)
191	(3)	192	(1)	193	(2)	194	(1)	195	(2)	196	(3)	197	(1)	198	(1)	199	(4)	200	(1)

Physics

1. Atomic radius is the distance between two nearest neighbours. For a fcc crystal, we have

$$\text{Atomic radius} = \frac{1}{2\sqrt{2}} \times \text{lattice parameter}$$

$$\Rightarrow r = \frac{a}{2\sqrt{2}}$$

$$\Rightarrow r = \frac{3.6}{2\sqrt{2}}\,\overset{0}{A} = \frac{3.6}{2.8}\,\overset{0}{A} = 1.27\,\overset{0}{A}$$

2. Volume of a sphere $= \frac{4}{3}\pi\,(\text{radius})^3$

$$\Rightarrow V = \frac{4}{3}\pi R^3$$

Taking logarithm on both sides, we have

$$\log V = \log\left(\frac{4}{3}\pi\right) + 3\log R$$

Differentiating both sides, we get

$$\frac{\Delta V}{V} = 0 + \frac{3\Delta R}{R}$$

Accordingly, $\frac{\Delta R}{R} = 2\%$ implies $\frac{\Delta V}{V} = 3 \times 2\% = 6\%$

3. At any point, the electric potential because of charge Q is

$$V = \frac{1}{4\pi\varepsilon_0} \times \frac{Q}{r} \qquad \ldots\ldots \text{(i)}$$

where r is the distance between the point and the charge.
At the same point, the electric field is

$$E = \frac{1}{4\pi\varepsilon_0} \times \frac{Q}{r^2} \qquad \ldots\ldots \text{(ii)}$$

Squaring equation (i) and comparing it with (ii), we get

$$E = \frac{4\pi\varepsilon_0 V^2}{Q} = \frac{4\pi\varepsilon_0 \times (Q \times 10^{11})^2}{Q} = 4\pi\varepsilon_0 Q \times 10^{22}\,V/m$$

4. The process of injecting a fraction of output energy of some device back to the input is known as feedback.
When the feedback energy (voltage or current) is out of phase with the input signal thereby opposing it, it is called negative feedback.
Now, voltage gain with feedback is

$$A_{vf} = \frac{A_v}{1 + \beta A_v}$$

where A_v is the voltage gain without feedback and β is the negative feedback.

Given $A_{vf} = 10$, $\beta = 9\% = \frac{9}{100}$

$$\therefore 10 = \frac{A_v}{1 + \frac{9}{100}A_v}$$

$$\Rightarrow 10 + \frac{9}{10}A_v = A_v$$

$$\Rightarrow 0.1A_v = 10 \text{ or } A_v = 100$$

5. Energy given by the cell is given as

$E = CV^2$

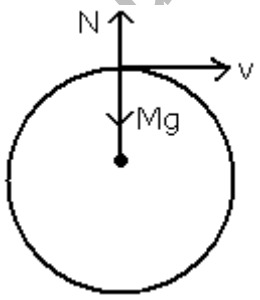
Here, C is the capacitance of the condenser $= \frac{A\varepsilon_0}{d}$

V is the potential difference across the plates = Ed

Therefore, we have

$$E = \left(\frac{A\varepsilon_0}{d}\right)(Ed)^2 = A\varepsilon_0 E^2 d$$

6. The forces on the car are as shown in the figure below.



Balancing the forces, we get

$$Mg - N = M\frac{v^2}{R}$$

For weightlessness N = 0

$$\therefore \frac{Mv^2}{R} = Mg$$

where R is the radius of curvature and v is the speed of the car.

Therefore, $v = \sqrt{Rg}$

Substituting the values as R = 20 m, g = 10.0 m/s^2, we get

$v = \sqrt{20 \times 10.0} = 14.14 \text{m/s}^2$

Thus, the speed of the car at the top of the hill is between 14 m/s and 15 m/s.

7. The radius of gyration is given in terms of moment of inertia as

$$K = \sqrt{\frac{I}{M}}$$

Hence, for the disc and ring of the same mass, we have

$$\frac{K_{disc}}{K_{ring}} = \sqrt{\frac{I_{disc}}{I_{ring}}} \qquad \text{..... (i)}$$

But I_{disc} (about its axis) $= \frac{1}{2}MR^2$

and I_{ring} (about its axis) $= MR^2$

Therefore, equation (i) becomes

$$\frac{K_{disc}}{K_{ring}} = \sqrt{\frac{\frac{1}{2}MR^2}{MR^2}} = 1 : \sqrt{2}$$

8. According to Einstein's photoelectric equation,

$KE_{max} = E - \phi$

where ϕ is the work function and KE_{max} is the maximum kinetic energy of the photoelectron.

$\therefore h\nu = eV_0 + \phi$

$$h\nu = \frac{hc}{\lambda} = 5 \text{ eV} + 6.2 \text{ eV} = 11.2 \text{ eV}$$

$$\therefore \lambda = \left(\frac{12400}{11.2}\right)\text{Å} \approx 1000\,\text{Å}$$

Hence, the radiation lies in the ultraviolet region.

9. Given, the ground state energy of hydrogen atom is

$E_1 = -13.6$ eV

Energy of the electron in the first excited state (i.e. n = 2) is

$$E_2 = -\frac{13.6}{(2)^2}\text{eV}$$

Therefore, the excitation energy is

$$\Delta E = E_2 - E_1 = -\frac{13.6}{4} - (-13.6) = -3.4 + 13.6 = 10.2 \text{ eV}$$

10. Voltage across the 2Ω resistor is given from Ohm's law as
$V = 2 \times 3 = 6$ V
So, the voltage across the lowest arm is
$V_1 = 6$ V
Now, the current across the 5Ω resistor is
$$I = \frac{6}{1+5} = 1 \text{ A}$$
Therefore, the power across the 5Ω resistor is
$P = I^2R = (1)^2 \times 5 = 5$ W

11. The p–n photodiode is a semiconductor diode which produces a significant current when illuminated. It is reverse-biased but is operated below the breakdown voltage.
Energy of radiation = Band gap energy
i.e. $h\nu = 2.0$ eV
$$\nu = \frac{2.0 \times 1.6 \times 10^{-19}}{6.6 \times 10^{-34}} \approx 5 \times 10^{14} \text{ Hz}$$

12. The power generated by the turbine is
$$P_{generated} = P_{input} \times \frac{90}{100} = \frac{Mgh}{t} \times \frac{90}{100}$$
Substituting the given values, we get
$$\frac{M}{t} = 15 \text{ kg/s}, g = 10 \text{ m/s}^2, h = 60 \text{ m}$$
$$P_{generated} = (15 \times 10 \times 60) \times \frac{90}{100} = 8.1 \text{ kW}$$

13. In general, whenever we are to go from any known scale to any unknown scale, then we follow the equation
$$\frac{(\text{Temperature on known scale}) - (\text{LFP for known scale})}{(\text{UFP} - \text{LFP})_{\text{known}}}$$
$$= \frac{(\text{Temperature on unknown scale}) - (\text{LFP for unknown scale})}{(\text{UFP} - \text{LFP})_{\text{unknown}}}$$
$$\Rightarrow \frac{39-0}{100-0} = \frac{t-39}{239-39}$$
$$\Rightarrow t = 117°\text{W}$$

14. In a cyclic process, a system starts from one point and ends at the same point. In this case, the change in the internal energy must be zero, and therefore, the thermal energy added to the system must equal the work done during the cycle. That is in a cyclic process: $\Delta U = 0$ or $E = 0$.

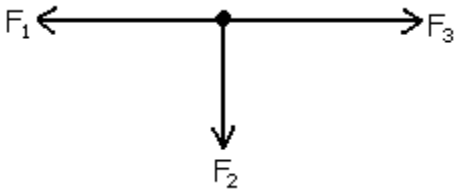
15. Acceleration of simple harmonic motion is

$a_{max} = -\omega^2 A$

$\frac{(a_{max})_1}{(a_{max})_2} = \frac{\omega_1^2}{\omega_2^2}$ (as A remains the same)

$\frac{(a_{max})_1}{(a_{max})_2} = \frac{(100)^2}{(1000)^2} = \left(\frac{1}{10}\right)^2 = 1:10^2$

16. The free-body diagram of the loop is shown in the figure below.



Therefore, the force on QP will be equal and opposite to the sum of the forces on the other sides.

Thus, we have

$F_{QP} = \sqrt{(F_3 - F_1)^2 + F_2^2}$

17. If N is the number of radioactive nuclei present at some instant, then

$N = N_0 e^{-\lambda t}$

The constant N_0 represents the number of radioactive nuclei at t = 0.

Now, $\frac{N_1}{N_2} = \frac{e^{-\lambda_1 t}}{e^{-\lambda_2 t}}$

$\Rightarrow \frac{N_1}{N_2} = \frac{e^{-5\lambda t}}{e^{-\lambda t}} = e^{-4\lambda t}$

But $\frac{N_1}{N_2} = \frac{1}{e}$ (as given)

Therefore, $\frac{1}{e} = \frac{1}{e^{4\lambda t}}$

$\Rightarrow 4\lambda t = 1$

$\Rightarrow t = \frac{1}{4\lambda}$

18. If two thin lenses of focal lengths f_1 and f_2 are placed in contact coaxially, then the equivalent focal length of the combination is

$$\frac{1}{F}=\frac{1}{f_1}+\frac{1}{f_2}-\frac{0}{f_1f_2}=\frac{1}{f_1}+\frac{1}{f_2}$$

Power for the combination is

$$P=\frac{1}{F}=\frac{1}{f_1}+\frac{1}{f_2}=\frac{f_1+f_2}{f_1f_2}$$

19. Distance travelled by the particle in the n^{th} second is

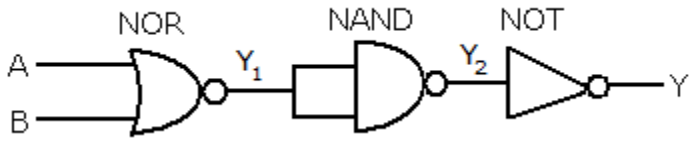
$$S_n=u+\frac{1}{2}a(2n-1)$$

where u is the initial speed and a is the acceleration of the particle.

Here, n = 3, u = 0, a $=\frac{4}{3}m/s^2$

$$\therefore S_{3rd}=0+\frac{1}{2}\times\frac{4}{3}\times(2\times3-1)=\frac{4}{6}\times5=\frac{10}{3}m$$

20. The gate circuit can be shown by giving two inputs A and B.



Output of the NOR gate is

$$Y_1=\overline{A+B}$$

Output of the NAND gate is

$$Y_2=\overline{Y_1\cdot Y_1}$$
$$=\overline{\overline{A+B}}.\overline{\overline{A+B}}$$
$$=\overline{\overline{A+B}}+\overline{\overline{A+B}}$$
$$=(A+B)+(A+B)$$
$$=A+B$$

Output of the NOT gate is

$$Y=\overline{Y_2}$$
$$=\overline{A+B}$$

which is the output of a NOR gate.

21. After passing through a magnetic field, the magnitude of mass and velocity of the particle remains the same, and so its energy does not change, i.e. the kinetic energy will remain T.

22. After stretching, the specific resistance (ρ) will remain the same.
Now, the original resistance of the wire is

$$R = \frac{\rho l}{A}$$

$$R \propto \frac{l}{A} \text{ or } R \propto \frac{l^2}{V} \qquad \text{(as V = Al)}$$

and therefore, the new resistance will be

$$R' \propto \frac{(1+10\%l)^2}{V}$$

Hence, we get

$$\frac{R'}{R} = \frac{\left(l + \frac{10}{100}l\right)^2}{l^2}$$

$$\Rightarrow \frac{R'}{R} = \frac{\left(\frac{11l}{10}\right)^2}{l^2} = \frac{121}{100}$$

$\therefore R' = 1.21\ R$

23. We know that the heat absorbed by the kettle is equal to the heat gained by water.

$$VIt = ms\Delta t$$

$$\Rightarrow t = \frac{ms\Delta t}{VI}$$

It is given that I = 4 A, V = 220 V, m = 1 kg, Δt = (100 − 20)°C and s = 4200 J/kg°C.
Substituting the given values, we get

$$t = \frac{1 \times 4200 \times 80}{220 \times 4} = 6.3 \text{ min}$$

24. The discharge of electricity through gases is a phenomenon which can be systematically studied with the help of a discharge tube. Collisions between the charged particles emitted from the cathode and the atoms of the gas produce a coloured glow in the tube.

25. The de Broglie wavelength of a particle is given by

$$\lambda = \frac{h}{p}$$

where h is the Planck's constant.
Similarly, the wavelength of an electron is given by

$$\lambda_e = \frac{h}{p_e}$$

It is given that $\lambda = \lambda_e$

So, $p = p_e$

$\therefore mv = m_e v_e$

$\therefore v = \frac{m_e v_e}{m}$

It is known that $m_e = 9.1 \times 10^{-31}$ kg, $v_e = 3 \times 10^6$ m/s, m = 1 mg = 1×10^{-6} kg

Substituting the given data, we get

$v = \frac{9.1 \times 10^{-31} \times 3 \times 10^6}{1 \times 10^{-6}} = 2.7 \times 10^{-18}$ ms^{-1}

26. The particle has maximum instantaneous velocity at a point at which its slope is maximum.

Therefore, $V_{max} = \frac{dx}{dt} =$ maximum slope

In the figure, the slope is maximum at point C. Hence, the velocity is maximum at this point.

27. Let E be the emf of the cell and V be the terminal potential difference, then according to the potentiometer experiment, we have

$\frac{E}{V} = \frac{l_1}{l_2}$

where l_1 and l_2 are the lengths of the potentiometer wire with and without being short circuited through a resistance.

Since $\frac{E}{V} = \frac{R+r}{R}$ $\quad [\because E = I(R+r) \text{ and } V = IR]$

$\therefore \frac{R+r}{R} = \frac{l_1}{l_2}$

$\Rightarrow 1 + \frac{r}{R} = \frac{110}{100}$

$\Rightarrow \frac{r}{R} = \frac{10}{100}$

$\Rightarrow r = \frac{1}{10} \times 10 = 1\ \Omega$

28. Binding energy of a nucleus containing N neutrons and Z protons is

$BE = [NM_n + ZM_p - M(A, Z)]\ c^2$

$\Rightarrow \frac{BE}{c^2} = NM_n + ZM_p - M(A,z)$

$\Rightarrow \frac{BE}{c^2} = (A-Z)M_n + ZM_p - M(A,Z)$ $\quad$ (as N = A – Z)

$\Rightarrow M(A,Z) = ZM_p + (A-Z)M_n - BE/c^2$

29. To have the resultant force only along the y-direction, the minimum additional force will need to be along the x-direction. This force will be as shown below.

$F = -(F_{resultant})_x$

$$F_{resultant} = [(4-2)(\cos 30^o \hat{j} - \sin 30^o \hat{i}) + 1(\cos 60^o \hat{i} + \sin 60^o \hat{j})$$

$$= \left[2\left(\frac{\sqrt{3}}{2}\hat{j} - \frac{1}{2}\hat{i}\right) + \left(\frac{1}{2}\hat{i} + \frac{\sqrt{3}}{2}\hat{j}\right)\right]$$

$$= \left[\left(\sqrt{3} + \frac{\sqrt{3}}{2}\right)\hat{j} + \left(-\hat{i} + \frac{\hat{i}}{2}\right)\right]$$

$$= \left[-\frac{1}{2}\hat{i} + \frac{3\sqrt{3}}{2}\hat{j}\right]$$

$$= -\frac{\hat{i}}{2} + \frac{3\sqrt{3}}{2}\hat{j}$$

$$\therefore F = -\left(-\frac{\hat{i}}{2}\right) = \frac{1}{2}\hat{i}$$

Hence, $|F| = 0.5$ N

30. Resultant intensity of two periodic waves is given by

$$I = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\delta$$

where δ is the phase difference between the waves.

For maximum intensity, $\delta = 2n\pi$; n = 0, 1, 2, ...
Therefore, for zero order maxima $\cos\delta = 1$.

$$I_{max} = I_1 + I_2 + 2\sqrt{I_1 I_2} = (\sqrt{I_1} + \sqrt{I_2})^2$$

For minimum intensity, $\delta = (2n - 1)\pi$; n = 1, 2, ...
Therefore, for first order minima $\cos\delta = -1$.

$$I_{min} = I_1 + I_2 - 2\sqrt{I_1 I_2}$$
$$= (\sqrt{I_1} - \sqrt{I_2})^2$$

Therefore, we get

$$I_{max} + I_{min} = (\sqrt{I_1} + \sqrt{I_2})^2 + (\sqrt{I_1} - \sqrt{I_2})^2$$
$$= 2(I_1 + I_2)$$

31. Let the mass of the shell be m_1 and its velocity be v_1.
Similarly, let the mass of the gun be m_2 and its velocity be v_2.
From the conservation of momentum, we get

$m_1v_1 + m_2v_2 = 0$

$\Rightarrow 0.2v_1 - 4v_2 = 0$ (negative sign because v2 is opposite to v1)

$\Rightarrow v_2 = \frac{0.2}{4}v_1$ ..... (i)

Now, the conservation of energy gives

$$\frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2 = 1050$$

$$\Rightarrow \frac{1}{2}\times 0.2v_1^2 + \frac{1}{2}\times 4\times v_2^2 = 1050$$

$\Rightarrow 0.1v_1^2 + 2v_2^2 = 1050$ ..... (ii)

Substituting equation (i) in (ii), we get

$$0.1v_1^2 + 2\left(\frac{0.2v_1}{4}\right)^2 = 1050$$

$$0.1v_1^2 + \frac{0.2^2v_1^2}{8} = 1050$$

$$0.8v_1^2 + 0.04v_1^2 = 8400$$

$$0.84v_1^2 = 8400$$

$$v_1^2 = \frac{8400}{0.84} = 10000$$

$\therefore v_1 = 100$ m/s

32. As the ring conducts electricity, the electric field at its centre is zero, i.e.

$\vec{E}_{total} = 0$

$\Rightarrow \vec{E}_{AKB} + \vec{E}_{ACDB} = 0$

$\Rightarrow \vec{E}_{ACDB} = -\vec{E}_{AKB}$

$\Rightarrow \vec{E}_{ACDB} = -\vec{E}$ (along KO)

Therefore, the electric field at the centre because of the charge on the part ACDB of the ring is E along OK.

33. Velocity of electromagnetic radiation is the velocity of light (c) which is

$$c = \frac{1}{\sqrt{\mu_0\varepsilon_0}}$$

where μ_0 is the permeability and ε_0 is the permittivity of free space.

34. The given equation of a point performing SHM is written as

$$x = a\sin\left(\omega t + \frac{\pi}{6}\right) \qquad \ldots\ldots \text{(i)}$$

Differentiating equation (i) w.r.t. time, we get

$$v = \frac{dx}{dt} = a\omega\cos\left(\omega t + \frac{\pi}{6}\right)$$

It is given that $v = \frac{a\omega}{2}$, so that

$$\frac{a\omega}{2} = a\omega\cos\left(\omega t + \frac{\pi}{6}\right)$$

$$\Rightarrow \frac{1}{2} = \cos\left(\omega t + \frac{\pi}{6}\right)$$

$$\Rightarrow \cos\frac{\pi}{3} = \cos\left(\omega t + \frac{\pi}{6}\right)$$

$$\Rightarrow \omega t + \frac{\pi}{6} = \frac{\pi}{3}$$

$$\Rightarrow \omega t = \frac{\pi}{6}$$

$$\Rightarrow t = \frac{\pi}{6\omega} = \frac{\pi \times T}{6 \times 2\pi} = \frac{T}{12}$$

Thus, at time $\frac{T}{12}$, the velocity of the point will be equal to half of its maximum velocity.

35. If I is the current flowing in the circuit, then the flux linked with the circuit is observed to be proportional to I, i.e.

$\phi \propto I$

$\Rightarrow \phi = LI \qquad \ldots\ldots \text{(i)}$

where L is called self-inductance or coefficient of self-inductance or simply the inductance of the coil.

Net flux through solenoid is

$\phi = 500 \times 4 \times 10^{-3} = 2$ Wb

Substituting this value in equation (i), we get

$2 = L \times 2$

$\Rightarrow L = 1$ H

36. The object height, image height, object distance and image distance are related as

$$\frac{I}{O}=\frac{v}{u}$$

Here, $O = 1.39 \times 10^9$, $v = 0.1$ m, $u = 1.5 \times 10^{11}$ m

$$\therefore I=\frac{0.1}{1.5\times10^{11}}\times1.39\times10^{9}$$

$$=9.2\times10^{-4}\,\text{m}$$

37. Power = rate of work done in one complete cycle

$$\Rightarrow P_{avg}=\frac{W}{T}$$

$$\Rightarrow P_{avg}=\frac{\left(E_0I_0\cos\phi\right)\frac{T}{2}}{T}$$

$$\Rightarrow P_{avg}=\frac{E_0I_0\cos\phi}{2}$$

where cos ϕ is called the power factor of an AC circuit.

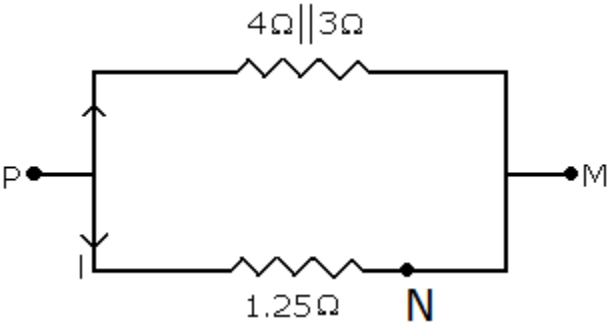
38. Potential difference across PM (i.e. across 4Ω resistor) is

$V = 4 \times 1 = 4$ V

Equivalent resistance of the lower side arm is

$$R_{eq}=1+\frac{0.5\times0.5}{0.5+0.5}=1.25\Omega$$

Now the circuit can be shown as



Let current I flow through the lower branch. Hence, we get

$1.25\ I = 4$ V

$$\Rightarrow I=\frac{4}{1.25}=3.2\text{A}$$

Therefore, a current of 3.2 A current flows through the 1Ω resistor, and hence, the potential difference between points M and N is

$V' = 3.2 \times 1 = 3.2$ V

39. Let u and v be the initial and final velocities of the particle and a and s be the constant acceleration and distance covered by it, respectively.
From the third equation of motion, we have

$$v^2 = u^2 + 2as$$

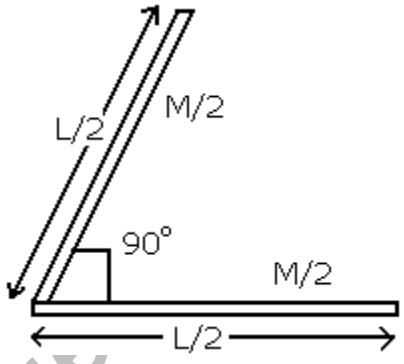
$$\Rightarrow (20)^2 = (10)^2 + 2a \times 135$$

$$\Rightarrow a = \frac{300}{2 \times 135} = \frac{10}{9} ms^{-2}$$

Now using the first equation of motion v = u + at, we get

$$\Rightarrow t = \frac{v - u}{a} = \frac{20 - 10}{(10/9)} = \frac{10 \times 9}{10} = 9s$$

40. Since the rod is bent at the middle, each part of it will have the same length, i.e. $\left(\frac{L}{2}\right)$ and mass $\left(\frac{M}{2}\right)$ as shown.



The moment of inertia of each part through its one end is

$$I = \frac{1}{3}\left(\frac{M}{2}\right)\left(\frac{L}{2}\right)^2$$

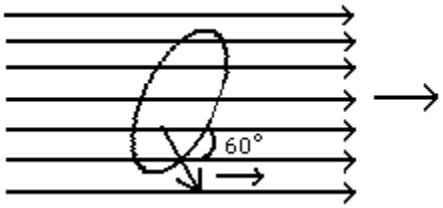
Hence, the net moment of inertia through its middle point O is

$$I_{total} = \frac{1}{3}\left(\frac{M}{2}\right)\left(\frac{L}{2}\right)^2 + \frac{1}{3}\left(\frac{M}{2}\right)\left(\frac{L}{2}\right)^2 = \frac{1}{3}\left[\frac{ML^2}{8} + \frac{ML^2}{8}\right] = \frac{ML^2}{12}$$

41. The magnetic flux ϕ passing through a plane surface of area A placed in a uniform magnetic field B is given by

$\phi = BA\cos\theta$

where θ is the angle between the direction of B and the normal to the plane.



Here, $\theta = 60°, B = \frac{1}{\pi}\text{Wb/m}^2, A = \pi(0.2)^2$

Therefore, $\phi = \frac{1}{\pi}\times\pi(0.2)^2\times\cos 60° = (0.2)^2\times\frac{1}{2} = 0.02\text{Wb}$

42. The situation is shown in the figure.

The horizontal momentum does not change.

Hence, the change in the vertical momentum is

$mv\sin\theta - (-mv\sin\theta) = 2mv\sin\theta$

$= 2mv\sin 45 = 2mv\frac{1}{\sqrt{2}} = \sqrt{2}mv$

43. The path difference between two points is

$\Delta x = 15 - 10 = 5$ m

Time period T = 0.05 s

$\Rightarrow$ frequency $\nu = \frac{1}{T} = \frac{1}{0.05} = 20\text{Hz}$

Velocity V = 300 m/s

$\therefore$ Wavelength, $\lambda = \frac{V}{\nu} = \frac{300}{20} = 15\text{m}$

Hence, the phase difference will be

$\Delta\phi = \frac{2\pi}{\lambda}\times\Delta x = \frac{2\pi}{15}\times 5 = \frac{2\pi}{3}$

44. The density of nuclear matter is independent of the mass number. So, the required ratio is 1:1.

45. When sand is being dropped, the momentum of the belt changes.
This momentum is related to force by Newton's second law as

Force required, $F = \frac{d(mv)}{dt}$

$= v\left(\frac{dm}{dt}\right) = vM$ (as velocity v is constant)

F = Mv newton

46. Writing the given wave equation

$y = 0.25 \sin (10\pi x - 2\pi t)$ ..... (i)

The minus (−) between $(10\pi x)$ and $(2\pi t)$ implies that the wave is travelling along the positive x direction.

Now compare equation (i) with the standard wave equation as

$y = A \sin (kx - \omega t)$ ..... (ii)

Hence, we have

$A = 0.25$ m, $\omega = 2\pi$, $k = 10\pi$ m

$\therefore \frac{2\pi}{T} = 2\pi \left(\because \omega = \frac{2\pi}{T}\right)$

$\Rightarrow f = 1$ Hz $\left(\because f = \frac{1}{T}\right)$

Also, $\lambda = \frac{2\pi}{k} = \frac{2\pi}{10\pi} = 0.2$ m

Therefore, the wave is travelling along the +ve x direction with frequency 1 Hz and wavelength 0.2 m.

47. Ferromagnetism decreases with rise in temperature. If we heat a ferromagnetic substance, then at a definite temperature, the ferromagnetic property of the substance suddenly disappears and the substance becomes paramagnetic. The temperature above which a ferromagnetic substance becomes paramagnetic is called the Curie temperature of the substance.

48. The ideal gas law is

$PV = nRT$

$PV = \frac{m}{M}RT$

$\Rightarrow \frac{PV}{m} = \frac{1}{M}RT$

$$\Rightarrow \frac{P}{\rho} = \frac{RT}{M}$$

where ρ is the density of the gas.

$$\frac{\rho}{P} \propto \frac{1}{T}$$

$$\therefore \frac{\rho_1 / P_1}{\rho_2 / P_2} = \frac{T_2}{T_1}$$

$$\Rightarrow \frac{x}{(\rho_2 / P_2)} = \frac{383}{283}$$

$$\Rightarrow \frac{\rho_2}{P_2} = \frac{283}{383}x$$

49. The dimensions of the quantities are as shown below.

(A) Energy density $= \frac{\text{Energy}}{\text{Volume}}$

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

(B) Refractive index has no dimensions.

(C) Dielectric constant has no dimensions.

(D) Young's modulus $Y = \frac{Fl}{A\Delta l} = \frac{[MLT^{-2}][L]}{[L^2][L]} = [ML^{-1}T^{-2}]$

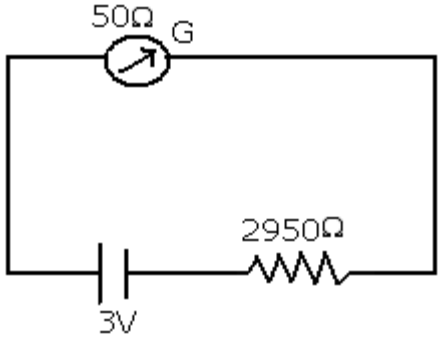
(E) Magnetic field $B = \frac{F}{Il} = \frac{[MLT^{-2}]}{[A][L]} = [MT^{-2}A^{-1}]$

Therefore, energy density and Young's modulus have the same dimensions.

So, option (3) is correct.

50. Current through the galvanometer will be

$$I = \frac{3}{(50+2950)} = 10^{-3}\,A$$



Current for 30 divisions = 10^{-3} A

Current for 20 divisions $= \frac{10^{-3}}{30} \times 20 = \frac{2}{3} \times 10^{-3}\,A$

For the same deflection to be obtained for 20 divisions, let resistance added be R.

$$\frac{2}{3}\times 10^{-3} = \frac{3}{(50+1R)}$$

$$\therefore 50+R = \frac{9}{2\times 10^{-3}} = 4.5\times 10^{3}$$

$$\therefore R = 4.5\times 10^{3} - 50$$

$$\therefore R = 4450\ \Omega$$

Chemistry

51. $M = \frac{M_1V_1 + M_2V_2 + M_3V_3}{V}$

where M = $[H^+]$ in mixture

M_1V_1 = $[H^+]$ of 1st acid × its volume

M_2V_2 = $[H^+]$ of 2nd acid × its volume

M_3V_3 = $[H^+]$ of 3rd acid × its volume

Assume the volume of each solution is 1 L.

$[H_3O^+]$ in the solution of pH 3 is 10^{-3} M.

$[H_3O^+]$ in the solution of pH 4 is 10^{-4} M.

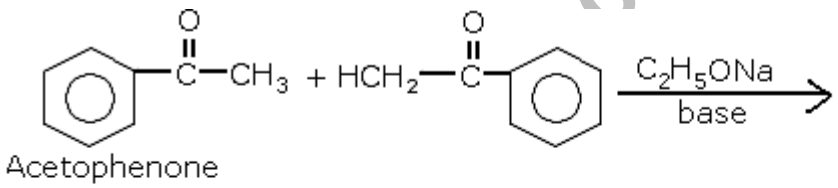
$[H_3O^+]$ in the solution of pH 5 is 10^{-5} M.

$$\text{Total}[H_3O^+] = \left(\frac{10^{-3} + 10^{-5}}{3}\right)$$

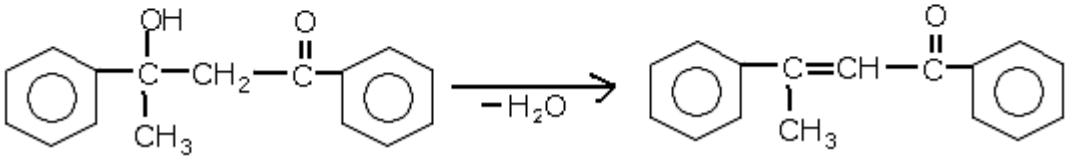
$$= 0.00037$$

$$= 3.7 \times 10^{-4}\ \text{M}$$

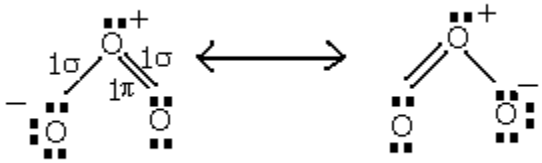
52.



Acetophenone



53. The O_3 molecule is bent with an angle of 116.8° and equal O–O distance of 128 pm. The ozone molecule consists of 2 sigma bonds and 1 pi bond. The angular shape of the ozone molecule is represented as



54. $[Fe(CN)_6]^{3-} + e^- \rightarrow [Fe(CN)_6]^{4-}$; $E° = 0.35$ V

$Fe^{3+} + e^- \rightarrow Fe^{2+}$; $E° = 0.77$ V

The reduction potential of Fe^{3+}/Fe^{2+} is higher; hence, Fe^{3+} is the strongest oxidising agent.

55. Green Chemistry involves reactions which reduce the use and production of hazardous or toxic chemicals to reduce pollution in the environment.

56. ∵ Internal energy (ΔE) = q + W
It is a state function because it is independent of the path. It is an extensive property.
∵ Gibbs energy (G) = H – TS
It is also a state function because it is independent of the path. It is also an extensive property.
Heat (q) and work (W) are not state functions being path dependent.

57. According to Heisenberg's uncertainty principle, it is impossible to determine simultaneously the position and momentum of a moving microscopic particle, i.e.

$$\Delta x \times \Delta p \geq \frac{h}{4\pi}$$

$$\text{Here, } \Delta x = \Delta p \text{ and } \Delta p = m$$

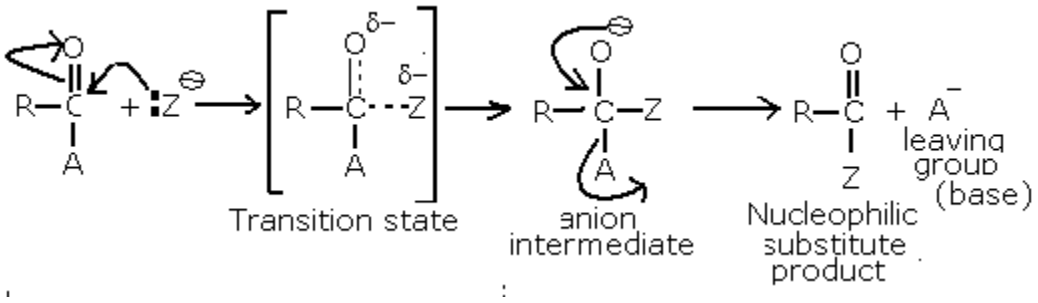
$$\Delta v \Rightarrow (m.\Delta v)(m.\Delta v) \geq \frac{h}{4\pi}$$

$$\therefore \Delta v^2 = \frac{h}{m^2 4\pi}$$

$$\Delta v = \frac{1}{2m}\sqrt{\frac{h}{\pi}}$$

58. The second ionisation energies of the first transition series increase almost regularly with increase in atomic number. However, the value for Cr is sufficiently higher. This is due to stable configuration of Cr^+ ($3d^5$ exactly half filled).

59. The nucleophilic acyl substitution is completed in two steps as shown below.



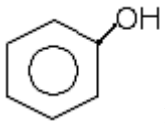
The reactivity of the compound may be explained on the basicity of the leaving group. A weaker base is a better leaving group. The basicity order is
$Cl^- > RCOO^- > RO^- > NH_2^-$
Hence, the order of leaving tendency is

$Cl^- > RCOO^- > R{-}O^- > NH_2^-$

Therefore, the order of reactivity of acyl compounds is
Acyl chloride > Acid anhydride > Ester > Amide

60. According to Kohlrausch's law at infinite dilution when the dissociation is complete, each ion makes a definite contribution to equivalent conductivity of the electrolyte irrespective of the nature of the other ion with which it is associated.

61.



is more reactive towards electrophilic substitution because the –OH group least destabilises the carbocation. Further, –OH is a strongly activating group, while $-NO_2$ and –Cl are deactivating groups.

62.

$$6.02\times10^{23}\ \text{molecules of water} = 1\ \text{mol} = 178\ \text{g}$$

$$\therefore \text{Mass of one molecule of water} = \frac{18}{6.023\times10^{23}}\ \text{g}$$

$$\because d = \frac{m}{V}$$

$$\therefore V = \frac{m}{d}$$

$$= \frac{18}{6.023\times10^{23}\times1}$$

$$\approx 3\times10^{-23}\ \text{cm}^3$$

63. $[V(gly)_2(OH)_2(NH_3)_2]^+$

$V_{23} = [Ar]\ 4s^2, 3d^3$

Oxidation state of V in $[V(gly)_2(OH)_2(NH_3)_2]^+$ is

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

$x = +5$

$V^{5+} = [Ar]\ 3d^\circ$ (No unpaired electron)

$[Fe(en)(bpy)(NH_3)_2]^{2+}$

$Fe_{26} = [Ar]\ 4s^2, 3d^6$

Oxidation state of Fe in $[Fe(en)(bpy)(NH_3)_2]^{2+}$ is

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

$x = +2$

$Fe^{2+} = [Ar]\ 3d^6$

But en, bpy and NH_3 are all strong field ligands, so pairing occurs and thus there are no unpaired electrons.

$[Co(OX)_2(OH)_2]^-$

$Co_{27} = [Ar]\ 4s^2, 3d^7$

Oxidation state of Co in $[Co(OX)_2(OH)_2]^-$ is

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

$x - 6 = -1$

$x = +5$

$Co^{5+} = [Ar]\ 3d^4$ (4 unpaired electrons)

$[Ti(NH_3)_6]^{3+}$

$Ti_{22} = [Ar]\ 4s^2, 3d^2$

Oxidation state of Ti in $[Ti(NH_3)_6]^{3+}$ is +3; thus, it contains 1 unpaired electron.

Hence, $[Co(OX)_2(OH)_2]^-$ has the highest paramagnetic behaviour.

64. The temperature of gas remains constant; hence, the kinetic energy of molecules remains the same.

65. $\Delta H = \Delta E + \Delta nRT$

Δn = number of moles of product − number of moles of reactants

$\Delta G = \Delta H - T\Delta S$

For a spontaneous process, ΔG must be negative.

$PCl_{5(g)} \rightarrow PCl_{3(g)} + Cl_{2(g)}$

In this reaction,

$\Delta n = 2 - 1 = 1 > 0$

Thus, ΔH is positive, i.e. > 0

If ΔH is positive, then to maintain the value of ΔG negative, ΔS should be positive, i.e. $\Delta S > 0$.

66. The relative reactivity of alkyl halides towards S_N2 reaction is
Primary > Secondary > Tertiary
Here, CH_3CH_2Br is the least hindered; hence, it has the highest relative rate towards the S_N2 reaction.

67. $3MnO_4^- + 5C_2O_4^{2-} + 24H^+ \rightarrow 3Mn^{2+} + 10CO_2 + 12H_2O$

$\because$ Number of moles of MnO_4^- required to oxidise 5 moles of $C_2O_4^{2-} = 3$

$\therefore$ Number of moles of MnO_4^- required to oxidise 1 mole of $C_2O_4^{2-} = \frac{3}{5} = 0.6\,mol$

68. $Fe(OH)_{3(s)} \square Fe^{3+}{}_{(aq)} + 3OH^-{}_{(aq)}$

$\therefore K = [Fe^{3+}][OH^-]^3$

Hence, if OH^- ion concentration is decreased by $\frac{1}{4}$ times, then equilibrium concentration of Fe^{3+} will increase by 64 times.

69. Generally, the size or radius of ions increases in a group. Li has the smallest size and thus binds with the maximum number of water molecules, becoming the largest in size in an aqueous solution. Hence, the order of ionic radii (size) of alkali metal ions in the aqueous solution is
$Li^+ > Na^+ > K^+ > Rb^+ > Cs^+$
Thus, the order of mobility
$Cs^+ > Rb^+ > K^+ > Na^+ > Li^+$

70. The thermal stability of alkali metal hydrides decreases as
LiH > NaH > KH > RbH > CsH
Because the size of cation increases as
$Li^+ < Na^+ < K^+ < Rb^+ < Cs^+$

71. In general, the bond dissociation energy decreases as the bond length increases, but the bond dissociation energy of F_2 is less than Cl_2. This is due to greater interelectronic repulsion between the lone pair of electrons on the two bonded F atoms. Hence, the order of the bond dissociation energy is
$Cl_2 > Br_2 > F_2 > I_2$

72. Given,

$\Delta G^0_{H_2O(l)} = -237.2$

$\Delta G^0_{CO_2(g)} = -394.4$

$\Delta G^0_{C_5H_{12}(g)} = -8.2$

$C_5H_{12} + 16O_2 \rightarrow 5CO_2 + 6H_2O$

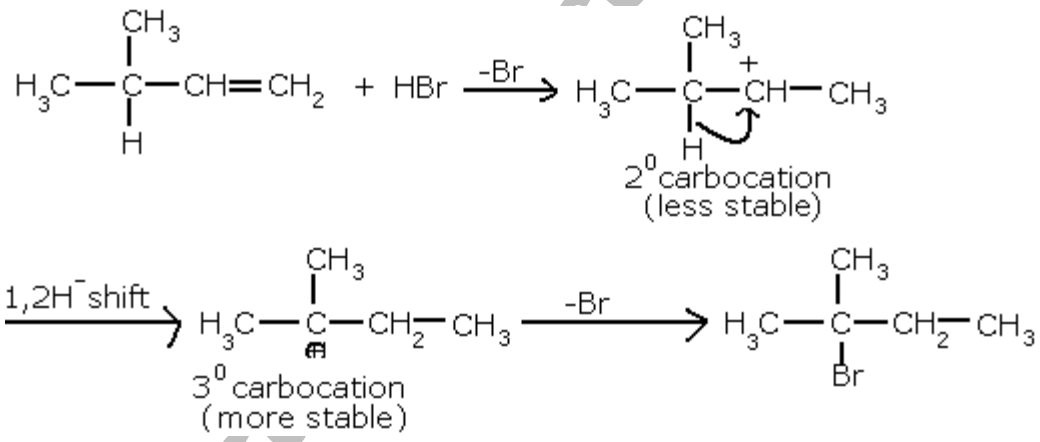
$$\Delta G^\circ = 5\times\Delta G^0_{CO_2} + 6\times\Delta G^0_{H_2O} - \left(\Delta G^0_{C_5H_{12}} + \Delta G^0_{O_2}\right)$$
$$= 5\times(-394.4) + 6\times(-237.2) - [(-8.2) + 0]$$
$$= -3387 kJ / mol$$

In a pentane-oxygen fuel cell, 32 electrons are involved.

$$\Delta G^\circ = nFE^0_{cell}$$
$$-3387\times10^3 = 32\times96500\times E^0_{cell}$$
$$E^0_{cell} = \frac{-3387\times10^3}{32\times96500}$$
$$= \frac{-3387}{3088}$$
$$= 1.0968$$

73. The mechanism of electrophilic addition reaction is consistent with the occurrence of rearrangement leading to more stable carbocation. The order of stability of carbocation is

Tertiary > Secondary > Primary > CH_3



74. The strength of their conjugate acids is in the order:

$HC\equiv CH > H_2C = CH_2 > CH_3—CH_3$

Therefore, the correct order of the strength of their conjugate base is

$$CH_3CH_2^{\ominus} > H_2C=\overset{\ominus}{C}H > HC\equiv\overset{\ominus}{C}$$

75. Packing fraction of simple cube

$$= \frac{z\times\frac{4}{3}\pi r^3}{a^3} = \frac{1\times\frac{4}{3}\pi r^3}{(2r)^3}$$
$$= 0.52$$

($\because$ For primitive cell a = 2r)

$\therefore$ Volume occupied = 52%

The number of atoms in a unit cell of diamond is 8.

76. For simple cubic, a = 2r

$\therefore r = \frac{a}{2}$

For body centred cubic,

$a = \frac{4r}{\sqrt{3}}$

$r = \frac{\sqrt{3}a}{4}$

For face centred cubic,

$a = 2\sqrt{2}r$

$r = \frac{a}{2\sqrt{2}}$

Hence, the ratio of radii in simple cubic, body-centred cubic and face-centred cubic is

$\frac{a}{2} : \frac{\sqrt{3}a}{4} : \frac{a}{2\sqrt{2}}$

77. $\log k_1 = \log 10^{16} - \frac{2000}{2.303T}$ ...(i)

$\log k_2 = \log 10^{15} - \frac{1000}{2.303T}$ ... (ii)

Hence, from equations (i) and (ii),

$t = \frac{1000}{2.303}K$ when $k_1 = k_2$

78. Volume of a gas at STP = 22.41 L

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

22.4 L 5×22.4 L

$\therefore$ To burn 22.4 L C_3H_8, the oxygen required is

$= 5 \times 22.4$ L

$\therefore$ To burn 1 L C_3H_8, the oxygen required will be

$= \frac{5 \times 22.4}{22.4}$

= 5 L

79. In NO_2^- ion, N-atom undergoes sp^2 hybridisation. The angle between hybrid orbitals should be 120° but one lone pair of electrons is lying on N-atom; hence, the bond angle decreases to 115°.
In NO_2 molecule, N-atom has one unpaired electron in the sp^2 hybrid orbital. The bond angle should be 120° but actually it is 132°. It may be due to one unpaired electron in the sp^2-hybrid orbital.
Hence, the increasing order of bond angles is $NO_2^- < NO_2 < NO_2^+$.

80. $CH_3CH=\overset{*}{C}HCH_2\overset{*}{C}HBrCH_3$
Because there are two chiral centres in the given compound, the number of stereoisomers = $2^2 = 4$.

81. In alkaline Earth metals on moving downwards, the size of the cation increases, thus basicity increases. Hence, the increasing order of basicity is
$MgCl_2 < CaCl_2 < SrCl_2 < BaCl_2$
Therefore, the solution of $BaCl_2$ will record the highest pH.

82. $He_2^+:(\sigma 1s)^2(\sigma^* 1s)^1$

$$\text{Bond order} = \frac{2-1}{2} = \frac{1}{2}$$

C_2^{2-} : $(\sigma\ 2s)^2\ (\sigma^*\ 2s)^2\ \ (\pi\ 2p_x)^2\ (\pi\ 2p_y)^2\ (\sigma\ 2p_z)^2$

$$\text{Bond order} = \frac{8-2}{2} = 3$$

$$O_2^-:(\sigma 2s)^2(\overset{*}{\sigma} 2s)^2(\sigma 2p_z)^2(\pi 2p_x)^2(\pi 2p_y)^2(\overset{*}{\pi} 2p_x)^2(\overset{*}{\pi} 2p_y)^1$$

$$\text{Bond order} = \frac{8-5}{2} = 1\frac{1}{2}$$

$$NO:(\sigma 2s)^2(\overset{*}{\sigma} 2s)^2(\sigma 2p_z)^2(\pi 2p_x)^2(\pi 2p_y)^2(\overset{*}{\pi} 2p_x)^1$$

$$\text{Bond order} = \frac{8-3}{2} = 2\frac{1}{2}$$

Hence, the order of increasing bond orede is
$He_2^+ < O_2^- < NO < C_2^{2-}$

83. For a body-centred cube,

$$\text{Packing fraction} = \frac{2\times\frac{4}{3}\pi r^3}{\left(\frac{4r}{\sqrt{3}}\right)^3} = \left(\frac{\sqrt{3}\pi}{8}\right) = 0.68$$

where edge length $a = \frac{4r}{\sqrt{3}}$

$\therefore$ Volume occupied = 68% and volume vacant = 32%

84. The n-type semiconductors are obtained when Si or Ge are doped with elements of group 15, e.g. arsenic (As), while the p-type semiconductors are obtained when Si or Ge are doped with traces of elements of group 13, i.e. indium (In) and boron (B).

85.

Element	%	At. Wt.	Relative No. of atoms	Simplest ratio of atoms
C	38.71	12	3.23	$\frac{3.23}{3.23}=1$
H	9.67	1	9.67	$\frac{9.67}{3.23}=3$
O	51.62	16	3.23	$\frac{3.23}{3.23}=1$

Hence, the empirical formula is CH_3O.

86. $\Delta x \times \Delta p \geq \frac{h}{4\pi}$ and $\Delta p = m\Delta v$

where Δp = uncertainty in momentum and Δv = uncertainty in velocity

Here, $\Delta p = 1 \times 10^{-18}$ g cms^{-1}

$m = 9 \times 10^{-28}$ g

$$\Delta v = \frac{\Delta p}{m} = \frac{1\times10^{-18}}{9\times10^{-28}}$$

$$= 1.1\times10^{9}$$

$$\approx 1.0\times10^{9}\ \text{cms}^{-1}$$

87.

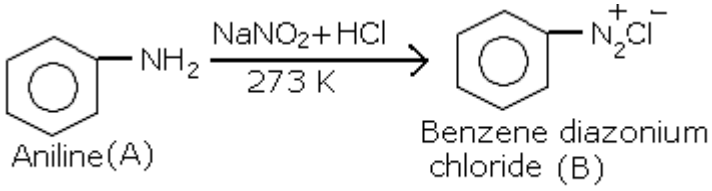
$$PbO + 2HCl \rightarrow PbCl_2 + H_2O$$
$$(223.2) \quad (73) \quad (278.2)$$

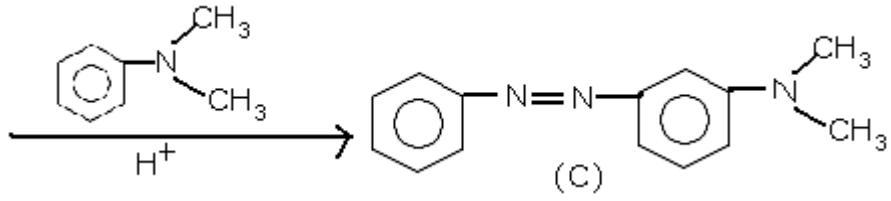
HCl is in excess; hence, PbO is the limiting reactant.

Since 224 g PbO gives 1 mole $PbCl_2$

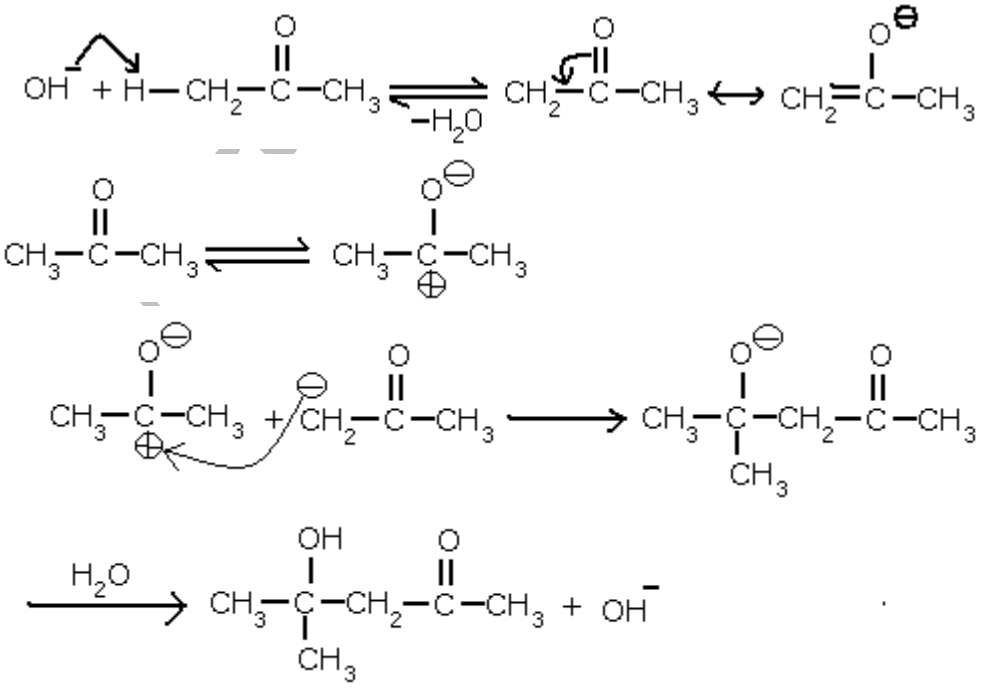
$$6.5\,g\,PbO = \frac{6.5}{223.2} = 0.029\,mol$$

88.





89. Among the given compounds, carbonyl carbon (> C = O), i.e. ketone is more electrophilic in nature and thus loses α-H with a base. Example: In the aldol condensation reaction, the α-hydrogen atom of aldehyde or ketone is abstracted by a strong base.



90. Higher the electronegativity of the atom, higher will be the stability of carbanion on it. Higher the s-character, higher will be the electronegativity of the atom.

$$RC\equiv\overset{\ominus}{C} > C_6H_5\overset{\ominus}{} > R_2C=\overset{\ominus}{C}H > R_3C-\overset{\ominus}{C}H_2$$

91. Here, $\Delta H_{H-H} = 434\ kJ\ mol^{-1}$

$\Delta H_{Cl-Cl} = 242\ kJ\ mol^{-1}$

$\Delta H_{H-Cl} = 431\ kJ\ mol^{-1}$

$$\therefore \frac{1}{2}H_2+\frac{1}{2}Cl_2 \rightarrow HCl$$

$$\Delta H_{reaction} = \frac{1}{2}\Delta H_{H-H}+\frac{1}{2}\Delta H_{Cl-Cl}-\Delta H_{H-Cl}$$

$$=\frac{1}{2}\times 434+\frac{1}{2}\times 242-431$$

$$=217+121-431$$

$$=-93\,kJ\,mol^{-1}$$

92.

$$2AB_2(g) \rightleftharpoons 2AB(g)+B_2(g)$$

1	0	0	Initial moles
$2(1-x)$	$2x$	x	

where $x = degree\ of\ dissociation$

$Total\ moles\ at\ equilibrium = 2-2x+2x+x = (2+x)$

So,

$$p_{AB_2} = \frac{2(1-x)p}{(2+x)}$$

$$p_{AB} = \frac{2xp}{(2+x)}$$

$$p_{B_2} = \frac{xp}{(2+x)}$$

$$K_p = \frac{(p_{AB})^2(p_{B_2})}{(p_{AB_2})}$$

$$=\frac{\left(\frac{2xp}{2+x}\right)^2\left(\frac{x}{2+x}P\right)}{\left(\frac{2(1-x)}{(2+x)}P\right)}$$

$$=\frac{2x^3p}{(2+x)^2(1-x)}$$

$[\because x <<< 1 \text{ and } 2, \text{so} (1-x) \approx 1, (2+x) \approx 2]$

$$\Rightarrow K_p = \frac{2x^3p^2}{(2)^2(1)}$$

$$= \frac{x^3p}{2}$$

$$x = \left(\frac{2K_p}{p^2}\right)^{1/3}$$

93. Thyroxin is an amine hormone. It is secreted by the thyroid gland. Its function is to control the metabolism of carbohydrates, proteins and lipids.

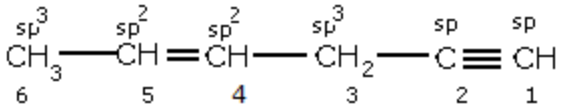
94. Natural rubber is cis-polyisoprene. It is prepared from latex which is obtained from the rubber tree.

95. –C–C– sp^3

–C=C– sp^2

–C≡C– sp

=C=C= sp



Hence, the state of hybridisation of carbon 1, 3 and 5 is sp, sp^3 and sp^2, respectively.

96. From the given equation,

$X \rightleftharpoons Y + Z$

1	0	0	Initial mole
$(1-\alpha)$	α	α	Mole at equilibrium

$$K_{p_1} = \frac{P_Y \times P_Z}{P_X}$$

$$= \frac{\left[\frac{\alpha \times p_1}{1+\alpha}\right]\left[\frac{\alpha \times p_1}{1+\alpha}\right]}{\left[\frac{1-\alpha}{1+\alpha}\right]p_1}$$

$$K_{p_1} = \frac{\alpha^2 p_1}{1-\alpha^2} \quad \text{.....(i)}$$

From the given equation,

A	⇌	2B	
1		0	Initial mole
$(1-\alpha)$		2α	Mole at equilibrium

$$K_{p_2} = \frac{\left[\frac{2\alpha}{1+\alpha} \times p_2\right]^2}{\left[\frac{1-\alpha}{1+\alpha}\right] p_2}$$

$$= \frac{4\alpha^2 p_2}{1-\alpha^2} \quad \text{.....(ii)}$$

From equations (i) and (ii),

$$\frac{K_{p_1}}{K_{p_2}} = \frac{p_1}{4p_2}$$

$$\Rightarrow \frac{9}{1} = \frac{p_1}{4p_2}$$

$$\therefore \frac{p_1}{p_2} = \frac{36}{1}$$

97. Deoxyribonucleic acid (DNA) has the purine bases adenine and uracil. According to the base pairing rule, adenine pairs with thymine (A≡T) and cytosine pairs with guanine (C≡G).

98. Let the rate of the reaction w.r.t. $[CH_3COCH_3]$, $[Br_2]$ and $[H^+]$ be x, y and z, respectively. Thus,

Rate $\propto [CH_3COCH_3]^x [Br_2]^y [H^+]^z$

$5.7 \times 10^{-5} = [0.30]^x [0.05]^y [0.05]^z$ ....(i)

$5.7 \times 10^{-5} = [0.30]^x [0.10]^y [0.05]^z$ ....(ii)

$1.2 \times 10^{-4} = [0.30]^x [0.10]^y [0.10]^z$ ....(iii)

$3.1 \times 10^{-4} = [0.40]^x [0.05]^y [0.20]^z$ ....(iv)

From equations (i) and (ii),

y = 0

From equations (ii) and (iii),

z = 1

From equations (i) and (iv),

x = 1

Thus, rate law $\propto [CH_3COCH_3][H^+]$

$= k[CH_3COCH_3][H^+]$

99. $HI_{(g)} \rightleftharpoons \frac{1}{2}H_{2(g)} + \frac{1}{2}I_{2(g)}$

$$K_1 = \frac{[H_2]^{1/2}[I_2]^{1/2}}{[HI]} \quad .....(i)$$

$H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$

$$K_2 = \frac{[HI]^2}{[H_2][I_2]} \quad .....(ii)$$

From equations (i) and (ii),

$$K_1^2 = \frac{1}{K_2}$$

$$\because K_1 = 8.0$$

$$\therefore K_2 = \frac{1}{K_1^2} = \frac{1}{8^2} = \frac{1}{64}$$

100. $I^- < Br^- < Cl^- < OH^- < H_2O < C_2O_4^{2-} < NH_3 < en < NO_2^- < CN^-$

The CN^- is the strongest ligand among these; hence, the magnitude of Δ_{oct} will be maximum in $[Co(CN)_6]^{3-}$.

Biology

101. The fluid mosaic model of the plasma membrane was given by Singer and Nicolson (1972). According to this model, the plasma membrane is a quasi-fluid structure consisting of bimolecular lipid layer and proteins. The flip-flop movement is rarely found in lipid molecules, whereas it remains absent in protein.

102. In angiosperms, the embryo sac is a 7-celled 8-nucleate structure which consists of a haploid egg nucleus and antipodal cells.

103. C_4 plants show Kranz anatomy and have more number of chloroplasts in their bundle sheath cells. Also, Kranz anatomy allows photosynthesis to occur at very low concentration of CO_2. Thus, making C_4 plants more effective.

104. Oxytocin hormone is released in the neurohypophysis of the pituitary gland. It promotes the contraction of the uterine muscles and it also helps in parturition, therefore it is also known as birth hormone.

105. Gel electrophoresis is used for the separation of DNA fragments according to their size. When genomic DNA is extracted from any tissue, it is cleaved into segments of different sizes. Later, these fragments are subjected to the electrical field in which they are separated because of the presence of charges on them.

106. When a large number of ribosomes attaches to the endoplasmic reticulum, it is known as a polyribosome. It helps in the translational process.

107.

	Method		Mode of action
A.	The pill	1.	Prevents ovulation
B.	Condom	2.	Prevents sperms from reaching the cervix
C.	Vasectomy	3.	Semen contains no sperms
D.	Copper-T	4.	Prevents implantation

108. Vital capacity of the lungs is the largest possible expiration after the largest possible inspiration.

Vital Capacity = Inspiratory Reserve Volume + Total Volume + Expiratory Reserve Volume

Total Lung Capacity (TLC) = Vital Capacity (VC) + Residual Volume (RV)

Therefore, VC = TLC – RV

109. *Pteris* and *Polytrichum* are pteridophytes, and they have independent saprophyte and gametophyte.
Funaria is a bryophyte in which both gametophyte and sporophyte are present and alternate with each other.
Cedrus is a conifer in which the male and female gametophytes do not have free-living existence.

110. Vitamin A deficiency causes night blindness among children. Golden rice is a transgenic crop which is rich in Vitamin A and may help in solving the problem of night blindness in developing countries.

111. A lake near a village suffered heavy mortality of fish within a few days, because lots of urea and phosphate fertilisers were used in the crops in the vicinity. Enrichment of the aquatic bodies resulted in eutrophication, turning the water green and stinky. As a result, it caused excessive cyanophycean growth resulting in the increase of oxygen demand. Finally, the death of aquatic animals occurs because of less dissolved oxygen.

112. The diagram of the cochlea represents three different parts—perilymph, tectorial membrane and endolymph. The cochlea arises from the sacculus. It is a spirally coiled duct and known as lagena.

113. Senescence is programmed death. In plants, senescence is confined not only to the whole plant but also may be limited to a particular organ such as the leaf, flower or the phloem and xylem. Abscission is the natural shedding of leaves, and it is a senescence phenomenon.

114. According to the histogen theory for shoot apical meristem, there are three distinct meristematic zones (layers) called dermatogens, periblem and plerome. The dermatogen is the outermost histogen giving rise to the epidermis, the periblem is the middle one producing the cortex and the plerome is the innermost resulting in central cylinder, i.e. the vascular tissue.

115. Nitrogen fixation in the root nodules of *Alnus* is brought about by the actinomycete *Frankia*.

116. HCl secretion in the stomach activates inactive pepsinogen into active pepsin. If the parietal cell of gastric glands is blocked with an inhibitor, HCl will not be secreted, resulting in the lack of pepsin synthesis.

117. Quinine is the first electron acceptor for electrons given out by photosystem II.

118. *Trichoderma harzianum* has proved a useful microorganism for biological control of soil-borne plant pathogens. They have an inhibitory effect on the growth of the mycelium of *Pythium*, thereby helping in suppressing fungi from causing damping off disease of seedlings.

119. Basophils release heparin, histamine and serotonin as part of the body's defence mechanism at the site of infection or injury.

120. The presence of scales on the hind limbs and eggs with a calcareous shell indicate the reptilian ancestry of birds.

121. In pea, the endosperm is consumed by the developing embryo in the seed. When the endosperm is completely absorbed by the growing embryo and the food reserve gets stored in the cotyledons, such seeds are called non-endospermic or exalbuminous.

122. In human, at the end of the first meiotic division, the male germ cells differentiate into the secondary spermatocytes.

123. In the DNA molecule, there are two strands which run antiparallel—one in the 5′–3′ direction and the other in the 3′–5′ direction. The two chains are held together by hydrogen bonds between their bases. The antiparallel nature of DNA was shown through the double helix model of Watson and Crick.

124. The use of disease-free seeds from disease-resistant varieties is the most important control measure which could be taken to successfully grow chickpea in an area where bacterial blight disease is common.

125. The rupture and fractionation do not usually occur in the water column in vessels/tracheids during the ascent of sap because of cohesive and adhesive forces acting on the water column. The water molecules have a great mutual attraction with each other which helps in building a continuous water column.

126. Calcium metabolism in our body is controlled by the hormone parathormone secreted by the parathyroid gland. It acts to maintain normal blood levels of calcium by increasing the number of osteoclasts which break down the bone matrix and release calcium into the blood. It also increases the reabsorption of calcium and magnesium ions in the kidney tubules, so that their concentration is maintained in the blood.

127. About 70% of the total global carbon is found in oceans in the form of both living organisms and non-living dead remains of the organisms. This oceanic reservoir regulates the amount of carbon dioxide in the atmosphere. The atmosphere contains only about one percent of the total global carbon.

128. Heterosporous ferns are characterised by the formation of two different types of spores—microspores and megaspores. *Salvinia* is an aquatic fern and produces two types of spores.

129. A cypsela is a dry indehiscent single-seeded fruit formed from a bicarpellary syncarpous inferior ovary. It is a characteristic fruit of Family Compositae.

130. The amnion is an extra embryonic membrane in human which prevents desiccation of the embryo inside the uterus. It encloses the embryo in the amniotic cavity. This cavity is filled with amniotic fluid, in which the embryo is protected from desiccation and from external pressure.

131. The fleshy receptacle of the syconus of fig encloses several achenes. An achene is a thin dry pericarp. It is free from the seed except at one point. The fruit develops from a monocarpellary pistil with a superior unilocular ovary.

132. Bordeaux mixture is used primarily as a fungicide; it was first used to control downy mildew disease of grape vine caused by the fungus *Plasmopara viticola*. In fact, it was the first pesticide to be used commercially. 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 litres of waters.

133. Unisexuality of flowers prevents autogamy but not geitonogamy. In self-fertilisation, the male and female gametes are derived from the same individual.

134. The length of different internodes in a culm of sugarcane is variable because of the intercalary meristem. The intercalary meristem occurs in the internodes of grasses (sugarcane) between the leaf nodes and enables the longitudinal growth of the stem.

135. The correct differences between rod cells and cone cells of our retina:

Features	Rod Cells	Cone Cells
(1) Visual acuity	Low	High
(2) Visual pigment contained	Rhodopsin	Iodopsin
(3) Overall function	Vision in poor light	Colour vision and detailed vision in bright light
(4) Distribution	Distributed all over the retina	More concentrated in the centre of the retina

136. In C_4 plants, phosphoenolpyruvate (PEP) acts as the CO_2 acceptor in the mesophyll cell. It forms the first stable product oxaloacetate (OAA) which is later reduced to form malate. Later, malic acid is transferred to the bundle sheath cell for further action.

137. GUU – Valine, GCU – Alanine, UAG & UGA – Stop codons, AUG – Methionine, UUA – Leucine, UCA – Serine

138. The cell wall of fungi is made of chitin. However, oomycetes is an exception as the cell wall in this group consists of cellulose. *Pythium* belongs to Oomycetes; hence, its cell wall is made of cellulose.

139. The slow rate of decomposition of fallen logs in nature is due to their low cellulose content. Cellulose, in fact, helps in microbial activity and is an essential part in death and decay of plants.

140. Carbohydrates are commonly found as starch in plant storage organs. It is useful as a storage material because it is chemically non-reactive and osmotically inactive. Carbohydrates perform a very vital role in living organisms. In plants, it is stored in the form of energy primarily in the form of deposition. Animals feed on these carbohydrates for their requirement of energy.

141. The parathyroid glands and adrenal glands are endocrine glands. Adrenal glands are present over the kidney. The parathyroid glands are present near the thyroid gland.

142.

Column I		Column II
A. Amoebiasis	1.	Use only sterilised food and water
B. Diphtheria	2.	DPT vaccine
C. Cholera	3.	Use oral rehydration therapy
D. Syphilis	4.	*Treponema pallidum*

143. Replum is present in the ovary of mustard. It is a characteristic feature of Family Brassicaceae. Here, a false septum is formed which develops between the parietal placentation. As a result, the unilocular ovary becomes bilocular.

144. The correct matching of the site of action on the given substrate, the enzyme acting upon it and the end-product can be shown as follows:

(1) Duodenum : Triglycerides $\xrightarrow{\text{Lipase}}$ Monoglycerides

(2) Small intestine : Starch $\alpha \xrightarrow{\text{Amylase}}$ Disaccharide (maltose)

(3) Small intestine : Proteins $\xrightarrow{\text{Trypsin}}$ Amino acids

(4) Stomach : Proteins $\xrightarrow{\text{Pepsin}}$ Amino acids

145. Modern detergents contain enzyme preparations of alkaliphiles. The alkaliphiles maintain an alkaline level of about 9 pH inside the cell. It helps in keeping the right pH level by pumping in H^+ at the right rate.

146. The haemoglobin of a human foetus has a higher affinity for oxygen than that of an adult.

147. The theory of continuity of germplasm was proposed by August Weismann. It proposes that the content of the germ cells passes to the next generation without being affected because of any change in the body. Thus, it rules out the theory of inheritance of the acquired characters.

148. The most active phagocytic white blood cells are neutrophils and monocytes. The neutrophil is a type of white blood cell which engulfs bacteria and releases various substances such as lysozyme and oxidising agents. The monocyte is the largest form of white blood cell. It is phagocytic in nature and destroys bacteria and removes cell debris.

149. According to the Central Pollution Control Board (CPCB), a particulate size of diameter 2.5 μ or less is responsible for the greatest harm to human health. Our natural defence systems in the form of nasal hair are not capable of filtering suspended particulate matter of size less than 2.5 μ.

150. Hashish causes afterthought perceptions and hallucinations. It is a preparation of cannabis composed of compressed trichomes collected from the cannabis plant. A psychoactive effect of hashish is very much similar to marijuana.

151. The two subunits of ribosomes remain united at a critical ion level of Mg. The level of Mg ions decides the binding of both subunits during the translational process

152. During the propagation of a nerve impulse, the action potential results from the movement of Na^+ ions from extracellular fluid to intracellular fluid. Stimulation of the nerve fibre generates an action potential resulting in the propagation of the nerve impulse. Na^+ enters followed by the movement of K^+ ions.

153. Bacterial leaf blight of rice is caused by a species of *Xanthomonas*.

154. Darwin's finches are an excellent example of adaptive radiation. This is an evolutionary process driven by the process of natural selection. In adaptive radiation, a single species diversify into a large number of descendents which occupy various environmental conditions.

155. Earthworms have no skeleton. During burrowing, the anterior end becomes turgid and functions as a hydraulic skeleton. This is due to the coelomic fluid which consists of water, salts and four types of cells—chloragogen cell, circular cell, monocytes and amoebocytes.

156. Adenine and guanine are purines. Uracil, cytosine and thymine are pyrimidines.

157. One of the main objectives of the production/use of herbicide-resistant genetically modified crops is to reduce herbicide accumulation in food particles for health safety. Genetically modified foods are naturally resistant to pests; hence, they reduce the application of herbicides.

158. Area d has all the 10 species and a less number of habitats; hence, it has more population.

159. Under innate immunity, the saliva in the mouth and the tears from the eyes belong to physiological barriers.

160. Cornea transplant in humans is hardly ever rejected because it has no blood supply. The cornea is a transparent layer of tissue occurring over the iris and lens. It is a living tissue and takes oxygen directly from the air but is devoid of any blood supply. Because blood supply is absent, the antigen–antibody reaction is absent, making the transplantation successful in majority of the cases.

161. Fermentation consumes $NADH^2$, and the e^- acceptor is released as unused NAD^+. Glycolysis uses an external e^- acceptor NAD^+.

162. *Gnetum* can be distinguished from *Cycas* and *Pinus* on the basis of showing affinities towards angiosperms. The presence of vessel elements and the absence of archegonia in *Gnetum* are the key features which show its angiospermic affinities. These two features are absent in confers such as *Cycas* and *Pinus*.

163. Thorn of Bougainvillea and tendril of Cucurbita are examples of homologous organs. Both are part of leaf and get modified into structures performing different functions.

164. There is a decline in tribal population as boys marry girls only from their own tribe among the isolated small tribal populations.

165. Human insulin is commercially produced from a transgenic species of *E. coli*. An insulin-producing gene is inserted into the *E. coli* genome through genetic engineering. Later, such engineered bacteria are cloned for the production of insulin.

166. Archaebacteria is an ancient bacteria which differs from a typical prokaryotic or eukaryotic cell. Archaebacteria can survive in tough environmental conditions such as high salt concentration (halophiles), low pH (acidophiles) and under anaerobic conditions produces methane (methanogens).

167. *Thermococcus*, *Methanococcus* and *Methanobacterium* exemplify archaebacteria which lack any histones resembling those found in eukaryotes but whose DNA is negatively super coiled.

168. Malonate is a competitive inhibitor of enzyme succinic dehydrogenase. It binds to the active site of the enzyme and competes with succinate. In the trichloroacetic acid cycle, it inhibits complex II.

169. Cry-I endotoxins obtained from *Bacillus thuringiensis* are effective against boll worms. Boll worms attack the fruiting bodies of cotton and destroy them.

170. Vacuole in a plant cell is membrane-bound and contains water and excretory substances. The membrane of vacuole is known as tonoplast. It also helps in regulating the water inside the plant cell.

171. Lesser interspecific competition is not observed in biodiversity hotspots. Biodiversity hotspots are characterised by species richness and a high degree of endemism. Loss of habitat is one of the most important threats to biodiversity hotspots.

172. Medical termination of pregnancy (MTP) during the first trimester is generally safe. Intrauterine devices such as copper-T are effective. Statement a and c are correct.

173. *Paecilomyces lilacinus* is effective for biological control of nematodal diseases in plants. It is a cosmopolitan filamentous fungus which inhabits the soil, decaying plants and food products.

174. The correctly matched chromosomal abnormality/linkage:
(1) Klinefelter's syndrome — 44 autosomes + XXY
(2) Colourblindness — X-linked
(3) Erythroblastosis foetalis — Rh-linked
(4) Down syndrome — 23rd trisomy

175. The correct numbers:
(1) Floating ribs in humans — 4
(2) Amino acids found in proteins — 20
(3) Types of diabetes — 2
(4) Cervical vertebrae in humans — 11

176. In germinating seeds, fatty acids are degraded exclusively in the glyoxysome. It is the site of occurrence of glyoxylate cycle in which fatty acids are subjected to β-oxidation.

177. Filiform apparatus is present in the synergid cells and is rich in endoplasmic reticulum. It guides the entry of the pollen tube into synergid cells.

178. *Jatropha* is tried in India as a biofuel substitute for fossil fuels. These are fuels of biological origin and constitute a renewable form of energy.

179. Pollen exine is resistant to enzyme action. The exine of pollen is chemically made of sporopollenin—one of the most resistant of organic materials. An enzyme which can degrade sporopollenin is yet to be known.

180. In antisense technology, a piece of RNA which is complementary in sequence is used to stop the expression of a specific gene. This technology is mostly used to modify the activity of a disease-causing gene. Antisense RNA can undergo complementary base pairing with m-RNA, thereby preventing its expression.

181. Haploids are more suitable for mutation studies than diploids. This is because all mutations, whether dominant or recessive, are expressed in haploids. Because the haploid has no allelic counterpart to dominate or suppress it, it expresses all genotypic changes in the form of specific phenotypes.

182. Annelida possess true coelom. Pseudocoelomate is an animal whose body cavity is a pseudocoel. It is a cavity between the gut and the outer body wall derived from a persistent blastocoel. Pseudocoelomates include animals in Phyla Rotifer and Nematoda.

183. The importance of day length in the flowering of plants is known as photoperiodism. It was discovered by Garner and Allard (1920) when they observed that the Maryland Mammoth variety of tobacco could be made to flower in summer by reducing the light hours with artificial darkening.

184. In humans, blood passes from the vena cava to the diastolic right atrium of the heart because of suction pull.

185. Cockroach belongs to Phylum Arthropoda. Arthropods are characterised by 10 pairs of spiracles. Two pairs of spiracles are present on the thorax and 8 pairs are present on the abdomen.

186. The linking of antibiotic resistance gene with the plasmid vector became possible with DNA ligase. It is an NAD-dependent enzyme and catalyses the formation of phosphodiester bonds. DNA ligase is also used in recombinant DNA technology in which the desired gene is inserted in the vector-forming recombinant molecule.

187. The menstrual fluid is normally non-clotting because a fibrinolysin is released along with necrotic endometrial material.

188. Mollusca is mostly oviparous, and a few are viviparous. Fertilisation is external or internal, and development is direct or indirect through free larval forms.

189. The nephridia of earthworm and the Malpighian tubules of cockroach are excretory organs. The excretory system of earthworm consists of a large number of minute, coiled and segmentally arranged tubules called nephridia. Malpighian tubules in cockroach are extremely fine unbranched thread-like structures present at the junction of the midgut and the hindgut.

190. The chemiosmotic hypothesis was proposed by Mitchell to explain the coupling of iP to ADP forming ATP. During the transfer of electrons along the electron transport system, protons are pumped in the perimitochondrial space. It results in the generation of the concentration gradient between the matrix and the perimitochondrial space. The concentration gradient facilitates the movement of protons resulting in the coupling of iP and ADP. The reaction is catalysed by the enzyme ATP synthetase, and ATP is formed.

191.

(A) During open heart surgery, blood is circulated in the heart lung machine.

(B) Blockage in coronary arteries cannot be removed by angiography. Angiography, in fact, is radiographic visualisation of the blood vessels after injecting a radio-opaque agent.

(C) Computerised axial tomography (CAT) shows the detailed internal structure as seen in a section of the body.

(D) X-rays have remarkable ability to penetrate materials which do not transmit visible light. It is commonly employed for diagnosis of disease of the heart, lungs and bones.

Hence, the correct statements in the given question are (A) and (C).

192. The series of organisms eating and being eaten by others is called the food chain. The number of trophic levels in the food chain is restricted to 3–5 as there is loss of energy during the transfer from one trophic level to another. The food chain helps in the maintenance of ecological balance. If carnivores are removed from any ecosystem, it will result in an increase in the population of herbivores.

193. *Ascaris* or roundworm is a common parasite found in the large intestines of human. It is characterised by the presence of neither true coelom nor metamerism.

194. Kangaroo rat is a desert rodent. Its body is covered by hair. It feeds on dry seeds and does not require drinking water. It conserves water as the urine excreted is very concentrated, and it does not use water to regulate body temperature. Most of the water is metabolically produced by the oxidation of the food it eats.

195. The concept of coacervate was given by Oparin and Sydney. Coacervate, according to them, is an aggregate of macromolecules such as proteins, carbohydrates and lipids capable of converting them into certain complex molecules such as starch. Coacervate droplets arise spontaneously under appropriate environmental conditions. They are considered the originator of prebiological systems which eventually give rise to living organisms; however, they could not reproduce.

196.

Characteristics	Animals
Bilateral symmetry	Liver fluke, Taenia
Jointed appendages	Cockroach, Prawn, Scorpion
Ventral solid central nervous system	Scorpion, Spider, Cockroach
Metameric segmentation	Annelids
Radial symmetry	Sea anemone

197. The fruit of pomegranate is chambered, developed from the inferior ovary and has seeds with a succulent testa. Such a fruit is known as balausta. It is a special type of false berry in which the syncarpous pistil consists of two rows of fused carpels. The seeds possess a bright red juicy testa.

198. CFCs 14%, CH_4 20% is the correct percentage of the two greenhouse gases which contribute to the total global warming.

199. World Summit on Sustainable Development (2002) was held in Johannesburg, South Africa. It was attended by 190 countries and decided to achieve significant reduction in the loss of biodiversity by 2010.

200. *Quercus* species is the dominant component in temperate deciduous forests. Commonly, it is known as cork and has multiple commercial applications.

AIPMT - 2009
(Physics, Chemistry and Biology)
Prelims

Time: 3 hrs **Total Marks: 600**

General Instructions:

1. The Answer sheet is inside this Text booklet. When you are directed to open the text booklet, take out the Answer Sheet and fill in the particulars on side – 1 and side – 2 carefully with blue/black ball point pen only.
2. The test is of 3 hours duration and consists of 200 questions. Each question carries 3 marks. For each correct response the candidate will get 3 marks. For each incorrect response, one mark will be deducted. The maximum marks are 600.
3. Use Blue / Black ball point pen only for writing particulars on this page / marking responses.
4. Rough work is to be done on the space provided for this purpose in the text booklet only.
5. On completion of the test, the candidate must handover the answer sheet to the invigilator in the room/ Hall. The candidates are allowed to take away this text booklet with them.
6. The candidates should ensure that the Answer sheet is not folded. Do not make any stray marks on the Answer sheet. Do not write your roll no. anywhere else except in the specified space in the Test booklet / Answer Sheet.
7. Use of white fluid for correction is not permissible on the Answer Sheet.

Physics

1. An explosion blows a rock into three parts. Two parts go off at right angles to each other. These two are, 1kg first part moving with a velocity of 12 ms^{-1} and 2kg second part moving with a velocity of 8 ms^{-1}. If the third part flies off with a velocity of 4 ms^{-1}, its mass would be

(1) 5 kg
(2) 7 kg
(3) 17 kg
(4) 3kg

2. A conducting circular loop is placed in a uniform magnetic field of 0.04 T with its plane perpendicular to the magnetic field. The radius of the loop starts shrinking at 2mms^{-1}. The induced emf in the loop when the radius is 2cm is

(1) 3.2 πμV
(2) 4.8 πμV
(3) 0.8 πμV
(4) 1.6 πμV

3. If the dimensions of a physical quantity are given by $M^aL^bT^c$, then the physical quantity will be

(1) pressure if a = 1, b = -1, c = -2
(2) velocity if a = 1, b = 0, c = -1
(3) acceleration if a = 1, b = 1, c = -2
(4) force if a = 0, b = -1, c = -2

4. In the nuclear decay given below

$${}^{A}_{z}X \rightarrow {}^{A}_{Z+1}Y \rightarrow {}^{A-4}_{Z-1}B^{*} \rightarrow {}^{A-4}_{Z-1}B,$$

The particles emitted in the sequence are

(1) β, α, γ
(2) γ, β, α
(3) β, γ, α
(4) α, β, γ

5. Three concentric spherical shells have radii a, b and c(a < b < c) and have surface charge densities σ, - σ and σ respectively. If V_A, V_B and V_C denote the potentials of the three shells, then for c = a + b we have

(1) $V_C = V_A \neq V_B$
(2) $V_C = V_B \neq V_A$
(3) $V_C \neq V_B = V_A$
(4) $V_C = V_B = V_A$

6. A bus is moving with a speed of 10 ms^{-1} on a straight road. A scooterist wishes to overtake the bus in 100s. If the bus is at a distance of 1 km from the scooterist, with what speed should the scooterist chase the bus?

(1) 20 ms^{-1}
(2) 40 ms^{-1}
(3) 25 ms^{-1}
(4) 10 ms^{-1}

7. Under the influence of a uniform magnetic field, a charged particle moves with constant speed v in a circle of radius R. The time period of rotation of the particle

(1) depends on v and not on R
(2) depends on R and not on v
(3) is independent of both v and R
(4) depends on both v and R

8. A wave in a string has amplitude of 2 cm. The wave travels in the +ve direction of x-axis with a speed of 128 ms^{-1} and it is noted that 5 complete waves fit in 4 m length of the string. The equation describing the wave is

(1) y = (0.02)m sin (7.85 x + 1005t)
(2) y = (0.02)m sin (15.7 x - 2010t)
(3) y = (0.02)m sin (15.7 x + 2010t)
(4) y = (0.02)m sin (7.85 x - 1005t)

9. A simple pendulum performs simple harmonic motion about x = 0 with an amplitude a and time period T. The speed of the pendulum at $x = \frac{a}{2}$ will be

(1) $\frac{\pi\sqrt{3}}{2T}$
(2) $\frac{\pi a}{T}$
(3) $\frac{3\pi^2 a}{T}$
(4) $\frac{\pi a\sqrt{3}}{T}$

10. A p-n photodiode is fabricated from a semiconductor with a band gap of 2.5 eV. It can detect a signal of wavelength

(1) 6000 $\mathring{A}$
(2) 4000 nm
(3) 6000 nm
(4) 4000 $\mathring{A}$

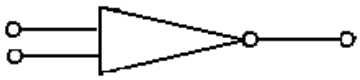
11. A body of mass 1kg is thrown upwards with a velocity 20 ms^{-1}. It momentarily comes to rest after attaining a height of 18 m. How much energy is lost due to air friction? (g = 10 ms^{-2})

(1) 20 J
(2) 30 J
(3) 40 J
(4) 10 J

12. The symbolic representation of four logic gates

(i)

(ii)



(iii)

(iv)

The logic symbols for OR, NOT and NAND gates are respectively

(1) (iii),
(2) (iv), (ii)
(3) (2) (iv), (i), (iii)
(4) (3) (iv), (ii), (i)
(5) (4) (i), (iii), (iv)

13. If $\vec{F}$ is the force acting on a particle having position vector $\vec{r}$ and $\vec{\tau}$ be the torque of this force about the origin, then

(1) $\vec{r}\cdot\vec{\tau}\neq 0 \text{ and } \vec{F}\cdot\vec{\tau}=0$
(2) $\vec{r}\cdot\vec{\tau}<0 \text{ and } \vec{F}\cdot\vec{\tau}<0$
(3) $\vec{r}\cdot\vec{\tau}=0 \text{ and } \vec{F}\cdot\vec{\tau}=0$
(4) $\vec{r}\cdot\vec{\tau}=0 \text{ and } \vec{F}\cdot\vec{\tau}\neq 0$

14. If diamagnetic substance is brought near the north or the south pole of a bar magnet, it is

(1) repelled by both the poles
(2) repelled by the north pole and attracted by the south pole
(3) attracted by the north pole and repelled by the south pole
(4) attracted by both the poles

15. The mass of a lift is 2000 kg. When the tension in the supporting cable is 28000 N, then its acceleration is

(1) 30 ms^{-2} downwards
(2) 4 ms^{-2} upwards
(3) 4 ms^{-2} downwards
(4) 14 ms^{-2} upwards

16. The number of beta particles emitted by a radioactive substance is twice the number of alpha particles emitted by it. The resulting daughter is an

(1) isobar of parent
(2) isomer of parent
(3) isotone of parent
(4) isotope of parent

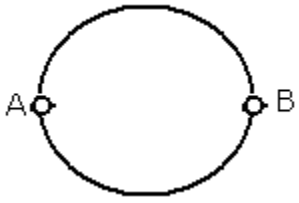
17. A rectangular, a square, a circular and an elliptical loop, all in the (x-y) plane, are moving out of a uniform magnetic field with a constant velocity, $\vec{v} = v\hat{i}$. The magnetic field is directed along the negative z-axis direction. The induced emf, during the passage of these loops, out of the field region, will not remain constant for

(1) the rectangular, circular and elliptical loops
(2) the circular and the elliptical loops
(3) only the elliptical loop
(4) any of the four loops

18. A particle starts its motion from rest under the action of a constant force. If the distance covered in first 10 s is s_1 and that covered in the first 20 s is s_2, then

(1) $s_2 = 2s_1$
(2) $s_2 = 3s_1$
(3) $s_2 = 4s_1$
(4) $s_2 = s_1$

19. A wire of resistance 12Ω is bent to form a complete circle of radius 10 cm. The resistance between its two diametrically opposite points, A and B as shown in the figure, is



(1) 0.6 πΩ
(2) 3 Ω
(3) 6 πΩ
(4) 6 Ω

20. The electric field part of an electromagnetic wave in a medium is represented by

$E_x = 0$;

$$Ey = 2.5\frac{N}{C}\cos\left[\left(2\pi\times10^{6}\frac{rad}{m}\right)t-\left(\pi\times10^{-2}\frac{rad}{s}\right)\times\right]$$

$E_z = 0$. The wave is

(1) moving along y direction with frequency $2\pi \times 10^6$Hz and wavelength 200m.
(2) moving along x direction with frequency 10^6 Hz and wavelength 100 m
(3) moving along x direction with frequency 10^6Hz and wavelength 200m
(4) moving along -x direction with frequency 10^6 Hz and wavelength 200m

21. A thin circular ring of mass M and radius R is rotating in a horizontal plane about an axis vertical to its plane with a constant angular velocity ω. If two objects each of mass m be attached gently to the opposite ends of a diameter of the ring will then rotate with an angular velocity

(1) $\frac{\omega(M-2m)}{M+2m}$
(2) $\frac{\omega M}{M+2m}$
(3) $\frac{\omega(M+2m)}{M}$
(4) $\frac{\omega M}{M+m}$

22. A transistor is operated in common-emitter configuration at $V_c = 2$ volt such that a change in the base current from 100 μA to 200 μA produces a change in the collector current from 5mA to 10mA. The current gain is

(1) 75
(2) 100
(3) 112
(4) 50

23. A black body at 227 °C radiates heat at the rate of 7 cal $cm^{-2}s^{-1}$. At a temperature of 727 °C, the rate of heat radiated in the same units will be

(1) 60
(2) 50
(3) 112
(4) 80

24. A student measures the terminal potential difference (V) of a cell (of emf ε and internal resistance r) as a function of the current (I) flowing through it. The slope and intercept of the graph between V and I, then respectively equal

(1) ε and – r
(2) –r and ε
(3) r and -ε
(4) -ε and r

25. Two bodies of mass 1 kg and 3 kg have position vectors $\hat{i}+2\hat{j}+\hat{k}$ and $-3\hat{i}-2\hat{j}+\hat{k}$ respectively. The centre of mass of this system has a position vector

(1) $-2\hat{i}+2\hat{k}$
(2) $-2\hat{i}-\hat{j}+\hat{k}$
(3) $2\hat{i}-\hat{j}-2\hat{k}$
(4) $-\hat{i}+\hat{j}+\hat{k}$

26. The internal energy change in a system that has absorbed 2 kcal of heat and done 500 J of work is

(1) 8900J
(2) 6400J
(3) 5400J
(4) 7900J

27. An engine pumps water continuously through a hose. Water leaves the hose with a velocity v and m is the mass per unit length of the water jet. What is the rate at which kinetic energy is imparted to water?

(1) $\frac{1}{2}mv^3$
(2) mv^3
(3) $\frac{1}{2}mv^2$
(4) $\frac{1}{2}m^2v^2$

28. The driver of a car travelling with speed 30 ms^{-1} towards a hill sounds a horn of frequency 600 Hz. If the velocity of sound in air is 330 ms^{-1}, the frequency of reflected sound as heard by the driver is

(1) 550 Hz
(2) 555.5 Hz
(3) 720 Hz
(4) 500Hz

29. In a Rutherford scattering experiment when a projectile of charge Z_1 and mass M_1 approaches a target nucleus of charge Z_2 and mass M_2, the distance of closest approach is r_0. The energy of the projectile is

(1) directly proportional to $M_1 \times M_2$
(2) directly proportional to Z_1Z_2
(3) inversely proportional to Z_1
(4) directly proportional to mass M_1

30. Three capacitors each of capacitance C and of breakdown voltage V are joined in series. The capacitance and breakdown voltage of the combination will be

(1) $\frac{C}{3}, \frac{V}{3}$
(2) $3C, \frac{V}{3}$
(3) $\frac{C}{3}, 3V$
(4) 3C, 3V

31. The magnetic force acting on a charged particle of charge – 2 μC in a magnetic field of 2 T acting in y direction, when the particle velocity is $(2\hat{i} + 3\hat{j}) \times 10^6$ ms^{-1} is.

(1) 8 N in –z direction
(2) 4 N in z direction
(3) 8 N in y direction
(4) 8 N in z direction

32. Which one of the following equations of motion represents simple harmonic motion?

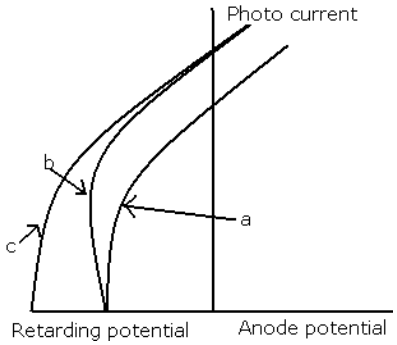
(1) Acceleration = $-k_0x + k_1x^2$
(2) Acceleration = $-k(x + a)$
(3) Acceleration = $k(x + a)$
(4) Acceleration = kx

Where k, k_0, k_1 and a are all positive.

33. Monochromatic light of wavelength 667 nm is produced by a helium neon laser. The power emitted is 9 mW. The number of photons arriving per second on the average at a target irradiated by this beam is

(1) 9×10^{17}
(2) 3×10^{16}
(3) 9×10^{15}
(4) 3×10^{19}

34. The figure shows a plot of photo current versus anode potential for a photo sensitive surface for three different radiations. Which one of the following is a correct statement?



(1) Curves a and b represent incident radiations of different frequencies and different intensities

(2) Curves a and b represent incident radiations of same frequency but of different intensities

(3) Curves b and c represent incident radiations of different frequencies and different intensities

(4) Curves b and c represent incident radiations of same frequency having same intensity

35. Power dissipated in an L-C-R series circuit connected to an AC source of emf ε is

(1) $\dfrac{\varepsilon^2 R}{\left[R^2+\left(L\omega-\dfrac{1}{C\omega}\right)^2\right]}$

(2) $\dfrac{\sqrt{R^2+\left(L\omega-\dfrac{1}{C\omega}\right)^2}}{R}$

(3) $\dfrac{\varepsilon^2\left[R^2+\left(L\omega-\dfrac{1}{C\omega}\right)^2\right]}{R}$

(4) $\dfrac{\varepsilon^2 R}{\sqrt{R^2+\left(L\omega-\dfrac{1}{C\omega}\right)^2}}$

36. The electric potential at a point (x, y, z) is given by $V = -x^2y - xz^3 + 4$

The electric field $\vec{E}$ at that point is

(1) $\vec{E} = \hat{i}(2xy + z^3) + \hat{j}x^2 + \hat{k}3xz^2$

(2) $\vec{E} = \hat{i}2xy + \hat{j}(x^2 + y^2) + \hat{k}(3xz - y^2)$

(3) $\vec{E} = \hat{i}z^3 + \hat{j}xyz + \hat{k}z^2$

(4) $\vec{E} = \hat{i}(2xy - z^3) + \hat{j}xy^2 + \hat{k}3z^2x$

37. A bar magnet having a magnetic moment of 2×10^4 JT^{-1} is free to rotate in a horizontal plane. A horizontal magnetic field $B = 6 \times 10^{-4}$ T exists in the space. The work done in taking the magnet slowly from a direction parallel to the field to a direction 60° from the field is

(1) 0.6 J
(2) 12 J
(3) 6 J
(4) 2 J

38. A galvanometer having a coil resistance of 60 Ω shows full scale deflection when a current of 1.0 A passes through it. It can be converted into an ammeter to read currents upto 5.0 A by

(1) putting in parallel a resistance of 240 Ω
(2) putting in series a resistance of 15 Ω
(3) putting in series a resistance of 240 Ω
(4) putting in parallel a resistance of 15 Ω

39. The two ends of a rod of length L and a uniform cross-sectional area A are kept at two temperatures T_1 and T_2 ($T_1 > T_2$). The rate of heat transfer $\frac{dQ}{dt}$, through the rod in a steady state is given by

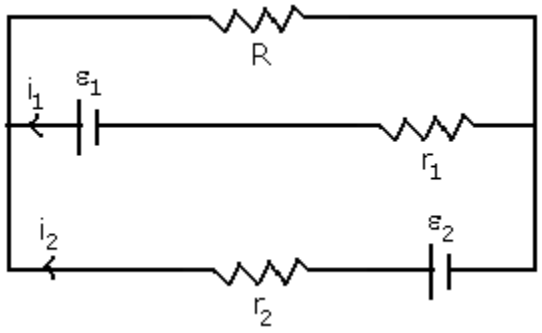
(1) $\frac{dQ}{dt} = \frac{KL(T_1 - T_2)}{A}$

(2) $\frac{dQ}{dt} = \frac{K(T_1 - T_2)}{LA}$

(3) $\frac{dQ}{dt} = KLA(T_1 - T_2)$

(4) $\frac{dQ}{dt} = \frac{KA(T_1 - T_2)}{L}$

40. See the electrical circuit shown in this figure. Which of the following equations is a correct equation for it?



(1) $\varepsilon_1 - (i_1 + i_2)R - i_1 r_1 = 0$

(2) $\varepsilon_2 - i_2 r_2 - \varepsilon_1 - i_1 r_1 = 0$

(3) $-\varepsilon_2 - (i_1 + i_2)R + i_2 r_2 = 0$

(4) $\varepsilon_1 - (i_1 + i_2)R + i_1 r_1 = 0$

41. The mean free path of electrons in a metal is 4×10^{-8} m. The electric field which can give on an average 2 eV energy to an electron in the metal will be in unit of Vm^{-1}

(1) 8×10^{7}

(2) 5×10^{-11}

(3) 8×10^{-11}

(4) 5×10^{7}

42. The number of photoelectrons emitted by light of a frequency ν (higher than the threshold frequency ν_0) is proportional to

(1) $\nu - \nu_0$

(2) threshold frequency

(3) intensity of light

(4) frequency of light (ν)

43. Each of the two strings of length 51.6 cm and 49.1 cm are tensioned separately by 20 N force. Mass per unit length of both the strings is same and equal to 1 gm^{-1}. When both the strings vibrate simultaneously the number of beats is

(1) 5

(2) 7

(3) 8

(4) 3

44. The ionization energy of the electron in the hydrogen atom in its ground state is 13.6 eV. The atoms are excited to higher energy levels to emit radiations of 6 wavelengths. Maximum wavelength of emitted radiation corresponds to the transition between

(1) n = 3 to n = 2 states
(2) n = 3 to n = 1 states
(3) n = 2 to n = 1 states
(4) n = 4 to n = 3 states

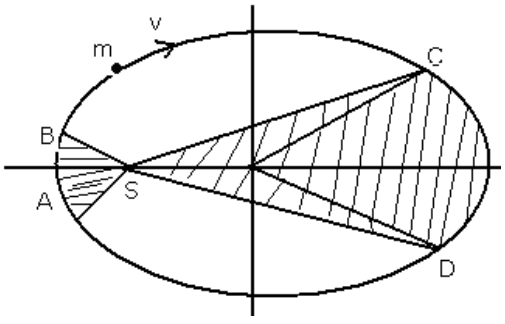
45. Four identical thin rods each of mass M and length l, form a square frame. Moment of inertia of this frame about an axis through the centre of the square and perpendicular to its plane is

(1) $\frac{4}{3}Ml^2$
(2) $\frac{2}{3}Ml^2$
(3) $\frac{13}{3}Ml^2$
(4) $\frac{1}{3}Ml^2$

46. In thermodynamic processes which of the following statements is not true?

(1) In an adiabatic process the system is insulated from the surroundings
(2) In an isochoric process pressure remains constant
(3) In an isothermal process the temperature remains constant
(4) In an adiabatic process PV^{γ} = constant

47. The figure shows elliptical orbit of a planet m about the sun S. The shaded area SCD is twice the shaded area SAB. If t_1 is the time for the planet to move from C to D and t_2 is the time to move from A to B, then



(1) $t_1 > t_2$
(2) $t_1 = 4t_2$
(3) $t_1 = 2t_2$
(4) $t_1 = t_2$

48. Sodium has body centred packing. Distance between two nearest atoms is 3.7 Å. The lattice parameter is

(1) 6.8 Å
(2) 4.3 Å
(3) 3.0 Å
(4) 8.6 Å

49. A block of mass M is attached to the lower end of a vertical spring. The spring is hung from a ceiling and has force constant value k. The mass is released from rest with the spring initially unstretched. The maximum extension produced in the length of the spring will be

(1) $\frac{Mg}{k}$ Mg/k
(2) 2Mg/k
(3) 4 Mg/k
(4) Mg/2k

50. A body, under the action of a force $\vec{F} = 6\hat{i} - 8\hat{j} + 10\hat{k}$, acquires an acceleration of 1 ms^{-2}. The mass of this body must be

(1) $2\sqrt{10}$kg
(2) 10 kg
(3) 20 kg
(4) $10\sqrt{2}$kg

Chemistry

51. Which of the following molecules acts as a Lewis acid?

(1) $(CH_3)_3B$

(2) $(CH_3)_2O$

(3) $(CH_3)_3P$

(4) $(CH_3)_3N$

52. Which of the following reactions is an example of nucleophilic substitution reaction?

(1) $RX + KOH \rightarrow ROH + KX$

(2) $2RX + 2Na \rightarrow R — R + 2NaX$

(3) $RX + H_2 \rightarrow RH + HX$

(4) $RX + Mg \rightarrow RMgX$

53. From the following bond energies :

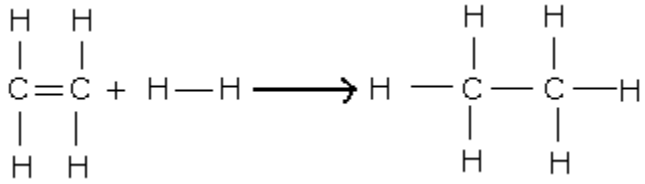
H — H bond energy : 431.37 kJ mol^{-1}

C = C bond energy : 606.10 kJ mol^{-1}

C — C bond energy : 336.49 kJ mol^{-1}

C — H bond energy : 410.50 kJ mol^{-1}

Enthalpy for the reaction,



will be

(1) 1523.6 kJ mol^{-1}

(2) –243.6 kJ mol^{-1}

(3) -120.0 kJ mol^{-1}

(4) 553.0 kJ mol^{-1}

54. Which one of the elements with the following outer orbital configurations may exhibit the largest number of oxidation states?

(1) $3d^3, 4s^2$

(2) $3d^5, 4s^1$

(3) $3d^5, 4s^2$

(4) $3d^2, 4s^2$

55. The ionization constant of ammonium hydroxide is 1.77×10^{-5} at 298 K. Hydrolysis constant of ammonium chloride is

(1) 5.65×10^{-10}
(2) 6.50×10^{-12}
(3) 5.65×10^{-13}
(4) 5.65×10^{-12}

56. Which of the following oxides is not expected to react with sodium hydroxide?

(1) B_2O_3
(2) CaO
(3) SiO_2
(4) BeO

57. Which of the following does not show optical isomerism?

(1) $[Co(en)_2Cl_2]^+$
(2) $[Co(NH_3)_3Cl_3]^0$
(3) $[Co(en)Cl_2(NH_3)_2]^+$
(4) $[Co(en)_3]^{3+}$

58. Which one of the following is employed as a tranquilizer?

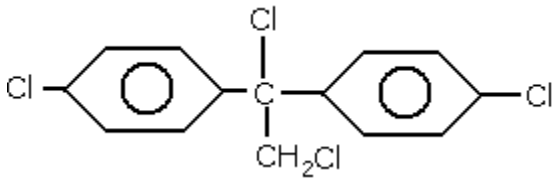
(1) Equanil
(2) Naproxen
(3) Tetracycline
(4) Chloropheninamine

59. Al_2O_3 is reduced by electrolysis at low potentials and high currents. If 4.5×10^4 A of current is passed through molten Al_2O_3 for 6 hrs, what mass of aluminium is produced?
(Assume 100% current efficiency, atomic mass of Al = 27g mol^{-1})

(1) 9.0×10^3 g
(2) 8.1×10^4 g
(3) 2.4×10^5 g
(4) 1.3×10^4 g

60. Trichloroacetaldehyde, CCl_3CHO reacts with chlorobenzene in presence of sulphuric acid and produces

(1)



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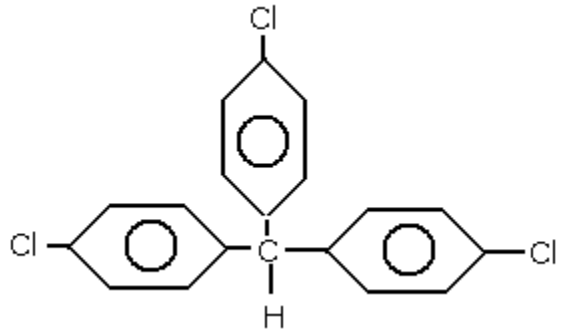

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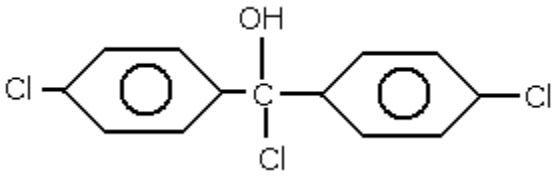

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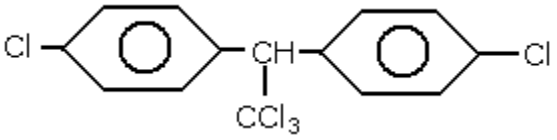


61. Which of the following complex ions is expected to absorb visible light?
(At no Zn = 30, Sc = 21, Ti = 22, Cr = 24)

(1) $[Sc(H_2O)_3(NH_3)_3]^{3+}$
(2) $[Ti(en)_2(NH_3)_2]^{4+}$
(3) $[Cr(NH_3)_6]^{3+}$
(4) $[Zn(NH_3)_6]^{2+}$

62. Half-life period of a first order reaction is 1386 s. The specific rate constant of the reaction is

(1) $5.0 \times 10^{-3}\ s^{-1}$
(2) $0.5 \times 10^{-2}\ s^{-1}$
(3) $0.5 \times 10^{-3}\ s^{-1}$
(4) $5.0 \times 10^{-2}\ s^{-1}$

63. Consider the following reaction,

$$\text{Phenol} \xrightarrow{\text{Zn dust}} X \xrightarrow[\text{Anhydrous } AlCl_3]{CH_3Cl} Y \xrightarrow[KMnO_4]{\text{Alkaline}} Z,$$

the product, Z is

(1) toluene
(2) benzaldehyde
(3) benzoic acid
(4) benzene

64. Copper crystallizes in a face-centred cubic lattice with a unit cell length of 361 pm. What is the radius of copper atom in pm?

(1) 128
(2) 157
(3) 181
(4) 108

65. For the reaction, A + B → products, it is observed that:

(A) On doubling the initial concentration of A only, the rate of reaction is also doubled and

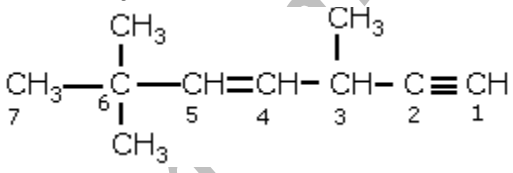
(B) On doubling the initial concentrations of both A and B, there is a change by a factor of 8 in the rate of the reaction is, given by

(1) rate = k $[A]^2[B]$
(2) rate = k $[A][B]^2$
(3) rate = k $[A]^2[B]^2$
(4) rate = k [A][B]

66. According to MO theory which of the following lists ranks the nitrogen species in terms of increasing bond order?

(1) $N_2^- < N_2 < N_2^{2-}$
(2) $N_2^{2-} < N_2^- < N_2$
(3) $N_2 < N_2^{2-} < N_2^-$
(4) $N_2^- < N_2^{2-} < N_2$

67. The state of hybridization of C_2, C_3, C_5 and C_6 of the hydrocarbon,



is in the following sequence

(1) sp, sp^3, sp^2 and sp^3
(2) sp^3, sp^2, sp^2 and sp
(3) sp, sp^2, sp^2 and sp^3
(4) sp, sp^2, sp^3 and sp^2

68. Among the following which is the strongest oxidizing agent?

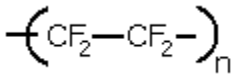
(1) F_2
(2) Br_2
(3) I_2
(4) Cl_2

69. The equivalent conductance of $\frac{M}{32}$ solution of a weak monobasic acid is 8.0 mho cm^2 and at infinite dilution is 400 mho cm^2. The dissociation constant of this acid is

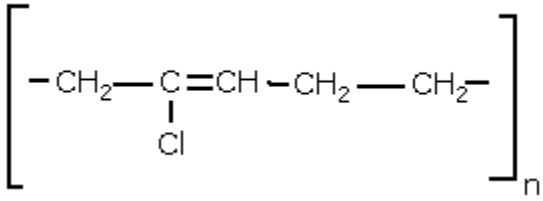
(1) 1.25×10^{-5}
(2) 1.25×10^{-6}
(3) 6.25×10^{-4}
(4) 1.25×10^{-4}

70. Structures of some common polymers are given. Which one is not correctly presented?

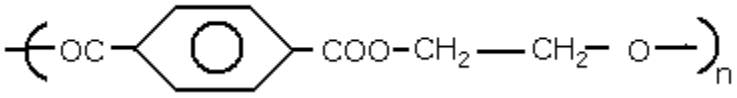
(1) Teflon



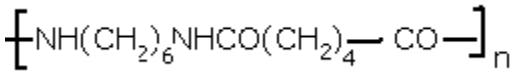
(2) Neoprene



(3) Terylene



(4) Nylon



71. Oxidation number of P in PO_4^{3-}, of S in SO_4^{2-} and that of Cr in $Cr_2O_7^{2-}$ are respectively,

(1) +5, +6 and +6
(2) +3, +6 and +5
(3) +5, +3 and +6
(4) -3, +6 and +6

72. The IUPAC name of the compound having the formula $CH{\equiv}C{-}CH{=}CH_2$ is

(1) 3-butene-1-yne
(2) 1-butyn-3-ene
(3) but-1-yne-3-ene
(4) 1-butene-3-yne

73. In the case of alkali metals, the covalent character decreases in the order

(1) MCl > MI > MBr > MF
(2) MF > MCl > MBr > MI
(3) MF > MCl > MI > MBr
(4) MI > MBr > MCl > MF

74. Given,

(i) $Cu^{2+} + 2e^- \rightarrow Cu$, $E° = 0.337$ V

(ii) $Cu^{2+} + e^- \rightarrow Cu^+$ $E° = 0.153$ V

Electrode potential, E° for the reaction, $Cu + e^- \rightarrow Cu$, will be

(1) 0.52 V
(2) 0.90 V
(3) 0.30 V
(4) 0.38 V

75. For the reaction, $N_2 + 3H_2 \rightarrow 2NH_3$, if $\frac{d[NH_3]}{dt} = 2 \times 10^{-4}\ mol^{-1}s^{-1}$ the value of $-\frac{d[H_2]}{dt}$ would be

(1) $3 \times 10^{-4} mol\ L^{-1}\ s^{-1}$
(2) $4 \times 10^{-4} mol\ L^{-1}\ s^{-1}$
(3) $6 \times 10^{-4} mol\ L^{-1}\ s^{-1}$
(4) $1 \times 10^{-4} mol\ L^{-1}\ s^{-1}$

76. What is the $[OH^-]$ in the final solution prepared by mixing 20.0 mL of 0.050 M HCl with 30.0 mL of 0.10 Ba $(OH)_2$?

(1) 0.10 M
(2) 0.40 M
(3) 0.0050 M
(4) 0.12 M

77. Out of TiF_6^{2-}, CoF_6^{3-}, Cu_2Cl_2 and $NiCl_4^{2-}$ (Z of Ti = 22, Co = 27, Cu = 29, Ni = 28) the colourless species are

(1) TiF_6^{2-} and CoF_6^{3-}
(2) Cu_2Cl_2 and $NiCl_4^{2-}$
(3) TiF_6^{2-} and Cu_2Cl_2
(4) CoF_6^{3-} and $NiCl_4^{2-}$

78. Amongst the elements with following electronic configurations, which one of them may have the highest ionization energy?

(1) [Ne] $3s^2\ 3p^3$
(2) [Ne] $3s^2\ 3p^2$
(3) [Ar] $3d^{10}, 4s^2\ 4p^3$
(4) [Ne] $3s^2\ 3p^1$

79. Maximum number of electrons in a subshell of an atom is determined by the following

(1) 4l + 2
(2) 2l + 1
(3) 4l – 2
(4) $2n^2$

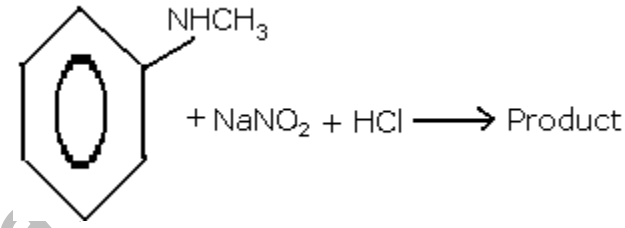
80. Lithium metal crystallizes in a body centered cubic crystal. If the length of the side of the unit cell of lithium is 351 pm, the atomic radius of the lithium will be

(1) 240.8 pm
(2) 151.8 pm
(3) 75.5 pm
(4) 300.5 pm

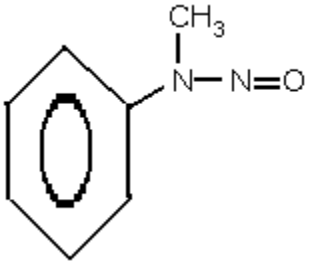
81. The segment of DNA, which acts as the instrumental manual for the synthesis of the protein is

(1) nucleotide
(2) ribose
(3) gene
(4) nucleoside

82. Predict the product,



(1)



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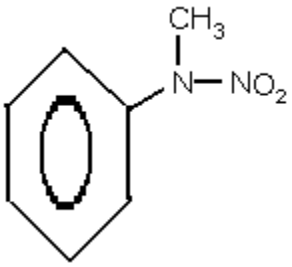

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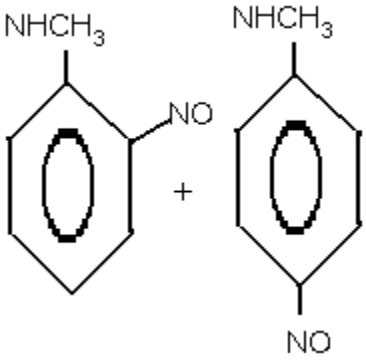

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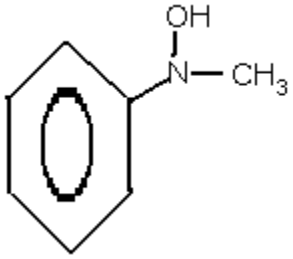


83. Which of the following compounds will exhibit cis-trans (geometrical) isomerism?

(1) 2-butene
(2) Butanol
(3) 2-butyne
(4) 2-butenol

84. The values of ΔH and ΔS for the reaction $C_{(graphite)} + CO_{2(g)} \rightarrow 2CO_{(g)}$ are 170 kJ and 170 JK^{-1}, respectively. This reaction will be spontaneous at

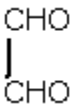
(1) 710 K
(2) 910 K
(3) 1110 K
(4) 510 K

85. $H_2COH.CH_2OH$ on heating with periodic acid gives

(1) $2CO_2$

(2) 2 HCOOH

(3)



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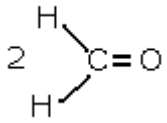


86. The dissociation constants for acetic acid and HCN at 25^0C are $1.5x10^{-5}$ and 4.5×10^{-10} respectively. The equilibrium constant for the equilibrium, $CN^- + CH_3COOH \; HCN + CH_3COO^-$ would be

(1) 3.0×10^5

(2) 3.0×10^{-5}

(3) 3.0×10^{-4}

(4) $3.0x\ 10^4$

87. Nitrobenzene can be prepared from benzene by using a mixture of conc. HNO_3 and conc. H_2SO_4. In the mixture, nitric acid acts as a/an:

(1) reducing agent

(2) acid

(3) base

(4) catalyst

88. In the reaction,

$BrO_3^{-3}{}_{(aq)} + 5Br^-_{(aq)} + 6H^+ \rightarrow 3Br_{2(l)} + 3H_2O_{(l)}$

The rate of appearance of bromine (Br_2) is related to rate of disappearance of bromide ions as following

(1) $\frac{d[Br_2]}{dt} = -\frac{3}{5}\frac{d[Br^-]}{dt}$

(2) $\frac{d[Br_2]}{dt} = -\frac{5}{3}\frac{d[Br^-]}{dt}$

(3) $\frac{d[Br_2]}{dt} = \frac{5}{3}\frac{d[Br^-]}{dt}$

(4) $\frac{d[Br_2]}{dt} = \frac{3}{5}\frac{d[Br^-]}{dt}$

89. In which of the following molecules/ions BF_3, NO_2, NH^{-2} and H_2O, the central atom is sp^2 hybridized?

(1) NO_2^- and NH_2^-
(2) NH_2^- and H_2O
(3) NO_2^- and H_2O
(4) BF_3 and NO_2^-

90. Which of the following hormones contain iodine?

(1) Insulin
(2) Testosterone
(3) Adrenaline
(4) Thyroxine

91. 10g of hydrogen and 64g of oxygen were filled in a steel vessel and exploded. Amount of water produced in this reaction will be

(1) 2 mol
(2) 3 mol
(3) 4 mol
(4) 1 mol

92. The energy absorbed by each molecule (A_2) of a substance is 4.4×10^{-19} J and bond energy per molecule is 4.0×10^{-19} J. The kinetic energy of the molecule per atom will be

(1) 2.0×10^{-20} J
(2) 2.2×10^{-19} J
(3) 2.0×10^{-19} J
(4) 4.0×10^{-20} J

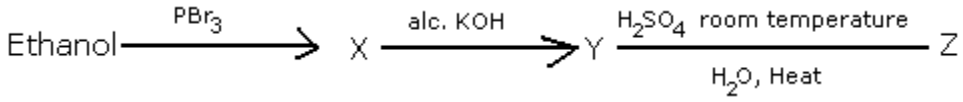
93. The straight chain polymer is formed by

(1) hydrolysis of $(CH_3)_3$ SiCl followed by condensation polymerisation
(2) hydrolysis of CH_3SiCl_3 followed by condensation polymerisation
(3) hydrolysis of $(CH_3)_4$ Si by addition polymerisation
(4) hydrolysis of $(CH_3)_2SiCl_2$ followed by condensation polymerisation

94. The stability of +1 oxidation state increases in the sequence

(1) Al < Ga < In < Ti
(2) Ti < In < Ga < Al
(3) In < Ti < Ga < Al
(4) Ga < In < Al < Ti

95. Consider the following reaction



the product Z, is

(1) $CH_2=CH_2$
(2) CH_3CH_2-O-CH_2-CH_3
(3) CH_3-CH_2-0-SO_3H
(4) CH_3CH_2OH

96. A 0.0020 m aqueous solution of an ionic compound $[Co(NH_3)_5(NO_2)]Cl$ freezes at –0.00732°C. Number of moles of ions which 1 mol of ionic compound produces on being dissolved in water will be (K_f = -1.86^{0}C /m)

(1) 2
(2) 3
(3) 4
(4) 1

97. What is the dominant intermolecular force of bond that must be overcome in converting liquid CH_3OH to gas?

(1) Hydrogen bonding
(2) Dipole-dipole interaction
(3) Covalent bonds
(4) London dispersion force

98. Benzene reacts with CH_3Cl in the presence of anhydrous $AlCl_3$ to form

(1) toluene
(2) chlorobenzene
(3) benzylchloride
(4) xylene

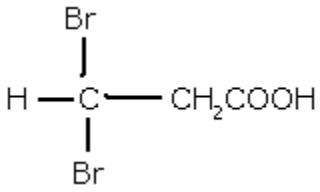
99. Which of the following is not permissible arrangement of electrons in an atom?

(1) n=4,l=0,m=0,s=-1/2
(2) n=5, l=3, m=0, s=+½
(3) n=3, l=2, m=3, s=-1/2
(4) n=3, l=2, m=2, s=-1/2

100. Propionic acid with Br_2 yields a dibromo product. Its structure would be

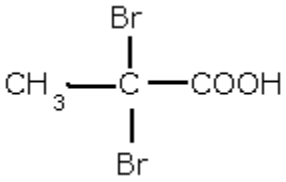
(1) $CH_2Br - CHBr - COOH$

(2)



(3) $CH_2Br - CH_2 - COBr$

(4)

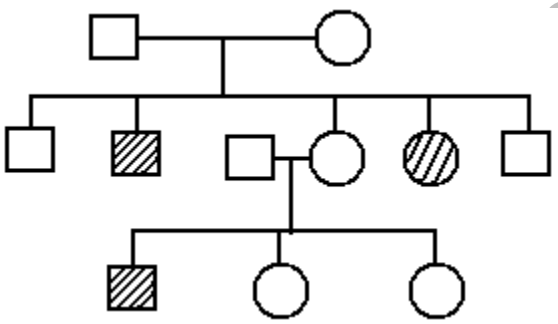


Biology

101. Which one of the following is correct pairing of a body part and the kind of muscle tissue that moves it?
(1) Biceps of upper arm – Smooth muscle fibres
(2) Abdominal wall – Smooth muscle
(3) Iris – Involuntary smooth muscle
(4) Heart wall – Involuntary unstriated muscle

102. The epithelial tissue present on the inner surface of bronchioles and fallopian tube is
(1) Glandular
(2) Ciliated
(3) Squamous
(4) Cuboidal

103. Study the pedigree chart given below:
What does it show?

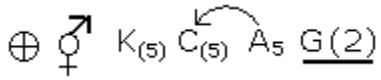


(1) Inheritance of a condition like phenylketonuria as an autosomal recessive trait.
(2) The pedigree chart is wrong as this is not possible
(3) Inheritance of a recessive sex-linked disease like haemophilia
(4) Inheritance of a sex-linked inborn error of metabolism like phenylketonuria

104. Manganese is required in
(1) plant cell wall formation
(2) Photolysis of water during photosynthesis
(3) chlorophyll synthesis
(4) nucleic acid synthesis

105. Polyethylene glycol method is used for
(1) biodiesel production
(2) seedless fruit production
(3) energy production from sewage
(4) gene transfer without a vector

106. The floral formula



is that of:
(1) Soyabean
(2) Sunhemp
(3) Tobacco
(4) Tulip

107. Which one of the following groups of animals is bilaterally symmetrical and triploblastic?
(1) Aschelminthe (round worms)
(2) Ctenophores
(3) Sponges
(4) Coelenterates (Cnidarians)

108. Which one of the following is commonly used in transfer of foreign DNA into crop plants?
(1) *Meloidogyne incognita*
(2) *Agrobacterium tumefaciens*
(3) *Penicillium expansum*
(4) *Trichoderma harzianum*

109. Which one of the following is the correct matching of the events occurring during menstrual cycle?
(1) Proliferative phase : Rapid regeneration of myometrium and maturation of graffian follicle.
(2) Development of corpus luteum : Secretory phase and increased secretion of progesterone.
(3) Menstruation : Breakdown of myometrium and ovum not fertilized.
(4) Ovulation : LH and FSH attain peak level and sharp fall in the secretion of progesterone.

110. Which one is the wrong pairing for the disease and its causal organism?
(1) Black rust of wheat – *Puccinia graminis*
(2) Loose smut of wheat – *Ustilago nuda*
(3) Root-knot of vegetables – *Meloidogyne sp*
(4) Late blight of potato – *Alternaria solani*

111. Global agreement in specific control strategies to reduce the release of ozone depleting substances, was adopted by
(1) The montreal Protocol
(2) The Koyoto Protocol
(3) The Vienna Convention
(4) Rio de Janeiro Conference

112. What is true about Bt toxin?
(1) Bt protein exists as active toxin in the *Baccillus*
(2) The activated toxin enters the ovaries of the pest to sterilise it and thus prevent its multiplication.
(3) The concerned *Bacillus* has antitoxins.
(4) The inactive protoxin gets converted into active form in the insect gut.

113. Peripatus is a connecting link between
(1) mollusca and echinodermata
(2) annelida and arthropoda
(3) coelenterata and porifera
(4) ctenophora and platyhelminthes

114. T.O. Diener discovered a
(1) free infectious DNA
(2) infectious protein
(3) bacteriophage
(4) free infectious RNA

115. Seminal plasma in humans is rich in
(1) fructose and calcium but has no enzymes
(2) glucose and certain enzymes but has no calcium
(3) fructose and certain enzymes but poor in calcium
(4) fructose, calcium and certain enzymes

116. A fruit developed from hypanthodium inflorescence is called
(1) sorosis
(2) syconus
(3) caryopsis
(4) hasperidium

117. The cell junctions called tight, adhering and gap junctions are found in
(1) connective tissue
(2) epithelial tissue
(3) neural tissue
(4) muscular tissue

118. What will happen if the stretch receptors of the urinary bladder wall are totally removed?
(1) Micturition will continue
(2) Urine will continue to collect normally in the bladder
(3) There will be no micturition
(4) Urine will not collect in the bladder

119. If a live earthworm is pricked with a needle on its outer surface without damaging its gut, the fluid that comes out is
(1) coelomic fluid
(2) haemolymph
(3) slimy mucus
(4) excretory fluid

120. The most popularly known grouping is the ABO grouping. It is named ABO and not ABC, because "O" in it refers to having
(1) overdominance of this type on the genes for A and B types
(2) one antibody only-either anti – A or anti-B on the RBCs
(3) no antigens A and B on RBCs
(4) other antigens besides A and B on RBCs

121. One of the synthetic auxin is
(1) IAA
(2) GA
(3) IBA
(4) NAA

122. A person likely to develop tetanus is immunized by administering
(1) preformed antibodies
(2) wide spectrum antibiotics
(3) weakened germs
(4) dead germs

123. Alzheimer disease in humans is associated with the deficiency of
(1) glutamic acid
(2) acetylcholine
(3) gamma aminobutyric acid (GABA)
(4) dopamine

124. Biochemical Oxygen Demand (BOD) in a river water
(1) has no relationship with concentration of oxygen in the water
(2) gives a measure of salmonella in the water
(3) increases when sewage gets mixed with river water
(4) remains unchanged when algal bloom occurs

125. The genetic defect- Adenosine deaminase (ADA) deficiency may be cured permanently by
(1) administering adenosine deaminase activators
(2) introducing bone morrow cells producing ADA into cells at early embryonic stages
(3) enzyme replacement therapy
(4) periodic infusion of genetically engineered lymphocytes having functional ADA cDNA.

126. Compared to blood our lymph has
(1) plasma without proteins
(2) more WBCs and no RBCs
(3) more RBCs and less WBCs
(4) no plasma

127. Sickle cell anemia is
(1) caused by substitution of valine by glutamic acid in the beta globin chain of haemoglobin
(2) caused by a change in a single base pair of DNA
(3) characterized by elongated sickle like RBCs with a nucleus
(4) an autosomal linked dominant trait

128. Which of the following plant species you would select for the production of bioethanol?
(1) *Zea mays*
(2) *Pongamia*
(3) *Jatropha*
(4) *Brassica*

129. When breast feeding is replaced by less nutritive food low in proteins and calories, the infants below the age of one year likely to suffer from
(1) rickets
(2) kwashiorkor
(3) pellagra
(4) marasmus

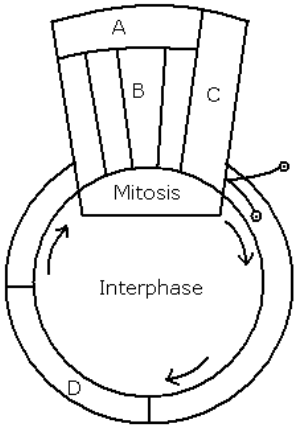
130. A young infant may be feeding entirely on mother's milk which is white in colour but the stools which the infant passes out is quite yellowish. What is this yellow colour due to
(1) bile pigments passed through bile juice
(2) undigested milk protein casein
(3) pancreatic juice poured into duodenum
(4) intestinal juice

131. Which one of the following has maximum genetic diversity in India?
(1) Mango
(2) Wheat
(3) Tea
(4) Teak

132. Oxygenic photosynthesis occurs in
(1) *Oscillatoria*
(2) *Rhodospirillum*
(3) *Chlorobium*
(4) *Chromatium*

133. There is no DNA in
(1) mature RBCs
(2) a mature spermatozoan
(3) hair root
(4) an enucleated ovum

134. 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?

(1) C–Karyokinesis
(2) D–Synthetic phase
(3) A–Cytokinesis
(4) B–Metaphase

135. Tiger is not a resident in which one of the following national park?

(1) Sunderbans
(2) Gir
(3) Jim Corbett
(4) Ranthambhor

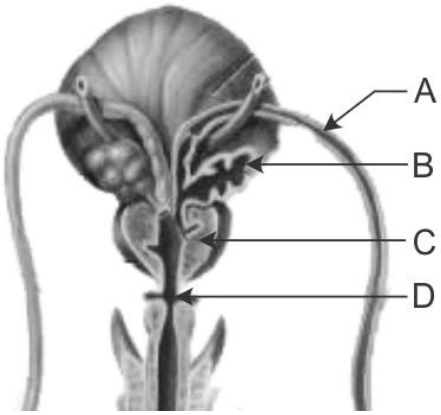
136. Which of the following statements is true regarding digestion and absorption of food in humans?

(1) Fructose and amino acids are absorbed through intestinal mucosa with the help of carrier ions like Na^+
(2) Chylomicrons are small lipoprotein particles that are transported from intestine into blood capillaries.
(3) About 60% of starch is hydrolysed by salivary amylase in our mouth
(4) Oxyntic celis in our stomach secrete the proenzyme pepsinogen.

137. Synapsis occurs between

(1) mRNA and ribosomes
(2) spindle fibres and centromere
(3) two homologous chromosomes
(4) a male and a famela gamete

138. Given below is a diagrammatic sketch of a portion of human male reproductive system. Select the correct set of the names of the parts labeled A, B, C, D.



(1) vas deferents (A) : seminal vesicle (B) ; prostate (C); bulbourethral gland (D)
(2) vas deferens (A) ; seminal vesicle (B); bulbourethral gland (D)
(3) ureter (A); seminal vesicle (B); prostate (C); bulbourethral gland (D)
(4) uteter (A); prostate (B); seminal vesicle (C); bulbourethral gland (D)

139. What is not true for genetic code?
(1) It is nearly universal
(2) It is degenerate
(3) It is unambiguours
(4) A codon in mRNA is read in a non-contiguous fashion

140. Which one of the following plants is monoecious?
(1) *Pinus*
(2) *Cycas*
(3) *Papaya*
(4) *Marchantia*

141. Cyclic photophosphorylation results in the formation of
(1) ATP and NADPH
(2) ATP, NADPH and O_2
(3) ATP
(4) NADPH

142. The letter T in T–lymphocyte refers to
(1) Thalamus
(2) Tonsil
(3) Thymus
(4) Thyroid

143. Foetal ejection reflex in human female is induced by
(1) release of oxytocin from pituitary
(2) fully developed foetus and placenta
(3) differentiation of mammary glands
(4) pressure exerted by amniotic fluid

144. Anatomically fairly old dicotyledonous root is distinguished from the dicotyledonous stem by
(1) absence of secondary phloem
(2) presence of cortex
(3) position of protoxylem
(4) absence of secondary xylem

145. Plasmodesmata are
(1) locomotary structures
(2) membranes connecting the nucleus with plasmalemma
(3) connections between adjacent cells
(4) lignified cemented layers between cells

146. Removal of introns and joining the exons in a defined order in a transcription unit is called
(1) tailing
(2) transformation
(3) capping
(4) splicing

147. Phylogenetic system of classification is based on
(1) morphological features
(2) chemical constituents
(3) floral characters
(4) evolutionary relationships

148. Which part of human brain is concerned with the regulation of body temperature?
(1) Cerebellum
(2) Cerebrum
(3) Hypothalamus
(4) Medulla Oblongata

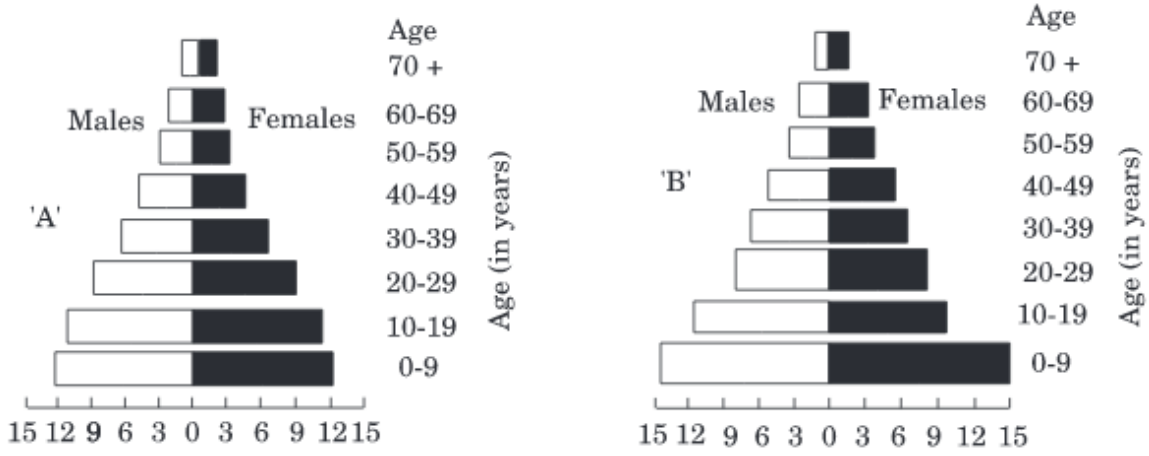
149. Semi-conservative replication of DNA was first demonstrated in
(1) *Escherichia col*
(2) *Streptococcus pneumonia*
(3) *Salmonella typhimurium*
(4) *Drosophila melanogaster*

150. Which one of the following pairs of animals comprises' jawless fishes'?
(1) Macherals and Rohu
(2) Lampreys and hag fishes
(3) Guppies and hag fishes
(4) Lampreys and eels

151. Which of the following is a pair of viral diseases?
(1) common cold, AIDS
(2) dysentery, common cold
(3) typhoid, tuberculosis
(4) ringwork, AIDS

152. Aerobic respiratory pathway is appropriately termed
(1) parabolic
(2) amphibolic
(3) anabolic
(4) catabolic

153. A country with a high rate of population growth took measures to reduce it. The Figure below shows age–sex pyramids of populations A and B twenty years apart.



Select the correct interpretation about them:
Interpretations :
(1) "B" is earlier pyramid and shows stabilized growth rate
(2) "B" is more recent showing that population is very young

(3) "A" is the earlier pyramid and no change has occurred in the growth rate
(4) "A" is more recent and shows slight reduction in the growth rate

154. Cytoskeleton is made up of
(1) callose deposits
(2) cellulosic microfibrils
(3) proteinaceous filaments
(4) calcium carbonate granules

155. An example of axile placentation is
(1) *Dianthus*
(2) Lemon
(3) Marigold
(4) *Argemone*

156. Which one of the following has haplontic life cycle?
(1) *Polytrichum*
(2) *Ustilago*
(3) Wheat
(4) *Funaria*

157. Steps taken by the Government of India to control air pollution include
(1) compulsory PUC (Pollution Under Control) certification of petrol driven vehicles which tests for carbon monoxide and hydrocarbons
(2) permission to use only pure diesel with a maximum of 500 ppm sulphur as fuel for vehicles.
(3) use of non-polluting compressed Natural Gas (CNG) only as fuel by all buses and trucks.
(4) compulsory mixing of 20% ethyl alcohol with petrol and 20% biodiesel with diesel.

158. Which one of the following is considered important in the development of seed habit?
(1) Heterospory
(2) Haplontic life cycle
(3) Free-living gametophyte
(4) Dependent sporophyte

159. The annular and spirally thickened conducting elements generally develop in the protoxylem when the root or stem is
(1) elongating
(2) widening
(3) differentiating
(4) maturing

160. The correct sequence of plants in a hydrosere is
(1) Volvox → Hydrilla → Pistia → Scirpus → Lantana → Oak

(2) Pistia → Volvox → Scirpus → Hydrilla → Oak → Lantana
(3) Oak → Lantana → Volvox → Hydrilla → Pistia → Scirpus
(4) Oak → Lantana → Scirpus → Pistia → Hydrilla → Volvox

161. Stroma in the chloroplasts of higher plant contains
(1) light-dependent reaction enzymes
(2) ribosomes
(3) chlorophyll
(4) light-independent reaction enzymes

162. A health disorder that results from the deficiency of thyroxine in adults and characterized by (i) a low metabolic rate, (ii) increase in body weight and (iii) tendency to retain water in tissues is
(1) simple goiter
(2) myxoedema
(3) cretinism
(4) hypothyroidism

163. Mannitol is the stored food in
(1) *Porphyra*
(2) *Fucus*
(3) *Gracillaria*
(4) *Chara*

164. Which one of the following pair is wrongly matched?
(1) Alcohol – nitrogenase
(2) Fruit juice – pectinase
(3) Textile – amylase
(4) Detergents - lipase

165. Which one of the following is not used as a biopesticide?
(1) *Trichoderma harzianum*
(2) Nuclear polyhedrosis Virus (NPV)
(3) *Xanthomonas campestris*
(4) *Bacillus thuringiensis*

166. Which one of the following is a vascular cryptogam?
(1) *Ginkgo*
(2) *Marchantia*
(3) *Cedrus*
(4) *Equisetum*

167. In a standard ECG which one of the following alphabets is the correct representation of the respective activity of the human heart?
(1) S – start of systole
(2) T – end of diastole
(3) P – depolarization of the atria
(4) R – repolarisation of ventricles

168. Uric acid is the chief nitrogenous component of the excretory products of
(1) earthworm
(2) cockroach
(3) frog
(4) man

169. Guard cells help in
(1) transpiration
(2) guttation
(3) fighting against infection
(4) protection against grazing

170. Montreal protocol aims at
(1) Biodiversity conservation
(2) Control of water pollution
(3) Control CO_2 emission
(4) Reduction of ozone depleting substances

171. DDT residues are rapidly passed through food chain causing biomagnification because DDT is
(1) moderately toxic
(2) non-toxic to aquatic animals
(3) water soluble
(4) lipo soluble

172. Vegetative propagation in mint occurs by
(1) offset
(2) rhizome
(3) sucker
(4) runner

173. Select the incorrect statement from the following
(1) Galactosemia is an inborn error of metabolism
(2) Small population size results in random genetic drift in a population
(3) Baldness is a sex-limited trait
(4) Linkage is an exception to the principle of independent assortment in heredity

174. Cotyledons and testa respectively are edible parts in
(1) walnut and tamarind
(2) French bean and coconut
(3) cashew nut and litchi
(4) groundnut and pomegranate

175. Which one of the following statements is correct?
(1) Benign tumours show the property of metastasis
(2) Heroin accelerates body functions
(3) Malignant tumours may exhibit metastasis
(4) Patients who have undergone surgery are given cannabinoids to relieve pain

176. The correct sequence of spermatogenetic stages leading to the formation of sperms in a mature human testes is
(1) spermatogonia – spermatocyte – spermatid – sperms
(2) spermatid – spermatocyte – spermatogonia – sperms
(3) spermatogonia – spermatid – spermatocyte – sperms
(4) spermatocyte – spermatogonia – spermatid – sperms

177. Use of anti-histamines and steroids give quick relief from
(1) nausea
(2) cough
(3) headache
(4) allergy

178. Chipko movement was launched for the protection of
(1) forests
(2) livestock
(3) wet lands
(4) grasslands

179. Which one of the following is the most likely root cause why menstruation is not taking place in regularly cycling human female?
(1) Maintenance of the hypertrophical endometrial lining
(2) Maintenance of high concentration of sex hormones in the blood stream
(3) Retention of well-developed corpus luteum
(4) Fertilization of the ovum

180. Globulins contained in human blood plasma are primarily involved in
(1) somotic balance of body fluids
(2) oxygen transport in the blood
(3) clotting of blood
(4) defence mechanisms of body

181. Palisade parenchyma is absent in leaves of
(1) mustard
(2) soybean
(3) gram
(4) sorghum

182. In barley stem vascular bundles are
(1) closed and scattered
(2) open and in a ring
(3) closed and radial
(4) open and scattered

183. Which one of the following is the correct matching of three items and their grouping category?

Items	Group
(1) Ilium, ischium, pubis	coxal bones
(2) actin, myosin, rhodopsin	muscle proteins
(3) cytosine, uracil, thiamine	pyrimidines
(4) malleus, incus, cochlea	ear ossicles

184. Somaclones are obtained by
(1) plant breeding
(2) irradiation
(3) genetic engineering
(4) tissue culture

185. In the case of peppered moth (*Biston betularia*) the black-coloured form became dominant over the light-coloured form in England during industrial revolution This is an example of
(1) appearance of the darker coloured individuals due to very poor sunlight
(2) protective mimicry
(3) inheritance of darker colour character acquired due to the darker environment
(4) natural selection whereby the darker forms were selected

186. Transgenic plants are the ones
(1) generated by introducing foreign DNA into a cell and regenerating a plant from that cell.
(2) produced after protoplast fusion in artificial medium
(3) grown in artificial medium after hybridization in the field
(4) produced by a somatic embryo in artificial medium

187. Which one of the following pairs of food components in humans reaches the stomach totally undigested?
(1) Starch and fat
(2) Fat and cellulose
(3) Starch and cellulose
(4) Protein and starch

188. A change in the amount of yolk and its distribution in the egg will affect
(1) pattern of cleavage
(2) number of blastomeres produced
(3) fertilization
(4) formation of zygote

189. Middle lamella is composed mainly of
(1) muramic acid
(2) calcium pectate
(3) phosphoglycerides
(4) hemicellulose

190. Elbow joint is an example of
(1) hinge joint
(2) gliding joint
(3) ball and socket joint
(4) pivot joint

191. Which of the following is a symbiotic nitrogen fixer?
(1) *Azotobacter*
(2) *Frankia*
(3) *Azolla*
(4) *Glomus*

192. Whose experiments cracked the DNA and discovered unequivocally that a genetic code is a 'triplet'?
(1) Hershey and Chase
(2) Morgan and Sturtevant
(3) Beadle and Tatum
(4) Nirenberg and Mathaei

193. Which one of the following types of organisms occupies more than one trophic level in a pond ecosystem?
(1) Fish
(2) Zooplankton
(3) Frog
(4) Phytoplankton

194. Which one of the following acids is a derivative of carotenoids?
(1) Indole-3-acetic acid
(2) Gibberellic acid
(3) Abscisic acid
(4) Indole butyric acid

195. The bacterium *Bacillus thuringiensis* is widely used in contemporary biology as
(1) insecticide
(2) agent for production of dairy products
(3) source of industrial enzyme
(4) indicator of water pollution

196. An example of a seed with endosperm, perisperm, and caruncle is
(1) coffee
(2) lily
(3) castor
(4) cotton

197. Reduction in vascular tissue, mechanical tissue and cuticle is characteristic of
(1) mesophytes
(2) epiphytes
(3) hydrophytes
(4) xerophytes

198. Point mutation involves
(1) change in single base pair
(2) duplication
(3) deletion
(4) insertion

199. Which one of the following correctly describes the location of some body parts in the earthworm *Pheretima*?
(1) Four pairs of spermathecae in 4 – 7 segments
(2) One pair of ovaries attached at intersegmental septum of 14^{th} and 15^{th} segments.
(3) Two pairs of testes in 10^{th} and 11^{th} segments
(4) Two pairs of accessory glands in 16 – 18 segments

200. The kind of tissue that forms the supportive structure in our pinna (external ears) is also found in
(1) nails
(2) ear ossicles
(3) tip of the nose
(4) vertebrae

AIPMT - 2009
(Physics, Chemistry and Biology)
Prelims Answer Key and Solution

Answers

1	(1)	2	(1)	3	(1)	4	(1)	5	(1)	6	(1)	7	(3)	8	(4)	9	(4)	10	(4)
11	(1)	12	(3)	13	(3)	14	(1)	15	(2)	16	(4)	17	(2)	18	(3)	19	(1)	20	(3)
21	(2)	22	(4)	23	(3)	24	(2)	25	(2)	26	(4)	27	(1)	28	(3)	29	(2)	30	(3)
31	(1)	32	(2)	33	(2)	34	(2)	35	(1)	36	(1)	37	(3)	38	(4)	39	(4)	40	(1)
41	(4)	42	(3)	43	(2)	44	(4)	45	(1)	46	(2)	47	(3)	48	(2)	49	(2)	50	(4)
51	(1)	52	(1)	53	(3)	54	(3)	55	(1)	56	(2)	57	(2)	58	(1)	59	(2)	60	(4)
61	(3)	62	(3)	63	(3)	64	(1)	65	(2)	66	(2)	67	(1)	68	(1)	69	(1)	70	(2)
71	(1)	72	(4)	73	(4)	74	(1)	75	(1)	76	(1)	77	(3)	78	(1)	79	(1)	80	(2)
81	(3)	82	(1)	83	(1)	84	(3)	85	(4)	86	(4)	87	(3)	88	(1)	89	(4)	90	(4)
91	(3)	92	(1)	93	(4)	94	(1)	95	(4)	96	(1)	97	(1)	98	(1)	99	(3)	100	(4)
101	(2)	102	(2)	103	(1)	104	(3)	105	(4)	106	(3)	107	(1)	108	(2)	109	(2)	110	(4)
111	(1)	112	(4)	113	(2)	114	(1)	115	(3)	116	(2)	117	(2)	118	(3)	119	(1)	120	(3)
121	(4)	122	(3)	123	(2)	124	(3)	125	(2)	126	(2)	127	(2)	128	(3)	129	(2)	130	(1)
131	(2)	132	(1)	133	(1)	134	(2)	135	(2)	136	(1)	137	(3)	138	(1)	139	(4)	140	(1)
141	(3)	142	(3)	143	(2)	144	(3)	145	(3)	146	(4)	147	(4)	148	(3)	149	(1)	150	(2)
151	(1)	152	(2)	153	(4)	154	(3)	155	(2)	156	(2)	157	(1)	158	(1)	159	(4)	160	(1)
161	(4)	162	(2)	163	(2)	164	(1)	165	(3)	166	(4)	167	(3)	168	(2)	169	(1)	170	(4)
171	(4)	172	(3)	173	(3)	174	(4)	175	(3)	176	(1)	177	(4)	178	(1)	179	(4)	180	(4)
181	(4)	182	(1)	183	(1)	184	(4)	185	(2)	186	(1)	187	(2)	188	(1)	189	(2)	190	(1)
191	(2)	192	(4)	193	(1)	194	(3)	195	(1)	196	(3)	197	(3)	198	(1)	199	(3)	200	(3)

Physics

1. Momentum of the first part = mv = 1 × 12 = 12 kg ms^{-1}
Momentum of the second part = mv = 2 × 8 = 16 kg ms^{-1}
$\therefore$ Resultant momentum $= \sqrt{(12)^2 + (16)^2} = 20$ kg ms^{-1}
The third part should also have the same momentum.
Let the mass of the third part be M, then
4 × M = 20
$\therefore$ M = 5 kg

2. Here, B = 0.04 T and $-\frac{dr}{dt} = 2 \text{mms}^{-1}$

Induced emf, $E = \frac{d\phi}{dt} = \frac{-BdA}{dt} = -B\frac{d(\pi r^2)}{dt} = -B\pi(2r)\frac{dr}{dt}$
Now, if r = 2 cm, the induced emf is
E = −0.04 × π × 2 × 2 × 10^{-2} × 2 × 10^{-3} = 3.2 πμV

3.
(i) Dimensions of pressure [P] = [M^{1}L^{-1}T^{-2}]
Here, a = 1, b = 1, c = −2
This matches the given data.
(ii) Dimensions of velocity [v] = [M^{0}L^{1}T^{-1}]
Here, a = 0, b = 1, c = −1
This does not match with the given data.
(iii) Dimensions of acceleration [a] = [M^{0}L^{1}T^{-2}]
Here, a = 0, b = 1, c = −2
This does not match with the given data.
(iv) Dimensions of force [F] = [M^{1}L^{1}T^{-2}]
Here a = 1, b = 1, c = −2
Hence, the correct quantity will be pressure.

4. Alpha particles are positively charged particles with charge +2e and mass 4m. Emission of an α-particle reduces the mass of the radionuclide by 4 and its atomic number by 2. β-particles are negatively charged particles with rest mass and charge same as that of electrons. γ-particles carry no charge and mass.
Hence, the radioactive transition will be

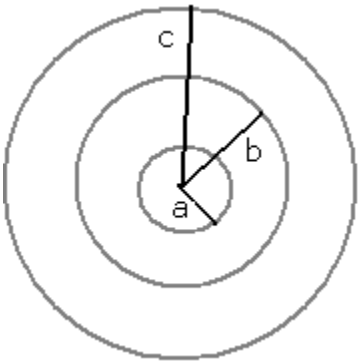
$${}^{A}_{z}X \rightarrow {}^{A}_{Z+1}Y + \beta^0_{-1}$$

$${}^{A}_{Z+1}Y \rightarrow {}^{A-4}_{Z-1}B^* + \alpha^4_2$$

$${}^{A-4}_{Z+1}B^* \rightarrow {}^{A-4}_{Z-1}B + \gamma^0_0$$

Therefore, the particles are emitted in the sequence β, α, γ.

5. The three concentric shells are placed as shown below.



The charges on the three surfaces are

$q_A = 4\pi a^2\sigma$; $q_B = -4\pi b^2\sigma$; $q_C = 4\pi c^2\sigma$

Shells B and C lie outside the shell A. Hence, the potential at any point on shell A is

$$V_A = \frac{1}{4\pi\varepsilon_0}\left(\frac{q_a}{a}+\frac{q_b}{b}+\frac{q_c}{c}\right)$$

$$= \frac{1}{4\pi\varepsilon_0}\frac{4\pi a^2\sigma}{a} - \frac{1}{4\pi\varepsilon_0}\frac{4\pi b^2\sigma}{b} + \frac{1}{4\pi\varepsilon_0}\cdot\frac{4\pi c^2\sigma}{c}$$

$$= \frac{\sigma}{\varepsilon_0}(a-b+c) = \frac{\sigma}{\varepsilon_0}(2a) \qquad (\because c = a+b)$$

Shell C lies outside the shell B and A lies inside it. Hence, the potential at any point on shell B is

$$V_B = \frac{1}{4\pi\varepsilon_0}\left(\frac{q_A}{b}+\frac{q_B}{b}+\frac{q_C}{c}\right)$$

$$= \frac{1}{4\pi\varepsilon_0}\cdot\frac{4\pi a^2\sigma}{b} - \frac{1}{4\pi\varepsilon_0}\frac{4\pi b^2\sigma}{b} + \frac{1}{4\pi\varepsilon_0}\cdot\frac{4\pi c^2\sigma}{c}$$

$$= \frac{\sigma}{\varepsilon_0}\left(\frac{a^2}{b}-b+c\right) = \frac{\sigma}{\varepsilon_0}\left(\frac{a^2}{b}-b+a+b\right) \qquad (\because c = a+b)$$

$$= \frac{\sigma}{\varepsilon_0}\left(\frac{a^2}{b}+a\right)$$

Shells A and B lie inside shell C. Hence, the potential at any point on shell C is

$$V_C = \frac{q_A}{c} + \frac{q_B}{c} + \frac{q_C}{c}$$

$$= \frac{1}{4\pi\varepsilon_0}\cdot\frac{4\pi a^2\sigma}{c} - \frac{1}{4\pi\varepsilon_0}\cdot\frac{4\pi b^2\sigma}{c} + \frac{1}{4\pi\varepsilon_0}\cdot\frac{4\pi c^2\sigma}{c}$$

$$= \frac{\sigma}{\varepsilon_0}\left(\frac{a^2}{c} - \frac{b^2}{c} + c\right) = \frac{\sigma}{\varepsilon_0}\left(\frac{a^2}{a+b} - \frac{b^2}{a+b} + a + b\right)$$

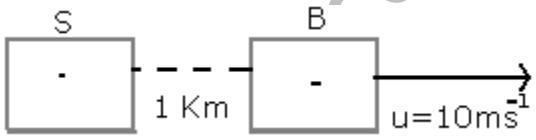
$$= \frac{\sigma}{\varepsilon_0}\left(\frac{a^2 - b^2 + (a+b)^2}{a+b}\right) = \frac{\sigma}{\varepsilon_0}\left(\frac{a^2 - b^2 + a^2 + 2ab + b^2}{a+b}\right)$$

$$= \frac{\sigma}{\varepsilon_0}\left(\frac{2a^2 + 2ab}{a+b}\right) = \frac{\sigma}{\varepsilon_0}\left(\frac{2a(a+b)}{a+b}\right) = \frac{\sigma}{\varepsilon_0}(2a)$$

$$= \frac{\sigma}{\varepsilon_0}\left(\frac{a^2}{c} - \frac{b^2}{c} + c\right) = \frac{\sigma}{\varepsilon_0}(2a) \quad (\because c = a + b)$$

Hence, we see that $V_A = V_c \neq V_B$

6. The situation is as shown below.



Let v be the relative velocity of the scooter (S) w.r.t. bus (B), then the speed of scooter is

$v_S = v + v_B$ ..... (i)

Now, the relative velocity is

Relative velocity = displacement/time

$$= \frac{1000}{100} = 10 ms^{-1}$$

And v_B is given as 10 ms^{-1}.

Substituting the values in equation (i), we get

$v_S = 10 + 10 = 20\ ms^{-1}$

7. The time period of circular motion of the charged particle is given by

$$T = \frac{2\pi r}{v} = \frac{2\pi}{v} \times \frac{mv}{Bq} \quad [\because mv = BqR]$$

$$\Rightarrow T = \frac{2\pi m}{Bq}$$

Hence, the time period of rotation of the charged particle in uniform magnetic field is independent of both v and R.

8. It is given that the amplitude of the wave is A = 2 cm = 0.02 m
Direction = + ve x direction, v = 128 ms^{-1} and $5\lambda = 4$
Now, we know that

$$k = \frac{2\pi}{\lambda} = \frac{2\pi \times 5}{4} = 7.85$$

And $v = \frac{\omega}{k} = 128 ms^{-1}$

$$\Rightarrow \omega = v \times k = 128 \times 7.85 = 1005$$

The standard wave equation is y = A sin (kx - ωt)
$\therefore$ y = 2 sin (7.85x – 1005t)
= (0.02)m sin (7.85x – 1005t)

9. We have y = A sinωt
So, the velocity is

$$v = \frac{dy}{dt}$$

$$= A\omega \cos \omega t = A\omega \sqrt{1 - \sin^2 \omega t}$$

$$= A\omega \sqrt{1 - \frac{y^2}{A^2}} = A\omega \frac{\sqrt{A^2 - y^2}}{A}$$

$$= \omega \sqrt{A^2 - y^2}$$

It is given that $y = \frac{a}{2}$ and amplitude is 'a'.

$$\therefore \ v = \omega \sqrt{a^2 - \frac{a^2}{4}} = \omega \sqrt{\frac{3a^2}{4}} = \frac{2\pi}{T} \frac{a\sqrt{3}}{2} = \frac{\pi a \sqrt{3}}{T}$$

10. Energy of a wave is $E = h\nu = h\frac{c}{\lambda}$

$$\Rightarrow \lambda = \frac{hc}{E}$$

where h is the Planck's constant and c is the velocity of light.
Substituting the values of h, c and E in the above equation, we get

$$\lambda = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{2.5 \times 1.6 \times 10^{-19}} = 5000 \text{ Å}$$

As 4000 Å < 5000 Å, a signal of wavelength 4000 Å can be detected by the photodiode.

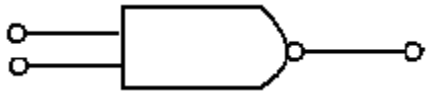
11. Initially, the body possesses only kinetic energy and after attaining the maximum height, its kinetic energy is zero.

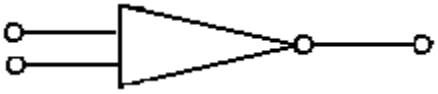
Therefore, the loss of energy = KE – PE $= \frac{1}{2}mv^2 - mgh$

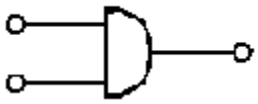
$= \frac{1}{2} \times 1 \times 400 - 1 \times 18 \times 10$

= 200 – 180 = 20 J

12.

(i)  : NAND gate

(ii)  : NOT gate

(iii)  : AND gate

(iv)  : OR gate

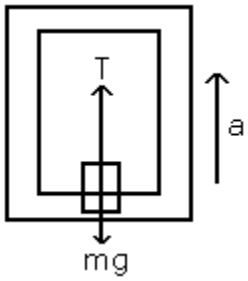
Hence, the correct answer is option (3).

13. Torque is given in terms of r and F as $\vec{\tau} = \vec{r} \times \vec{F}$

Torque is perpendicular to both $\vec{r}$ and $\vec{F}$; hence, their dot product zero $\vec{r} \cdot \vec{\tau} = 0$ and $\vec{F} \cdot \vec{\tau} = 0$.

14. Diamagnetic substances are weakly magnetised in a direction opposite to that of the applied magnetic field. These are repelled in an external magnetic field, i.e. have a tendency to move from the high to the low field region.

15. The lift is accelerating upwards with acceleration 'a'.



Hence, the equation of motion is written as

$T - mg = ma$

$28000 - (2000 \times 10) = 2000\ a$

$\Rightarrow\ a = \dfrac{8000}{2000} = 4 ms^{-2}$

The net acceleration will be upwards as tension is greater than the weight.

16. Let the radioactive substance be ${}^{A}_{Z}X$. Radioactive transition is given by

$${}^{A}_{Z}X \xrightarrow{-\alpha} {}^{A-4}_{Z-2}X \xrightarrow{-2\beta} {}^{A-4}_{Z}X$$

Hence, we get the atoms of the element with the same atomic number but different mass numbers. Such elements are called isotopes.

17. When a loop of certain area is passed through a magnetic field, an emf is induced in it. This emf depends on the area being swept by the field. Now, the area being swept per second from the magnetic field is not constant for elliptical and circular loops. So, the induced emf during the passage of these loops out of the field region will not remain constant.

18. Since the body starts from rest u = 0

$\therefore s = \dfrac{1}{2}at^2$

Now $s_1 = \dfrac{1}{2}a(10)^2$ ... (i)

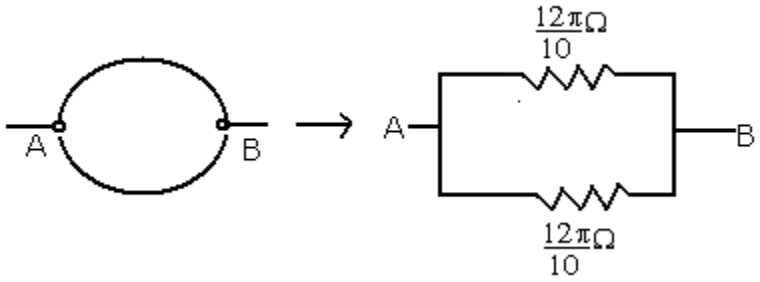
And $s_2 = \dfrac{1}{2}a(20)^2$ ... (ii)

Dividing equation (i) and equation (ii), we get

$\dfrac{s_1}{s_2} = \dfrac{(10)^2}{(20)^2}$

$s_2 = 4s_1$

19. The wire in the form of a resistance network can be shown as



Circumference of circle = $2\times\pi\frac{10}{100}=\frac{2\pi}{10}=\frac{\pi}{5}$

Resistance of wire $=12\times\frac{\pi}{5}=\frac{12\pi}{5}$

Resistance of each section $=\frac{12\pi}{10}\Omega$

$\therefore$ Equivalent resistance

$$=\frac{\frac{12\pi}{10}\times\frac{12\pi}{10}}{\frac{12\pi}{10}+\frac{12\pi}{10}}=\frac{6\pi}{10}=0.6\pi\Omega$$

20. Comparing the given equation

$$E_y=2.5\frac{N}{C}\cos\left[\left(2\pi\times10^6\frac{rad}{m}\right)t-\left(\pi\times10^{-2}\frac{rad}{sec}\right)x\right]$$

with the standard equation $E_y = E_0 \cos(\omega t - kx)$, we get

$\omega = 2\pi f = 2\pi\times 10^6$

$\therefore f = 10^6$ Hz

Moreover, we know that

$$\frac{2\pi}{\lambda}=k=\pi\times10^{-2}m^{-1}$$

$$\Rightarrow\lambda=200m$$

Hence, the wave is moving along a positive x-direction with a frequency of 10^6 Hz and wavelength 200 m.

21. From the conservation of angular momentum, we have

$I_1\omega_1 = I_2\omega_2$ ... (i)

In the given case,

$I_1 = MR^2$

$I_2 = MR^2 + 2mR^2$

$\omega_1 = \omega$

Then from equation (i), we get

$$\omega_2 = \frac{I_1}{I_2}\omega = \frac{M}{M+2m}\omega$$

22. For a transistor

$I_E = I_B + I_C$

where I_E = Emitter current

I_B = Base current

I_C = Collector current

The current gain is $\beta = \frac{\Delta I_c}{\Delta I_B}$

It is given that $\Delta I_C = 10\text{ mA} - 5\text{ mA} = 5\times10^{-3}\text{ A}$ and

$\Delta I_B = 200\ \mu\text{A} - 100\ \mu\text{A} = 100\times10^{-6}\text{ A}$

$$\therefore \beta = \frac{5}{100}\times1000 = 50$$

23. We know that

$E = \sigma T^4$

$$\therefore \frac{E_1}{E_2} = \left[\frac{T_1}{T_2}\right]^4$$

It is given that $T_1 = 227°C$ and $T_2 = 727°C$

$$\Rightarrow E_2 = 7\left[\frac{273+727}{273+227}\right]^4 = \left(\frac{1000}{500}\right)^4\times7 = 112\text{ cal cm}^{-2}\text{s}^{-1}$$

24. The emf of the cell is given in terms of potential difference across the plates and its internal resistance as

$\varepsilon = V + Ir$

$\therefore V = -Ir + \varepsilon$

Comparing the above equation with the straight line equation $y = mx + c$, we get

Slope of the graph = $-r$ and intercept = ε

25. The position vector of the centre of mass is

$$\vec{r} = \frac{m_1\vec{r}_1 + m_2\vec{r}_2}{m_1 + m_2}$$

$$= \frac{1(\hat{i}+2\hat{j}+\hat{k}) + 3(-3\hat{i}-2\hat{j}+\hat{k})}{1+3}$$

$$= \frac{1}{4}(-8\hat{i}-4\hat{j}+4\hat{k})$$

$$= -2\hat{i}-\hat{j}+\hat{k}$$

The centre of mass changes its position only under translatory motion. There is no effect of rotatory motion on the position of the centre of mass of the body.

26. According to the first law of thermodynamics, the internal energy of the system will be

$\Delta U = Q - W$

$= (2 \times 10^3 \times 4.2) - 500$

$= 8400 - 500$

$= 7900$ J

27. The rate of flowing mass is

$$\frac{dm}{dt} = \frac{dm}{dx} \times \frac{dx}{dt}$$

Now, m is the mass per unit length, i.e. $\frac{dm}{dx} = m$

Hence, we have $\frac{dm}{dt} = m \times \frac{dx}{dt} = mv$

Therefore, the rate of KE is

$$\frac{dK}{dt} = \frac{1}{2}\left(\frac{dm}{dt}\right)v^2 \quad \text{(For constant v)}$$

$$\frac{dK}{dt} = \frac{1}{2}(mv)v^2 = \frac{1}{2}mv^3$$

28. Whenever there is a relative motion between a source of sound and the observer (listener), the frequency of sound heard by the observer is different from the actual frequency of sound which is emitted by the source.

The sound reflects from the hill and reaches the driver.

Hence, we can say that the source is moving closer to the observer.

The frequency heard after reflection will be

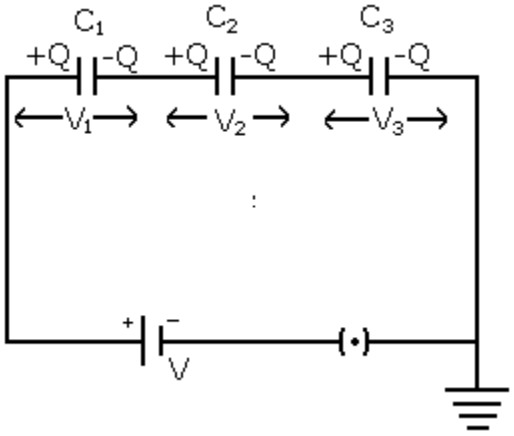
$$n' = n\left(\frac{c+v}{c-v}\right)$$
$$= 600 \times \left(\frac{330+30}{330-30}\right)$$
$$= 600 \times \frac{360}{300}$$
$$= 720 \text{ Hz}$$

29. A particle of mass M_1 and charge Z_1 possesses initial velocity u when it is at a large distance from the nucleus of an atom with atomic number Z_2. At the distance of closest approach, the kinetic energy of the particle is completely converted to potential energy. Mathematically, we will have

$$\frac{1}{2}M_1u^2 = \frac{1}{4\pi\varepsilon_0}\frac{Z_1Z_2}{r_0}$$

So, the energy of the particle is directly proportional to Z_1Z_2.

30. In a series arrangement, the charge on each plate of each capacitor has the same magnitude.



The potential difference of the combination will add and produce a total voltage across the circuit as

$V_s = V_1 + V_2 + V_3$

$V_s = 3V$

The equivalent capacitance C_s is

$$\frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$
$$= \frac{1}{C} + \frac{1}{C} + \frac{1}{C} = \frac{3}{C}$$
$$\Rightarrow C_s = \frac{C}{3}$$

31. Magnetic Lorentz force is

$$\vec{F} = q(\vec{v} \times \vec{B})$$

$$= \left(-2\times10^{-6}\right)\begin{bmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2\times10^{6} & 3\times10^{6} & 0 \\ 0 & 2 & 0 \end{bmatrix}$$

$$= \left(-2\times10^{-6}\right)\left(4\times10^{6}\right)\hat{k}$$

$$= 8\left(-\hat{k}\right)$$

Hence, the force is 8 N along the negative z-axis.

32. For simple harmonic motion, the restoring force is directly proportional to negative displacement.

$F \propto -y$

$F = -ky$

Force is also

$F = ma$

$$\therefore a = -\frac{k}{m}y$$

For unit mass, we have

$a = -ky$

For $y = x + a$, we get

Acceleration $= -k(x + a)$

33. It is given that $\lambda = 667\ nm = 667 \times 10^{-9}\ m$, $P = 9 \times 10^{-3}\ W$

Now, power is

$$\text{Power} = \frac{\text{energy}}{\text{time}}$$

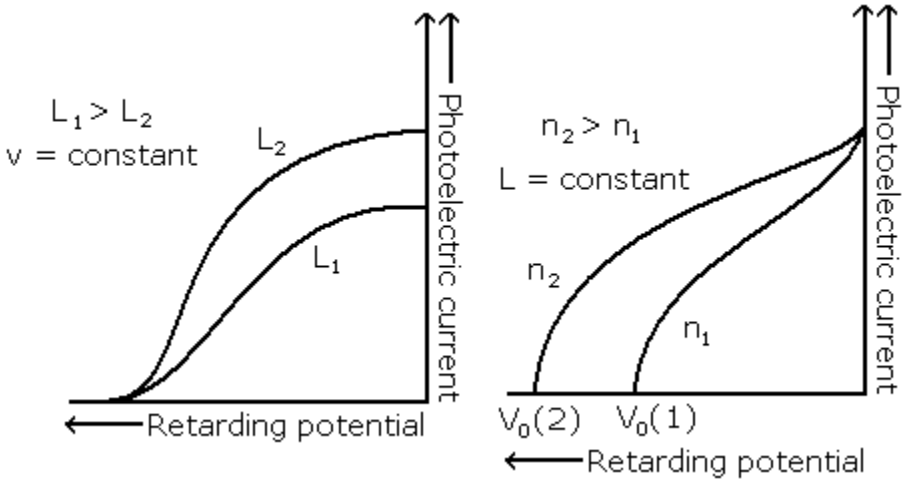
$$= \frac{nhc}{\lambda t}$$

$$= \frac{Nhc}{\lambda}$$

where N is the number of photons emitted per second.

$$\Rightarrow N = \frac{P\times\lambda}{hc} = \frac{9\times10^{-3}\times667\times10^{-9}}{6.6\times10^{-34}\times3\times10^{8}} = 3\times10^{16}\ /\ s$$

34. The plots of photo current versus retarding potential for constant frequency and for constant intensity are shown below.



From the two graphs, we can conclude that the curves a and b represent incident radiations of the same frequency but of different intensities.

35. Power dissipated in a series L–C–R circuit is

$$P = I_{rms}^2 R = \frac{\varepsilon_{rms}^2 R}{|Z|^2} = \frac{\varepsilon^2 R}{\left[R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2\right]}$$

36. Potential gradient is related with electric field according to the following relation:

$$E = \frac{-dV}{dr}$$

$$\vec{E} = \left[-\frac{\partial V}{\partial x}\hat{i} - \frac{\partial V}{\partial y}\hat{j} - \frac{\partial V}{\partial x}\hat{k}\right]$$

$$= \hat{i}(2xy + z^3) + \hat{j}(x^2) + \hat{k}3xz^2$$

37. When the magnetic dipole is rotated from initial position θ_1 to θ_2, then work done is

$W = MB(\cos\theta_1 - \cos\theta_2) = MB(\cos 0° - \cos 60°)$

$$= MB\left(1 - \frac{1}{2}\right) = \frac{MB}{2}$$

$$= \frac{2 \times 10^4 \times 6 \times 10^{-4}}{2} = 6\ J$$

38. Given, $G_1 = 60\ \Omega$, $I_g = 1.0$ A, $I = 5$ A

For a galvanometer as an ammeter, a resistance is to be connected in parallel. We have

$I_g G_1 = (I - I_g)S$

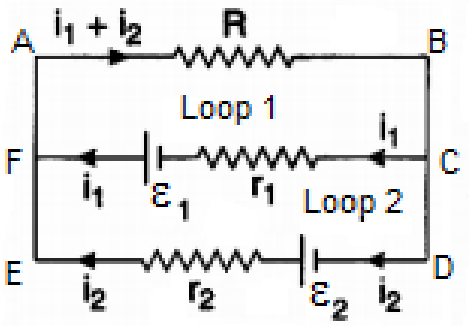
$$\therefore S = \frac{I_g G_1}{I - I_g} = \frac{1}{5-1} \times 60 = 15\ \Omega$$

Hence, a galvanometer can be converted to an ammeter by putting a 15 Ω resistance in parallel.

39. For a rod of length L and area of cross-section A whose faces are maintained at temperature T_1 and T_2, respectively, the rate of heat flowing from one face to the other face in time t in a steady state is given by

$$\frac{dQ}{dt} = \frac{KA(T_1 - T_2)}{L}$$

40. The circuit can be considered in loops as shown in the figure below:



According to Kirchhoff's voltage rule, we have for loop ABCFA

$$\varepsilon_1 - (i_1 + i_2)R - i_1 r_1 = 0$$

Similarly, for loop FCDEF, we have

$$-\varepsilon_1 + i_1 r_1 - i_2 r_2 + \varepsilon_2 = 0$$

And for loop ABCDEFA, we have

$$\varepsilon_2 - (i_1 + i_2)R - i_2 r_2 = 0$$

Hence, the correct option is (1).

41. Energy = 2 eV

$\therefore eV_0 = 2$ eV

$\Rightarrow V_0 = 2$ V

Now, the electric field will be

$$E = \frac{2}{4 \times 10^{-8}} = 0.5 \times 10^8 = 5 \times 10^7\ \text{Vm}^{-1}$$

42. The number of photoelectrons emitted is directly proportional to the intensity of light.

43. Frequency of vibration of the first string is

$$f_1 = \frac{1}{2l_1}\sqrt{\frac{T}{m}}$$

$$= \frac{1}{2\times 51.6\times 10^{-2}}\sqrt{\frac{20}{10^{-3}}}$$

$$= 137 \text{ Hz}$$

Similarly, the frequency of the second string is

$$f_2 = \frac{1}{2l_2}\sqrt{\frac{T}{m}}$$

$$= \frac{1}{2\times 49.1\times 10^{-2}}\sqrt{\frac{20}{10^{-3}}}$$

$$= 144 \text{ Hz}$$

Therefore, the number of beats = $f_2 - f_1 = 144 - 137 = 7$ beats.

44. Number of spectral lines is

$$N = \frac{n(n-1)}{2}$$

$$\Rightarrow \frac{n(n-1)}{2} = 6$$

$n^2 - n - 12 = 0$

$(n - 4)(n + 3) = 0$

$\Rightarrow n = 4$

Now, in any transition, the first line of the series has the maximum wavelength, and therefore, the electron jumps from the 4^{th} orbit to the 3^{rd} orbit.

45. According to the parallel axis theorem, the moment of inertia of the frame about an axis through the centre of the square and perpendicular to its plane is equal to four times the moment of inertia of a rod about an axis through its centre of mass and perpendicular to it + [(mass of rod) × square of perpendicular distance between two axes].

$$= 4\left(\frac{Ml^2}{12} + M\left(\frac{l}{2}\right)^2\right) = 4\times\frac{Ml^2}{3} = \frac{4}{3}Ml^2$$

46. For an adiabatic process, there should not be any exchange of heat between the system and its surroundings. All walls of the container must be perfectly insulated. In adiabatic changes, gases obey Poisson's law, i.e. PV^{γ} = constant. In an isochoric process, the volume remains constant. In an isobaric process, the pressure remains constant. Hence, the correct answer is option (2).

47. According to Kepler's second law, the line joining the Sun to the planet sweeps out equal areas in equal time interval, i.e. the areal velocity is constant.

$$\frac{dA}{dt} = \text{constant}$$

$$\frac{A_1}{t_1} = \frac{A_2}{t_2}$$

$$\Rightarrow t_1 = \frac{A_1}{A_2} t_2$$

Given $A_1 = 2A_2$

$\therefore t_1 = 2t_2$

48. The nearest neighbour distance for a body-centred cubic cell is

$$d = \frac{\sqrt{3}}{2} a$$

where a is the lattice parameter.

$$\Rightarrow 3.7 = \frac{\sqrt{3}a}{2}$$

$$\Rightarrow a = \frac{2 \times 3.7}{\sqrt{3}} = 4.3 \overset{\circ}{A}$$

49. Let x be the extension in the spring.
Applying conservation of energy, the loss in potential energy is equal to the gain in spring energy.
Hence, we get

$$Mgx = \frac{1}{2} kx^2$$

$$\Rightarrow x = \frac{2Mg}{k}$$

50. Here, $\vec{F} = 6\hat{i} - 8\hat{j} + 10\hat{k}$

$$|F| = \sqrt{36 + 64 + 100}$$

$$= 10\sqrt{2} N$$

Given, $a = 1 ms^{-2}$

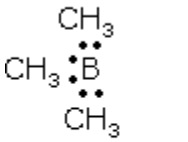
We know that F = ma

$$\therefore m = \frac{10\sqrt{2}}{1} = 10\sqrt{2} kg$$

Chemistry

51.

(1)

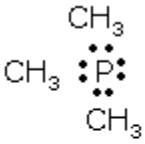


incomplete octet (Lewis acid)

(2)

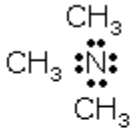
complete octet and presence of lp of e^- (Lewis base)

(3)



complete octet and presence of lp of e^- (Lewis base)

(4)



complete octet and presence of lp of e^- (Lewis base)

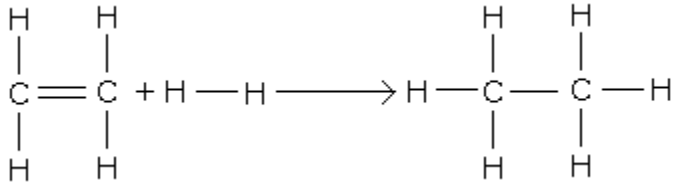
Here, lp means lone pair.

52. $KOH \rightarrow K^+ + OH^-$

$RX + OH^- + K^+ \rightarrow R-OH + KX$

nucleophile

53. For the reaction,



$\Delta H_r = [4 \times BE_{(C-H)} + 1 \times BE_{(C=C)} + 1 \times BE_{(H-H)}] - [6 \times BE_{(C-H)} + 1 \times BE_{(C-C)}]$
$= (4 \times 410.50 + 1 \times 606.10 + 1 \times 431.37) - [(6 \times 410.50) + (1 \times 336.49)]$
$= -120.0 \text{ kJ mol}^{-1}$

54. (1) $3d^3, 4s^2 \Rightarrow$ O.S. = 3 + 2 = 5
(2) $3d^5, 4s^1 \Rightarrow$ O.S. = 5 + 1 = 6
(3) $3d^5, 4s^2 \Rightarrow$ O.S. = 5 + 2 = 7
(4) $3d^2, 4s^2 \Rightarrow$ O.S. = 2 + 2 = 4
Hence, the element with $3d^5, 4s^2$ configuration exhibits the largest number of oxidation states.

55. Given, $K_b(NH_4OH) = 1.77 \times 10^{-5}$
$NH_4OH \rightarrow NH_4^+ + OH^-$

$$K_b = \frac{[NH_4^+][OH^-]}{[NH_4OH]} = 1.77 \times 10^{-5} \quad \text{... (i)}$$

Hydrolysis of NH_4Cl takes place as
$NH_4Cl + H_2O \rightarrow NH_4OH + HCl$
$NH_4^+ + H_2O \rightarrow NH_4OH + H^+$

$$\text{Hydrolysis constant, } K_h = \frac{[NH_4OH][H^+]}{[NH_4^+]} \quad \text{... (ii)}$$

$$K_h = \frac{[NH_4OH][H^+][OH^-]}{[NH_4^+][OH]} \quad \text{... (iii)}$$

From Eqs. (i) and (iii),

$$K_h = \frac{K_w}{K_b} \qquad (\because [H^+][OH^-] = K_w)$$

$$= \frac{10^{-14}}{1.77 \times 10^{-5}}$$
$$= 5.65 \times 10^{-10}$$

56. Sodium hydroxide (NaOH), being a strong alkali, never reacts with a basic oxide. Among the given options, B_2O_3 and BeO are amphoteric oxides, and CaO is a basic oxide. Therefore, NaOH does not breach with CaO.

57. Optical isomerism is exhibited by only those complexes in which elements of symmetry are absent. Octahedral complexes of the types [M (aa)], [M (aa)x, y_2] have absence of symmetry, thus exhibiting optical isomerism. Here, 'aa' represents a monodentate ligand and M represents a central metal ion.
Hence, because of presence of symmetry elements, $[Co(NH_3)_3Cl_3]^0$ does not exhibit optical isomerism.

58. Drugs used to reduce anxiety and to treat mental diseases are called tranquillisers. These drugs are also known as psychotherapeutic drugs. Luminal, seconal and equanil are two commonly used tranquillisers.

59. Al_2O_3 ionises

$Al_2O_3 \rightarrow Al^{3+} + AlO_3^{3-}$

At the cathode:

$Al^{3+} + 3e^- \rightarrow Al$

$3F \rightarrow 27g$

$\because$ Mass of aluminium deposited by 3 F of electricity = 27 g

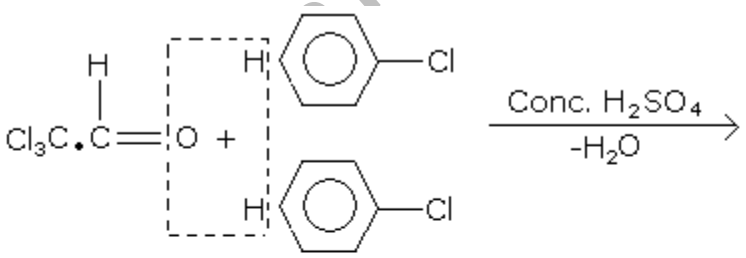
$\because$ Mass of aluminium deposited by $4.0 \times 10^4 \times 6 \times 3600$ C of electricity

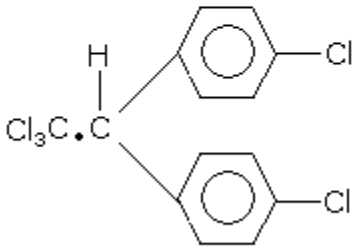
$$= \frac{27 \times 4.0 \times 10^4 \times 6 \times 3600}{3F} g$$

$$= \frac{27 \times 4.0 \times 10^4 \times 6 \times 3600}{3 \times 96500} g$$

$$= 8.1 \times 10^4 g$$

60.





dichlorodiphenyl trichloroethane (DDT)

61.

(1) In $[Sc(H_2O)_3(NH_3)_3]^{3+}$, Sc is present as Sc^{3+}.

$Sc^{3+} = [Ar]\ 3d^0, 4s^0$

In this complex, excitation of electrons is not possible. It will not absorb visible light.

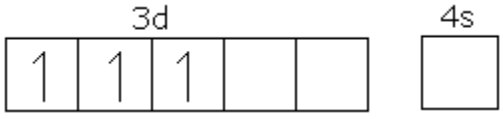
(2) In $[Ti(en)_2(NH_3)_2]^{4+}$, Ti is present as Ti^{4+}.

$Ti^{4+} = [Ar]\ 3d^0, 4s^0$

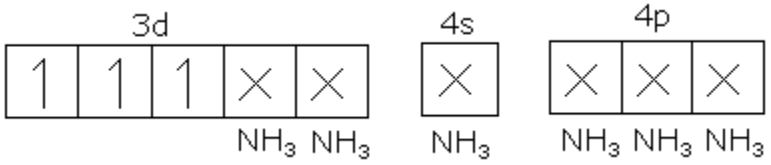
Hence, it will not absorb visible light.

(3) In $[Cr(NH_3)_6]^{3+}$, Cr is present as Cr^{3+}.

$Cr^{3+} = [Ar]\ 3d^3, 4s^0$



$[Cr(NH_3)_6]^{3+} = [Ar]$

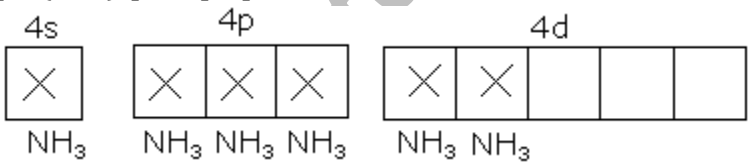


Since this complex has three unpaired electrons, excitation of electrons is possible, and thus, it is expected that this complex will absorb visible light.

(4) In $[Zn(NH_3)_6]^{2+}$, Zn is present as Zn^{2+}.

$Zn^{2+} = [Ar]\ 3d^{10}, 4s^0$

$[Zn(NH_3)_6]^{2+} = [Ar]\ 3d^{10}$



Hence, this complex will not absorb visible light.

62. For half-life of first order reaction $k = \frac{2.303}{t}\ln\frac{A_0}{A_t}$

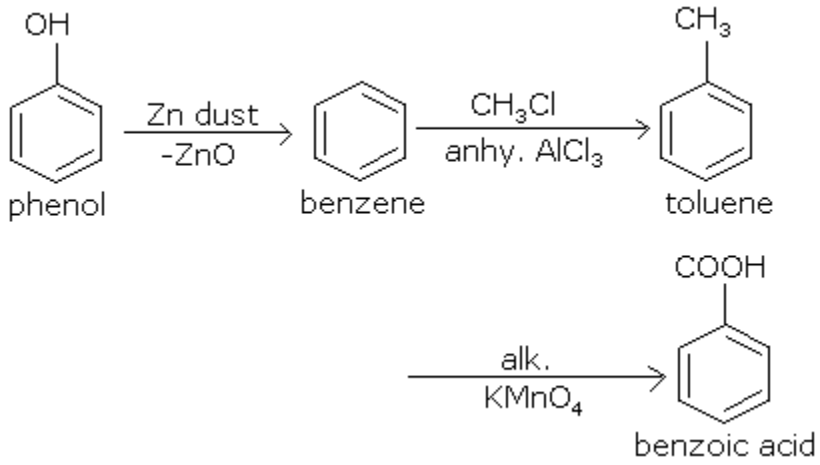
Specific rate constant

$$k = \frac{0.693}{t_{1/2}}$$

$$= \frac{0.693}{1386}$$

$$= 0.5 \times 10^{-3} s^{-1}$$

63. (i) Zn dust converts the –OH group into –H.
(ii) Reaction with CH_3Cl in the presence of anhydrous $AlCl_3$ is called Friedel–Crafts alkylation.
(iii) Alkaline $KMnO_4$ converts the complete carbon chain which is directly attached with the benzene ring into the –COOH group.



64. In a face-centred cubic lattice,

$$\text{Radius} = \frac{\sqrt{2}a}{4}$$

$\therefore$ Radius of copper atom (fcc lattice)

$$= \frac{\sqrt{2} \times 361}{4} = 128\,\text{pm}$$

65. For the reaction,
$A + B \rightarrow$ Products
On doubling the initial concentration of A only, the rate of reaction is also doubled; therefore,
Rate $\propto [A]^1$ ... (i)
Initially, the rate law is
Rate = $k[A][B]^y$ ... (ii)
If the concentration of A and B both are doubled, the rate changes by a factor of 8
$8 \times \text{Rate} = k[2A][2B]^y$ ... (iii)
[$\because$ Rate $\propto [A]^1$]
Dividing Eq. (iii) by Eq. (ii),
$8 = 2 \times 2^y$
$4 = 2^y$
$\therefore y = 2$
Hence, rate = $k[A][B]^2$

66. $N_2(7+7=14)=\sigma 1s^2,\overset{*}{\sigma} 1s^2,\sigma 2s^2,\overset{*}{\sigma} 2s^2,\pi 2p_x^2 \approx \pi p_y^2,\sigma 2p_z^2$

$$BO=\frac{10-4}{2}=3$$

$N_2^-(7+7+1=15)$

$=\sigma 1s^2,\overset{*}{\sigma} 1s^2,\sigma 2s^2,\overset{*}{\sigma} 2s^2,\sigma 2p_z^2\,\pi 2p_x^2 \approx \pi p_y^2,\overset{*}{\pi} 2p_x^1$

$$BO=\frac{10-5}{2}=2.5$$

$N_2^{2-}(7+7+2=16)$

$=\sigma 1s^2,\overset{*}{\sigma} 1s^2,\sigma 2s^2,\overset{*}{\sigma} 2s^2,\sigma 2p_z^2\,\pi 2p_x^2 \approx \pi p_y^2,\overset{*}{\pi} 2p_x^1 \approx \overset{*}{\pi} 2p_y^1$

$$BO=\frac{10-6}{2}=2$$

Hence, the increasing order of BO is

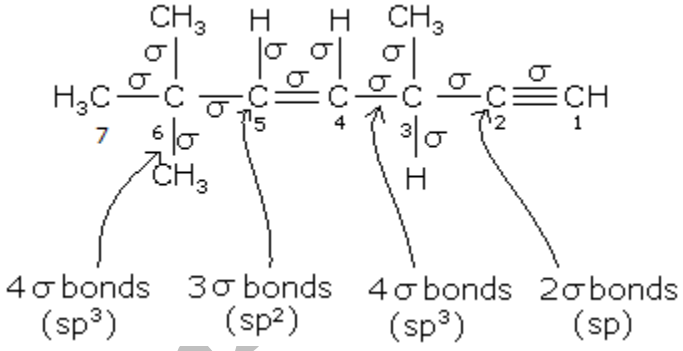
$N_2^{2-} < N_2^- < N_2$

67. Count the number of σ bonds and then find hybridisation as follows.

If the number of σ bonds = 2; hybridisation is sp.

If the number of σ bonds = 3; hybridisation is sp^2.

If the number of σ bonds = 4; hybridisation is sp^3.



68. Fluorine is the most electronegative element because electronegativity decreases on moving down the group. Hence, it reduces readily into F^- ion and is the strongest oxidising agent.

69. Degree of dissociation $\alpha=\frac{\Lambda^c}{\Lambda\infty}$

where Λ^c and $\Lambda\infty$ are equivalent conductances at a given concentration and at infinite dilution, respectively.

$$\Rightarrow \alpha=\frac{8.0}{400}=2\times 10^{-2}$$

From Ostwald's dilution law (for weak monobasic acid),

$$K_a = \frac{C\alpha^2}{(1-\alpha)}$$
$$= C\alpha^2 \qquad (\because 1 >> \alpha)$$
$$= \frac{1}{32}(2\times10^{-2})^2$$
$$= 1.25\times10^{-5}$$

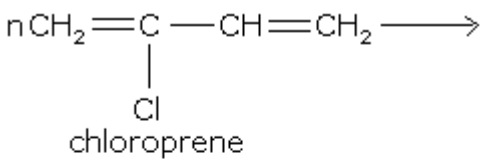
70.

(1) *Teflon* is a polymer of tetrafluoroethylene.

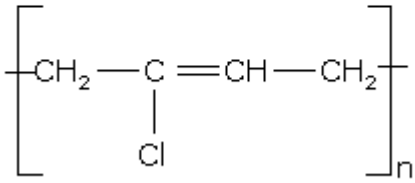
$$nCF_2 = CF_2 \xrightarrow{\Delta} \{CF_2 - CF_2\}_n$$

teflon

(2) Neoprene is a polymer of chloroprene.
(2-chloro buta -1, 3-diene)

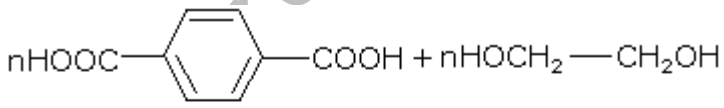


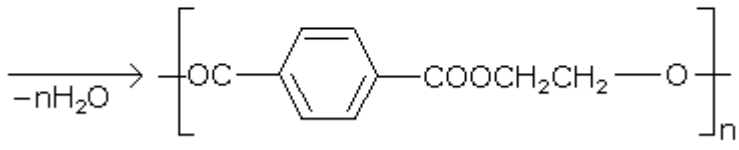
chloroprene



neoprene (synthetic rubber)

(3) Terylene is a polymer of terephthalic acid and ethylene glycol.

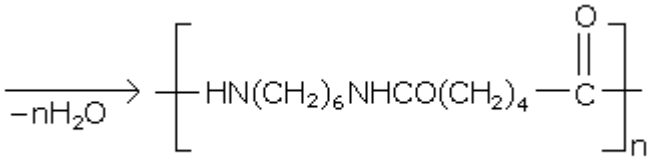




terylene or dacron

(4) Nylon-66 is a polymer of hexamethylenediamine and adipic acid.

$nH_2N(CH_2)_6NH_2 + nHOOC—(CH_2)_4COOH$



nylon - 66

71. Let the oxidation state of P in PO_4^{3-} be x.

PO_4^{3-}

$\therefore x + 4(-2) = -3$

$x - 8 = -3$

$x = +5$

Let the oxidation state of S in SO_4^{2-} be y.

SO_4^{2-}

$\therefore y + 4(-2) = -2$

$y - 8 = -2$

$y = +6$

Let the oxidation state of Cr in $Cr_2O_7^{2-}$ be z.

$Cr_2O_7^{2-}$

$\therefore 2 \times z + 7(-2) = -2$

$2z - 14 = -2$

$z = +6$

Hence, the oxidation states of P, S and Cr are +5, +6 and +6, respectively.

72. Double bonds have a preference over triple bonds while naming

4 3 2 1

$CH \equiv C - CH = CH_2$ is $1-$butene$-3-$yne.

73. In the given options, the cation is the same, but anions are different. Among halogens, the order of size is

$F < Cl < Br < I$

$\therefore$ Order of covalent character is

$MI > MBr > MCl > MF$

74. $\Delta G° = -nFE°$, where $\Delta G°$ is free energy change under standard conditions.

F is the charge on one mole of e^- = 96500 C.

n is the number of electrons in each half reaction.

E° is EMF of the cell under standard conditions.

For reaction, $Cu^{2+} + 2e^- \rightarrow Cu$;

$\Delta G° = -2 \times F \times 0.337$ ... (i)

For reaction, $Cu^+ \rightarrow Cu^{2+} + e^-$;

$\Delta G° = +1 \times F \times 0.153$ ... (ii)

Adding Eqs. (i) and (ii), we get

$Cu^+ + e^- \rightarrow Cu$; $\Delta G° = -0.521\ F$

$\Delta G° = -nFE°$

$-0.521\ F = -nFE°$

$\therefore E° = 0.52\ V$

75. For the reaction,

$N_2 + 3H_2 \rightarrow 2NH_3$

$$\text{Rate} = -\frac{d[N_2]}{dt} = -\frac{1}{3}\frac{d[H_2]}{dt} = +\frac{1}{2}\frac{d[NH_3]}{dt}$$

$$-\frac{1}{3}\frac{d[H_2]}{dt} = +\frac{1}{2}\frac{d[NH_3]}{dt}$$

$$-\frac{d[H_2]}{dt} = \frac{3}{2}\times 2\times 10^{-4}\,\text{mol}\,L^{-1}\,s^{-1}$$

$$= 3\times 10^{-4}\,\text{mol}\,L^{-1}\,s^{-1}$$

76. Number of milliequivalents of HCl

= 20 × 0.050 × 1 = 1

Number of milliequivalents of $Ba(OH)_2$

= 2 × 30 × 0.10 = 6

$[OH^-]$ of final solution

$$= \frac{\text{Milliequivalents of } Ba(OH)_2 - \text{milliequivalents of HCl}}{\text{total volume}}$$

$$= \frac{6-1}{50} = 0.1\,M$$

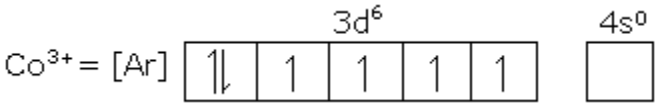
77.

(a) In TiF_6^{2-}, Ti is present as Ti^{4+}.

Ti^{4+} = [Ar] $3d^0$, $4s^0$

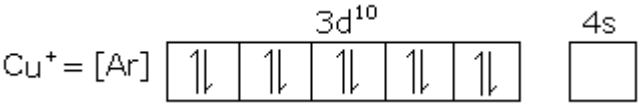
Hence, TiF_6^{2-} is colourless because of no unpaired electrons.

(b) In CoF_6^{3-}, Co is present as Co^{3+}.



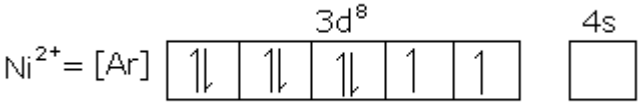
Because of the presence of unpaired electrons, CoF_6^{3-} is coloured.

(c) In Cu_2Cl_2, Cu is present as Cu^+.



Because of the absence of unpaired electron, Cu_2Cl_2 is colourless.

(d) In $NiCl_4^{2-}$, Ni is present as Ni^{2+}.



Since unpaired electrons are present, $NiCl_4^{2-}$ is coloured.

Hence, TiF_6^{2-} and Cu_2Cl_2 are colourless species.

78. An atom with a half-filled p-subshell has the highest ionisation value because more energy is required to remove an electron from the stable electronic configuration.

79. Total number of subshells = (2l + 1)

$\therefore$ Maximum number of electrons in the subshell = 2(2l + 1) = 4l + 2

80. In the body-centred cubic (bcc) crystal,

$a\sqrt{3} = 4r$

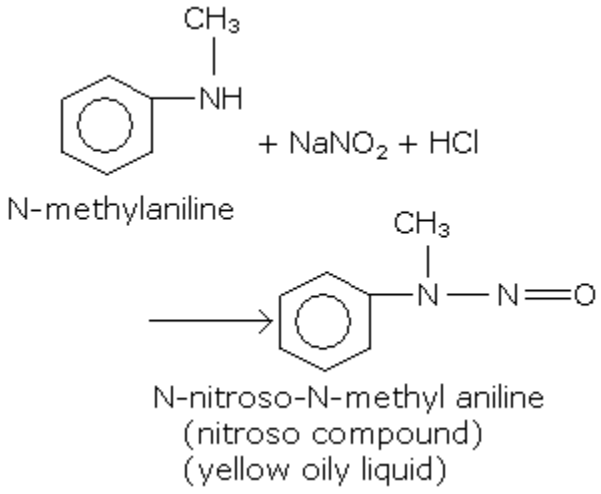
Hence, the atomic radius of lithium $r = \frac{a\sqrt{3}}{4}$

$= \frac{351 \times 1.732}{4}$

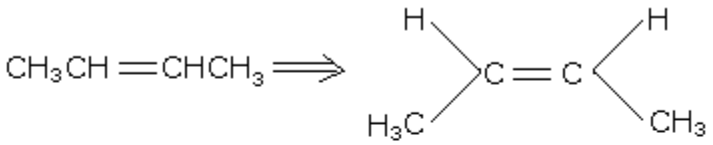
= 151.98 pm

81. The segment of DNA which acts as the instrumental manual for the synthesis of the protein is the gene. Every protein in a cell has a corresponding gene.

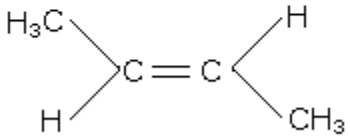
82.



83.



cis-form



trans-form

$CH_3CH_2CH_2OH \Rightarrow$ no geometrical isomers

$CH_3C{\equiv}CCH_3 \Rightarrow$ no geometrical isomers

$CH_3CH_2C(OH){=}CH_2 \Rightarrow$ no geometrical isomers

84. $\Delta G = \Delta H - T\Delta S$

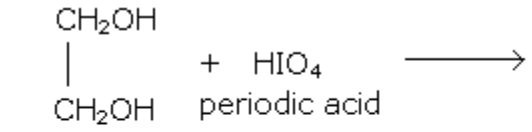
$0 = (170 \times 10^3 J) - T\,(170\ JK^{-1})$

$T = 1000\ K$

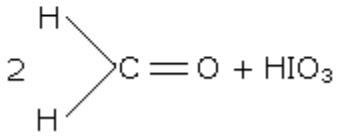
For a spontaneous reaction, ΔG is −ve.

Hence, T should be >1000 K.

85.



ethylene glycol



86. Given, $CH_3COOH \rightarrow CH_3COO^- + H^+$

$K_a = 1.5 \times 10^{-5}$ ... (i)

$HCN \rightarrow H^+ + CN^-$; $K_{a_1} = 4.5 \times 10^{-10}$ ... (ii)

$CN^- + CH_3COOH \rightarrow HCN + CH_3COO^-$

$K = ?$

On subtracting Eq. (ii) from Eq. (i), we get

$CH_3COOH + CN^- \rightarrow HCN + CH_3COO^-$;

$$K = \frac{K_a}{K_{a_1}} = \frac{1.5\times10^{-5}}{4.5\times10^{-10}} = \frac{10^5}{3} = 3.33\times10^4$$

87. Conc. H_2SO_4 and conc. HNO_3 react in the following manner:

$$HNO_3 + H_2SO_4 \rightarrow H_2NO_3^+ + HSO_4^-$$

Base Acid

$$H_2NO_3^+ \rightarrow NO_2^+ + H_2O$$

Nitronium ion

Hence, in this reaction, HNO_3 acts as a base and H_2SO_4 acts as an acid.

88. For reaction,

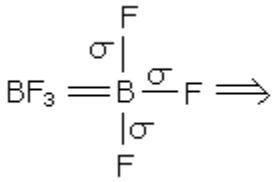
$$BrO_3^-{}_{(aq)} + 5Br^-{}_{(aq)} + 6H^+ \rightarrow 3Br_{2(l)} + 3H_2O_{(l)}$$

Rate of appearance of bromide $(Br^-) = -\frac{1}{5}\frac{d[Br^-]}{dt}$ and for $Br_2 = \frac{1}{3}\frac{d[Br_2]}{dt}$

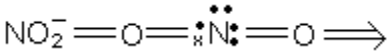
$$\Rightarrow \frac{1}{3}\frac{d[Br_2]}{dt} = -\frac{1}{5}\frac{d[Br^-]}{dt}$$

$$\Rightarrow \frac{d[Br_2]}{dt} = -\frac{3}{5}\frac{d[Br^-]}{dt}$$

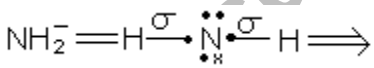
89.



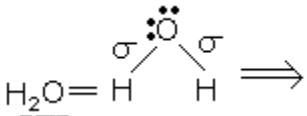
3σ bonds, i.e. sp^2 hybridisation



2σ bonds +1 lone pair of electrons, i.e. sp^2 hybridisation



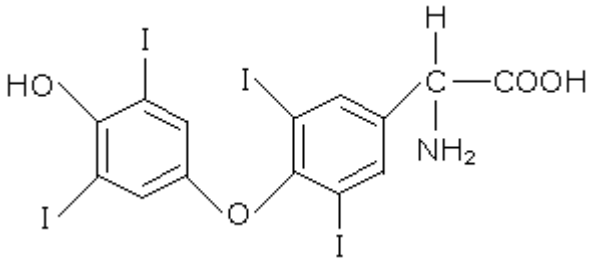
2σ bonds +2 lone pairs, i.e. sp^3 hybridisation



2σ bonds +2 lone pairs, i.e. sp^3 hybridisation

Thus, in BF_3 and NO_2^-, the central atom is sp^2 hybridised.

90. Thyroxine is 3, 5, 3′, 5′-tetra iodothyronine. It is secreted by follicular cells of the thyroid glands. Its structure is as



Thyroxine stimulates the consumption of oxygen, and thus, the metabolism of all cells or tissues in the body.

91.

$$H_2 + \frac{1}{2}O_2 \rightarrow H_2O$$

$$1\,\text{mol} \quad \frac{1}{2}\,\text{mol} \quad 1\,\text{mol}$$

$$\frac{10}{2}\,\text{mol} \quad \frac{64}{32}\,\text{mol} \quad ?$$

$$5\,\text{mol} \quad 2\,\text{mol}$$

$$\frac{1}{2}\,\text{mol}\,O_2 \text{ gives} = 1\,\text{mol}\,H_2O$$

$$\therefore 2\,\text{mol}\,O_2 \text{ will give} = 1 \times 2 \times 2 = 4\,\text{mol}$$

92.

$$\text{KE of molecule} = \text{Energy absorbed by molecule} - \text{BE per molecule}$$

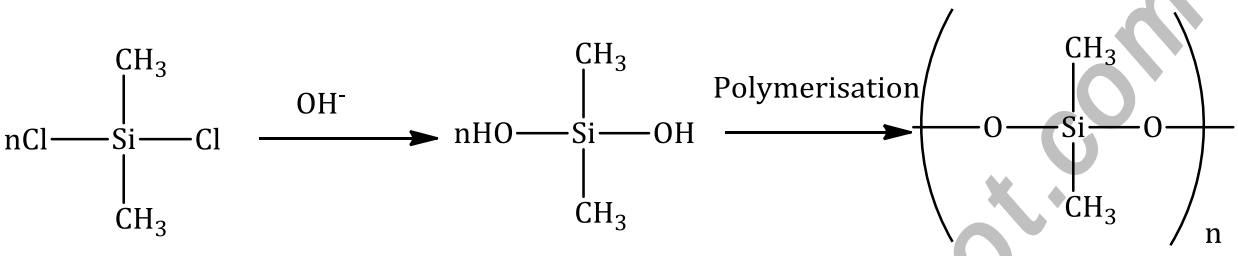
$$= [(4.4 \times 10^{-19}) - (4.0 \times 10^{-19})]\,\text{J}$$

$$= 0.4 \times 10^{-19}\,\text{J}$$

$$\text{KE per atom} = \frac{0.4 \times 10^{-19}}{2}\,\text{J}$$

$$= 2.0 \times 10^{-20}\,\text{J}$$

93.



Straight chain silanes are silicone oils. These are more stable at high temperature than mineral oils and have fewer tendencies to thicken at low temperature.

94. The given elements belong to the third group. These elements mainly exhibit +3 and +1 oxidation state. The stability of the lower oxidation state, i.e. +1 state, increases because of an inert pair effect. The sequence of stability is
Al < Ga < In < Ti

95.

$$C_2H_5OH \xrightarrow{PBr_3} C_2H_5Br \xrightarrow[-KBr\ -H_2O]{\text{Alc. KOH}} CH_2=CH_2$$

(ethanol) (X) (Y)

$$\xrightarrow{H_2SO_4} CH_3-CH_2OSO_3H \xrightarrow[-H_2SO_4]{H_2O/\Delta} CH_3CH_2OH$$

Ethanol (Z)

96. Given,
Molality, m = 0.0020 m
$\Delta T_f = 0°C - 0.00732°C = 0.00732°\ C$
$K_f = 1.86°\ C/m$

$$\Delta T_f = i \cdot K_f \times m$$

$$i = \frac{\Delta T_f}{K_f \times m}$$

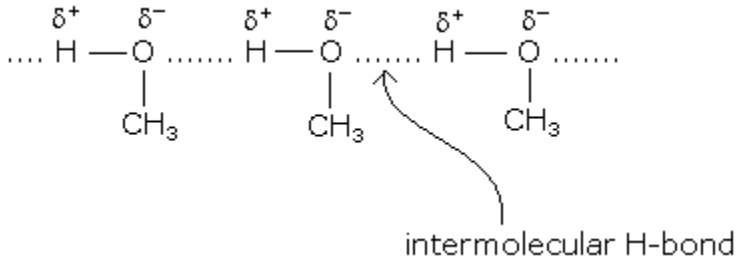
$$= \frac{0.00732}{1.86 \times 0.0020}$$

$$= 1.96 \approx 2$$

Because the compound is ionic, the number of moles produced is equal to the van't Hoff factor i. Hence, 2 moles of ions are produced.

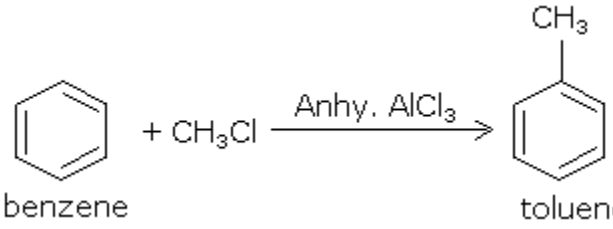
$$[Co(NH_3)_5NO_2]Cl \rightarrow \underbrace{[Co(NH_3)_5NO_2]^+ + Cl^-}_{2\text{ions}}$$

97. Intermolecular H-bonding exists in between CH_3OH molecules.



Hence, it is the intermolecular H-bonding which must be overcome in converting liquid CH_3OH to gas.

98.



This reaction is known as Friedel–Crafts alkylation of benzene. When C_6H_6 is treated with R–X in the presence of $AlCl_3$ catalyst, alkyl benzene is produced. $AlCl_3$ helps in $R^{\oplus}$ formation and heterolytic cleavage of the C–X bond.

99. If n = 3, then l = 0 to (3 – 1). So, l = 0, 1, 2.

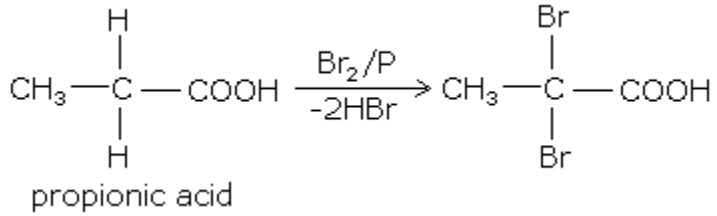
m = –l to + l

= –2, –1, 0, +1, +2

$s = \pm\frac{1}{2}$

Therefore, option (3) is not a permissible set of quantum numbers.

100.



This reaction is called Hell–Volhard–Zelinsky (HVZ) reduction. The HVZ reaction is α -halogenation of R–COOH. R–COOH-containing α -hydrogen is treated with Cl_2, Br_2 in red P.

Biology

101. The structure of the abdominal wall is similar in principle to the thoracic wall and is made of smooth muscles.

102. Ciliated epithelium shows the presence of cilia on its outer surface. These cilia are capable of rapid, rhythmic, wavelike beatings in a certain direction. Ciliated epithelium is usually found in air passages (e.g. the nose). It is also found in the uterus and fallopian tubes of females.

103. The chart shows the inheritance of a condition such as phenylketonuria as an autosomal recessive trait. The parents need to be heterozygous as two of their children suffer from the disease. It cannot be recessive sex-linked inheritance because then the male parent would also be a sufferer.

104. Manganese is essential for many plant functions. One is its importance in the synthesis of chlorophyll.

105. Direct gene transfer is the transfer of naked DNA into plant cells, but the presence of a rigid plant cell wall acts as a barrier to uptake. Therefore, protoplasts are the favoured target for direct gene transfer which utilises the interaction between polyethylene glycol, naked DNA and the protoplast membrane to effect the transport of the DNA into the cytoplasm.

106. The given floral formula is of tobacco. It belongs to Family Solanaceae. The flower is actinomorphic, bisexual and with superior ovary. Soyabean and sunhemp have monocarpellary pistil, and tulip has a trimerous flower and perianth.

107. Aschelminthes is bilaterally symmetrical and triploblastic. These are mostly aquatic, free-living or parasitic. These are mostly aquatic, free-living or parasitic.

108. *Agrobacterium tumefaciens* is the causal agent of crown gall disease in over 140 species of dicot. This disease is caused by a DNA plasmid (Ti plasmid) carried by bacterium and transferred to the plant cells. Ti plasmid has widely been used in plant engineering as a vector to transfer genes in the host plant to form transgenic plants.

109. The corpus luteum is essential for establishing and maintaining pregnancy in females. In the ovary, the corpus luteum secretes oestrogen and progesterone, which are steroid hormones responsible for the thickening of the endometrium and its development and maintenance, respectively.

110. Late blight is caused by the fungus *Phytophthora infestans*. Late blight appears on potato or tomato leaves as pale green water-soaked spots, often beginning at leaf tips or edges.

111. Global agreement in specific control strategies to reduce the release of ozone-depleting substances was adopted by the Montreal Protocol. The treaty was originally signed in 1987 and substantially amended in 1990 and 1992. The Montreal Protocol stipulates that the production and consumption of compounds which deplete ozone in the stratosphere—chlorofluorocarbons (CFCs), halogens, carbon tetrachloride and methyl chloroform—are to be phased out by 2000.

112. Bt toxin is present in the form of an inactive protoxin in the plant which gets converted to the active form in the insect gut.

113. *Peripatus* is a genus of Onychophora (Velvet worms). It is said to be a living fossil because it has been unchanged for approximately 570 million years. *Peripatus* is a connecting link between *Annelida* and *Arthropoda*.

114. Theodor O. Diener discovered the potato spindle tuber viroid (PSTVd), the first viroid ever identified, in 1971. PSTVd is a small, circular RNA molecule. Dr Diener discovered that the pathogen-causing potato spindle tuber disease is not a virus as previously believed but a much smaller, free RNA molecule.

115. Human seminal plasma is a complex mixture of proteins, glycoproteins, peptides, glycopeptides and prostaglandins secreted by organs of the male reproductive tract. Seminal plasma in humans is rich in fructose and certain enzymes but poor in calcium.

116. Syconus is an aggregate fruit, consisting of numerous seed-like pericarps enclosed within a hollow, fleshy receptacle where the flowers were attached. It develops from a hypanthodium inflorescence.

117. The cell junctions called tight, adhering and gap junctions are found in epithelial tissue. Epithelial tissue covers the whole surface of the body and is made of cells closely packed and ranged in one or more layers.

118. Urination or micturition is the act of passing urine which is a reflex phenomenon. As urine accumulates in the bladder, stretch receptors are activated which pass the stimulus to the spinal cord. In the absence of stretch receptors, the urine would get collected and would overflow.

119. If a live earthworm is pricked with a needle on its outer surface without damaging its gut, the fluid which comes out is coelomic fluid, because coelomic fluid lies between the body wall and the alimentary canal.

120. Humans show the presence of the ABO blood group system. It is named ABO and not ABC, because blood group 'O' individuals do not have either A or B antigens on the surface of their RBCs, but their blood serum contains IgM anti-A antibodies and anti-B antibodies against the A and B blood group antigens. Therefore, a group 'O' individual can receive blood only from a group 'O' individual but can donate blood to individuals of any blood group (i.e. A, B, O or AB).

121. NAA is a synthetic auxin. Some widely used weed killers are synthetic auxins. Synthetic auxin analogues include 1-naphtaleneacetic acid (NAA), 2,4-dichlorophenoxy acetic acid (2,4-D) and 2,4,5-trichlorophenoxy acetic acid (2,4,5-T).

122. Tetanus toxoid is a vaccine consisting of growth products of *Clostridium tetani* treated with formaldehyde serving as an active immunising agent. Hence, it is made of weakened germs.

123. Alzheimer disease in humans is associated with the deficiency of acetylcholine. Acetylcholine is the neurotransmitter produced by neurons called cholinergic neurons.

124. Biochemical oxygen demand (BOD) in river water increases when sewage mixes with river water. Biochemical oxygen demand or biological oxygen demand is a chemical procedure for determining how fast biological organisms use up oxygen in an aquatic medium.

125. By introducing bone marrow cells producing ADA into cells at early embryonic stages, the genetic ADA deficiency may be cured permanently.

126. Lymph is a mobile connective tissue comprising lymph plasma and lymph corpuscles. Its composition is just like blood plasma except that it lacks RBCs and large plasma proteins.

127. Sickle cell anaemia is caused by a change in a single base pair of DNA. Sickle cell anaemia is the name of a specific form of sickle cell disease in which there is homozygosity for the mutation which causes HbS.

128. *Jatropha* is useful for the production of bioethanol. *Jatropha* is a genus of approximately 175 succulent plants, shrubs and trees from the Family Euphorbiaceae. Oil from *Jatropha curcas* seeds is used for making biodiesel. Jatropha oil is being promoted as an easily grown biofuel crop in hundreds of projects throughout India and other developing countries.

129. If breastfeeding is replaced by less nutritive food low in proteins and calories, infants below the age of one year are likely to suffer from marasmus. Marasmus is a form of malnutrition which occurs when there is not enough nutrients (proteins, carbohydrates and lipids) in the diet.

130. Young infants may be feeding entirely on mother's milk which is white, but the stools which the infant pass out are quite yellowish because bile pigments are passed through bile juice. Bile pigments are any of several coloured compounds derived from porphyrin which are found in bile, principally bilirubin and biliverdin. Bile pigment is produced regularly when old red blood cells are broken down, mainly by the spleen.

131. Wheat genetics is more complicated than that of most other domesticated species. Some wheat species are diploid with two sets of chromosomes, but many are stable polyploids with four sets of chromosomes (tetraploid) or six (hexaploid).

132. Oxygenic photosynthesis occurs in *Oscillatoria*. *Oscillatoria* is a genus of filamentous cyanobacteria which is named for the oscillation in its movements.

133. Red blood cells are the most common type of blood cells delivering oxygen to the body tissues via the blood. There is no DNA in mature RBCs. The reticulocyte is the immediate precursor of the mature RBC, and within 24 hours of release into the peripheral circulation, it evolves into the mature RBC.

134. In the schematic break-up of the phases/stages of the cell cycle, the synthetic phase is the correct indication of the stage/phase in the cell cycle.

135. Tiger is not a resident in the Gir National Park. According to official census figures, Gir has about 300 lions and 300 leopards, making it one of the major big-cat concentrations in India. Sambar, spotted deer, blue bull, chousingha, chinkara and wild boar thrive in Gir.

136. Fructose and amino acids are absorbed through intestinal mucosa with the help of carrier ions such as Na^+, while carbohydrates are absorbed as monosaccharides which are obtained by the breaking down of polysaccharides.

137. Synapsis is the pairing of two homologous chromosomes which occur during prophase-I of meiosis. The two chromosomes of each homolog pair exchange segments of DNA in a process known as crossing over.

138. The human male reproductive system consists of several sex organs which are a part of the human reproductive process. In the diagram of the male reproductive system of human, the points indicated by A, B, C and D are vas deferens, seminal vesicle, prostate and bulbourethral gland.

139. The genetic code consists of 64 triplets of nucleotides. These triplets are called codons. With three exceptions, each codon encodes for one of the 20 amino acids used in the synthesis of proteins. This produces some redundancy in the code—most amino acids being encoded by more than one codon.

140. *Pinus* plant is monoecious, i.e. both male and female cones are present in the same plant but on different branches.

141. Cyclic photophosphorylation results in the formation of ATP. This process is called photophosphorylation.

142. The letter T in T-lymphocyte refers to thymus. In human anatomy, the thymus is an organ located in the upper anterior portion of the chest cavity just behind the sternum and is the site of maturation of T-lymphocytes.

143. Foetal ejection reflex in a human female is induced by the fully developed foetus and placenta. When a woman is in the lithotomy position or semi-sitting position, the foetal ejection reflex is impaired and the pain caused by the sacrum's inability to move as the baby descends can be intolerable.

144. Anatomically fairly old dicotyledonous root is distinguished from the dicotyledonous stem by the position of the protoxylem. In the dicot root, the protoxylem is located near the periphery of the vascular cylinder, while in the dicot stem, the protoxylem is located near the centre of the vascular bundle, i.e. the xylem is endarch.

145. Plasmodesmata are connections between adjacent cells. Plasmodesmata are narrow channels which act as intercellular cytoplasmic bridges to facilitate communication and transport of materials between plant cells.

146. Splicing is the removal of introns and the joining of exons in a defined order in a transcription unit. In molecular biology, splicing is a modification of RNA after transcription, in which introns are removed and exons are joined.

147. The phylogenetic system of classification is based on evolutionary relationships. This phylogenetic classification system names only clades—groups of organisms which descended from a common ancestor. In phylogenetic classification, we can name any clade on this tree.

148. The hypothalamus part of the human brain is concerned with the regulation of body temperature. The hypothalamus is a portion of the brain which contains several small nuclei with a variety of functions. The hypothalamus is small cone-shaped structure which projects downward, ending in the pituitary.

149. Semiconservative replication of DNA was first demonstrated in *Escherichia coli*.

150. Lampreys and hagfish are unusual, jawless fish which comprise Order Cyclostomata, so named because of the circular shape of the mouth.

151. Common cold and AIDS is a pair of viral diseases.

152. All energy-releasing pathways whether aerobic (requiring oxygen) or anaerobic (not requiring oxygen) begin with a pathway called glycolysis which occurs in the cytoplasm (cytosol). The aerobic respiratory pathway is appropriately termed amphibolic. Aerobic respiration is the main energy-releasing pathway leading to ATP formation. It occurs in the mitochondria. Aerobic respiration yields 36 ATP.

153. 'A' is more recent and shows slight reduction in growth rate.

154. The cytoskeleton is made of three kinds of protein filaments—actin filaments (also called microfilaments), intermediate filaments and microtubules. These fibres are mainly made of tubulin and actin proteins.

155. In flowering plants, placentation occurs where the ovules are attached inside the ovary. An example of axile placentation is lemon. In this type of placentation, the ovary is sectioned by radial spokes with placentas in separate locules.

156. *Ustilago* has a haplontic life cycle. This is the simplest and most primitive type of life cycle. The other patterns of life cycle have originated from this type. This type is found in all Chlorophyceae.

157. The step taken by the Government of India to control air pollution includes compulsory PUC (pollution under control) certification of petrol-driven vehicles which tests for carbon monoxide and hydrocarbons.

158. Heterospory is considered important in the development of seed habit. Heterospory is the production of spores of two different sizes and sexes by the sporophytes of land plants.

159. The annular and spirally thickened conducting elements generally develop in the protoxylem when the root or stem is maturing.

160. The correct sequence of plants in a hydrosere is Volvox, Hydrilla, Pistia, Scirpus, Lantana and Oak. A hydrosere is a plant succession which occurs in a freshwater lake. In time, an area of open freshwater such as a lake will naturally dry out ultimately becoming a woodland. During this change, a range of land types such as swamp and marsh will succeed each other. The succession from open water to climax woodland is likely to take at least two hundred years.

161. Stroma in the chloroplasts of higher plants contains light-independent reaction enzymes. Within the stroma are stacks of thylakoids, the sub-organelles which are the sites of photosynthesis.

162. Myxoedema is caused by deficiency of the thyroid hormone or thyroxine in adults. It is characterised by an increase in body weight, puffy appearance, low metabolic rate and tendency to retain water in tissues.

163. Mannitol is the food stored in *Fucus*. *Fucus* is a genus of brown alga in Class Phaeophyceae found in the intertidal zones of rocky seashores almost everywhere in the world.

164. Alcohol and nitrogenase pair is wrongly matched. Ethanol produces alcohol.

165. *Xanthomonas campestris* is not used as a biopesticide. It is a plant pathogen which causes black rot in cotton plant.

166. *Equisetum* is a vascular cryptogam. It is the only living genus in Equisetaceae, a family of vascular plants which reproduce by spores rather than seeds. They are commonly known as horsetails.

167. In a standard ECG, the P-wave is a small upward wave which indicates the depolarisation of the atria. This is caused by activation of the SA node.

168. Uric acid is the chief nitrogenous component of the excretory product of cockroach. Animals which live in dry conditions have to conserve water in their bodies. Therefore, they synthesise crystals of uric acid from ammonia. Uric acid crystals are

non-toxic and can be retained in the body for a considerable time. Uricotelic animals include most insects (e.g. cockroach), reptiles and birds.

169. Guard cells help in transpiration. Transpiration is the evaporation of water from the aerial parts of plants, especially leaves, but also stems, flowers and roots. The stomatal opening facilitated by guard cells allows the diffusion of carbon dioxide and oxygen during photosynthesis.

170. The aim of the Montreal Protocol was to protect the ozone layer in the stratosphere by decreasing and eventually eliminating the use of ozone-depleting substances such as CFCs.

171. DDT residues are rapidly passed through the food chain causing biomagnification because DDT is liposoluble. Biomagnification, also known as bioamplification or biological magnification, is the increase in concentration of a substance such as a pesticide.

172. Vegetative propagation in mint occurs through suckers. Vegetative reproduction is a type of asexual reproduction for plants; it is a process by which new plants arise from the vegetative parts without the production of seeds or spores.

173. Baldness is a sex-influenced trait. The dominance of alleles may differ in heterozygotes of the two sexes.

174. Cotyledons and testa are the edible parts in groundnut and pomegranate. A cotyledon is a significant part of the embryo within the seed of a plant. Upon germination, the cotyledon may become the embryonic first leaves of a seedling. Testa is often thick or the hard outer coat of a seed.

175. Malignant tumours may exhibit metastasis. Cancer is a class of diseases in which a group of cells displays uncontrolled growth, invasion and sometimes metastasis as it spreads to other locations in the body via the lymph or blood.

176. The formation of sperms in mature human testes is completed in three important phases in gametogenesis—multiplication, growth and maturation. During these phases, germ cells change into spermatogonia which then change into spermatocytes during the growth phase which change into spermatoids and spermatids into sperms.

177. The use of anti-histamines and steroids give a quick relief from allergy. Antihistamines are drugs which block the action of histamine at the H1 receptor sites, responsible for immediate hypersensitivity reactions such as sneezing and itching.

178. Chipko Movement was launched for the protection of forests. The first Chipko action occurred in April 1973.

179. Fertilisation of ovum is the most likely root cause why menstruation is not taking place in regularly cycling human female. For fertilisation to occur, one of these sperms must attach itself to the ovum and penetrate its outer surface. The fertilised ovum will then continue travelling down the fallopian tube, taking several days until it reaches the uterus. When it arrives, it attaches itself to the lining of the uterus and continues to grow. If the ovum is not fertilised, then it will die, and the progesterone and oestrogen hormone levels will drop. Without these hormones, the prepared uterus lining breaks up and is released through the vagina. This is known as a 'period'.

180. Globulins contained in human blood plasma are primarily involved in the defence mechanism of the body. Globulin is one of the two types of serum proteins, the other being albumin. Globulins can be divided into three fractions based on their electrophoretic mobility. Most of the alpha and beta globulins are synthesised by the liver, whereas gamma globulins are produced by lymphocytes and plasma cells in lymphoid tissue.

181. Palisade parenchyma is absent in the leaves of sorghum. It is a leaf tissue composed of columnar cells containing numerous chloroplasts in which the long axis of each cell is perpendicular to the leaf surface.

182. In barley stem, vascular bundles are closed and scattered. They are open only for an hour in the day time and never open at night.

183. The pelvic girdle is formed by two innominate bones consisting of three separate bones—ilium, ischium and pubis.

184. Genetic variation present among plant cells during tissue culture is called somaclonal variation. This variation has been used to develop several useful varieties against resistance to diseases and pests, better yield and better quality.

185. For peppered moth (*Biston betularia*), the black-coloured form became dominant over the light-coloured form in England during the Industrial Revolution. This is an example of protective mimicry. This group is about species which gains protection from predators by mimicking other species which are unpalatable or dangerous.

186. Transgenic plants are the ones generated by introducing foreign DNA into a cell and regenerating a plant from that cell.

187. Fat and cellulose are food components in human which reaches the stomach totally undigested.

188. A change in the amount of yolk and its distribution in the egg will affect the pattern of cleavage. In eggs with less yolk, the cleavage is equal, and the resulting blastomeres are of similar size. If the yolk is localised, such as in frog eggs, then cleavages are unequal.

189. Middle lamella is mainly composed of calcium pectate. Calcium is deposited in plant cell walls during their formation. It is required for the stability and function of cell membranes and acts as a type of 'cementing agent' in the cell walls in the form of calcium pectate.

190. Elbow joint is an example of hinge joint.

191. *Frankia* is a symbiotic nitrogen fixer in the root nodules of several non-legume plants such as *Casuarina* and *Alnus*.

192. Nirenberg and Matthaei (1961) experimentally proved that a single amino acid is determined by a sequence of three nitrogen bases. The sequence of three nitrogen bases determining a single amino acid is called a triplet code. The Nirenberg and Matthaei experiments cracked the DNA and discovered unequivocally that a genetic code is a triplet.

193. A pond ecosystem is a delicate balance of fish, plants and other animals. Fish occupy more than one tropic level in a pond ecosystem. Small fish act as secondary consumers. They feed on primary consumers. Large fish act as tertiary consumers. They feed on smaller fish.

194. Abscisic acid is a derivative of carotenoids.

195. The bacterium *Bacillus thuringiensis* is widely used in contemporary biology as an insecticide. *Bacillus thuringiensis* (also known as Bt) is a Gram-positive, soil-dwelling bacterium of the genus *Bacillus*. *Bacillus thuringiensis* produces a parasporal insecticidal crystal protein.

196. An example of a seed with endosperm, perisperm and caruncle is castor. Castor seed is the source of castor oil which has a wide variety of uses.

197. Reduction in vascular tissue, mechanical tissue and cuticle is characteristic of hydrophytes.

198. A point mutation is a simple change in one base of the gene sequence.

199. In *Pheretima*, two pairs of testes sacs are situated in the 10th and 11th segments. Each testes sac of the 10th segment encloses a testes and a seminal funnel. Each testes sac of the 11th segment encloses a testis, a seminal vesicle and a seminal funnel.

200. The kind of tissue which forms the supportive structure in our pinna (external ears) is also found at the tip of the nose. External pinna is made of elastic cartilage. It is the passage towards the middle ear.

AIPMT - 2010
(Physics, Chemistry and Biology)
Prelims (Code A)

Time: 3 hrs **Total Marks: 600**

General Instructions:

1. The Answer sheet is inside this Text booklet. When you are directed to open the text booklet, take out the Answer Sheet and fill in the particulars on side – 1 and side – 2 carefully with blue/black ball point pen only.
2. The test is of 3 hours duration and consists of 200 questions. Each question carries 3 marks. For each correct response the candidate will get 3 marks. For each incorrect response, one mark will be deducted. The maximum marks are 600.
3. Use Blue / Black ball point pen only for writing particulars on this page / marking responses.
4. Rough work is to be done on the space provided for this purpose in the text booklet only.
5. On completion of the test, the candidate must handover the answer sheet to the invigilator in the room/ Hall. The candidates are allowed to take away this text booklet with them.
6. Make sure that the CODE printed on side – 2 of the answer sheet is the same as that on this booklet, In case of discrepancy, the candidate should immediately report the matter to the invigilator for the replacement of both the test Booklet and the Answer Sheet.
7. The candidates should ensure that the Answer sheet is not folded. Do not make any stray marks on the Answer sheet. Do not write your roll no. anywhere else except in the specified space in the Test booklet / Answer Sheet.
8. Use of white fluid for correction is not permissible on the Answer Sheet.

Physics

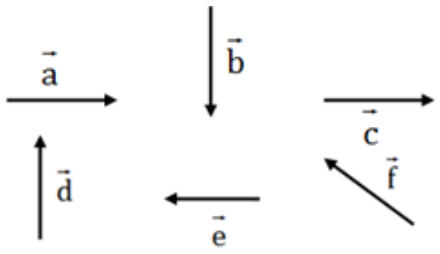
1. The dimension of $\frac{1}{2}\varepsilon_o E^2$ where ε_o is permittivity of free space and E is electric field, is

(1) $M\,L\,T^{-1}$
(2) $M\,L^2\,T^{-2}$
(3) $M\,L^{-1}\,T^{-2}$
(4) $M\,L^2\,T^{-1}$

2. A particle moves a distance x in time t according to equation $x = (t + 5)^{-1}$. The acceleration of particle is proportional to

(1) $(\text{Velocity})^{2/3}$
(2) $(\text{Velocity})^{3/2}$
(3) $(\text{Distance})^2$
(4) $(\text{Distance})^{-2}$

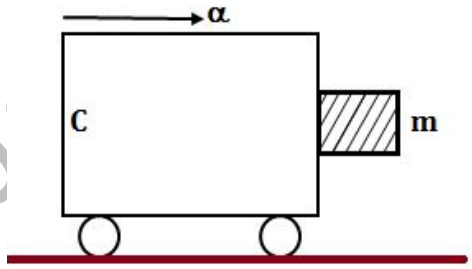
3. Six vectors $\vec{a}$, through $\vec{f}$ have the magnitudes and directions indicated in the figure. Which of the following statements is true?



(1) $\vec{b}+\vec{e}=\vec{f}$
(2) $\vec{b}+\vec{c}=\vec{f}$
(3) $\vec{d}+\vec{c}=\vec{f}$
(4) $\vec{d}+\vec{e}=\vec{f}$

4. A particle has initial velocity $\left(3\hat{i}+4\hat{j}\right)$ and has acceleration $\left(0.4\hat{i}+0.3\hat{j}\right)$. Its speed after 10 s is
(1) 10 units
(2) 7 units
(3) $7\sqrt{2}$ units
(4) 8.5 units

5. A block of mass m is in contact with the cart C as shown in the figure.



The coefficient of static friction between the block and the cart is μ. The acceleration α of the cart that will prevent the block from falling satisfies

(1) $\alpha < \frac{g}{\mu}$
(2) $\alpha > \frac{mg}{\mu}$
(3) $\alpha > \frac{g}{\mu m}$
(4) $\alpha \geq \frac{g}{\mu}$

6. A man of 50 kg mass is standing in a gravity free space at a height of 10 m above the floor. He throws a stone of 0.5 kg mass downwards with a speed 2 m/s. When the stone reaches the floor, the distance of the man above the floor will be
(1) 20 m
(2) 9.9 m
(3) 10.1 m
(4) 10 m

7. An engine pumps water through a hose pipe. Water passes through the pipe and leaves it with a velocity of 2 m/s. The mass per unit length of water in the pipe is 100 kg/m. What is the power of the engine?
(1) 800 W
(2) 400 W
(3) 200 W
(4) 100 W

8. A ball moving with velocity 2 m/s collides head on with another stationary ball of double the mass. If the coefficient of restitution is 0.5 then their velocities (in m/s) after collision will be
(1) 0, 2
(2) 0, 1
(3) 1, 1
(4) 1, 0.5

9. A gramophone record is revolving with an angular velocityω. A coin is placed at a distance r from the centre of the record. The static coefficient of friction is μ. The coin will revolve with the record if
(1) $r \geq \frac{\mu g}{\omega^2}$
(2) $r = \mu g \omega^2$
(3) $r < \frac{\omega^2}{\mu g}$
(4) $r \leq \frac{\mu g}{\omega^2}$

10. A circular disc of moment of inertia I_t is rotating in a horizontal plane, about its symmetry axis, with a constant angular speed ω_i. Another disc of moment of inertia I_b is dropped coaxially onto the rotating disc. Initially the second disc has zero angular speed. Eventually both the discs rotate with a constant angular speed ω_f. The energy lost by the initially rotating disc to friction is

(1) $\frac{1}{2}\frac{I_b I_t}{(I_t + I_b)}\omega_i^2$

(2) $\frac{1}{2}\frac{I_b^2}{(I_t + I_b)}\omega_i^2$

(3) $\frac{1}{2}\frac{I_t^2}{(I_t + I_b)}\omega_i^2$

(4) $\frac{I_b - I_t}{(I_t + I_b)}\omega_i^2$

11. Two particles which are initially at rest move towards each other under the action of their internal attraction. If their speeds are v and 2v at any instant, then the speed of centre of mass of the system will be

(1) v

(2) 2 v

(3) Zero

(4) 1.5 v

12. The radii of circular orbits of two satellites A and B of the Earth are 4R and R, respectively. If the speed of satellite A is 3 V, then the speed of satellite B will be

(1) $\frac{3V}{2}$

(2) $\frac{3V}{4}$

(3) 6 V

(4) 12 V

13. A particle of mass M is situated at the centre of a spherical shell of same mass and radius a. The gravitational potential at a point situated at $\frac{a}{2}$ distance from the centre, will be

(1) $-\frac{4GM}{a}$

(2) $-\frac{3GM}{a}$

(3) $-\frac{GM}{a}$

(4) $-\frac{GM}{a}$

14. A ball is dropped from a high rise platform at t = 0 starting from rest. After 6 seconds another ball is thrown downwards from the same platform with a speed v. The two balls meet at t = 18 s. What is the value of v?
(Take g = 10 m/s^2)
(1) 60 m/s
(2) 75 m/s
(3) 55 m/s
(4) 40 m/s

15. A cylindrical metallic rod in thermal contact with two reservoirs of heat at its two ends conducts an amount of heat Q in time t. The metallic rod is melted and the material is formed into a rod of half the radius of the original rod. What is the amount of heat conducted by the new rod, when placed in thermal contact with the two reservoirs in time t?
(1) $\frac{Q}{4}$
(2) $\frac{Q}{2}$
(3) $\frac{Q}{16}$
(4) 2Q

16. The total radiant energy per unit area, normal to the direction of incidence, received at a distance R from the centre of a star of radius r, whose outer surface radiates as a black body at a temperature T K is given by
(where σ is Stefan's constant)
(1) $\frac{4\pi\sigma r^2 T^4}{R^2}$
(2) $\frac{\sigma r^2 T^4}{R^2}$
(3) $\frac{\sigma r^2 T^4}{4\pi R^2}$
(4) $\frac{\sigma r^4 T^4}{R^4}$
(Where σ is Stefan's constant)

17. If ΔU and ΔW represent the increase in internal energy and work done by the system respectively in a thermodynamical process, which of the following is true?
(1) $\Delta U = -\Delta W$, in a isothermal process
(2) $\Delta U = -\Delta W$, in a adiabatic process
(3) $\Delta U = \Delta W$, in a isothermal process
(4) $\Delta U = \Delta W$, in a adiabatic process

18. 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
(1) Simple harmonic motion of frequency $\omega/2\pi$
(2) Simple harmonic motion of frequency ω/π
(3) Simple harmonic motion of frequency $3\omega/2\pi$
(4) Non simple harmonic motion

19. The period of oscillation of a mass M suspended from a spring of negligible mass is T. If along with it, another mass M is also suspended, the period of oscillation will now be
(1) $\sqrt{2}T$
(2) T
(3) $\frac{T}{\sqrt{2}}$
(4) 2T

20. A transverse wave is represented by $y = A\sin(\omega t - kx)$. For what value of the wavelength is the wave velocity equal to the maximum particle velocity?
(1) A
(2) $\frac{\pi A}{2}$
(3) πA
(4) $2\pi A$

21. A tuning fork of frequency 512 Hz makes 4 beats per second with the vibrating string of a piano. The beat frequency decreases to 2 beats per sec when the tension in the piano string is slightly increased. The frequency of the piano string before increasing the tension was
(1) 508 Hz
(2) 510 Hz
(3) 514 Hz
(4) 516 Hz

22. Which of the following statement is false for the properties of electromagnetic waves?
(1) These waves do not require any material medium for propagation.
(2) Both electric and magnetic field vectors attain the maxima and minima at the same place and same time.
(3) The energy in electromagnetic wave is divided equally between electric and magnetic vectors.
(4) Both electric and magnetic field vectors are parallel to each other and perpendicular to the direction of propagation of wave.

23. A lens having focal length f and aperture of diameter d forms an image of intensity I. Aperture of diameter $\frac{d}{2}$ in central region of lens is covered by a black paper. Focal length of lens and intensity of image now will be respectively

(1) $\frac{f}{2}$ and $\frac{I}{2}$

(2) f and $\frac{I}{4}$

(3) $\frac{3f}{4}$ and $\frac{I}{2}$

(4) f and $\frac{3I}{2}$

24. A ray of light travelling in a transparent medium of refractive index μ, falls on a surface separating the medium from air at an angle of incidence of 45 °. For which of the following value of μ the ray can undergo total internal reflection?

(1) μ = 1.25

(2) μ = 1.33

(3) μ = 1.40

(4) μ = 1.50

25. Two positive ions, each carrying a charge q, are separated by a distance d. If F is the force of repulsion between the ions, the number of electrons missing from each ion will be (e being the charge on an electron)

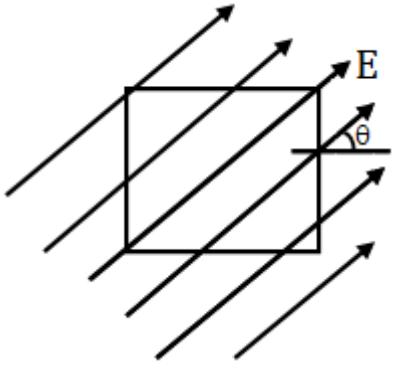
(1) $\frac{4\pi\varepsilon_o Fd^2}{q^2}$

(2) $\frac{4\pi\varepsilon_o Fd^2}{e^2}$

(3) $\sqrt{\frac{4\pi\varepsilon_o Fe^2}{d^2}}$

(4) $\sqrt{\frac{4\pi\varepsilon_o Fd^2}{e^2}}$

26. A square surface of side L meter in the plane of the paper is placed in a uniform electric field E (volt/m) acting along the same plane at an angle θ with the horizontal side of the square as shown in figure. The electric flux linked to the surface, in units of volt-m, is



(1) Zero
(2) EL^2
(3) $EL^2 \cos\theta$
(4) $EL^2 \sin\theta$

27. A series combination of n_1 capacitors, each of value C_1, is charged by a source of potential difference 4 V. When another parallel combination of n_2 capacitors, each of value C_2, is charged by a source of potential difference V, it has the same (total) energy stored in it, as the first combination has. The value of C_2, in terms of C_1, is then

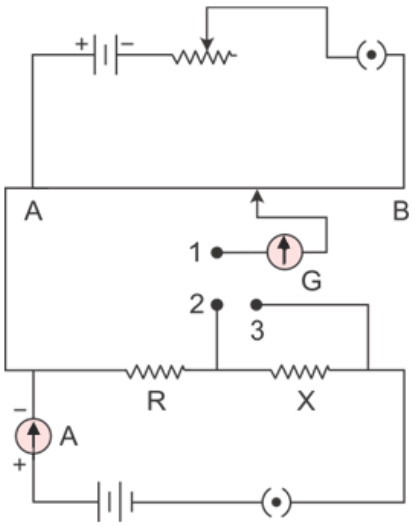
(1) $\frac{16C_1}{n_1 n_2}$

(2) $\frac{2C_1}{n_1 n_2}$

(3) $16\frac{n_2}{n_1}C_1$

(4) $2\frac{n_2}{n_1}C_1$

28. A potentiometer circuit is set up as shown. The potential gradient, across the potentiometer wire, is k volt/cm and the ammeter, present in the circuit, reads 1.0 A when two way key is switched off. The balance points, when the key between the terminals (i) 1 and 2 (ii) 1 and 3, is plugged in, are found to be at lengths l_1 cm and l_2 cm respectively. The magnitudes, of the resistors R and X, in ohms, are then, equal, respectively, to



(1) kl_1 and kl_2
(2) $k(l_2 - l_1)$ and kl_2
(3) kl_1 and $k(l_2 - l_1)$
(4) $k(l_2 - l_1)$ and kl_1

29. A galvanometer has a coil of resistance 100 ohm and gives a full scale deflection for 30 mA current. If it is to work as a voltmeter of 30 volt range, the resistance required to be added will be
(1) 1000 Ω
(2) 900 Ω
(3) 1800 Ω
(4) 500 Ω

30. Consider the following two statements
(A) Kirchhoff's junction law follows from the conservation of charge.
(B) Kirchhoff's loop law follows from the conservation of energy.
Which of the following is correct?

(1) Both (A) and (B) are correct
(2) Both (A) and (B) are wrong
(3) (A) is correct and (B) is wrong
(4) (A) is wrong and (B) is correct

31. In producing chlorine by electrolysis 100 kW power at 125 V is being consumed. How much chlorine per minute is liberated (E.C.E. of chlorine is 0.367×10^{-6} kg/C)
(1) 3.67×10^{-3} kg
(2) 1.76×10^{-3} kg
(3) 9.67×10^{-3} kg
(4) 17.61×10^{-3} kg

32. A square current carrying loop is suspended in uniform magnetic field acting in the plane of the loop. If the force on one arm of the loop is $\vec{F}$ the net force on the remaining three arms of the loop is

(1) $\vec{F}$

(2) $3\vec{F}$

(3) $-\vec{F}$

(4) $-3\vec{F}$

33. A thin ring of radius R meter has charge q coulomb uniformly spread on it. The ring rotates about its axis with a constant frequency of f revolutions/s. The value of magnetic induction in Wb/m^2 at the centre of the ring is

(1) $\frac{\mu_0 qf}{2R}$

(2) $\frac{\mu_0 qf}{2\pi R}$

(3) $\frac{\mu_0 q}{2\pi fR}$

(4) $\frac{\mu_0 q}{2fR}$

34. Electromagnets are made of soft iron because soft iron has

(1) high retentivity and low coercive force

(2) low retentivity and high coercive force

(3) high retentivity and high coercive force

(4) low retentivity and low coercive force

35. A vibration magnetometer placed in magnetic meridian has a small bar magnet, the magnet executes oscillations with a time period of 2 sec in earth's horizontal magnetic field of 24 microtesla. When a horizontal field of 18 microtesla is produced opposite to the earth's field by placing a current carrying wire, the new time period of magnet will be

(1) 4 s

(2) 1 s

(3) 2 s

(4) 3 s

36. A conducting circular loop is placed in a uniform magnetic field, B = 0.025 T with its plane perpendicular to the loop. The radius of the loop is made to shrink at a constant rate of 1 mms^{-1}. The induced emf when the radius is 2 cm is

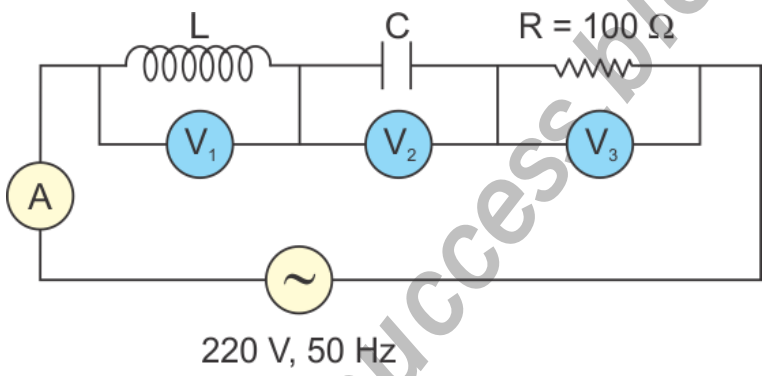
(1) 2 μV

(2) 2π μV

(3) π μV

(4) $\frac{\pi}{2}$ μV

37. In the given circuit the reading of voltmeter V_1 and V_2 are 300 volts each. The reading of the voltmeter V_3 and ammeter A are respectively



(1) 100 V, 2.0 A

(2) 150 V, 2.2 A

(3) 220 V, 2.2 A

(4) 220 V, 2.0 A

38. A 220-volt input is supplied to a transformer. The output circuit draws a current of 2.0 ampere at 440 volts. If the efficiency of the transformer is 80%, the current drawn by the primary windings of the transformer is

(1) 5.0 ampere

(2) 3.6 ampere

(3) 2.8 ampere

(4) 2.5 ampere

39. A source S_1 is producing 10^{15} photons per second of wavelength 5000 Å. Another source S_2 is producing 1.02×10^{15} photons per second of wavelength 5100 Å. Then (power of S_2)/(power of S_1) is equal to

(1) 0.98

(2) 1.00

(3) 1.02

(4) 1.04

40. A beam of cathode rays is subjected to crossed electric (E) and magnetic field (B). The fields are adjusted such that the beam is not deflected. The specific charge of the cathode rays is given by (where V is the potential difference between cathode and anode)

(1) $\frac{E^2}{2VB^2}$

(2) $\frac{B^2}{2VE^2}$

(3) $\frac{2VB^2}{E^2}$

(4) $\frac{2VE^2}{B^2}$

41. The potential difference that must be applied to stop the fastest photo electrons emitted by a nickel surface, having work function 5.01 eV, when ultraviolet light of 200 nm falls on it, must be

(1) 1.2 V

(2) 2.4 V

(3) –1.2 V

(4) –2.4 V

42. The activity of a radioactive sample is measured as N_0 counts per minute at t = 0 and N_0/e counts per minute at t = 5 minutes. The time (in minutes) at which the activity reduces to half its value is

(1) $5 \log_e 2$

(2) $\log_e \frac{2}{5}$

(3) $\frac{5}{\log_e 2}$

(4) $5 \log_{10} 5$

43. The energy of a hydrogen atom in the ground state is –13.6 eV. The energy of a He^+ ion in the first excited state will be

(1) –6.8 eV

(2) –13.6 eV

(3) –27.2 eV

(4) –54.4 eV

44. The mass of a $^{7}_{3}Li$ nucleus is 0.042 u less than the sum of the masses of all its nucleons. The binding energy per nucleon of $^{7}_{3}Li$ nucleus is nearly

(1) 23 MeV
(2) 46 MeV
(3) 5.6 MeV
(4) 3.9 MeV

45. 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

(1) $\frac{1}{v^4}$
(2) $\frac{1}{Ze}$
(3) v^2
(4) $\frac{1}{m}$

46. A common emitter amplifier has a voltage gain of 50, an input impedance of 100 Ω and an output impedance of 200 Ω. The power gain of the amplifier is

(1) 50
(2) 500
(3) 1000
(4) 1250

47. Which one of the following bonds produces a solid that reflects light in the visible region and whose electrical conductivity decreases with temperature and has high melting point?

(1) Covalent bonding
(2) Metallic bonding
(3) Van der Waal's bonding
(4) Ionic bonding

48. The device that can act as a complete electronic circuit is

(1) zener diode
(2) junction diode
(3) integrated circuit
(4) junction transistor

49. Which of the following statement is False?

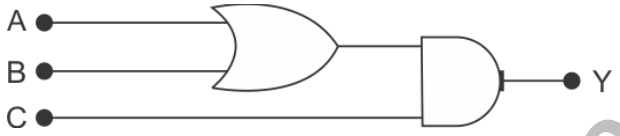
(1) The resistance of intrinsic semiconductor decreases with increase of temperature

(2) Pure Si doped with trivalent impurities gives a p-type semiconductor

(3) Majority carriers in a n-type semiconductors are holes

(4) Minority carriers in a p-type semiconductor are electrons

50. To get an output Y = 1 from the circuit shown below, the input must be



	A	B	C
(1)	1	0	0
(2)	0	1	0
(3)	0	0	1
(4)	1	0	1

Chemistry

51. An increase in equivalent conductance of a strong electrolyte with dilution is mainly due to
(1) increase in number of ions
(2) increase in ionic mobility of ions
(3) 100% ionisation of electrolyte at normal dilution
(4) increase in both i.e. number of ions and ionic mobility of ions

52. 25.3 g of sodium carbonate (Na_2CO_3) is dissolved in enough water to make 250 ml of solution. If sodium carbonate dissociates completely, molar concentration of sodium ion(Na^+) and carbonate ion(CO_3^{2-}) are respectively (Molar mass of Na_2CO_3 = 106 g mol^{-1})
(1) 0.477 M and 0.477 M
(2) 0.955 M and 1.910 M
(3) 1.910 M and 0.955 M
(4) 1.90 M and 1.910 M

53. Property of the alkaline earth metals that increase with their atomic number
(1) electronegativity
(2) solubility of their hydroxides in water
(3) solubility of their sulphates in water
(4) ionization energy

54. Which of the following pairs has the same size?
(1) Zn^{2+}, Hf^{4+}
(2) Fe^{2+}, Ni^{2+}
(3) Zr^{4+}, Ti^{4+}
(4) Zr^{4+}, Hf^{4+}

55. In a buffer solution containing equal concentration of B^- and HB, the K_b for B^- is 10^{-10}. The pH of buffer solution is
(1) 4
(2) 10
(3) 7
(4) 6

56. An aqueous solution is 1.00 molal in KI. Which change will cause the vapour pressure of the solution to increase?
(1) Addition of water
(2) Addition of NaCl
(3) Addition of Na_2SO_4

(4) Addition of 1.00 molal KI

57. What is $[H^+]$ in mol/L of a solution that is 0.20 M in CH_3COONa and 0.10 M in CH_3COOH? K_a for $CH_3COOH = 1.8 \times 10^{-5}$.
(1) 9.0×10^{-6}
(2) 3.5×10^{-4}
(3) 1.1×10^{-5}
(4) 1.8×10^{-5}

58. For the reaction $N_2O_{5(g)} \rightarrow 2NO_{2(g)} + \frac{1}{2}O_{2(g)}$ the value of rate of disappearance of N_2O_5 is given as 6.25×10^{-3} mol $L^{-1}s^{-1}$. The rate of formation of NO_2 and O_2 is given respectively as:
(1) 1.25×10^{-2} mol $L^{-1}s^{-1}$ and 6.25×10^{-3} mol $L^{-1}s^{-1}$
(2) 6.25×10^{-3} mol $L^{-1}s^{-1}$ and 6.25×10^{-3} mol $L^{-1}s^{-1}$
(3) 1.25×10^{-2} mol $L^{-1}s^{-1}$ and 3.125×10^{-3} mol $L^{-1}s^{-1}$
(4) 6.25×10^{-3} mol $L^{-1}s^{-1}$ and 3.125×10^{-3} mol $L^{-1}s^{-1}$

59. Standard entropies of X_2, Y_2 and XY_3 are 60, 40 and 50 $JK^{-1}mol^{-1}$ respectively. For the reaction $\frac{1}{2}X_2 + \frac{3}{2}Y_2 \rightleftharpoons XY_3, \Delta H = -30kJ$ to be at equilibrium, the temperature should be
(1) 500 K
(2) 750 K
(3) 1000 K
(4) 1250 K

60. During the kinetic study of the reaction $2A + B \rightarrow C + D$, following results were obtained

Run	[A]/mol L^{-1}	[B]/ mol L^{-1}	Initial rate of formation of D/mol L^{-1} min^{-1}
I	0.1	0.1	6.0×10^{-3}
II	0.3	0.2	7.2×10^{-2}
III	0.3	0.4	2.88×10^{-1}
IV	0.4	0.1	2.40×10^{-2}

Based on the above data which one of the following is correct?
(1) rate = $k[A][B]^2$
(2) rate = $k[A]^2[B]$
(3) rate = $k[A][B]$
(4) rate = $k[A]^2[B]^2$

61. For the reduction of silver ions with copper metal, the standard cell potential was found to be + 0.46 V at 25°C. The value of standard Gibbs energy, ΔG^0 will be (F = 96500 C mol^{-1})
(1) –98.0 kJ
(2) –89.0 kJ
(3) –89.0 J
(4) –44.5 kJ

62. Which one of the following species does not exist under normal conditions?
(1) Li_2
(2) Be_2^+
(3) Be_2
(4) B_2

63. AB crystallizes in a body centred cubic lattice with edge length 'a' equal to 387 pm. The distance between two oppositely charged ions in the lattice is
(1) 300 pm
(2) 335 pm
(3) 250 pm
(4) 200 pm

64. For an endothermic reaction, energy of activation is E_a and enthalpy of reaction is ΔH (both of these in kJ/mol). Minimum value of E_a will be
(1) Equal to zero
(2) Less than ΔH
(3) Equal to ΔH
(4) More than ΔH

65. Which one of the following ions has electronic configuration $[Ar]3d^6$?
(1) Co^{3+}
(2) Ni^{3+}
(3) Mn^{3+}
(4) Fe^{3+}
(At. nos. Mn = 25, Fe = 26, Co = 27, Ni = 28)

66. In which of the following equilibrium K_c and K_p are not equal?
(1) $2C_{(S)} + O_{2(g)} \rightarrow 2CO_{2(g)}$
(2) $2NO_{(g)} \rightarrow N_{2(g)} + O_{2(g)}$
(3) $SO_{2(g)} + NO_{2(g)} \rightarrow SO_{3(g)} + NO_{(g)}$
(4) $H_{2(g)} + I_{2(g)} \rightarrow 2HI_{(g)}$

67. If pH of a saturated solution of $Ba(OH)_2$ is 12, the value of its $K_{(sp)}$ is
(1) $5.00 \times 10^{-7}\ M^3$
(2) $4.00 \times 10^{-6}\ M^3$
(3) $4.00 \times 10^{-7}\ M^3$
(4) $5.00 \times 10^{-6}\ M^3$

68. Which of the following ions will exhibit colour in aqueous solutions?
(1) Sc^{3+} (Z = 21)
(2) La^{3+} (Z = 57)
(3) Ti^{3+} (Z = 22)
(4) Lu^{3+} (Z = 71)

69. The correct order of increasing bond angles in the following species is
(1) $ClO_2^- < Cl_2O < ClO_2$
(2) $Cl_2O < ClO_2 < ClO_2^-$
(3) $ClO_2 < Cl_2O < ClO_2^-$
(4) $Cl_2O < ClO_2^- < ClO_2$

70. Which one of the following compounds is peroxide?
(1) NO_2
(2) KO_2
(3) BaO_2
(4) MnO_2

71. In which of the following pairs of molecules/ions, the central atoms have sp^2 hybridization?
(1) BF_3 and NH_2^-
(2) NO_2^- and NH_3
(3) BF_3 and NO_2^-
(4) NH_2^- and H_2O

72. The correct order of the decreasing ionic radii among the following isoelectronic species is
(1) $K^+ > Ca^{2+} > Cl^- > S^{2-}$
(2) $Ca^{2+} > K^+ > S^{2-} > Cl^-$
(3) $Cl^- > S^{2-} > Ca^{2+} > K^+$
(4) $S^{2-} > Cl^- > K^+ > Ca^{2+}$

73. The number of atoms in 0.1 mol of a triatomic gas is ($N_A = 6.02 \times 10^{23}$ mol^{-1})
(1) 1.800×10^{22}
(2) 6.026×10^{22}
(3) 1.806×10^{23}
(4) 3.600×10^{23}

74. Which of the following complex ion is not expected to absorb visible light?
(1) $[Ni(H_2O)_6]^{2+}$
(2) $[Ni(CN)_4]^{2-}$
(3) $[Cr(NH_3)_6]^{3+}$
(4) $[Fe(H_2O)_6]^{2+}$

75. Which of the following alkaline earth metal sulphates has hydration enthalpy higher than the lattice enthalpy?
(1) $SrSO_4$
(2) $CaSO_4$
(3) $BeSO_4$
(4) $BaSO_4$

76. The existence of two different coloured complexes with the composition of $[Co(NH_3)_4Cl_2]^+$ is due to
(1) Ionization isomerism
(2) Linkage isomerism
(3) Geometrical isomerism
(4) Coordination isomerism

77. Oxidation states of P in $H_4P_2O_5$, $H_4P_2O_6$, $H_4P_2O_7$, are respectively
(1) + 3, + 4, + 5
(2) + 3, + 5, + 4
(3) + 5, + 3, + 4
(4) + 5, + 4, + 3

78. The tendency of BF_3, BCl_3 and BBr_3 to behave as Lewis acid decreases in the sequence
(1) $BF_3 > BCl_3 > BBr_3$
(2) $BCl_3 > BF_3 > BBr_3$
(3) $BBr_3 > BCl_3 > BF_3$
(4) $BBr_3 > BF_3 > BCl_3$

79. Which of the following represents the correct order of increasing electron gain enthalpy with negative sign for the elements O, S, F and Cl?
(1) S < O < Cl < F
(2) Cl < F < O < S
(3) O < S < F < Cl

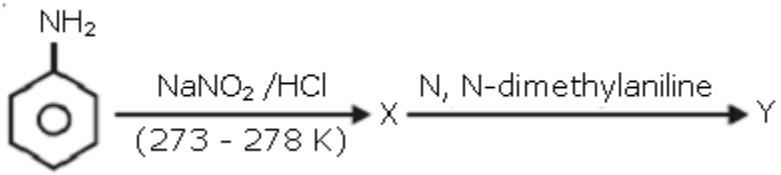
(4) F < S < O < Cl

80. Crystal field stabilization energy for high spin d^4 octahedral complex is
(1) $-0.6\ \Delta_o$
(2) $-1.8\ \Delta_o$
(3) $-1.6\ \Delta_o + P$
(4) $-1.2\ \Delta_o$

81. In which one of the following species the central atom has the type of hybridization which is not the same as that present in the other three?
(1) PCl_5
(2) SF_4
(3) I^{3-}
(4) $SbCl_5^{2-}$

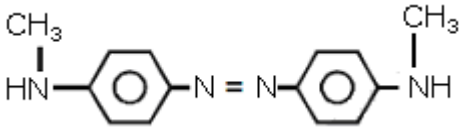
82. Which one of the following molecular hydrides acts as a Lewis acid?
(1) CH_4
(2) NH_3
(3) H_2O
(4) B_2H_6

83. Aniline in a set of the following reactions yielded a coloured product Y



The structure of Y would be

(1)



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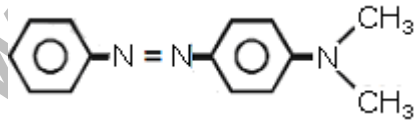

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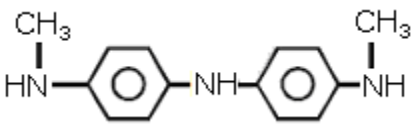
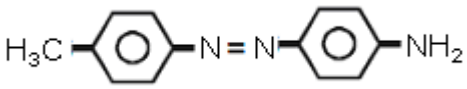


(4)



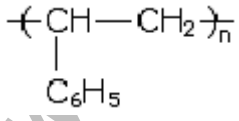
84. The reaction of toluene with Cl_2 in presence of $FeCl_3$ gives X and reaction in presence of light gives Y. Thus, X and Y are
(1) X = Benzyl chloride, Y = m-chlorotoluene
(2) X = Benzal chloride, Y = o-chlorotoluene
(3) X = m-chlorotoluene, Y = p-chlorotoluene
(4) X = o-and p-chlorotoluene, Y = Trichloromethyl benzene

85. Liquid hydrocarbons can be converted to a mixture of gaseous hydrocarbons by
(1) Hydrolysis
(2) Oxidation
(3) Cracking
(4) Distillation under reduced pressure

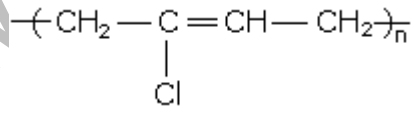
86. Which one of the following is employed as a Tranquilizer drug?
(1) Mifepristone
(2) Promethazine
(3) Valium
(4) Naproxen

87. Which one of the following does not exhibit the phenomenon of mutarotation?
(1) (–) Fructose
(2) (+) Sucrose
(3) (+) Lactose
(4) (+) Maltose

88. Which of the following structures represents Neoprene polymer?
(1)



(2)



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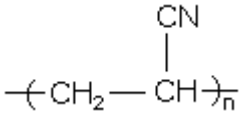

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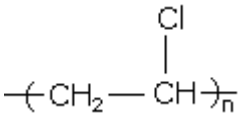
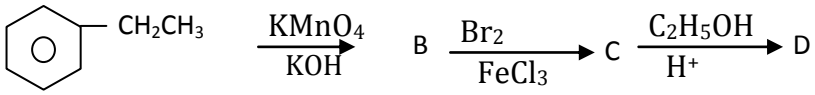
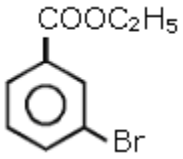
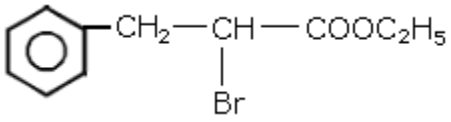


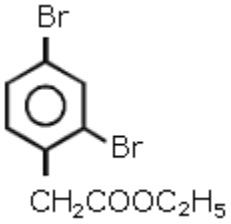
89. In a set of reactions, ethyl benzene yielded a product D.

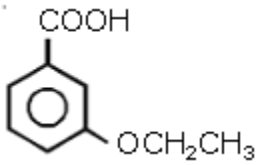


D would be

(1) 

(2) 

(3) 

(4) 

90. Which one is most reactive towards S_N1 reaction?

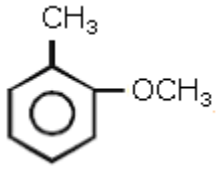
(1) $C_6H_5CH_2Br$

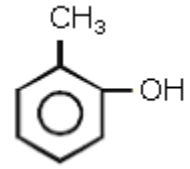
(2) $C_6H_5CH(C_6H_5)Br$

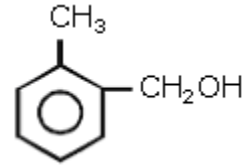
(3) $C_6H_5CH(CH_3)Br$

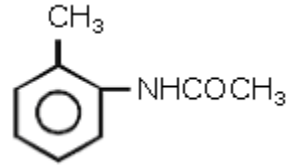
(4) $C_6H_5C(CH_3)(C_6H_5)Br$

91. Which one is most reactive towards electrophilic reagent?

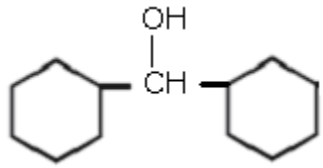
(1) 

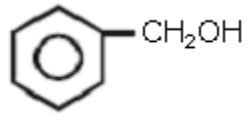
(2) 

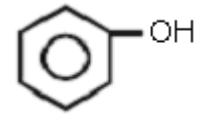
(3) 

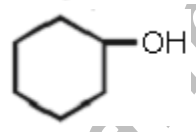
(4) 

92. Which one of the following compounds has the most acidic nature?

(1) 

(2) 

(3) 

(4) 

93. Given are cyclohexanol (I), acetic acid (II), 2, 4, 6-trinitrophenol (III) and phenol (IV). In these the order of decreasing acidic character will be

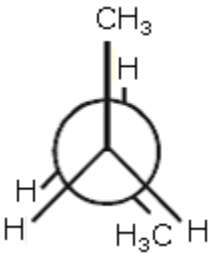
(1) III > IV > II > I
(2) III > II > IV > I
(3) II > III > I > IV
(4) II > III > IV > I

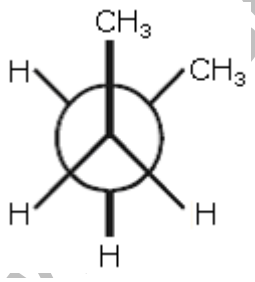
94. Which of the following statements about primary amines is 'False'?
(1) Alkyl amines are stronger bases than ammonia
(2) Alkyl amines are stronger bases than aryl amines
(3) Alkyl amines react with nitrous acid to produce alcohols
(4) Aryl amines react with nitrous acid to produce phenols

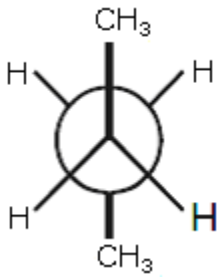
95. Acetamide is treated with the following reagents separately. Which one of these would yield methyl amine?
(1) PCl_5
(2) $NaOH + Br_2$
(3) Sodalime
(4) Hot conc. H_2SO_4

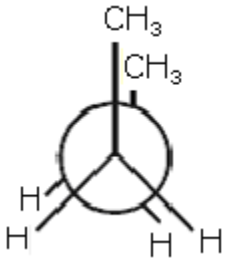
96. Which of the following reactions will not result in the formation of carbon-carbon bonds?
(1) Friedel-Craft's acylation
(2) Reimer-Tieman reaction
(3) Cannizzaro reaction
(4) Wurtz reaction

97. In the following the most stable conformation of n-butane is

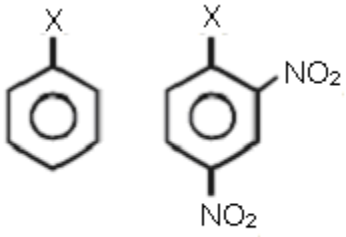
(1) 

(2) 

(3) 

(4) 

98. The correct order of increasing reactivity of C-X bond towards nucleophile in the following compound is



(I) (II) (III) (IV)

(1) III < II < I < IV
(2) I < II < IV < III
(3) II < III < I < IV
(4) IV < III < I < II

99. Among the given compounds, the most susceptible to nucleophilic attack at the carbonyl group is
(1) CH_3COCl
(2) CH_3COOCH_3
(3) CH_3CONH_2
(4) $CH_3COOCOCH_3$

100. A solution of sucrose (molar mass = 342 g mol^{-1}) has been prepared by dissolving 68.5 g of sucrose in 1000 g of water. The freezing point of the solution obtained will be (K_f for water = 1.86 K kg mol^{-1})
(1) –0.570°C
(2) –0.372°C
(3) –0.520°C
(4) +0.372°C

Biology

101. Virus envelope is known as
(1) Core
(2) Capsid
(3) Virion
(4) Nucleoprotein

102. Some hyperthermophilic organisms that grow in highly acidic (pH 2) habitats belong to the two groups:
(1) Liverworts and yeasts
(2) Eubacteria and archaea
(3) Cyanobacteria and diatoms
(4) Protists and mosses

103. Infectious proteins are present in
(1) Satellite viruses
(2) Gemini viruses
(3) Prions
(4) Viroids

104. Male and female gametophytes are independent and free-living in:
(1) Sphagnum
(2) Mustard
(3) Castor
(4) Pinus

105. Single-celled eukaryotes are included in
(1) Monera
(2) Protista
(3) Fungi
(4) Archaea

106. One example of animals having a single opening to the outside that serves both as mouth as well as anus is:
(1) *Fasciola*
(2) *Octopus*
(3) *Asterias*
(4) *Ascidia*

107. Which one of the following statements about all the four of *Spongilla*, Leech, Dolphin and Penguin is correct?
(1) All are bilaterally symmetrical
(2) Penguin is homoiothermic while the remaining three are poikilothermic
(3) Leech is a fresh water form while all others are marine
(4) *Spongilla* has special collared cells called choanocytes, not found in the remaining three

108. Which one of the following kinds of animals are *triploblastic*?
(1) Corals
(2) Flat worms
(3) Sponges
(4) Ctenophores

109. Which one of the following statements about certain given animals is correct?
(1) Flat worms (Platyhelminthes) are coelomates
(2) Round worms (Aschelminthes) are pseudocoelomates
(3) Molluses are acoelomates
(4) Insects are pseudocoelomates

110. The plasma membrane consists mainly of
(1) Proteins embedded in a carbohydrate bilayer
(2) Phospholipids embedded in a protein bilayer
(3) Proteins embedded in a phospholipid bilayer
(4) Proteins embedded in a polymer of glucose molecules

111. Which one of the following structures between two adjacent cells is an effective transport pathway?
(1) Plasmalemma
(2) Plasmodesmata
(3) Plastoquinones
(4) Endoplasmic reticulum

112. Which one of the following has its own DNA?
(1) Peroxisome
(2) Mitochondria
(3) Dictyosome
(4) Lysosome

113. The main arena of various types of activities of a cell is
(1) Nucleus
(2) Plasma membrane
(3) Mitochondrian
(4) Cytoplasm

114. During mitosis ER and nucleolus begin to disappear at
(1) Early prophase
(2) Late prophase
(3) Early metaphase
(4) Late metaphase

115. Algae have cell wall made up of
(1) Cellulose, hemicellulose and pectins
(2) Cellulose, galactans and mannans
(3) Hemicellulose, pectins and proteins
(4) Pectins, cellulose and proteins

116. Membrane-bound organelles are absent in
(1) *Plasmodium*
(2) *Saccharomyces*
(3) *Streptococcus*
(4) *Chlamydomonas*

117. The kind of epithelium which forms the inner walls of blood vessels is
(1) Squamous epithelium
(2) Cuboidal epithelium
(3) Columnar epithelium
(4) Ciliated columnar epithelium

118. Which stages of cell division do the following figures A and B represent respectively?

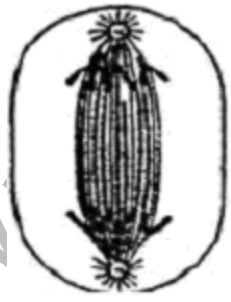

A

Fig. A


B

Fig. B

(1) Prophase — Anaphase
(2) Metaphase — Telophase
(3) Telophase — Metaphase

(4) Late Anaphase — Prophase

119. Which one of the following cannot be explained on the basis of Mendel's Law of Dominance?
(1) Factors occur in pairs
(2) The discrete unit controlling a particular character is called a factor
(3) Out of one pair of factors one is dominant, and the other recessive
(4) Alleles do not show any blending and both the characters recover as such in F2 generation

120. The genotype of a plant showing the dominant phenotype can be determined by
(1) Back cross
(2) Test cross
(3) Dihybrid cross
(4) Pedigree analysis

121. The one aspect which is not a salient feature of genetic code, is its being
(1) Specific
(2) Degenerate
(3) Ambiguous
(4) Universal

122. Satellite DNA is useful tool in
(1) Genetic engineering
(2) Organ transplantation
(3) Sex determination
(4) Forensic science

123. Which one of the following does not follow the central dogma of molecular biology?
(1) HIV
(2) Pea
(3) Mucor
(4) Chlamydomonas

124. ABO blood groups in humans are controlled by the gene *I*. It has three alleles–*I*A, *I*B and *i*. Since there are three different alleles, six different genotypes are possible. How many phenotypes can occur?
(1) Two
(2) Three
(3) One
(4) Four

125. Select the correct statement from the ones given below with respect to dihybrid cross
(1) Tightly linked genes on the same chromosome show very few recombinations
(2) Tightly linked genes on the same chromosome show higher recombinations
(3) Genes far apart on the same chromosome show very few recombinations
(4) Genes loosely linked on the same chromosome show similar recombinations as the tightly linked ones

126. Select the two correct statements out of the four (a–d) given below about lac operon.
(a) Glucose or galactose may bind with the repressor and inactivate it
(b) In the absence of lactose the repressor binds with the operator region
(c) The z-gene codes for permease
(d) This was elucidated by Francois Jacob and Jacque Monod
The correct statements are
(1) (a) and (b)
(2) (b) and (c)
(3) (a) and (c)
(4) (b) and (d)

127. Which one of the following symbols and its representation, used in human pedigree analysis is correct?
(1)  = male affected
(2)  = mating between relatives
(3)  = unaffected male
(4)  = unaffected female

128. Darwin's finches are a good example of
(1) Convergent evolution
(2) Industrial melanism
(3) Connecting link
(4) Adaptive radiation

129. The scutellum observed in a grain of wheat or maize is comparable to which part of the seed in other monocotyledons?
(1) Plumule
(2) Cotyledon
(3) Endosperm
(4) Aleurone layer

130. Which one of the following is not a micronutrient?
(1) Boron
(2) Molybdenum
(3) Magnesium
(4) Zinc

131. An element playing important role in nitrogen fixation is
(1) Zinc
(2) Molybdenum
(3) Copper
(4) Manganese

132. Which one of the following is not a lateral meristem?
(1) Intercalary meristem
(2) Intrafascicular cambium
(3) Interfascicular cambium
(4) Phellogen

133. C4 plants are more efficient in photosynthesis than C3 plants due to
(1) Lower rate of photorespiration
(2) Higher leaf area
(3) Presence of larger number of chloroplasts in the leaf cells
(4) Presence of thin cuticle

134. In unilocular ovary with a single ovule the placentation is
(1) Axile
(2) Marginal
(3) Basal
(4) Free Central

135. The chief water conducting elements of xylem in gymnosperms are
(1) Tracheids
(2) Vessels
(3) Fibers
(4) Transfusion tissue

136. The technical term used for the androecium in a flower of China rose (Hibiscus rosasinensis) is
(1) Polyadelphous
(2) Monadelphous
(3) Diadelphous
(4) Polyandrous

137. Ovary is half-inferior in the flowers of
(1) Cucumber
(2) Guava
(3) Plum
(4) Brinjal

138. Heartwood differs from sapwood in
(1) Being susceptible to pests and pathogens
(2) Presence of rays and fibres
(3) Absence of vessels and parenchyma
(4) Having dead and non-conducting elements

139. Keel is characteristic of the flowers of
(1) Bean
(2) Gulmohur
(3) Cassia
(4) Calotropis

140. One of the free-living anaerobic nitrogen-fixer is
(1) Azotobacter
(2) Beijernickia
(3) Rhodospirillum
(4) Rhizobium

141. PGA as the first CO_2 fixation product was discovered in photosynthesis of
(1) Alga
(2) Bryophyte
(3) Gymnosperm
(4) Angiosperm

142. The energy releasing metabolic process in which substrate is oxidised without an external electron acceptor is called
(1) Photorespiration
(2) Glycolysis
(3) Fermentation
(4) Aerobic respiration

143. Photoperiodism was first characterised in
(1) Cotton
(2) Tobacco
(3) Potato
(4) Tomato

144. Listed below are four respiratory capacities (a - c) and four jumbled respiratory volumes of a normal human adult

Respiratory capacities	**Respiratory volumes**
(a) Residual volume	2500 mL
(b) Vital capacity	3500 mL
(c) Inspiratory reserve volume	1200 mL
(d) Inspiratory capacity	4500 mL

Which one of the following is the **correct** matching of two capacities and volumes?

(1) (a) 4500 mL, (b) 3500 mL
(2) (b) 2500 mL, (c) 4500 mL
(3) (c) 1200 mL, (d) 2500 mL
(4) (d) 3500 mL, (a) 1200 mL

145. What is true about RBCs in humans?

(1) They do not carry CO2 at all
(2) They carry about 20-25 percent of CO2
(3) They transport 99.5 percent of O2
(4) They transport about 80 percent oxygen only and the rest 20 percent of it is transported in dissolved state in blood plasma

146. 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?

(1) The flow of blood into the pulmonary artery will be reduced
(2) The flow of blood into the aorta will be slowed down
(3) The pacemaker will stop working
(4) The blood will tend to flow back into the left atrium

147. Which one of the following statements in regard to the excretion by the human kidneys is correct?

(1) Ascending limb of Loop of Henle is impermeable to electrolytes
(2) Descending limb of Loop of Henle is impermeable to water
(3) Distal convoluted tubule is incapable of reabsorbing HCO3
(4) Nearly 99 percent of the glomerular filtrate is reabsorbed by the renal tubules

148. Low Ca++ in the body fluid may be the cause of

(1) Gout
(2) Tetany
(3) Anaemia
(4) Angina pectoris

149. If for some reason our goblet cells are non-functional this will adversely affect
(1) Smooth movement of food down the intestine
(2) Production of somatostatin
(3) Secretion of sebum from the sebaceous glands
(4) Maturation of sperms

150. The nerve centres which control the body temperature and the urge for eating are contained in
(1) Thalamus
(2) Hypothalamus
(3) Pons
(4) Cerebellum

151. Vasa efferentia are the ductules leading from
(1) Epididymis to urethra
(2) Testicular lobules to rete testis
(3) Rete testis to vas deferens
(4) Vas deferens to epididymis

152. The first movements of the foetus and appearance of hair on its head are usually observed during which month of pregnancy?
(1) Third month
(2) Fourth month
(3) Fifth month
(4) Sixth month

153. Cu ions released from copper- releasing Intra Uterine Devices (IUDs)
(1) Prevent ovulation
(2) Make uterus unsuitable for implantation
(3) Increase phagocytosis sperms
(4) Suppress sperm motility

154. Carrier ions like Na+ facilitate the absorption of substances like
(1) Fructose and some amino acids
(2) Amino acids and glucose
(3) Glucose and fatty acids
(4) Fatty acids and glycerol

155. Which one of the following pairs is incorrectly matched?
(1) Insulin–Diabetes mellitus (disease)
(2) Glucagon – Beta cells (source)
(3) Somatostatin – Delta cells (source)
(4) Corpus luteum – Relaxin (secretion)

156. The principal nitrogenous excretory compound in humans is synthesised
(1) In the liver but eliminated mostly through kidneys
(2) In kidneys but eliminated mostly through liver
(3) In kidneys as well as eliminated by kidneys
(4) In liver and also eliminated by the same through bile

157. Injury to adrenal cortex is not likely to affect the secretion of which one of the following?
(1) Cortisol
(2) Aldosterone
(3) Both Androstenedione and Dehydroepiandrosterone
(4) Adrenaline

158. Which one of the following statements about human sperm is correct?
(1) Acrosome serves no particular function
(2) Acrosome has a conical pointed structure used for piercing and penetrating the egg resulting in fertilization
(3) The sperm lysins in the acrosome dissolve the egg envelope facilitating fertilization
(4) Acrosome serves as a sensory structure leading the sperm towards the ovum

159. Coiling of garden pea tendrils around any support is an example of
(1) Thermotaxis
(2) Thigmotaxis
(3) Thigmonasty
(4) Thigmotropism

160. Apomictic embryos in citrus arise from
(1) Diploid egg
(2) Synergids
(3) Maternal sporophytic tissue in ovule
(4) Antipodal cells

161. Wind pollinated flowers are
(1) Small, producing nectar and dry pollen
(2) Small, brightly coloured, producing large number of pollen grains
(3) Small, producing large number of dry pollen grains
(4) Large, producing abundant nectar and pollen

162. Phototropic curvature is the result of uneven distribution of
(1) Auxin
(2) Gibberellin
(3) Phytochrome
(4) Cytokinins

163. Transfer of pollen grains from the anther to the stigma of another flower of the same plant is called
(1) Autogamy
(2) Xenogamy
(3) Geitonogamy
(4) Karyogamy

164. Seminal plasma in human males is rich in
(1) Ribose and potassium
(2) Fructose and calcium
(3) Glucose and calcium
(4) DNA and testosterone

165. Sertoli cells are found in
(1) Pancreas and secrete cholecystokinin
(2) Ovaries and secrete progesterone
(3) Adrenal cortex and secrete adrenaline
(4) Seminiferous tubules and provide nutrition of germ cells

166. The part of Fallopian tube closest to the ovary is
(1) Ampulla
(2) Isthmus
(3) Infundibulum
(4) Cervix

167. In vitro fertilisation is a technique that involves transfer of which one of the following into the fallopian tube?
(1) Zygote only
(2) Embryo only, upto 8 cell stage
(3) Either zygote or early embryo upto 8 cell stage
(4) Embryo of 32 cell stage

168. The permissible use of the technique amniocentesis is for
(1) Detecting any genetic abnormality
(2) Detecting sex of the unborn foetus
(3) Artificial insemination
(4) Transfer of embryo into the uterus of a surrogate mother

169. The signals for parturition originate from
(1) Fully developed foetus only
(2) Placenta only
(3) Placenta as well as fully developed foet
(4) Oxytocin released from maternal pituita

170. The biomass available for consumption by the herbivores and the decomposers is called
(1) Gross primary productivity
(2) Net primary productivity
(3) Secondary productivity
(4) Standing crop

171. Which one of the following is one of the characteristics of a biological community?
(1) Sex-ratio
(2) Stratification
(3) Natality
(4) Mortality

172. Which one of the following is an example ex-situ conservation?
(1) National park
(2) Wildlife sanctuary
(3) Seed bank
(4) Sacred groves

173. A renewable exhaustible natural resource is
(1) Forest
(2) Coal
(3) Petroleum
(4) Minerals

174. The two gases making highest relative contribution to the greenhouse gases are
(1) CO2 and N2O
(2) CO2 and CH4
(3) CH4 and N2O
(4) CFC5 and N2O

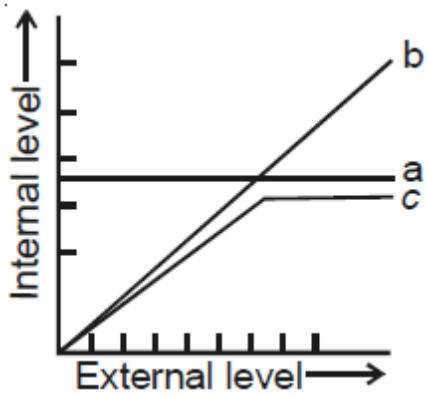
175. Select the correct statement from the following
(1) Activated sludge-sediment in settlement tanks of sewage treatment plant is a rich source of aerobic bacteria
(2) Biogas is produced by the activity of aerobic bacteria on animal waste
(3) Methanobacterium is an aerobic bacterium found in rumen of cattle
(4) Biogas, commonly called gobar gas, is pure methane

176. Which two of the following changes (a–d) usually tend to occur inthe plain dwellers when they move to high altitudes (3,500 m or more)?
(a) Increase in red blood cell size
(b) Increase in red blood cell production
(c) Increased breathing rate
(d) Increase in thrombocyte count
Changes occurring are
(1) (a) and (b)
(2) (b) and (c)
(3) (c) and (d)
(4) (a) and (d)

177. dB is a standard abbreviation used for the quantitative expression of
(1) A certain pesticide
(2) The density of bacteria in a medium
(3) A particular pollutant
(4) The dominant Bacillus in a culture

178. Study the four statements (a–d) given below and select the two correct ones outo of them
(a) A lion eating a deer and a sparrow feeding on grain are ecologically similar in being consumers
(b) Predator star fish Pisaster helps in maintaining species diversity of some invertebrates
(c) Predators ultimately lead to the extinction of prey species
(d) Production of chemicals such as nicotine, strychnine by the plants are metabolic disorders
The two correct statements are:
(1) (a) and (b)
(2) (b) and (c)
(3) (c) and (d)
(4) (a) and (d)

179. The figure given below is a diagrammatic representation of response of organisms to abiotic factors. What do a, b and c represent respectively?



	(a)	(b)	(c)
(1)	Regulator	Conformer	Partial regulator
(2)	Conformer	Regulator	Partial regulator
(3)	Regulator	Partial regulator	Conformer
(4)	Partial	regulator	Regulator Conformer

180. Widal test is used for the diagnosis of
(1) Typhoid
(2) Malaria
(3) Pneumonia
(4) Tubercolosis

181. Ringworm in humans is caused by
(1) Viruses
(2) Bacteria
(3) Fungi
(4) Nematodes

182. Which one of the following is not used in organic farming?
(1) Snail
(2) Glomus
(3) Earthworm
(4) Oscillatoria

183. A common biocontrol agent for the control of plant diseases is
(1) Trichoderma
(2) Baculovirus
(3) Bacillus thuringiensis
(4) Glomus

184. The common nitrogen-fixer in paddy fields is
(1) Frankia
(2) Rhizobium
(3) Azospirillum
(4) Oscillatoria

185. Consider the following four statements (a–d) regarding kidney transplant and select the two correct ones out of these.
(a) Even if a kidney transplant is proper the recipient may need to take immunosuppressants for a long time
(b) The cell-mediated immune response is responsible for the graft rejection
(c) The B-lymphocytes are responsible for rejection of the graft
(d) The acceptance or rejection of a kidney transplant depends on specific interferons
The two correct statements are
(1) (a) & (b)
(2) (b) & (c)
(3) (c) & (d)
(4) (a) & (c)

186. Which one of the following statements is correct with respect to AIDS?
(1) The causative HIV retrovirus enters helper T-lymphocytes thus reducing their numbers
(2) The HIV can be transmitted through eating food together with an infected person
(3) Drug addicts are least susceptible to HIV infection
(4) AIDS patients are being fully cured cent per cent with proper care and nutrition

187. Select the correct statement from the ones given below
(1) Cocaine is given to patients after surgery as it stimulates recovery
(2) Barbiturates when given to criminals make them tell the truth
(3) Morphine is often given to persons who have undergone surgery as a pain killer
(4) Chewing tobacco lowers blood pressure and heart rate

188. Toxic agents present in food which interfere with thyroxine synthesis lead to the development of
(1) Thyrotoxicosis
(2) Toxic goiter
(3) Cretinism
(4) Simple goiter

189. The second maturation division of the mammalian ovum occurs
(1) In the Graafian follicle following the first maturation division
(2) Shortly after ovulation before the ovum makes entry into the Fallopian tube
(3) Until after the ovum has been penetrated by a sperm
(4) Until the nucleus of the sperm has fused with that of the ovum

190. Which one of the following statements about morula in humans is correct?
(1) It has more cytoplasm and more DNA than an uncleaved zygote
(2) It has almost equal quantity of cytoplasm as an uncleaved zygote but much more DNA
(3) It has far less cytoplasm as well as less DNA than in an uncleaved zygote
(4) It has more or less equal quantity of cytoplasm and DNA as in uncleaved zygote

191. Stirred-tank bioreactors have been designed for
(1) Availability of oxygen throughout the process
(2) Addition of preservatives to the product
(3) Purification of the product
(4) Ensuring anaerobic conditions in the culture vessel

192. Breeding of crops with high levels of minerals, vitamins and proteins is called
(1) Micropropagation
(2) Somatic hybridisation
(3) Biofortification
(4) Biomagnification

193. DNA or RNA segment tagged with a radioactive molecule is called
(1) Plasmid
(2) Vector
(3) Probe
(4) Clone

194. Which one of the following is used as vector for cloning genes into higher organisms?
(1) Retrovirus
(2) Baculovirus
(3) Salmonella typhimurium
(4) Rhizopus nigricans

195. The genetically-modified (GM) brinjal in India has been developed for
(1) Drought-resistance
(2) Insect-resistance
(3) Enhancing shelf life
(4) Enhancing mineral content

196. Genetic engineering has been successfully used for producing
(1) Animals like bulls for farm work as they have super power
(2) Transgenic mice for testing safety of polio vaccine before use in humans
(3) Transgenic models for studying new treatments for certain cardiac diseases
(4) Transgenic Cow-Rosie which produces high fat milk for making ghee

197. Restriction endonucleases are enzymes which
(1) Remove nucleotides from the ends of the DNA molecule
(2) Make cuts at specific positions within the DNA molecule
(3) Recognize a specific nucleotide sequence for binding of DNA ligase
(4) Restrict the action of the enzyme DNA polymerase

198. Some of the characteristics of Bt cotton are
(1) High yield and resistance to bollworms
(2) Long fibre and resistance to aphids
(3) Medium yield, long fibre and resistance to beetle pests
(4) High yield and production of toxic protein crystals which kill dipteran pests

199. An improved variety of transgenic basmati rice
(1) Give high yield but has no characteristic aroma
(2) Does not require chemical fertilizers and growth hormones
(3) Gives high yield and is rich in vitamin A
(4) Is completely resistant to all insect pests and diseases of paddy

200. Which one of the following palindromic base sequences in DNA can be easily cut at about the middle by some particular restriction enzyme?
(1) 5′ CACGTA 3′; 3′ CTCAGT 5′
(2) 5′ CGTTCG 3′; 3′ ATGGTA 5′
(3) 5′ GATATG 3′; 3′ CTACTA 5′
(4) 5′ GAATTC 3′; 3′ CTTAAG 5′

AIPMT - 2010
(Physics, Chemistry and Biology)
Prelims Answer Key and Solution
Code A

Answers

1	(3)	2	(2)	3	(4)	4	(3)	5	(4)	6	(3)	7	(1)	8	(2)	9	(4)	10	(1)
11	(3)	12	(3)	13	(2)	14	(2)	15	(3)	16	(2)	17	(2)	18	(2)	19	(1)	20	(4)
21	(1)	22	(4)	23	(4)	24	(4)	25	(4)	26	(1)	27	(1)	28	(3)	29	(2)	30	(1)
31	(4)	32	(3)	33	(1)	34	(4)	35	(1)	36	(3)	37	(3)	38	(1)	39	(2)	40	(1)
41	(3)	42	(1)	43	(2)	44	(3)	45	(4)	46	(4)	47	(2)	48	(3)	49	(3)	50	(4)
51	(2)	52	(3)	53	(2)	54	(4)	55	(1)	56	(1)	57	(1)	58	(3)	59	(2)	60	(1)
61	(2)	62	(3)	63	(2)	64	(4)	65	(1)	66	(1)	67	(1)	68	(3)	69	(1)	70	(3)
71	(3)	72	(4)	73	(3)	74	(2)	75	(3)	76	(3)	77	(1)	78	(3)	79	(3)	80	(1)
81	(4)	82	(4)	83	(2)	84	(4)	85	(3)	86	(3)	87	(2)	88	(2)	89	(1)	90	(4)
91	(2)	92	(3)	93	(2)	94	(4)	95	(2)	96	(3)	97	(3)	98	(2)	99	(1)	100	(2)
101	(2)	102	(2)	103	(3)	104	(1)	105	(2)	106	(1)	107	(4)	108	(2)	109	(2)	110	(3)
111	(2)	112	(2)	113	(4)	114	(1)	115	(2)	116	(3)	117	(1)	118	(4)	119	(4)	120	(2)
121	(3)	122	(4)	123	(1)	124	(4)	125	(1)	126	(4)	127	(2)	128	(4)	129	(2)	130	(3)
131	(2)	132	(1)	133	(1)	134	(3)	135	(1)	136	(2)	137	(3)	138	(4)	139	(1)	140	(3)
141	(1)	142	(3)	143	(2)	144	(4)	145	(2)	146	(1)	147	(4)	148	(2)	149	(1)	150	(2)
151	(3)	152	(3)	153	(4)	154	(1)	155	(2)	156	(1)	157	(4)	158	(3)	159	(4)	160	(3)
161	(3)	162	(1)	163	(3)	164	(2)	165	(4)	166	(3)	167	(3)	168	(1)	169	(3)	170	(2)
171	(2)	172	(3)	173	(1)	174	(2)	175	(1)	176	(2)	177	(3)	178	(1)	179	(1)	180	(1)
181	(3)	182	(1)	183	(1)	184	(3)	185	(1)	186	(1)	187	(3)	188	(4)	189	(3)	190	(2)
191	(1)	192	(3)	193	(3)	194	(1)	195	(2)	196	(2)	197	(2)	198	(1)	199	(3)	200	(4)

Physics

1. Energy density of an electric field is

$$U_L = \frac{1}{2}\varepsilon_o E^2$$

where, ε_o = permittivity of free space

$$\frac{\text{Energy}}{\text{Volume}} = \frac{M^1\ L^2\ T^{-2}}{L^3} = M^1\ L^{-1}\ T^{-2}$$

Hence, the dimension of $\frac{1}{2}\varepsilon_o E^2$ is $M\ L^{-1}\ T^{-2}$.

2. Given that the displacement of the particle is $x = (t + 5)^{-1}$.

$$\rightarrow v = \frac{dx}{dt}$$

$$\therefore v = -1\ (t + 5)^{-2}$$

$$\rightarrow a = \frac{dv}{dt}$$

$$\therefore a = 2(t + 5)^{-3} \text{ -------- (Equation 1)}$$

$$\text{Or, } a = 2v^{3/2}$$

$$\text{Or, } a \propto v^{3/2}$$

Also, $v^3 = (t + 5)^{-3}$

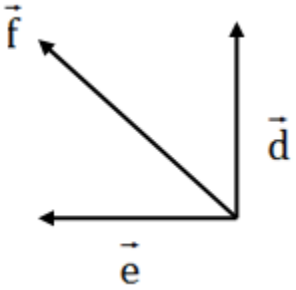
Substituting the above in equation (1), we get

$$a = 2v^3$$

$$\text{Or, } a \propto v^3$$

Hence, option (1) is correct.

3.



From the figure, we get

$$\vec{d} + \vec{e} = \vec{f}$$

4.

Speed of the particle is given as

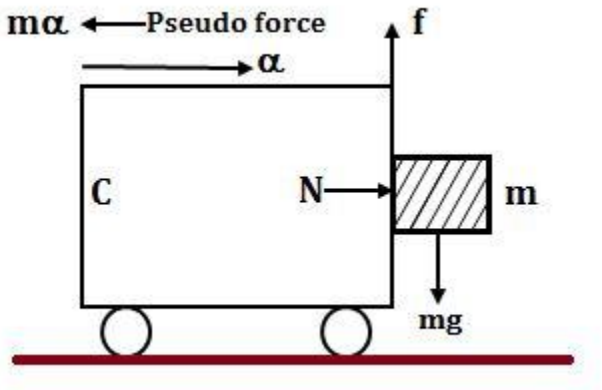
$\vec{v} = \vec{u} + \vec{a}t$

$= \left(3\hat{i} + 4\hat{j}\right) + \left(0.4\hat{i} + 0.3\hat{j}\right)10$

$= 7\hat{i} + 7\hat{j}$

$\Rightarrow v = |\vec{v}| = \sqrt{7^2 + 7^2} = \sqrt{98} = 7\sqrt{2}$ units

5.



Given that the coefficient of static friction between the block and the cart is μ.

Pseudo force or fictitious force = $F_{pseudo} = m\alpha = N$

Frictional force = $F_{frict} = \mu N = \mu m\alpha$

To stop from sliding, $F_{frict} \geq mg$

$\therefore \mu m\alpha \geq mg$

Or $\alpha \geq \frac{g}{\mu}$

6. Given that the man is in gravity-free space.

$\therefore$ Force acting on the man and the stone system is zero.

Let the distance the man goes above when the stone reaches the floor be 'x'.

$\rightarrow$ Centre of mass of the system remains at 10 m above the floor.

$M_{man} \times x = M_{stone} \times 10$

$50 \times x = 0.5 \text{ kg} \times 10$

$\therefore x = 0.1$ m

So, the distance of the man from the floor = 10 + x

= 10 + 0.1

= 10.1 m

$\therefore$ Total height = 10.1 m

7. Given that

Mass per unit length of water $\mu = 100$ kg/m

Velocity of water $v = 2$ m/s

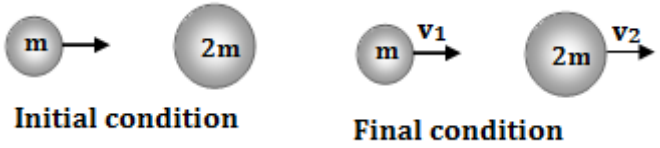
Power of engine $P = dv^3\rho$ -------- (where mass/length = $\mu = d\rho$)

$= \mu v^3$

$= (100 \text{ kg/m}) \times (2 \text{ m/s})^3$

$= 800$ W

8.



Given that $m_2 = 2m_1$,

$m_1 = m$, $m_2 = 2m$,

$u_1 = 2$ m/s, $u_2 = 0$ m/s and $e = 0.5$

Let v_1 and v_2 be the final velocities of the moving balls, respectively.

According to the law of conservation of linear momentum, we get

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

$\therefore m \times 2 + 2m \times 0 = mv_1 + 2m \times v_2$

Or, $2m = m\,v_1 + 2mv_2$

Or, $2 = v_1 + v_2$ -------- (Equation 1)

Coefficient of restitution, $e = \dfrac{v_2 - v_1}{u_1 - u_2}$

$\text{Or}, 0.5 = \dfrac{v_2 - v_1}{2 - 0}$

$\text{Or}, 1 = v_2 - v_1$ --------(Equation 2)

Solving equations (1) and (2), we get

$v_1 = 0$ m/s and $v_2 = 1$

9. Here, the frictional force provides the centripetal force.

The coin will revolve with the record, i.e. its static condition is

Frictional force ≥ Centrifugal force

$\text{Or}, \mu mg^3 \geq mr\omega^2$

$\text{Or}, r \leq \dfrac{\mu g}{\omega^2}$

10. Because there is no external torque applied to the system, the angular momentum of the system is conserved.

$\therefore L_{initial} = L_{final}$

According to the conservation of angular momentum, we get

$I_t\omega_i = (I_t + I_b)\omega_f$

Or, $\omega_f = \frac{I_t\omega_i}{(I_t + I_b)}$ ------- (Equation 1)

Initial energy, $E_i = \frac{1}{2}I_t\omega_i^2$------- (Equation 2)

Final energy, $E_f = \frac{1}{2}(I_t + I_b)\omega_f^2$------- (Equation 3)

Substiuting the valueof ω_f from equation 1 in equation 3, we get

$$E_f = \frac{1}{2}(I_t + I_b)\left(\frac{I_t\omega_i}{I_t + I_b}\right)^2$$

$$E_f = \frac{1}{2}\frac{I_t^2\omega_i^2}{(I_t + I_b)}$$------- (Equation 4)

Loss of energy = $E_i - E_f$

$$= \frac{1}{2}I_t\omega_i^2 - \frac{1}{2}\frac{I_t^2\omega_i^2}{(I_t + I_b)}$$

$$= \frac{1}{2}\omega_i^2\left[I_t - \frac{I_t^2}{(I_t + I_b)}\right]$$

$$= \frac{\omega_i^2}{2}\left[\frac{I_t^2 + I_tI_b - I_t^2}{I_t + I_b}\right]$$

$$= \frac{\omega_i^2}{2}\left[\frac{I_tI_b}{I_t + I_b}\right]$$

Or, Loss of energy = $\frac{1}{2}\frac{I_tI_b}{(I_t + I_b)}\omega_i^2$

11. As there is no external force acting on the two-particle system, there will not be any change in the velocity of the centre of mass of the system.

$\therefore V_{CM}$ = zero

12. Orbit speed of the satellite around the Earth is

$$V = \sqrt{\frac{GM}{r}}$$

Given that

Radius of satellite A, $r_A = 4R$ and $V_B = 3$ V

Radius of satellite B, $r_B = R$ and V_B = ?

$$V_A = \sqrt{\frac{GM}{r_A}} \text{-------- (Equation 1)}$$

$$V_B = \sqrt{\frac{GM}{r_B}} \text{-------- (Equation 2)}$$

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

$$\frac{V_B}{V_A} = \sqrt{\frac{r_A}{r_B}}$$

Substituting the given values in the above equation, we get

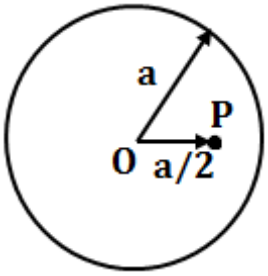
$$V_B = 3V\sqrt{\frac{4R}{R}}$$

$$\therefore V_B = 6V$$

13. Given that

Mass of the particle = M = Mass of the spherical shell and

Radius of the spherical shell = a



Gravitational potential at point P due to the spherical shell is

$$V_1 = -\frac{GM}{a}$$

Gravitational potential at point P due to the particle at point O is

$$V_2 = -\frac{GM}{a/2}$$

Total gravitational potential at point P = V = $V_1 - V_2$

$$\therefore V = -\frac{GM}{a} - \frac{GM}{a/2}$$

$$= -\frac{GM}{a} - \frac{2GM}{a}$$

$$\therefore V = -\frac{3GM}{a}$$

14. Let the distance from the platform where the two balls meet be 'x'.

We know that : $h = ut + \frac{1}{2}gt^2$ -------- (Equation 1)

For the first ball:

u = 0 m/s, t = 18 s, g = 10 m/s^2

Substituting the given values in equation (1), we get

$x = 0 + \frac{1}{2} \times 10 \times (18)^2$

$x = \frac{1}{2} \times 10 \times (18)^2$ -------- (Equation 2)

For the second ball:

u = v m/s, t = 18 – 6 = 12 s, g = 10 m/s^2

Substituting the given values in equation (1), we get

$x = 12v + \frac{1}{2} \times 10 \times (12)^2$

$x = 12v + \frac{1}{2} \times 10 \times (12)^2$ -------- (Equation 3)

From equation (2) and (3), we get

$\frac{1}{2} \times 10 \times (18)^2 = 12v + \frac{1}{2} \times 10 \times (12)^2$

Or, $12v = \frac{1}{2} \times 10 \times \left[(18)^2 - (12)^2\right]$

$\rightarrow 12v = \frac{1}{2} \times 10 \times \left[(18+12)(18-12)^2\right]$

$\rightarrow v = \frac{10 \times 30 \times 6}{2 \times 12}$

$\therefore v = 75$ m/s

15. The amount of heat which flows through the cylindrical metallic rod is

$Q = \frac{KA(T_2 - T_1)}{L} t$ -------- (Equation 1)

Here, the radius of the rod reduces to half of the original radius.

$\rightarrow$ Area of cross section of new rod, $A' = \pi\left(\frac{R}{2}\right)^2$

$\therefore A' = \frac{\pi R^2}{4} = \frac{A}{4}$ -------- (Equation 2)

Volume of the rod remains unchanged

$\therefore AL = A'L'$

$\therefore L' = L\frac{A}{A'} = 4L$ ------- (Equation 3)

The amount of heat that flows in the same time 't' through the new rod is given as

$$Q' = \frac{KA'(T_2 - T_1)}{L'}t \text{ -------- (Equation 4)}$$

Substituting the values from equation (2) amd (3) in equation (1), we get

$$Q' = \frac{K\left(A/4\right)(T_2 - T_1)}{4L}t = \frac{1}{16}\frac{KA(T_2 - T_1)}{L}t = \frac{Q}{16}$$

16. According to the Stefan–Boltzmann law, power radiated by the star of radius r whose outer surface radiates as a black body at a temperature T K is

$$P = 4\pi r^2 \sigma T^4$$

Radiant power per unit area received at a distance R from the centre of the star is given as

$$U = \frac{P}{4\pi R^2} \text{ -------- (where R is the distance from the centre of the star)}$$

$$U = \frac{4\pi r^2 \sigma T^4}{4\pi R^2} = \frac{\sigma r^2 T^4}{R^2}$$

17. According to the 1st law of thermodynamics $\Delta Q = \Delta U + \Delta W$

where ΔQ is the heat supplied to the system.

In an adiabatic process, $\Delta Q = 0$

$\therefore \Delta U + \Delta W = 0$

Or $\Delta U = -\Delta W$

In an isothermal process, $\Delta U = 0$

$\therefore \Delta Q = \Delta W$

Hence, option (2) is correct.

18. Given that $x = a\sin^2\omega t$

$$\text{Or, } x = a\left(\frac{1 - \cos 2\omega t}{2}\right) \text{ --------- } (\because \cos 2\theta = 1 - 2\sin^2\theta)$$

$$\text{Or, } x = \frac{a}{2} - \frac{\cos 2\omega t}{2}$$

$$\text{Velocity} = \frac{dx}{dt} = a\omega \sin 2\omega t$$

$$\text{Acceleration, } a = \frac{d^2x}{dt^2} = 2a\omega^2 \cos 2\omega t$$

$\therefore a \propto -x$ is satisfied.

Hence, the motion of the particle is simple harmonic.

$$\text{Time period} = \frac{2\pi}{2\omega} = \frac{\pi}{\omega}$$

19.

Time period of oscillation, $T = 2\pi\sqrt{\frac{M}{k}}$

where, M = Mass suspended and k = Spring constant

When another mass 'M' is suspended, then the time period of oscillation will be

$T' = 2\pi\sqrt{\frac{M+M}{k}} = 2\pi\sqrt{\frac{2M}{k}}$

Or, $T' = \sqrt{2} \times 2\pi\sqrt{\frac{M}{k}}$

$\rightarrow T' = \sqrt{2}T$

20. Given wave equation is

$y = A\sin(\omega t - kx)$

Wave velocity, $v = \frac{\omega}{k}$ --------- (Eqaution 1)

Particle velocity is given as

$v_p = \frac{dy}{dx} = \omega A\cos(\omega t - kx)$

Maximum particle velocity, $(v_p)_{max} = A\omega$ --------- (Eqaution 2)

Here, given that $v_p = (v_p)_{max}$

$\therefore \frac{\omega}{k} = A\omega$

$\rightarrow \frac{1}{k} = A$ ---------$\left(\because k = \frac{2\pi}{\lambda}\right)$

Or, $\frac{\lambda}{2\pi} = A$

$\therefore \lambda = 2\pi A$

21. Let the frequency of the tuning fork and the piano string be f_1 and f_2, respectively.

$\therefore f_2 = f_1 \pm 4 = 512 \pm 4$

$\therefore f_2 = 516$ Hz or 508 Hz

Frequency $\propto$ tension

Hence, the correct option is (1).

22. EM waves do not necessarily follow the property that both electric and magnetic field vectors are parallel to each other and perpendicular to the direction of the propagation of wave.

23. Focal length of the lens remains the same.

Intensity of the image formed is proportional to the area exposed to the incident light.

$\rightarrow$ Intensity $\propto$ Area

i.e., $\frac{I_2}{I_1} = \frac{A_2}{A_1}$ -------- (Equation 1)

In first case:

Area exposed, $A_1 = \left(\frac{d}{2}\right)^2 = \frac{\pi d^2}{4}$ --------- (Equation 2)

In the second case after blocking:

Area exposed, $A_2 = \frac{\pi d^2}{4} - \frac{\pi (d/2)^2}{4}$

$= \frac{\pi d^2}{4} - \frac{\pi d^2}{16} = \frac{3\pi d^2}{16}$

$\rightarrow A_2 = \frac{3\pi d^2}{16}$ --------- (Equation 3)

Substituting the values from equation (2) and (3) in equation (1), we get

$\frac{I_2}{I_1} = \frac{3\pi d^2}{16} \times \frac{4}{\pi d^2}$

$\frac{I_2}{I_1} = \frac{3}{4}$

Or, $I_2 = \frac{3}{4} I_1$

Or, $I_2 = \frac{3}{4} I$ ($\because I_1 = I$)

24. For total internal reflection, the angle of incidence must be greater than the critical angle.

i.e., $\sin i > \sin C$

where, C = Critical angle

But, $\sin C = \frac{1}{\mu}$

$\therefore \sin i > \frac{1}{\mu}$

Or, $\mu > \frac{1}{\sin i}$

i.e., $\mu > \frac{1}{\sin 45°}$

$\rightarrow \mu > \sqrt{2}$

Or, $\mu > 1.414$

Hence, the value of μ is 1.50.

25. According to Coulomb's law, the force of repulsion between the two positive ions each of charge q separated by a distance d is given by

$$F = \frac{1}{4\pi\varepsilon_0} \times \frac{(q)(q)}{d^2}$$

$$F = \frac{1}{4\pi\varepsilon_0} \times \frac{q^2}{d^2}$$

$$\therefore q^2 = 4\pi\varepsilon_0 F d^2$$

$$\rightarrow q = \sqrt{4\pi\varepsilon_0 F d^2} \text{ --------- (Equation 1)}$$

$\because q = ne$

$$\therefore n = \frac{q}{e}$$

Substituting the value of q from equation (1), we get

$$n = \frac{\sqrt{4\pi\varepsilon_0 F d^2}}{e}$$

$$\text{Or, } n = \sqrt{\frac{4\pi\varepsilon_0 F d^2}{e^2}}$$

26.

Flux is given as

$\phi = \vec{E}.\vec{A}$

where, A is the area though which the flux passes

$\phi = \vec{E}.\vec{A} = EA\cos 90° = 0$ --------- ($\because$ Here, $\vec{E} \perp$ Area vector)

27. For a series combination of capacitors, the total capacitance is

$C_s = \frac{C_1}{n_1}$ ---------(Equation 1)

$\therefore$ Total energy stored is given as

$U_s = \frac{1}{2}C_s(4V)^2$

$= \frac{1}{2}\left(\frac{C_1}{n_1}\right)(4V)^2$ ---------(From equation 1)

For parallel combination of capacitors, the total capacitance is given as

$C_p = n_2C_2$ ---------(Equation 3)

$\therefore$ Total energy stored is given as

$U_p = \frac{1}{2}C_sV^2$

$= \frac{1}{2}(n_2C_2)V^2$ ---------(From equation 3)

Here, given that $U_s = U_p$

$\therefore \frac{1}{2}\left(\frac{C_1}{n_1}\right)(4V)^2 = \frac{1}{2}(n_2C_2)V^2$

$\frac{16C_1}{n_1} = n_2C_2$

$\therefore C_2 = \frac{16C_1}{n_1n_2}$

28. When the two-way key is switched off, the current through R and X = 1 A.

Potential difference between the terminals 1 and 2 across resistor R is

$V_{12} = V_R = IR = kl_1$

$\therefore R = \frac{kl_1}{I}$

$\rightarrow R = kl_1$ --------- $(\because I = 1A)$

Potential difference between the terminals 1 and 3 across resistors R and X is

$V_{13} = V_R + V_X = I(R + X) = kl_2$

$\therefore R + X = \frac{kl_2}{I}$

$\rightarrow R + X = kl_2$ --------- $(\because I = 1A)$

Substituting the value of R, we get

$kl_1 + X = kl_2$

$\therefore X = kl_2 - kl_1$

$Or, X = k(l_2 - l_1)\Omega$

29. Given that

$G = 100\Omega$, $I_g = 30$ mA and $V = 30$ V

Resistance R required to be added is calculated as

$$R = \frac{V}{I_g} - G$$

$$= \frac{30\ V}{30 \times 10^{-3}\ mA} - 100 \text{ --------- } (\because I = 1A)$$

$$\therefore R = 1000 - 100 = 900\ \Omega$$

30. Kirchhoff's junction law is based on the conservation of charge, because it states that the algebraic sum of current entering or leaving as mode is zero, so statement (3) is correct.

Kirchhoff's loop rule is based on the conservation of energy, so statement (2) is correct.

Hence, the correct option is (1).

31. Here, P = 100 kW = 100×10^3 W and V = 125 V

We know that $P = V \times I$

$$\therefore I = \frac{P}{V} = \frac{100 \times 10^3\ W}{125\ V} = 800A$$

According to the Faraday's law of electrolysis, we get

$$m = ZIt$$

Substituting the values in the above equation, we get

$$m = \left(0.367 \times 10^{-6}\right) \times 800 \times 60$$

$$\therefore m = 17.61 \times 10^{-3} kg$$

32. The forces acting on opposite sides of the loop are equal in magnitude but opposite in direction.

Thus, if the force $\vec{F}$ acts on one side of the loop, then the force $-\vec{F}$ acts on the remaining side of the loop.

33. The charge q moves in circular motion. So, the current produced due to its motion is I = qf.

Magnetic field induction at the centre of the ring of radius R is

$$B = \frac{\mu_0 2\pi I}{4\pi R} = \frac{\mu_0 I}{2R} = \frac{\mu_0 qf}{2R}$$

34. Soft iron has low retentivity and low coercive force. It is a soft magnetic material, and hence, electromagnets are made of soft iron.

35. The time period T is

$$T = 2\pi\sqrt{\frac{1}{MB}}$$

$$\text{Or, } T \propto \frac{1}{\sqrt{B}}$$

$$\therefore \frac{T_2}{T_1} = \sqrt{\frac{B_1}{B_2}}$$

Here, $B_1 = 24\ \mu T$ and $T_1 = 2\ s$

$B_2 = 24\ \mu T - 18\ \mu T = 6\ \mu T$ and we have to find T_2

Substituting the given values in the above equation, we get

$$\frac{T_2}{2\ s} = \sqrt{\frac{24\ \mu T}{6\ \mu T}}$$

$$\therefore T_2 = (2\ s)\sqrt{\frac{24\ \mu T}{6\ \mu T}}$$

$$\therefore T_2 = 4\ s$$

36. Given that

B = 0.025 T, r = 2 cm = 2×10^{-2} cm

Here, the radius of the loop is made to shrink at a constant rate of 1 mms^{-1}.

i.e., $\frac{dr}{dt} = 1 \times 10^{-3}\ ms^{-1}$

Magnetic fluxlinked iwth the coil is given as

$\phi = BA\cos\theta$

$= B(\pi r^2)\cos 0°$

$\therefore \phi = B\pi r^2$ --------- (Equation 1)

Magnitude of the induced emf is given as

$$|\varepsilon| = \frac{d\phi}{dt}$$

$$|\varepsilon| = \frac{d(B\pi r^2)}{dt}$$

$$|\varepsilon| = B\pi 2r\frac{dr}{dt}$$

Substituting the given values, we get

$$|\varepsilon| = 0.025 \times \pi \times 2 \times 2 \times 10^{-2} \times 1 \times 10^{-3}$$

$$\therefore |\varepsilon| = \pi\ \mu V$$

37. Here, $V_1 = 300\ V = V_2$.

So, the given LCR circuit is in resonance.

The reading of 'V_3' will be the same as the peak value of the AC source, i.e. 220 V.

$\therefore V_R = 300\ V$

$Z = R = 100\Omega$

$$\text{Current } I = \frac{V}{Z} = \frac{220\ V}{100\ \Omega} = 2.2\ A$$

This is the reading of the ammeter.

38. Given that

$V_P = 220\ V$, $V_S = 440\ V$, $I_S = 2\ A$

Efficiency of the transformer = 80%

Efficiency of the transformer η is

$$\eta = \frac{\text{Output power}}{\text{Input power}}$$

$$\eta = \frac{V_S I_S}{V_P I_P}$$

$$\frac{80}{100} = \frac{440 \times 2}{220 \times I_P}$$

$$\therefore I_P = \frac{440 \times 2 \times 100}{220 \times 80}$$

$$\therefore I_P = 5\ A$$

39. For source S_1:

Given that $\lambda_1 = 5000$ Å,

Number of photons emitted per second $N_1 = 10^{15}$

Energy of each photon is

$$E_1 = \frac{hc}{\lambda_1} \text{ ---------(Equation 1)}$$

Power of source, $S_1 = P_1 = E_1 N_1$

$$\therefore P_1 = \frac{hcN_1}{\lambda_1} \text{ ---------(Equation 2)}$$

For source S_2:

Given that $\lambda_2 = 5100$ Å,

Number of photons emitted per second $N_2 = 1.02 \times 10^{15}$

Energy of each photon is

$E_2 = \frac{hc}{\lambda_2}$ ---------(Equation 3)

Power of source, $S_2 = P_2 = E_2 N_2$

$\therefore P_2 = \frac{hcN_2}{\lambda_2}$ ---------(Equation 4)

Dividing equation (2) by equation (4), we get

$$\frac{\text{Power of } S_2}{\text{Powerof } S_1} = \frac{P_2}{P_1} = \frac{\frac{hcN_2}{\lambda_2}}{\frac{hcN_1}{\lambda_1}}$$

$\therefore \frac{P_2}{P_1} = \frac{N_2\lambda_1}{N_1\lambda_2}$

$\rightarrow \quad = \frac{1.02\times10^{15}\times5000}{10^{15}\times5100} = \frac{51}{51} = 1$

40. When force on an electron due to the magnetic field is equal to the force on an electron due to the electric field, the beam remains undeflected.

Beu = eE

Or $u = \frac{E}{B}$ --------- (Equation 1)

If V is the potential difference between the anode and the cathode, then

$eV = \frac{1}{2}mu^2$

Or, $\Rightarrow \frac{u^2}{2V} = \frac{E^2}{2VB^2}$ --------- (From equation 1)

Specific charge on the cathode = $\frac{e}{m} = \frac{E^2}{2VB^2}$

41. Given that λ = 200 nm and ϕ_o = 5.01 eV

According to Einstein's photoelectric equation,

$eV_s = h\nu - \phi_o$

$eV_s = h\frac{c}{\lambda} - \phi_o$

where, V_s = Stopping potential

$eV_s = \frac{1240 \text{ eV nm}}{200 \text{ nm}} - 5.01 \text{ eV}$

=6.2 eV - 5.01 eV

=1.2 eV

Hence, the potential difference which must be applied to stop photoelectrons = $-V_s$ = 1.2 eV.

42. According to the activity law, we get

$R = R_o e^{-\lambda t}$

Here, $R_o = N_o$ counts per minute,

$R = \frac{N_o}{e}$ counts per minute and t = 5 minutes

Substituting the given values, we get

$\frac{N_o}{e} = N_o e^{-5\lambda}$

$e^{-1} = e^{-5\lambda}$

$\therefore \lambda = \frac{1}{5}$ per minute

At $t = T_{1/2}$, R reduces to $\frac{R_o}{2}$

$\therefore \frac{R_o}{2} = R_o e^{-\lambda T_{1/2}}$

$e^{\lambda T_{1/2}} = 2$

Taking natural logarithms on both the sides, we get

$\lambda T_{1/2} = \log_e 2$

Or, $T_{1/2} = \frac{\log_e 2}{\lambda} = \frac{\log_e 2}{(1/5)}$

$\therefore T_{1/2} = 5\log_e 2$ minutes

43.

Energy of hydrogen atom in the n^{th} orbit is given as

$E_n = \frac{Z^2}{n^2}(-13.6 \text{ eV})$

For hydrogen atom, Z = 1

$\therefore E_n = \frac{-13.6 \text{ eV}}{n^2}$

For ground state. n=1

$\therefore E_n = \frac{-13.6 \text{ eV}}{1^2} = -13.6 \text{ eV}$

For He^+ ion, Z=2

$E_n = \frac{4(-13.6 \text{ eV})}{n^2} = \frac{-54.4 \text{ eV}}{n^2}$

For first excited state, n=2

$\therefore E_n = \frac{-54.4 \text{ eV}}{(2)^2} = -13.6$

Hence, the energy in the He^+ ion in the first excited state is the same as that of the energy of the hydrogen atom in the ground state.

44. Given that

Mass defect = $\Delta M = 0.042\ u = 0.042 \times 931.5\ MeV/c^2 = 39.1\ MeV/c^2$

Binding energy $BE = \Delta Mc^2$

$= (39.1\ MeV/c^2)\ c^2$

$= 39.1\ MeV$

Binding energy per nucleon = $\frac{BE}{A} = \frac{39.1\ MeV}{7}$

$\therefore$ Binding energy per nucleon = 5.6 MeV

45. At the distance of closest approach, KE = PE.

$$\frac{1}{2}mv^2 = \frac{1}{4\pi\varepsilon_o}\frac{(2e)(Ze)}{r_o}$$

$$\text{Or, } r_o = \frac{1}{4\pi\varepsilon_o}\frac{2Ze^2}{\left(\frac{1}{2}mv^2\right)}$$

$$\therefore r_o \propto \frac{1}{m}$$

46. Given that

$R_i = 100\Omega$, $R_o = 200\Omega$ and voltage gain = 50

$$\text{Resistance gain} = \frac{R_o}{R_i} = \frac{200}{100} = 2\ \Omega$$

$$\text{Power gain} = \frac{(\text{Voltage gain})^2}{\text{Resistance gain}}$$

$$= \frac{50 \times 50}{2}$$

$\therefore$ Power gain = 1250

47. The electrical conductivity decreases with temperature and has a high melting point. Only metallic bonding has this kind of property.

48. An integrated circuit contains all electronic devices and can act as a complete electronic circuit. Hence, option (3) is correct.

49. Majority carriers in an n-type semiconductor are electrons and minority carriers are holes.

50. Boolean expression of the given logic gate is

$(A + B)\cdot C = Y$

Truth table:

The output Y is 1 for inputs A = 1, B = 0 and C = 1.

Hence, the correct option is (4).

A	B	C	(A + B)	(A + B)·C = Y
0	1	0	1	0
0	0	1	0	0
1	0	1	1	1
1	0	0	1	0

Chemistry

51. The number of particles carrying current per cm^3 decreases on dilution. As a result, the mobility of ions increases, which in turn increases the equivalent conductance of a strong electrolyte.

52.

$$\text{Molarity} = \frac{\text{Mass of solute(gms)}}{\text{gram molecular weight of solute}} \times \frac{1000}{\text{volume of solution(ml)}}$$

$$= \frac{25.3 \times 1000}{106 \times 250} = 0.955\text{M}$$

$Na_2CO_3 \rightarrow 2Na + CO_3^{-2}$

$= 2 \times 0.955$

So, for $Na^+ = 2 \times 0.955 = 1.910\,\text{M}$, for $CO_3^{-2} = 0.955\,\text{M}$

53. Solubility of their hydroxides in water increases with an increase in the atomic number.

54. Zr^{4+} and Hf^{4+} have similar ionic radii due to lanthanide contraction, i.e. imperfect shielding of one 4f electron by the other.

55. $pOH = pK_b + \log\frac{[B^-]}{[HB]}$ $\left[\because pOH = pK_b + \log\frac{[\text{salt}]}{[\text{Base}]}\right]$

$\Rightarrow pOH = -\log(10^{-10}) + \log 1 = 10 + 0 = 10$ ($\because$ concentration of $[B^-] = [HB]$)

$\therefore pH = 14 - 10 = 4$ [As pOH + pH = 14]

56. With addition of water, the concentration decreases; thus, vapour pressure increases.

57. $CH_3COOH \rightarrow CH_3COO^- + H^+$

$C - x \quad x \quad x$

$CH_3COONa \rightarrow CH_3COO^- + Na^+$

$0.2 \quad 0.2\ M \quad 0.2\ M$

$$K_a = \frac{[CH_3COO^-][H^+]}{[CH_3COOH]}$$

$[CH_3COOH] = C - x \approx C = 0.1M$

$[CH_3COO^-] = 0.2 + x \approx 0.2M$

$$\therefore [H^+] = \frac{K_a[CH_3COOH]}{[CH_3COO^-]}$$

$$= \frac{1.8 \times 10^{-5} \times 0.1}{0.2}$$

$[H^+] = 9 \times 10^{-6}$

58.

$$N_2O_{5(g)} \rightarrow 2NO_{2(g)} + \frac{1}{2}O_{2(g)}$$

$$-\frac{d[N_2O_5]}{dt} = \frac{1}{2}\frac{d[NO_2]}{dt} = \frac{2d[O_2]}{dt}$$

$$\frac{d[NO_2]}{dt} = \frac{-2d[N_2O_5]}{dt} = 2 \times 6.25 \times 10^{-3}$$

$= 1.25 \times 10^{-2}\ mol\ L^{-1}s^{-1}$

$$\frac{d[O_2]}{dt} = -\frac{1}{2}\frac{d[N_2O_5]}{dt}$$

$$= \frac{1}{2} \times 6.25 \times 10^{-3}$$

$= 3.125 \times 10^{-3}\ mol\ L^{-1}s^{-1}$

59.

$$\frac{1}{2}X_2 + \frac{3}{2}Y_2 \rightarrow XY_3$$

$$\Delta S^\circ = \sum S_P^\circ - \sum S_R^\circ = 50 - \left(\frac{1}{2} \times 60 + \frac{3}{2} \times 40\right)$$

$= 50 - (30 + 60)$

$\Delta S^\circ = -40\ JK^{-1}\ mol^{-1}$

$$T = \frac{\Delta H^\circ}{\Delta S^\circ} = \frac{-30 \times 10^3\ J\ mol^{-1}}{-40\ JK^{-1}mol^{-1}} = 750K$$

60.

$$\frac{7\cdot2\times10^{-2}}{2\cdot88\times10^{-1}}=\frac{[0\cdot2]^b[0\cdot3]^a}{[0\cdot4]^b[0\cdot3]^a}$$

$$\therefore \frac{1}{4}=\frac{1}{2^b}$$

$$2^b = 2^2$$

$$b = 2$$

$$\frac{6\times10^{-3}}{2.4\times10^{-2}}=\frac{[0.1]^a[0.1]^b}{[0.4]^a[0.1]^b}$$

$$\frac{1}{4}=\frac{1}{4^a}$$

$$4^1 = 4^a$$

$$a = 1$$

Thus, rate = $k[A]^a[B]^b = k[A][B]^2$

61.

$$Cu + 2Ag^+ \rightarrow Cu^{+2} + 2Ag$$

The standard Gibbs energy change (ΔG°) is given by

$\Delta G^\circ = -nFE^\circ = -2 \times 96500 \times 0.46$

$= -88780J$

$\approx -89kJ$

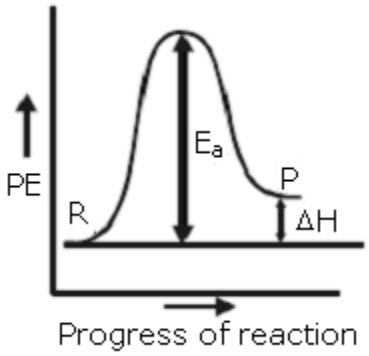
62. Bond order of Be_2 is zero. So, it does not exist under normal conditions.

63.

$$2(r^+ + r^-) = \sqrt{3}a$$

$$\Rightarrow r^+ + r^- = \frac{\sqrt{3}\times387}{2} = 335\,pm$$

64.



From the above graph, we observe that the minimum value of E_a will be more than ΔH.

65.

$Co = [Ar]3d^7 4s^2$

$\therefore\ Co^{+3} = [Ar]3d^6$

66. The relation between K_p and K_c is given by $K_p = K_c(RT)^{\Delta n}$, Δn = no. of moles of gaseous products − no. of moles of gaseous reactants.

$\Delta n = 2 - 1 = 1, >0$ for the reaction

$2C_{(s)} + O_{2(g)} \rightarrow 2CO_{2(g)}$

Thus, $K_p \neq K_c$

67.

$pH = 12$, so $pOH = 2$

[As pOH + pH = 14]

$\therefore\ [OH^-] = 10^{-2}$

$Ba(OH)_2 \rightarrow Ba^{+2} + 2OH^-$

$\quad\quad\quad\quad\quad\quad S \quad\quad 2S$

$2S = 10^{-2}$

$S = \dfrac{10^{-2}}{2} = 5 \times 10^{-3} M$

$K_{sp} = [Ba^{+2}][OH^-]^2$

$= [5 \times 10^{-3}][10^{-2}]^2$

$K_{sp} = 5 \times 10^{-7} M^3$

68. $Ti^{3+} = 3d^1$; Ti^{3+} contains an unpaired electron. So, it will exhibit colour in aqueous solution.

69. The correct order of increasing bond angles in the given species is

$ClO_2^- < Cl_2O < ClO_2$

Bond angle decreases due to repulsion between 1p and 1p as the number of lone pairs of electrons increases. Also, as the electronegativity of the central atom decreases, the bond angle decreases.

70. In peroxides, the oxidation state of O is −1.

In BaO_2, $+2 + (x \times 2) = 0$

$x = -1$

BaO_2 has peroxide linkage. So, BaO_2 is peroxide.

71. BF_3 and NO_2^- are sp^2 hybridised, while NH_2^-, NH_3 and H_2O are sp^3 hybridised.

72. Among isoelectronic species, ionic radii increase with an increase in negative charge as Z_{eff} decreases, and ionic radii decrease with an increase in positive charge as Z_{eff} increases. So, option (4) is the correct order.

73. Number of atoms = $N_A \times$ mole $\times 3$
$= 6.023 \times 10^{23} \times 0.1 \times 3$
$= 1.806 \times 10^{23}$

74. $[Ni(CN)_4]^{2-}$ does not contain any unpaired electrons. So, it cannot absorb visible light.

75. Hydration enthalpy varies inversely with size. In the sulphates of alkaline earth metals, the lattice energy remains almost constant. The order of size of alkaline earth metals is

$Be^{2+} < Ca^{2+} < Sr^{2+} < Ba^{2+}$

The order of hydration energy is

$Be^{2+} > Ca^{2+} > Sr^{2+} > Ba^{2+}$

Hence, $BeSO_4$ has hydration enthalpy higher than lattice enthalpy.

76. The existence of two different coloured complexes with the composition of $[Co(NH_3)_4Cl_2]^+$ is due to geometrical isomerism. Both compounds exist as cis and trans forms.

77. $H_4P_2O_5$: $2x = 6$
$x = 3$
$H_4P_2O_6$: $2x = 8$
$x = 4$
$H_4P_2O_7$: $2x = 10$
$x = 5$

78. $p\pi - p\pi$ back bonding decreases in the order $BBr_3 > BCl_3 > BF_3$.

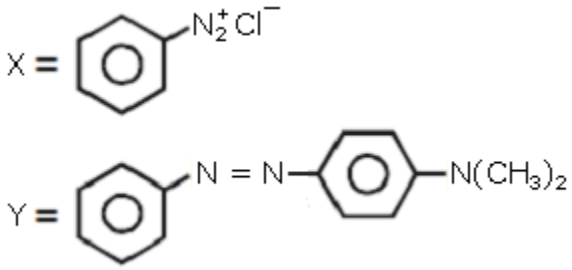
79. The order of enthalpy is O < S < F < Cl because electron gain enthalpy depends on electronegativity and size of the elements.

80. $3(-0.4) + 1(0.6)$
$= -0.6\ \Delta_o$

81. PCl_5 – sp^3d, SF_4 – sp^3d, I^{3-} – sp^3d, $SbCl_5^{2-}$ – sp^3d^2

82. A substance which can accept an electron pair to form a coordinate covalent bond with a donor is called a Lewis acid. B_2H_6 is e^- deficient and hence acts as a Lewis acid.

83.



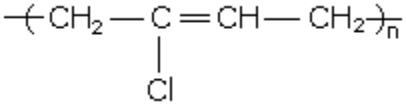
84. Cl_2 in the presence of $FeCl_3 \rightarrow$ Ring substitution
X = o-and p-chlorotoluene
Cl_2 in the presence of light $\rightarrow$ Side chain substitution
Y = trichloromethyl benzene

85. When an alkane is heated to high temperature in the absence of air, pyrolysis occurs and a mixture of lower hydrocarbons and H_2 is produced. This process is called cracking.

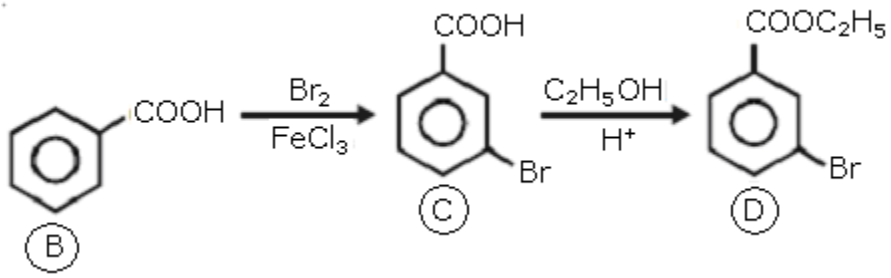
86. Tranquillisers are drugs essentially used in the management and treatment of psychoses and neuroses. *Valium* (diazepam) is a tranquilliser. *Valium* is a benzodiazepine. It is used to relieve anxiety and to provide sedation and light anaesthesia.

87. The spontaneous change in the specific rotation of an optically active compound is called mutarotation. Because of the absence of hemiacetal linkage, (+) sucrose does not exhibit mutarotation.

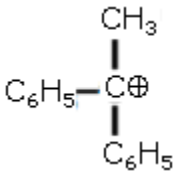
88. Neoprene is a polymer. Chloroprene is a monomer.



89.



90.

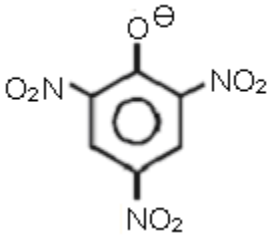


The carbocation is the most stable.

91. Because of greater e^--releasing effect of –OH, it activates the ring towards electrophilic substitution and is therefore more reactive towards electrophilic reagent.

92. Phenoxide ions are more resonance stabilised and thus release a proton more easily and are therefore more acidic.

93.



2,4,6-trinitrophenol has maximum resonance stabilisation and maximum –I and –M effect due to three $-NO_2$ groups; therefore, it is more acidic than CH_3COOH.

94. Aryl amines react with nitrous acid to form diazonium salt.

95. Hofmann bromamide reaction.

96. Cannizzaro reaction: Aldehydes which have no α–hydrogen atom undergo this reaction involving disproportionation (self-oxidation and reduction) on treating with conc. alkali.

97. The conformation of n-butane is most stable because the heavier groups in it are present at maximum possible distance.

98. Based on carbocation stability.
Alkyl halides (3° > 2°) are more reactive than aryl halides towards nucleophilic substitution.

99. Cl^- is a weak base and therefore is a good leaving group. So, CH_3COCl is the most susceptible to nucleophilic attack.

100. $\Delta T_f = K_f m$
$\Delta T_f = 1.86 \times 68.5/342 = 0.372°C$
$\Delta T_f = T_o - T_s$
$\Delta T_f = 0 - 0.372 = -0.372\ °C$

Biology

101. A capsid is the protein shell of a virus. It consists of several oligomeric structural subunits made of protein called protomers. It encloses the genetic material of the virus. Capsids are broadly classified according to their structure. The majority of viruses have capsids with either helical or icosahedral structure.

102. Eubacteria such as blue-green algae (*Synechococcus*, *Phormidium*) and thermoacidophiles (Archaebacteria) are environmentally tough. They can withstand the acidic environment.

103. A proteinaceous infectious particle, or prion, is an infectious agent composed primarily of protein. Prions are the cause of several diseases in a variety of mammals, including bovine spongiform encephalopathy (BSE, also known as 'mad cow disease') in cattle and Creutzfeldt–Jakob disease (CJD) in humans. In general usage, the prion refers to the theoretical unit of infection. All known prion diseases affect the structure of the brain or other neural tissue and all are currently untreatable and universally fatal.

104. Pteridophytes show alternation of generation in which gametophyte and sporophyte alternate with each other. The gametophytic generation is represented in the form of a prothallus which later on forms an independent and free-living gametophyte. However, gametophytes are highly reduced in gymnosperms and angiosperms.

105. Single-celled eukaryotes are included in Protista. The term Protista was proposed by E. Heckle.

106. Fasciola belongs to Phylum Platyhelminthes. These worms have an incomplete alimentary canal and there is a single opening both for ingestion and egestion. This is also called a blind sac body plan. In Octopus and Asterias, the alimentary canal is complete.

107. Spongilla belongs to Phylum Porifera, in which the characteristic cells are choanocytes. These are absent in Leech, Dolphin and Penguin.

108. Flatworms are triploblastic and acoelomate, whereas sponges have a cell aggregate type of body plan, and ctenophores and corals are diploblastic.

109. Roundworms are (Aschelminthes) and pseudocoelomate, whereas flatworms are acoelomate, and molluscs and insects are coelomate.

110. According to the fluid mosaic model, the plasma membrane consists of proteins and lipids. Proteins are found embedded in a phospholipid bilayer. This is the most accepted model of the plasma membrane.

111. Plasmodesmata are present in between two adjacent cells. They are a category of gap junctions in plants and are an effective transport pathway.

112. Mitochondria are semiautonomous organelles because of the presence of circular DNA and 70S ribosomes. They synthesise the requisite mitochondrial proteins.

113. The nucleus is the centre of all vital or metabolic activities. It contains genetic material which through transcription ensures the proteinaceous requirements of the cell.

114. Disappearance of the nuclear membrane and the nucleolus begins in the early prophase, and thus, these are not observed in the late prophase.

115. The cell wall in algae is made of cellulose, galactans and mannans. It provides strength, rigidity and smoothness for aquatic life.

116. Prokaryotes lack membrane-bound organelles such as mitochondria and Golgi bodies. An organised nucleus is also absent, and the genetic material is in the form of a genophore.

117. Blood vessels are lined with simple squamous epithelium. This epithelium is present where diffusion and filtration take place.

118. Figure 'A' is anaphase which is marked by the presence of chromatids at the two poles. Figure 'B' is early prophase where nuclear membrane and nucleolus are intact and there is a separation of centrioles.

119. In Mendel's law of inheritance, there is no mixing of alleles. Alleles do not show any blending and both characters recover as such in the F2 generation.

120. The test cross is preferred to determine the genotype of F1. Here, an F1 is crossed with the homozygous recessive parent. When offspring are produced in the ratio of 1:1, it confirms that the F1 is heterozygous in genotypic constitution.

121. Codons are specific in their coding behaviour and they always code for the same amino acid. Hence, genetic codes are non-ambiguous. However, GUG is an exception to it. It codes for both methionine and valine.

122. Satellite DNA regions such as VNTR/RFLP are the basis of DNA fingerprinting. Each human being has specific VNTR which is utilised in confirming his identity.

123. HIV belongs to the retrovirus group which shows reverse central dogma or reverse transcription. Here, through reverse transcription, mRNA forms DNA which later on forms RNA. Finally, such RNA forms protein during translation.

124. The ABO blood group system is an example of multiple alleles in which three alleles determine the blood groups. The three alleles are IA, IB and i. IA and IB are co-dominant among themselves and individually they are dominant to i. They together form six genotypes and four phenotypes (A, B, AB and O).

125. In linkage, genes tend to inherit together. If the two genes are placed very close to each other, there is very little chance of crossing over in between them. As a result, very few recombinants are formed.

126. The operon concept was given by Jacob and Monad. In lac operon, lactose acts as the inducer. In the absence of lactose, the repressor binds with the operator region and the operon is off. When lactose binds with repressor protein, the operon turns on, and thus, it exerts negative control.

127.
(1) Unspecified sex
(2) Unaffected female
(3) Unaffected male

128. Darwin's finches are a good example of adaptive radiation. It is an evolutionary process starting from a point in a geographical area and giving rise to a new species depending on the habitat. Darwin's finches were mainly in South America, some flew to Galapagos Islands and some variations got selected and gave rise to new species.

129. The scutellum observed in a grain of wheat or maize is comparable to a single shield-shaped cotyledon in monocots. It is nutritive in function.

130. Macronutrients are essential nutrients which together provide the most metabolic energy and plants cannot survive in their absence. Some macronutrients are nitrogen, phosphorus, potassium and magnesium.

131. Nitrogen fixation is carried out by nitrogenase enzyme. It is made of two complexes—Mo–Fe and Fe–S.

132. Apical and intercalary meristems are primary meristems. The apical meristem is present at the apical portion of the plant, and the intercalary meristem is a leftover tissue of the primary meristem.

133. C4 plants are more efficient than C3 plants because of the absence of photorespiration. C4 plants are known for Kranz anatomy which ensures that oxygenase activity of RuBisCO is nil. As a result, the fixation of carbon occurs more efficiently in comparison to C3 plants.

134. Unilocular ovary with a single ovule is associated with advance types of placentation. It occurs in Family Asteraceae and Family Poaceae.

135. The chief water-conducting elements of the xylem in gymnosperms are tracheids. The presence of vessels is an angiospermic character; hence, they are absent in pteridophytes and gymnosperms.

136. China rose family shows cohesion of stamens by the union of filaments into a single bundle, known as monadelphous.

137. The ovary is half-inferior in the flowers of Family Rosaceae. It occurs in the flowers of the rose and plum families.

138. Heartwood differs from sapwood in having dead and non-conducting elements. It becomes dead because of the formation of tyloses which block the conduction of water. Later, over a period of time, it becomes a solid dead column of wood.

139. Keel is a characteristic of the flowers of Family Papilionaceae. It is the anterior shortest petal.

140. Rhodospirillum is a free-living anaerobic nitrogen fixer. Others are aerobic nitrogen fixers.

141. Calvin worked on Chlorella and Scenedesmus through the radio-autographic technique to find the pathway of the dark reaction.

142. The energy-releasing metabolic process in which the substrate is oxidised without an external electron acceptor is called fermentation. $NADH_2$ produced during glycolysis in used in the reduction of pyruvate in fermentation.

143. In 1920, W. W. Garner and H. A. Allard discovered a mutation in the tobacco variety Maryland Mammoth which prevented the plant from flowering in the summer as normal tobacco plants do. Maryland Mammoth would not bloom until late December.

Experimenting with artificial lighting in winter and artificial darkening in summer, they found that Maryland Mammoth was affected by photoperiod. Because it would flower only when exposed to short periods of light, they called it a short-day plant.

144. Inspiratory capacity is TV + IRV = 3500 ml and residual volume is 1200 ml.

145. About 97% of O_2 is transported by RBCs in the blood. The remaining 3% of O_2 is carried in the dissolved state through the plasma. Nearly 20–25% of CO_2 is transported by RBCs, whereas 70% of it is carried as bicarbonates.

146. If because of injury the chordae tendineae of the tricuspid valves of human heart is partially non-functional, the flow of blood into the pulmonary artery is reduced because of the backflow of blood into the right atrium.

147. A comparison of the volume of filtrate formed per day (180 litre) with urine released (1.5 litre) suggests that nearly 99% of the filtrate is reabsorbed by the renal tubules.

148. Tetany is rapid spasms (wild contraction) in muscles due to low Ca^{2+} in the body fluid. Low plasma calcium increases the permeability of neuronal membranes to sodium ions, causing progressive depolarisation. This increases the ease with which action potentials can be initiated. If the plasma Ca^{2+} decreases to less than 50% of the normal value of 9.4 mg/dl, action potentials may be spontaneously generated, causing contraction of peripheral skeletal muscles.

149. Goblet cells present in the intestine secrete mucous. Mucous will help in smooth movement of food down the intestine. Hence, if goblet cells are non-functional, the movement of food will be adversely affected.

150. Hypothalamus is the thermoregulatory centre. It also contains the hunger and thirst centre.

151. Vasa efferentia are ducts which carry the sperms outside the testis, i.e. from rete testis to vas deferens.

152. The first movement of the foetus and the appearance of hair are observed during the fifth month of pregnancy.

153. The copper ions released from copper-releasing IUDs suppress sperm motility and the fertilising capacity of sperms.

154. Carrier ions such as Na^+ facilitate participates in the process of facilitated transport. They help in the absorption of substances such as fructose and some amino acids.

155. Glucagon hormone is secreted by alpha cells of the pancreas and beta cells secrete insulin.

156. The principal nitrogenous compound in humans is urea, synthesised in the liver and eliminated by the kidneys.

157. If the adrenal cortex is injured, it will not affect the secretion of adrenaline, which is secreted by the adrenal medulla.

158. The acrosome is a cap-like structure present in the sperm head. It is a modified Golgi apparatus and secretes sperm lysins, which are enzymatic in nature. It helps in breaking the ovum barrier or zona pellucida during fertilisation.

159. Coiling of garden pea tendrils around any support is an example of thigmotropic movement. It is a paratonic growth movement due to touch stimulus.

160. Apomictic embryos in citrus arise from maternal sporophytic tissue in the ovule. It is a type of sporophytic budding or adventive embryony.

161. Wind-pollinated flowers are small, producing a large number of dry pollen grains. These are colourless, odourless and nectarless flowers.

162. Phototropic curvature is the result of uneven distribution of auxin. Here, cell elongation occurs on the darker side resulting in the bending of the stem or phototropic movement.

163. The transfer of pollen grains from the anther to the stigma of another flower of the same plant is called geitonogamy. Genetically, it is self-pollination, but functionally, it is cross-pollination.

164. Seminal plasma in humans is the secretion of accessory glands. It is rich in fructose, calcium and some enzymes.

165. Sertoli cells, also called nurse cells, are present in seminiferous tubules. They provide nourishment to the developing sperms.

166. The part of the fallopian tube closest to the ovary is the infundibulum. The function of the infundibulum is to take up the developing ovum from the abdominal cavity released by the ovaries.

167. ZIFT is an example of IVF in which the zygote or early embryo up to the 8 blastomere stage are transferred into the fallopian tube. If the embryo is more than 8 blastomeres, then it is transferred into the uterus called IUT.

168. The permissible use of the technique amniocentesis is for detecting any genetic abnormality. The technique, however, is misused for the detection of sex of the foetus.

169. The signals for parturition originates from the foetus and placenta, leading to mild uterine contractions called foetal ejection reflex.

170. The biomass available for consumption by herbivores and decomposers is called net primary productivity. It is the stored biomass which is transferred from one trophic level to the other trophic level.

171. Sex ratio, natality and mortality are characteristics of population. Stratification, on the other hand, is a structural component of biological community.

172. Conservation practices carried out in artificial condition are known as *ex situ* conservation. The seed bank is an example of *ex situ* conservation. Others are *in situ*/on site conservation strategies.

173. Coal and petroleum – Non-renewable and exhaustible
Minerals – Renewable and inexhaustible

174. CO_2 – 60% global warming/greenhouse effect
CH_4 – 20% global warming/greenhouse effect

175. The activated sludge–sediment in settlement tanks of a sewage treatment plant is a rich source of aerobic bacteria. The process is mostly carried out by anaerobes such as methanogens.

176. When a person moves to higher altitudes, the pO_2 and total atmospheric pressure decrease. Hypoxia stimulates the JG cells of the kidneys to release erythropoietin hormone which stimulates erythropoiesis in the bone marrow causing polycythaemia. Hypoxia will also increase the breathing rate. Initially, the size of RBCs will increase, but later, the size of RBCs becomes normal. There is also increase in the number of RBCs.

177. Decibel (dB) is the standard abbreviation used for the quantitative expression of noise pollution measurement.

178. Carnivores (lion) and herbivores (sparrow) are consumers; hence, a lion eating a deer and a sparrow feeding on grain are ecologically similar in being consumers.

Pisaster controls prey population and reduces competition among prey species.

179.

a. Regulators – Mammals and birds
b. Conformer – All plants and 99% animals
c. Partial regulator – Certain plants and animals

180. The Widal test is used for the diagnosis of typhoid.

181. The term ringworm or ringworms refers to fungal infections on the surface of the skin. The most common of the dermatophyte fungi include *Trichophyton rubrum*, *T. tonsurans*, *T. Interdigitale*, *T. mentagrophytes*, *Microsporum canis* and *Epidermophyton floccosum*.

182. Glomus – Endomycorrhiza
Oscillatoria – BGA
Earthworm
All are biofertilisers and help in organic farming. However, the snail plays no role in being a biofertiliser.

183. Several strains of *Trichoderma* have been developed as biocontrol agents against fungal diseases of plants. The various mechanisms include antibiosis, parasitism, inducing host-plant resistance and competition. Most biocontrol agents are from the *Trichoderma* species *T. harzianum*, *T. viride* and *T. hamatum*.

184. The common nitrogen-fixer in paddy fields is *Azospirillum*. *Azospirillum lipoferum* is a very useful soil and root bacterium. It is an associative symbiotic nitrogen-fixing bacterium. It is found in the soil around plant roots and the root surface. When *A. lipoferum* is added to the soil, it multiplies in millions and can supply 20–40 kg of nitrogen per hectare per season. It also produces growth-promoting substances such as indole acetic acid (IAA) and gibberellins, and promotes root proliferation. It increases rootlet density and root branching, resulting in the increased uptake of mineral and water.

185. Kidney transplant is an allograft. As no two individuals have the same HLA alleles or MHC proteins except identical twins, the person requires immunosuppressant drug (e.g. cyclosporin) throughout life. CMI, i.e. T-cell-mediated immunity, is responsible for graft rejection.

186. Human immunodeficiency virus (HIV) causes weakness of the immune system. When it infects the body, it prefers to attack certain cells of the defence system. These cells are called helper T cells which are a fundamental part of the immune system. The

helper T cells have CD4 molecules on the surface to which HIV binds. As a result, the number of helper T cells is depleted.

187. Morphine is a narcotic drug obtained from opium. It interacts predominantly with the μ-opioid receptor in the central nervous system. Its primary actions of therapeutic value are analgesia and sedation; hence, it is frequently given to patients after surgery.

188. Toxic agents in food which interfere with thyroxine synthesis will lead to simple goitre. Thyrotoxicosis and toxic goitre are under the category of hyperthyroidism.

189. The second maturation division of the mammalian ovum occurs after the penetration of the ovum by sperm.

190. Cleavage divisions are mitotic divisions in which the single-celled zygote is converted to a multicellular morula. However, during cleavage divisions, there is no growth of resultant daughter cells/blastomeres. So, the DNA content will increase, but there is no increase or insignificant increase in the amount of protoplasm.

191. Stirred-tank bioreactors are aerobic reactors. They have been designed in a way that oxygen remains available throughout the process. Availability of oxygen is ensured by regular stirring of liquids inside the tank.

192. Biofortification is a method of breeding crops to increase their nutritional value. This can be done either through conventional selective breeding or through genetic engineering. Biofortification differs from ordinary fortification because it focuses on making plant foods more nutritious as the plants are growing rather than having nutrients added to the foods when they are being processed.

193. The DNA/RNA segment tagged with a radioactive molecule is called a probe. DNA probe, for instance, is a single-stranded DNA molecule used in laboratory experiments to detect the presence of a complementary sequence among a mixture of other singled-stranded DNA molecules.

194. Retroviruses are used as vectors. A retrovirus is any virus belonging to the viral Family Retroviridae. All the genetic material in retroviruses is in the form of RNA molecules, while the genetic material of their hosts is in the form of DNA. When a retrovirus, disarmed of its pathogenic qualities, infects a host cell, it will introduce its RNA together with some enzymes into the cell. It is utilised in gene therapy.

195. GM brinjal has been developed for insect resistance. It is actually Bt brinjal with Bt toxin gene for the production of Bt toxins. Bt brinjal has the gene from *Bacillus thuringiensis*, a common soil bacterium which is widely used to develop GM crops.

196. Because the first gene transfers into mice were successfully executed in 1980, transgenic mice have allowed researchers to observe experimentally what happens to an entire organism during the progression of a disease. Transgenic mice have become models for studying human diseases and their treatments.

197. A restriction endonuclease is an enzyme which cuts double-stranded or single-stranded DNA at specific recognition nucleotide sequences known as restriction sites. Such enzymes, found in bacteria and Archaea, are thought to have evolved to provide a defence mechanism against invading viruses. Restriction endonucleases are now widely used in recombinant DNA technology.

198. Bt cotton shows resistance to cotton bollworms. The proteins encoded by cryIIAb and cryIAc are used to control cotton bollworms. These proteins have no effect on dipterans such as mosquitoes and flies, which do not attack cotton plant.

199. Transgenic basmati rice, called golden rice, is a variety of *Oryza sativa* produced through genetic engineering to biosynthesise beta-carotene, a precursor of pro-vitamin A in the edible parts of rice.

200. In DNA, the palindromic sequence is a sequence of base pairs which read identically from both ends. Restriction enzymes normally act on the palindromic sequences.
Example: 5′ GAATTC 3′
3′ CTTAAG 5′

AIPMT - 2010
(Physics, Chemistry and Biology)
Mains (Code C)

Time: 3 hrs **Total Marks: 480**

General Instructions:

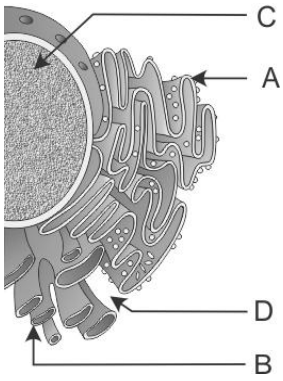
1. The Answer sheet is inside this Text booklet. When you are directed to open the text booklet, take out the Answer Sheet and fill in the particulars on side – 1 and side – 2 carefully with blue/black ball point pen only.
2. The test is of 3 hours duration and consists of 120 questions. Each question carries 4 marks. For each correct response the candidate will get 4 marks. For each incorrect response, one mark will be deducted. The maximum marks are 480.
3. Use Blue / Black ball point pen only for writing particulars on this page / marking responses.
4. Rough work is to be done on the space provided for this purpose in the text booklet only.
5. On completion of the test, the candidate must handover the answer sheet to the invigilator in the room/ Hall. The candidates are allowed to take away this text booklet with them.
6. Make sure that the CODE printed on side – 2 of the answer sheet is the same as that on this booklet, In case of discrepancy, the candidate should immediately report the matter to the invigilator for the replacement of both the test Booklet and the Answer Sheet.
7. The candidates should ensure that the Answer sheet is not folded. Do not make any stray marks on the Answer sheet. Do not write your roll no. anywhere else except in the specified space in the Test booklet / Answer Sheet.
8. Use of white fluid for correction is not permissible on the Answer Sheet.

Biology

1. Which one of the following pairs of structures is correctly matched with their correct description?

Structures	Description
(1) Tibia and fibula	Both form parts of knee joint
(2) Cartilage and cornea	No blood supply but do require oxygen for respiratory need
(3)Shoulder joint and elbow joint	Ball and socket type of joint
(4) Premolars and molars	20 in all and 3– rooted

2. Identify the components labelled A, B, C and D in the diagram below from the list (i) to (viii) given along with



Components:

(i) Cristae of mitochondria
(ii) Inner membrane of mitochondria
(iii) Cytoplasm
(iv) Smooth endoplasmic reticulum
(v) Rough endoplasmic reticulum
(vi) Mitochondrial matrix
(vii) Cell vacuole
(viii) Nucleus

The correct components are:

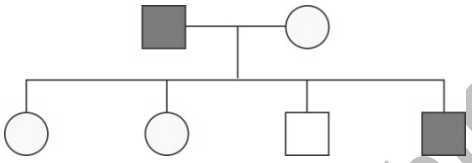
	A	B	C	D
(1)	(v)	(iv)	(viii)	(iii)
(2)	(i)	(iv)	(viii)	(vi)
(3)	(vi)	(v)	(iv)	(vii)
(4)	(v)	(i)	(iii)	(ii)

3. Fastest distribution of some injectable material/medicine and with no risk of any kind can be achieved by injecting it into the

(1) Muscles
(2) Arteries
(3) Veins
(4) Lymph vessels

4. Which one of the following statements about the particular entity is true?
(1) Centromere is found in animal cells, which produces aster during cell division
(2) The gene for producing insulin is present in everybody cell
(3) Nucleosome is formed of nucleotides
(4) DNA consists of a core of eight histones

5. Study the pedigree chart of a certain family given below and select the correct conclusion which can be drawn for the character

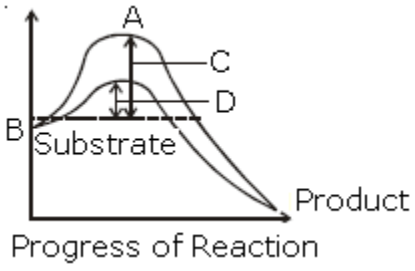


(1) The female parent is heterozygous
(2) The parents could not have had a normal daughter for this character
(3) The trait under study could not be colour blindness
(4) The male parent is homozygous dominant

6. Leguminous plants are able to fix atmospheric nitrogen through the process of symbiotic nitrogen fixation. Which one of the following statements is not correct during this process of nitrogen fixation?
(1) Leghaemoglobin scavenges oxygen and is pinkish in colour
(2) Nodules act as sites for nitrogen fixation
(3) The enzyme nitrogenase catalyses the conversion of atmospheric N_2 to NH_3
(4) Nitrogenase is insensitive to oxygen

7. Which one of the following is a xerophytic plant in which the stem is modified into the flat green and succulent structure?
(1) Opuntia
(2) Casuarina
(3) Hydrilla
(4) Acacia

8. The figure given below shows the conversion of a substrate into product by an enzyme. In which one of the four options (1–4) the components of reaction labelled as A, B, C and D are identified correctly?



	A	B	C	D
(1)	Potential Energy	Transition State	Activation energy with enzyme	Activation energy without enzyme
(2)	Transition State	Potential Energy	Activation energy without enzyme	Activation energy with enzyme
(3)	Potential Energy	Transition State	Activation energy with enzyme	Activation energy without enzyme
(4)	Activation energy with enzyme	Transition State	Activation energy without enzyme	Potential energy

9. Which of the following are used in gene cloning?
(1) Nucleoids
(2) Lomasomes
(3) Mesosomes
(4) Plasmids

10. When domestic sewage mixes with river water
(1) Small animals like rats will die after drinking river water
(2) The increased microbial activity releases micronutrients such as iron
(3) The increased microbial activity uses up dissolved oxygen
(4) The river water is still suitable for drinking as impurities are only about 0.1%

11. Given below are four statements (A-D) each with one or two blanks. Select the option which correctly fills up the blanks in two statements

Statements:

(A) Wings of butterfly and birds look alike and are the results of (i)_____evolution.
(B) Miller showed that CH_4, H_2, NH_3 and (i)_____, when exposed to electric discharge in a flask resulted in formation of (ii)_____.
(C) Vermiform appendix is a (i)_____ organ and an (ii)_____ evidence of evolution.
(D) According to Darwin evolution took place due to (i)_____ and (ii)_____ of the fittest.

(1) (D) – (i) Small variations, (ii) Survival,
(A) – (i) Convergent
(2) (A) – (i) Convergent,

(B) – (i) Oxygen, (ii) nucleosides
(3) (B) – (i) Water vapour, (ii) Amino acids
(C) – (i) Rudimentary, (ii) Anatomical
(4) (C) – (i) Vestigial, (ii) Anatomical
(D) – (i) Mutations, (ii) Multiplication

12. Aestivation of petals in the flower of cotton is correctly shown in

(1)

(2)

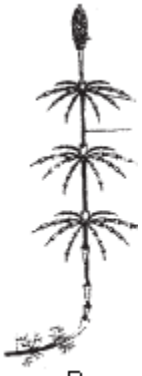
(3)

(4)

13. In which one of the following organisms its excretory organs are **correctly** stated?
(1) Humans – Kidneys, sebaceous glands and tear glands
(2) Earthworm – Pharyngeal, integumentary and septal nephridia
(3) Cockroach – Malpighian tubules and enteric caeca
(4) Frog – Kidneys, skin and buccal epithelium

14. Examine the figures A, B, C and D. In which one of the four options all the items A, B, C and D are correct?


A


B


C


D

	A	B	C	D
(1)	Chara	Marchantia	Fucus	Pinus
(2)	Equisetum	Ginkgo	Selaginella	Lycopodium
(3)	Selaginella	Equisetum	Salvinia	Ginkgo
(4)	Funaria	Adiantum	Salvinia	Riccia

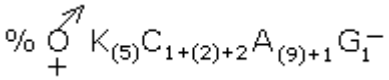
15. The most apparent change during the evolutionary history of *Homo sapiens* is traced in

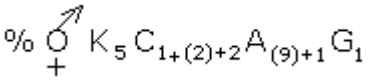
(1) Loss of body hair
(2) Walking upright
(3) Shortening of the jaws
(4) Remarkable increase in the brain size

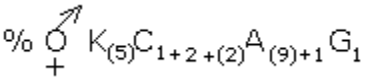
16. Which one of the following is now being commercially produced by biotechnological procedures?

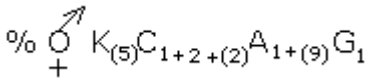
(1) Nicotine
(2) Morphine
(3) Quinine
(4) Insulin

17. The correct floral formula of soybean is

(1) 

(2) 

(3) 

(4) 

18. If for some reason the parietal cells of the gut epithelium become partially non-functional, what is likely to happen?

(1) The pancreatic enzymes and specially the trypsin and lipase will not work efficiently
(2) The pH of stomach will fall abruptly
(3) Steapsin will be more effective
(4) Proteins will not be adequately hydrolysed by pepsin into proteoses and peptones

19. Which one of the following is most appropriately defined?

(1) Host is an organism which provides food to another organism
(2) Amensalism is a relationship in which one species is benefited whereas the other is unaffected
(3) Predator is an organism that catches and kills other organism for food
(4) Parasite is an organism which always lives inside the body of other organism and may kill it

20. Read the following four statements, A, B, C and D and select the right option having both correct statements.

STATEMENTS:

(A) Z scheme of light reaction takes place in presence of PSI only.
(B) Only PS I is functional in cyclic photophosphorylation.
(C) Cyclic photophosphorylation results into synthesis of ATP and NADPH2
(D) Stroma lamellae lack PS II as well as NADP.

(1) B and D
(2) A and B
(3) B and C
(4) C and D

21. Which one of the following techniques is safest for the detection of cancers?
(1) Magnetic resonance imaging (MRI)
(2) Radiography (X-ray)
(3) Computed tomography (CT)
(4) Histopathological studies

22. Signals from fully developed foetus and placenta ultimately lead to parturition which requires the release of
(1) Estrogen from placenta
(2) Oxytocin from maternal pituitary
(3) Oxytocin from foetal pituitary
(4) Relaxin from placenta

23. Select the correct matching of a hormone, its source and function.

	Hormone	Source	Function
(1)	Vasopressin	Posterior Pituitary	Increases loss of water through urine
(2)	Norepinephrine	Adrenal Medulla	Increases heart beat, rate of respiration and alertness
(3)	Glucagon	Beta-cells of Islets of Langerhans	Stimulates glycogenolysis
(4)	Prolactin	Posterior Pituitary	Regulates growth of mammary glands and milk formation in females

24. In eukaryotic cell transcription, RNA splicing and RNA capping take place inside the
(1) Ribosomes
(2) Nucleus
(3) Dictyosomes
(4) ER

25. Given below are four statements (a-d) regarding human blood circulatory system
(a) Arteries are thick-walled and have narrow lumen as compared to veins
(b) Angina is acute chest pain when the blood circulation to the brain is reduced
(c) Persons with blood group AB can donate blood to any person with any blood group under ABO system
(d) Calcium ions play a very important role in blood clotting

Which two of the above statements are correct?
(1) (a) & (d)
(2) (a) & (b)
(3) (b) & (c)
(4) (c) & (d)

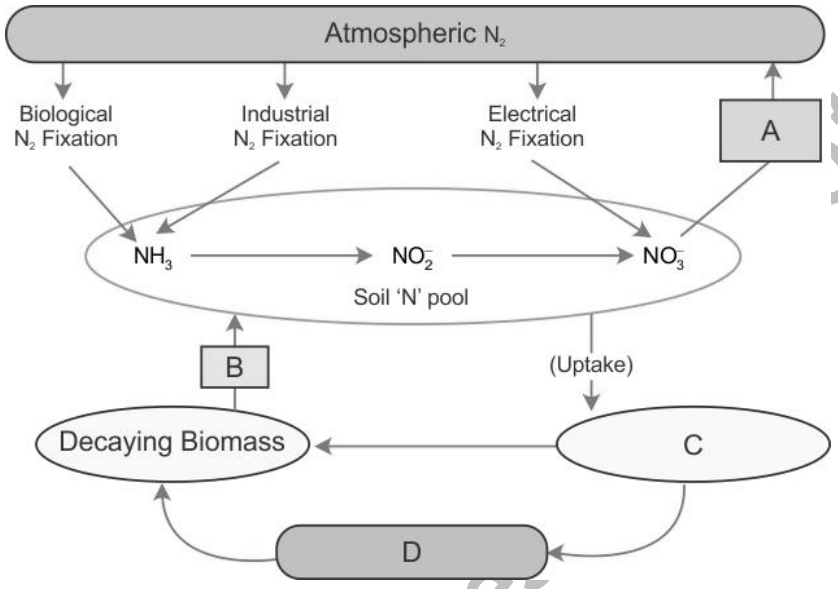
26. In human female the blastocyst
(1) Forms placenta even before implantation
(2) Gets implanted into uterus 3 days afterovulation
(3) Gets nutrition from uterine endometrial secretion only after implantation
(4) Gets implanted in endometrium by the trophoblast cells

27. The haemoglobin content per 100 ml of blood of a normal healthy human adult is
(1) 5 - 11 g
(2) 25 - 30 g
(3) 17 - 20 g
(4) 12 - 16 g

28. An example of endomycorrhiza is
(1) Nostoc
(2) Glomus
(3) Agaricus
(4) Rhizobium

29. One of the commonly used plant growth hormone is tea plantations is
(1) Ethylene
(2) Abscisic acid
(3) Zeatin
(4) Indole - 3 - acetic acid

30. Study the cycle shown below and select the option which gives correct words for all the four blanks A, B, C and D.



	A	B	C	D
(1)	Nitrification	Ammonification	Animals	Plants
(2)	Denitrification	Ammonification	Plants	Animals
(3)	Nitrification	Denitrification	Animals	Plants
(4)	Denitrification	Nitrification	Plants	Animals

31. Jaundice is a disorder of
(1) Excretory system
(2) Skin and eyes
(3) Digestive system
(4) Circulatoy system

32. Kranz anatomy is one of the characteristics of the leaves of
(1) Potato
(2) Wheat
(3) Sugarcane
(4) Mustard

33. In Antirrhinum two plants with pink flowers were hybridized. The F1 plants produced red, pink and white flowers in the proportion of 1 red, 2 pink and 1 white. What could be the genotype of the two plants used for hybridization? Red flower colour is determined by RR, and white by rr genes.
(1) rrrr
(2) RR
(3) Rr
(4) rr

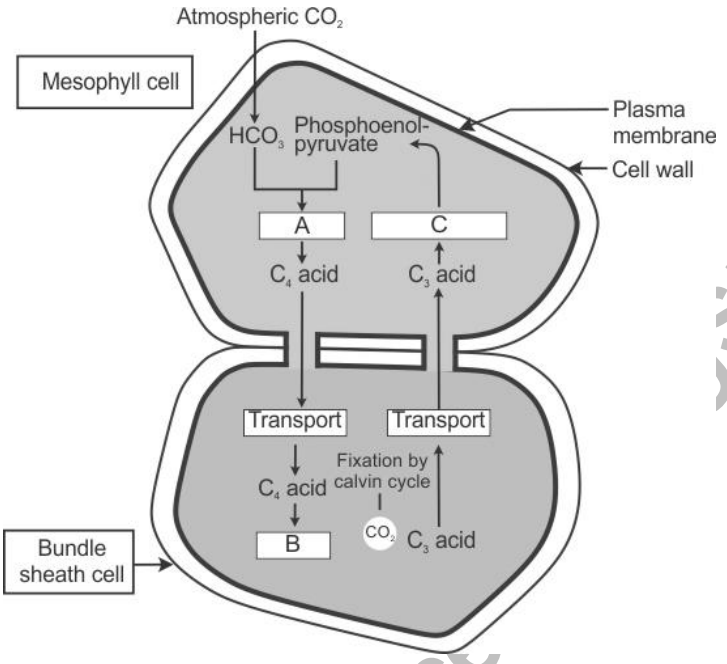
34. Transport of food material in higher plants takes place through
(1) Companion cells
(2) Transfusion tissue
(3) Tracheids
(4) Sieve elements

35. Which one of the following is monoecious?
(1) Marchantia
(2) Cycas
(3) Pinus
(4) Date palm

36. A cross in which an organism showing a dominant phenotype in crossed with the recessive parent in order to know its genotype is called :
(1) Monohybrid cross
(2) Back cross
(3) Test cross
(4) Dihybrid cross

37. The Indian Rhinoceros is a natural inhabitant of which one of the Indian states?
(1) Uttarakhand
(2) Uttar Pradesh
(3) Himachal Pradesh
(4) Assam

38. Study the pathway given below :



In which of the following options correct words for all the three blanks A, B and C are indicated?

	A	B	C
(1)	Decarboxylation	Reduction	Regeneration
(2)	Fixation	Transamination	Regencration
(3)	Fixation	Decarboxylation	Regeneration
(4)	Carboxylation	Decarboxylation	Reduction

39. Black (stem) rust of wheat is caused by :

(1) *Alternaria solani*
(2) *Ustilago nuda*
(3) *Puccinia graminis*
(4) *Xanthomonas oryzae*

40. Secretions from which one of the following are rich in fructose, calcium and some enzymes?

(1) Male accessory glands
(2) Liver
(3) Pancreas
(4) Salivary glands

41. A person suffering from a disease caused by Plasmodium, experiences recurring chill and fever at the time when?
(1) The sporozoites released from RBCs are being rapidly killed and broken down inside spleen
(2) The trophozoites reach maximum growth and give out certain toxins
(3) The parasite after its rapid multiplication inside RBCs ruptures them, releasing the stage to enter fresh RBCs
(4) The microgametocytes and megagametocytes are being destroyed by the WBCs

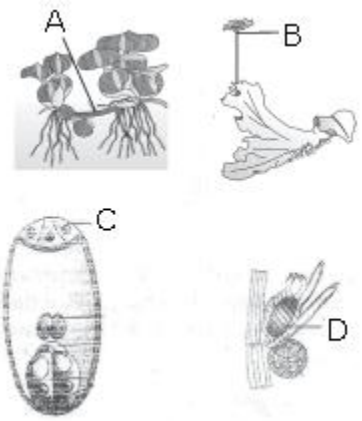
42. ABO blood grouping is controlled by gene I which has three alleles and show co-dominance. There are six genotypes. How many phenotypes in all are possible?
(1) Six
(2) Three
(3) Four
(4) Five

43. Three of the following statements about enzymes are correct and one is wrong. Which one is wrong?
(1) Enzymes require optimum pH for maximal activity
(2) Enzymes are denatured at high temperature but in certain exceptional organisms they are effective even at temperatures 80°-90°C
(3) Enzymes are highly specific
(4) Most enzymes are proteins but some are lipids

44. An elaborate network of filamentous proteinaceous structures present in the cytoplasm which helps in the maintenance of cell shape is called
(1) Thylakoid
(2) Endoplasmic Reticulum
(3) Plasmalemma
(4) Cytoskeleton

45. Examine the figures (A-D) given below and select the right option out of 1-4, in which all the four structures A, B, C and D are identified correctly

Structures:



	A	B	C	D
(1)	Rhizome	Sporangiophore	Polar cell	Globule
(2)	Runner	Archegoniophore	Synergid	Antheridium
(3)	Offset	Antheridiophore	Antipodals	Oogonium
(4)	Sucker	Seta	Megaspore mother cell	Gemma cup

46. Root development is promoted by

(1) Abscisic acid
(2) Auxin
(3) Gibberellin
(4) Ethylene

47. Consider the following four statements A, B, C and D and select the right option for two **correct** statements.

Statements

(A) In vexillary aestivation, the large posterior petal is called standard, two lateral ones are wings and two small anterior petals are termed keel

(B) The floral formula for Liliaceae is

$$\oplus \, \delta \, P_{3+3} \, A_{5+5} + G_2$$

(C) In pea flower the stamens are monadelphous

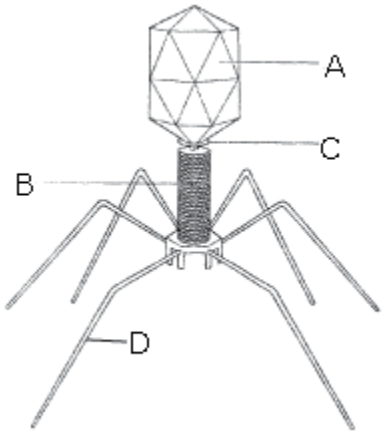
(D) The floral formula for Solanaceae is

$$\oplus \, \delta \, K_{(5)} \, C_{(5)} \, A_{(4)} + G_{\infty}$$

The correct statements are

(1) (A) and (C)
(2) (A) and (B)
(3) (B) and (C)
(4) (C) and (D)

48. Given below is the diagram of a bacteriophage. In which one of the options all the four parts A, B, C and D are correct?



	A	B	C	D
(1)	Tail fibres	Head	Sheath	Collar
(2)	Sheath	Collar	Head	Tail fibres
(3)	Head	Sheath	Collar	Tail fibres
(4)	Collar	Tail fibres	Head	Sheath

49. In genetic engineering, a DNA segment (gene) of interest is transferred to the host cell through a vector. Consider the following four agents (A-D) in this regard and select the correct option about which one or more of these can be used as a vector/vectors

Statements

(A) A bacterium
(B) Plasmid
(C) Plasmodium
(D) Bacteriophage

Options:

(1) (A), (B) and (D) only
(2) (A) only
(3) (A) and (C) only
(4) (B) and (D) only

50. Which one of the following cannot be used for preparation of vaccines against plague?
(1) Formalin-inactivated suspensions of virulent bacteria
(2) Avirulent live bacteria
(3) Synthetic capsular polysaccharide material
(4) Heat-killed suspensions of virulent bacteria

51. The fruit fly *Drosophila melanogaster* was found to be very suitable for experimental verification of chromosomal theory of inheritance by Morgan and his colleagues because :
(1) It reproduces parthenogenetically
(2) A single mating produces two young flies
(3) Smaller female is easily recognisable from larger male
(4) It completes life cycle in about two weeks

52. The lac operon consists of
(1) Four regulatory genes only
(2) One regulatory gene and three structural genes
(3) Two regulatory genes and two structural genes
(4) Three regulatory genes and three structural genes

53. Crocodile and penguin are similar to Whale and Dogfish in which one of the following features?
(1) Possess a solid single stranded central nervous system
(2) Lay eggs and guard them till they hatch
(3) Possess bony skeleton.
(4) Have gill slits at some stage

54. Select the answer with correct matching of the structure, its location and function

	Structure	Location	Function
(1)	Eustachian tube	Anterior part of internal ear	Equalizes air pressure on either sides of tympanic membrane
(2)	Cerebellum	Mid brain	Controls respiration and gastric secretions
(3)	Hypothalamus	Fore brain	Controls body temperature, urge for eating and drinking
(4)	Blind spot	Near the place where optic nerve leaves the eye	Rods and cones are present but inactive here

55. Select the correct combination of the statements (a-d) regarding the characteristics of certain organisms

(a) Methanogens are Archaebacteria which produce methane in marshy areas
(b) Nostoc is a filamentous blue-green alga which fixes atmospheric nitrogen
(c) Chemosynthetic autotrophic bacteria synthesize cellulose from glucose
(d) Mycoplasma lack a cell wall and can survive without oxygen

The correct statements are

(1) (b), (c)
(2) (a), (b), (c)
(3) (b), (c), (d)
(4) (a), (b), (d)

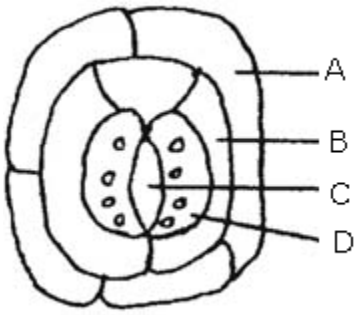
56. Which one of the following is the correct description of a certain part of a normal human skeleton?

(1) Parietal bone and the temporal bone of the skull are joined by fibrous joint
(2) First vertebra is axis which articulates with the occipital condyles
(3) The 9th and 10th pairs of ribs are called the floating ribs
(4) Glenoid cavity is a depression to which the thigh bone articulates

57. Vegetative propagation in Pistia occurs by

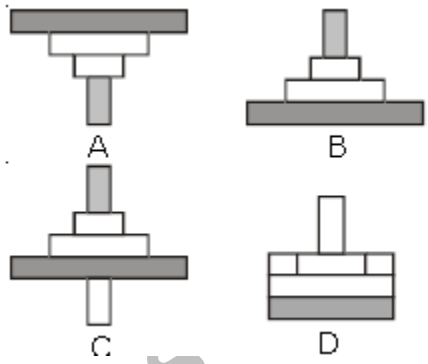
(1) Stolen
(2) Offset
(3) Runner
(4) Sucker

58. Given below is the diagram of a stomatal apparatus. In which of the following all the four parts labelled as A, B, C and D are correctly identified?



	A	B	C	D
(1)	Subsidiary Cell	Epidermal Cell	Guard Cell	Stomatal aperture
(2)	Guard Cell	Stomatal Aperture	Subsidiary Cell	Epidermal cell
(3)	Epidermal Cell	Guard Cell	Stomatal Aperture	Subsidiary cell
(4)	Epidermal Cell	Subsidiary Cell	Stomatal Aperture	Guard cell

59. Which of the following representations shows the pyramid of numbers in a forest ecosystem?



(1) D
(2) A
(3) B
(4) C

60. The 3′-5′phosphodiester linkages inside a polynucleotide chain serve to join
(1) One DNA strand with the other DNA strand
(2) One nucleoside with another nucleoside
(3) One nucleotide with another nucleotide
(4) One nitrogenous base with pentose sugar

Physics

61. A current loop consists of two identical semicircular parts each of radius R, one lying in the x-y plane and the other in x-z plane. If the current in the loop is i, the resultant magnetic field due to the two semicircular parts at their common centre is

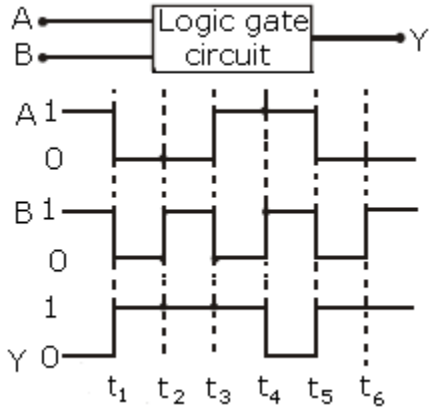
(1) $\frac{\mu_0 i}{2\sqrt{2}R}$

(2) $\frac{\mu_0 i}{2R}$

(3) $\frac{\mu_0 i}{4R}$

(4) $\frac{\mu_0 i}{\sqrt{2}R}$

62. The following figure shows a logic gate circuit with two inputs A and B and the output Y. The voltage waveforms of A, B and Y are as given



The logic gate is

(1) NOR gate

(2) OR gate

(3) AND gate

(4) NAND gate

63. Two parallel metal plates having charges +Q and –Q face each other at a certain distance between them. If the plates are now dipped in kerosene oil tank, the electric field between the plates will

(1) Become zero

(2) Increase

(3) Decrease

(4) Remain same

64. The electric field at a distance $\frac{3R}{2}$ from the centre of a charged conducting spherical shell of radius R is E. The electric field at a distance $\frac{R}{2}$ from the centre of the sphere is

(1) Zero
(2) E
(3) $\frac{E}{2}$
(4) $\frac{E}{3}$

65. A student measures the distance traversed in free fall of a body, initially at rest in a given time. He uses this data to estimate g, the acceleration due to gravity. If the maximum percentage errors in measurement of the distance and the time are e_1 and e_2 respectively, the percentage error in the estimation of g is

(1) $e_2 - e_1$
(2) $e_1 + 2e_2$
(3) $e_1 + e_2$
(4) $e_1 - 2e_2$

66. When monochromatic radiation of intensity I fall on a metal surface, the number of photoelectron and their maximum kinetic energy are N and T respectively. If the intensity of radiation is 2I, the number of emitted electrons and their maximum kinetic energy are respectively

(1) N and 2T
(2) 2N and T
(3) 2N and 2T
(4) N and T

67. The electric field of an electromagnetic wave in free space is given by $\bar{E} = 10\cos\left(10^7 t + kx\right)\hat{j}\ V/m$, where t and x are in seconds and metres respectively. It can be inferred that

(a) The wavelength λ is 188.4 m
(b) The wave number k is 0.33 rad/m
(c) The wave amplitude is 10 V/m
(d) The wave is propagating along +x direction

Which one of the following pairs of statements is correct?

(1) (c) & (d)
(2) (a) and (b)
(3) (b) & (c)
(4) (a) & (c)

68. The speed of light in media M_1 and M_2 is 1.5×10^8 m/s and 2.0×10^8 m/s respectively. A ray of light enters from medium M_1 to M_2 at an incidence angle i. If the ray suffers total internal reflection, the value of i is

(1) Equal to $\text{Sin}^{-1}\left(\frac{2}{3}\right)$

(2) Equal to or less than $\text{Sin}^{-1}\left(\frac{3}{5}\right)$

(3) Equal to or greater than $\text{Sin}^{-1}\left(\frac{3}{4}\right)$

(4) Less than $\text{Sin}^{-1}\left(\frac{2}{3}\right)$

69. A ray of light is incident on a 60° prism at the minimum deviation position. The angle of refraction at the first face (i.e., incident face) of the prism is

(1) Zero
(2) 30°
(3) 45°
(4) 60°

70. For transistor action

(a) Base, emitter and collector regions should have similar size and doping concentrations.
(b) The base region must be very thin and lightly doped.
(c) The emitter-base junction is forward biased and base-collector junction is reverse biased.
(d) Both the emitter-base junction as well as the base-collector junction are forward biased.

Which one of the following pairs of statements is correct?

(1) (d), (a)
(2) (a), (b)
(3) (b), (c)
(4) (c), (d)

71. The additional kinetic energy to be provided to a satellite of mass m revolving around a planet of mass M, to transfer it from a circular orbit of radius R_1 to another of radius R_2 ($R_2 > R_1$) is

(1) $GmM\left(\frac{1}{R_1^2}-\frac{1}{R_2^2}\right)$

(2) $GmM\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$

(3) $2GmM\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$

(4) $\frac{1}{2}GmM\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$

72. The speed of a projectile at its maximum height is half of its initial speed. The angle of projection is

(1) 60°

(2) 15°

(3) 30°

(4) 45°

73. From a circular disc of radius R and mass 9M, a small disc of mass M and radius $\frac{R}{3}$ is removed concentrically. The moment of inertia of the remaining disc about an axis perpendicular to the plane of the disc and passing through its centre is

(1) $\frac{40}{9}MR^2$

(2) MR^2

(3) $4\ MR^2$

(4) $\frac{4}{9}MR^2$

74. A particle moves in x-y plane according to rule x = a sin ωt and y = a cosωt. The particle follows

(1) An elliptical path

(2) A circular path

(3) A parabolic path

(4) A straight line path inclined equally to x and y-axes

75. A closely wound solenoid of 2000 turns and area of cross-section 1.5×10^{-4} m^2 carries a current of 2.0 A. It is suspended through its centre and perpendicular to its length, allowing it to turn in a horizontal plane in a uniform magnetic field 5×10^{-2} tesla making an angle of 30° with the axis of the solenoid. The torque on the solenoid will be

(1) 3×10^{-3} Nm
(2) 1.5×10^{-3} Nm
(3) 1.5×10^{-2} Nm
(4) 3×10^{-2} Nm

76. The decay constant of a radio isotope is λ. If A_1 and A_2 are its activities at times t_1 and t_2 respectively, the number of nuclei which have decayed during the time ($t_1 - t_2$)

(1) $A_1t_1 - A_2t_2$
(2) $A_1 - A_2$
(3) $(A_1 - A_2)/\lambda$
(4) $\lambda(A_1 - A_2)$

77. A particle having a mass of 10^{-2} kg carries a charge of 5×10^{-8} C. The particle is given an initial horizontal velocity of 10^5 ms^{-1} in the presence of electric field $\vec{E}$ and magnetic field $\vec{B}$. To keep the particle moving in a horizontal direction, it is necessary that

(a) $\vec{B}$ should be perpendicular to the direction of velocity and $\vec{E}$ should be along the direction of velocity.
(b) Both $\vec{B}$ and $\vec{E}$ should be along the direction of velocity.
(c) Both $\vec{B}$ and $\vec{E}$ are mutually perpendicular and perpendicular to the direction of velocity.
(d) $\vec{B}$ should be along the direction of velocity and $\vec{E}$ should be perpendicular to the direction of velocity.

Which one of the following pairs of statements is possible?

(1) (a) and (c)
(2) (c) and (d)
(3) (b) and (c)
(4) (b) and (d)

78. The binding energy per nucleon in deuterium and helium nuclei are 1.1 MeV and 7.0 MeV, respectively. When two deuterium nuclei fuse to form a helium nucleus the energy released in the fusion is

(1) 23.6 MeV
(2) 2.2 MeV
(3) 28.0 MeV
(4) 30.2 MeV

79. The electron in the hydrogen atom jumps from excited state (n = 3) to its ground state (n = 1) and the photons thus emitted irradiate a photosensitive material. If the work function of the material is 5.1 eV, the stopping potential is estimated to be (the energy of the electron in nth state $E_n = -\frac{13.6}{n^2}eV$)

(1) 5.1 V
(2) 12.1 V
(3) 17.2 V
(4) 7 V

80. If c_p and c_v denote the specific heats (per unit mass) of an ideal gas of molecular weight M, then

(1) $c_p - c_v = R/M^2$
(2) $c_p - c_v = R$
(3) $c_p - c_v = R/M$
(4) $c_p - c_v = MR$

where R is the molar gas constant

81. A condenser of capacity C is charged to a potential difference of V_1. The plates of the condenser are then connected to an ideal inductor of inductance L. The current through the inductor when the potential difference across the condenser reduces to V_2 is

(1) $\left(\frac{C(V_1 - V_2)^2}{L}\right)^{\frac{1}{2}}$

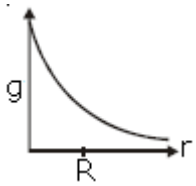
(2) $\frac{C(V_1^2 - V_2^2)}{L}$

(3) $\frac{C(V_1^2 + V_2^2)}{L}$

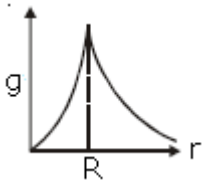
(4) $\left(\frac{C(V_1^2 - V_2^2)}{L}\right)^{\frac{1}{2}}$

82. The dependence of acceleration due to gravity g on the distance r from the centre of the earth, assumed to be a sphere of radius R of uniform density is as shown in figures below

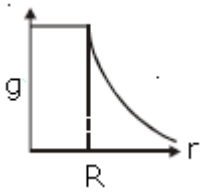
(a)



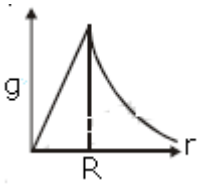
(b)



(c)



(d)



The correct figure is

(1) (d)
(2) (a)
(3) (b)
(4) (c)

83. A solid cylinder and a hollow cylinder, both of the same mass and same external diameters are released from the same height at the same time on an inclined plane. Both roll down without slipping. Which one will reach the bottom first?

(1) Both together only when angle of inclination of plane is 45°
(2) Both together
(3) Hollow cylinder
(4) Solid cylinder

84. The thermo e.m.f. E in volts of a certain thermo-couple is found to vary with temperature difference θ in °C between the two junctions according to the relation $E = 30\theta - \frac{\theta^2}{15}$.

The neutral temperature for the thermo-couple will be

(1) 450°C
(2) 400°C
(3) 225°C
(4) 30°C

85.

(a) Centre of gravity (C.G.) of a body is the point at which the weight of the body acts
(b) Centre of mass coincides with the centre of gravity if the earth is assumed to have infinitely large radius
(c) To evaluate the gravitational field intensity due to a body at an external point, the entire mass of the body can be considered to be concentrated at its C.G.
(d) The radius of gyration of a body rotating about an axis is the length of the perpendicular dropped from the C.G. of the body to the axis

Which one of the following pairs of statements is correct?

(1) (d) and (a)
(2) (a) and (b)
(3) (b) and (c)
(4) (c) and (d)

86. The magnetic moment of a diamagnetic atom is

(1) Much greater than one
(2) 1
(3) Between zero and one
(4) Equal to zero

87. Two identical bar magnets are fixed with their centres at a distance d apart. A stationary charge Q is placed at P in between the gap of the two magnets at a distance D from the centre O as shown in the figure

The force on the charge Q is

(1) Zero
(2) Directed along OP
(3) Directed along PO
(4) Directed perpendicular to the plane of paper

88. A particle of mass M starting from rest undergoes uniform acceleration. If the speed acquired in time T is V, the power delivered to the particle is

(1) $\frac{MV^2}{T}$

(2) $\frac{1}{2}\frac{MV^2}{T^2}$

(3) $\frac{MV^2}{T^2}$

(4) $\frac{1}{2}\frac{MV^2}{T}$

89. A thin circular ring of mass M and radius r is rotating about its axis with constant angular velocity ω. Two objects each of mass m are attached gently to the opposite ends of a diameter of the ring. The ring now rotates with angular velocity given by

(1) $\frac{(M+2m)\omega}{2m}$

(2) $\frac{2M\omega}{M+2m}$

(3) $\frac{(M+2m)\omega}{M}$

(4) $\frac{M\omega}{M+2m}$

90. A monoatomic gas at pressure P_1 and V_1 is compressed adiabatically to $\frac{1}{8}$th its original volume. What is the final pressure of the gas?

(1) 64 P_1

(2) P_1

(3) 16 P_1

(4) 32 P_1

Chemistry

91. Among the elements Ca, Mg, P and Cl, the order of increasing atomic radii is
(1) Mg < Ca < Cl < P
(2) Cl < P < Mg < Ca
(3) P < Cl < Ca < Mg
(4) Ca < Mg < P < Cl

92. The reaction,
$2A_{(g)} + B_{(g)} \rightarrow 3C_{(g)} + D_{(g)}$
is begun with the concentrations of A and B both at an initial value of 1.00 M. When equilibrium is reached, the concentration of D is measured and found to be 0.25 M. The value for the equilibrium constant for this reaction is given by the expression:
(1) $[(0.75)^3(0.25)] \div [(1.00)^2(1.00)]$
(2) $[(0.75)^3(0.25)] \div [(0.50)^2(0.75)]$
(3) $[(0.75)^3(0.25)] \div [(0.50)^2(0.25)]$
(4) $[(0.75)^3(0.25)] \div [(0.75)^2(0.25)]$

93. Which of the following expressions correctly represents the equivalent conductance at infinite dilution of $Al_2(SO_4)_3$. Given that $\Lambda^0_{Al^{5+}}$ and $\Lambda^0_{SO_4^{5-}}$ are the equivalent conductances at infinite dilution of the respective ions?
(1) $2\Lambda^0_{Al^{3+}} + 3\Lambda^0_{SO_4^{2-}}$
(2) $\Lambda^0_{Al^{3+}} + \Lambda^0_{SO_4^{2-}}$
(3) $\left(2\Lambda^0_{Al^{3+}} + 3\Lambda^0_{SO_4^{2-}}\right) \times 6$
(4) $\frac{1}{3}\Lambda^0 Al^{3+} + \frac{1}{2}\Lambda^0 SO_4^{2-}$

94. The pressure exerted by 6.0 g of methane gas in a 0.03 m^3 vessel at 129°C is (Atomic masses :C = 12.01, H = 1.01 and R = 8.314 JK^{-1} mol^{-1})
(1) 215216 Pa
(2) 13409 Pa
(3) 41648 Pa
(4) 31684 Pa

95. Match List-I (Equations) with List-II (Type of process) and select the correct option.

List-I **Equations**	**List-II** **Types of processes**
(a) $K_p > Q$	(i) Non-spontaneous
(b) $\Delta G° < RT \ln Q$	(ii) Equilibrium

(c) $K_p = Q$ (iii) Spontaneous and endothermic

(d) $T > \frac{\Delta H}{\Delta S}$ (iv) Spontaneous

(1) a - (i), b - (ii), c - (iii), d - (iv)
(2) a - (iii), b - (iv), c - (ii), d - (i)
(3) a - (iv), (b -(i), c - (ii), d - (iii)
(4) a - (ii), b - (i), c - (iv), d - (iii)

96. Among the following four compounds:
a. Phenol
b. Methyl phenol
c. Meta-nitrophenol
d. Para-nitrophenol
The acidity order is:
(1) d > c > a > b
(2) c > d > a > b
(3) a > d > c > b
(4) b > a > c > d

97. Among the following which one has the highest cation to anion size ratio?
(1) CsI
(2) CsF
(3) LiF
(4) NaF

98. Three moles of an ideal gas expanded spontaneously into vacuum. The work done will be
(1) Infinite
(2) 3 Joules
(3) 9 Joules
(4) Zero

99. Which of the following species is not electrophilic in nature?
(1) $\overset{\oplus}{Cl}$
(2) BH_3
(3) $\overset{\oplus}{H_3O}$
(4) $\overset{\oplus}{NO_2}$

100. A 0.66 kg ball is moving with a speed of 100 m/s. The associated wavelength will be ($h = 6.6 \times 10^{-34}$ Js)

(1) 6.6×10^{-32} m
(2) 6.6×10^{-34} m
(3) 1.0×10^{-35} m
(4) 1.0×10^{-32} m

101. Consider the following relations for emf of a electrochemical cell

(a) emf of cell = (Oxidation potential of anode) – (Reduction potential of cathode)
(b) emf of cell = (Oxidation potential of anode) + (Reduction potential of cathode)
(c) emf of cell = (Reduction potential of anode) + (Reduction potential of cathode)
(d) emf of cell = (Oxidation potential of anode) – (Oxidation potential of cathode)

Which of the above relations are correct?

(1) (c) and (a)
(2) (a) and (b)
(3) (c) and (d)
(4) (b) and (d)

102. In which of the following molecules the central atom does not have sp^3d hybridization?

(1) CH_4
(2) SF_4
(3) BF_4^-
(4) NH_4^+

103. For vaporization of water at 1 atmospheric pressure, the values of ΔH and ΔS are 40.63 kJ mol^{-1} and 108.8 JK^{-1} mol^{-1}, respectively. The temperature when Gibbs energy change (ΔG) for this transformation will be zero, is:

(1) 273.4 K
(2) 393.4 K
(3) 373.4 K
(4) 293.4 K

104. Match List-I (substances) with List-II (process) employed in the manufacture of the substances and select the correct option

List-I (Substances)	**List-II (Processes)**
a. Sulphuric acid	(i) Haber's Process

b. Steel (ii) Bessemer's Process
c. Sodium hydroxide (iii) Leblanc Process
d. Ammonia (iv) Contact Process

(1) a-(i), b-(iv), c-(ii), d-(iii)
(2) a-(i), b-(ii), c-(iii), d-(iv)
(3) a-(iv), b-(iii), c-(ii), d-(i)
(4) a-(iv), b-(ii), c-(iii), d-(i)

105. When glycerol is treated with excess of HI, it produces
(1) 2-iodopropane
(2) Allyl iodide
(3) Propene
(4) Glycerol triiodide

106. Some statements about heavy water are given below:
a. Heavy water is used as a moderator in nuclear reactors.
b. Heavy water is more associated than ordinary water.
c. Heavy water is more effective solvent than ordinary water.
Which of the above statements are correct?
(1) a and b
(2) a, b and c
(3) b and c
(4) a and c

107. The compound A on heating gives a colourless gas and a residue that is dissolved in water to obtain B. Excess of CO_2 is bubbled through aqueous solution of B, C is formed which is recovered in the solid form. Solid C on gentle heating gives back A. The compound is
(1) $CaCO_3$
(2) Na_2CO_3
(3) K_2CO_3
(4) $CaSO_4.2H_2O$

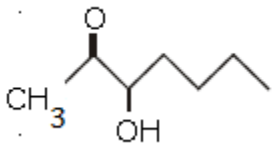
108. Match the compounds given in List-I with their characteristic reactions given in List-II. Select the correct option

List-I (Compounds)	**List-II (Reactions)**
a. $CH_3CH_2CH_2CH_2NH_2$	(i) Alkaline hydrolysis
b. $CH_3C{\equiv}CH$	(ii) With KOH (alcohol) and $CHCl_3$ produces bad smell
c. $CH_3CH_2COOCH_3$	(iii)Gives white ppt. with ammoniacal $AgNO_3$
d. $CH_3CH(OH)CH_3$	(iv) With Lucas reagent cloudiness appears after 5 minutes

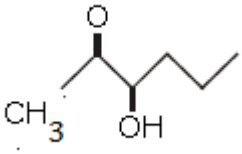
(1) (ii), b- (i), c -(iv), d -(iii)
(2) a -(iii), b-(ii), c- (i), d- (iv)
(3) a -(ii), b -(iii), c -(i), d -(iv)
(4) a -(iv), b-(ii), c -(iii), d -(i)

109. Which one of the following compounds will be most readily dehydrated?

(1)



(2)



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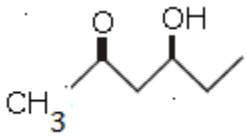

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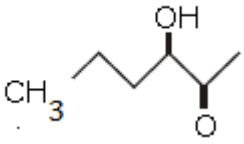
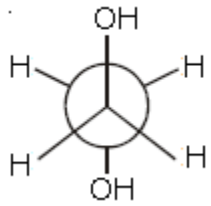


110. The rate of the reaction $2NO + Cl_2 \rightarrow 2NOCl$ is given by the rate equation rate = $k[NO]^2[Cl_2]$
The value of the rate constant can be increased by
(1) Increasing the temperature
(2) Increasing the concentration of NO
(3) Increasing the concentration of the Cl_2
(4) Doing all of these

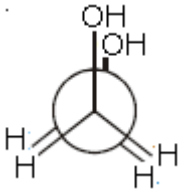
111. Which one of the following complexes is not expected to exhibit isomerism?
(1) $[Ni(NH_3)_4 (H_2O)_2]^{2+}$
(2) $[Pt (NH_3)_2 Cl_2]$
(3) $[Ni (NH_3)_2 Cl_2]$
(4) $[Ni (en)_3]^{2+}$

112. Which of the following conformers for ethylene glycol is most stable?

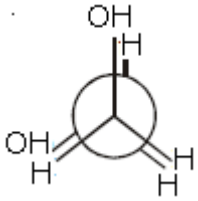
(1)



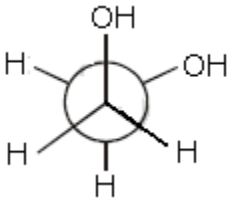
(2)



(3)



(4)



113. The IUPAC name of the compound $CH_3CH=CHC\equiv CH$ is:

(1) Pent-4-yn-2-ene
(2) Pent-3-en-1-yne
(3) Pent-2-en-4-yne
(4) Pent-1-yn-3-ene

114. Which of the following oxidation states is the most common among the lanthanoids?

(1) 4
(2) 2
(3) 5
(4) 3

115. How many bridging oxygen atoms are present in P_4O_{10}?

(1) 6
(2) 4
(3) 2

(4) 5

116. Some of the properties of the two species, NO_3^- and H_3O^+ are described below. Which one of them is correct?

(1) Dissimilar in hybridization for the central atom with different structures
(2) Isostructural with same hybridization for the central atom
(3) Isostructural with different hybridization for the central atom
(4) Similar in hybridization for the central atom with different structures

117. The following two reactions are known :

$Fe_2O_{3(s)} + 3CO_{(g)} \rightarrow 2Fe_{(s)} + 3CO_{2(g)}; \Delta H = -26.8$ kJ

$FeO_{(s)} + CO_{(g)} \rightarrow Fe_{(s)} + CO_{2(g)}; \Delta H = -16.5$ kJ

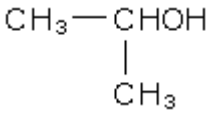
The value of ΔH for the following reaction

$Fe_2O_{3(s)} + CO_{(g)} \rightarrow 2FeO_{(s)} + CO_{2(g)}$ is:

(1) +10.3 kJ
(2) – 43.3 kJ
(3) –10.3 kJ
(4) +6.2 kJ

118. Following compounds are given

a. CH_3CH_2OH
b. CH_3COCH_3
c.



d. CH_3OH

Which of the above compound(s), on being warmed with iodine solution and NaOH, will give iodoform?

(1) a, c and d
(2) Only b
(3) a, b and c
(4) a and b

119. Fructose reduces Tollen's reagent due to:

(1) Asymmetric carbons
(2) Primary alcoholic group
(3) Secondary alcoholic group
(4) Enolisation of fructose followed by conversion to aldehyde by base

120. In the following reaction

$$C_6H_5CH_2Br \xrightarrow[2H_5O^+]{1.Mg.Ether} X,$$

the product 'X' is

(1) $C_6H_5CH_2OCH_2C_6H_5$

(2) $C_6H_5CH_2OH$

(3) $C_6H_5CH_3$

(4) $C_6H_5CH_2CH_2C_6H_5$

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(Physics, Chemistry and Biology)
Mains Answer Key and Solution
Code C

Answers

1	(3)	2	(2)	3	(4)	4	(3)	5	(4)	6	(4)	7	(1)	8	(2)	9	(4)	10	(3)
11	(1)	12	(4)	13	(2)	14	(3)	15	(4)	16	(4)	17	(4)	18	(4)	19	(3)	20	(1)
21	(1)	22	(2)	23	(2)	24	(2)	25	(1)	26	(4)	27	(4)	28	(2)	29	(4)	30	(2)
31	(3)	32	(3)	33	(3)	34	(4)	35	(3)	36	(3)	37	(4)	38	(3)	39	(3)	40	(1)
41	(2)	42	(3)	43	(4)	44	(4)	45	(3)	46	(2)	47	(4)	48	(3)	49	(4)	50	(4)
51	(4)	52	(2)	53	(4)	54	(3)	55	(4)	56	(1)	57	(2)	58	(4)	59	(3)	60	(3)
61	(1)	62	(4)	63	(3)	64	(1)	65	(2)	66	(2)	67	(4)	68	(3)	69	(2)	70	(3)
71	(4)	72	(1)	73	(1)	74	(2)	75	(3)	76	(3)	77	(3)	78	(1)	79	(4)	80	(3)
81	(4)	82	(4)	83	(4)	84	(3)	85	(1)	86	(4)	87	(1)	88	(4)	89	(4)	90	(4)
91	(2)	92	(2)	93	(2)	94	(3)	95	(3)	96	(1)	97	(2)	98	(4)	99	(3)	100	(3)
101	(4)	102	(2)	103	(3)	104	(4)	105	(2)	106	(1)	107	(1)	108	(3)	109	(4)	110	(1)
111	(3)	112	(4)	113	(2)	114	(3)	115	(1)	116	(1)	117	(4)	118	(3)	119	(4)	120	(3)

Solutions
Biology

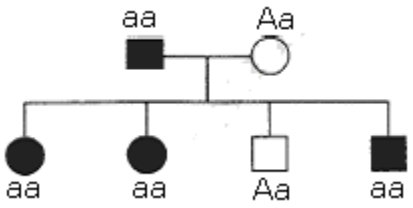
1. Cartilage is a vascular tissue as the blood vessels innervate only the perichondrium. The cornea does not have blood vessels; it receives nutrients via diffusion from the tear fluid externally and the aqueous humour internally. It gets oxygen directly through the air. Oxygen first dissolves in the tears and then diffuses throughout the cornea to keep it healthy.

2. Golgi body and endoplasmic reticulum are often found associated to the nuclear membrane.

3. Rapid distribution of drugs can occur through intravenous injection. Intramuscular injection, on the other hand, is given for producing local effect.

4. The insulin gene is found in every body cell but is not expressed in all cells.

5.



Since the female is normal and both male and female in the subsequent generations are showing the trait, it means the female is heterozygous for the given trait.

6. Nitrogenase is sensitive against O_2. In *Rhizobia*, nitrogenase enzyme is protected by the presence of leg-haemoglobin which combines with oxygen thereby protecting the oxidation of the enzyme.

7. *Opuntia* is a xerophytic plant in which the stem is modified to a spine. The modification is known as a phylloclade.

8. Activation energy is required for overcoming the energy barrier which reduces in the presence of enzyme.

9. Plasmids are extra-chromosomal genetic material found in bacteria. They are used as vectors in gene cloning.

10. When domestic sewage mixes with river water, it increases the microbial load resulting in increase of BOD and decrease of dissolved oxygen (DO) because of decomposing activity of microbes.

11. According to Darwin, evolution took place because of small variations and survival of the fittest. Wings of butterfly and birds are analogous or convergent. Vermiform appendix is a vestigial organ.

12.

Twisted aestivation is a characteristic feature of Malvaceae and it is observed in cotton.

13. Earthworm has three types of nephridia—pharyngeal, integumentary and septal nephridia.

14. A – *Selaginella*, B – *Equisetum*, C – *Salvinia*, D – *Ginkgo*

15. Human evolution is marked with a gradual increase of brain size or cranial capacity. It is consistently observed among the genus *Homo* reaching its peak in *Homo sapiens*.

16. Insulin is utilised in patients with diabetes. It is artificially produced by biotechnological methods.

17. Soyabean is a leguminous plant. It is characterised by typical 5 petals and diadelphous stamen.

$$\% \; \overset{\nearrow}{\underset{+}{\delta}} \; K_{(5)} C_{1+2+(2)} A_{(9)+1} G_1$$

18. In the absence of parietal or oxyntic cells, HCl will not be released. Hence, pepsinogen will fail to convert into active pepsin as it requires an acidic medium.

19. A predator is an organism which catches and kills other organisms for food.

20.

(A) The Z scheme of the light reaction takes place in the presence of both PSII and PSI.
(B) Only PS I is functional in cyclic photophosphorylation.
(C) Cyclic photophosphorylation results in the synthesis of only ATP and no $NADPH_2$ is formed.
(D) Stroma lamellae lack PS II and NADP.

21. Histopathological study is the invasive technique.
Radiography and CT involves X-rays which are harmful.
Hence, MRI is the safest for the detection of cancers. It uses a magnetic field and radio waves to create detailed images of the body.

22. Signals from the fully developed foetus and placenta ultimately lead to parturition which requires the release of oxytocin or pitocin from the maternal pituitary. It causes contractions in the uterine muscles to help in parturition.

23. Vasopressin decreases loss of water through urine. Glucagon is released from α-cells. Prolactin is released from the anterior pituitary.

24. In eukaryotes, Hn RNA is the immediate transcriptional product. It undergoes post-transcriptional modification to produce mature RNA. The reaction occurs in the nucleus. Mature mRNA enters the cytoplasm only after completion of splicing, capping and tailing.

25. Angina is due to reduced blood supply to the heart wall through the coronary artery. A person with blood group AB is the universal recipient. However, the blood group O is known as the universal donor.

26. Blastocyst starts getting nutrition before implantation.

27. The haemoglobin content per 100 ml of blood of a normal healthy human adult is 12–16 g. However, in females, the amount is slightly lesser in comparison to males.

28. *Nostoc* – Blue-green algae
Agaricus – Basidiomycetes
Rhizobium – Eubacteria

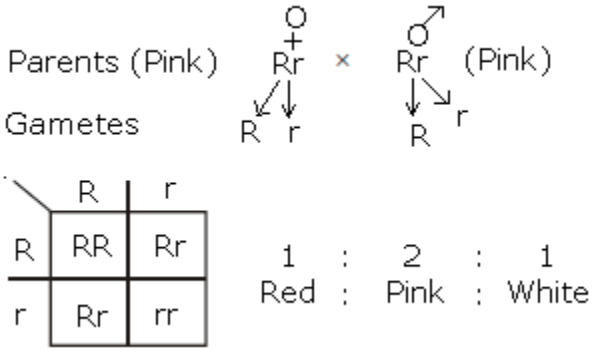
29. Auxin (indole acetic acid) is commonly used in stem cutting, and it is one of the most common growth hormone. IAA enhances simultaneous leaf and root system development. They help to initiate rooting in stem cuttings, an application widely used for plant propagation.

30. A – Denitrification: It is the conversion of nitrogenous compounds directly into molecular nitrogen.
B – Ammonification: Decaying biomass is enacted by the ammonifying bacteria to form ammonia from hydrocarbon, and the process is known as ammonification.
C – Plants
D – Animals

31. Jaundice can be due to blockage/inflammation of the bile duct in the liver as liver is a part of the digestive system,

32. Kranz anatomy of the leaf is a characteristics feature of the C4 plant such as sugarcane and maize. It is known as a dimorphic chloroplast.

33.



34. Sieve elements are part of the phloem and are the main transporting element of food in plants.

35. *Pinus* is monoecious as it has both male and female cones on the same plant.

36. When F1 is crossed with the recessive parent, it is known as a test cross (Tt × Tt). Back cross includes a cross of F_1 with any of the parents, i.e. (Tt × tt) or (Tt × TT).

37. Kaziranga National Park in Assam is famous for rhinoceros.

38. A – Fixation of CO_2 by PEP carboxylase
B – Decarboxylation
C – Regeneration

39. The causal organism for black stem rust disease is *Puccinia graminis tritici*. The stem rust fungus attacks the parts of the plant which are above the ground.

40. Male accessory glands include a pair of seminal vesicles, a prostate gland and a pair of bulbourethral glands. Their secretions are called seminal plasma, which is rich in fructose, has calcium and some enzymes.

41. In malaria, chill and fever are due to the release of haemozoin, a toxic substance formed by the breakdown of haemoglobin present in RBC. In erythrocytic schizogony, it will be released after the rupture of RBC.

42. The ABO blood group is controlled by three alleles—I^A, I^B and i. The relation among these alleles are ($I^A = I^B$) > I, resulting in six genotypes. These genotypes give rise to four phenotypes in the form of blood groups A, B, AB and O.

43. Most enzymes are proteins, but they are never in the form of lipids. However, some are RNA enzymes.

44. The cytoskeleton is an elaborate network of filamentous proteinaceous structures present in the cytoplasm which helps in the maintenance of cell shape. The major cytoskeletons are microtubules, microfilaments and intermediate filaments.

45. A – Offset of Eichhornia
B – Antheridiophore of Marchantia
C – Antipodals
D – Oogonium (nucule) of Chara

46. Root development is promoted by auxin. Rooting hormone 'Rootone' is NAA, a variant of auxin.

47. Pea plant is known for diadelphous stamens—stamens are in two bundles of 9 and 1.

48. A - Head
B - Sheath
C - Collar
D - Tail fibre

49. Plasmids and bacteriophages are used as vectors in genetic engineering.

50. Synthetic capsular polysaccharide vaccines are available for treatment of pneumonia caused by *Streptococcus pneumonia*, *Haemophilus influenzae* and for meningitis caused by *Neisseria meningitidis*. They are not available for plague.

51. The advantage of Drosophila is their short life cycle which enabled Morgan to analyse the results in several generations. In addition, many offspring are produced from a single mating. However, the female in Drosophila is larger than the male.

52. *Lac* operon consists of one regulator gene and three structural genes. Regulatory gene is represented by 'i' and structural genes are represented by 'z', 'y' and 'a'.

53. Crocodile, penguin, whale and dogfish are chordates. So, all have gill slits at some stage of development.

54. Hypothalamus is the floor of the diencephalon which is a part of the forebrain. It has a thermoregulatory centre and hunger and thirst centres.

55. Chemosynthetic autotrophs oxidise inorganic substances to produce energy and helps in the cycling of minerals.

56. Immovable/fixed/fibrous joints are present between the skull bones. So, the parietal bone and the temporal bone of the skull are joined by fibrous joints.

57. *Lemna*, *Pistia*, *Eichhornia* - Offset

58. A - Epidermal cell, B - Subsidiary cell, C - Stomatal aperture, D - Guard cell

59. Pyramid of number is inverted in the single tree ecosystem only.

60. The 3′–5′ phosphodiester bond is formed between carbon 3 of one nucleotide and carbon 5 of the other nucleotide. The bond is catalysed by the enzyme DNA ligase.

Physics

61. The magnitude of the field because of the loop in the xy plane is

$$\left|\vec{B}_1\right| = \frac{1}{2}\left(\frac{\mu_0 i}{2R}\right)$$

Similarly, the magnitude of the field because of the loop in the xz plane is

$$\left|\vec{B}_2\right| = \frac{1}{2}\left(\frac{\mu_0 i}{2R}\right)$$

Therefore, the magnitude of the resultant field because of the entire current loop is

$$\left|\vec{B}\right| = \sqrt{B_1^2 + B_2^2} \Rightarrow \left|\vec{B}\right| = \sqrt{2}\left|\vec{B}_1\right|$$

$$\left|\vec{B}\right| = \frac{\mu_0 i}{4R}\sqrt{2} = \frac{\mu_0 i}{2\sqrt{2}R}$$

62. From the figure, voltage waveforms A, B and Y can be represented in the form of a truth table as

A	B	Y
1	1	0
0	0	1
0	1	1
1	0	1

This truth table is of the NAND gate.

63. Electric field in vacuum is

$$E = \frac{\sigma}{\varepsilon_0}$$

Electric field in a medium of dielectric constant K is

$$E' = \frac{\sigma}{\varepsilon_0 K}$$

We know that for kerosene, K > 1

$\therefore E < E_0$

Hence, the electric filed between the planes will decrease.

64. The distance R/2 means that the point is inside the shell. The electric field inside the shell is always zero. Hence, at a distance R/2 from the centre, the electric field will be zero.

65. From the equation of kinematics, we have

$$h = ut + \frac{1}{2}gt^2$$

$$\Rightarrow h = \frac{1}{2}gt^2 \qquad (\because u = 0)$$

$$\therefore g = \frac{2h}{t^2}$$

Taking natural logarithm on both sides, we get

$$\ln g = \ln h - 2\ln t$$

Hence, the maximum error will be

$$\left(\frac{\Delta g}{g} \times 100\right)_{max} = \frac{\Delta h}{h} \times 100 + 2\frac{\Delta t}{t} \times 100$$

$= e_1 + 2e_2$

66. Number of photoelectrons $\propto$ Intensity

Hence, if the radiation intensity becomes 2I, then the number of photoelectrons becomes 2N.

Maximum kinetic energy is independent of intensity.

Hence, it remains as T.

67. Comparing with $\bar{E} = A\cos(\omega t + kx)$, we have A = amplitude $= 10\frac{V}{m}$. Hence, inference (c) is correct.

$\omega = 10^7, C = 3 \times 10^8$

We know that $C = \frac{\omega}{k}$

$$\Rightarrow 3 \times 10^8 = \frac{10^7}{k}$$

So, $k = \frac{1}{30} = 0.033\ rad/m$

Hence, inference (b) is not correct.

We also have $\frac{2\pi}{\lambda} = k = \frac{1}{30}$ i.e. $\lambda = 188.4\,m$

Hence, inference (a) is correct.

The wave propagation is in the $\hat{j}$ direction, i.e. in the +y direction. So, inference (d) is not correct.

68. The refractive index of medium M_1 is $\mu_1 = \frac{c}{v} = \frac{3\times10^8}{1.5\times10^8} = 2$

Similarly, the refractive index of medium M_2 is $\mu_2 = \frac{c}{v} = \frac{3\times10^8}{2\times10^8} = \frac{3}{2}$

For total internal reflection $\sin i \geq \sin C$

We know that $\sin C = \frac{\mu_2}{\mu_1}$

Hence, we get $\mu_1 \sin i \geq \mu_2 \sin 90^0$

$\Rightarrow 2\sin i \geq \frac{3}{2}$

$\Rightarrow \sin i \geq \frac{3}{4}$

$\Rightarrow i \geq \sin^{-1}\left(\frac{3}{4}\right)$

69. For a prism, the angle of the prism is
$A = r_1 + r_2$
In minimum deviation position
$r_1 = r_2 = r$
Hence, $A = 2r$, which implies $r = \frac{60}{2} = 30°$

70. In terms of size, the collector is the largest and the emitter has heavy doping concentration. Hence, (a) is not correct.
The base should be very thin and lightly doped. Hence, (b) is correct.
The emitter–base junction is forward biased and the base–collector junction is reverse biased. Hence, (c) is also correct.
The emitter–base junction is forward biased and the collector–base junction is reverse biased. So, (d) is not correct.

71. $-\frac{GMm}{2R_1} + KE = -\frac{GMm}{2R_2}$

$KE = \frac{GMm}{2}\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$

72. $v = v_0 \cos\theta$ is the speed of the projectile at its maximum height.

$$\therefore \frac{v_0}{2} = v_0 \cos\theta$$

$$\cos\theta = \frac{1}{2}$$

$$\theta = 60°$$

73. The moment of inertia of the disc is $\frac{1}{2}MR^2$

Hence, the moment of inertia of the disc of mass 9M and radius R is $\frac{9MR^2}{2}$

Now, the moment of inertia of the removed portion of the disc is $\frac{1}{2}M\left(\frac{R}{3}\right)^2 = \frac{MR^2}{18}$

$I = I_1 - I_2$ is the moment of inertia of the remaining disc. So, we get

$$I = \frac{9MR^2}{2} - \frac{MR^2}{18}$$

$$I = \frac{81MR^2 - MR^2}{18}$$

$$I = \frac{40MR^2}{9}$$

74. Given $\frac{x}{a} = \sin\omega t$, $\frac{y}{a} = \cos\omega t$

$$\Rightarrow \frac{y^2}{a^2} + \frac{x^2}{a^2} = 1 \Rightarrow y^2 + x^2 = a^2$$

which represents a circle.

So, the particle follows a circular path.

75. We know that the magnetic moment is M = NIA

$M = 2000 \times 1.5 \times 10^{-4} \times 2 = 0.6$ J/T

The torque on the solenoid is

$$\tau = MB\sin\theta = MB\sin 30 = 0.6 \times 5 \times 10^{-2} \times \frac{1}{2}$$

$$\tau = 1.5 \times 10^{-2} \text{Nm}$$

76. The activity of the radioactive sample is $A = \lambda N$, where $N = N_0 e^{-\lambda t}$

So, $A_1 = \lambda N_1$ and $A_2 = \lambda N_2$

$$\Rightarrow N_1 - N_2 = \left[\frac{A_1 - A_2}{\lambda}\right]$$

77. To keep the particle moving in a horizontal direction, it is necessary that both $\vec{B}$ and $\vec{E}$ should either be along the direction of velocity or both $\vec{B}$ and $\vec{E}$ should be mutually perpendicular to each other and perpendicular to the direction of velocity.

78. When two deuterium nuclei fuse to form a helium nucleus, the energy released is

$${}_1H^2 + {}_1H^2 \rightarrow {}_2He^4 + \Delta E$$

The binding energy of deuterium is $2 \times 1.1 = 2.2$ MeV.

The binding energy of helium is $4 \times 7 = 28$ MeV.

Hence, the energy released is

$$\Delta E = (28 - 2 \times 2.2) \text{ MeV}$$

$$\therefore \Delta E = 23.6 \text{ MeV}$$

79. The electron jumps from the excited state (n = 3) to the ground state (n = 1). Hence, the energy released in the process is

$$E = h\nu = E_3 - E_1 = \frac{-13.6}{3^2} - \frac{-13.6}{1^2}$$

$$E = \frac{-13.6}{9} + 13.6 = 12.1 \text{ eV}$$

According to Einstein's photoelectric equation, we have

$$eV_0 = h\nu - \phi_0$$

$$\therefore eV_0 = 12.1 - 5.1 = 7 \text{ eV}$$

$$\Rightarrow V_0 = 7 \text{ V}$$

80. Let C_p and C_v be the molar specific heat at constant pressure and volume, respectively. Then, we have

$C_p = Mc_p$

$C_v = Mc_v$

We know that $C_p - C_v = R$ is the relation for the ideal gas. Hence, we get

$Mc_p - Mc_v = R$

$$c_p - c_v = \frac{R}{M}$$

81. Initial energy stored in the capacitor $U = \frac{1}{2}CV_1^2$

Final energy in the capacitor $U' = \frac{1}{2}CV_2^2$

Also, energy in the inductor when current i flows through it is $U_L = \frac{1}{2}Li^2$

Using the conservation of energy, we get

$$\frac{1}{2}CV_1^2 = \frac{1}{2}CV_2^2 + \frac{1}{2}Li^2$$
$$\therefore Li^2 = C\left(V_1^2 - V_2^2\right)$$
$$\therefore i = \sqrt{\frac{C\left(V_1^2 - V_2^2\right)}{L}}$$

82. The acceleration due to gravity at a depth d is

$$g' = g\left(1 - \frac{d}{R}\right) = g\left(\frac{R-d}{R}\right)$$

Hence, for distance r < R, we get

$$g' = \frac{gr}{R} \qquad (R - d = r)$$
$$\Rightarrow g' \propto r$$

The acceleration due to gravity at a height h above the surface of the Earth is

$$g' = \frac{g}{\left(1 + \frac{h}{R}\right)^2} = \frac{gR^2}{r^2} \qquad (R + h = r)$$

$$\therefore g' \propto \frac{1}{r^2}$$

Hence, for distance r < R, we get

$$g' = \frac{gr}{R}$$
$$\Rightarrow g' \propto r$$

So, we see that the graph will be the one shown in figure (d). Hence, option (1) is correct.

83. The time taken to reach the bottom of an inclined plane is

$$t = \sqrt{\frac{2l\left(1 + \frac{k^2}{R^2}\right)}{g\sin\theta}}$$

where l = length of inclined plane
K for a solid cylinder is smaller than that for a hollow cylinder.
Hence, the time taken by a solid cylinder is less to reach the bottom.

84. For a thermocouple, it is given that

$$E = 30\theta - \frac{\theta^2}{15} \Rightarrow \frac{dE}{d\theta} = 30 - \frac{2\theta}{15}$$

At neutral temperature $\frac{dE}{d\theta} = 0$

$$\Rightarrow 30 - \frac{2\theta}{15} = 0 \Rightarrow \theta = 225°C$$

85. By the definition of centre of gravity and radius of gyration, the statements 'a' and 'd' are correct.

86. In materials such as bismuth, copper, lead, silicon and water, magnetic moment = 0. When they are placed in an external magnetic field, the orbits of electrons get perturbed, and consequently, a weak magnetic moment is induced in a direction opposite to the external field.

87. Since the charge is stationary, no effect of magnetic field because of bar magnets can be felt.

88. $\text{Power delivered} = \frac{\text{Work done}}{\text{Time taken}}$

Work done $\Rightarrow$ dw = fdx

$dw = ma\int_0^{\frac{1}{2}aT^2} dx$ where 'a' is acceleration.

$$w = ma\left[\frac{1}{2}aT^2\right]$$

$$w = \frac{ma^2T^2}{2}$$

We know that $a = \frac{V}{T}$

$\therefore$ Power is $p = \frac{w}{T} = \frac{mV^2}{T^2}\frac{T^2}{2T} = \frac{mV^2}{2T}$

89. No external torque is acting about the axis. Hence, the angular momentum remains conserved.

$I_1\omega_1 = I_2\omega_2$

$MR^2\omega = (M + 2m)R^2\omega'$

$$\omega' = \frac{M\omega}{(M+2m)}$$

90. The ideal gas equation for an adiabatic process is PV^{γ} = constant

$$PV^{5/3} = P'\left(\frac{V}{8}\right)^{5/3}$$

$$P' = P(8)^{5/3} = P(2)^5$$

$$P' = 32P$$

Chemistry

91. In a period, the atomic size decreases from left to right. Mg, P and Cl belong to period 3 and Ca belongs to period 4. So, Cl < P < Mg < Ca.

92.

	2A +	B +	3C +	D
Initial	1	1	0	0
Eq.	$1-0.50$	$1-0.25$	0.75	0.25

So, the equilibrium constant $= K = \dfrac{(0.75)^3(0.25)}{(0.50)^2(0.75)}$

93. As equivalent conductance is given for ions, equivalent conductance of $Al_2(SO_4)_3$ is

$$\Lambda^0_{Al^{3+}} + \Lambda^0_{SO_4^{2-}}$$

94. Using the ideal gas equation or universal gas equation, PV = nRT

$$PV = \frac{w}{M}$$

$$P = \frac{6}{16.05} \times \frac{8.314 \times 402}{0.03}$$

$$= 41648\,Pa$$

95. $K_p > Q \rightarrow$ Reaction moves in the forward direction

$\Delta G < RT\ln Q$, ΔG = +ve = reaction is non-spontaneous

$K_p = Q$ = Reaction is in equilibrium

$$T > \frac{\Delta H}{\Delta S} = \Delta H \text{ = +ve}$$

Thus, $\Delta H < T\Delta S$ spontaneous

96. In phenols, the presence of the withdrawing group increases the acidic character and the electron-donating group decreases the acidic character compared to phenol.

The nitro group at the para position stabilises the phenoxide ion to a greater extent than at the meta position. So, the correct order of stability is
Para-nitrophenol > meta-nitrophenol > phenol > methyl phenol

97. $Cs^+ > Na^+ > Li^+ \rightarrow$ atomic radii
$I^- > F^- \rightarrow$ atomic radii
The cation is large and the anion is the smallest; therefore, the cation to anion size ratio is maximum.
$\therefore$ CsF has the highest cation to anion size ratio.

98. The gas expands spontaneously into vacuum, $P_{ext} = 0$
$W = 0$

99. $Cl^+, BH_3, \overset{\oplus}{N}O_2$ are electron deficient. So, they cannot be electrophilic.

100. From de Broglie's theory, $\lambda = \frac{h}{mv}$

$$= \frac{6.6 \times 10^{-34}}{0.66 \times 100} = 10^{-35}\ m$$

101. $E_{cell} = E^0_{\underset{(Red)}{cathode}} - E^0_{\underset{(Red)}{Anode}}$

Or

$E_{cell} = E^0_{\underset{(Red)}{cathode}} - E^0_{\underset{(oxid)}{Anode}}$

Or

$E_{cell} = E^0_{\underset{(oxid)}{Anode}} - E^0_{\underset{(oxid)}{cathode}}$

102. $SF_4 = sp^3d$ as the structure of SF_4 is trigonal bipyramidal.

103. $\Delta G = \Delta H - T\Delta S$ from the Gibbs–Helmholtz equation.
Given $\Delta G = 0$
$\Delta H = T\Delta S$,

$$T = \frac{40.63 \times 10^3}{108.8} = 373.4\,K$$

104. Contact process: The process can be divided into three stages:

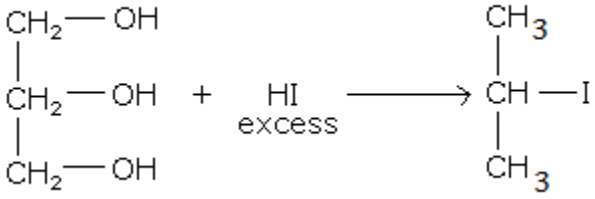
1. Preparation and purification of sulphur dioxide
2. Catalytic oxidation (using vanadium pentoxide catalyst) of sulphur dioxide to sulphur trioxide
3. Conversion of sulphur trioxide to sulphuric acid

Haber process: $N_{2\,(g)} + 3\,H_{2\,(g)} \rightleftharpoons 2\,NH_{3\,(g)}$ ($\Delta H = -92.4\ kJ \cdot mol^{-1}$) Fe as a catalyst and Mo as a promoter.

Bessemer process: The key principle is the removal of impurities from molten pig iron by oxidation with air being blown through the molten iron. The oxidation also raises the temperature of the iron mass and keeps it molten.

Leblanc process: It is actually used for the preparation of sodium carbonate.

105.



(Glycerol) (2-Iodopropane)

106. Dielectric constant of H_2O > D_2O. Therefore, H_2O is the more effective solvent. BP of D_2O > BP of H_2O. Hence, it is used as a moderator in nuclear reactors and is more associated than ordinary water.

107. A → $CaCO_3$
B → $Ca(OH)_2$
C → $Ca(HCO_3)_2$

108.

$$CH_3(CH_2)_3NH_2 \xrightarrow[CHCl_3]{Alc.KOH} CH_3CH_2CH_2CH_2NC + 3\,KCl + 3\,H_2O$$

Bad smell

$$CH_3C \equiv CH + Amm.\,AgNO_3 \rightarrow CH_3C \equiv C^-\,Ag^+ + HNO_3$$

White ppt.

$$CH_3CH_2COOCH_3 + NaOH \xrightarrow{Heat} CH_3CH_2COONa + CH_3OH$$

$$CH_3CH(OH)CH_3 + Conc.HCl \xrightarrow{Anhy.ZnCl_2} CH_3 - \underset{\displaystyle Cl}{\underset{|}{CH}} - CH_3 + H_2O$$

(cloudiness appears in 5 minutes)

109. The stability of the carbocation depends on the carbocation intermediate. More the stability of carbocation, faster the rate of dehydration.

110. Concentration does not affect the rate constant. For a zero-order reaction, rate constant = rate of reaction, which is independent of the concentration of reactions.

Hence, the value of the rate constant can be increased by increasing the temperature.

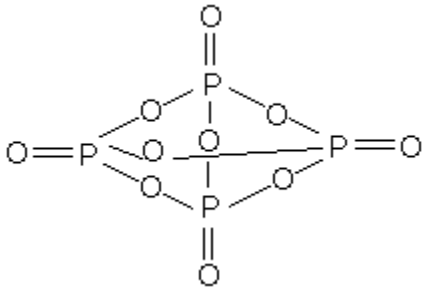
111. $[Ni(NH_3)_2Cl_2]$ has tetrahedral geometry and hence does not exhibit isomerism because of the presence of symmetry elements.

112. The conformation is the most stable because of intramolecular H bonding.

113. The IUPAC name of the compound $CH_3CH=CHC\equiv CH$ is pent-3-en-1-yne.

114. The common oxidation state of lanthanides is +3. Along with +3, they can show +1 and +4 also.

115. The structure of P_4O_{10} is



There are 6 bridging oxygen atoms.

116. $NO_3^- = sp^2$, central atom is sp^2 hybridised and has trigonal planar geometry.

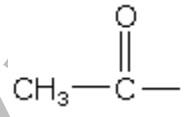
$H_3O^+ = sp^3$, central atom is sp^3 hybridised and has pyramidal geometry.

117. ΔH for $Fe_2O_{3(s)} + CO_{(g)} \rightarrow 2FeO_{(s)} + CO_{2(g)}$ is

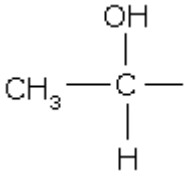
$\Delta H_{(1)} - 2\,\Delta H_{(2)}$

i.e. $-26.8 - (2)(-16.5) = 6.2$ kJ

118. Compounds with either



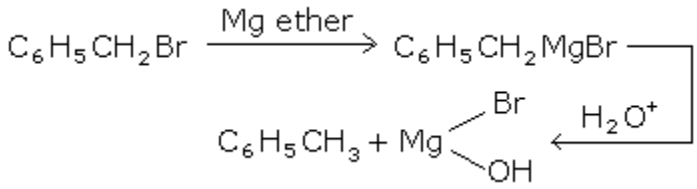
OR



gives iodoform when warmed with I_2 and NaOH.

119. Fructose reduces Tollens' reagent because of enolisation of fructose, followed by conversion to aldehyde by base.

120.



AIPMT - 2011
(Physics, Chemistry and Biology)
Prelims (Code A)

Time: 3 hrs **Total Marks: 600**

General Instructions:

1. The Answer sheet is inside this Text booklet. When you are directed to open the text booklet, take out the Answer Sheet and fill in the particulars on side – 1 and side – 2 carefully with blue/black ball point pen only.
2. The test is of 3 hours duration and consists of 200 questions. Each question carries 3 marks. For each correct response the candidate will get 3 marks. For each incorrect response, one mark will be deducted. The maximum marks are 600.
3. Use Blue / Black ball point pen only for writing particulars on this page / marking responses.
4. Rough work is to be done on the space provided for this purpose in the text booklet only.
5. On completion of the test, the candidate must handover the answer sheet to the invigilator in the room/ Hall. The candidates are allowed to take away this text booklet with them.
6. Make sure that the CODE printed on side – 2 of the answer sheet is the same as that on this booklet, In case of discrepancy, the candidate should immediately report the matter to the invigilator for the replacement of both the test Booklet and the Answer Sheet.
7. The candidates should ensure that the Answer sheet is not folded. Do not make any stray marks on the Answer sheet. Do not write your roll no. anywhere else except in the specified space in the Test booklet / Answer Sheet.
8. Use of white fluid for correction is not permissible on the Answer Sheet.

Physics

1. The dimension of $(\mu_o \in_o)^{-\frac{1}{2}}$ are :

(1) $\left[L^{-\frac{1}{2}}T^{\frac{1}{2}}\right]$

(2) $\left[L^{\frac{1}{2}}T^{-\frac{1}{2}}\right]$

(3) $\left[L^{-1}T\right]$

(4) $\left[LT^{-1}\right]$

2. The moment of inertia of a thin uniform rod of mass M and length L about an axis passing through its mid-point and perpendicular to its length is I_o. Its moment of inertia about an axis pass through one of its ends and perpendicular to its length is:
(1) $I_o + ML^2$
(2) $I_0 + \frac{ML^2}{2}$
(3) $I_0 + \frac{ML^2}{4}$
(4) $I_0 + 2ML^2$

3. A boy standing at the top of a tower of 20 m height drops a stone. Assuming g = 10 ms^{-2}, the velocity with which it hits the ground is:
(1) 5.0 m/s
(2) 10.0 m/s
(3) 20.0 m/s
(4) 40.0 m/s

4. A person of mass 60 kg is inside a lift of mass 940 kg and presses the button on control panel. The lift starts moving upwards with an acceleration 1.0 m/s^2. If g = 10 ms^{-2}, the tension in the supporting cable is:
(1) 1200 N
(2) 8600 N
(3) 9680 N
(4) 11000 N

5. A body projected vertically from the Earth reaches a height equal to Earth's before returning to the Earth. The power exerted by the gravitational force is greatest:
(1) At the instant just after the body is projected
(2) At the highest position of the body
(3) At the instant just before the body hits earth
(4) It remains constant all through

6. The instantaneous angular position of a point on a rotating wheel is given by the equation $\theta(t)=2t^3-6t^2$
The torque on the wheel becomes zero at:
(1) t = 2 s
(2) t = 1 s
(3) t = 0.5 s
(4) t = 0.25 s

7. A particle moves in a circle of radius 5 cm with constant speed and time period 0.2π s. The acceleration of the particle is:
(1) $5\ m/s^2$
(2) $15\ m/s^2$
(3) $25\ m/s^2$
(4) $36\ m/s^2$

8. A body of mass M hits normally a rigid wall with velocity V and bounces back with the same velocity. The impulse experienced by the body is:
(1) Zero
(2) MV
(3) 1.5 MV
(4) 2 MV

9. A planet moving along an elliptical orbit is closest to the Sun at a distance r_1 and farthest away at a distance of r_2. If v_1 and v_2 are the linear velocities at these points respectively, then the ratio $\frac{v_1}{v_2}$ is:
(1) r_1 / r_2
(2) $(r_1/r_2)^2$
(3) r_2 / r_1
(4) $(r_2/r_1)^2$

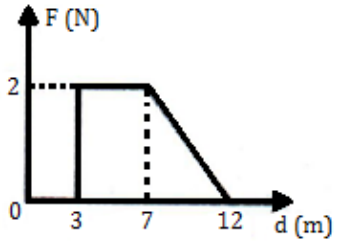
10. A radioactive nucleus of mass M emits a photon of frequency ν and the nucleus recoils. The recoil energy will be:
(1) $h\nu$
(2) $Mc^2 - h\nu$
(3) $h^2\nu^2 / 2MC^2$
(4) zero

11. The potential energy of a system increases if work is done:
(1) Upon the system by a conservative force.
(2) Upon the system by a nonconservative force .
(3) By the system against a conservative force.
(4) By the system against a nonconservative force.

12. A body is moving with velocity 30 m/s towards east. After 10 seconds its velocity becomes 40 m/s towards north. The average acceleration of the body is:
(1) $5\ m/s^2$
(2) $1\ m/s^2$
(3) $7\ m/s^2$
(4) $\sqrt{7}\ m/s^2$

13. A missile is fired for maximum range with an initial velocity of 20 m/s. If g = 10 m/s^2, the range of the missile is:
(1) 20 m
(2) 40 m
(3) 50 m
(4) 60 m

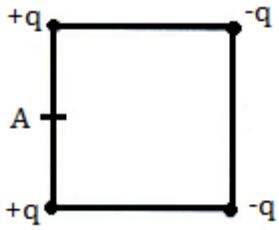
14. Force F on a particle moving in a straight line varies with distance d as shown in the figure. The work done on the particle during its displacement of 12 m is:



(1) 13 J
(2) 18 J
(3) 21 J
(4) 26 J

15. A charge Q is enclosed by a Gaussian spherical surface of radius R. If the radius is doubled, then the outward electric flux will:
(1) Be doubled
(2) Increase four times
(3) Be reduced to half
(4) Remain the same

16. Four electric charges +q, +q, -q and –q are placed at the corners of a square of side 2L (see figure). The electric potential at point A, midway between the two charges +q and +q is:



(1) Zero
(2) $\frac{1}{4\pi\epsilon_o}\frac{2q}{L}(1+\sqrt{5})$
(3) $\frac{1}{4\pi\epsilon_o}\frac{2q}{L}(1+\frac{1}{\sqrt{5}})$
(4) $\frac{1}{4\pi\epsilon_o}\frac{2q}{L}(1-\frac{1}{\sqrt{5}})$

17. A parallel plate condenser has a uniform electric field E (V/m) in the space between the plates. If the distance between the plates is d (m) and area of each plate is A (m^2), the energy (joules) stored in the condenser is:

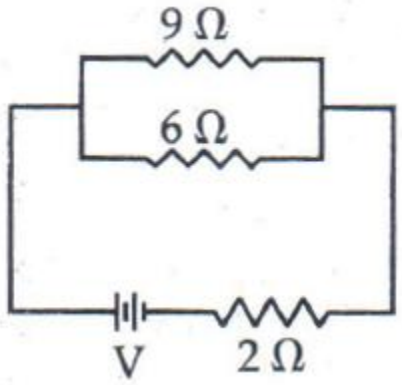
(1) $\frac{1}{2}\in_o E^2Ad$

(2) $\frac{E^2Ad}{\in_o}$

(3) $\frac{1}{2}\in_o E^2$

(4) $\in_o EAd$

18. If power dissipated in the 9 Ω resistor in the circuit shown is 36 W, the potential difference across the 2 Ω resistor is:



(1) 2 Volt
(2) 4 Volt
(3) 8 Volt
(4) 10 Volt

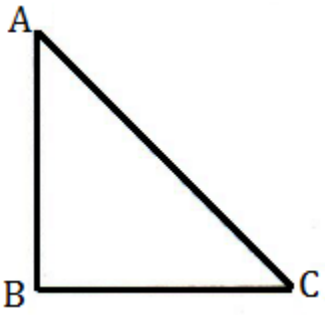
19. A current of 2 A flows through a 2 Ω resistor when connected across a battery. The same battery supplies a current of 0.5 A when connected across a 9 Ω resistor. The internal resistance of the battery is:

(1) 1 Ω
(2) 0.5 Ω
(3) 1/3 Ω
(4) ¼ Ω

20. The rate of increase of thermo-e.m.f. with temperature at the neutral temperature of a thermocouple:

(1) Is negative
(2) Is positive
(3) Is zero
(4) Depends upon the choice of the two materials of the thermocouple

21. A current carrying closed loop in the form of a right angle isosceles triangle ABC is placed in a uniform magnetic field acting along AB. If the magnetic force on the arm BC is $\vec{F}$, the force on the arm AC is:



(1) $\sqrt{2}\vec{F}$

(2) $-\sqrt{2}\vec{F}$

(3) $-\vec{F}$

(4) $\vec{F}$

22. The power obtained in a reactor using U^{235} disintegration is 1000 kW. The mass decay of U^{235} per hour is:

(1) 1 microgram

(2) 10 microgram

(3) 20 microgram

(4) 40 microgram

23. There are four light-weight rod samples A, B, C, D separately suspended by threads. A bar magnet is slowly brought near each sample and the following observations are noted:

(i) A is feebly repelled

(ii) B is feebly attracted

(iii) C is strongly attracted

(iv) D remains unaffected

Which one of the following is true?

(1) A is of non-magnetic material

(2) B is of a paramagnetic material

(3) C is of a diamagnetic material

(4) D is of a ferromagnetic material

24. The electric and the magnetic field, associated with an e.m. wave, propagating along the + z-axis, can be represented by:

(1) $\left[\vec{E}=E_o\hat{j},\vec{B}=B_o\hat{k}\right]$

(2) $\left[\vec{E}=E_o\hat{i},\vec{B}=B_o\hat{j}\right]$

(3) $\left[\vec{E}=E_o\hat{k},\vec{B}=B_o\hat{i}\right]$

(4) $\left[\vec{E}=E_o\hat{j},\vec{B}=B_o\hat{i}\right]$

25. A uniform electric field and a uniform magnetic field are acting along the same direction in a certain region. If an electron is projected in the region such that its velocity is pointed along the direction of fields, then the electron:

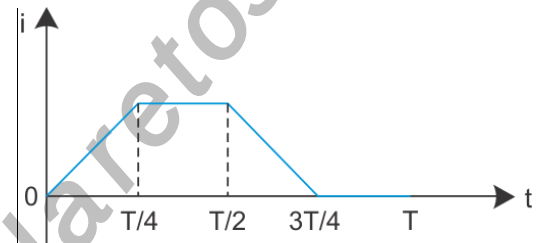
(1) Will turn towards left of direction of motion

(2) Will turn towards right of direction of motion

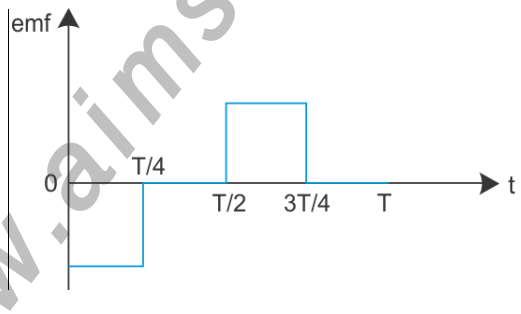
(3) Speed will decrease

(4) Speed will increase

26. The current I in a coil varies with time as shown in the figure. The variation of induced emf with time would be:



(1)



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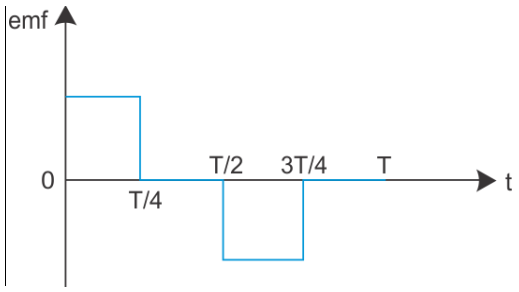

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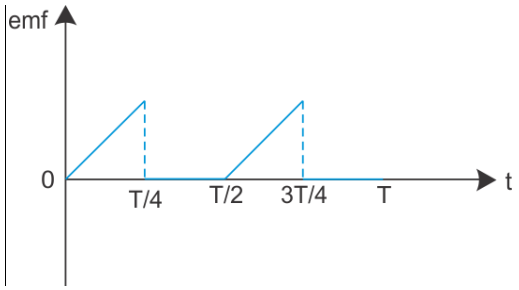

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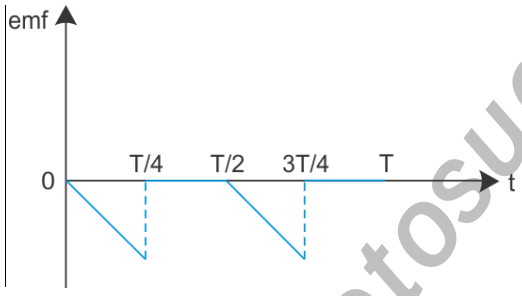


27. In an ac circuit an alternating voltage e = 200 $\sqrt{2}$ sin 100 t volts is connected to a capacitor of capacity 1 μF. The r.m.s value of the current in the circuit is:

(1) 20 mA
(2) 10 mA
(3) 100 mA
(4) 200 mA

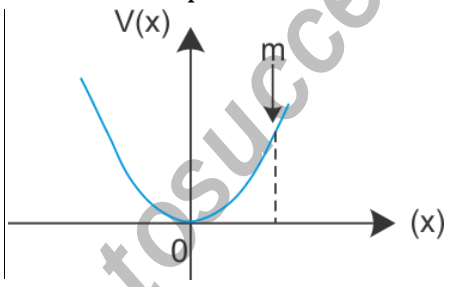
28. An ac voltage is applied to a resistance R and an inductor L in series. If R and the inductive reactance are both equal to 3 Ω, the phase difference between the applied voltage and the current in the circuit is:

(1) zero
(2) $\frac{\pi}{6}$
(3) $\frac{\pi}{4}$
(4) $\frac{\pi}{2}$

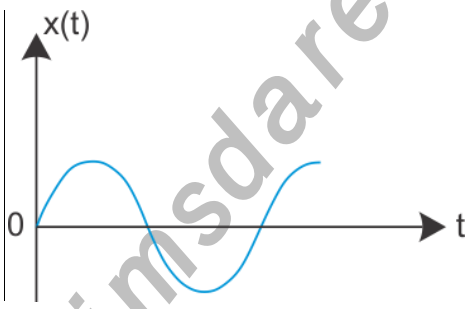
29. When 1 kg of ice at 0 °C melts to water at 0 °C, the resulting change in its entropy, taking latent heat of ice to be 80 Cal/°C, is:
(1) 293 cal/K
(2) 273 cal/K
(3) 8×10^4 cal/K
(4) 80 cal/K

30. During an isothermal expansion, a confined ideal gas does - 150 J of work against its surroundings. This implies that:
(1) 150 J of heat has been added to the gas
(2) 150 J of heat has been removed from the gas
(3) 300 J of heat has been added to the gas
(4) No heat is transferred because the process is isothermal

31. A particle of mass m is released from rest and follows a parabolic path as shown. Assuming that the displacement of the mass from the origin is small, which graph correctly depicts the position of the particle as a function of time?



(1)



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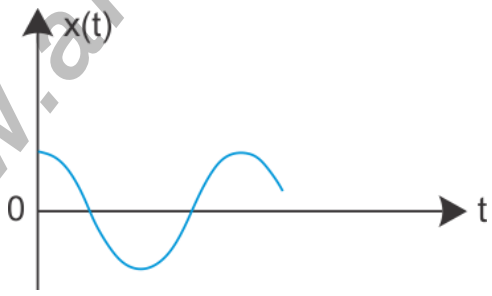

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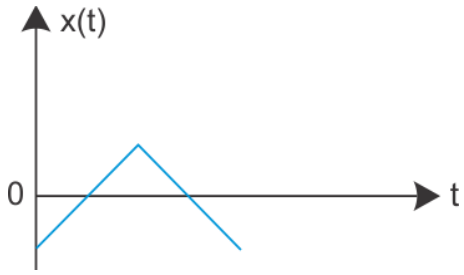

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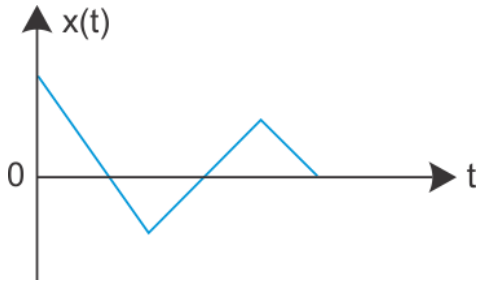


32. Two waves are represented by the equation $y_1 = a \sin(\omega t + kx + 0.57)$ m and $y_2 = a \cos(\omega t + kx)$m, where x is in metre and t in sec. The phase difference between them is:

(1) 0.57 radian
(2) 1.0 radian
(3) 1.25 radian
(4) 1.57 radian

33. Out of the following functions representing motion of a particle which represents SHM:

(A) $Y = \sin\omega t - \cos\omega t$
(B) $Y = \sin^3\omega t$
(C) $Y = 5\cos\left(\frac{3\pi}{4} - 3\omega t\right)$
(D) $Y = 1 + \omega t + \omega^2 t^2$

(1) Only (A) and (B)
(2) Only (A)
(3) Only (D) does not represent SHM
(4) Only (A) and (C)

34. Sound waves travel at 350 m/s through warm air and at 3500 m/s through brass. The wavelength of a 700 Hz acoustic wave as it enters brass from warm air:

(1) Decrease by a factor 20
(2) Decrease by a factor 10
(3) Increases by a factor 20
(4) Increases by a factor 10

35. The decreasing order of wavelength of infrared, microwave, ultraviolet and gamma rays is:
(1) Infrared, microwave, ultraviolet, gamma rays
(2) Microwave, infrared, ultraviolet, gamma rays
(3) Gamma rays, ultraviolet, infrared, microwaves
(4) Microwaves, gamma rays, infrared, ultraviolet

36. The wavelength of the first line of Lyman series for hydrogen atom is equal to that of the second line of Balmer series for a hydrogen like ion. The atomic number Z of hydrogen like ion is:
(1) 2
(2) 3
(3) 4
(4) 1

37. Which of the following is not due to total internal reflection?
(1) Brilliance of diamond
(2) Working of optical fibre
(3) Difference between apparent and real depth of a pond
(4) Mirage on hot summer days

38. A biconvex lens has radius of curvature of magnitude 20 cm. Which one of the following options describes best the image formed of an object of height 2 cm placed 30 cm from the lens?
(1) Real, inverted, height = 1 cm
(2) Virtual, upright, height = 1 cm
(3) Virtual, upright, height = 0.5 cm
(4) Real, inverted, height = 4 cm

39. In photoelectric emission process from a metal of work function 1.8 eV, the kinetic energy of the most energetic electrons is 0.5 eV. The corresponding stopping potential is:
(1) 2.3 V
(2) 1.8 V
(3) 1.3 V
(4) 0.5 V

40. Electrons used in an electron microscope are accelerated by a voltage of 25 kV. If the voltage is increased to 100 kV, then the de-Broglie wavelength associated with the electrons would:
(1) Increase by 4 times
(2) Increase by 2 times
(3) Decrease by 2 times
(4) Decrease by 4 times

41. Light of two different frequencies whose photons have energies 1 eV and 2.5 eV respectively illuminate a metallic surface whose work function is 0.5 eV successively. Ratio of maximum speeds of emitted electrons will be:
(1) 1:5
(2) 1:4
(3) 1:2
(4) 1:1

42. In the Davisson and Germer experiment, the velocity of electrons emitted from the electron gun can be increased by:
(1) Decreasing the potential difference between the anode and filament
(2) Increasing the potential difference between the anode and filament
(3) Increasing the filament current
(4) Decreasing the filament current

43. The half life of a radioactive isotope 'X' is 50 years. It decays to another element 'Y' which is stable. The two elements 'X' and 'Y' were found to be in the ratio of 1:15 in a sample of a given rock. The age of the rock was estimated to be:
(1) 100 years
(2) 150 years
(3) 200 years
(4) 250 years

44. Photoelectric emission occurs only when the incident light has more than a certain minimum:
(1) frequency
(2) power
(3) wavelength
(4) intensity

45. Fusion reaction takes place at high temperature because:
(1) Molecules break up at high temperature
(2) Nuclei break up at high temperature
(3) Atoms get ionized at high temperature
(4) Kinetic energy is high enough to overcome the coulomb repulsion between nuclei

46. A nucleus ${}^{m}_{n}X$ emits one α - particle and two β - particles. The resulting nucleus is:
(1) ${}^{m-4}_{n-2}Y$
(2) ${}^{m-6}_{n-4}Z$
(3) ${}^{m-6}_{n}Y$
(4) ${}^{m-4}_{n}X$

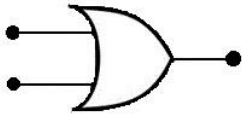
47. A transistor is operated in common emitter configuration at $V_C = 2$ V such that a change in the base current from 100 μA to 300 μA produces a change in the collector current from 10 mA to 20 mA. The current gain is:
(1) 25
(2) 50
(3) 75
(4) 100

48. If a small amount of antimony is added to germanium crystal:
(1) Its resistance is increased
(2) It becomes a p-type semiconductor
(3) The antimony becomes an acceptor atom
(4) There will be more free electrons than holes in the semiconductor

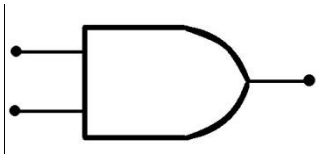
49. In forward biasing of the p-n junction
(1) The positive terminal of the battery is connected to p –side and the depletion region becomes thin
(2) The positive terminal of the battery is connected to p-side and the depletion region becomes thick
(3) The positive terminal of the battery is connected to n-side and the depletion region becomes thin
(4) The positive terminal of the battery is connected to n-side and the depletion region becomes thick

50. Symbolic representation of four logic gates are shown as:

(1)



(2)



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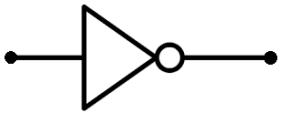

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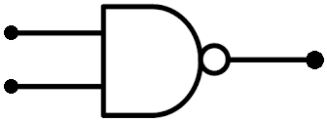


Pick out which ones are for AND, NAND and NOT gates, respectively:

(1) (ii), (iv) and (iii)

(2) (ii), (iii) and (iv)

(3) (iii), (ii) and (i)

(4) (iii), (ii) and (iv)

Chemistry

51. The total number of atomic orbitals in fourth energy level of an atom is
(1) 4
(2) 8
(3) 16
(4) 32

52. The electrode potentials for

$Cu^{2+}_{(aq)} + e^- \rightarrow Cu^+_{(aq)}$

and $Cu^+_{(aq)} + e^- \rightarrow Cu_{(s)}$

are + 0.15 V and + 0.50 V respectively. The value of $E^o_{Cu^{2+}/Cu}$ will be :
(1) 0.150 V
(2) 0.500 V
(3) 0.325 V
(4) 0.650 V

53. Mole fraction of the solute in a 1.00 molal aqueous solution is :
(1) 1.7700
(2) 0.1770
(3) 0.0177
(4) 0.0344

54. By what factor does the average velocity of a gaseous molecule increase when the temperature (in Kelvin) is doubled?
(1) 1.4
(2) 2.0
(3) 2.8
(4) 4.0

55. 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)
(1) 8.73
(2) 9.08
(3) 9.43
(4) 11.72

56. Two gases A and B having the same volume diffuse through a porous partition in 20 and 10 seconds respectively. The molecular mass of A is 49 u. Molecular mass of B will be :
(1) 25.00 u
(2) 50.00 u
(3) 12.25 u
(4) 6.50 u

57. Which of the following is correct option for free expansion of an ideal gas under adiabatic condition?
(1) $q=0,\Delta T<0,w\neq 0$
(2) $q=0,\Delta T\neq 0,w=0$
(3) $q\neq 0,\Delta T=0,w=0$
(4) $q=0,\Delta T=0,w=0$

58. For the reaction $N_{2(g)} + O_{2(g)} \rightarrow 2NO_{(g)}$, the equilibrium constant is K_1. The equilibrium constant is K_2 for the reaction $2NO_{(g)} + O_{2\,(g)} \rightarrow 2NO_{2(g)}$. What is K for the reaction $NO_{2\,(g)} \rightarrow 1/2\ N_{2\,(g)} + O_{2\,(g)} \uparrow$
(1) $1/(K_1K_2)$
(2) $1/(2\ K_1K_2)$
(3) $1/(4\ K_1K_2)$
(4) $[1/K_1K_2]^{1/2}$

59. If x is amount of adsorbate and m is amount of adsorbent, which of the following relations is not related to adsorption process?
(1) $\frac{x}{m} = p \times T$
(2) x/m = f(p) at constant T
(3) x/m = (T) at constant p
(4) p = f (T) at constant (x/m)

60. If the enthalpy change for the transition of liquid water to steam is 30 kJ mol^{-1} at 27°C, the entropy change for the process would be :
(1) 100 J mol^{-1} K^{-1}
(2) 10 J mol^{-1} K^{-1}
(3) 1.0 J mol^{-1} K^{-1}
(4) 0.1 J mol^{-1} K^{-1}

61. The van't Hoff factor i for a compound which undergoes dissociation in one solvent and association in other solvent is respectively :
(1) Greater than one and greater than one
(2) Less than one and greater than one
(3) Less than one and less than one
(4) Greater than one and less than one

62. Standard electrode potential for Sn^{4+} / Sn^{2+} couple is +0.15 V and that for the Cr^{3+}/ Cr couple is -0.74 V. These two couples in their standard state are connected to make a cell. The cell potential will be :
(1) +1.83 V
(2) +1.19 V
(3) +0.89 V
(4) +.018 V

63. A gaseous mixture was prepared by taking equal mole of CO and N_2. If the total pressure of the mixture was found 1 atmosphere, the partial pressure of the nitrogen (N_2) in the mixture is :
(1) 1 atm
(2) 0.5 atm
(3) 0.8 atm
(4) 0.9 atm

64. If the E^o_{Cell} for a given reaction has a negative value, then which of the following gives the correct relationships for the values of ΔG^o and K_{eq}?
(1) $\Delta G^o > 0$; $K_{eq} < 1$
(2) $\Delta G^o > 0$; $K_{eq} > 1$
(3) $\Delta G^o < 0$; $K_{eq} > 1$
(4) $\Delta G^o < 0$; $K_{eq} < 1$

65. The freezing point depression constant for water is -1.86^oCm^{-1}. If 5.00 g Na_2SO_4 is dissolved in 45.0 g H_2O, the freezing point is changed by -3.82^oC. Calculate the van't Hoff factor for Na_2SO_4
(1) 0.381
(2) 2.05
(3) 2.63
(4) 3.11

66. The energies E_1 and E_2 of two radiations are 25 eV and 50 eV respectively. The relation between their wavelengths i.e λ_1 and λ_2 will be:

(1) $\lambda_1 = \frac{1}{2}\lambda_2$

(2) $\lambda_1 = \lambda_2$

(3) $\lambda_1 = 2\lambda_2$

(4) $\lambda_1 = 4\lambda_2$

67. 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 :

(1) X > Y > Z

(2) Y > Z > X

(3) Y > X > Z

(4) Z > X > Y

68. Which one of the following statements for the order of a reaction is **incorrect?**

(1) Order of reaction is always whole number

(2) Order can be determined only experimentally

(3) Order is not influenced by stoichiometric coefficient of the reactants

(4) Order of reaction is sum of power to the concentration terms of reactants to express the rate of reaction

69. Enthalpy change for the reaction,

$4H_{(g)} \rightarrow 2H_{2(g)}$ is -869.6kJ

The dissociation energy of H – H bond is:

(1) +217.4 kJ

(2) -434.8 kJ

(3) -869.6 kJ

(4) +434.8 kJ

70. If n = 6 the correct sequence for filling of electrons will be :

(1) ns $\rightarrow$ np (n-1)d $\rightarrow$ (n-2) f

(2) ns $\rightarrow$ n(n-2)f $\rightarrow$ (n-1)d $\rightarrow$ np

(3) ns $\rightarrow$ (n-1)d $\rightarrow$ (n-2)f $\rightarrow$ np

(4) ns $\rightarrow$ (n-2)f $\rightarrow$ np $\rightarrow$ (n-1)d

71. Which of the following compounds has the lowest melting point?
(1) CaF_2
(2) $CaCl_2$
(3) $CaBr_2$
(4) CaI_2

72. Which of the following pairs of metal is purified by van Arkel method?
(1) Ni and Fe
(2) Ga and In
(3) Zr and Ti
(4) Ag and Au

73. The correct order of increasing bond length of C – H, C- O, C – C and C = C is :
(1) C – H < C – O < C – C < C = C
(2) C – H < C = C < C – O < C - C
(3) C – C < C = C < C – O < C - H
(4) C – O < C – H < C – C < C = C

74. Acidified$K_2Cr_2O_7$ solution turns green when Na_2SO_3 is added to it. This is due to the formation of :
(1) $CrSO_4$
(2) $Cr_2(SO_4)_3$
(3) CrO_4^{2--}
(4) $Cr_2(SO_3)_3$

75. For the four successive transition elements (Cr, Mn, Fe and Co), the stability of +2 oxidation state will be there in which of the following order?
(1) Cr > Mn > Co > Fe
(2) Mn > Fe > Cr > Co
(3) Fe > Mn > Co > Cr
(4) Co > Mn > Fe > Cr

76. Which of the two ions from the list given below that have the geometry that is explained by the same hybridization of orbitals, NO_2^-, NO_3^-, NH_2^-, NH_4^+, SCN^- ?
(1) NO_2^- and NH_2^-
(2) NO_2^- and NO_3^-
(3) NH_4^+ and NO_3^-
(4) SCN^- and NH_2^-

77. Which of the following elements is present as the impurity to the maximum extent in the pig iron ?
(1) Phosphorus
(2) Manganese
(3) Carbon
(4) Silicon

78. Which of the following is least likely to behave as Lewis base ?
(1) OH^-
(2) H_2O
(3) NH_3
(4) BF_3

79. Which one of the following is present as an active ingredient in bleaching powder for bleaching action?
(1) $Ca\ Cl_2$
(2) $CaOCl_2$
(3) $Ca(OCl)_2$
(4) $Ca\ O_2Cl$

80. The complex, [Pt (Py) (NH_3) Br Cl] will have how many geometrical isomers
(1) 2
(2) 3
(3) 4
(4) 0

81. Name the type of the structure of silicate in which one oxygen atom of $[SiO_4]^{4-}$ is shared?
(1) Three dimensional
(2) Linear chain silicate
(3) Sheet silicate
(4) Pyrosilicate

82. 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 ?
(1) Geometrical isomerism
(2) Linkage isomerism
(3) Ionization isomerism
(4) Coordination isomerism

83. The d- electron configurations of Cr^{2+}, Mn^{2+}, Fe^{2+} and CO^{2+} are d^4, d^5,d^6 and d^7 respectively. Which one of the following will exhibit minimum paramagnetic behavior?
(1) $[Cr(H_2O)_6]^{2+}$
(2) $[Mn(H_2O)_6]^{2+}$
(3) $[Fe(H_2O)_6]^{2+}$
(4) $[Co(H_2O)6]^{2+}$
(At.Nos. Cr = 24, Mn = 25, Fe = 26, Co = 27)

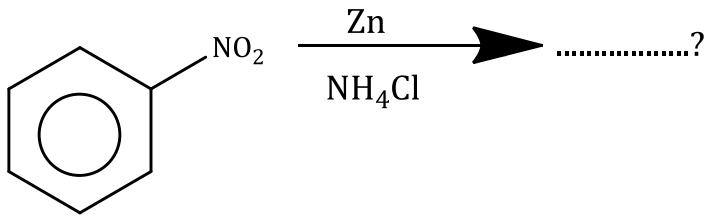
84. Of the following complex ions, which is diamagnetic in nature?
(1) $[CoF_6]^{3-}$
(2) $[NiCl_4]^{2-}$
(3) $[Ni(CN)_4]^{2-}$
(4) $[Cu\ Cl_4]^{2-}$

85. Which of the following has the minimum bond length?
(1) O_2
(2) O_2^+
(3) O_2^-
(4) O_2^{2-}

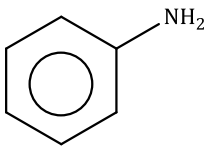
86. The value of ΔH for the reaction
$X_{2(g)} + 4Y_{2(g)} \rightarrow 2XY_{4(g)}$ is less than zero. Formation of $XY_{4(g)}$ will e favoured at:
Formation of $XY_{4(g)}$ will be favoured at :
(1) High pressure and low temperature
(2) High temperature and high pressure
(3) Low pressure and low temperature
(4) High temperature and low pressure

87. Of the following which one is classified as polyster polymer?
(1) Nylon – 66
(2) Terylene
(3) Bakelite
(4) Melamine

88. What is the product obtained in the following reaction :



(1)



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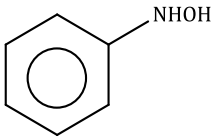

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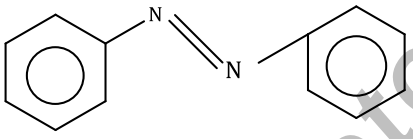

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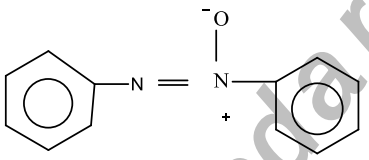
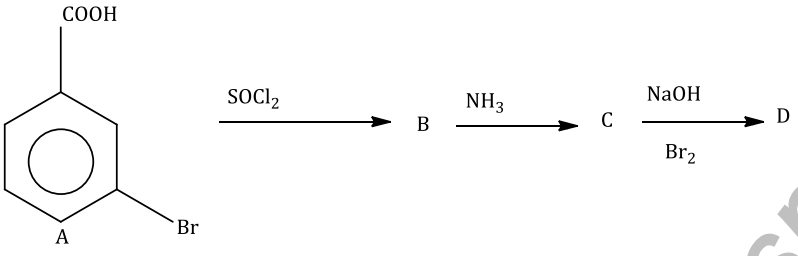
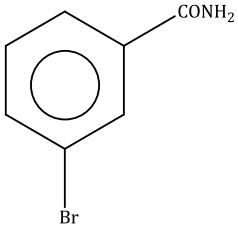


89. In a set of reactions m – bromobenzoic acid gave a product D. Identify the product D.



(1)



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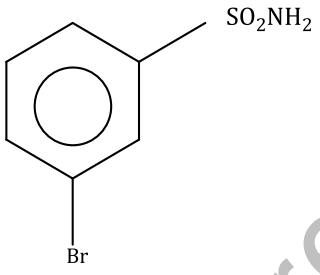

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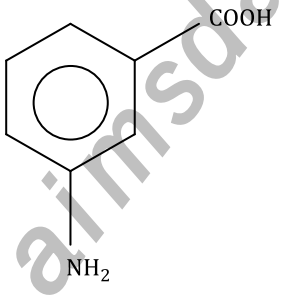

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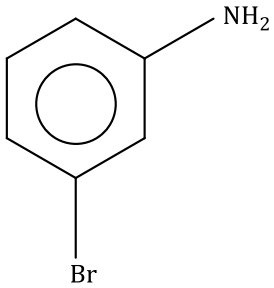
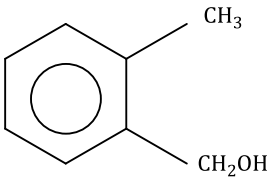


90. In Duma's method of estimation of nitrogen 0.35 g of an organic compound gave 55 mL of nitrogen collected at 300 K temperature and 715 mm pressure. The percentage composition of nitrogen in the compound would be :
(Aqueous tension at 300 K = 15 mm)
(1) 14.45
(2) 15.45
(3) 16.45
(4) 17.45

91. Which one of the following is most reactive towards electrophilic reagent?
(1)



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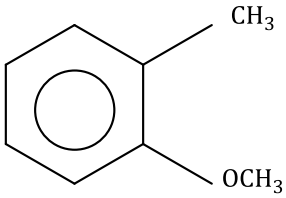

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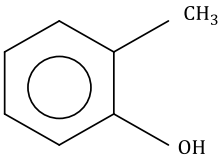

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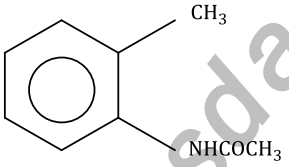


92. Which one is a nucleophilic substitution reaction among the following?

(1) $CH_3CHO+HCN \rightarrow CH_3CH(OH)CN$

(2) $CH_3-CH=CH_2+H_2O \xrightarrow[CH_3-\underset{\underset{OH}{|}}{CH}-CH_3]{H^+}$

(3)

$$RCHO + R'MgX \rightarrow R-\underset{\underset{OH}{|}}{CH}-R'$$

(4)

$$CH_3-CH_2-\underset{\underset{CH_3}{|}}{CH}-CH_2Br + NH_3 \rightarrow CH_3-CH_2-\underset{\underset{CH_3}{|}}{CH}-CH_2NH_2$$

93. Considering the state of hybridization of carbon atoms, find out the molecule among the following which is linear?

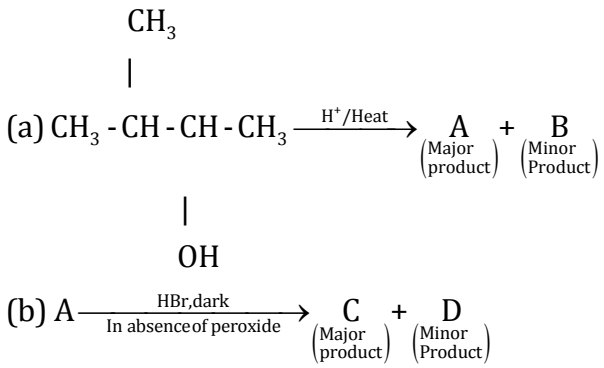
(1) $CH_3 - CH_2 - CH_2 - CH_3$

(2) $CH_3 - CH = CH - CH_3$

(3) $CH_3 - C \equiv C - CH_3$

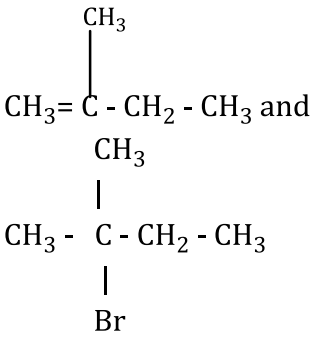
(4) $CH_2 = CH - CH_2 - C \equiv CH$

94. In the following reactions,

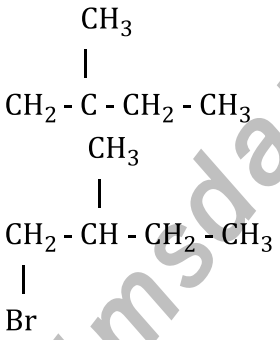


The major products (A) and (C) are respectively:

(1)



(2)



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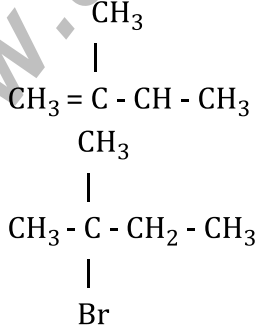
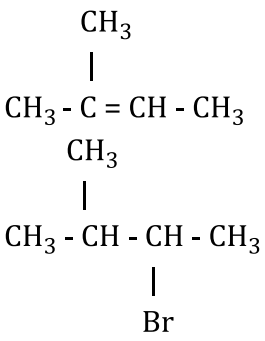


(4)



95. The Lassaigne's extract is boiled with conc HNO_3 while testing for halogens. By doing so it :

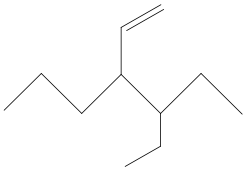
(1) Increases the concentration of NO_3^- ions

(2) Decomposes Na_2S and NaCN, if formed

(3) Helps in the precipitation of AgCl

(4) Increases the solubility product of AgCl

96. The correct IUPAC name of the compound



is:

(1) 3 – (1-ethyl propyl) hex – 1 ene

(2) 4 –Ethyl – 3 – propyl hex – 1 – ene

(3) 3-Ethyl – 4 – ethenyl heptane

(4) 3 – Ethyl – 4 – propyl hex – 5 - ene

97. Clemmensen reduction of a ketone is carried out in the presence of which of the following?

(1) H_2 and Pt as catalyst

(2) Glycol with KOH

(3) Zn – Hg with HCl

(4) Li AlH_4

98. Which one of the following is employed as Antihistamine?

(1) Omeprazole

(2) Chloramphenicol

(3) Diphenyl hydramine

(4) Norothindrone

99. Which one of the following statements is not true regarding (+) Lactose?
(1) (+) Lactose, $C_{12}H_{22}O_{11}$ contains 8 – OH groups
(2) On hydrolysis (+) Lactose gives equal amount of D (+) glucose and D(+) galactose.
(3) (+) Lactose is a β - glycoside formed by the union of molecule of D(+) glucose and a molecule of D (+) galactose
(4) (+) Lactose is a reducing sugar and does not exhibit mutarotation

100. Which one of the following statement is not true?
(1) Oxides of sulphur, nitrogen and carbon are the most widespread air pollutant
(2) pH of drinking water should be between 5.5 – 9.5
(3) Concentration of DO below 6 ppm is good for the growth of fish
(4) Clean water would have a BOD value of less than 5 ppm

Biology

101. The ''Eyes'' of the potato tuber are :
(1) Axilliary buds
(2) Root buds
(3) Flower buds
(4) Shoot buds

102. Organisms called Methanoges are most abundant in a :
(1) Hot spring
(2) Sulphur rock
(3) Cattle yard
(4) Polluted stream

103. Which one of the following have the highest number of species in nature ?
(1) Angiosperms
(2) Fungi
(3) Insects
(4) Birds

104. Archegoniophore is present in :
(1) Funaria
(2) Marchantia
(3) Chara
(4) Adiantum

105. Compared with the gametophytes of the bryophytes, the gametophytes of vasucler planttend to be :
(1) Smaller and to have smaller sex oragans
(2) Smaller but to have larger sex oragans
(3) Larger but to have smaller sex organs
(4) Larger and to have larger sex oragans

106. The gametophyte is not an independent, free – living generation in :
(1) Pinus
(2) Polytrichum
(3) Adiantum
(4) Marchantia

107. Important site for formation of glycoproteins and glycolipide is :
(1) Lysosome
(2) Vacuole
(3) Golgi apparatus
(4) Plastid

108. Peptide synthesis inside a cell takes place in :
(1) Ribosomes
(2) Chloroplast
(3) Mitochondria
(4) Chromoplast

109. In eubacteria, a cellular component that resembles eukaryotic cell is
(1) *Cell wall*
(2) *Plasma membrane*
(3) *Nucleus*
(4) *Ribosomes*

110. Mutations can be induced with
(1) Gamna radiations
(2) Infra red radiations
(3) I A A
(4) Ethylene

111. A collection of plants and seeds having diverse alleles of all the genes of a crop is called
(1) *Genome*
(2) *Herbarium*
(3) Germplasm
(4) *Gene library*

112. Which one of the following also acts as a catalyst in bacterial cell ?
(1) 23 sr RNA
(2) 5 sr RNA
(3) Sn RNA
(4) Hn RNA

113. Which one of the following statements is correct
(1) Flower of tulp is modified shoot
(2) In tomato, fruit is a capsule
(3) Seeds of orchids have oil – rich endosperm
(4) Placentation in primrose is basal

114. The correct floral formula of chilli is

⊕ ⚥ $K_5 \overset{\frown}{C_5 A_{(5)}} G_{\underline{2}}$

⊕ ⚥ $K_{(5)} C_5 A_5 G_{\underline{(2)}}$

⊕ ⚥ $K_{(5)} \overset{\frown}{C_{(5)} A_5} G_{\underline{(2)}}$

⊕ ⚥ $K_{(5)} C_{(5)} A_{(5)} G_{\underline{2}}$

115. Nitrifying bacteria
(1) Reduce nitrates to free nitrogen
(2) Oxidize ammonia too nitrates
(3) Convert free nitrogen to nitrogen compounds
(4) Convert proteins into ammonia

116. The function of leghemoglobin in the root nodules of legumes is :
(1) *Expression of nif gene*
(2) *Inhibition of nitrogenase activity*
(3) *Oxygen removal*
(4) *Nodule differentiation*

117. Which one of the following elements in plants is not remobilized?
(1) Sulphur
(2) Phosphorus
(3) Calcium
(4) Potassium

118. A drupe develops in :
(1) Tomato
(2) Mango
(3) Wheat
(4) Pea

119. Groud tissue included :
(1) All tissues internal to endodermis
(2) All tissues external to endodermis
(3) All tissues except epidermis and vascular bundles
(4) Epidermis and cortex

120. In land plants, the guard cells differ from other epidermal cells in having
(1) Chloroplasts
(2) Cytoskeleton
(3) Mitochondria
(4) Endoplasmic reticulum

121. The ovary is half inferior in flowers of :
(1) *Guava*
(2) *Peach*
(3) *Cucumber*
(4) *Cotton*

122. The cork cambium, cork and secondary, cortex are collectively called
(1) phellem
(2) phelloderm
(3) Phellogen
(4) Periderm

123. Which one of the following is wrongly matched ?
(1) Cassia - imbricate astivation
(2) Root pressure - Guttation
(3) Pucinia - Smut
(4) Root – exarch protoxylem

124. Flowers are Zygomorphic in :
(1) Datura
(2) Mustard
(3) Gulmohur
(4) Tomato

125. CAM helps the plants in :
(1) *Reproduction*
(2) *Conserving water*
(3) *Secondary growth*
(4) *Disease resistance*

126. Of the total incident solar radiation the proportion of PAR is :
(1) More than 80 %
(2) About 70 %
(3) About 60%
(4) Less than 50%

127. A prokaryotic autotrophic nitrogen fixing symbiont is found in :
(1) Pisum
(2) Alnus
(3) Cycas
(4) Cicer

128. Nucellar polymbryony is reported in species of :
(1) Brassica
(2) Citrus
(3) Gossypium
(4) triticum

129. Fillform apparatus is a characteristics feature of :
(1) Zygore
(2) Suspensor
(3) Egg
(4) Synegrid

130. What would be the number of chromososmes of the aleurone cells of a plant with 42 chromosomes In its root tip cells ?
(1) 21
(2) 42
(3) 63
(4) 84

131. Wind pollination is common in :
(1) orchids
(2) Legumes
(3) Lillies
(4) Grasses

132. In Which one of the following pollination is autogamous ?
(1) Cleistogamy
(2) Geitonogamy
(3) Xenogamy
(4) Chasmogamy

133. Mass of living matter at a trophic level in an area at any time is called :
(1) Standing state
(2) Standing crop
(3) Detritus
(4) Humus

134. Which one of the following statements is wrong in case of Bhopal tragedy?
(1) It took place in the night of December 2/3, 1984
(2) Methyl Isocyanate gas leakage took place
(3) Thousand of human beings died
(4) Radiactive fall out engulfed Bhopal

135. Secondary sewage treatment is mainly a :
(1) Biological process
(2) Physical process
(3) Mechanical process
(4) Chemical processs

136. Eutrophication is often seen in :
(1) Mountains
(2) Desserts
(3) Fresh water lakes
(4) Ocean

137. Large woody vines are more commonly found in :
(1) Alpine forests
(2) Temperate forests
(3) Mangroves
(4) Tropical rainforests

138. Which one of the following expanded forms of the following acronyms is correct?
(1) IUCN = International union for conservation of nature and natural Resources
(2) IPCC = International panel for climate change
(3) UNEP = United nations Environental policy
(4) EPA = Environmental Pollution agency

139. Which one of the following statements is correct for secondary succession
(1) It is similer to primary succession except that it has a relatively fast pace.
(2) It begins on a bare rock
(3) It occurs on a deforested site
(4) It follows primary succession

140. Which one of the following shows maximum genetic diversity in india
(1) Mango
(2) Groundnut
(3) Rice
(4) Maize

141. Which one of the following is not a biofertilizer?
(1) Mycorrhiza
(2) Agrobacteirum
(3) Rhizobium
(4) Nostoc

142. Which one of the following acts as a physiological barrier to the entry of microorganisms in human body ?
(1) Skin
(2) Epithelium of Urogential tract
(3) Tears
(4) Monocytes

143. Which one of the following helps in absorption of phosphorus from soil by plants ?
(1) Anabaema
(2) Glomus
(3) Rhozobium
(4) Frankia

144. Himgiri developed by hybridization and selection for disease resistance against cost pathogens is a varity of
(1) Wheat
(2) Chilli
(3) maize
(4) sugarcane

145. which of the following is mainly produced by the activity an anaerobic bacteria on sewage ?
(1) marsh gas
(2) Laughing gas
(3) propane
(4) Mustard gas

146. Agarose extraxcted from sea weeds finds use in :
(1) *Gel electrophoresis*
(2) *Spectrophotpmetry*
(3) *Tissue culture*
(4) *PCR*

147. Maximum number of existing transgenic animals is of :
(1) *Pig*
(2) *Fish*
(3) Mice
(4) *Cow*

148. Continues addition of sugars in 'fed batch' fermentation is done to :
(1) Degrade sewage
(2) Produce methane
(3) Obtain antibiotics
(4) Purify enzymes

149. The process of RNA interference has been used in the development of plants resistance to :
(1) *Insects*
(2) *Nematodes*
(3) *Fungi*
(4) *Viruses*

150. ''Jaya'' and ''Ratna'' Developed for green revolution in india are the varieties of :
(1) Bajra
(2) Maize
(3) Rice
(4) Wheat

151. Which one of the following organisms is not an example of eukaryotic cells?
(1) Amoeba proteus
(2) Paramecium caudatum
(3) Escherichia coli
(4) Euglena viridis

152. Which one of the following amimals is correctly matched with its particular named taxonomic category?
(1) Housefly – Musca, an order
(2) Tiger – tigris, the species
(3) Cuttlefish – Mollusca, a class
(4) Humans – Primata, the family

153. In which one of the following the genus nane, its two characters and its class/phylum are correctly matched ?

Genus Name	**Two characters**		**Class/Phylum**
(1) Aurelia	(a)	cnidoblasts	Coelenterata
	(b)	Organ level of organization	
(2) Ascaris	(a)	Body segmented	Annelida
	(b)	Males and females distinct	
(3) Salamandra	(a)	A tympanum represents ear	Amphibia
	(b)	Fertilization is external	
(4) Pteropus	(a)	Skin possesses hair	Mammalia
	(b)	Oviparous	

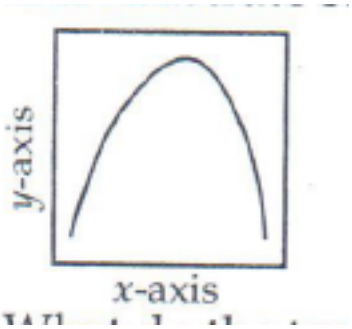
154. Which one of the following groups of animals correctly matched with its one characteristics feature matched with its one characterstics feature without even a single exception?

(1) Mammalia : Give birth to young ones
(2) Reptilia : Posses 3 – chambered heart with one incompletely divided ventricle
(3) Chordata : possess a mouth provided with an upper and lower jaw
(4) Chondrichethyes : posses cartilaginous endoskeleton

155. What will you look for to identify the sex of the following ?

(1) Male shark – Claspers borne on pelvic fins
(2) Female Ascaris – sharply curved posterior end
(3) Male frog – A copulatory pad on the first digit of the hind limb
(4) Female cockroach – Anal cerci

156. The curve given below shows enzymatic activity with relation to three conditions (pH,temperature and substract concentration)



What do the axises (x and y) represent

	X – axis	y-axis
(1)	enzymatic activity,	temperature
(2)	enzymatic activity	pH
(3)	temperature	enzyme activity
(4)	substract concentration,	enzymatic activity

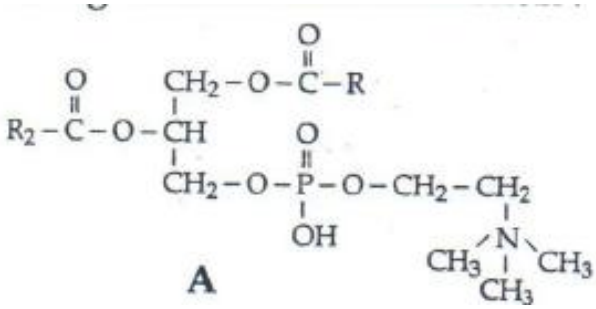
157. The ciliated columnar epithelial cells in humans are known to occur in :

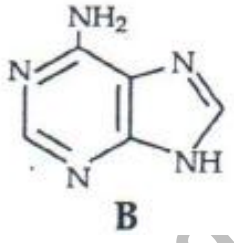
(1) Fallopian tubes and urethra
(2) Eustachian tube and stomach lining
(3) Bronchiloes and fallopian tubes
(4) Bille duct and oesophagus

158. Select the correct option with respect to motosis

(1) Chromosomes move to the spindle equator and get aligned along equatorial plate in metaphase
(2) Chromatids separate but remain In the centre of the cell in anaphase
(3) Chromatids start moving towards opposite poles in telophase
(4) Golgi complex and endoplasmic reticulum are still visible at the end prophase.

159. Which one of the following structural formulae of two organic compounds is correctly identified along with its related function ?





(1) A: Lecithin – A component of cell membrane
(2) B: Adenine – a nucleotide that makes up nucleic acids
(3) A : Triglyceride – major source of energy
(4) B : Uracil – a component of DNA

160. What was the most significant trend in the evolution of modern man (Homo sapiens) from his ancestors ?
(1) Increasing brain capacity
(2) Upright posture
(3) Shortening of jaws
(4) Binocular vision

161. .Which one of the following conditions correctly describes the manner of determining the sex in the given example ?
(1) Homozygous sex chromosomes (XX) produce male in Drosophils
(2) Homozygous sex chromosomes (ZZ) determine female sex in birds
(3) XO type of sex chromosomes determine male sex in grasshopper
(4) Xo condition in humans as found in Turner Syndrome, determines female sex.

162. A person with unknown blood group under ABO system has suffered much blood has loss in an accident the needs immediate blood transfusion. His one friend who has a valid certificate of his own blood type, offers for blood donation without delay. What would have been the type of blood group of the donor friend ?
(1) Type A
(2) Type B
(3) Type AB
(4) Type O

163. What are those structures that appear as ' beads – on – string' in the chromosomes when viewed under electron microscope ?
(1) Base pairs
(2) Genes
(3) Nucleotides
(4) Nucleosomes

164. Match the source gland with its respective hormone as well as the function.

Source gland	Hormone	Function
(1) Thyroid	Thyroxine	Regulates blood calcium level
(2) Anterior Pituitary	Oxytocin	Contraction of uterus muscles during child birth
(3) Posterior pituitary	Vasopressin	Stimulates resorption of water in the distal tubules in the nephron
(4) Corpus luteum	Estrogen	Supports pregnency

165. Which of the following is correctly stated as it happens in the common cockroach ?
(1) The food is ground by mandibles and gizzard
(2) Malpighian tubules are excretory organs projecting out from the colon.
(3) Oxygen is transported by heamoglobin in food
(4) Nitrogenous excretory product is urea

166. A large proporation of oxygen is left unused in the human blood even after its uptake by the body tissues This O2
(1) Helps in releasing more O_2 to the epithelial tissues
(2) Acts as a reserve during muscular exercise
(3) Raises the pCO_2 of blood to 75 mm of Hg
(4) Is enough to keep oxyhaemogloin saturdation at 96 5

167. Which of one of the following ezymes carries out intial step in the digestion of milk in humans?
(1) Trypsin
(2) Pepsin
(3) Renin
(4) Lipase

168. Which one of the following is not a part of a renel pyramid ?
(1) Loops of Henle
(2) Peritubular capillaries
(3) Covoluted tubules
(4) Collecting ducts

169. One very special feature in the earthworm pheretima is that :
(1) It has a long dorsal tubular heart
(2) Fertilization of eggs occurs inside the body
(3) The typhlosole greatly increases the effective absorption area of the digested food in the intensive
(4) The S – shaped satae embedded in the integument are the defensive weapons used against the enemies.

170. Two friends are eating together on a dining table. One of them suddenly starts coughing while swallowing some food. This coughing would have been due to improper movement of :
(1) Tongue
(2) Epiglottis
(3) Diaphragm
(4) Neck

171. Arteries are best defined as the vessels which :
(1) Carry blood from one visceral organ to another visceral organ
(2) Supply oxygenated blood to the different organs
(3) Carry blood away from the heart to different organs
(4) Break up into capillaries which reunite to form a vein

172. 'Bundle of His' is a part of which one of the following organs in humans ?
(1) pancreas
(2) Brain
(3) Heart
(4) Kidney

173. The purplish red pigment rhodopsin contained in the rods type of photoreceptor cells of the human eye, is a derivative of :
(1) Vitamin A
(2) Vitamin B_1
(3) Vitamin C
(4) Vitamin D

174. Which one of the following plasma proteins is involved in the coagulation of blood?
(1) Fibrinogen
(2) An albumin
(3) Serum amylase
(4) A globulin

175. When a neuron is in resting state i.e not conducting any impulse, the axonal membrane is :

(1) Comparatively more permeable to K^+ ions and nearly impermeable to Na^+ ions
(2) Comparatively more permeable to Na^+ ions and nearly impermeable to K^+ ions
(3) Equally permeable to both Na^+ and K^+ ions
(4) Impermeable to both Na^+ and K^+ ions

176. Which one of the following correctly explains the function of a specific part of a human nephron ?

(1) Afferent arteriole : carries the blood away from the glomerulus towards renel vein
(2) Podocytes : Create minute spaces (slit pores) for the filtration of blood into bowman' capsule.
(3) Henle's loop : Most reabosorption of the major substances from the glomerular filtrate
(4) Distal convoluted tubule : reabsorption of K^+ ions into the surroundings blood capillaries

177. Given below is an incomplete table about certain hormones, their source gland and one major effect of each on the body in humans. Identify the correct option for the three blanks A,B, and C.

GLAND	SECRETION	EFFECT ON BODY
A	Oestrogen	Maintennce of secondary sexual characters
Alpha Cells of Islets of Langerhans	B	Raises blood sugar level
Anterior Pituitary	C	Over secretion leads to giganistsm

Options :

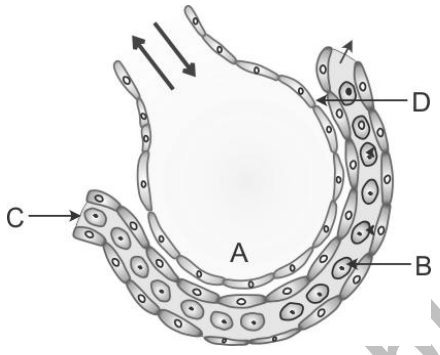
	A	B	C
(1)	Placenta	Glucagon	Calcitonin
(2)	Ovary	Glucagon	Growth Hormone
(3)	Placenta	Insulin	Vasopressin
(4)	Ovary	Insulin	Calcitonin

178. Uricotelic mode of passing out nitrogenous wastes if found in:

(1) Insects and Amphibians
(2) Reptiles and Birds
(3) Birds and Annelids
(4) Amphibians and Reptiles

179. The figure given below shows a small part of human lung where exchange of gases takes place.

In which one of the options given below, the one part A,B,C, or D is correctly identified along with its function



Options :

(1) B : red blood cell – transport of CO_2 mainly

(2) C : arterial capillary - passes oxygen to tissues

(3) A : Alveolar cavity – main site of exchange of respiratory gases

(4) D : capillary wall – exchange of O_2 and CO_2 takes place here

180. Which one of the following statement is correct regarding blood pressure

(1) 90/110 mm Hg may harm vital organs like brain and kidney

(2) 130/90 mm Hg is considered high and requires treatment

(3) 100/55 mm Hg is considered an ideal blood pressure

(4) 105/50 mmHg makes one very active

181. Which one of the following statements is correct with respect to kidney function regulation ?

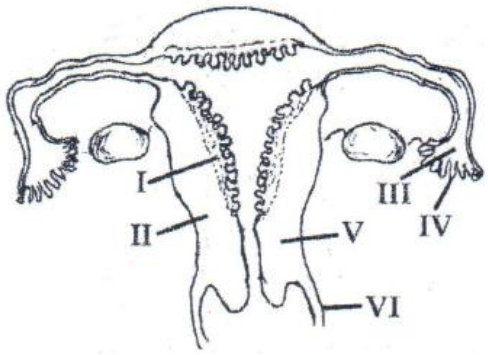
(1) During summer when body loses lot of water evaporation, the release of ADH is supresssed

(2) When someone drinks lot of water, ADH release is supressed

(3) Exposure to cold temperature stimulates ADH release

(4) An increase in glomerular blood flow stimulates formation of Angiotensin II.

182. The figure given below depicts a diagrammatic sectional view of the female reproductive system of humans. Which one set of three parts out of I – VI have been correctly identified ?



(1) (I) Perimetrium, (II) Myometrium, (III) Fallopian tube
(2) (II) Endometrium, (III) Infundibulum (IV) Fimbriar
(3) (III) Infundibulum, (IV)Fimbriae, (V) Cervix
(4) (IV) Oviducal funnel, (V)Uterus, (VI) Cervix

183. The tastes in humans are situated outside the addominal cavity a pouch called scrotum, The purpose served is for :
(1) Providing a secondary sexual feature for exhibiting the male sex
(2) Maintaining the scrotal temperature lower then the internal body temperature
(3) Escaping any possible compression by the visceral organs
(4) Providing more space for the growth of epididymis

184. Which one of the following is the most widely accepted method of contraception in india, as at present ?
(1) IUD's (Intra uterine devices)
(2) Cervical caps
(3) Tubectomy
(4) Diaphragms

185. If for some reason, the vasa efferentia in the human reproductive system get blocked, the gametes will not be transported from :
(1) Vagina to uterus
(2) Tastes to epididymis
(3) Epididymis to vas deferns
(4) Ovary to uterus

186. Medical termination of preganancy (MTP) is considerd safe up to how many weeks of preganancy ?
(1) Six weeks
(2) Eight weeks
(3) Twelve weeks
(4) Eighteen weeks

187. Which one of the following is categorized as parasite in true sense ?
(1) The cuckoo (koel) lays its eggs in crow's nest
(2) The female Amopheles bites and sucks blood from humans
(3) Human foetus developing inside the uterus draws nourishment from the mother.
(4) Head louse living on the human scalp as well as lying eggs on human hair

188. What type of human population is represented by the following age pyramid ?

(1) Expenditure population
(2) Vanishing population
(3) Stable poplution
(4) Declining population

189. Which one of the following statements for pyramid of energy is incorrect, wheras the remaining three are correct
(1) It is upright in shape
(2) Its base is broad
(3) It shows energy content of different trophic level organisms
(4) It is inverted in shape

190. Ethanol is commercially produced through a particular species of :
(1) Aspergillus
(2) Saccharmyces
(3) Clostridium
(4) trichoderma

191. Consider the following four conditions (a-d) and select the correct pair of them as adaption to environment in desert lizards

The conditions :

(a) Burrowimg in soil to escape high temperature

(b) Losing heat rapidly from the body during hig temperature

(c) Bask in sun when temperature is low

(d) Insulating body due to thick fatty dermis

Options :

(1) (a),(b)

(2) (c),(d)

(3) (a),(c)

(4) (b),(d)

192. When one of the following pairs of gases are the major cause of '' Greenhouse effect''

(1) CO_2 and N_2O

(2) CO_2 and O_3

(3) CO_2 and CO

(4) CFCs and SO_2

193. Where will we look for the sporozoites of the malarial parasite?

(1) Salivary glands of freshly moulted *Anopheles mosquito*

(2) Saliva of infected female *Anopheles mosquito*

(3) Red Blood Corpuscles of humans suffering from malaria

(4) Spleen of infected humans

194. When two unrelated individuals or lines are crosse, the performance of F1 hybrid is often superior too both its parants. This Phenomenon is called :

(1) Metamorphosis

(2) Heteosis

(3) Transformation

(4) Splicing

195. A certain patient is suspected to be suffering from acquired immno deficiency syndrome. Which diagnostic technique will you recommend for its detection?

(1) WIDAL

(2) ELISA

(3) MRI

(4) Ultra sound

196. At which stage of HIV infection does one usually show symtoms of AIDS?

(1) Within 15 days of sexual contact with an infected person

(2) When the infecting retrovirus enters host cells

(3) When viral DNA is produced by reverse transcriptase
(4) When HIV replicates rapidly in helper T- Lymphocytes and damages large number of these

197. Given below is a sample of a portion of DNA strand giving the base sequency on the opposite strands. What is so special shown in it ?
5' _____GAATTC_____3'
3'_____CTTAAG_____5'
(1) Palindromic seqeuency of base pairs
(2) Replication completed
(3) Deletion mutation
(4) Start codon at the 5' end

198. The most common substract used in distliieries for the production of ethanol is :
(1) Molasses
(2) Corn meal
(3) Soya meal
(4) Ground gram

199. A organism used as a biofertilizer for raising soyabean crop is :
(1) Nostoc
(2) Azotobacter
(3) Azospirllium
(4) Rhizobium

200. There is a restriction endonucleaus called EcoRL. What does ''co'' part in it stand for ?
(1) Coli
(2) Colon
(3) Coelom
(4) Coenzyme

AIPMT - 2011
(Physics, Chemistry and Biology)
Prelims Answer Key and Solution
Code A

Answers

1	(4)	2	(3)	3	(3)	4	(4)	5	(3)	6	(2)	7	(1)	8	(4)	9	(3)	10	(3)
11	(3)	12	(1)	13	(2)	14	(1)	15	(4)	16	(4)	17	(1)	18	(4)	19	(3)	20	(3)
21	()	22	(4)	23	(2)	24	(2)	25	(3)	26	(1)	27	(1)	28	(3)	29	(1)	30	(1)
31	(2)	32	(2)	33	(4)	34	(4)	35	(2)	36	(1)	37	(3)	38	(4)	39	(4)	40	(3)
41	(3)	42	(2)	43	(3)	44	(1)	45	(4)	46	(4)	47	(2)	48	(4)	49	(1)	50	(1)
51	(3)	52	(3)	53	(3)	54	(1)	55	(3)	56	(3)	57	(4)	58	(4)	59	(1)	60	(1)
61	(4)	62	(3)	63	(2)	64	(1)	65	(3)	66	(3)	67	(4)	68	(1)	69	(4)	70	(2)
71	(4)	72	(3)	73	(2)	74	(2)	75	(2)	76	(2)	77	(3)	78	(4)	79	(3)	80	(2)
81	(4)	82	(4)	83	(4)	84	(3)	85	(2)	86	(1)	87	(2)	88	(2)	89	(4)	90	(3)
91	(3)	92	(4)	93	(3)	94	(3)	95	(2)	96	(2)	97	(3)	98	(3)	99	(4)	100	(3)
101	(1)	102	(3)	103	(3)	104	(2)	105	(1)	106	(1)	107	(3)	108	(1)	109	(2)	110	(1)
111	(3)	112	(1)	113	(1)	114	(3)	115	(2)	116	(3)	117	(3)	118	(2)	119	(3)	120	(1)
121	(2)	122	(4)	123	(3)	124	(3)	125	(2)	126	(4)	127	(3)	128	(2)	129	(4)	130	(3)
131	(4)	132	(1)	133	(2)	134	(4)	135	(1)	136	(3)	137	(4)	138	(1)	139	(3)	140	(3)
141	(2)	142	(3)	143	(2)	144	(1)	145	(1)	146	(1)	147	(3)	148	(4)	149	(2)	150	(3)
151	(3)	152	(2)	153	(3)	154	(4)	155	(1)	156	(3)	157	(3)	158	(1)	159	(1)	160	(1)
161	(3)	162	(4)	163	(4)	164	(3)	165	(1)	166	(2)	167	(2)	168	(3)	169	(3)	170	(2)
171	(3)	172	(3)	173	(1)	174	(1)	175	(1)	176	(2)	177	(2)	178	(2)	179	(3)	180	(1)
181	(2)	182	(3)	183	(2)	184	(1)	185	(2)	186	(3)	187	(4)	188	(4)	189	(4)	190	(2)
191	(3)	192	(1)	193	(2)	194	(2)	195	(2)	196	(4)	197	(1)	198	(1)	199	(4)	200	(1)

Physics

1. We know that the given expression is for speed of light, i.e.

$$c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$$

Hence, the dimension of speed of light is $[LT^{-1}]$.

2. Using the theorem of parallel axis, we get the moment of inertia of the rod along an axis passing through one of its ends and perpendicular to its length as

$I = I_{CM} + Mh^2$

$$I = I_0 + M\left(\frac{L}{2}\right)^2$$

$$I = I_0 + \frac{ML^2}{4}$$

3. Given, $g = 10\ ms^{-2}$, $h = 20$ m, $u = 0$.

From the third equation of kinematics, we have

$$v^2 = u^2 + 2gh$$

$$v = \sqrt{2gh}$$

$$= \sqrt{2 \times 10 \times 20} = \sqrt{400}$$

$$= 20\ ms^{-1}$$

4. Total mass = Mass of the lift + Mass of the person

= 940 + 60 = 1000 kg

The forces on the lift are balanced as

$T - mg = ma$

Hence, $T - 1000 \times 10 = 1000 \times 1$

$\therefore T = 11000$ N

5. We know that power is related to force and velocity as

$P = F \cdot v = Fv \cos \theta$

So, just before hitting θ is zero and both F and v are maximum. Hence, power will be the greatest.

6. It is given that torque $\tau = 0$.

Hence, we can say that $a = 0$.

Now, we know that $a = \frac{d^2\theta}{dt^2}$

$\text{Given}\,\theta(t) = 2t^3 - 6t^2$

$\text{So}, \frac{d\theta}{dt} = 6t^2 - 12t$

$\Rightarrow \frac{d^2\theta}{dt^2} = 12t - 12$

$\therefore 12t - 12 = 0$

$\therefore t = 1\ \text{s}$

7. Given $r = 5\ \text{cm} = 5 \times 10^{-2}\ \text{m}$ and $T = 0.2\pi\ \text{s}$.

We know that acceleration for circular motion is given as $a = r\omega^2$.

Hence, we get

$a = r\omega^2 = \frac{4\pi^2}{T^2} r$

$= \frac{4 \times \pi^2 \times 5 \times 10^2}{(0.2\pi)^2} = 5\,\text{ms}^{-2}$

8. We know that impulse is given as

$J = |\Delta p|$

$= MV - (-MV)$

$= 2MV$

9. From the law of conservation of angular momentum, we have

$Mr_1v_1 = mr_2v_2$

$\therefore r_1v_1 = r_2v_2$

$\frac{v_1}{v_2} = \frac{r_2}{r_1}$

10. The momentum of a photon is

$p = \frac{h\nu}{c}$

Hence, the recoil energy will be

$E = \frac{p^2}{2m}$

$\therefore E = \frac{\left(\frac{h\nu}{c}\right)^2}{2M} = \frac{h^2\nu^2}{2Mc^2}$

11. The potential energy of a system increases if work is done by the system against a conservative force.

$-\Delta U = W_{\text{conservative face}}$

12. The magnitude of average acceleration is

$$\text{Average acceleration} = \frac{\text{change in velocity}}{\text{Total time}}$$

$$a = \frac{|v_f - v_i|}{\Delta t} = \frac{\sqrt{30^2 + 40^2}}{10} = \frac{\sqrt{900 + 1600}}{10}$$

$$= 5\,ms^{-2}$$

13. For the maximum range of the projectile, the angle of projection θ should be 45°.

$$R_{max} = \frac{u^2}{g}$$

Given $u = 20\ ms^{-1}$ and $g = 10\ ms^{-2}$

$$\therefore R_{max} = \frac{(20)^2}{10} = \frac{400}{10}$$

$$R_{max} = 40\ m$$

14. Work done is equal to the area under the force–displacement graph.

$$\therefore W = \left[2 \times (7-3) + \frac{1}{2} \times 2 \times (12-7)\right]$$

$$\therefore W = 8 + 5 = 13\ J$$

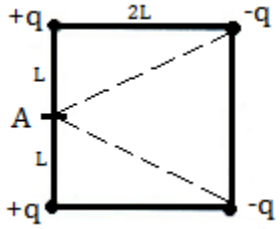
15. The total electric flux coming from a charged surface is

$$\phi = \frac{\text{Net enclosed charge}}{\varepsilon_0}$$

Hence, we can say that the electric flux depends only on the net charge enclosed by the surface. So, the flux will remain the same even if the radius is doubled.

16. The electric potential at a distance r because of a charge q is

$$V = \frac{1}{4\pi\varepsilon_0}\frac{q}{r}$$



Here, $V_A = 2V_{+q} + 2V_{-q}$

$$\therefore V = \frac{1}{4\pi\varepsilon_0}\left[\frac{2q}{L} - \frac{2q}{L\sqrt{5}}\right]$$

$$V = \frac{2q}{4\pi\varepsilon_0 L}\left(1 - \frac{1}{\sqrt{5}}\right)$$

17. The energy stored in a condenser is

$$U = \frac{1}{2}CV^2$$

$$\therefore U = \frac{1}{2}\left(\frac{A\varepsilon_0}{d}\right)(Ed)^2 \qquad \left(\because C = \frac{A\varepsilon_0}{d} \text{ and } V = Ed\right)$$

$$\therefore U = \frac{1}{2}\varepsilon_0 E^2 Ad$$

18. The electric power is $P = i^2R$

$$\therefore \text{ Current } \quad i = \sqrt{\frac{P}{R}}$$

For resistance of 9Ω, we get

$$i_1 = \sqrt{\frac{36}{9}} = \sqrt{4} = 2 \text{ A}$$

$$i_2 = \frac{i_1 \times R}{6} = \frac{2 \times 9}{6} = 3 \text{ A}$$

$$i = i_1 + i_2 = 2 + 3 = 5 \text{ A}$$

$$\therefore V_2 = iR_2 = 5 \times 2 = 10 \text{ V}$$

19. The emf and internal resistance of a cell are related to the current as

$$i = \frac{E}{R + r}$$

$$\therefore 2 = \frac{E}{2 + r} \qquad \text{.....(i)}$$

$$\text{Also } 0.5 = \frac{E}{9 + r} \qquad \text{.....(ii)}$$

From equations (i) and (ii), we have

$$\frac{2}{0.5} = \frac{9 + r}{2 + r} = 4$$

$$\therefore 3r = 1 \Rightarrow$$

$$r = \frac{1}{3}\ \Omega$$

20. The expression for thermo-emf with temperature is

$e = at + bt^2$

Hence, the rate of increase is

$\frac{de}{dt} = a + 2bt$

Neutral temperature is $T_n = -\frac{a}{2b}$

Hence, at the netural temperature $\frac{de}{dt} = 0$

21. $F_{AB} = 0$

$F_{AB} + F_{BC} + F_{CA} = 0$

$F_{BC} + F_{CA} = 0$

$F_{CA} = -F_{BC} = -F$

22. The power obtained is P = 1000 kW = 1000×10^3 W

Hence, the energy obtained per hour is

E = Pt = $1000 \times 10^3 \times 3600$ J

Hence, we get the mass as

$E = mc^2 = Pt$

$\therefore m = \frac{Pt}{c^2}$

$\therefore m = \frac{1000 \times 10^3 \times 3600}{\left(3 \times 10^8\right)^2}$

$\therefore m = 4 \times 10^{-8}\ \text{kg} = 4 \times 10^{-5}\ \text{g}$

$\therefore m = 40 \times 10^{-6}\ \text{g} = 40\ \mu\text{g}$

23. Non-magnetic materials remain unaffected by a bar magnet. Hence, A cannot be non-magnetic.

Paramagnetic materials are feebly attracted by a bar magnet. Hence, B will be a paramagnetic material.

Diamagnetic materials are feebly repelled, and hence, C cannot be diamagnetic.

Ferromagnetic materials will be strongly attracted by a bar magnet. Hence, D cannot be a ferromagnetic material.

So, the correct option is (2).

24. In an electromagnetic wave, the electric and magnetic fields are perpendicular to each other and perpendicular to the direction of propagation.

Hence, if the direction of propagation of the wave is along the +z-axis, then the direction of electric and magnetic fields should be along the x and y axes.

We also know that $\vec{E}\times\vec{B}$ points in the direction of propagation. So, we get an electric field along the +x-axis and a magnetic field along the +y-axis, respectively.

25. The force on the electron while moving in the magnetic field is

$$\vec{F}=q\left(\vec{v}\times\vec{B}\right)$$

Since it moves along B itself, no force will act and there will be no change in speed due to the magnetic field.

Now, the force on the electron while moving in the electric field is

$$\vec{F}=q\vec{E}$$

Since q is negative, the force will act in the direction opposite to the direction of the electric field. So, the speed decreases.

26. We know that the induced emf is

$$e=-L\frac{di}{dt}$$

During the time interval 0 to $\frac{T}{4}, \frac{di}{dt}=\text{constant}$

Hence, we get e as negative and constant. So, options (2), (3) and (4) can be discarded.

For the next time interval $\frac{T}{4}\text{ to }\frac{T}{2}, \frac{di}{dt}=0$

Hence, we get e = 0.

So, the correct option is (1).

27. It is given that $e=200\sqrt{2}\sin 100t;\ C=1\mu F$

From the above expression of e, we get $\omega = 100$ and $E_{rms} = 200$ V.

The capacitive reactance is

$$X_c=\frac{1}{\omega C}=\frac{1}{100\times1\times10^{-6}}=10^4\ \Omega$$

Hence, the r.m.s. value of the current is

$$i_{rms}=\frac{E_{rms}}{X_c}$$

$$i_{rms}=\frac{200}{10^4}=2\times10^{-2}A=20\text{ mA}$$

28. We know that

$$\tan\phi = \frac{X_L}{R} = \frac{\omega L}{R}$$

$$\therefore \tan\phi = \frac{3\ \Omega}{3\ \Omega}$$

$$\therefore \tan\phi = 1$$

$$\Rightarrow \phi = \tan^{-1}(1)$$

$$\therefore \phi = 45^{o}$$

$$\therefore \phi = \frac{\pi}{4}\text{rad}$$

29. Change in entropy is

$$\Delta S = \frac{\Delta Q}{T} = \frac{ml}{T} = \frac{1000\times 80}{273} = 293\ \text{cal}\,k^{-1}$$

30. From the first law of thermodynamics, we have

$\Delta U = Q + W$

For an isothermal process, the change in internal energy is $\Delta U = 0$.

$\therefore Q = -W$

It is given that $W = -150$ J

$\therefore Q = +150$ J

When Q is positive, we can say that heat is added to the gas.

31. Potential V versus x is parabolic in nature.

SHM starts from the extreme position, and x versus t should be a cosine curve according to the equation $y = A\cos(\omega t + \phi)$. So, option (2) is correct.

32. It is given that $y_1 = a\sin(\omega t + kx + 0.57)$m

And $y_2 = a\cos(\omega t + kx)$m

We can write the above equation as $y_2 = a\sin\left(\frac{\pi}{2} + \omega t + kx\right)$m

Hence, the phase difference is

$$\Delta\phi = \phi_2 - \phi_1$$

$$= \frac{\pi}{2} - 0.57$$

$$= 1.57 - 0.57$$

$$= 1\,\text{rad}$$

33. For a simple harmonic motion, we have the equation

$$\frac{d^2y}{dt^2} \propto -y$$

The equations Y = sin $\omega t - \cos\omega t$ and Y = 5 cos $\left(\frac{3\pi}{4} - 3\omega t\right)$ satisfy this condition, and the equation y = 1 + $\omega t - \omega^2 t^2$ is not periodic and the equation y = $\sin^3 \omega t$ is periodic but not SHM. So, option (1) is the correct answer.

34. Velocity of sound is $v = n\lambda$

Hence, for water and brass, we have

$$\frac{v_1}{v_2} = \frac{n_1\lambda_1}{n_2\lambda_2} \qquad (\text{but } n_1 = n_2)$$

$$\lambda_2 = \lambda_1 \frac{v_2}{v_1} = \lambda_1 \times \frac{3500}{350} = \lambda_1 \times 10$$

$$\lambda_2 = 10\lambda_1$$

Hence, the wavelength increases by a factor of 10.

35. Microwaves have the highest wavelength, followed by infrared, ultraviolet and gamma rays.

Hence, the decreasing order of wavelength of various rays is Microwave > Infrared > Ultraviolet > Gamma rays.

36. The Lyman series for H-ion is given by the expression

$$\frac{1}{\lambda} = R\left(\frac{1}{1^2} - \frac{1}{2^2}\right)$$

Similarly, for H-like ion, we have the second line of Balmer series as

$$\frac{1}{\lambda} = Z^2R\left(\frac{1}{2^2} - \frac{1}{4^2}\right)$$

Since both lines have the same wavelength, we get

$$\left(\frac{1}{1^2} - \frac{1}{2^2}\right) = Z^2\left(\frac{1}{4} - \frac{1}{16}\right)$$

$$\left(1 - \frac{1}{4}\right) = Z^2\left(\frac{1}{4} - \frac{1}{16}\right)$$

$$\frac{3}{4} = Z^2\frac{3}{16}$$

$$Z^2 = 4$$

$$\therefore Z = 2$$

37. The brilliance of diamond is due to total internal reflection.

The working of optical fibre is due to total internal reflection.

Mirage on hot summer days is also due to total internal reflection.

But, the difference in apparent and real depths can be explained due to refraction and not due to total internal reflection.

38. Radius of curvature of a biconvex lens is R = 20 cm.

We assume that refractive index of glass is $\mu = 1.5$.

The lens maker's formula gives us that

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$= (1.5 - 1)\left(\frac{1}{+20} - \frac{1}{-20}\right)$$

$$= 0.5 \times \left(\frac{1}{10}\right)$$

$$= \frac{1}{20}$$

Hence, the focal length of the lens is also f = 20 cm.

It is given that u = −30 cm.

Hence, from the lens formula, we get

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\frac{1}{20} = \frac{1}{v} - \frac{1}{-30}$$

$$\therefore \frac{1}{v} = \frac{1}{20} - \frac{1}{30} = \frac{1}{60}$$

$$\therefore v = 60\,\text{cm}$$

Therefore, the image is real.

It is now given that the height of the object is $h_o = 2$ cm.

Hence, we have

$$\frac{h_i}{h_0} = m = \frac{v}{u} = \frac{60}{-30} = -2$$

$$\therefore h_i = -2 \times h_o$$

$$\therefore h_i = -4\ \text{cm}$$

Therefore, the image is inverted and has a height of 4 cm.

39. The most energetic electrons have maximum kinetic energy.

Now, the maximum kinetic energy of photoelectrons is

$$K.E_{max} = eV_0$$

where V_0 is the stopping potential.

Hence, we get

$$V_0 = \frac{K.E_{max}}{e}$$
$$= \frac{0.5\ eV}{e}$$
$$= 0.5\ V$$

40. The de Broglie wavelength is associated with voltage as

$$\lambda = \frac{12.27}{\sqrt{V}}$$
$$\Rightarrow \lambda \propto \frac{1}{\sqrt{V}}$$

Hence, for two different voltages, we have

$$\frac{\lambda_1}{\lambda_2} = \sqrt{\frac{V_2}{V_1}}$$
$$\therefore \lambda_2 = \lambda_1 \sqrt{\frac{V_1}{V_2}}$$
$$\therefore \lambda_2 = \lambda_1 \sqrt{\frac{25}{100}}$$
$$\Rightarrow \lambda_2 = \lambda_1 \sqrt{\frac{1}{4}} = \frac{\lambda_1}{2}$$

So, the wavelength decreases by a factor of 2.

41. Kinetic energy is

$$K.E = \frac{1}{2}mv^2$$
$$\therefore v_{max} = \sqrt{\frac{2K.E_{max}}{m}} = \sqrt{\frac{2}{m}K.E_{max}}$$

Now, from Einstein's photoelectric equation, we get

$$K.E = E - \phi$$

where E is the energy of the photon, and

ϕ is the work function.

Therefore, we have

$$\frac{v_{1\,max}}{v_{2\,max}} = \sqrt{\frac{K.E_1}{K.E_2}}$$
$$= \sqrt{\frac{E_1 - \phi}{E_2 - \phi}}$$
$$= \sqrt{\frac{1-0.5}{2.5-0.5}} = \sqrt{\frac{0.5}{2}} = \sqrt{\frac{1}{4}} = \frac{1}{2}$$

42. In the Davisson and Germer experiment, the velocity of the electrons emitted from the electron gun can be increased by increasing the potential difference between the anode and the filament.

43. It is given that X:Y = 1:15.

We know that

$$\frac{N}{N_0} = \left(\frac{1}{2}\right)^{t/t_1/2}$$
$$\frac{1}{16} = \left(\frac{1}{2}\right)^{t/50}$$
$$t = 4 \times 50$$
$$t = 200\,yr$$

44. We know that photoelectric emission is possible when incident radiation has a certain minimum threshold frequency.

45. Fusion reaction occurs at high temperatures because the kinetic energy is high enough to overcome the Coulomb repulsion between the nuclei.

46. The resultant decay reaction is shown below.

$${}^{m}_{n}X \xrightarrow{\alpha} {}^{m-4}_{n-2}X \xrightarrow{2\beta} {}^{m-4}_{n}X$$

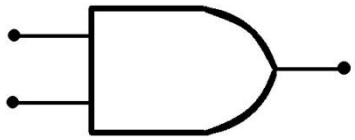
47. The current gain in a transistor is

$$\beta = \frac{\Delta I_C}{\Delta I_B} = \frac{(20-10)\ mA}{(300-100)\ \mu A} = \frac{10 \times 10^{-3}}{200 \times 10^{-6}} = 50$$

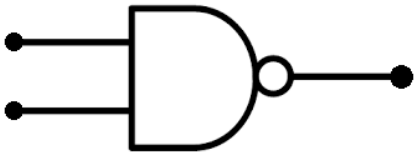
48. When a small amount of antimony is added to a germanium crystal, the crystal becomes an n-type semiconductor because antimony is a pentavalent substrate. It has excess free electrons. So, there will be more free electrons than holes in the semiconductor.

49. In forward biasing of a p–n junction, the positive terminal of the battery is connected to the p-side and the depletion region becomes thin.

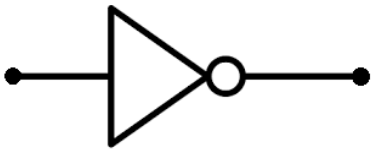
50. The AND gate is represented as



The NAND gate is represented as



The NOT gate is represented as



Chemistry

51. The total number of atomic orbitals in an orbit = $n^2 = 4^2 = 16$.

52. $\Delta G = \Delta G_1° + \Delta G_2°$

$-nFE° = -nFE_1° + -nFE_2°$

$-2FE° = -0.15F - 0.50F$

$-2FE° = -F(0.15 + 0.50)$

$\therefore E° = 0.65/2 = 0.325$ volt

53. Number of moles of solute(n_{solute}) = 1

Weight of the solvent ($W_{solvent}$) = 1000 g

$n_{solvent} = 1000/18 = 55.56$

$$X_{solute} = \frac{1}{1+55.56} = 0.0177$$

54. $V_{average} \propto \sqrt{T}$

$$\frac{(V_{average})_2}{(V_{average})_1} = \sqrt{\frac{2T}{T}} = 1.4$$

55. Given: $[NH_3] = 0.3$ M $[NH_4^+] = 0.2$ M

$K_b = 1.8 \times 10^{-5}$

$$pOH = pk_b + \log\frac{[salt]}{[base]} = 4.74 + \log\frac{0.2}{0.3} = 4.74 + 0.3010 - 0.4771 = 4.56$$

$$pH = 14 - 4.56 = 9.436$$

56.

$$\frac{r_A}{r_B} = \sqrt{\frac{M_B}{M_A}}$$

$$\frac{V/20}{V/10} = \sqrt{\frac{M_B}{49}}$$

$$\frac{1}{2} = \sqrt{\frac{M_B}{49}}$$

$$M_B = \frac{1}{4} x49 = 12.25\,u$$

57. For free expansion of an ideal gas under adiabatic condition,

$q = 0, \Delta T = 0, w = 0$

58. $N_{2(g)} + O_{2(g)} \rightarrow 2NO_{(g)}$; K_1.....(i)

$2NO_{(g)} + O_{2\,(g)} \rightarrow 2NO_{2(g)}$; K_2.....(ii)

$N_{2(g)} + O_{2(g)} \rightarrow 2NO_{2(g)}$; $K = K_1 \times K_2$

Now for $NO_{2(g)} \rightarrow 1/2\ N_{2(g)} + O_{2(g)}$; $K = \left[\frac{1}{K_1 K_2}\right]^{1/2}$

59. $\frac{x}{m} = p \times T$ is not the correct relation.

60.

$$\Delta S_{vap} = \frac{\Delta H_{vap}}{T} = \frac{30KJmol-1}{300K} = 100Jmol^{-1}K^{-1}$$

61. i > 1, for a compound which dissociates in water

i < 1, on association

62. Given:

$E°_{Sn+4/Sn+2} = +0.15V$

$E°_{Cr+3/Cr} = -0.74$ V

Therefore, $E°_{cell} = E°_{Cathode} - E°_{Anode} = 0.15 - (-0.74) = 0.89$ V

63. The gaseous mixture was prepared by taking equal moles of CO and N_2.

So, $n_{CO} = n_{N2}$

The total pressure of the mixture is 1 atm.

So, $P_{CO} + P_{N2} = 1$ atm

$2\ P_{N2} = 1$ atm

$P_{N2} = 0.5$ atm

64. $\Delta G° = -nE°F$

$E°cell > 0$

$\Delta G° = -RT\ lnK_{eq}$

$\Delta G° > 0$; $K_{eq} < 1$

65. We know, $\Delta T_f = i \times K_f \times m$

$$i = \frac{\Delta T_f \times W_A}{K_f \times n_B \times 1000} = \frac{3.82 \times 45}{1.86 \times \frac{5}{142} \times 1000} = 2.63$$

66. $\lambda_1 = 2\lambda_2$

67. As the standard reduction potential decreases, the reducing power increases.

68. The order of the reaction can be zero, whole number or fraction.

69. Dissociation energy of H–H bond = 869.6/2 = 434.8 kJ

70. If n = 6, the correct sequence of filling of electrons will be ns $\rightarrow$ n(n-2)f $\rightarrow$(n-1)d$\rightarrow$np

71. As covalent character increases, the melting point decreases.
$CaF_2 > CaCl_2 > CaBr_2 > CaI_2$

72. The metals purified by van Arkel method are Zr and Ti.

73. The correct order of increasing bond length is C–H < C=C < C–O < C–C.

74. The reaction can be represented as given below:
$K_2Cr_2O_7 + 3Na_2SO_3 + 4H_2SO_4 \rightarrow 3Na_2SO_4 + K_2SO_4 + Cr_2(SO_4)_3$

75. The correct order is Mn > Fe > Cr > Co.

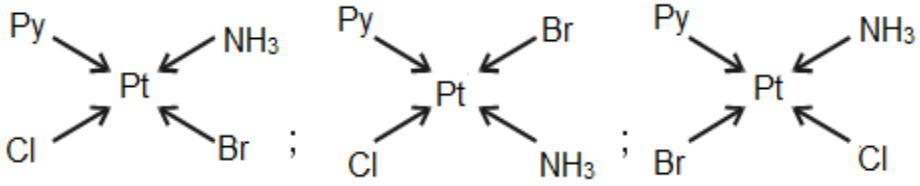
76. NO_2^- and NO_3^- both have sp^2 hybridisation.

77. Carbon is present as the impurity to the maximum extent in pig iron.

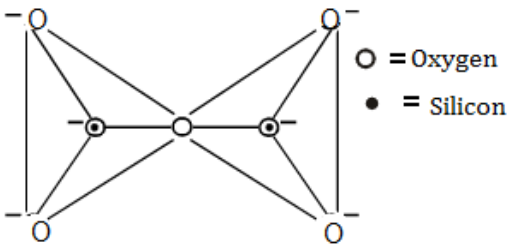
78. BF_3 is the least likely to behave as a Lewis base because it is an electron-deficient species.

79. $Ca(OCl)_2$ is present as an active ingredient in bleaching powder for bleaching action.

80.



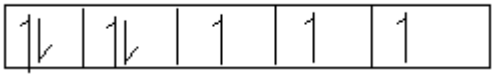
81.



Pyrosilicate $[Si_2O_7]^{6-}$

82. The complexes $[Co(NH_3)_6][Cr(CN)_6]$ and $[Cr(NH_3)_6][Co(CN)_6$ are examples of coordination isomerism.

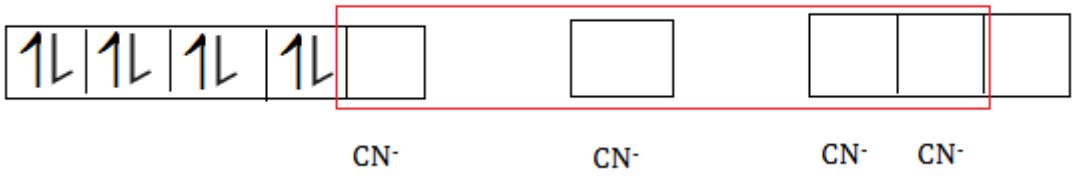
83. Co^{2+}: $3d^7\ 4s^0$



It has minimum number of unpaired electrons.
Mn^{2+}, Fe^{2+} and Cr^{2+} have 5, 4 and 4 unpaired electrons

84. $[Ni(CN)_4]^{2-}$
$Ni^{2+} = 3d^8\ 4s^0$

dsp^2 - hybridisation



85. As bond order (BO) increases, bond length decreases.

O_2^+ BO $= \frac{10-5}{2} = 2.5$

O_2^- BO $= \frac{10-7}{2} = 1.5$

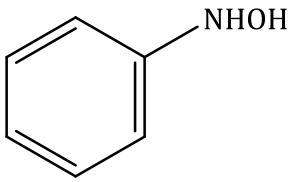
O_2 BO $= \frac{10-6}{2} = 2$

O_2^{2-} BO $= \frac{10-8}{2} = 1$

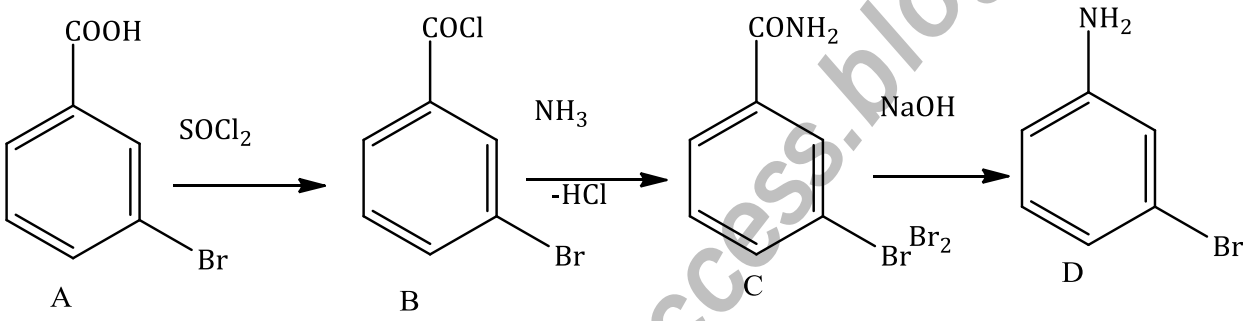
86. Formation of $XY_{4(g)}$ will be favoured at high pressure and low temperature.
Δn_g = −ve and ΔH = −ve

87. Terylene is a polyester polymer obtained from monomer units of terephthalic acid and ethylene glycol.

88.



89.



90. Given:

$W = 0.35g$

$\rho = 715mm$

$\rho_1 = 15mm (\text{aqueous tension of water})$

$T = 300K$

$v = 55ml$

$$\left(\frac{\rho - \rho_1}{T}\right) v \times \frac{273}{760} = V ml$$

$$V = \frac{(715-15)\times 55 \times 273}{300 \times 760} = 46.98ml$$

$$\%\text{ of } N_2 = \frac{28}{22400} \times \frac{46.098}{0.35} \times 100 = 16.45\%$$

91. +R effect of OH is greater than that of OCH_3.

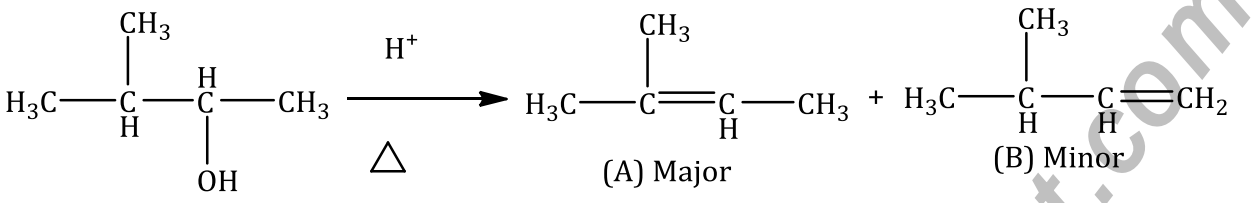
92. Nucleophilic substitution

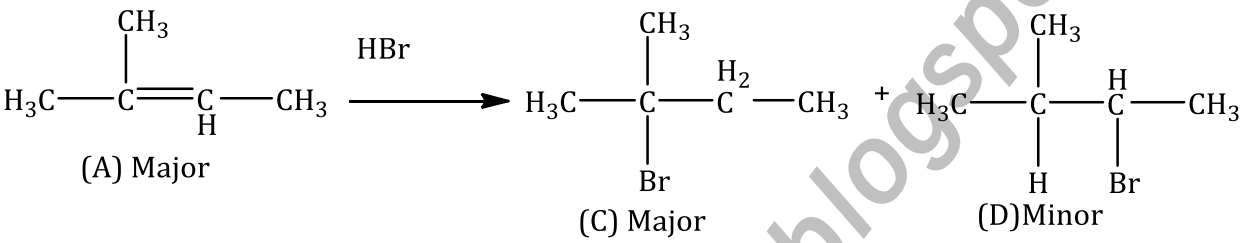
93. $CH_3-C \equiv C-CH_3$ (linear)

$\downarrow \quad \downarrow$

sp sp

94.





95. $Na_2S + 2HNO_3 \rightarrow 2NaNO_3 + H_2S$

$NaCN + HNO_3 \rightarrow NaNO_3 + HCN$

96. 4–Ethyl–3–propyl hex–1–ene

97. Zn–Hg with HCl

98. Diphenyl hydramine is employed as antihistamine.

99. (+) Lactose is a reducing sugar and it exhibits mutarotation.

100. Concentration of DO below 6 ppm is good for the growth of fish.

Biology

101. The eyes are nothing but the axillary buds which develop from nodes.

102. Methanogens belong to Archaebacteria which are found in cattle yards and paddy fields.

103. The highest number of species are of insects as they come under Phylum Arthropoda and Class Insecta with more than 7,00,000 species.

104. *Marchantia polymorpha* possesses a female gametophyte and archegoniophore at the tip.

105. Gametophytes are reduced and few-celled in all vascular plants (pteridophytes, gymnosperms and angiosperms).

106. In all gymnosperms and angiosperms, the gametophyte is dependent on the sporophyte, and *Pinus* is a gymnosperm.

107. Golgi complex performs glycosyl transferase activity of lipids and proteins to form glycoproteins and glycolipids.

108. Peptide bond formation takes place in ribosomes.

109. Lipoprotein cell membrane is found in both, but ribosomes are of different kinds.

110. Mutation can be induced with energy radiations such as ultraviolet rays and gamma rays which cause changes in the structure of DNA.

111. Germplasm can be selected as seed which contains the information for a species' genetic makeup.

112. 23S rRNA acts as a catalyst in which the larger subunit helps in catalysing peptide bond formation.

113. In tulips, the stem is modified to bulbs.
Fruit is a capsule in berries.
No endosperm is formed in orchid seeds.
Primrose has central placentation.

114. The chilli belongs to Family Solanaceae which has 5 stamens.

115. Nitrifying bacteria oxidise ammonia to nitrite and further into nitrate.

$$NH_3 \longrightarrow NO_2^- \longrightarrow NO_3^-$$

116. Leghaemoglobins are haem proteins and were first identified in the root nodules of leguminous plants. They are crucial for supplying sufficient oxygen to root nodule bacteria for nitrogen fixation to occur.

117. Calcium is not mobile in the plant. It is an important constituent of cell walls and can only be supplied in the xylem sap. Thus, if the plant runs out of a supply of calcium, it cannot remobilise calcium from older tissues.

118. A drupe is a type of fruit in which an outer fleshy part surrounds a shell. Mango possesses drupe.
Tomato has berry, wheat has caryopsis and pea has legume.

119. Ground tissue includes cortex, endoderm, pericycle and pith.

120. Epidermal cells do not have chloroplasts.

121. The half inferior ovary is surrounded by a receptacle which is seen in perigynous flowers. Examples: Peach, melon

122. The cork cambium, cork and secondary cortex are collectively called periderm.

123. *Puccinia* is black rust and not smut.

124. Zygomorphic flowers are those which divide into two parts. Examples: Gulmohar, pea, snapdragon datura, mustard and tomato are actinomorphic flowers which can be divided into equal halves along any diameter.

125. CAM is a carbon fixation pathway which prevails in dry conditions such as desert plants. Stomata remain shut during the day which reduces transpiration, thus conserving water.

126. Photosynthetically active radiation (PAR) is a range of solar radiation which plants use for photosynthesis. They use only 2–10% of radiation.

127. *Anabaena*, a prokaryotic autotrophic nitrogen-fixing symbiont, is found in the roots of *Cycas*.

128. Nucellar polyembryony is the form of seed production in which the nucellar tissue produces additional embryos which are genetically identical to the parent plant. This type of polyembryony occurs in citrus varieties, mango and *Opuntia*.

129. Filiform apparatus is a prolongation of the synergids beyond the summit of the embryo sac.

130. The outermost cell layer of endosperm (3n) of seed is called the aleurone layer. Because the cells of the aleurone layer are triploid, the number of chromosomes would be 21 × 3 = 63 as root tip cells (2n) have 42 chromosomes.

131. Wind pollination describes the process of the transfer of pollen from one individual plant to another, whereby the pollen is carried by air currents. This occurs mostly in grasses and gymnosperms.

132. Autogamy is a type of self-pollination where the pollen is transferred to the stigma of the same flower. Cleistogamy is also known as automatic self-pollination, the trait of certain flowering plants where the plants propagate by using non-opening, self-pollinating flowers.

133. The amount of living matter present in an ecosystem in its different trophic levels is called standing crop. It is expressed in the form of number or biomass per unit area.

134. The Bhopal gas tragedy was not due to radioactive activities. It was due to the leakage of the harmful gas methyl isocyanate (MIC) from the plant owned, managed and operated by Union Carbide India Limited (UCIL) in the central Indian city of Bhopal.

135. Secondary wastewater treatment is accomplished through a biological process which removes biodegradable material. This treatment process uses microorganisms (both aerobic and anaerobic) to consume dissolved and suspended organic matter, producing carbon dioxide and other by-products.

136. The enrichment of bodies of freshwater by inorganic plant nutrients such as nitrates and phosphates is termed eutrophication.

137. Woody vines such as epiphytes and lianas are found in tropical rainforests.

138. IUCN - International Union for Conservation of Nature and Natural Resources
IPCC - Intergovernmental Panel for Climate Change
UNEP - United Nations Environment Programme
EPA - Environmental Protection Agency

139. Secondary succession occurs in barren land, abandoned sites, cut forests and lands which have been flooded.

140. Rice has more than 50,000 genetically different strains, while mango has 1000 varieties.

141. Agrobacterium is not a biofertiliser. It is a gene transfer agent.

142. The entry of microorganisms into the human body is due to physiological barriers such as tears in eyes, saliva in the mouth and HCl in the stomach.

143. Anabaena - Nitrogen fixation by converting nitrogen into ammonia.
Glomus - Helps in phosphorus absorption.
Rhizobium - Helps in converting atmospheric nitrogen into compounds of nitrogen.
Frankia - Helps in nitrogen fixation.

144. Himgiri is a variety of wheat which is resistant to yellow rust or stripe rust and hill bunt.

145. Marsh gas (methane) is produced by microorganisms called methanogens which are anaerobes. They are commonly found in wet areas and sewage.

146. The agarose gel acts as a matrix which slows down the DNA segments as they move to the opposite charged end of the gel. A larger segment will have a tougher time moving through the gel, while a smaller segment will move faster because it is easier to move it through the gel.

147. 95% of existing transgenic animals are mice which are used as laboratory specimens to carry out research.

148. In fed batch fermentation, purification of enzymes is carried out by the continuous addition of sugars.

149. RNA interference or RNAi is a process in which RNA molecules inhibit gene expression causing destruction of specific RNA molecules. It is used in the development of plants resistant to nematodes such as *Meloidogyne incognita* and *Caenorhabditis elegans*.

150. Jaya and Ratna are released throughout the rice-growing belts of India.

151. *E. coli* is a prokaryotic cell. The rest are eukaryotic cells.

152. The scientific name of tiger is *Panthera tigris*; *Panthera* is the genus and *tigris* is the species.
Musca is the genus of housefly (*Musca domestica*).
Mollusca is the phylum of cuttlefish.
Primata is the order of human beings.

153. *Salamandra* is a tailed amphibian which has a tympanum which represents the ear.
Aurelia belongs to Phylum Cnidaria.
Ascaris belongs to Phylum Aschelminthes.
Pteropus belongs to Class Mammalia and possesses hair on its body and is viviparous.

154. Chondrichthyes or cartilaginous fish possess cartilaginous endoskeleton.
Reptilia have a three-chambered heart consisting of two atria, one variably partitioned ventricle.
Chordates possess pharyngeal slits to filter food out of the water which enters the mouth.
Mammals give birth to young ones but with an exception. The platypus is a mammal which is oviparous.

155. Male shark - possesses claspers on the pelvic fins for internal fertilisation.
Female Ascaris - the anterior end is curved.
Male frog- No such copulatory pad is seen in limbs.
Female cockroach - Cerci is found only in male cockroach.

156. The X-axis represents temperature and the Y-axis represents enzyme activity. All enzymes act at an optimum temperature, and below this temperature, enzyme activity declines.

157. Ciliated columnar epithelium occurs in bronchioles and fallopian tubes.

158. Chromatids show poleward movement in anaphase; Golgi apparatus and endoplasmic reticulum disappear at late prophase.

159. Structure A is the formula of lecithin which is a phospholipid and is the component of cell membranes.
Structure B is the formula of adenine which is a nitrogenous base.

160. The significant trend in evolution in modern man is his increasing brain capacity. The brain size has significantly increased from Neanderthal Man to Modern Man.

161. In grasshopper, males have only one X chromosome (XO), while females have two chromosomes (XX).

162. The person with blood group O can donate blood to any group and is said to be a universal donor.

163. Eukaryotic chromosomes consist of repeated units of chromatin called nucleosomes which are like beads on a string when seen under an electron microscope.

164. Vasopressin - Released into the blood from the posterior lobe of the pituitary. It stimulates reabsorption of water in the distal tubules in the nephron.

Thyroxine - Secreted by the thyroid gland. It stimulates absorption of glucose by the intestinal wall.

Oxytocin - Secreted by the posterior pituitary which stimulates contraction of uterine muscles during childbirth.

Oestrogen - Secreted from the Graafian follicle which controls secondary sex traits and the menstrual cycle.

165. In cockroach, the food is grinded by mandibles and gizzard.
There is no oxygen transporting pigment, and the nitrogenous excretory product is uric acid.
The Malpighian tubules are found at the junction of the midgut and hindgut.

166. Our venous blood is 75% saturated with oxygen which acts as a reserve during muscular exercise.

167. In humans, milk protein-digesting enzyme in the stomach is pepsin. In calves, it is rennin. Rennin is also present in small amounts in human infants but not adults. Pepsin acts on water-soluble milk protein (caseinogen) to form casein. This combines with calcium salts which get readily digested enzymatically.

168. Convoluted tubules such as the proximal convoluted tubule (PCT) and the distal convoluted tubule (DCT) are present in the Bowman's capsule of the renal cortex, whereas loops of Henle are in medullary pyramids.

169. The intestine of earthworm *Pheretima* possesses a typhlosole which greatly increases the effective absorption area of the digested food in the intestine.

170. The food when swallowed reaches the epiglottis and reaches the oesophagus. When the glottis is not properly closed, some food reaches the respiratory tract and cough starts.

171. The vessels of the arteries carry blood away from the heart to different organs.

172. A bundle of conducting muscle fibres in the heart leading from the atrioventricular node to the ventricles is called the bundle of His.

173. Vitamin A is the precursor of the purplish red pigment rhodopsin contained in the photoreceptor cells of the human eye.

174. Fibrinogen is a protein in the blood plasma which is essential for the coagulation of blood.

175. Neurons are excitable because their membranes are in a polarised state. Different types of selectively permeable channels are present on the neural membrane. When a neuron is not conducting any impulse, the axonal membrane is comparatively more permeable to potassium ion (K^+) and nearly impermeable to sodium ion (Na^+).

176. Podocytes are specialised squamous epithelial cells in the inner wall of the Bowman's capsule. This forms filtration slits for the filtration of blood into the Bowman's capsule.

177. Ovary secretes oestrogen for the maintenance of secondary sexual characters.
Alpha cells of the islets of Langerhans secrete glucagon which raises the blood sugar level.
The anterior lobe of the pituitary secretes growth hormone. Its oversecretion leads to gigantism.

178. Reptiles and birds secrete nitrogenous waste in the solid paste form which is uric acid. So, they are said to be uricotelic animals.

179. A is the alveolar cavity which is the main site of exchange of respiratory gases.

180. High blood pressure refers to 190/110 which is said to be hypertension. Hypertension causes harm to vital organs such as the brain and kidneys.

181. The osmolarity of blood decreases when we drink lot of water which inhibits the release of ADH. It becomes less permeable to water and excess water is eliminated.

182. I - Uterine cavity
II - Endometrium
III - Infundibulum
IV - Fimbriae
V - Cervix

183. The scrotum acts as a thermoregulator and keeps the testicular temperature 2°C lower than the body temperature for normal spermatogenesis.

184. An intrauterine device (IUD) is the most common contraceptive method in females. It prevents the fertilisation of the egg by damaging or killing the sperm.

185. If vas efferentia is blocked, the gametes will not enter the epididymis.
The path is
Seminiferous tubules ⟶ Rete testis ⟶ Vasa efferentia ⟶ Epididymis

186. Medical termination of pregnancy (MTP) is considered safe up to 12 weeks of pregnancy.

187. Head louse living on the human scalp and laying eggs on human hair is a parasite.
Female mosquito needs human blood for reproduction.
The cuckoo (koel) lays its egg in the crow's nest and is a brood parasite.

188. The following pyramid represents declining population. It is urn-shaped with the least number of pre-reproductive individuals.

189. The pyramid of energy is never inverted as there is always a gradual decrease in the energy content at successive trophic levels from the producers to various consumers.

190. Ethanol is produced from *Saccharomyces* which is a species of yeast.

191. The desert lizards under extreme temperatures remain underground and come out from the soil when there is low temperature.

192. CO_2, CH_4, N_2O and CFC are common greenhouse gases but the concentration of CO_2 and N_2O is higher compared to the other gases.

193. Sporozoites are present in the saliva of the infected female *Anopheles* mosquito.

194. Heterosis or hybrid vigour refers to the phenomenon in which the progeny of unrelated varieties of a species or crosses between species exhibit greater biomass, speed of development and fertility than both parents.

195. AIDS is detected by a diagnostic test called enzyme-linked immunosorbent assay (ELISA).
WIDAL test is carried out for detection of typhoid.
MRI is performed to create detailed images of organs and tissues which use magnetic field and radiowaves.
Ultrasound, also called sonography, is an imaging method which uses high-frequency sound waves to produce images of structures within your body.

196. AIDS (acquired immunodeficiency syndrome) is caused by HIV (human immunodeficiency virus). T_4 lymphocytes are the principal target cells of HIV.

197. The portion of a DNA strand shows a palindromic sequence of base pairs.

198. Molasses are used commonly in distilleries for ethanol production.

199. Soyabean crop is associated symbiotically with *Rhizobium*.

200. EcoRI is an endonuclease enzyme isolated from strains of *E. coli*. 'co' stands for 'coli' which is a species of bacteria from where it is obtained.

AIPMT - 2011
(Physics, Chemistry and Biology)
Mains (Code C)

Time: 3 hrs **Total Marks: 480**

General Instructions:

1. The Answer sheet is inside this Text booklet. When you are directed to open the text booklet, take out the Answer Sheet and fill in the particulars on side – 1 and side – 2 carefully with blue/black ball point pen only.
2. The test is of 3 hours duration and consists of 120 questions. Each question carries 4 marks. For each correct response the candidate will get 4 marks. For each incorrect response, one mark will be deducted. The maximum marks are 480.
3. Use Blue / Black ball point pen only for writing particulars on this page / marking responses.
4. Rough work is to be done on the space provided for this purpose in the text booklet only.
5. On completion of the test, the candidate must handover the answer sheet to the invigilator in the room/ Hall. The candidates are allowed to take away this text booklet with them.
6. Make sure that the CODE printed on side – 2 of the answer sheet is the same as that on this booklet, In case of discrepancy, the candidate should immediately report the matter to the invigilator for the replacement of both the test Booklet and the Answer Sheet.
7. The candidates should ensure that the Answer sheet is not folded. Do not make any stray marks on the Answer sheet. Do not write your roll no. anywhere else except in the specified space in the Test booklet / Answer Sheet.
8. Use of white fluid for correction is not permissible on the Answer Sheet.

Biology

1. The cells lining the blood vessels belong to the category of
   (1) Columnar epithelium
   (2) Connective tissue
   (3) Smooth muscle tissue
   (4) Squamous epithelium

2. Consider the following statements (A-D) about organic farming
   A. Utilizes genetically modified crops like Bt cotton
   B. Uses only naturally produced inputs like compost
   C. Does not use pesticides and urea
   D. Produces vegetables rich in vitamins and minerals
   Which of the above statements are correct?

(1) (B) and (C) only
(2) (A) and (B) only
(3) (B), (C) and (D)
(4) (C) and (D) only

3. Select the correct statement with respect to diseases and immunisation
(1) Certain protozoans have been used to mass produce hepatitis B vaccine
(2) Injection of snake antivenom against snake bite is an example of active immunisation
(3) If due to some reason B-and T-lymphocytes are damaged, the body will not produce antibodies against a pathogen
(4) Injection of dead / inactivated pathogens causes passive immunity

4. Selaginella and Salvinia are considered to represent a significant step toward evolution of seed habit because
(1) Megaspores possess endosperm and embryo surrounded by seed coat
(2) Embryo develops in female gametophyte which is retained on parent sporophyte
(3) Female gametophyte is free and gets dispersed like seeds
(4) Female gametophyte lacks archegonia

5. Which one of the following animals may occupy more than one trophic levels in the same ecosystem at the same time?
(1) Goat
(2) Frog
(3) Sparrow
(4) Lion

6. Which one of the following is essential for photolysis of water?
(1) Copper
(2) Boron
(3) Manganese
(4) Zinc

7. What happens during fertilisation in humans after many sperms reach close to the ovum?
(1) Cells of corona radiata trap all the sperms except one
(2) Only two sperms nearest the ovum penetrate zona pellucida
(3) Secretions of acrosome helps one sperm enter cytoplasm of ovum through zona pellucida
(4) All sperms except the one nearest to the ovum lose their tails

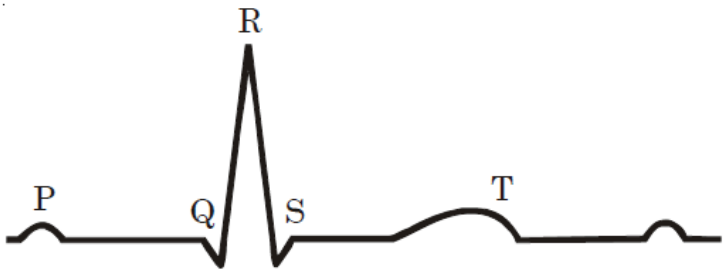
8. Bulk of carbon dioxide (CO_2) released from body tissues into the blood is present as
(1) 70% carbamino-haemoglobin and 30% as bicarbonate
(2) Carbamino-haemoglobin in RBCs
(3) Bicarbonate in blood plasma and RBCs
(4) Free CO2 in blood plasma

9. In mitochondria, protons accumulate in the
(1) Intermembrane space
(2) Matrix
(3) Outer membrane
(4) Inner membrane

10. The unequivocal proof of DNA as the genetic material came from the studies on a
(1) Viroid
(2) Bacterial virus
(3) Bacterium
(4) Fungus

11. Whorled simple leaves with reticulate venation are present in
(1) China Rose
(2) Alstonia
(3) Calotropis
(4) Neem

12. Given below is the ECG of a normal human. Which one of its components is correctly interpreted below?



(1) Peak P and Peak R together – systolic and diastolic blood pressures
(2) Peak P – Initiation of left atrial contraction only
(3) Complex QRS – One complete pulse
(4) Peak T – Initiation of total cardiac contraction

13. Three of the following pairs of the human skeletal parts are correctly matched with their respective inclusive skeletal category and one pair is not matched. Identify the non-matching pair.

	Pairs of skeletal parts	**Category**
(1)	Humerus ulna	Appendicular skeleton
(2)	Malleus and stapes	Ear ossicles
(3)	Sternum and Ribs	Axial skeleton
(4)	Clavicle and Glenoid cavity	Pelvic girdle

14. What is common between vegetative reproduction and Apomixis?
(1) Both occur round the year
(2) Both produces progeny identical to the parent
(3) Both are applicable to only dicot plants
(4) Both bypass the flowering phase

15. Read the following statement having two blanks (A and B)
"A drug used for ___(A)___ patients is obtained from a species of the organism ___(B)___."
The one correct option for the two blanks is

	Blank-A	**Blank-B**
(1)	Swine flu	Monascus
(2)	AIDS	Pseudomonas
(3)	Heart	Penicillium
(4)	Organ-transplant	Trichoderma

16. Which one of the following conditions of the zygotic cell would lead to the birth of a normal human female child?
(1) Only one X chromosome
(2) One X and one Y chromosome
(3) Two X chromosome
(4) Only one Y chromosome

17. The 24 hour (diurnal) rhythm of our body such as the sleep-wake cycle is regulated by the hormone.
(1) Adrenaline
(2) Melatonin
(3) Calcitonin
(4) Prolactin

18. Which one of the following pairs is wrongly matched while the remaining three are correct?
(1) Bryophyllum – Leaf buds
(2) Agave – Bulbils
(3) Penicillium – Conidia
(4) Water hyacinth – Runner

19. Function of companion cells is
(1) Loading of sucrose into sieve elements by passive transport
(2) Loading of sucrose into sieve elements
(3) Providing energy to sieve elements for active transport
(4) Providing water to phloem

20. Which one of the following is not considered as a part of the endomembrane system?
(1) Vacuole
(2) Lysosome
(3) Golgi complex
(4) Peroxisome

21. In Kranz anatomy, the bundle sheath cells have
(1) Thin walls, no intercellular spaces and several chloroplasts
(2) Thick walls, many intercellular spaces and few chloroplasts
(3) Thin walls, many intercellular spaces and no chloroplasts
(4) Thick walls, no intercellular spaces and large number of chloroplasts

22. Sweet potato is homologous to
(1) Ginger
(2) Turnip
(3) Potato
(4) Colocasia

23. Ureters act as urinogenital ducts in
(1) Frog's both males and females
(2) Frog's males
(3) Human males
(4) Human females

24. Which one of the following is a possibility for most of us in regard to breathing, by making a *conscious effort*?
(1) One can consciously breathe in and breathe out by moving the diaphragm alone, without moving the ribs at all
(2) The lungs can be made fully empty by forcefully breathing out all air from them
(3) One can breathe out air totally without oxygen
(4) One can breathe out air through Eustachian tubes by closing both the nose and the mouth

25. Read the following four statements (A-D) about certain mistakes in two of them
(A) The first transgenic buffalo Rosie produced milk which was human alpha-lactalbumin enriched
(B) Restriction enzymes are used in isolation of DNA from other macro-molecules
(C) Downstream processing is one of the steps of R-DNA technology
(D) Disarmed pathogen vectors are also used in transfer of R-DNA into the host
Which are the two statements having mistakes?
(1) Statements (A) and (C)
(2) Statements (A) and (B)
(3) Statements (B) and (C)
(4) Statements (C) and (D)

26. The pathogen Microsporum responsible for ringworm disease in humans belongs to the same Kingdom of organisms as that of
(1) Rhizopus, a mould
(2) Ascaris, a round worm
(3) Taenia, a tapeworm
(4) Wuchereria, a filarial worm

27. Which one of the following techniques made it possible to genetically engineer living organisms?
(1) Heavier isotope labelling
(2) Hybridization
(3) Recombinant DNA techniques
(4) X-ray diffraction

28. "Good ozone" is found in the
(1) Stratosphere
(2) Ionosphere
(3) Mesosphere
(4) Troposphere

29. Guttation is the result of
(1) Osmosis
(2) Root pressure
(3) Diffusion
(4) Transpiration

30. Biodiversity of a geographical region represents
(1) Genetic diversity present in the dominant species of the region
(2) Species endemic to the region
(3) Endangered species found in the region
(4) The diversity in the organisms living in the region

31. At metaphase, chromosomes are attached to the spindle fibres by their
(1) Kinetochores
(2) Centromere
(3) Satellites
(4) Secondary constrictions

32. Which one of the following is a wrong matching of a microbe and its industrial product, while the remaining three are correct?
(1) Clostridium butylicum - lactic acid
(2) Aspergillus niger - citric acid
(3) Yeast - statins
(4) Acetobacter aceti - acetic acid

33. Silencing of mRNA has been used in producing transgenic plants resistant to
(1) White rusts
(2) Bacterial blights
(3) Bollworms
(4) Nematodes

34. Which one of the following statements is totally wrong about the occurrence of notochord while the other three are correct
(1) It is absent throughout life in humans from the very beginning
(2) It is present throughout life in Amphioxus
(3) It is present only in larval tail in Ascidians
(4) It is replaced by a vertebral column in adult frog

35. The technique called gamete intrafallopian transfer (GIFT) is recommended for those females
(1) Who's cervical canal is too narrow to allow passage for the sperms
(2) Who cannot provide suitable environment for fertilisation
(3) Who cannot produce an ovum
(4) Who cannot retain the foetus inside uterus

36. Common cold is not cured by antibiotics because it is
(1) Caused by a Gram-negative bacterium
(2) Not an infectious disease
(3) Caused by a virus
(4) Caused by a Gram-positive bacterium

37. Which one of the following options gives the correct matching of a disease with its causative organism and mode of infection

Disease	Causative Organisms	Mode of Infection
(1)Elephantiasis	Wuchereria bancrofti	With infected water and food
(2)Malaria	Plasmodium vivax	Bite of female Anopheles mosquito
(3)Typhoid	Salmonella typhii	With inspired air
(4)Pneumonia	Streptococcus pneumoniae	Droplet infection

38. Frogs differ from humans in possessing
(1) Nucleated red blood cells
(2) Thyroid as well as parathyroid
(3) Paired cerebral hemispheres
(4) Hepatic portal system

39. Test cross in plants or in Drosophila involves crossing
(1) The F_1 hybrid with a double recessive genotype
(2) Between two genotypes with dominant trait
(3) Between two genotypes with recessive trait
(4) Between two F_1 hybrids

40. The logistic population growth is expressed by the equation

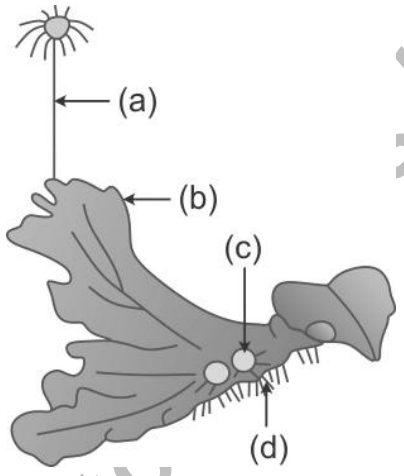
(1) $dN/dt = rN$

(2) $dN/dt = rN\left(\frac{N-K}{N}\right)$

(3) $dt/dN = Nr\left(\frac{K-N}{K}\right)$

(4) $dN/dt = rN\left(\frac{K-N}{K}\right)$

41. Examine the figure given below and select the right option giving all the four parts (a, b, c, d) correctly identified



a	b	c	d
(1) Seta	Sporophyte	Protonema	Rhizoids
(2)Antheridiophore	Male thallus	Globule	Roots
(3)Archegoniophore	Female thallus	Gemma- cup	Rhizoids
(4)Archegoniophore	Female thallus	Bud	Foot

42. About which day in a normal human menstrual cycle does rapid secretion of LH (Popularly called LH-surge) normally occurs

(1) 5th day

(2) 11th day

(3) 14th day

(4) 20th day

43. In history of biology, human genome project led to the development of?

(1) Bioinformatics

(2) Biosystematics

(3) Biotechnology

(4) Biomonitoring

44. Which one of the following correctly represents the normal adult human dental formula?

(1) $\frac{2}{2},\frac{1}{1},\frac{2}{2},\frac{3}{3}$

(2) $\frac{3}{3},\frac{1}{1},\frac{3}{3},\frac{3}{3}$

(3) $\frac{3}{3},\frac{1}{1},\frac{3}{2},\frac{1}{1}$

(4) $\frac{2}{2},\frac{1}{1},\frac{3}{2},\frac{3}{3}$

45. The type of muscles present in our

(1) Thigh are striated and voluntary

(2) Upper arm are smooth muscle fibres fusiform in shape

(3) Heart are involuntary and unstriated smooth muscles

(4) Intestine are striated and involuntary

46. Which one of the following is not an essential mineral element for plants while the remaining three are?

(1) Cadmium

(2) Phosphorus

(3) Iron

(4) Manganese

47. Consider the following four statements whether they are correct or wrong?

(A) The sporophyte in liverworts is more elaborate than that in mosses

(B) Salvinia is heterosporous

(C) The life-cycle in all seed bearing plants is diplontic

(D) In Pinus male and female cones are borne on different trees

The two wrong statements together are

(1) Statements (B) and (C)

(2) Statements (A) and (B)

(3) Statements (A) and (C)

(4) Statements (A) and (D)

48. Consider the following four statements (A-D) related to the common frog Rana tigrina, and select the correct option stating which ones are true (T) and which ones are false (F).

Statements:

(A) One dry land it would die due to lack of O2 if its mouth is forcibly kept closed for a few days.

(B) It has four chambered heart.

(C) On dry land it turns uricotelic from ureotelic.
(D) Its life history is carried out in pond water.
Options:

	(A)	(B)	(C)	(D)
(1)	F	F	T	T
(2)	F	T	T	F
(3)	T	F	F	T
(4)	T	T	F	F

49. The figure shows four animals (a), (b), (c) and (d). Select the correct answer with respect to a common characteristic of two of these animals.

(a)  (b) 

(c)  (d) 

(1) (a) and (d) have cnidoblasts for self-defence
(2) (c) and (d) have a true coelom
(3) (a) and (d) respire mainly through body wall
(4) (b) and (c) show radial symmetry

50. In angiosperms, functional megaspore develops into
(1) Endosperm
(2) Pollen sac
(3) Embryo sac
(4) Ovule

51. Which one of the following aspects is an exclusive characteristic of living things?
(1) Perception of events happening in the environment and their memory
(2) Increase in mass by accumulation of material both on surface as well as internally
(3) Isolated metabolic reactions occur in vitro
(4) Increase in mass from inside only

52. Some vascular bundles are described as open because these
(1) Possess conjunctive tissue between xylem and phloem
(2) Are not surrounded by pericycle
(3) Are surrounded by pericycle but no endodermis
(4) Are capable of producing secondary xylem and phloem

53. *Bacillus thuringiensis* forms protein crystals which contain insecticidal protein.

This protein :
(1) Is activated by acid pH of the foregut of the insect pest
(2) Does not kill the carrier bacterium which is itself resistant to this toxin
(3) Binds with epithelial cells of midgut of the insect pest ultimately killing it
(4) Is coded by several genes including the gene cry

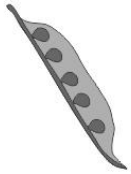
54. One of the constituents of the pancreatic juice while poured into the duodenum in humans is
(1) Trypsin
(2) Enterokinase
(3) Trypsinogen
(4) Chymotrypsin

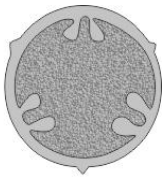
55. Which one of the following structures in Pheretima is correctly matched with its function?
(1) Setae-defence against predators
(2) Typhlosole - storage of extra nutrients
(3) Clitellum - secretes cocoon
(4) Gizzard - absorbs digested food

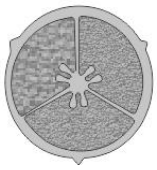
56. Both, hydrarch and xerarch successions lead to
(1) Highly dry conditions
(2) Excessive wet conditions
(3) Medium water conditions
(4) Xeric conditions

57. The breakdown of detritus into smaller particles by earthworm is a process called
(1) Mineralisation
(2) Catabolism
(3) Humification
(4) Fragmentation

58. Which one of the following diagrams represents the placentation in Dianthus?

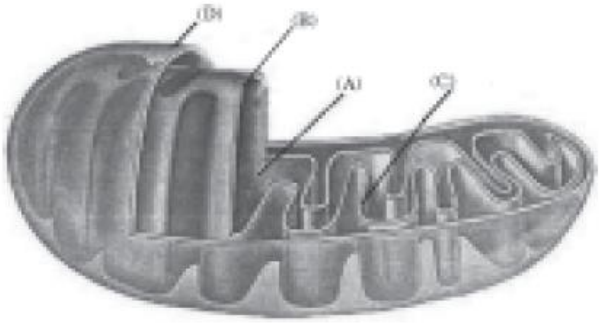
(1) 

(2) 

(3) 

(4) 

59. The figure below shows the structure of a mitochondrion with its four parts labelled (A), (B), (C) and (D). Select the part correctly matched with its function.



(1) Part (C): Cristae – possess single circular DNA molecule and ribosomes
(2) Part (A): Matrix – major site for respiratory chain enzymes
(3) Part (D): Outer membrane – gives rise to inner membrane by splitting
(4) Part (B): Inner membrane – forms infoldings called cristae

60. Consider the following statement (A)-(D) each with one or two blanks.
(A) Bears go into ____(1)____ during winter to ___(2)_____ cold weather
(B) A conical age pyramid with a broad base represents _____(3)_____ human population
(C) A wasp pollinating a fig flower is an example of _____(4)_____
(D) An area with high levels of species richness is known as _____(5)_____
Which one of the following options, gives the correct fill ups for the respective blank numbers from (1) to (5) in the statements?
(1) (3) - expanding, (4) - commensalism, (5) -biodiversity park
(2) (1) - hibernation, (2) - escape, (3) - expanding,(5) - hot spot
(3) (3) - stable, (4) - commensalism, (5) – marsh
(4) (1) - aestivation, (2) - escape, (3) - stable, (4) -mutualism

Physics

61. A galvanometer of resistance G is shunted by a resistance S ohm. To keep the main current in the circuit unchanged, the resistance to be put in series with the galvanometer is

(1) $\frac{G^2}{(S+G)}$

(2) $\frac{G}{(S+G)}$

(3) $\frac{S^2}{(S+G)}$

(4) $\frac{SG}{(S+G)}$

62. A particle covers half of its total distance with speed v_1 and the rest half distance with speed v_2. Its average speed during the complete journey is

(1) $\frac{2v_1^2v_2^2}{v_1^2+v_2^2}$

(2) $\frac{v_1+v_2}{2}$

(3) $\frac{v_1v_2}{v_1+v_2}$

(4) $\frac{2v_1v_2}{v_1+v_2}$

63. A thermocouple of negligible resistance produces an e.m.f. of 40 μV/°C in the linear range of temperature. A galvanometer of resistance 10 ohm whose sensitivity is 1 μA/div, is employed with the thermocouple. The smallest value of temperature difference that can be detected by the system will be

(1) 0.1 °C

(2) 0.25 °C

(3) 0.5 °C

(4) 1 °C

64. A mass m moving horizontally (along the x-axis) with velocity v collides and sticks to a mass of 3m moving vertically upward (along the y-axis) with velocity 2v. The final velocity of the combination is

(1) $\frac{2}{3}v\hat{i}+\frac{1}{3}v\hat{j}$

(2) $\frac{3}{2}v\hat{i}+\frac{1}{4}v\hat{j}$

(3) $\frac{1}{4}v\hat{i}+\frac{3}{2}v\hat{j}$

(4) $\frac{1}{3}v\hat{i}+\frac{2}{3}v\hat{j}$

65. A converging beam of rays is incident on a diverging lens. Having passed through the lens the rays intersect at a point 15 cm from the lens on the opposite side. If the lens is removed, the point where the rays meet will move 5 cm closer to the lens. The focal length of the lens is

(1) -30 cm

(2) 5 cm

(3) -10 cm

(4) 20 cm

66. The threshold frequency for a photosensitive metal is 3.3×10^{14} Hz. If light of frequency 8.2×10^{14} Hz is incident on this metal, the cut-off voltage for the photoelectric emission is nearly

(1) 5 V

(2) 1 V

(3) 2 V

(4) 3 V

67. An electron in the hydrogen atom jumps from excited state n to the ground state. The wavelength so emitted, illuminates a photosensitive material having work function 2.75 eV. If the stopping potential of the photoelectron is 10 V, then the value of n is

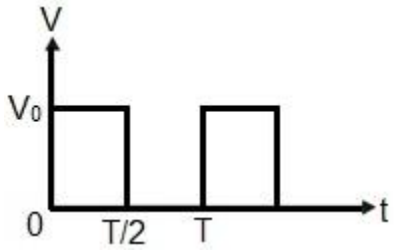
(1) 5

(2) 2

(3) 3

(4) 4

68. The r.m.s. value of potential difference V shown in the figure is



(1) $\frac{V_o}{2}$

(2) $\frac{V_o}{\sqrt{3}}$

(3) V_0

(4) $\frac{V_o}{\sqrt{2}}$

69. A particle of mass M is situated at the centre of a spherical shell of same mass and radius a. The magnitude of the gravitational potential at a point situated at $\frac{a}{2}$ distance from the centre, will be

(1) $\frac{4GM}{a}$

(2) $\frac{GM}{a}$

(3) $\frac{2GM}{a}$

(4) $\frac{3GM}{a}$

70. Two particles are oscillating along two close parallel straight lines side by side, with the same frequency and amplitudes. They pass each other, moving in opposite directions when their displacement is half of the amplitude. The mean positions of the two particles lie on a straight line perpendicular to the paths of the two particles. The phase difference is

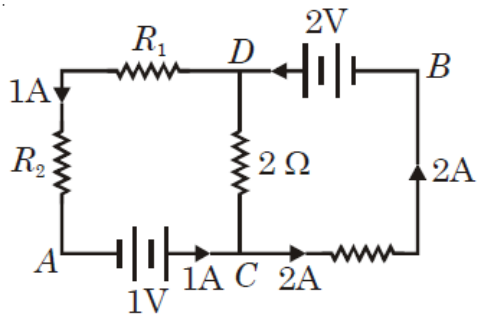
(1) π

(2) $\frac{\pi}{6}$

(3) 0

(4) $\frac{2\pi}{3}$

71. In the circuit shown in the figure, if the potential at point A is taken to be zero, the potential at point B is



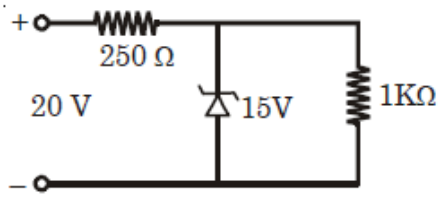
(1) -2V
(2) +1V
(3) -1 V
(4) +2 V

72. A conveyor belt is moving at a constant speed of 2 m/s. A box is gently dropped on it. The coefficient of friction between them is μ = 0.5. The distance that the box will move relative to belt before coming to rest on it, taking g = 10 ms^{-2}, is
(1) Zero
(2) 0.4 m
(3) 1.2 m
(4) 0.6 m

73. A mass of diatomic gas (γ = 1.4) at a pressure of 2 atmospheres is compressed adiabatically so that its temperature rises from 27 °C to 927 °C. The pressure of the gas in the final state is
(1) 256 atm
(2) 8 atm
(3) 28 atm
(4) 68.7 atm

74. Charge q is uniformly spread on a thin ring of radius R. The ring rotates about its axis with a uniform frequency f Hz. The magnitude of magnetic induction at the center of the ring is:
(1) $\frac{\mu_0 q}{2\pi fR}$
(2) $\frac{\mu_0 qf}{2\pi R}$
(3) $\frac{\mu_0 qf}{2R}$
(4) $\frac{\mu_0 q}{2fR}$

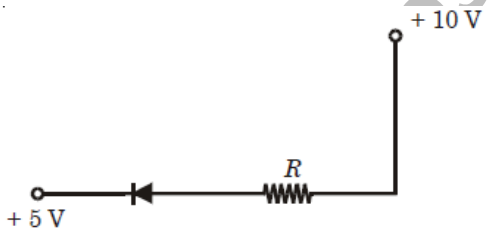
75. A zener diode, having breakdown voltage equal to 15 V is used in a voltage regulator circuit shown in figure. The current through the diode is:



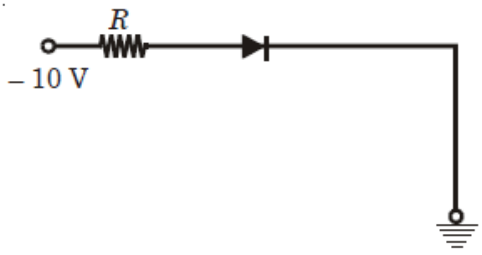
(1) 20 mA
(2) 5 mA
(3) 10 mA
(4) 15 mA

76. Out of the following which one is not a possible energy for a photon to be emitted by hydrogen atom according to Bohr's atomic model?
(1) 13.6 eV
(2) 0.65 eV
(3) 1.9 eV
(4) 11.1 eV

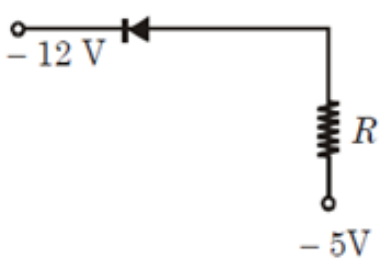
77. In the following figure, the diodes which are forward biased are
(a)



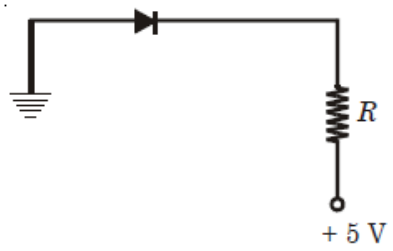
(b)



(c)



(d)



(1) (b) and (d)
(2) (a), (b) and (d)
(3) (c) only
(4) (c) and (a)

78. Two radioactive nuclei P and Q in a given sample decay into a stable nucleus R. At time t = 0, number of P species are $4N_0$ and that of Q are N_0. Half-life of P (for conversion to R) is 1 minute whereas that of Q is 2 minutes. Initially there are no nuclei of R present in the sample. When number of nuclei of P and Q are equal the number of nuclei of R present in the sample would be:

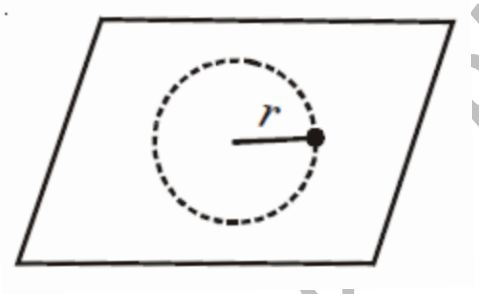
(1) $\frac{5N_0}{2}$
(2) $2N_0$
(3) $3N_0$
(4) $\frac{9N_0}{2}$

79. Pure Si at 500 K has equal number of electron (n_e) and hole (n_h) concentrations of $1.5 \times 10^{16}\ m^{-3}$. Doping by Indium increases n_h to $4.5 \times 10^{22}\ m^{-3}$.
The doped semiconductor is of:
(1) n-type with electron concentration $n_e = 2.5 \times 10^{23}\ m^{-3}$
(2) p-type having electron concentration $n_e = 5 \times 10^{9}\ m^{-3}$
(3) n-type with electron concentration $n_e = 2.5 \times 10^{22}\ m^{-3}$
(4) p-type with electron concentration $n_e = 2.5 \times 10^{10}\ m^{-3}$

80. A thin prism of angle 15° made of glass of refractive index $\mu_1 = 1.5$ is combined with another prism of glass of refractive index $\mu_2 = 1.75$. The combination of the prisms produces dispersion without deviation. The angle of the second prism should be
(1) 12°
(2) 5°
(3) 7°
(4) 10°

81. Two identical piano wires, kept under the same tension T have a fundamental frequency of 600 Hz. The fractional increase in the tension of one of the wires which will lead to occurrence of 6 beats /s when both the wires oscillate together would be
(1) 0.04
(2) 0.01
(3) 0.02
(4) 0.03

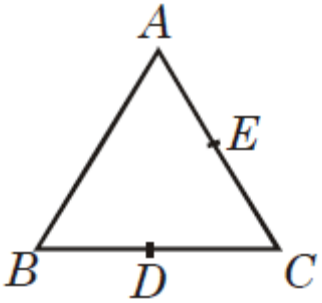
82. A small mass attached to a string rotates on a frictionless table top as shown. If the tension in the string is increased by pulling the string causing the radius of the circular motion to decrease by a factor of 2, the kinetic energy of the mass will



(1) Increase by a factor of 4
(2) Decrease by a factor of 2
(3) Remain constant
(4) Increase by a factor of 2

83. The electric potential V at any, point (x, y, z), in metres in space is given by $V = 4x^2$ volt. The electric field at the point (1, 0, 2) in volt/metre, is
(1) 16 along positive x-axis
(2) 8 along negative x-axis
(3) 8 along positive x-axis
(4) 16 along negative x-axis

84. Three charges, each +q, are placed at the corners of an isosceles triangle ABC of sides BC and AC, 2a. D and E are the mid points of BC and CA.
The work done in taking a charge Q from D to E is



(1) Zero

(2) $\frac{3qQ}{4\pi\varepsilon_0 a}$

(3) $\frac{3qQ}{8\pi\varepsilon_0 a}$

(4) $\frac{qQ}{4\pi\varepsilon_0 a}$

85. A particle of mass m is thrown upwards from the surface of the Earth, with a velocity u. The mass and the radius of the Earth are, respectively, M and R. G is the gravitational constant and g is the acceleration due to gravity on the surface of the Earth. The minimum value of u so that the particle does not return back to Earth, is

(1) $\sqrt{2gR^2}$

(2) $\sqrt{\frac{2GM}{R^2}}$

(3) $\sqrt{\frac{2GM}{R}}$

(4) $\sqrt{\frac{2gM}{R^2}}$

86. A short bar magnet of magnetic moment 0.4 JT^{-1} is placed in a uniform magnetic field of 0.16 T. The magnet is in stable equilibrium when the potential energy is

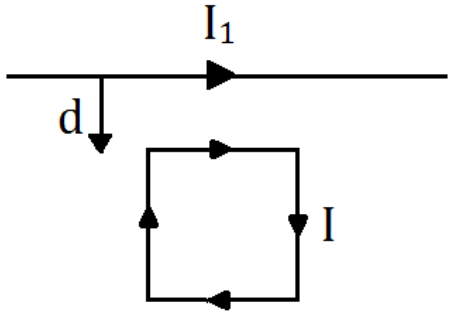
(1) – 0.082 J

(2) 0.064 J

(3) – 0.064 J

(4) Zero

87. A square loop, carrying a steady current I, is placed in a horizontal plane near a long straight conductor carrying a steady current I_1 at a distance d from the conductor as shown in figure. The loop will experience



(1) A net torque acting downward normal to the horizontal plane

(2) A net attractive force towards the conductor

(3) A net repulsive force away from the conductor
(4) A net torque acting upward perpendicular to the horizontal plane

88. A projectile is fired at an angle of 45° with the horizontal. Elevation angle of the projectile at its highest point as seen from the point of projection is

(1) $\tan^{-}\left(\frac{\sqrt{3}}{2}\right)$

(2) 45°

(3) 60°

(4) $\tan^{-1}\frac{1}{2}$

89. A coil has resistance 30 ohm and inductive reactance 20 ohm at 50 Hz frequency. If an ac source of 200 volt, 100 Hz is connected across the coil, the current in the coil will be

(1) $\frac{20}{\sqrt{13}}$ A

(2) 2.0 A

(3) 4.0 A

(4) 8.0 A

90. The density of a material in CGS system of units is 4 g/cm^3. In a system of units in which unit of length is 10 cm and unit of mass is 100 g, the value of density of material will be

(1) 400

(2) 0.04

(3) 0.4

(4) 40

Chemistry

91. Match list-I with List-II for the composition of substances and select the correct answer using the code given below the lists

List – I Substances		List – II Composition	
(A)	Plaster of Paris	(i)	$CaSO_4.2H_2O$
(B)	Epsomite	(ii)	$CaSO_4.\frac{1}{2}H_2O$
(C)	Kieserite	(iii)	$MgSO_4.7H_2O$
(D)	Gypsum	(iv)	$MgSO_4.H_2O$
		(v)	$CaSO_4$

Code:

(A)	(B)	(C)	(D)
(1) (i)	(ii)	(iii)	(iv)
(2) (iv)	(iii)	(ii)	(i)
(3) (iii)	(iv)	(i)	(ii)
(4) (ii)	(iii)	(iv)	(i)

92. Which of the following statements is incorrect?

(1) Aluminium reacts with excess NaOH to give $Al(OH)_3$

(2) $NaHCO_3$ on heating gives Na_2CO_3

(3) Pure sodium metal dissolves in liquid ammonia to give blue solution

(4) NaOH reacts with glass to give sodium silicate

93. Which of the statements about "Denaturation" given below are correct?

Statements :

(a) Denaturation of proteins causes loss of secondary and tertiary structures of the protein

(b) Denaturation leads to the conversion of double strand of DNA into single strand

(c) Denaturation affects primary structure which gets distorted

Options

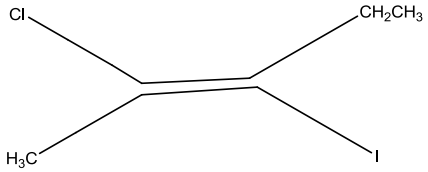
(1) (a) and (b)

(2) (a), (b) and (c)

(3) (b) and (c)

(4) (a) and (c)

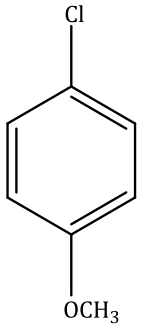
94. The IUPAC name of the following compound is



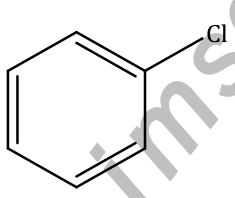
(1) trans-3-iodo-4-chloro-3-pentene
(2) cis-3-chloro-3-iodo-2-pentene
(3) trans-2-chloro-3-iodo-2-pentene
(4) cis-3-iodo-4-chloro-3-pentene

95. Which of the following oxide is amphoteric?
(1) SiO_2
(2) CO_2
(3) SnO_2
(4) CaO

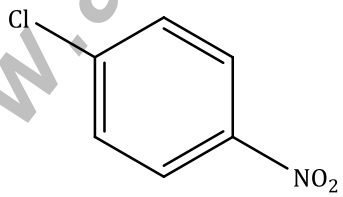
96. Which of the following compounds undergoes nucleophilic substitution reaction most easily?
(1)



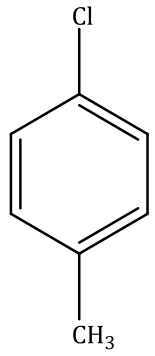
(2)



(3)

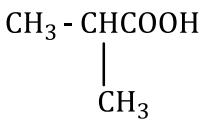


(4)



97. A bubble of air is underwater at temperature 15°C and the pressure 1.5 bar. If the bubble rises to the surface where the temperature is 25°C and the pressure is 1.0 bar what will happen to the volume of the bubble?
(1) Volume will become smaller by a factor of 0.70
(2) Volume will become greater by a factor of 2.5
(3) Volume will become greater by a factor of 1.6
(4) Volume will become greater by a factor of 1.1

98. An organic compound 'A' on treatment with NH_3 gives 'B' which on heating gives 'C' when treated in presence of KOH produces ethylamine. Compound with Br in the 'A' is
(1)



(2) CH_3CH_2COOH
(3) CH_3COOH
(4) $CH_3CH_2CH_2COOH$

99. Consider the following process

	ΔH(kJ/mol)
$\frac{1}{2}A \rightarrow B$	+150
$3B \rightarrow 2C+D$	-125
$E + A \rightarrow 2D$	+350

For $B + D \rightarrow E + 2$, ΔH will be

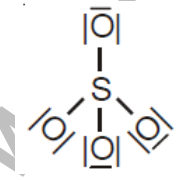
(1) -325 kJ/mol
(2) 325 kJ/mol
(3) 525 kJ/mol
(4) -175 kJ/mol

100. A 0.1 molal aqueous solution of a weak acid is 30% ionized. If K_f for water is 1.86°C/m, the freezing point of the solution will be
(1) 0.36°C
(2) – 0.24°C
(3) – 0.18°C
(4) – 0.54°C

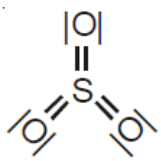
101. The following reactions take place in the blast furnace in the preparation of impure iron. Identify the reaction pertaining to the formation of the slag.
(1) $CaO_{(s)} + SiO_{2(s)} \rightarrow CaSiO_{3(s)}$
(2) $2C_{(s)} + O_{2(g)} \rightarrow 2CO_{(g)}$
(3) $Fe_2O_{3(s)} + 3CO_{(g)} \rightarrow 2Fe_{(l)} + 3CO_{2(g)}$
(4) $CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}$

102. In qualitative analysis, the metals of group I can be separated from other ions by precipitating them as chloride salts. A solution initially contains Ag^+ and Pb^{2+} at a concentration is 0.10 M. Aqueous HCl is added to this solution until the Cl^- concentration is 0.10 M. What will the concentration of Ag^+ and Pb^{2+} be at equilibrium?
(K_{sp} for AgCl = 1.8×10^{-10}, K_{sp} for $PbCl_2$ = 1.7×10^{-5})
(1) $[Ag^+] = 1.8 \times 10^{-9}$ M
$[Pb^{2+}] = 1.7 \times 10^{-3}$ M
(2) $[Ag^+] = 1.8 \times 10^{-11}$ M
$[Pb^{2+}] = 1.7 \times 10^{-4}$ M
(3) $[Ag^+] = 1.8 \times 10^{-7}$ M
$[Pb^{2+}] = 1.7 \times 10^{-6}$ M
(4) $[Ag^+] = 1.8 \times 10^{-11}$ M
$[Pb^{2+}] = 8.5 \times 10^{-5}$ M

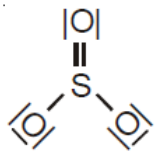
103. Which of the following structures is the most preferred and hence of lowest energy for SO_3?
(1)



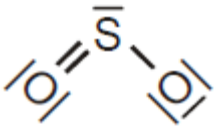
(2)



(3)



(4)



104. The unit of rate constant for a zero order reaction is
(1) $L^2\ mol^{-2}\ s^{-1}$
(2) s^{-1}
(3) $mol\ L^{-1}\ s^{-1}$
(4) $L\ mol^{-1}\ s^{-1}$

105. A solution contains Fe^{2+}, Fe^{3+} and I^- ions. This solution was treated with iodine at 35°C. E° for Fe^{3+}/Fe^{2+} is +0.77 V and E° for $I_2/2I^-$ = 0.536 V.
The favourable redox reaction is
(1) I^- will be oxidised to I_2
(2) Fe^{2+} will be oxidised to Fe^{3+}
(3) I_2 will be reduced to I^-
(4) There will be no redox reaction

106. 200 mL of an aqueous solution of a protein contains its 1.26 g. The Osmotic pressure of this solution at 300 K is found to be 2.57×10^{-3} bar. The molar mass of protein will be (R = 0.083 L bar mol–1 K^{-1})
(1) 31011 $g\ mol^{-1}$
(2) 61038 $g\ mol^{-1}$
(3) 51022 $g\ mol^{-1}$
(4) 122044 $g\ mol^{-1}$

107. The rate of the reaction
$2N_2O_5 \rightarrow 4\ NO_2 + O_2$
Can be written in three ways

$$\frac{-d[N_2O_5]}{dt} = k[N_2O_5]$$

$$\frac{d[NO_2]}{dt} = k'[N_2O_5]$$

$$\frac{d[O_2]}{dt} = k''[N_2O_5]$$

The relationship between k and k' and between k and k'' are
(1) k' = 2k; k'' = 2k
(2) k' = k; k'' = k
(3) k' = 2k; k'' = k
(4) k'= 2k; k'' = k/2

108. The half life of a substance in a certain enzyme -catalysed reaction is 138 s. The time required for the concentration of the substance to fall from 1.28 mg L–1 to 0.04 mg L–1 is
(1) 690 s
(2) 276 s
(3) 414 s
(4) 552 s

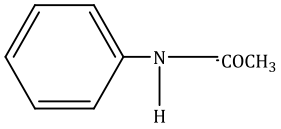
109. Which of the following complex compounds will exhibit highest paramagnetic behaviour?
(1) $[Co(NH_3)_6]^{3+}$
(2) $[Zn(NH_3)_6]^{2+}$
(3) $[Ti(NH_3)_6]^{3+}$
(4) $[Cr(NH_3)_6]^{3+}$
(At. No. Ti = 22, Cr = 24, Co = 27, Zn = 30)

110. A solid compound XY has NaCl structure. If the radius of the cation is 100 pm, the radius of the anion (Y^-) will be
(1) 241.5 pm
(2) 165.7 pm
(3) 275.1 pm
(4) 322.5 pm

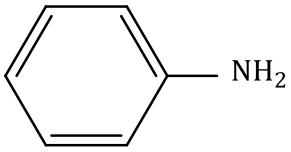
111. Which of the following is not a fat soluble vitamin?
(1) Vitamin E
(2) Vitamin A
(3) Vitamin B complex
(4) Vitamin D

112. Which of the following compounds is most basic?

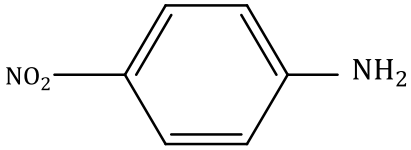
(1)



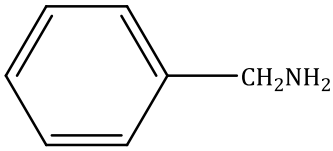
(2)



(3)



(4)



113. Which has the maximum number of molecules among the following?

(1) 8 g H_2
(2) 64 g SO_2
(3) 44 g CO_2
(4) 48 g O_3

114. Match the compounds given in List-I with List-II and select the suitable option using the code given below.

List-I	**List-II**
a. Benzaldehyde	(i) Phenolphthalein
b. Phthalic anhydride	(ii) Benzoin condensation
c. Phenyl benzoate	(iii) Oil of wintergreen
d. Methyl salicylate	(iv) Fries rearrangement

(1) a(ii), b(iii), c(iv), d(i)
(2) a(ii), b(i), c(iv), d(iii)
(3) a(iv), b(i), c(iii), d(ii)
(4) a(iv), b(ii), c(iii), d(i)

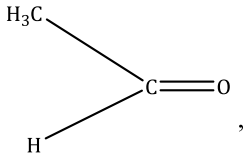
115. What is the value of electron gain enthalpy Na^+ if IE_1 of Na = 5.1 eV?

(1) + 2.55 eV
(2) +10.2 eV
(3) -5.1 eV
(4) -10.2 eV

116. Which of the following carbonyls will have the strongest C – O bond?

(1) $V(CO)^-_6$
(2) $Fe(CO)_5$
(3) $Mn(CO)^+_6$
(4) $Cr(CO)_6$

117. The order of reactivity of phenyl magnesium bromide (PhMgBr) with the following compounds :



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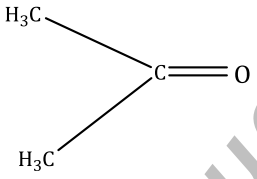
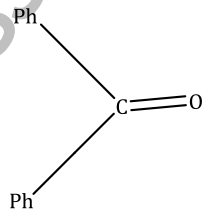


and


(1) I > II > II
(2) I > II > III
(3) III > II > I
(4) II > I > III

118. The pairs of species of oxygen and their magnetic behaviours are noted below. Which of the following presents the correct description?

(1) O^+_2, O_2 - Both paramagnetic
(2) O, O^{2-}_2 - Both paramagnetic
(3) O^-_2, O^{2-}_2 - Both diamagnetic
(4) O^+, O^{2-}_2 - Both paramagnetic

119. According to the Bohr Theory, which of the following transitions in the hydrogen atom will give rise to the least energetic photon?

(1) n = 6 to n = 5
(2) n = 5 to n = 3
(3) n = 6 to n = 1
(4) n = 5 to n = 4

120. Consider the reactions:

(i)

$$(CH_3)_2CH\text{-}CH_2Br \xrightarrow{C_2H_5OH} (CH_3)_2CH\text{-}CH_2OC_2H_5 + HBr^-$$

(ii)

$$(CH_3)_2CH\text{-}CH_2Br \xrightarrow{C_2H_5O^-} (CH_3)_2CH\text{-}CH_2OC_2H_5\ Br^-$$

The mechanisms of reactions (i) and (ii) are respectively

(1) S_N2 and S_N2

(2) S_N2 and S_N1

(3) S_N1 and S_N2

(4) S_N1 and S_N2

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Mains Answer Key and Solution
Code C

Answers

1	(4)	2	(1)	3	(3)	4	(2)	5	(3)	6	(3)	7	(3)	8	(3)	9	(1)	10	(2)
11	(2)	12	(3)	13	(4)	14	(2)	15	(4)	16	(3)	17	(2)	18	(4)	19	(2)	20	(4)
21	(4)	22	(2)	23	(2)	24	(1)	25	(2)	26	(1)	27	(3)	28	(1)	29	(2)	30	(4)
31	(1)	32	(1)	33	(4)	34	(1)	35	(3)	36	(3)	37	(4)	38	(1)	39	(1)	40	(4)
41	(3)	42	(3)	43	(1)	44	(1)	45	(1)	46	(1)	47	(4)	48	(1)	49	(2)	50	(3)
51	(1)	52	(4)	53	(3)	54	(3)	55	(3)	56	(3)	57	(4)	58	(4)	59	(4)	60	(2)
61	(1)	62	(4)	63	(2)	64	(3)	65	(1)	66	(3)	67	(4)	68	(4)	69	(4)	70	()
71	(2)	72	(2)	73	(1)	74	(3)	75	(2)	76	(4)	77	(4)	78	(4)	79	(2)	80	(4)
81	(3)	82	(1)	83	(2)	84	(1)	85	(3)	86	(3)	87	(2)	88	(4)	89	(3)	90	(4)
91	(4)	92	(1)	93	(1)	94	(3)	95	(3)	96	(3)	97	(3)	98	(2)	99	(4)	100	(2)
101	(1)	102	(1)	103	(2)	104	(3)	105	(1)	106	(2)	107	(4)	108	(1)	109	(4)	110	(1)
111	(3)	112	(4)	113	(1)	114	(2)	115	(3)	116	(3)	117	(2)	118	(1)	119	(1)	120	(1)

Biology

1. Simple squamous epithelium is present where diffusion and filtration are required. Cells lining our blood vessels belong to the category of simple squamous epithelium.

2. Organic farming is a zero-waste procedure where waste from one process is cycled as nutrients for other processes.

3. Clones of B cells are called plasma cells which produce antibodies. Helper T cells secrete interleukin-2 (IL-2) which stimulates B cells to produce antibodies.
Injection of snake antivenom against snake bite is an example of artificially acquired passive immunity.

4. *Selaginella* and *Salvinia* produce two types of spores differing in size and sex, the male microspore and the female megaspore, which develop into separate male and female gametophytes.

5. Sparrow can be herbivorous (eating seeds and fruits) or carnivorous (eating insects).

6. Manganese is essential for photolysis of water which takes up electrons from water.

7. During fertilisation, secretions of the acrosome help one sperm to enter the cytoplasm of the ovum through the zona pellucida.

8. 20–25% of CO_2 is transported by RBCs in the form of carbaminohaemoglobin, whereas 70% is carried as bicarbonate. About 7% of CO_2 is carried in a dissolved state in the plasma.

9. A pair of electrons from NADH is then passed through a series of electron transport carriers within complex I to coenzyme Q. The electrons flow just like water rolling downhill, with energy released upon each electron exchange. Within complex I, as each electron pair passes through, a pair of hydrogen ions (protons) is forced from the matrix to the intermembrane space.

10. Hershey and Chase worked with viruses which infect bacteria (bacteriophage).

11. China rose - alternate phyllotaxy
Alstonia - simple leaves
Calotropis - opposite phyllotaxy
Neem - compound leaf

12. P wave represents depolarisation of atria which leads to the contraction of both atria. QRS wave represents depolarisation of atria which initiates ventricular contraction. There is one ventricular contraction during one heartbeat as the heartbeat rate is equal to the pulse rate, so the QRS complex represents one complete pulse.

13. Clavicle and glenoid cavity are a part of the pectoral girdle.

14. Vegetative propagation and apomixis both produce progeny identical to the parent as they do not involve meiosis and syngamy.

15. In organ transplantation, cyclosporine drug is used which is obtained from the fungus *Trichoderma*.

16. In the human female,

$2n = 46$

$= 44 + XX$

17. The sleep–wake cycle is regulated by the melatonin hormone.

18. Water hyacinth or *Eichhornia* propagates vegetatively by offsets. It produces a tuft of leaves above and a cluster of small roots below.

19. Companion cells are responsible for conducting the sugars in sieve tube elements.

20. The endomembrane system includes all of the organelles involved in product exocytosis and some intracellular trafficking. Organelles include endoplasmic reticulum, Golgi body, lysosomes and plasma membrane.

21. The bundle sheath cells of C4 plants contain thicker walls, more chloroplasts and other organelles, and smaller central vacuoles.

22. Sweet potato - modified adventitious root for food storage.
Turnip - modified tap root for food storage.

23. Ureters act as the urinogenital duct in male frog. In human beings, the urethra acts as the male urinogenital duct.

24. A large muscular sheet called diaphragm forms the floor of the chest cavity. The diaphragm and ribcage move during breathing.
Inhalation: The ribcage moves up and outwards, whereas the diaphragm moves down.
Exhalation: The ribs move down and inwards, while the diaphragm moves up to its previous position, reducing the size of the chest cavity and pushing the air out of the lungs.

25. In Statement A, Rosie was the name of the cow which produced milk enriched with human alpha lactalbumin.
In Statement B, restriction endonucleases are used for cutting the DNA at specific points.

26. *Microsporum* which is responsible for ringworm disease belongs to Rhizopus which is a mould.

27. A series of procedures which are used to join together (recombine) DNA segments. A recombinant DNA molecule is constructed from segments of two or more different DNA molecules. Therefore, it is said to be genetically engineered.

28. Troposphere is considered the bad ozone layer. Tropospheric or ground-level ozone is toxic to humans, plants and corrosive to our machines and structures. Human sources of ozone (such as machinery) release it into the troposphere where it creates smog and health problems.

29. Root pressure leads to both guttation and bleeding.

30. Biodiversity refers to all the different kinds of living organisms within a given area which includes plants, animals, fungi and other living things.

31. The spindle fibres are attached during the meiosis stage by kinetochores which are a protein structure on chromatids.

32. Butyric acid is obtained from *Clostridium butylicum*.

33. Silencing of mRNA has been used in producing transgenic plants resistant to Nematoda, *Meloidogyne incognita*.

34. A notochord is present in the embryonic development of all chordates, but it is replaced by the vertebral column in vertebrates.

35. The artificial method of transfer of gametes into the fallopian tube of females is termed gamete intrafallopian transfer (GIFT).

36. The antibiotics target the cell wall. Viruses do not possess a cell wall. So, there is no effect of antibiotics when we have a common cold.

37.

Disease	Causative Organisms	Mode of Infection
Elephantiasis	*Wuchereria bancrofti*	Female mosquito
Malaria	*Plasmodium vivax*	Bite of female Anopheles mosquito
Typhoid	*Salmonella typhi*	Contaminated food and water
Pneumonia	*Streptococcus pneumoniae*	Droplet infection

38. They have a nucleus because they do not need much oxygen. Frogs can breathe under water and in air, so they do not need much oxygen; thus, their red blood cells did not eliminate the nucleus.

39. F_1 crossed with pure recessive parent,
Tt × tt or TtRr × ttrr

40. dN/dt = rN which explains exponential growth.

41. The female plant of *Marchantia* shows Archegoniophore, female thallus, bud and foot.

42. The level of oestrogen in your body is still increasing, and it eventually causes a rapid rise in luteinising hormone on Day 14.

43. For the human genome project, bioinformatics is an essential component as the biological raw data needs to be stored in public databanks. When the raw data are available, hypotheses may be formulated and tested *in silico*.

44. Dental formula of adult human is 2123/2123.
I = 2/2 means there are two incisors in a quadrant of the oral cavity, and so there are 2 + 2 (four) incisors in half of the jaw. For the whole set of teeth, it is 4 + 4 = 8 incisors. The same goes for canines, premolars and molars. So, the total number is 8 + 4 + 8 + 12 = 32.

45. The type of muscles present in our thigh is striated/voluntary/skeletal.

46. Other than the three, cadmium is not an essential element in plants. It is a heavy metal, and its poisoning causes itai-itai disease in humans.

47. In Statement A, the sporophyte is more elaborate in mosses as compared to liverworts.
In Statement D, male and female cones are borne on two different *Pinus* trees.

48. (A) Dry skin causes cutaneous respiration.
(B) Frog has three-chambered heart.
(C) Frog can never be uricotelic.
(D) Because of external fertilisation in water.

49. From Annelida to Chordata, all are Eucoelomate (possess coelom).
(C) - Mollusca (Octopus)
(D) - Arthropoda (Scorpion)

50. During megagametogenesis, functional megaspore (chalazal) gives rise to the embryo sac.

51. Consciousness or irritability is the most obvious complicated and technical character of living beings.

52. Vascular bundles are open describes that there is presence of cambium during secondary growth. Vascular cambium divides to form the secondary xylem towards the inner side while the secondary phloem outwards.

53. Bt toxin can bind with the midgut epithelium of the insect pest and create pores killing it.

54. Trypsinogen is in the inactive form and all enzymes of the pancreas are secreted in this form.

55. Clitellum - secretes cocoon during the breeding season of the earthworm
Gizzard - grinding of food particles
Setae - help in locomotion of the earthworm
Typhlosole - increases the absorption area in the intestine

56. Hydrarch and xerarch successions lead to medium water conditions (mesic climate).

57. The breakdown of detritus into smaller particles by the earthworm is a process called fragmentation. Others are performed by heterotrophic microbes.

58. Free placentation occurs in Dianthus where ovules develop on a central column in a compound ovary lacking septa or with septa at the base only.

59. Circular DNA and 70S ribosomes are present in the matrix.

60. Bears go into hibernation during the winter to escape the cold weather.

A conical age pyramid with a broad base represents expanding human population (triangular pyramid shows positive growth).

A wasp pollinating a fig flower is an example of commensalism.

An area with high levels of species richness is known as a marsh.

Physics

61. Let the current through the galvanometer be I.

When it is shunted with resistance S, the current through the circuit, changes. So, a resistance R is connected in series.

If the current has to be the same, then the effective resistance should be the same.

$$G = \left(\frac{GS}{G+S}\right) + R$$

$$\therefore R = G - \frac{GS}{G+S} = \frac{G^2 + GS - GS}{G+S}$$

$$\therefore R = \frac{G^2}{G+S}$$

62. The average speed is given as

$$v_{av} = \frac{\text{Total distance covered}}{\text{Total time taken}}$$

Let the total distance be 2S, i.e. S + S

Let the time taken to cover the two half distances be t_1 and t_2

So, we have

$$t_1 = \frac{S}{v_1}; t_2 = \frac{S}{v_2}$$

Therefore, we get

$$v_{av} = \frac{S+S}{\frac{S}{v_1} + \frac{S}{v_2}} = \frac{2S}{S\left(\frac{1}{v_1} + \frac{1}{v_2}\right)}$$

$$= \frac{2v_1 v_2}{v_1 + v_2}$$

63. The thermocouple produces 40 μV of emf for every 1 °C.

The sensitivity of the galvanometer is 1 μA/div

Hence, we can say that for a minimum deflection of 1 division, the current through the galvanometer should be 1 μA.

Hence, the voltage should be

$$V = IR = \left(1 \times 10^{-6} \times 10\right) = 10\ \mu V$$

Now, for 40 μV the temperature difference has to be 1 °C.

Hence, for an emf of 10 μV, the temperature has to be

$$\frac{1}{4}°C = 0.25\ °C$$

64. The momentum of first mass is $mv\hat{i}$

The momentum of second mass is $(3m)(2v)\hat{j}$

Let the velocity of the system after collision be $\vec{V}$

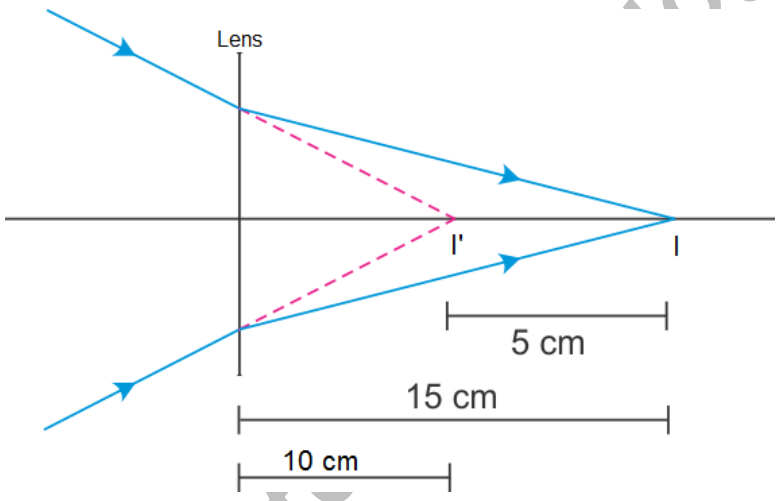
Using the law of conservation of momentum, we have

$$mv\hat{i}+(3m)(2v)\hat{j}=(4m)\vec{V}$$

$$\therefore v\hat{i}+6v\hat{j}=4\vec{V}$$

$$\Rightarrow \vec{V}=\frac{v}{4}\hat{i}+\frac{6}{4}v\hat{j}=\frac{1}{4}v\hat{i}+\frac{3}{2}v\hat{j}$$

65. The ray diagram of the scenario is shown below.



The light rays meet on the other side at a distance v = 15 cm

If the lens was not there, the rays will meet at a distance u = 15 – 5 = 10 cm.

This distance will act like the object for the lens.

Hence, from the lens equation we have

$$\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$$

$$\frac{1}{f}=\frac{1}{15}-\frac{1}{10}$$

$$\frac{1}{f}=\frac{2-3}{30}$$

$$\therefore f=-30 \text{ cm}$$

Hence, the lens is a concave lens.

66. The Einstein's photoelectric equation gives

$K.E = E - \phi = eV_0$

$\therefore eV_0 = h\nu - h\nu_0$

here, V_0 is the threshold voltage, ν is the frequency of incident light and ν_0 is the threshold frequency

Therefore, we have

$$V_0 = \frac{h}{e}(\nu - \nu_0)$$

$$= \frac{6.63\times10^{-34}}{1.6\times10^{-19}} \times \left(8.2\times10^{14} - 3.3\times10^{14}\right)$$

$$= 4.14\times10^{-15} \times 4.9\times10^{14}$$

$$= 2 \text{ V}$$

67. The work function of the material is ϕ = 2.75 eV

Stopping potential is V_0 = 10 V

According to Einstein's photoelectric equation, we have

$K.E = E - \phi$

$\therefore E = K.E + \phi$

$\Rightarrow E = eV_0 + \phi$

Substituting the values, we get

$E = 10 \text{ eV} + 2.75 \text{ eV}$

$\therefore E = 12.75 \text{ eV}$

Now, this energy difference is between the fourth energy level and the ground state of the hydrogen atom.

$E_4 - E_1 = 12.75$ eV

Hence, n = 4

68. The r.m.s voltage is given as

$$V_{r.m.s.} = \sqrt{\frac{1}{T}\int_0^{T/2} V_0^2 dt}$$

$$= \sqrt{\frac{V_0^2}{T}\int_0^{T/2} dt}$$

$$= \sqrt{\frac{V_0^2}{T}[T]_0^{T/2}} = \sqrt{\frac{V_0^2}{T}\times\frac{T}{2}}$$

$$= \frac{V_0}{\sqrt{2}}$$

69. The gravitational potential at a point x situated at a distance a/2 from the centre is equal to the potential due to particle as well as the potential due to the shell.
Hence, we have

$$V_x = V_{particle} + V_{sphere}$$

$$\therefore V_x = \frac{GM}{\frac{a}{2}} + \frac{GM}{a} = \frac{2GM}{a} + \frac{GM}{a} = \frac{3GM}{a}$$

70. The displacement of a particle is given in terms of amplitude as

$$x = a\sin\theta$$

When displacement is half the amplitude, we have

$$\frac{a}{2} = a\sin\theta$$

$$\Rightarrow \sin\theta = \frac{1}{2}$$

$$\therefore \theta = 30^\circ \quad \text{or} \quad 150^\circ$$

Now, we know that the two particles are moving in opposite directions.
Hence, if one has an angle 30°, the other will have an angle 150°.
Therefore, the phase difference between the two waves is

$$\phi = 150 - 30 = 120^\circ$$

$$\Rightarrow \phi = 120 \times \frac{\pi}{180} = \frac{2\pi}{3}$$

71. The potential at point A is zero.
The resistance between the points D and C is 2 Ω and the current through DC is 1 A.
Hence, the potential difference between D and C is

$V_D - V_C = 1 \times 2 = 2$ V

Now, the potential at A is zero. So, the potential at C is

$$V_C - V_A = 1$$

$$\therefore V_C = 1 \text{ V}$$

Hence, the potential at point D is

$$V_D - V_C = 2$$

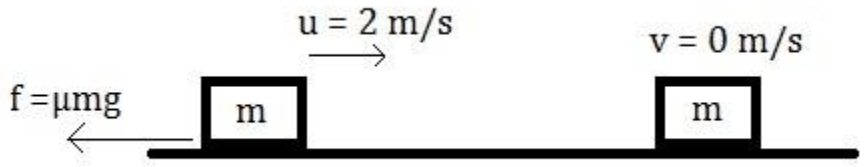
$$\therefore V_D = 2 + V_C = 2 + 1 = 3 \text{ V}$$

The potential difference between points D and B is 2 V. So, we get

$$V_D - V_B = 2$$

$$\therefore V_B = V_D - 2 = 3 - 2 = 1 \text{ V}$$

72. The motion of mass m on the conveyor belt is shown below:



The retardation on the block due to friction is

$$a = \frac{f}{m} = \frac{\mu mg}{m} = \mu g$$

Now, from the equation of kinematics, we get

$$v^2 = u^2 + 2as$$

$$\therefore 0 = u^2 - 2as$$

$$\therefore s = \frac{u^2}{2a} = \frac{2^2}{2\mu g} = \frac{4}{2 \times 0.5 \times 10}$$

$$\therefore s = 0.4 \text{ m}$$

73. The adiabatic equation between pressure and temperature is given as

$$P^{1-\gamma}T^{\gamma} = \text{constant}$$

Hence, we get

$$P_1^{1-\gamma}T_1^{\gamma} = P_2^{1-\gamma}T_2^{\gamma}$$

$$\therefore \left(\frac{P_2}{P_1}\right)^{1-\gamma} = \left(\frac{T_1}{T_2}\right)^{\gamma}$$

$$\Rightarrow \frac{P_2}{P_1} = \left(\frac{T_1}{T_2}\right)^{\frac{\gamma}{1-\gamma}}$$

We know that for a diatomic gas $\gamma = 1.4$

$P_1 = 2$ atm

$T_1 = 27\ ^\circ\text{C} = 300$ K

$T_2 = 927\ ^\circ\text{C} = 1200$ K

Hence, we get

$$\frac{P_2}{P_1} = \left(\frac{300}{1200}\right)^{\frac{1.4}{1-1.4}} = \left(\frac{300}{1200}\right)^{\frac{1.4}{-0.4}}$$

$$\therefore \frac{P_2}{P_1} = \left(\frac{300}{1200}\right)^{-3.5} = \left(\frac{1200}{300}\right)^{3.5}$$

$$\therefore \frac{P_2}{P_1} = 4^{3.5} = 128$$

$$\Rightarrow P_2 = 128P_1 = 128 \times 2 = 256 \text{ atm}$$

74. The magnetic field at the centre of a current carrying ring of radius R is given as

$$B = \frac{\mu_0 I}{2R}$$

Now, we know that the current is given as

$$I = \frac{q}{t} = qf$$

Hence, we get

$$B = \frac{\mu_0 qf}{2R}$$

75. The voltage across the diode remains constant.

Hence, the current across the 1 kΩ resistor is

$$I_1 = \frac{V}{R} = \frac{15}{1\times10^3} = 15 \text{ mA}$$

Now, the total voltage is 20 V. So, the voltage across the 250 Ω resistor is 5 V.

Therefore, the current is

$$I_{250} = \frac{V_{250}}{R_{250}} = \frac{5}{250} = 20 \text{ mA}$$

Hence, the current through the zener diode will be

$$I_z = I_{250} - I_1 = 20 - 15 = 5 \text{ mA}$$

76. The energy difference between the ground state (n = 1) and the first excited state (n = 2) is

$$E_2 - E_1 = -3.4 + 13.6 = 10.2 \text{ eV}$$

Similarly, the difference between the ground state (n = 1) and the second excited state (n = 2) is

$$E_3 - E_2 = -1.51 + 13.6 = 12.09 \text{ eV}$$

Hence, we can say that a difference of 11.1 eV is not possible at all.

77. For a diode to be forward biased its positive end should be connected to higher potential of the battery or the negative terminal should be connected to the lower potential of the battery.

From the four options given, (a) and (c) are forward biased and (b) and (d) are reverse biased.

78. The concentration of P initially is $4N_0$ and that of Q is N_0.

It is given that half-life of P is 1 minute and that of Q is 2 minutes.

Therefore, the number of nuclei after time t for P and Q will be same. This will be given as

$$N_P = N_Q$$

$$\frac{4N_0}{2^{\frac{t}{1}}} = \frac{N_0}{2^{\frac{t}{2}}}$$

$$\therefore 4 = 2^{\frac{t}{1}-\frac{t}{2}} = 2^{\frac{t}{2}}$$

$$\Rightarrow \frac{t}{2} = 2 \Rightarrow t = 4 \text{ minutes}$$

Hence, after 4 minutes both the species will have the same number of nuclei.

Therefore, at t = 4, we have

$$N'_P = \frac{4N_0}{2^{\frac{4}{1}}} = \frac{4N_0}{16} = \frac{N_0}{4}$$

$$N'_Q = \frac{N_0}{2^{\frac{4}{2}}} = \frac{N_0}{4}$$

Hence, after time t the sample will have

$$P \rightarrow \left(4N_0 - \frac{N_0}{4}\right)$$

$$Q \rightarrow \left(N_0 - \frac{N_0}{4}\right)$$

Let the nuclei of R be N_R, and so we have

$$N_R = \left(4N_0 - \frac{N_0}{4}\right) + \left(N_0 - \frac{N_0}{4}\right)$$

$$= 5N_0 - \frac{N_0}{2}$$

$$= \frac{9N_0}{2}$$

79. The hole concentration is $n_h = 4.5 \times 10^{22}\ m^{-3}$

The initial concentration of electron and hole is same, i.e. $n_i = 1.5 \times 10^{16}\ m^{-3}$

For a doped semiconductor, we have

$$n_e n_h = n_i^2$$

$$\therefore n_e\left(4.5\times10^{22}\right) = \left(1.5\times10^{16}\right)^2$$

$$\therefore n_e = \frac{\left(1.5\times10^{16}\right)^2}{\left(4.5\times10^{22}\right)} = 5\times10^{9}\ m^{-3}$$

Now, we can see that

$n_h = 4.5 \times 10^{22}\ m^{-3}$

$n_e = 5 \times 0^{9}\ m^{-3}$

$\Rightarrow n_h >> n_e$

Hence, the doped semiconductor is of p-type with $n_e = 5 \times 10^9\ m^{-3}$.

80. The deviation produced by a prism of angle A is given as

$$\delta = A(\mu - 1)$$

It is given that the combination of two prisms produces zero deviation. So, we have

$$\delta = \delta_1 + \delta_2 = 0$$

$$\therefore A_1(\mu_1 - 1) + A_2(\mu_2 - 1) = 0$$

$$\therefore A_1(\mu_1 - 1) = -A_2(\mu_2 - 1)$$

$$\therefore \frac{A_2}{A_1} = \frac{\mu_1 - 1}{1 - \mu_2} = \frac{1.5 - 1}{1 - 1.75} = \frac{0.5}{-0.75}$$

$$\therefore A_2 = A_1(-0.67) = 15 \times (-0.67) = -10°$$

Negative sign indicates the second prism is inverted with respect to the first.

So, we have $A_2 = 10°$

81. The relation between the fundamental frequency and tension in the wire is given as

$$n \propto \sqrt{T}$$

Taking logarithm on both sides, we get

$$\ln(n) = \frac{1}{2}\ln T$$

Differentiating on both sides, we have

$$\frac{1}{n}dn = \frac{1}{2T}dT$$

$$\therefore \frac{dT}{T} = 2\frac{dn}{n}$$

When tension changes, 6 beats are produced and initially, the fundamental frequency was 600 Hz. So, we get

$$\frac{dT}{T} = 2 \times \frac{6}{600} = \frac{2}{100} = 0.02$$

82. The radius of the loop initially is r, and after tightening the string, it becomes r/2.

However, the angular momentum of the rotation does not change in accordance with the conservation of angular momentum.

Hence, $L \rightarrow$ Constant

Now, the kinetic energy of the loop will be given as

$$KE = \frac{1}{2}\frac{L^2}{I}$$

here, I is the moment of inertia, which is given as $I = mr^2$

Hence, we have

$$\frac{KE_1}{KE_2} = \frac{\frac{1}{2}\frac{L^2}{I_1}}{\frac{1}{2}\frac{L^2}{I_2}} = \frac{I_2}{I_1}$$

$$\therefore \frac{KE_2}{KE_1} = \frac{I_1}{I_2} = \frac{mr^2}{m\frac{r^2}{4}} = 4$$

$$\therefore KE_2 = 4KE_1$$

Hence, the kinetic energy increases by a factor of 4.

83. The electric potential is given as $V = 4x^2$ V

Now, the electric field is related to potential as

$$\vec{E} = -\Delta\vec{V} = -\frac{dV}{dx}\hat{i} - \frac{dV}{dy}\hat{j} - \frac{dV}{dz}\hat{k}$$

$$\therefore \vec{E} = -\frac{dV}{dx}\hat{i} = -\frac{d\left(4x^2\right)}{dx}\hat{i}$$

$$\therefore \vec{E} = -8x\hat{i}$$

Hence, the electric field at a point (1, 0, 2) is given as

$$\vec{E} = -8\hat{i} = 8\left(-\hat{i}\right)$$

Hence, the electric field at a point (1, 0, 2) is 8 V/m along negative x-axis.

84. The triangle ABC is an isosceles triangle with BC and AC as equal sides.

Hence, the distance of points D and E from charge q is same. Hence, the potential at both the points will be same.

So, work done in taking the charge Q from D to E will be

$$W = Q\left(V_E - V_D\right) = 0$$

85. The minimum velocity that a particle should possess so that it does not return back to Earth is called the escape velocity.

It is given as

$$V = \sqrt{\frac{2GM}{R}}$$

here, G is the gravitational constant, M is the mass of the Earth and R is the radius of the Earth.

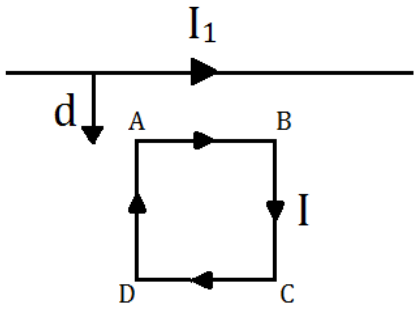
86. Potential energy is given as U = -MBcosθ

For stable equilibrium, we have cosθ = 1

Thus, we have

$$U = -MB = -(0.4)(0.16) = -0.064 \text{ J}$$

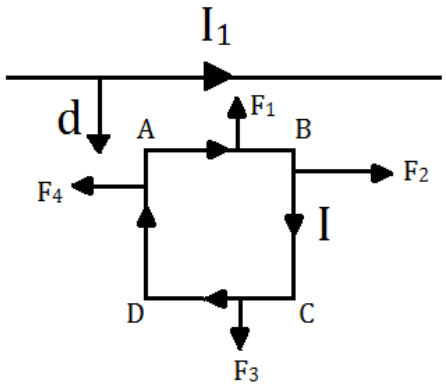
87. The sides of square loop are shown below:



The current I_1 in the wire produces a field according to right hand thumb rule.

It will be directed into the page below the wire.

Now, using Fleming's left hand rule, we get the forces on the sides AB, BC, CD and DI as shown in the figure below:



The forces F_2 and F_4 balance each other.

The forces F_1 and F_3 are given as

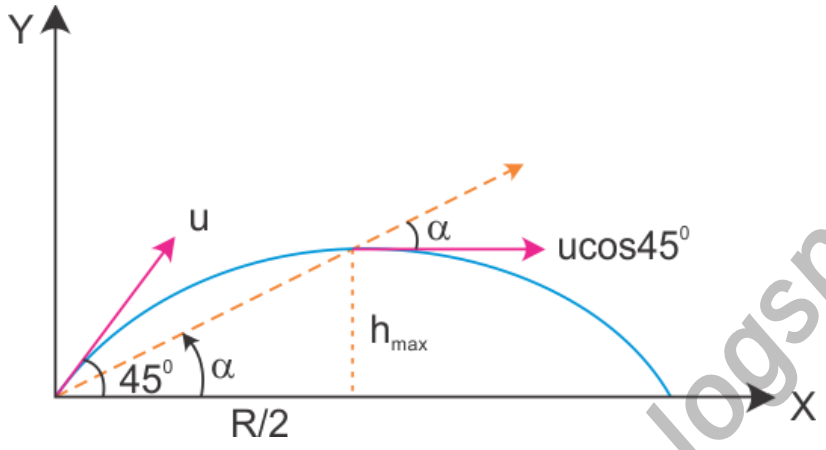
$$F_1 = \frac{\mu_0 I_1 I l}{2\pi d}$$

$$F_3 = \frac{\mu_0 I_1 I l}{2\pi (d+l)}$$

$$\therefore F_1 > F_3$$

Hence, the loop will be attracted towards the wire, i.e. will have a net attractive force towards the conductor.

88. The path of the projectile is shown below with angle of projection θ and angle of elevation α.



The maximum height is given as

$$H_{max} = \frac{u^2 \sin^2 45}{2g} = \frac{u^2}{4g}$$

The range of the projectile is given as

$$R_{max} = \frac{u^2 \sin 2\times 45}{g} = \frac{u^2}{g}$$

Now, when the projectile attains maximum height, it also attains half the range. So, we have

$$\frac{R}{2} = \frac{u^2}{2g}$$

Now, from the figure, we can see that

$$\tan\alpha = \frac{H_{max}}{R/2} = \frac{\frac{u^2}{4g}}{\frac{u^2}{2g}} = \frac{1}{2}$$

$$\therefore \alpha = \tan^{-1}\left(\frac{1}{2}\right)$$

89. The resistance in the coil is R = 30 Ω.

The inductive reactance at f = 50 Hz is X_L = 20 Ω

When the voltage source is connected across the coil, we get

$$f = 50 \text{ Hz} \Rightarrow X_L = \omega L = 2\pi f L = 20\ \Omega$$

$$\therefore f = 100 \text{ Hz} \Rightarrow X'_L = \omega' L = 2\pi f' L = 40\ \Omega \qquad (\because f' = 2f)$$

Therefore, the total resistance of the coil is

$$Z = \sqrt{R^2 + X_L^2} = \sqrt{30^2 + 40^2} = 50\ \Omega$$

Now, the current through the coil will be given as

$$I = \frac{V}{Z} = \frac{200}{50} = 4 \text{ A}$$

90. The density of a substance in CGS system is 4 g/cm^3

Hence, the unit in GS system is g/cm^3

When there is a system wherein the unit of mass is 100 g and unit of length is 10 cm, then we have

$$\frac{\text{g}}{\text{cm}^3}=\frac{\frac{1}{100}\text{g}}{\left(\frac{1}{10}\text{cm}\right)^3}=\frac{10^3\text{g}}{100\text{cm}^3}=10\frac{\text{g}}{\text{cm}^3}$$

Therefore, if a substance has density 4 g/cm^3 in CGS, then it will have density in other system as

$$4\times10\frac{\text{g}}{\text{cm}^3}=40\frac{\text{g}}{\text{cm}^3}$$

Chemistry

91. (A) Plaster of Paris = $CaSO_4.1/2\ H_2O$
(B) Epsomite = $MgSO_4.7H_2O$
(C) Kieserite = $MgSO_4.H_2O$
(D) Gypsum = $CaSO_4.2H_2O$

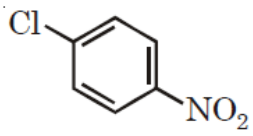
92. $2Al_{(s)} + 2NaOH_{(aq)} + 6H_2O_{(l)} \rightarrow 2Na^+ [Al(OH)_4]^-_{(aq)}$ [Sodium tetrahydroxoaluminate (III)] + $3H_{2(g)}$

93. Denaturation of proteins causes loss of secondary and tertiary structures of the protein and leads to the conversion of double strand of DNA into single strand.

94. trans-2-chloro-3-iodo-2-pentene

95. SnO_2 is an amphoteric oxide.

96.



has an electron withdrawing $-NO_2$ group, and hence, it undergoes nucleophilic substitution reaction most easily.

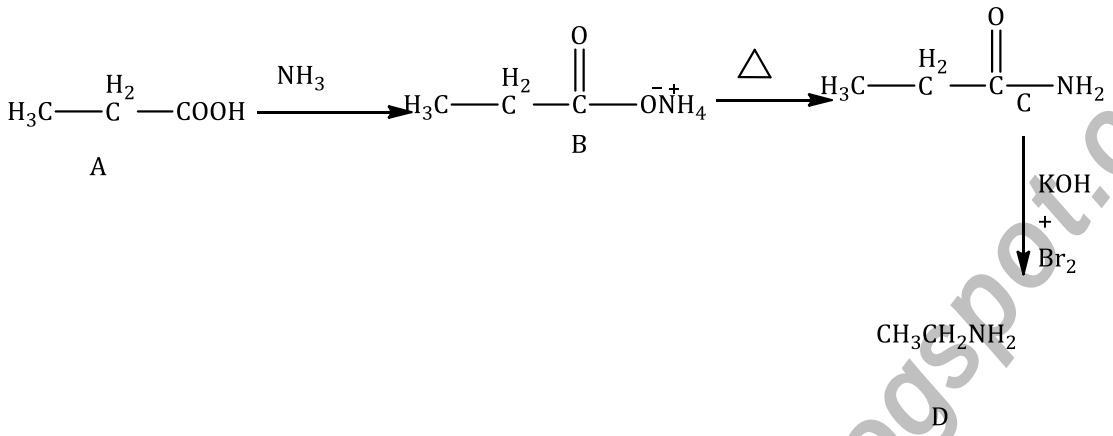
97.

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\frac{1.5 \times V_1}{288} = \frac{1 \times V_2}{298}$$

$$V_2 = \frac{1.5 \times 298 \times V_1}{288} = 1.6V_1$$

98.



99. $\frac{1}{2}A \rightarrow B$ $\Delta H=+150$.....(i)

$3B \rightarrow 2C+D$ $\Delta H=-125$.....(ii)

$E + A \rightarrow 2D$ $\Delta H = +350$... (iii)

Now, $2 \times$ (i) + (ii) − (iii), we have

$B + D \rightarrow E + 2C$

$\Delta H = 150 \times 2 + (-125) - 360 = -175$ kJ

100. $\Delta T_f = i K_f m$

$HA \longrightarrow H^+ + A^-$

$1 - \alpha \quad \alpha \quad \alpha$

$1 - 0.3 \quad 0.3 \quad 0.3$

$i = 1 - 0.3 + 0.3 + 0.3$

$i = 1.3$

$\Delta T_f = 1.3 \times 1.86 \times 0.1 = 0.2418$

$T_f = 0 - 0.2418 = -0.2418°C$

101. $CaO_{(s)} + SiO_{2(s)} \rightarrow CaSiO_{3(s)}$

102.

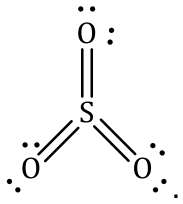
$K_{sp(AgCl)} = [Ag^+][Cl^-]$

$\therefore [Ag^+] = \frac{1.8 \times 10^{-10}}{10^{-1}} = 1.8 \times 10^{-9}$ M

$K_{sp(PbCl_2)} = [Pb^{+2}][Cl^-]^2$

$\therefore [Pb^{+2}] = \frac{1.7 \times 10^{-5}}{10^{-1} \times 10^{-1}} = 1.7 \times 10^{-3}$ M

103.



It has maximum number of covalent bonds.

104. For zero-order reaction

Rate = k[reactant]0

Hence, rate = k

$\therefore$ Unit of k is mol $L^{-1}s^{-1}$.

105.

$2Fe^{+3} + 2e^{-} \rightarrow 2Fe^{+2}$ $E^0 = 0.77V$

$2I^{-} \rightarrow I_2 + 2e^{-}$ $E^0 = 0.536V$

$2Fe^{+3} + 2I^{-} \rightarrow 2Fe^{+2} + I_2$

$E^0 = E^0_{ox} - E^0_{red} = 0.77 - 0.536 = 0.164V$

106.

$$\text{We know } \pi = \frac{w \times 1000}{M \times V} \times R \times T$$

$$\therefore M = \frac{w \times 1000}{\pi \times V} \times R \times T$$

$$\therefore M = \frac{1.26 \times 1000 \times 0.083 \times 300}{2.57 \times 10^{-3} \times 200} = 61038 \text{gmol}^{-1}$$

107.

$$\text{Rate} = -\frac{1}{2}\frac{d[N_2O_5]}{dt} = \frac{1}{4}\frac{d[NO_2]}{dt} = \frac{d[O_2]}{dt}$$

$\therefore 2k = k' = 4k''$

108. Because the concentration falls from 1.28 mgL^{-1} to 0.04 mgL^{-1},

Number of lives = 5

$\therefore$ Time required = $5 \times t_{1/2} = 5 \times 138 = 690$ s

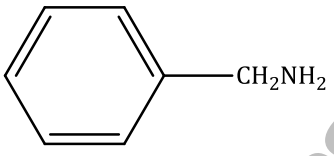
109. $[Cr(NH_3)_6]^{3+}$ has 3 unpaired electrons, and so, it exhibits highest paramagnetic behaviour.

110. For NaCl structure, $\frac{X^+}{Y^-} = 0.414$

$\therefore Y^- = \frac{100}{0.414} = 241.5$ pm

111. Vitamin B complex is not a fat-soluble vitamin.

112.



is the most basic because the lone pair of N is not involved in resonance with the benzene ring.

113.

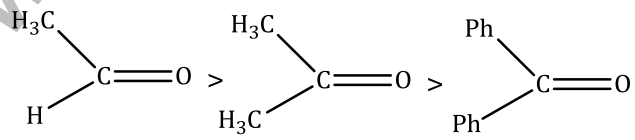
	Number of molecules
Moles of $CO_2 = \frac{44}{44} = 1$	N_A
Moles of $H_2 = \frac{8}{2} = 4$	$4N_A$
Moles of $O_3 = \frac{48}{48} = 1$	N_A
Moles of $SO_2 = \frac{64}{64} = 1$	N_A

114. a(ii), b(i), c(iv), d(iii)

115. It is the reverse of ionisation energy.

116. It will have the strongest C-O bond because as the positive charge on the central metal atom increases, the metal does not readily donate electron density to the Π^* orbitals of the C–O bond.

117. The order of reactivity with phenyl magnesium bromide is



118. O_2: $(\sigma 1s)^2(\sigma *1s)^2(\sigma 2s)^2\ (\sigma *2s)^2\ (\sigma 2p_z)^2(\Pi 2p^2_x=\Pi 2p^2_y)\ (\Pi^* 2p_x^1=\Pi^* 2p^1_y)$
It is paramagnetic because it has 2 unpaired electrons.
O_2^+: $(\sigma 1s)^2(\sigma *1s)^2(\sigma 2s)^2\ (\sigma *2s)^2\ (\sigma 2p_z)^2(\Pi 2p^2_x=\Pi 2p^2_y)\ (\Pi^* 2p_x^1=\Pi^* 2p^0_y)$
It is paramagnetic because it has 1 unpaired electron.

119.

$$E\alpha\left[\frac{1}{n^2_1}-\frac{1}{n^2_2}\right], \text{where } n_2 > n_1$$

So, the transition from n = 6 to n = 5 will give the least energetic proton.

120. Primary halides show S_N2 mechanism.

AIPMT - 2012
(Physics, Chemistry and Biology)
Mains (Code D)

Time: 3 hrs **Total Marks: 480**

General Instructions:

1. The Answer sheet is inside this Text booklet. When you are directed to open the text booklet, take out the Answer Sheet and fill in the particulars on side – 1 and side – 2 carefully with blue/black ball point pen only.
2. The test is of 3 hours duration and consists of 120 questions. Each question carries 4 marks. For each correct response the candidate will get 4 marks. For each incorrect response, one mark will be deducted. The maximum marks are 480.
3. Use Blue / Black ball point pen only for writing particulars on this page / marking responses.
4. Rough work is to be done on the space provided for this purpose in the text booklet only.
5. On completion of the test, the candidate must handover the answer sheet to the invigilator in the room/ Hall. The candidates are allowed to take away this text booklet with them.
6. Make sure that the CODE printed on side – 2 of the answer sheet is the same as that on this booklet, In case of discrepancy, the candidate should immediately report the matter to the invigilator for the replacement of both the test Booklet and the Answer Sheet.
7. The candidates should ensure that the Answer sheet is not folded. Do not make any stray marks on the Answer sheet. Do not write your roll no. anywhere else except in the specified space in the Test booklet / Answer Sheet.
8. Use of white fluid for correction is not permissible on the Answer Sheet.

Physics

1. The instantaneous values of alternating current and voltages in a circuit are given as

$i=\frac{1}{\sqrt{2}}\sin(100\pi t)$ ampere; $e=\frac{1}{\sqrt{2}}\sin(100\pi t+\pi/3)$ Volt

The average power in watts consumed in the circuit is:

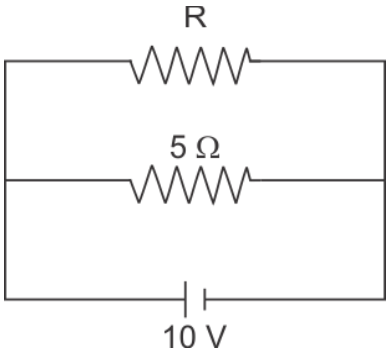
(1) $\sqrt{3}/4$

(2) $\frac{1}{2}$

(3) $\frac{1}{8}$

(4) $\frac{1}{4}$

2. The power dissipated in the circuit shown in the figure is 30 watts. The value of R is

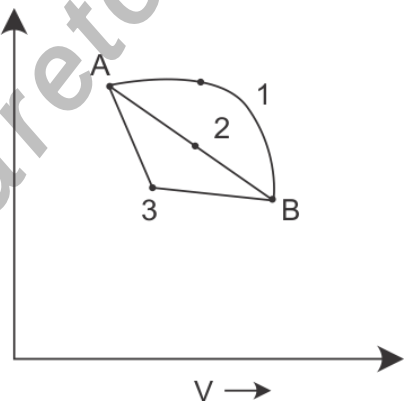


(1) 15Ω
(2) 10 Ω
(3) 30 Ω
(4) 20 Ω

3. The dimensions of $(\mu_o \varepsilon_o)^{-1/2}$ are:

(1) $[L^{-1} T]$
(2) $[L T^{-1}]$
(3) $[L^{1/2} T^{1/2}]$
(4) $[L^{1/2} T^{-1/2}]$

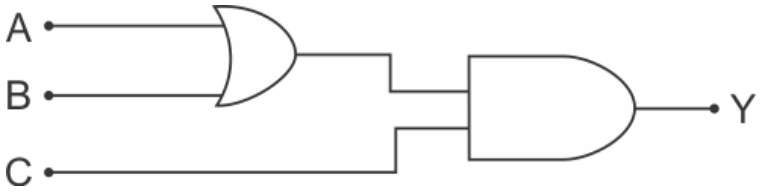
4. An ideal gas goes from state A to state B via three different processes as indicated in the P – V diagram:



If Q_1, Q_2, Q_3 indicate the heat absorbed by the gas along the three processes and ΔU_1, ΔU_2, ΔU_3 indicate the change in internal energy along the three processes respectively, then:

(1) $Q_3 > Q_2 > Q_1$ and $\Delta U_1 = \Delta U_2 = \Delta U_3$
(2) $Q_1 = Q_2 = Q_3$ and $\Delta U_1 > \Delta U_2 > \Delta U_3$
(3) $Q_3 > Q_2 > Q_1$ and $\Delta U_1 > \Delta U_2 > \Delta U_3$
(4) $Q_1 > Q_2 > Q_3$ and $\Delta U_1 = \Delta U_2 = \Delta U_3$

5. To get an output Y = 1 in given circuit which of the following is correct:



	A	B	C
(1)	1	0	1
(2)	1	1	0
(3)	0	1	0
(4)	1	0	0

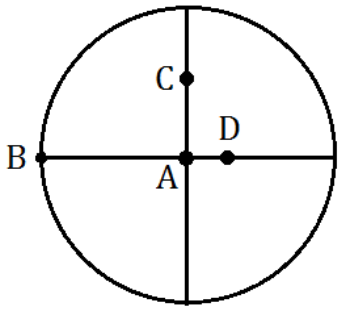
6. Two metallic spheres of radii 1 cm and 3 cm are given charges of -1×10^{-2} C and 5×10^{-2} C, respectively. If these are connected by a conducting wire, the final charge on the bigger sphere is:

(1) 3×10^{-2} C
(2) 4×10^{-2} C
(3) 1×10^{-2} C
(4) 2×10^{-2} C

7. Two radiations of photons energies 1 eV and 2.5 eV, successively illuminate a photosensitive metallic surface of work function 0.5 eV. The ratio of the maximum speeds of the emitted electrons is:

(1) 1 : 2
(2) 1 : 1
(3) 1 : 5
(4) 1 : 4

8. The moment of inertia of a uniform circular disc is maximum about an axis perpendicular to the disc and passing through:



(1) C
(2) D
(3) A
(4) B

9. A train moving at a speed of 220 ms^{-1} towards a stationary object emits a sound of frequency 1000 Hz. Some of the sound reaching the object gets reflected back to the train as echo. The frequency of the echo as detected by the driver of the train is (Speed of sound in air is 330 ms^{-1})

(1) 4000 Hz
(2) 5000 Hz
(3) 3000 Hz
(4) 3500 Hz

10. The half life of a radioactive nucleus is 50 days. The time interval ($t_2 - t_1$) between the time t_2 when $\frac{2}{3}$ of it has decayed and the time t_1 when $\frac{1}{3}$ of it has decayed is:

(1) 50 days
(2) 60 days
(3) 15 days
(4) 30 days

11. A car of mass m is moving on a level circular track of radius R. if μ_s represents the static friction between the road and tyres of the car, the maximum speed of the car in circular motion is given by:

(1) $\sqrt{Rg/\mu_s}$
(2) $\sqrt{mRg/\mu_s}$
(3) $\sqrt{\mu_s Rg}$
(4) $\sqrt{\mu_s mRg}$

12. A circular platform is mounted on a frictionless vertical axle. Its radius R = 2 m and its moment of inertia about the axle is 200 kg m^2. It is initially at rest. A 50 kg man stands on the edge of the platform and begins to walk along the edge at the speed of 1 ms^{-1} relative to the ground. Time taken by the man to complete one revolution is:

(1) $\frac{3\pi}{2}$ s
(2) 2π s
(3) $\frac{\pi}{2}$ s
(4) π s

13. If the momentum of an electron is changed by P, then the de Broglie wavelength associated with it changes by 0.5%. The initial momentum of electrons will be:

(1) 400 P

(2) $\frac{P}{200}$

(3) 100 P

(4) 200 P

14. If v_e is the escape velocity and v_o is the orbital velocity of satellite of orbit close to the Earth's surface, then these are related by:

(1) $v_o = v_e$

(2) $v_e = \sqrt{2v_o}$

(3) $v_e = \sqrt{2}\, v_o$

(4) $v_o = \sqrt{2}\, v_e$

15. The equation of simple harmonic wave is given by:

$y = 3 \sin \frac{\pi}{2}(50t - x)$,

where x and y are in metres and t is in seconds.

The ratio of maximum particle velocity to the wave velocity is:

(1) $\frac{3}{2}\pi$

(2) 3π

(3) $\frac{2}{3}\pi$

(4) 2π

16. A proton carrying 1 MeV kinetic energy is moving in a circular path of radius R in uniform magnetic field. What should be the energy of an α - particle to describe a circle of same radius in the same field?

(1) 1 MeV

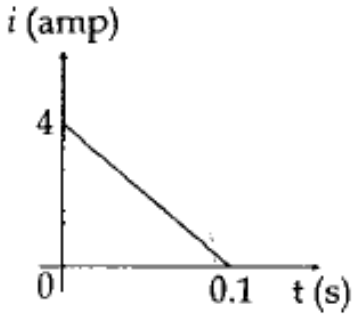
(2) 0.5 MeV

(3) 4 MeV

(4) 2 MeV

17. Three masses are placed on the x-axis: 300 g at origin, 500 g at x = 40 cm and 400 g at x = 70 cm. The distance of the centre of mass from the origin is:
(1) 45 cm
(2) 50 cm
(3) 30 cm
(4) 40 cm

18. In a coil of resistance 10 Ω, the induced current developed by changing magnetic flux through it, is shown in figure as a function of time. The magnitude of change in flux through the coil in Weber is



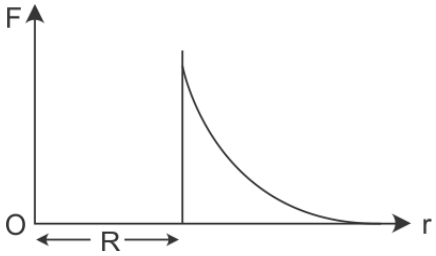
(1) 2
(2) 6
(3) 4
(4) 8

19. A parallel plate capacitor has a uniform electric field E in the space between the plates. If the distance between the plates is d and area of each plate is A, the energy stored in the capacitor is:
(1) E^2Ad/ε_o
(2) $\frac{1}{2}\varepsilon_o E^2 Ad$
(3) $\varepsilon_o EAd\, t/\sqrt{m}$
(4) $\frac{1}{2}\varepsilon_o E^2$

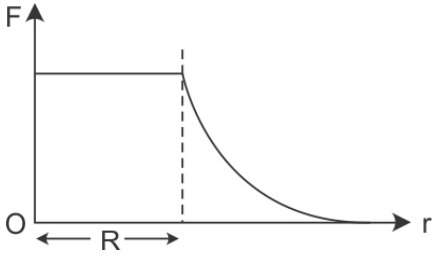
20. A car of mass m starts from rest and accelerates so that the instantaneous power delivered to the car has a constant magnitude P_o. The instantaneous velocity of this car is proportional to:
(1) $t^{1/2}$
(2) $t^{-1/2}$
(3) $t/\sqrt{m}$
(4) t^2P_o

21. Which one of the following plots represents the variation of gravitational field on a particle with distance r due to a thin spherical shell of radius R? (r is measured from the centre of the spherical shell)

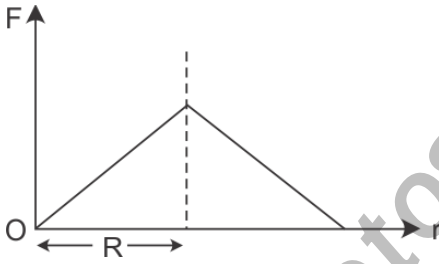
(1)



(2)



(3)



(4)

22. The input resistance of a silicon transistor is 100 Ω. Base current is changed by 40 μA which results in a change in collector current by 2 mA. This transistor is used as a common emitter amplifier with a load resistance of 4 kΩ. The voltage gain of the amplifier is:

(1) 3000
(2) 4000
(3) 1000
(4) 2000

23. For the angle of minimum deviation of a prism to be equal to its refracting angle, the prism must be made of a material whose refractive index:

(1) Lies between 2 and $\sqrt{2}$

(2) Is less than 1

(3) Is greater than 2

(4) Lies between $\sqrt{2}$ and 1

24. The transition from the state n = 3 to n = 1 in a hydrogen like atom results in ultraviolet radiation. Infrared radiation will be obtained in the transition from:

(1) $3 \rightarrow 2$

(2) $4 \rightarrow 2$

(3) $4 \rightarrow 3$

(4) $2 \rightarrow 1$

25. A rod of length 10 cm lies along the principal axis of a concave mirror of focal length 10 cm in such a way that its end closer to the pole is 20 cm away from the mirror. The length of the image is:

(1) 15 cm

(2) 2.5 cm

(3) 5 cm

(4) 10 cm

26. A slab of stone of area 0.36 m^2 and thickness 0.1 m is exposed on the lower surface to steam at 100 °C. A block of ice 0 °C rests on the upper surface of the slab. In one hour 4.8 kg of ice is melted. The thermal conductivity of slab is:

(Given latent heat of fusion of ice = 3.36×10^5 J kg^{-1})

(1) 1.29 J/m/s/°C

(2) 2.05 J/m/s/°C

(3) 1.02 J/m/s/°C

(4) 1.24 J/m/s/°C

27. A stone is dropped from a height h. It hits the ground with a certain momentum P. If the same stone is dropped from a height 100% more than previous height, the momentum when it hits the ground will change by:

(1) 41%

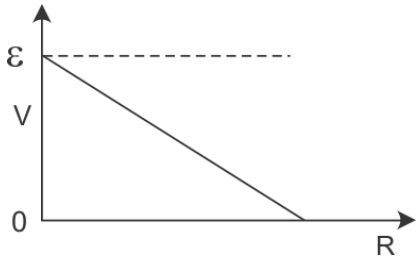
(2) 200%

(3) 100%

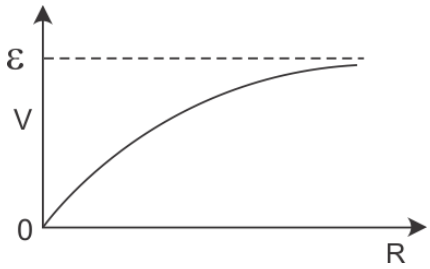
(4) 68%

28. A cell having an emf ε and internal resistance r is connected across a variable external resistance R. As the resistance R is increased, the plot of potential difference V across R is given by:

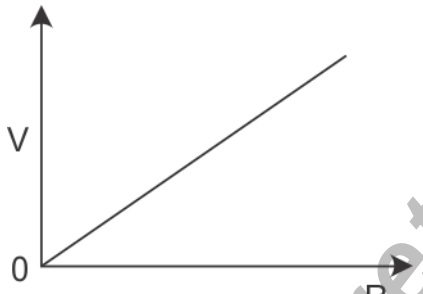
(1)



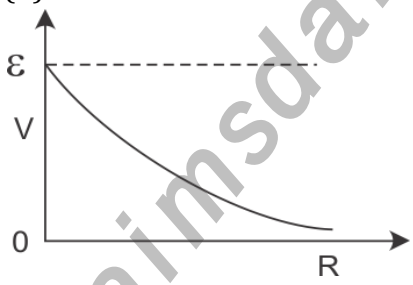
(2)



(3)



(4)



29. A magnetic needle suspended parallel to a magnetic field requires $\sqrt{3}$ J of work to turn it through 60°. The torque needed to maintain the needle in this position will be:

(1) 3 J

(2) $\sqrt{3}$ J

(3) $\frac{3}{2}$ J

(4) $2\sqrt{3}$ J

30. The ratio of amplitude of magnetic field to the amplitude of electric field for an electromagnetic wave propagating in vacuum is equal to:
(1) Reciprocal of speed of light in vacuum
(2) The ratio of magnetic permeability to the electric susceptibility of vacuum
(3) Unity
(4) The speed of light in vacuum

Biology

31. Read the following four statements (A – D) :
(A) In transcription adenosine pairs with uracil
(B) Regulation of lac operon by repressor is referred to as positive regulation
(C) The human genome has approximately 50,000 genes
(D) Haemophilia is a sex – linked recessive disease.
How many of the above statements are right?
(1) Three
(2) Four
(3) One
(4) Two

32. How man organisms in the list given below are autotrophs ?
Lactobacillus, Nostoc, Chara, Nitrosomonas, Nitrobacter, Streptomyces, Sacharomyces, Trypanosoma, Porphyra, Wolffia
(1) Five
(2) Six
(3) Three
(4) Four

33. How many plants in the list given below have marginal placentation?
Mustard, Gram, Tulip, Asparagus, arhar, Sun,nemp, Chilli, Colchicine, Onion, Moong, Pea, Tobacco
(1) Five
(2) Six
(3) Three
(4) Four

34. As compared to a dicot root, a monocot root has:
(1) Many xylem bundles
(2) Inconspicous annual rings
(3) Relatively thicker periderm
(4) More aboundant secondary xylem

35. A test cross is carried out to :
(1) Predict whether two traits are linked
(2) Asses the number of alleles of a gene
(3) Determine whether two species or varieties will breed successfully
(4) Determine the genotype of a plant at F_2

36. Which one of the following categories of animals is correctly described with no single exception in it?
(1) All bony fishes have four pairs of gills and an operculum on each side
(2) All sponges are marine and have collared cells
(3) All mammals are viviparous and posses diaphragm for breathing
(4) All reptiles posses scales, have a three chambered heart and are cold blooded (poikolothermal)

37. The rate of formation of new organic matter by rabbit in a grassland is called:
(1) Secondary productivity
(2) Net primary productivity
(3) Gross primary productivity
(4) Net productivity

38. In genetic engineering, the antibiotics are used:
(1) To select healthy vectors
(2) As sequences from where replication starts
(3) To keep the cultures free of infection.
(4) As selectable markers

39. The secretory phase in the human menstrual cycle is also called :
(1) Follicular phase lasting for about 6 days
(2) Luteal phase and lasts for about 13 days
(3) Follicular phase and lasts for about 13 days
(4) Luteal phase and lasts for about 6 days

40. In gobar gas, the maximum amount is that of:
(1) Methane
(2) Propane
(3) Carbon dioxide
(4) Butane

41. Through their effect on plant growth regulators, what do the temperature and light control in the plants?
(1) Flowering
(2) Closure of stoamata
(3) Fruit elongation
(4) Apical dominance

42. Which one of the following human organs is often called the '' Graveyard'' of RBC's?
(1) Kidney
(2) Spleen
(3) Liver
(4) Gall bladder

43. Which one of the following pairs of animals are similar to each other pertaining to the feature stated against them
(1) Garden lizard and crocodile - Three chambered heart
(2) Ascaris and Ancylostoma – Metameric segmentation
(3) Sea horse and flying fish – Cold blooded (poikilothermal)
(4) Pteropus and ornithorhynus – Viviparity

44. The idea of mutations was brought forth by :
(1) Gregor Mendal, who worked on *Pisum sativum*
(2) Hardy Weinberg, who worked on allel frequencies in a population
(3) Charles Darwin, who observed a wide variety of organism during sea voyage
(4) Hugo do varies, who worked on evening primrose

45. Select the correct statements about biodiversity:
(1) Large scale planting of Bt cotton has no adverse effect on biodiversity
(2) Western Ghats have a very high degree of species richness and endemism
(3) Conservation of biodiversity is just a fad pursued by the developed countries
(4) The desert areas of Rajasthan and Gujarat have a very high level of desert animal species as well as numerous rare animals

46. Plants with ovaries having only one or a few ovules, are generally pollinated by :
(1) Butterflies
(2) Birds
(3) Wind
(4) Bees

47. Consider the following four statements (a-d) and select the option which includes all the correct ones only
(a) Single cell spirulina can produce large quantities of food rich in protein, minerals, vitamins etc.
(b) Body weight-wise the microorganism Methylophilus methylotrophus may be able to produce several times more proteins than the cows per day
(c) Common button mushrooms are very rich source of vitamin C
(d) A rice variety has been developed which is very rich in calcium
Options:
(1) Statements (a),(c) and (d)
(2) Statements (b),(c) and (d)
(3) Statements (a),(b)
(4) Statements (c),(d)

48. Which one of the following biomolecules is correctly charactrised ?
(1) Palmitic acid – An unsaturated fatty acid with 18 carbon atoms
(2) Adenylic acid – Adenosine with a glucose phosphate molecule
(3) Alanine amino acid – Contains an amino group and an acidic group anywhere in the molecule
(4) Lecithin – a phosphorylated glyceride found in cell membrane

49. For its action, nitrogenase requires
(1) Light
(2) Mn^{2+}
(3) Super oxygen radicals
(4) High input of energy

50. Tobacco plants resistance to a nematode have been developed by tge introduction of DNA that produced (in the host cells).
(1) A particular hormone
(2) An antifeedant
(3) A toxic protein
(4) Both sense and anti-sense RNA

51. Where do certain symbiotic microorganisms normally occur in human body?
(1) Oral lining and tongue surface
(2) Vermiform appendix and return
(3) Duoenum
(4) Caecum

52. Identify the meiotic stage in which the homologus chromosomes separate while the sister chromatids remain associated at their centromeres:
(1) Metaphase II
(2) Anaphase I
(3) Anaphase II
(4) Metaphase I

53. Which one of the folllwing cellular parts is correctly described?
(1) Centrioles – sites for active RNA synthesis
(2) Ribosomes – those on chloroplasts are larger (80s) While those in the cytoplasm are smaller (70s)
(3) Lysosomes – optimally active at a pH of about 8.5
(4) Thylakoids – Flattened membranous sacs forming the grana of chloroplasts

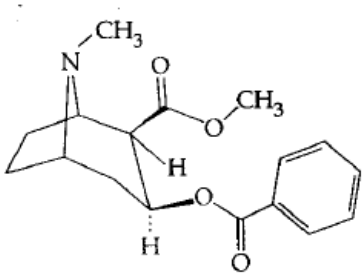
54. Cuscuta is an example of :
(1) Brood parasitism
(2) Predation
(3) Endoparasitism
(4) Ectoparasitism

55. The supportive skeletal structures in the human external ears and in the nose tip are examples of :
(1) Areolar tissue
(2) Bone
(3) Cartilage
(4) Ligament

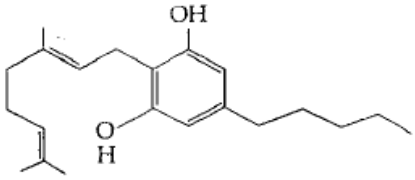
56. Read the following five statements (A-B) and answer as asked next to them
(a) In Equisetum the female gametophyte is retained on the parent sporophyte
(b) In Ginkgo male gametophyte is not independent
(c) The sporophyte in Riccia is more developed than that in Polytrichum
(d) Sexual reprocution in volvox is ispgamous
(e) The spors of slime molds lack cell walls.
How many of the above statements are correct?
(1) Three
(2) Four
(3) One
(4) Two

57. Identify the molecules (A) and (b) shown below and select the right option giving their source and use

(a)

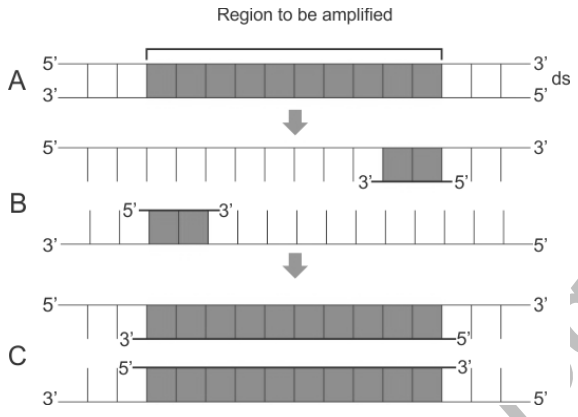


(b)



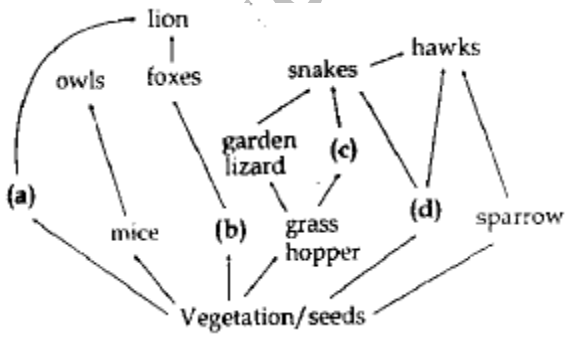
	Molecule	**Source**	**Use**
(1)	(b) Heroin	Cannabis Sativa	Depressant and slows down body functions
(2)	(b)Cannabinoid	Atropa belladonna	Produces hallucinations
(3)	(a) Morphine	Papaver somniferum	Sedative and pain killer
(4)	(a) Cocaine	Erythroxylum coca	Acclerates the transport of dopamine

58. The figure below shows three steps (A,B,C) of polymerase chain reaction (PCR) select the options giving correct identification together with what it represents ?



(1) A – Denaturtaion at a temperature of about 50°C
(2) C- Extension in the presence of heat stable DNA polymerse
(3) A – Annealing with two sets of primers
(4) B – Denaturation at a temperature of about 98°C separating the two DNA strands

59. Identify the likely organisms (a),(b),(c) and (d) in the food web shown below :



	(a)	(b)	(c)	(d)
(1)	Dog	Squirrel	Bat	Deer
(2)	Rat	Dog	Tortoise	Crow
(3)	Squirrel	Cat	Rat	Pigeon
(4)	Deer	Rabbit	Frog	rat

60. Which one of the following pairs of chemical substances, is correctly catgorised?
(1) Pepsin and prolactin- Two digestive enzymes secreted in stomach
(2) Troponin and mypson – complex proteins in striated muscles
(3) Secretin and rhodopsin – Polupeptide hormones
(4) Calcitonin and thymosin – Thyroid hormones

61. Vernalisation stimulates flowering in :
(1) Turmeric
(2) Carrot
(3) Ginger
(4) Zamikand

62. Green revolution in india occurred during :
(1) 1970's
(2) 1980's
(3) 1950's
(4) 1960's

63. A fall in glomerular filtration rate (GFR) activities :
(1) Adrenal cortex to release aldosteone
(2) Adrenal medulla to release adrenaline
(3) Posterior pitutaory to release vasopressin
(4) Juxta glomerular cells to release rennin

64. What is the function of germ pore?
(1) Absorption of water for seed germination
(2) Intiation of pollen tube
(3) Release of male gametes
(4) Emergence of radical

65. Which one of the following options gives the correct catagorisation of six animals according to the type of nitrogenous wastes (A,B,C), they give out ?

	A **AMMONOTELIC**	**B** **UREOTELIC**	**C** **URICOTELIC**
(1)	Frog, Lizards	Aquatic,Amphibia, Humans	Cockroach Pigeon
(2)	Aquatic Amphibia	Frog,Humans	Pigeon,Lizards Cockroach
(3)	Aquatic	Cockroach Humans	Frog,Pigeon Lizards
(4)	Pigeon Humans	Aquatic Amphibia Lizards	Cockroach Frog

66. Which one of the following of items in the options 1 – 4 are correctly categorized with one exception in it?

	ITEMS	CATEGORY	EXCEPTION
(1)	Kangaroo, Koala Wombat	Australian Marsupials	wombat
(2)	Plasmodium Cuscuta Trypanasoma	Protozoan Parasites	Cuscuta
(3)	Typhoid Pneumonia Diphtheria	Bacterial disease	Diphtheria
(4)	UAA,UAG,UGA	Stop Condons	UAG

67. Which one of the following generally acts as an antagonist to gibberllins ?
(1) Ethylene
(2) ABA
(3) IAA
(4) Zeatin

68. Which one of the following organisms is scientifically correctly named, correctly printed according to the international Rules of Nomenclature and correctly described?
(1) Plasmodium falciparum – A protozoan pathogen causing the most serious type of malaria
(2) Felis tigiris - The Indian tiger, well protected in gir forests
(3) E.coli- full name, Entamoeba coli, a commonly occurring bacterium in human intestine
(4) Musca domestic – The common house lizard a reptile

69. Read the following four statements (A-D)
(A) Colosturm is recommended for the new born because it is rich in antigens
(B) Chickengunya is caused by a gram negative bacterium
(C) Tissue culture has proved useful in obtaining virus – free plants
(D) Beer is manufactured by distillation of fermented grape juice
How many of the above statements are wrong ?
(1) Three
(2) Four
(3) One
(4) Two

70. Which one of the following organisms is correctly matched with its three characteristics ?
(1) Tomato : wisted aestivation, Axile placentation, Berry
(2) Onion : bulb, Imbricate aestivation, Axile placentation
(3) Maize : C_3 pathway, closed vascular bundles
(4) Pea : C_3Pathway, Ebdospermic seed, vexillary aestivation

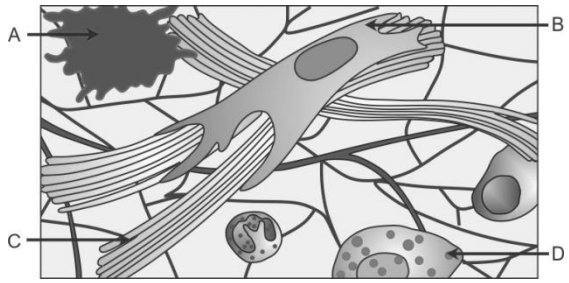
71. The second stage of hydrosere is occupied by plants like :
(1) Typha
(2) Salix
(3) Vallisneria
(4) Azollo

72. Which one of the following statements is correct with respect to immunity?
(1) The antibodies against small pox pathogen are produced by T-lymphocytes
(2) Antibodies are protein molecules, each of which has four light chains
(3) Rejection of a kidney graft is the function of B-lymphocytes
(4) Preformed antibodies need to be injected to treat the bite y a viper snake

73. Which one of the following reprsents a palindromic sequence in DNA?
(1) 5' - CCAATG – 3'
3' – GAATCC – 5'
(2) 5' – CATTAG – 3'
3' – GATAAC – 5'
(3) 5'- GATACC- 3'
3' – CCTAAG – 5'
(4) 5' – GAATTC – 3'
3'- CTTAAG – 5'

74. For its activity, Carboxypeptidase requires
(1) Iron
(2) Niacin
(3) Copper
(4) Zinc

75. Given below is the diagrammatic sketch of certain type of connective tissue. Identify the parts lebelled A,B,C and D, and select the right option about them.



	Part – A	**Part – B**	**Part –C**	**Part –D**
(1)	Mast cell	Macro – phage	Fibroblast	Collagen Fibreso
(2)	Macro – phage	Collagen fibres	Fibroblast	Mast Cell
(3)	Mast Cell	Collagen fibres	Fibroblast	Macro phage
(4)	Macro phage	Fibroblast	Collagen fibres	Mast cell

76. In the five – kingdom classification, chlamydomonas and chlorella have been included in:
(1) Algae
(2) Plantae
(3) Monera
(4) Protista

77. Read the following four statements (A-D) :
(A) Both, photophosphorylation and oxidative phosphorylation involve uphill transport of protons across the membrane
(B) In dicot stems, a new cambium originates from cells of pericycle at the time of secondary growth
(C) Stamens in flowers of Gloriosa and Petunia are polyandrous
(D) Symbiotic nitrogen – fixers occur in free – living state also in soil.
How many of the above statements are right?
(1) Three
(2) Four
(3) One
(4) Two

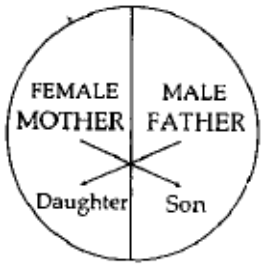
78. The domestic sewage in large cities :
(1) Is processed by aerobic and then anaerobic bacteria in the secondary treatment in sewage treatment plants (STPs)
(2) When treated in STPs does not really require the aeration step as the sewage contains adequate oxygen
(3) has very high amounts of suspended solids and dissolved salts
(4) has a high BOD as it contains both aerobic and anaerobic bacteria

79. Which one of the following pairs is wrongely matched ?
(1) Salvinia – Prothallus
(2) Viroids – RNA
(3) Mustard – Synergids
(4) Ginkgo – Archegonia

80. What is it that forms the basis of DNA fingerprinting?
(1) The relative difference in the DNA occurrence in blood, skin and saliva
(2) The relative amount of DNA in the ridges and grooves of the fingerprints
(3) Satelite DNA occurring as highlt repeated short DNA segments
(4) The relative proportions of purines of pyrimidines in DNA

81. Which one of the following characteristics is common both in humans and adult frogs?
(1) Internal fertilization
(2) Nucleated RBC's
(3) Ureotelic mode of excretion
(4) Four – Chambered heart

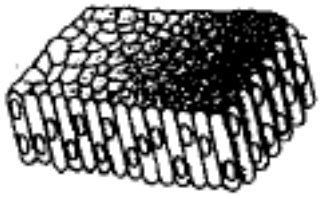
82. Represented below is the inheritance pattern of certain type of traits in humans. Which one of the following conditions could be an example of this pattern?



(1) Sickle cell anaemia
(2) Haemophillia
(3) Thalassemia
(4) Phenylketonuria

83. The four sketches (A,B,C and D) given below, represent four different types of animal tissues. Which one of these is correctly identified in the options given along with its correct location and function?

(A)



(B)

(C)

(D)

		Tissue	Location	Function
(1)	(C)	Collagen fibres	Cartilage	Attach skeletal muscles to bones
(2)	(D)	Smooth muscle Tissue	Heart	Heart contraction
(3)	(A)	Columnar Epithelium	Nephron	Secretion and absorption
(4)	(B)	Glandular Epithelium	Intensitine	Secretion

84. Which one of the following structure is an organelle within an organelle?
(1) Peroxisome
(2) ER
(3) Mesosome
(4) Ribosome

85. The first clinical gene therpy was given for treating
(1) Chicken pox
(2) Rheumatoid arthirits
(3) Adenosine deaminase deficiency
(4) Diabates mellitus

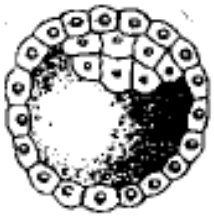
86. Sacred groves are specially useful in:
(1) Preventing soil erosion
(2) Year - round flow of water in rivers
(3) Conserving rare and threaterned species
(4) Generating environmental awareness

87. Which one of the following is a wrong statement regarding mutuations?
(1) Cancer cells commonly show chromosomal aberrations
(2) UV and Gamma rays are mutagens
(3) Change in a single base pair of DNA does not cause mutation
(4) Deletio and insertion of base pairs cause frame – shift mutations

88. Biolistics (gene-gun) is suitable for :
(1) Transformation of plant cells
(2) Constructing recombinant DNA by joining with vectors
(3) DNA finger printing
(4) Disarming pathogen vectors

89. Which one of the following statements is wrong ?
(1) Vegetative cell is larger than generative cell
(2) Pollen grains in some plants remain visible for months
(3) Intine is made up of cellulose and pectin
(4) When pollen is shed at two-celled stag, double fertilization does not take place

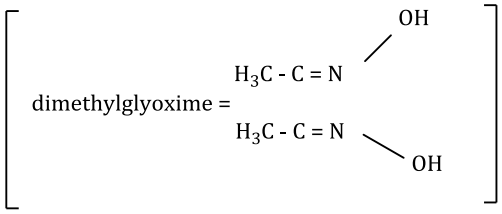
90. Identify the human development stage shown below as well as the related right place of its occurrence in a normal pregnant woman, and select the right option for the two together.



	Developmental Stage	Site of occurrence
(1)	Blastula	End part of Fallopian tube
(2)	Blastocyst	Uterine wall
(3)	8 – Celled morula	Starting point of fallopian tube
(4)	Late morula	Middle part of Fallopian tube

Chemistry

91. Red precipitate is obtained when ethanol solution of dimethylglyoxime is added to ammoniacal Ni (II). Which of the following statements is not true?
(1) Complex has symmetrical H – Bonding
(2) Red Complex has a tetrahedral geometry
(3) Dimethylglyoxime functions as bidentate ligand
(4) Red complex has a square planar geometry

dimethylglyoxime = 

92. During change of O_2 to O_2^- ion, the electron adds on which one of the following orbitals
(1) πorbital
(2) σ^*orbital
(3) σorbital
(4) π^*orbital

93. Consider the reaction :
$RCHO + NH_2NH_2 \rightarrow RCH = N - NH_2$
What sort of reaction is it?
(1) Free radical addition – elimination reaction
(2) Electrophilic substitution elimination reaction
(3) Nucleophilic addition – elimination reaction
(4) Electrophilic addition – elimination reaction

94. In which of the following arrangements the given sequence is not strictly according to the property indicated against it
(1) $H_2O < H_2S < H_2Se < H_2Te$: increasing pK_a values
(2) $NH_3 < PH_3 < AsH_3 < SbH_3$: increasing acidic character
(3) $CO_2 < SiO_2 < SnO_2 < PbO_2$: increasing oxidizing power
(4) HF < HCl < HBr < HI : Increasing acidic strength

95. The Gibbs energy for the decomposition of Al_2O_3 at 500°C is as fo

$$\frac{2}{3}Al_2O_3 \rightarrow \frac{4}{3}Al + O_2;$$

$\Delta_r G = +960$ kJ mol^{-1}

The potential difference needed for the electrolytic reduction of aluminium oxide (Al_2O_3) at 500°C is at least:

(1) 3.0 V
(2) 2.5 V
(3) 5.0 V
(4) 4.5 V

96. Given that the equilibrium constant for the reaction

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$$

has a value of 278 at a particular temperature. What is the value of the equilibrium constant for the following reaction at the same temperature?

$$SO_{3(g)} \rightleftharpoons SO_{2(g)} + \frac{1}{2}O_{2(g)}$$

(1) 3.6×10^{-3}
(2) 6.0×10^{-2}
(3) 1.3×10^{-5}
(4) 1.8×10^{-3}

97. Which of the following compounds can be used as antifreeze in automobile radiators?

(1) Glycol
(2) Nirophenol
(3) Ethyl alcohol
(4) Methyl alcohol

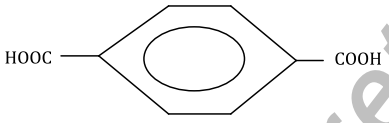
98. Molar conductivities $\left(\Lambda_m^o\right)$ at infinite dilution of NaCl, HCl and CH_3COONa are 126.4, 425.9 and 91.0 s cm^2 mol^{-1} respectively. Λ_m^o for CH_3COOH will be :

(1) 180.5 S cm^2 mol^{-1}
(2) 290.8 S cm^2 mol^{-1}
(3) 390.5 S cm^2 mol^{-1}
(4) 425.5 S cm^2 mol^{-1}

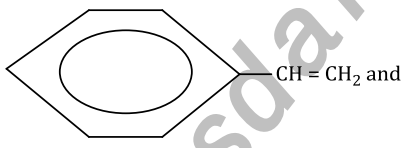
99. Vapour pressure of chloroform ($CHCl_3$) and dichloromethane (CH_2Cl_2) at 25°C are 200 mmHg and 41.5 mmHg respectively. Vapour pressure of the solution obtained by mixing 25.5 g of $CHCl_3$ and 40 g of CH_2Cl at the same temperature will be :
(Molecular mass of $CHCl_3$ = 119.5 u and molecular mass of CH_2Cl_2 = 85 u)
(1) 615.0 mmHg
(2) 347.9 mmHg
(3) 285.5 mmHg
(4) 173.9 mmHg

100. A certain gas takes three times as long to effuse out as helium. Its molecular mass will be :
(1) 36 u
(2) 64 u
(3) 9 u
(4) 27 u

101. Which one of the following sets forms the biodegradable polymer?
(1) $H_2N - CH_2 - COOH$ and
$H_2N - (CH_2)_5 - COOH$
(2) $HO - CH_2 - CH_2 - OH$ and



(3)



$CH_2 = CH - CH = CH_2$
(4) $CH_2 = CH - CN$ and
$CH_2 = CH - CH = CH_2$

102. The catalytic activity of transition metals and their compounds is ascribed mainly to:
(1) Their unfilled d – orbitals
(2) Their ability to adopt variable oxidation states
(3) Their chemical reactivity
(4) Their magnetic behavior

103. Given the reaction between 2 gases represented by A_2 and B_2 to give the compound $AB_{(g)}$

$A_{2(g)} + B_{2(g)} \rightleftharpoons 2\,AB_{(g)}$

At equilibrium, the concentration

of $A_2 = 3.0 \times 10^{-3}$ M

of $B_2 = 4.2 \times 10^{-3}$ M

of $AB = 2.8 \times 10^{-3}$ M

If the reaction takes place in a sealed vessel at 527°C, then the value of K_c will be :

(1) 1.9

(2) 0.62

(3) 4.5

(4) 2.0

104. Standard reduction potentials of the half reactions are given below:

$F_{2(g)} + 2e^- \rightarrow 2F^-_{(aq)}$; $E^0 = +2.85$ V

$Cl_{2(g)} + 2e^- \rightarrow 2Cl^-_{(aq)}$; $E^o = 1.36$ V

$Br_{2(l)} + 2e^- \rightarrow 2Br^-_{(aq)}$; $E^o = +1.06$ V

$I_{2(s)} + 2e^- \rightarrow 2I^-_{(aq)}$; $E^o = +0.53$ V

The strongest oxidizing and reducing agents respectively are:

(1) Br_2 and Cl^-

(2) Cl_2 and Br^-

(3) Cl_2 and I_2

(4) F_2 and I^-

105. For diatomic species are listed below.identify the correct order in which the bond order is increasing in them :

(1) $O_2^- < NO < C_2^{2-} < He_2^+$

(2) $C_2^{2-} < He_2^+ < O_2^- < NO$

(3) $He_2^+ < O_2^- < NO < C_2^{2-}$

(4) $NO < O_2^- < C_2^{2-} < He_2^+$

106. Low spin complex of d^6 – cation in an octahedral field will have the following energy:

(1) $\frac{-12}{5}\Delta_o + 3P$

(2) $\frac{-2}{5}\Delta_o + 2P$

(3) $\frac{-2}{5}\Delta_o + P$

(4) $\frac{-12}{5}\Delta_o + P$

(Δ_o = Crystal field splitting energy in an octahedral field, P = Electron pairing energy)

107. Which of the following compounds will give yellow precipitate with iodine and alkali?

(1) Methyl acetate
(2) Acetamide
(3) 2 – Hydroxypropane
(4) Acetophenone

108. The orbital angular momentum of a p – electron is given as :

(1) $\sqrt{3}\frac{h}{2\pi}$

(2) $\sqrt{\frac{3}{2}}\frac{h}{\pi}$

(3) $\sqrt{6}\frac{h}{2\pi}$

(4) $\frac{h}{\sqrt{2}\pi}$

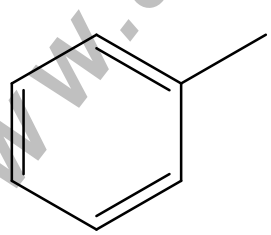
109. Which one of the following does not correctly represent the order of the property indicated against it ?

(1) $Ti^{3+} < V^{3+} < Cr^{3+} < Mn^{3+}$ increasing magnetic moment
(2) Ti < V < Cr < Mn increasing melting points
(3) Ti < V < Mn < Cr increasing 2nd ionization enthalpy
(4) Ti < V < Cr < Mn increasing number of oxidation states

110. Chloroamphenicol is an:

(1) Antihistaminic
(2) Antiseptic and disinfectant
(3) Antibiotic – broad spectrum
(4) Antifertility drug

111. Consider the following reaction:



$\xrightarrow[Pd - BaSO_4]{H_2}$ A

The product 'A' is:

(1) C_6H_5OH
(2) $C_6H_5COOH_3$

(3) C_6H_5Cl
(4) C_6H_5CHO

112. Which one of the following reagents will be able to distinguish between 1 – butyne and 2 – butyne ?
(1) HCl
(2) O_2
(3) Br_2
(4) $NaNH_2$

113. For real gases van der Waals equation is written as

$$\left(p+\frac{an^2}{V^2}\right)(V-nb)=nRT$$

Where 'a' and 'b' are van der Waals constants.
Two sets of gases are:
(I) O_2, CO_2, H_2 and He
(II) CH_4, O_2 and H_2
The gases given in set – I in increasing order of 'b' and gases given in set – II in decreasing order of 'a' are arranged below. Select the correct order from the following:
(1) (I) $O_2 < He < H_2 < CO_2$ (II) $H_2 > O_2 > CH_4$
(2) (I) $H_2 < He < O_2 < CO_2$ (II) $CH_4 > O_2 > H_2$
(3) (I) $H_2 < O_2 < He < CO_2$ (II) $O_2 > CH_4 > H_2$
(4) (I) $He < H_2 < CO < O_2$ (II) $CH_4 > H_2 > O_2$

114. Activation energy (E_a) and rate constants (k_1 and k_2) of a chemical reaction at two different temperatures (T_1 and T_2) related by :

(1) $\ln\frac{k_2}{k_1}=-\frac{E_a}{R}\left(\frac{1}{T_2}-\frac{1}{T_1}\right)$

(2) $\ln\frac{k_2}{k_1}=-\frac{E_a}{R}\left(\frac{1}{T_2}+\frac{1}{T_1}\right)$

(3) $\ln\frac{k_2}{k_1}=\frac{E_a}{R}\left(\frac{1}{T_1}-\frac{1}{T_2}\right)$

(4) $\ln\frac{k_2}{k_1}=-\frac{E_a}{R}\left(\frac{1}{T_1}-\frac{1}{T_2}\right)$

115. Which of the following exhibits only +3 oxidation state?
(1) Th
(2) Ac
(3) Pa
(4) U

116. Equal volumes of two monoatomic gases A and B ,at same temperature and pressure are mixed. The ratio of specific heats (C_p/C_v) of the mixture will be:
(1) 1.50
(2) 3.3
(3) 1.67
(4) 0.83

117. Structure of a mixed oxide is cubic close – packed (c.c.p) The cubic unit cell of mixed oxide is composed of oxide ions. One fourth of the tetrahedral voids are occupied by divalent metal A and the octahedral voids are occupied by a monovalent metal B. The formula of the oxide is :
(1) A_2BO_2
(2) $A_2B_3O_4$
(3) AB_2O_2
(4) ABO_2

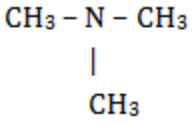
118. Four successive members of the first series of the transition metals are listed below. For which one of the standard potential $\left(E^{o}_{M^{2+}/M}\right)$ value has a positive sign?
(1) Ni (Z = 28)
(2) Cu (Z = 29)
(3) Fe (Z = 26)
(4) Co (Z = 27)

119. In the replacement reaction
$Cl + MF \rightarrow CF + MI$
The reaction will be most favourable if M happens to be
(1) K
(2) Rb
(3) Li
(4) Na

120. An organic compound (C_3H_9N) (A), when treated with nitrous acid, gave an alcohol and N_2 gas was evolved.(A) on warming with $CHCl_3$ and caustic potash gave (C) which on reduction gave isopropylmethylmine. Predict the structure of (A)

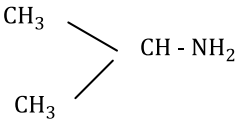
(1) $CH_3CH_2 - NH - CH_3$

(2)



(3) $CH_3CH_2CH_2 - NH_2$

(4)



AIPMT - 2012
(Physics, Chemistry and Biology)
Mains Answer Key and Solution
Code D

Answers

1	(3)	2	(2)	3	(2)	4	(4)	5	(1)	6	(1)	7	(1)	8	(4)	9	(2)	10	(1)
11	(3)	12	(2)	13	(4)	14	(3)	15	(1)	16	(1)	17	(4)	18	(1)	19	(2)	20	(4)
21	(1)	22	(4)	23	(1)	24	(3)	25	(3)	26	(4)	27	(1)	28	(2)	29	(1)	30	(1)
31	(4)	32	(2)	33	(2)	34	(1)	35	(4)	36	(1)	37	(1)	38	(4)	39	(2)	40	(1)
41	(1)	42	(2)	43	(3)	44	(4)	45	(2)	46	(3)	47	(3)	48	(4)	49	(4)	50	(4)
51	(4)	52	(2)	53	(4)	54	(4)	55	(3)	56	(3)	57	(3)	58	(4)	59	(4)	60	(2)
61	(2)	62	(4)	63	(4)	64	(2)	65	(2)	66	(2)	67	(2)	68	(1)	69	(1)	70	(3)
71	(3)	72	(4)	73	(4)	74	(4)	75	(4)	76	(4)	77	(4)	78	(1)	79	(1)	80	(3)
81	(3)	82	(2)	83	(4)	84	(4)	85	(3)	86	(3)	87	(3)	88	(1)	89	(4)	90	(2)
91	(2)	92	(4)	93	(3)	94	(1)	95	(2)	96	(2)	97	(1)	98	(3)	99	(Bonus)	100	(1)
101	(1)	102	(2)	103	(2)	104	(4)	105	(3)	106	(1)	107	(2)	108	(4)	109	(2)	110	(3)
111	(4)	112	(4)	113	(2)	114	(1,4)	115	(2)	116	(3)	117	(3)	118	(2)	119	(2)	120	(4)

Physics

1. The instantaneous current is

$$i = \frac{1}{\sqrt{2}}\sin(100\pi t)\ A$$

$$\Rightarrow i_0 = \frac{1}{\sqrt{2}}$$

Similarly, the instantaneous voltage is

$$e = \frac{1}{\sqrt{2}}\sin\left(100\pi t + \frac{\pi}{3}\right) V$$

$$\Rightarrow e_0 = \frac{1}{\sqrt{2}}$$

Now, the average power is

$$\langle P\rangle = V_{rms} I_{rms}\cos\phi$$

We know that

$$V_{rms} = \frac{1}{\sqrt{2}}e_0 = \frac{1}{\sqrt{2}}\frac{1}{\sqrt{2}} = \frac{1}{2}\ V;\ I_{rms} = \frac{1}{\sqrt{2}}i_0 = \frac{1}{\sqrt{2}}\frac{1}{\sqrt{2}} = \frac{1}{2}A$$

Also, from the expressions of instantaneous current and voltage, we see that

$$\cos\phi = \cos\frac{\pi}{3} = \frac{1}{2}$$

Hence, we get

$$\langle P\rangle = V_{rms} I_{rms}\cos\phi$$

$$= \frac{1}{2}\times\frac{1}{2}\times\frac{1}{2} = \frac{1}{8}\ W$$

2. The total power dissipated in the circuit is P = 30 W.

From the circuit, the equivalent resistance is

$$R_p = \frac{R_1 R_2}{R_1 + R_2} = \frac{5R}{5+R}$$

Now, we know that power is

$$P = \frac{V^2}{R} = \frac{V^2}{R_p}$$

$$\therefore P = \frac{V^2(5+R)}{5R}$$

$$\Rightarrow 30 = \frac{100(5+R)}{5R}$$

$$\therefore 150R = 500 + 100R$$

$$\therefore 50R = 500$$

$$\therefore R = 10\ \Omega$$

3. The given entity is $(\mu_0\varepsilon_0)^{-\frac{1}{2}}$

We know that this entity is equal to the speed of light c.
Hence, we have

$$c = (\mu_0\varepsilon_0)^{-\frac{1}{2}}$$

$$\Rightarrow \left|(\mu_0\varepsilon_0)^{-\frac{1}{2}}\right| = |c| = \left[M^0L^1T^{-1}\right] = \left[LT^{-1}\right]$$

4. The change in internal energy in any process depends on the initial and final states. Now, from the PV diagram, we see that the initial and final states of all the three processes are the same. Hence, we have

$\Delta U_1 = \Delta U_2 = \Delta U_3$

Now, from the first law of thermodynamics, we have

$\Delta Q = \Delta U + \Delta W$

ΔW is given from the area under the PV curve. So, from the image, we see that

$\Delta W_1 > \Delta W_2 > \Delta W_3$

So, we get

$Q_1 > Q_2 > Q_3$

5. For an output of Y = 1, we will need that both inputs of the AND gate should be 1. So, the output of the OR gate should be 1 and C = 1.

Now, the output of the OR gate will be 1 if either of A or B = 1.
Hence, out of the four options, the correct option will be A = 1, B = 0 and C = 1, i.e. option (1).

6. The radii of the two spheres are $R_1 = 1$ cm and $R_2 = 3$ cm.
Their charges are $Q_1 = -1 \times 10^{-2}$ C and $Q_2 = 5 \times 10^{-2}$ C, respectively.
Now, when the two spheres are connected, the potential on each of them becomes equal. Hence, we have

$$V_1 = V_2$$

$$\frac{1}{4\pi\varepsilon_0}\frac{Q_1}{R_1} = \frac{1}{4\pi\varepsilon_0}\frac{Q_2}{R_2}$$

$$\therefore \frac{Q_1}{R_1} = \frac{Q_2}{R_2}$$

$$\therefore \frac{Q_1}{1} = \frac{Q_2}{3}$$

$$\Rightarrow Q_1 = \frac{Q_2}{3}$$

But after the connection, the total charge has to be equal to

$Q = Q_1 + Q_2 = -1\times10^{-2} + 5\times10^{-2} = 4\times10^{-2}$ C

Hence, we get

$$Q_1 + Q_2 = \frac{Q_2}{3} + Q_2 = 4\times10^{-2} \text{ C}$$

$$\frac{4Q_2}{3} = 4\times10^{-2}$$

$$\therefore Q_2 = 3\times10^{-2} \text{ C}$$

Hence, the bigger sphere will have 3×10^{-2} C of charge on it.

7. According to Einstein's photoelectric equation, we have

$$KE_{max} = E - \phi$$

Here, ϕ is the work function and E is the energy of the incident photon radiation.

So, for both radiations, we will get

$$(KE_{max})_1 = 1 - 0.5$$

$$\therefore \frac{1}{2}mv_1^2 = 0.5 \qquad \text{.....(1)}$$

$$(KE_{max})_2 = 2.5 - 0.5$$

$$\therefore \frac{1}{2}mv_2^2 = 2.0 \qquad \text{.....(2)}$$

Dividing equations (1) and (2), we get

$$\frac{\frac{1}{2}mv_1^2}{\frac{1}{2}mv_2^2} = \frac{0.5}{2} = \frac{1}{4}$$

$$\therefore \frac{v_1^2}{v_2^2} = \frac{1}{4}$$

$$\Rightarrow \frac{v_1}{v_2} = \frac{1}{2}$$

8. According to the perpendicular axes theorem, we have

$$I = I_{CM} + mr^2$$

Now, from the figure, we can tell that r will be maximum for point B.

Hence, the moment of inertia of a uniform circular disc is maximum about an axis perpendicular to the disc and passing through B.

9. The train is moving with a speed v = 220 ms^{-1}.
The frequency of sound emitted by the train is n = 1000 Hz.
The speed of sound is c = 330 ms^{-1}.

The sound emitted by the train is reflected from an object and is heard by the observer on the train itself.
Therefore, the frequency received by the observer on the train is

$$n' = n\left(\frac{c+v}{c-v}\right)$$

$$n' = 1000\left(\frac{330+220}{330-220}\right)$$

$$n' = 1000\left(\frac{550}{110}\right)$$

$$n' = 1000 \times 5$$

$$n' = 5000 \text{ Hz}$$

10. The half-life of the radioactive nucleus is $T_{1/2} = 50$ days

The time when $\frac{2}{3}$ of the nucleus has decayed is t_2.

Now, this decayed nucleus decays further till time t_1 when $\frac{1}{3}$ of it is decayed.

Now, we see that

$$\frac{1}{2} \times \frac{2}{3} = \frac{1}{3}$$

So, from t_2 till t_1, one half-life will have occurred for the nucleus.
Therefore, we get

$$t_2 - t_1 = T_{1/2} = 50 \text{ days}$$

11. A car has to be turned safely on a curved road of radius R. The necessary centripetal force required for this circular motion is provided by the frictional force between the road and the tyres.

$$\frac{mv_{max}^2}{R} = \mu_s mg$$

$$\therefore v_{max}^2 = \mu_s gR$$

$$\therefore v_{max} = \sqrt{\mu_s Rg}$$

12. The circular platform is initially at rest. So, the initial angular momentum is zero.
Now, the man starts walking on the platform. So, the combined angular momentum is

$$L_p + L_m = I_p\omega_p + I_m\omega_m$$

According to the conservation of angular momentum, we get

$$I_p\omega_p + I_m\omega_m = 0$$

$$\therefore I_p\omega_p = -I_m\omega_m$$

$$\therefore I_p\omega_p = -m_m R^2\frac{v_m}{R} = -m_m v_m R$$

$$\therefore \omega_p = -\frac{m_m v_m R}{I_p}$$

As the man and platform both are rotating simultaneously in opposite directions, the relative speed of man will be more than his actual speed.

Let the relative speed of man w.r.t. to the platform be v_R. So, we have

$$v_R = v_m - v_p = v_m - R\omega_p$$

$$\therefore v_R = v_m - R\left(-\frac{m_m v_m R}{I_p}\right)$$

$$\therefore v_R = v_m\left(1+\frac{m_m R^2}{I_p}\right) = 1\left(1+\frac{50\times 2^2}{200}\right) = 1(1+1) = 2\text{ m/s}$$

Therefore, the time taken by man to complete one revolution will be

$$t = \frac{2\pi R}{v_R} = \frac{2\pi\times 2}{2} = 2\pi\text{ s}$$

13. Let the initial momentum of the electron be p. The change in momentum of electron is P.
Now, the de Broglie wavelength is

$$\lambda = \frac{h}{p}$$

$$\therefore \frac{d\lambda}{\lambda} = \left|\frac{1}{p}dp\right| = \frac{dp}{p}$$

The wavelength changes by 0.5%, so the momentum change is

$$\frac{P}{p} = \frac{0.5}{100}$$

$$p = \frac{100}{0.5}P = 200P$$

14. The escape velocity of a satellite from the surface of the Earth is

$$v_e = \sqrt{\frac{2GM}{R}}$$

Here, G is the universal gravitational constant, M is the mass of the Earth and R is the radius of the Earth.

Similarly, the orbital velocity of a satellite around the Earth is

$$v_o = \sqrt{\frac{GM}{R}}$$

Therefore, from the above two equations, we see that

$$v_e = \sqrt{2} \times \sqrt{\frac{GM}{R}} = \sqrt{2}\, v_o$$

15. The equation of a simple harmonic wave is

$$y = 3 \sin \frac{\pi}{2}(50t - x)$$

From the above equation, we see that the amplitude and the wave number are given, respectively, as

$$a = 3 \text{ m}; \; k = \frac{\pi}{2}$$

Now, the maximum particle velocity is

$$v_{max} = a\omega = a(2\pi n)$$

The wave velocity is

$$v = n\lambda = n\frac{2\pi}{k} = \frac{2\pi n}{k}$$

Hence, the ratio of maximum particle velocity to the wave velocity is

$$\frac{v_{max}}{v} = \frac{2\pi na}{\frac{2\pi n}{k}} = ka$$

$$\therefore \frac{v_{max}}{v} = \frac{\pi}{2} \times 3 = \frac{3\pi}{2}$$

16. A particle moving in a magnetic field will describe a circle of radius r.
This radius is

$$r = \frac{\sqrt{2m(K.E)}}{qB}$$

Where, m is the mass of the particle, KE is its kinetic energy, q is its charge and B is the strength of the magnetic field.

It is given that

$$r_{proton} = r_{\alpha}$$

$$\therefore \frac{\sqrt{2m_p(K.E)_p}}{q_pB} = \frac{\sqrt{2m_{\alpha}(K.E)_{\alpha}}}{q_{\alpha}B}$$

$$\therefore \frac{\sqrt{m_p(K.E)_p}}{q_p} = \frac{\sqrt{m_{\alpha}(K.E)_{\alpha}}}{q_{\alpha}}$$

$$\Rightarrow \frac{\sqrt{m_p \times 1\ MeV}}{e} = \frac{\sqrt{4m_p(K.E)_{\alpha}}}{2e}$$

$$\therefore m_p \times (1\ MeV) = \frac{4m_p(K.E)_{\alpha}}{4}$$

$$\therefore (K.E)_{\alpha} = 1\ meV$$

17. Let x_{CM} be the distance of centre of mass from the origin.
The standard equation of centre of mass is

$$x_{CM} = \frac{m_1x_1 + m_2x_2 + m_3x_3}{m_1 + m_2 + m_3}$$

$$= \frac{300 \times 0 + 500 \times 40 + 400 \times 70}{300 + 500 + 400}$$

$$= \frac{20000 + 28000}{1200}$$

$$= \frac{48000}{1200}$$

$$= 40\ cm$$

Hence, the distance of centre of mass from the origin is 40 cm.

18. When flux passes through the coil, the emf induced in it is given by

$$e = \left|\frac{d\phi}{dt}\right|$$

$$\therefore IR = \left|\frac{d\phi}{dt}\right|$$

$$\Rightarrow d\phi = IRdt = Idt \times R$$

Now, from the graph, we see that the product Idt will be the area under the graph.

So, we get

$$d\phi = Idt \times R = (\text{Area of triangle}) \times R = \frac{1}{2} \times 0.1 \times 4 \times 10 = 2 \text{ Wb}$$

19. The energy stored in the capacitor is given in terms of capacitance C and potential difference across its plates as

$$U = \frac{1}{2}CV^2$$

Now, the potential difference is given in terms of electric field as

$V = Ed$

The capacitance of a capacitor is

$$C = \frac{A\varepsilon_0}{d}$$

Therefore, the energy is

$$U = \frac{1}{2}\left(\frac{A\varepsilon_0}{d}\right)(Ed)^2$$

$$= \frac{1}{2}A\varepsilon_0 E^2 d$$

20. The instantaneous power is a product of force and instantaneous velocity.

$$P_0 = Fv = mav = m\frac{dv}{dt}v$$

$$\therefore vdv = \frac{P_0}{m}dt$$

Integrating the above equation, we get

$$\int vdv = \frac{P_0}{m}\int dt$$

$$\therefore \frac{v^2}{2} = \frac{P_0}{m}t$$

$$\therefore v^2 = \left(\frac{2P_0}{m}\right)t$$

$$\Rightarrow v^2 \propto t$$

$$\text{OR } v \propto t^{\frac{1}{2}}$$

21. The gravitational potential inside a shell is zero for the entire radius.

Hence, $0 < r < R$

$g_{in} = 0$

At the surface of the shell, we have

$$g_s = \frac{GM}{R^2}$$

which is a constant

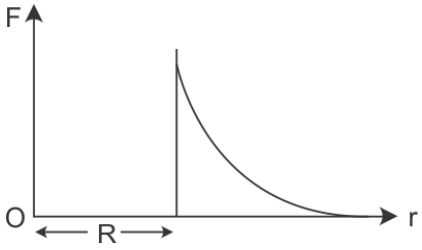
For a point outside the shell, the potential is

$$g_{out} = \frac{GM}{r^2}$$

$$\Rightarrow g \propto \frac{1}{r^2}$$

i.e. gravitational potential falls as the square of the distance.

So, the graph would be



22. The current gain for the transistor is

$$\beta = \frac{\Delta I_C}{\Delta I_B} = \frac{2\ mA}{40\ \mu A} = \frac{2\times10^{-3}}{40\times10^{-6}}$$

$$\therefore \beta = 50$$

Now, the voltage gain is

$$V_{gain} = \beta\left(\frac{R_{out}}{R_{in}}\right)$$

$$\therefore V_{gain} = \frac{50\times4\times10^3}{100} = 2000$$

23. The relation between the refractive index (μ) of the material of the prism, the angle (A) of the prism and the angle of minimum deviation (δ_m) is

$$\mu = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

For the case $\delta_m = A$, we get

$$\mu = \frac{\sin\left(\frac{A+A}{2}\right)}{\sin\left(\frac{A}{2}\right)} = \frac{\sin A}{\sin\left(\frac{A}{2}\right)} = \frac{2\sin\left(\frac{A}{2}\right)\cos\left(\frac{A}{2}\right)}{\sin\left(\frac{A}{2}\right)} \qquad \left[\because \sin(2A) = 2\sin A\cos A\right]$$

$$\therefore \mu = 2\cos\left(\frac{A}{2}\right)$$

Now, the range for the angle of prism is $0 < A < 90°$.

Hence, we have

$$\mu_{max} = 2\cos\left(\frac{0}{2}\right) = 2$$

$$\mu_{min} = 2\cos\left(\frac{90°}{2}\right) = 2\cos\left(\frac{\pi}{4}\right) = \frac{2}{\sqrt{2}} = \sqrt{2}$$

So, the range for μ is $\sqrt{2} < \mu < 2$.

24. The hydrogen spectrum has a spectral series as follows:

Lyman ($n \to 1$)

Balmer ($n \to 2$)

Bracket ($n \to 3$)

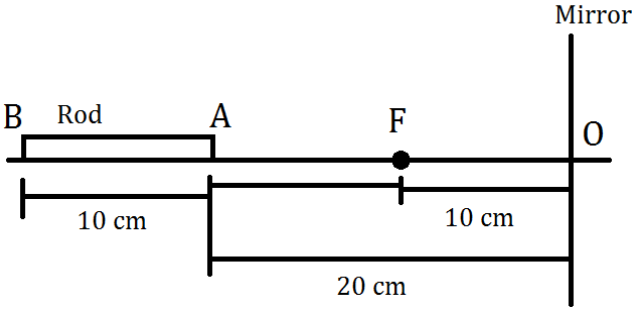
Paschen ($n \to 4$)

Pfund ($n \to 5$)

The infrared radiation is emitted when an electron jumps from a higher energy level to either 3, 4 or 5 levels. This is the case for the Bracket, Paschen and Pfund series.

Hence, the correct option out of the four will be $4 \to 3$.

25. The rod is placed as shown in the figure below.



For end A of the rod:

$u_A = -20$ cm; $f = -10$ cm

Hence, using the mirror equation, we get

$$\frac{1}{f}=\frac{1}{v}+\frac{1}{u}$$
$$\therefore \frac{1}{v_A}=\frac{1}{f}-\frac{1}{u_A}$$
$$\therefore \frac{1}{v_A}=\frac{1}{-10}-\frac{1}{-20}=-\frac{1}{10}+\frac{1}{20}=\frac{-1}{20}$$
$$\therefore v_A=-20 \text{ cm}$$

For end B of the rod:
$u_B = -30$ cm; $f = -10$ cm
Hence, using the mirror equation, we get
$$\frac{1}{f}=\frac{1}{v}+\frac{1}{u}$$
$$\therefore \frac{1}{v_B}=\frac{1}{f}-\frac{1}{u_B}$$
$$\therefore \frac{1}{v_B}=\frac{1}{-10}-\frac{1}{-30}=-\frac{1}{10}+\frac{1}{30}=\frac{-2}{30}$$
$$\therefore v_B=-15 \text{ cm}$$
Hence, the length of the image is
$$L=v_B-v_A=-15-(-20)=5 \text{ cm}$$

26. The rate of flow of heat through the stone is given by
$$\frac{dQ}{dt}=\frac{KA}{L}(T_1-T_2)$$
$$\therefore Q=\frac{KAt}{L}(T_1-T_2)$$
This heat is taken up by ice which eventually melts.
Hence, the heat given by steam is equal to the heat taken by ice.
Heat taken by ice is
$Q = mL_f$
Therefore, we have
$$\frac{KAt}{L}(T_1-T_2)=mL_f$$
$$\therefore K=\frac{mL_fL}{At(T_1-T_2)}$$
$$K=\frac{4.8\times3.36\times10^5\times0.1}{0.36\times(1\times3600)\times(100-0)}$$
$$K=1.24 \text{ J/m/s/°C}$$

27. The stone is dropped from a height. So, its initial velocity is zero.
Hence, its final velocity, i.e. the velocity with which it hits the ground, is

$$v = \sqrt{2gh}$$

So, the momentum at impact is

$$P = mv = m\sqrt{2gh}$$

$$\Rightarrow P \propto \sqrt{h}$$

$$\therefore \frac{P_2}{P_1} = \frac{\sqrt{h_2}}{\sqrt{h_1}}$$

Now, height is increased by 100% of the original. So, we get

$$h_2 = h + 100\%h$$
$$= h + h$$
$$= 2h$$

$$\Rightarrow \frac{P_2}{P_1} = \sqrt{\frac{2h}{h}} = \sqrt{2} = 1.41$$

$$\therefore P_2 = 1.41P = P + 0.41P = P + 41\%P$$

28. The cell of emf ε and internal resistance r is connected across resistance R.
The current through the circuit will then be

$$I = \frac{\varepsilon}{R + r}$$

Hence, the voltage across resistance R is given according to Ohm's law as

$$V = IR$$

$$= \frac{\varepsilon R}{R + r} = \frac{\varepsilon}{1 + \frac{r}{R}}$$

Now, the conditions can be set as

For $R = 0$

$$V = \frac{\varepsilon}{1 + \infty} = 0$$

For $R = \infty$

$$V = \frac{\varepsilon}{1 + 0} = \varepsilon$$

As R increases, V increases as 1/R decreases. So, (1 + 1/R) decreases. Hence, the graph will be as shown in option (2).

29. Work done by a magnetic field to turn the needle is

$$W = MB(\cos\theta_1 - \cos\theta_2)$$

$$\sqrt{3} = MB(\cos 0 - \cos 60)$$

$$\sqrt{3} = MB\left(1 - \frac{1}{2}\right)$$

$$\sqrt{3} = \frac{MB}{2} \qquad \text{.....(1)}$$

Hence, the torque acting on the needle is

$$\tau = MB\sin\theta$$

$$= MB\sin 60$$

$$\tau = \frac{\sqrt{3}}{2}MB \qquad \text{.....(2)}$$

Substitute equation (1) in (2) as

$$\tau = \sqrt{3} \times \frac{MB}{2} = \sqrt{3} \times \sqrt{3} = 3\ J$$

30. We know that the ratio of amplitude of the electric field to the amplitude of magnetic field is equal to the speed of light. That is

$$\frac{E_0}{B_0} = c$$

Therefore, we get

$$\frac{B_0}{E_0} = \frac{1}{c}$$

That is the reciprocal of the speed of light in vacuum.

Biology

31. All four of the given statements are correct.

32. *Nostoc*, *Chara*, *Porphyra* and *Wolffia* are photoautotrophs, while *Nitrosomonas* and *Nitrobacter* are chemoautotrophs.

33. Gram, Arhar, Sunhemp, Moong, Pea and Lupin belong to Family Fabaceae and show marginal placentation.

34. A dicot root is diarch to hexarch, while a monocot root exhibits polyarch condition and thus has many xylem bundles.

35. A test cross is carried out to predict and determine the genotype of plants in the F_2 generation.

36. Spongilla is a genus of freshwater sponges.
Most mammals are viviparous, but some mammals lay eggs; for example, platypus.
Most reptiles have a three-chambered heart, with the exception of crocodile which has a four-chambered heart.

37. The rate of accumulation of biomass at the primary consumer level is called secondary productivity.

38. Antibiotic-resistant genes are used as markers to select transformant and recombinant bacteria; hence, antibiotics are used as selectable markers.

39. The secretory phase of the human female menstrual cycle is also called the luteal phase. In this phase, the corpus luteum is formed which secretes the hormone progesterone which maintains pregnancy. In the absence of pregnancy, the phase lasts for 13–14 days.

40. The major component of gobar gas is methane, which comprises 60% to 70% of the total product.

41. In plants, the hormone vernalin controls vernalisation, which is the ability of the plant to flower in spring. The hormone florigen is responsible for photoperiodism in plants, i.e. the effect of the length of day and night on flowering in plants.

42. RBCs are destroyed in the spleen, and hence, it is called the 'graveyard' for RBCs.

43. Sea horse and flying fish are both cold-blooded animals.

44. Hugo de Vries was known for his mutation theory, which he proposed after he had discovered new forms of evening primrose.

45. The Western Ghats of India are a biodiversity hotspot and have a high degree of species richness and species endemism.

46. Wind-pollinated flowers generally have one or few ovules in the ovaries and a large number of pollen grains to increase the probability of successful pollination of each ovule.

47. Common button mushrooms are a very rich source of vitamin B.
A rice variety has been developed which is rich in vitamin A.

48. Lecithin is a phosphoglyceride present in the plasma membrane.

49. The enzyme nitrogenase requires a high input of energy to carry out biological nitrogen fixation.

50. Nematode or pest-resistant tobacco plants were developed using the RNA interference technology, which involves the formation of both sense and antisense RNA.

51. Caecum, a small blind sac, is considered the beginning of the large intestine and hosts some symbiotic microorganisms.

52. Homologous chromosomes separate during anaphase I of meiosis I.

53. Thylakoids are flattened disc-shaped, membranous sacs which form the grana of chloroplasts.

54. *Cuscuta* lives as a parasite on the shoot of many plants and hence is an ectoparasite.

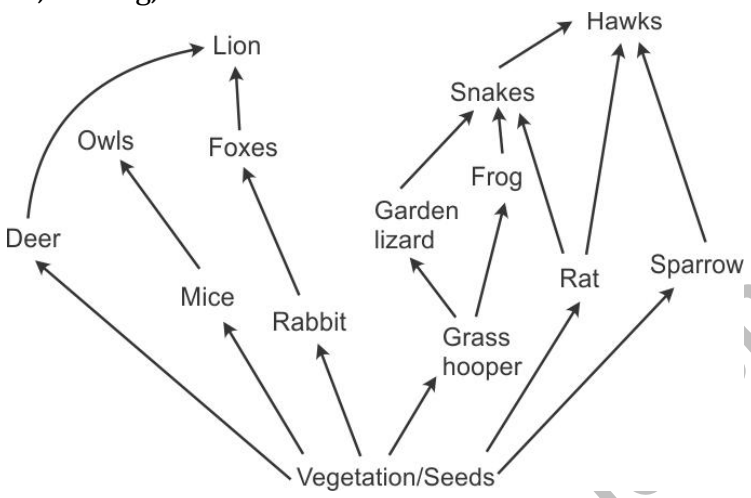
55. Ear pinna and the tip of the nose are made of elastic cartilage.

56. In Ginkgo, the male gamete is motile and free swimming, but the female gametophyte is not independent.

57. The molecule in figure 'a' is that of morphine, which is obtained from the plant *Papaver somniferum* and is used as a sedative and painkiller.

58. A – Represents denaturation which is usually done at about 95°C.
B – Represents annealing using two sets of primers.
C – Represents extension in the presence of heat-stable DNA polymerase.

59. a – deer, b – rabbit, c – frog, d – rat



60. Troponin is attached to the protein tropomyosin and lies within the groove between actin filaments in muscle tissue, whereas myosin is an ATP-dependent motor protein and helps in muscle contraction.

61. Like many biennials, carrot requires a vernalisation stimulus for flowering.

62. In India, the Green Revolution began in the 1960s through the introduction of high-yield crop varieties and the application of modern agricultural techniques, which led to the increase in food production in India.

63. A fall in the blood pressure results in the subsequent fall in the glomerular filtration rate. This in turn causes the activation of the renin–angiotensin–aldosterone system (RAAS) which causes the juxtaglomerular cells to releases renin.

64. The germ pore is the region on the pollen grain from where the pollen tube is formed.

65. The extent to which the excretory substances are diluted depends on the availability of water for those organisms. Thus, aquatic animals excrete ammonia, most terrestrial animals excrete urea and animals which live in arid regions expel waste in the form of uric acid.

66. *Plasmodium*, *Cuscuta* and *Trypanosoma* are parasites. *Plasmodium* and *Trypanosoma* are protozoa, whereas *Cuscuta* is a parasitic plant.

67. Abscisic acid is antagonistic to gibberellin, specifically in maintaining seed dormancy.

68. The scientific name for tiger is *Panthera tigris*.
E. coli is *Escherichia coli*.
Musca domestica is the scientific name for house fly.

69. Statements A, B and D are wrong.

70. In onion, the stem is modified as a bulb; it shows imbricate aestivation and has axile placentation.

71. The second stage of the hydrosere comprises submerged hydrophytes and consists of submerged plants such as *Vallisneria*.

72. To treat a patient for a bite by a viper snake bite, preformed antibodies need to be injected in the patient.

73. Palindromic sequences are DNA sequences which read the same in both strands from $5' \longrightarrow 3'$ direction.

74. Zinc is a cofactor required for the activity of the enzyme carboxypeptidase.

75. A – Macrophage
B – Fibroblast
C – Collagen fibres
D – Mast cell

76. In the five kingdom classification system, *Chlamydomonas* and *Chlorella* belong to the Kingdom Protista.

77. Statements C and D are correct.

78. In a wastewater treatment plant, for the treatment of domestic sewage, the secondary treatment includes biological treatment where aerobic and anaerobic bacteria are involved.

79. In *Salvinia*, both male and female gametophytes are found in the massulaes and not in the prothallus.

80. Satellite DNA occurring as highly repeated short DNA segments form the basis of the DNA fingerprinting technique.

81. In humans and adult frogs, ammonia is converted to urea in the liver before it is excreted from the body.

82. Haemophilia is an X-linked disorder and follows the criss-cross pattern of inheritance.

83. Figure B represents glandular epithelium cells, which are found in the intestinal lining where it has a secretory role.

84. Ribosomes are known as organelle within organelle because they are present within the mitochondria and chloroplasts which are cell organelles.

85. The first clinical gene therapy was given in 1990 to a 4-year-old girl with adenosine deaminase (ADA) deficiency.

86. Sacred grooves are a method of *in situ* conservation of biodiversity and conserving rare and threatened species.

87. Change in a single base pair of DNA is known as point mutation.

88. The gene gun method is a method of gene transfer without involving a vector and is used for gene transfer in plant cells.

89. In most angiosperms, the pollen grains are shed in the 2-celled stage, and further development of pollen grain occurs on the stigma, where it leads to the formation of the mature male gametophyte and participates in double fertilisation.

90. The figure represents the blastocyst stage. The blastocyst on reaching the uterus implants in the uterine wall.

Chemistry

91. It is square planar and not tetrahedral.

$NiCl_2 + DMG \rightarrow [Ni(dmg)_2]$

square planar

92. Configuration of O_2^- is

$\sigma(1s)^2\ \sigma^*(1s)^2\ \ \sigma(2s)^2\ \sigma^*(2s)^2\ \sigma(2p_z)^2\pi(2p_x)^2\pi(2p_y)^2\ \pi^*(2p_x)2\pi^*(2p_y)^1$

93. Nucleophilic addition–elimination reaction

94. As we move from the top to the bottom, the acidic nature increases, so K_a is high and pK_a is low.

95.

$\Delta G^\circ = -nFE^\circ$

$960 \times 1000 = -4 \times 96500 \times E^\circ$

$E^\circ = -2.48V = 2.5\,V$

96.

$$2SO_2 + O_2 \rightleftharpoons 2SO_3 \quad k = 278$$

$$SO_3 \rightleftharpoons SO_2 + 1/2O_2 \quad k' = 1/k$$

$$k' = \left(\frac{1}{k}\right)^{1/2} = \left(\frac{1}{278}\right)^{1/2} = 6 \times 10^{-2}$$

97. Glycol can be used as antifreeze in automobile radiators.

98. $CH_3COONa + HCl \rightarrow NaCl + CH_3COOH$

$91 + 425.9 = 126.4 + x$

$\therefore x = 390.5\ ohm^{-1}\ cm^2\ mol^{-1}$

99. Bonus question

$$n_{CHCl_3} = \frac{119.5}{25.5} = 0.213$$

$$n_{CH_2Cl_2} = \frac{85}{40} = 0.47$$

$$P_T = P°_A X_A + P°_B X_B$$

$$= 200 \times \frac{0.213}{0.683} + 41.5 \times \frac{0.47}{8.683}$$

$$= 62.37 + 28.55$$

$$= 90.92$$

100.

$$\text{We know } r \alpha \sqrt{\frac{1}{M}}$$

$$\frac{r_2}{r_1} = \sqrt{\frac{M_2}{M_1}}$$

$$\frac{\left(\frac{V_g}{3t}\right)}{\left(\frac{V_{He}}{t}\right)} = \sqrt{\frac{4}{M}}$$

$$\frac{1}{9} = \frac{4}{M}$$

$$M = 36 \text{g/mole}$$

101. Nylon-2-Nylon-6 is a biodegradable polymer obtained from glycine and aminocaproic acid.

102. The catalytic activity of transition metals and their compounds is ascribed mainly to their ability to adopt variable oxidation state.
Example: V_2O_5 is a catalyst used in the contact process.

103.

$$A_{2(g)} + B_{2(g)} \rightleftharpoons 2AB_{(g)}$$

$$Kc = \frac{[AB]_2}{[A_2][B_2]} = \frac{2.8 \times 2.8 \times 10^{-6}}{3 \times 10^{-3} \times 4.2 \times 10^{-3}} = 0.62$$

104. The strongest oxidising and reducing agents, respectively, are F_2 and I^-.

105. $\underset{0.5}{He_2^+} < \underset{1.5}{O_2^-} < \underset{2.5}{NO} < \underset{3.0}{C_2^{2-}}$

106. $d^6 - t_{2g}^6 e_g^0$

C.F.SE $= -0.4 \times 6\Delta_0 + 3P$

$= -\frac{12}{5}\Delta_0 + 3P$

107. 2-hydroxypropane gives a yellow precipitate of iodoform with iodine and alkali.

108.

Orbital angular momentum $= \frac{h}{2\Pi}\sqrt{\ell(\ell+1)}$

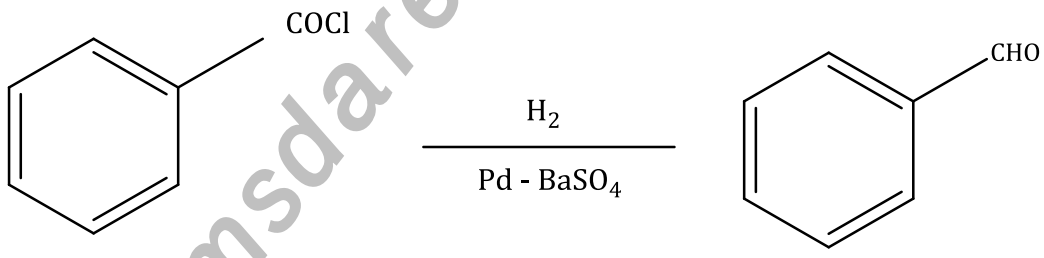
Since $\ell = 1$

So orbital angular momentum $= \frac{h}{2\Pi}\sqrt{1(1+1)} = \frac{h}{\sqrt{2}\Pi}$

109. As we move along the 3d series, the melting point increases up to Cr and then decreases.

110. Chloramphenicol is a broad spectrum antibiotic.

111.



112. $CH_3CH_2C \equiv CH \xrightarrow{NaNH_2} CH_3CH_2C \equiv CNa + 1/2\ H_2 \uparrow$

$CH_3{-}C{\equiv}C{-}CH_3 \xrightarrow{NaNH_2}$ No reaction

113. Sequence of van der Waals constant (a)

$H_2 < He < O_2 < CO_2$

Value 0.244 0.34 1.36 3.54

Sequence of van der Waals constant (b)

$CH_4 > O_2 > H_2$

Value 0.042 0.031 0.026

114. According to Arrhenius equation,

$$\ln \frac{k_2}{k_1} = -\frac{E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

115. Actinium is the only metal with stable oxidation state +3.

Electronic configuration = [Rn] $6d^1 7s^2$

116. For monoatomic gases, $\frac{C_p}{C_v} = \gamma = 1.67$

117.

For AB_2O_2

$$A^{+2} = \frac{1}{4} \times 8 = 2$$

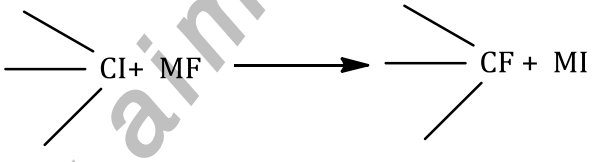
$$B^{+} = 4 \times 1 = 4$$

$$O^{2-} = 8 \times \frac{1}{8} + 6 \times \frac{1}{2} = 4$$

118. Only copper has positive $E^0_{R.P.}$

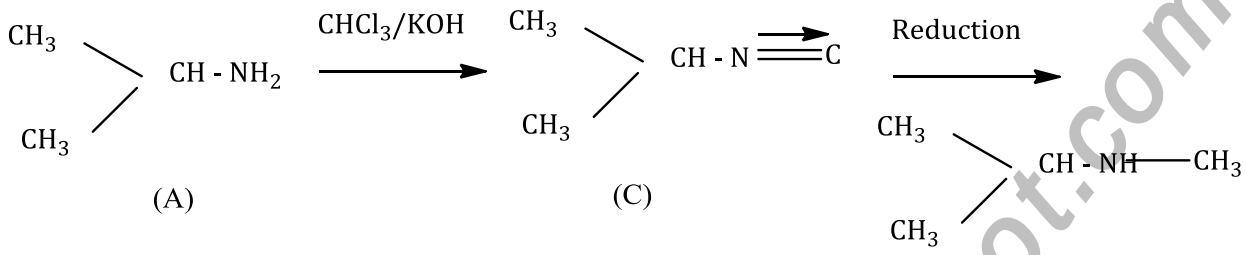
$E^0_{Cu+2/Cu} = 0.34$ volt

119.



Because the lattice energy of RbF is less than LiF, NaF and KF, the reaction will be faster with Rb.

120.



(A) (C)

AIPMT - 2012
(Physics, Chemistry and Biology)
Prelims (Code D)

Time: 3 hrs **Total Marks: 800**

General Instructions:

1. The Answer sheet is inside this Text booklet. When you are directed to open the text booklet, take out the Answer Sheet and fill in the particulars on side – 1 and side – 2 carefully with blue/black ball point pen only.
2. The test is of 3 hours duration and consists of 200 questions. Each question carries 3 marks. For each correct response the candidate will get 4 marks. For each incorrect response, one mark will be deducted. The maximum marks are 800.
3. Use Blue / Black ball point pen only for writing particulars on this page / marking responses.
4. Rough work is to be done on the space provided for this purpose in the text booklet only.
5. On completion of the test, the candidate must handover the answer sheet to the invigilator in the room/ Hall. The candidates are allowed to take away this text booklet with them.
6. Make sure that the CODE printed on side – 2 of the answer sheet is the same as that on this booklet, In case of discrepancy, the candidate should immediately report the matter to the invigilator for the replacement of both the test Booklet and the Answer Sheet.
7. The candidates should ensure that the Answer sheet is not folded. Do not make any stray marks on the Answer sheet. Do not write your roll no. anywhere else except in the specified space in the Test booklet / Answer Sheet.
8. Use of white fluid for correction is not permissible on the Answer Sheet.

Physics

1. Electron in hydrogen atom first jumps from third excited state to second excited state and then from second excited to the first excited state. The ratio of the wavelength $\lambda_1 : \lambda_2$ emitted in the two cases is

(1) 7/5
(2) 27/20
(3) 27/5
(4) 20/7

2. When a string is divided into three segments of length ℓ_1, ℓ_2 and ℓ_3 the fundamental frequencies of these three segments are ν_1, ν_2 and ν_3 respectively. The original fundamental frequency (ν) of the string is

(1) $\sqrt{\nu}=\sqrt{\nu_1}+\sqrt{\nu_2}+\sqrt{\nu_3}$

(2) $\nu = \nu_1 + \nu_2 + \nu_3$

(3) $\frac{1}{\nu}=\frac{1}{\nu_1}+\frac{1}{\nu_2}+\frac{1}{\nu_3}$

(4) $\frac{1}{\sqrt{\nu}}=\frac{1}{\sqrt{\nu_1}}+\frac{1}{\sqrt{\nu_2}}+\frac{1}{\sqrt{\nu_3}}$

3. A 200 W sodium street lamp emits yellow light of wavelength 0.6 μm. Assuming it to be 25% efficient in converting electrical energy to light, the number of photons of yellow light it emits per second is

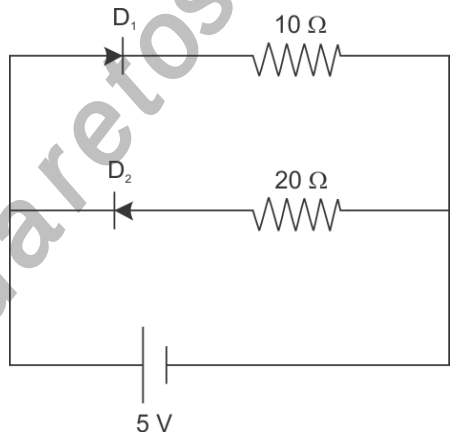
(1) 1.5×10^{20}

(2) 6×10^{18}

(3) 62×10^{20}

(4) 3×10^{19}

4. Two ideal diodes are connected to a battery as shown in the circuit. The current supplied by the battery is:



(1) 0.75 A

(2) zero

(3) 0.25 A

(4) 0.5 A

5. When a mass is rotating in a plane about a fixed point, its angular momentum is directed along:

(1) the line perpendicular to the plane of rotation

(2) the line making an angle of 45° to the plane of rotation

(3) the radius

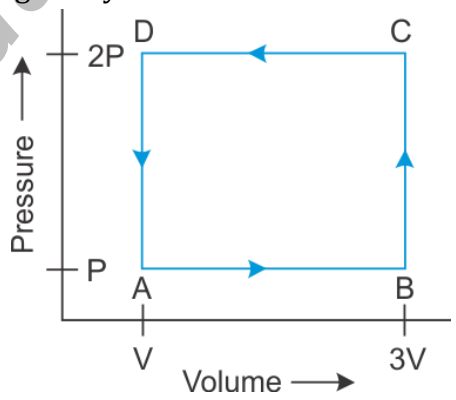
(4) the tangent to the orbit

6. An electric dipole of moment ´p´ is placed in an electric field of intensity ´E´. The dipole acquires a position such that the axis of the dipole makes an angle θ with the direction of the field. Assuming that the potential energy of the dipole to be zero when θ = 90°, the torque and the potential energy of the dipole will respectively be:
(1) p E sinθ, - p E cosθ
(2) p E sinθ, - 2 p E cosθ
(3) p E sinθ, - 2 p E cosθ
(4) p E cosθ, - p E cosθ

7. In a CE transistor amplifier, the audio signal voltage across the collector resistance of 2 kΩ is 2 V. If the base resistance is 1 kΩ and the current amplification of the transistor is 100, the input signal voltage is:
(1) 0.1 V
(2) 1.0 V
(3) 1 mV
(4) 10 mV

8. A coil of resistance 400 Ω is placed in a magnetic field. If the magnetic flux ϕ (wb) linked with the coil varies with time t (sec) as $\phi = 50t^2 + 4$. The current in the coil at t = 2 sec is:
(1) 0.5A
(2) 0.1 A
(3) 2 A
(4) 1 A

9. A thermodynamic system is taken through the cycle ABCD as shown in figure. Heat rejected by the gas during the cycle is:



(1) 2 PV
(2) 4 PV
(3) $\frac{1}{2}$PV
(4) PV

10. If the nuclear radius of ^{27}Al is 3.6 fermi, the approximate nuclear radius of ^{64}Cu in fermi is:
(1) 2.4
(2) 1.2
(3) 4.8
(4) 3.6

11. Two similar coils of radius R are lying concentrically with their planes at right angles to each other. The currents flowing in them are I and 2 I, respectively. The resultant magnetic field induction at the centre will be:
(1) $\frac{\sqrt{5}\,\mu_0 I}{2R}$
(2) $\frac{3\mu_0 I}{2R}$
(3) $\frac{\mu_0 I}{2R}$
(4) $\frac{\mu_0 I}{R}$

12. The potential energy of particle in a force field is, $U=\frac{A}{r^2}-\frac{B}{r}$,
where A and B are positive constants and r is the distance of particle from the centre of the field. For stable equilibrium, the distance of the particle is:
(1) B / 2A
(2) 2A / B
(3) A / B
(4) B / A

13. When a biconvex lens of glass having refractive index 1.47 is dipped in a liquid, it acts as a plane sheet of glass. This implies that the liquid must have refractive index:
(1) equal to that of glass
(2) less than one
(3) greater than that of glass
(4) less than that of glass

14. The horizontal range and the maximum height of a projectile are equal. The angle of projection of the projectiles is:

(1) $\theta = \tan^{-1}\left(\frac{1}{4}\right)$

(2) $\theta = \tan^{-1}(4)$

(3) $\theta = \tan^{-1}(2)$

(4) $\theta = 45^{o}$

15. In an electrical circuit R, L, C and an a.c. voltage source are all connected in series. When L is removed from the circuit, the phase difference between the voltage and the current in the circuit is $\pi/3$. If instead, C is removed from the circuit, the phase difference is again $\pi/3$. The power factor of the circuit is:

(1) $\frac{1}{2}$

(2) $\frac{1}{\sqrt{2}}$

(3) 1

(4) $\frac{\sqrt{3}}{2}$

16. If the radius of a star is R and it acts as a black body, what would be the temperature of the star, in which the rate of energy production is Q?

(1) $Q/4\pi R^2\sigma$

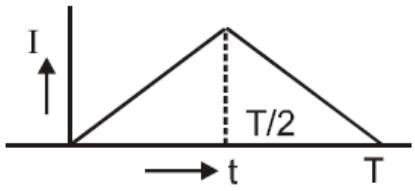
(2) $(Q/4\pi R^2\sigma)^{-1/2}$

(3) $(4\pi R^2 Q/\sigma)^{1/4}$

(4) $(Q/4\pi R^2\sigma)^{1/4}$

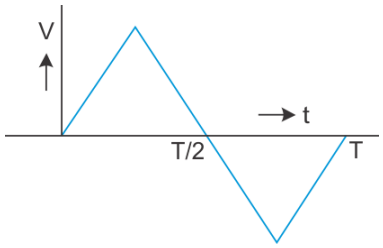
(σ stands for Stefan's constant)

17. The current (I) in the inductance is varying with time according to the plot shown in figure.

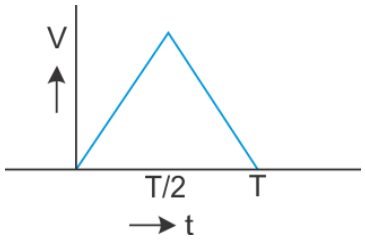


Which one of the following is the correct variation of voltage with time in the coil?

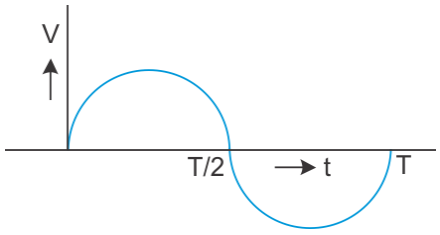
(1)



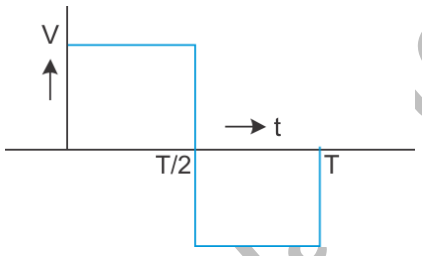
(2)



(3)



(4)



18. A milli voltmeter of 25 milli volt range is to be converted into an ammeter of 25 ampere range. The value (in ohm) of necessary shunt will be:

(1) 0.001
(2) 0.01
(3) 1
(4) 0.05

19. Two persons of masses 55 kg and 65 kg respectively, are at the opposite ends of a boat. The length of the boat is 3.0 m and weighs 100 kg. The 55 kg man walks up to the 65 kg man and sits with him. If the boat is in still water the centre of mass of the system shifts by:

(1) 3.0 m
(2) 2.3 m
(3) zero
(4) 0.75 m

20. A mixture consists of two radioactive materials A_1 and A_2 with half lives of 20 s and 10 s respectively. Initially the mixture has 40 g of A_1 and 160 g of A_2. The amount of the two in the mixture will become equal after:
(1) 60 s
(2) 80 s
(3) 20 s
(4) 40 s

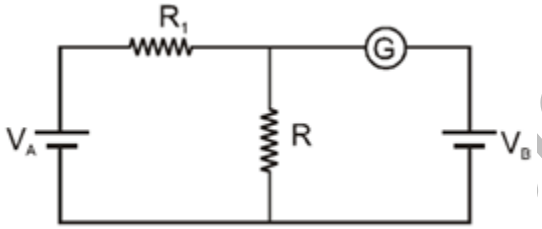
21. C and Si both have same lattice structure, having 4 bonding electrons in each. However, C is insulator where as Si is intrinsic semiconductor. This is because:
(1) In case of C the valence band is not completely filled at absolute zero temperature.
(2) In case of C the conduction band is partly filled even at absolute zero temperature.
(3) The four bonding electrons in the case of C lie in the second orbit, whereas in the case of Si they lie in the third.
(4) The four bonding electrons in the case of C lie in the third orbit, whereas for Si they lie in the fourth orbit.

22. The height at which the weight of a body becomes $1/16^{th}$, its weight on the surface of Earth (radius R), is:
(1) 5R
(2) 15R
(3) 3R
(4) 4R

23. An electron of a stationary hydrogen atom passes from the fifth energy level to the ground level. The velocity that the atom acquired as a result of photon emission will be:
(1) $\frac{24hR}{25m}$
(2) $\frac{25hR}{24m}$
(3) $\frac{25m}{24hR}$
(4) $\frac{24m}{25hR}$
(m is the mass of the electron, R is the Rydberg constant and h is the Planck's constant)

24. A compass needle which is allowed to move in a horizontal plane is taken to a geomagnetic pole. It:
(1) will become rigid showing no movement
(2) will stay in any position
(3) will stay in north-south direction only
(4) will stay in east-west direction only

25. In the circuit shown the cells A and B have negligible resistances. For $V_A = 12$ V, $R_1 = 500\ \Omega$ and $R = 100\ \Omega$ the galvanometer (G) shows no deflection. The value of V_B is:



(1) 4 V
(2) 2 V
(3) 12 V
(4) 6 V

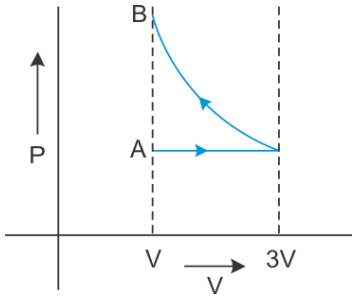
26. Four point charges - Q, -q, 2q and 2Q are placed, one at each corner of the square. The relation between Q and q for which the potential at the centre of the square is zero is:
(1) Q = -q
(2) $Q=-\frac{1}{q}$
(3) Q = q
(4) $Q = \frac{1}{q}$

27. A car of mass 1000 kg negotiates a banked curve of radius 90 m on a frictionless road. If the banking angle is 45°, the speed of the car is:
(1) 20 ms^{-1}
(2) 30 ms^{-1}
(3) 5 ms^{-1}
(4) 10 ms^{-1}

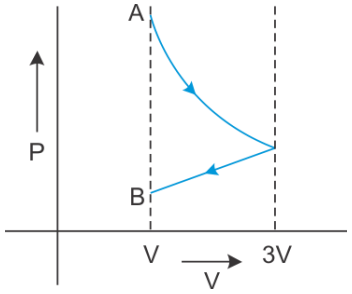
28. A solid cylinder of mass 3 kg is rolling on a horizontal surface with velocity 4ms^{-1}. It collides with a horizontal spring of force constant 200 Nm^{-1}. The maximum compression produced in the spring will be:
(1) 0.5 m
(2) 0.6 m
(3) 0.7 m
(4) 0.2 m

29. One mole of an ideal gas goes from an initial state A to final state B via two processes: It first undergoes isothermal expansion from volume V to 3V and then its volume is reduced from 3V to V at constant pressure. The correct P-V diagram representing the two processes is :

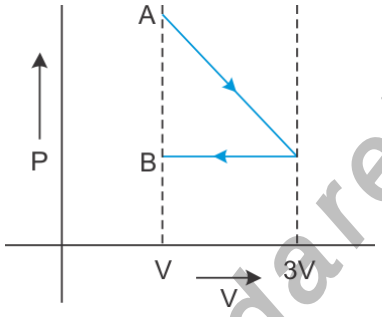
(1)



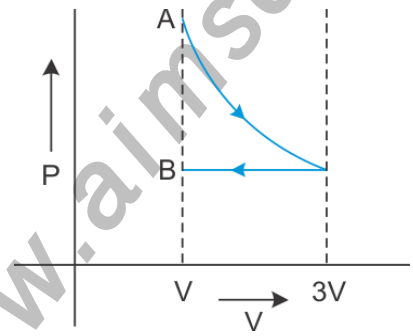
(2)



(3)



(4)



30. Two spheres A and B of masses m_1 and m_2 respectively collide. A is at rest initially and B is moving with velocity v along x-axis. After collision B has a velocity v/2 in a direction perpendicular to the original direction. The mass A moves after collision in the direction:

(1) same as that of B

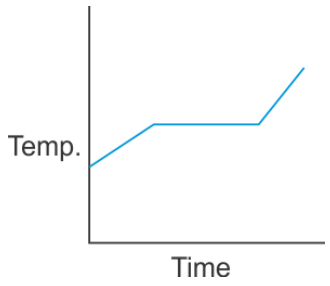
(2) Opposite to that of B

(3) $\theta = \tan^{-1}(1/2)$ to the x-axis

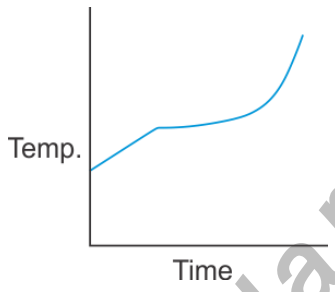
(4) $\theta = \tan^{-1}(-1/2)$ to the x-axis

31. Liquid oxygen at 50 K is heated to 300 K at constant pressure of 1 atm. The rate of heating is constant. Which one of the following graphs represents the variation of temperature with time?

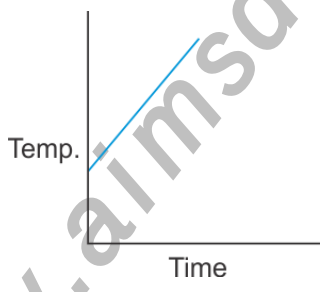
(1)



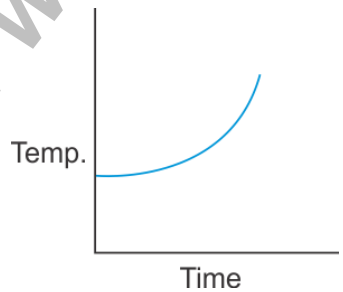
(2)



(3)



(4)



32. An alternating electric field of frequency ν, is applied across the dees (radius = R) of a cyclotron that is being used to accelerate protons (mass = m). The operating magnetic field (B) used in the cyclotron and the kinetic energy (K) of the proton beam produced by it, are given by:

(1) $B = \frac{m\nu}{e}$ and $K = 2m\pi^2\nu^2R^2$

(2) $B = \frac{2\pi m\nu}{e}$ and $K = m^2\pi\nu R^2$

(3) $B = \frac{2\pi m\nu}{e}$ and $K = 2m\pi^2\nu^2R^2$

(4) $B = \frac{m\nu}{e}$ and $K = m\pi\nu R^2$

33. A spherical planet has a mass M_P and diameter D_P. A particle of mass m falling freely near the surface of this planet will experience an acceleration due to gravity, equal to:

(1) $4GMp/D_p^2$

(2) GM_pm/D_p^2

(3) GM_p/D_p^2

(4) $4GM_pm/D_p^2$

34. A ray of light is incident at an angle of incidence i, on one face of prism of angle A (assumed to be small) and emerges normally from the opposite face. If the refractive index of the prism is μ, the angle of incidence i is nearly equal to:

(1) μA

(2) $\frac{\mu A}{2}$

(3) $\frac{A}{\mu}$

(4) $\frac{A}{2\mu}$

35. The damping force on an oscillator is directly proportional to the velocity. The units of the constant of proportionality are:

(1) $Kgms^{-1}$

(2) $Kgms^{-2}$

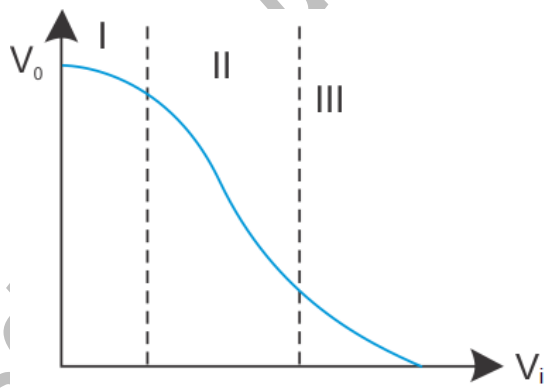
(3) Kgs^{-1}

(4) kgs

36. A concave mirror of focal length 'f_1' is placed at a distance of 'd' from a convex lens of focal length 'f_2'. A beam of light coming from infinity and falling on this convex lens – concave mirror combination returns to infinity. The distance 'd' must equal:
(1) $f_1 + f_2$
(2) $-f_1+f_2$
(3) $2f_1+f_2$
(4) $-2f_1+f_2$

37. A geostationary satellite is orbiting the Earth at a height of 5R above that surface of the Earth, R being the radius of the Earth. The time period of another satellite in hours at a height of 2R from the surface of the Earth is:
(1) 5
(2) 10
(3) $6\sqrt{2}$
(4) $\frac{6}{\sqrt{2}}$

38. Transfer characteristics [output voltage (V_0) vs input voltage (V_i)] for a base biased transistor in CE configuration is as shown in the figure. For using transistor as a switch, it is used:



(1) In region III
(2) Both in region (I) and (III)
(3) In region II
(4) In region I

39. If voltage across a bulb rated 220 volt – 100 watt drops by 2.5% of its rated value, the percentage of the rated value by which the power would decrease is:
(1) 20%
(2) 2.5%
(3) 5%
(4) 10 %

40. A particle has initial velocity $\left(2\vec{i}+3\vec{j}\right)$ and acceleration $\left(0.3\vec{i}+0.2\vec{j}\right)$. The magnitude of velocity after 10 seconds will be:

(1) $9\sqrt{2}$ units

(2) $5\sqrt{2}$ units

(3) 5 Units

(4) 9 Units

41. Monochromatic radiation emitted when electron on hydrogen atom jumps from first excited state to the ground state irradiates a photosensitive material. The stopping potential is measured to be 3.57 V. The threshold frequency of the materials is:

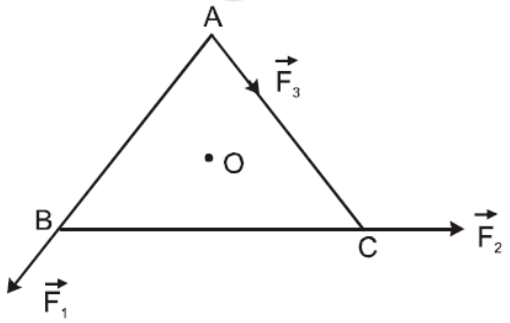
(1) 4×10^{15}Hz

(2) 5×10^{15} Hz

(3) 1.6×10^{15}Hz

(4) 2.5×10^{15} Hz

42. ABC is an equilateral triangle with O as its centre. $\vec{F}_1, \vec{F}_2$ and $\vec{F}_3$ represents three forces acting along the sides AB, BC and AC respectively. If the total torque about O is zero the magnitude of $\vec{F}_3$ is:



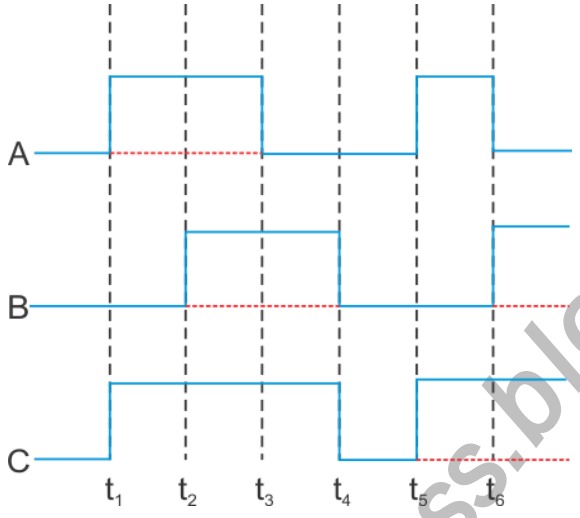
(1) F_1+F_2

(2) F_1-F_2

(3) $\frac{F_1+F_2}{2}$

(4) $2\ (F_1+F_2)$

43. The figure shows a logic circuit with two inputs A and B and the output C. The voltage wave forms across A, B and C are as given. The logic circuit gate is:



(1) OR gate
(2) NOR gate
(3) AND gate
(4) NAND gate

44. What is the flux through a cube of side 'a' if a point charge of q is at one of its corner?

(1) $\frac{2q}{\varepsilon_0}$

(2) $\frac{q}{8\varepsilon_0}$

(3) $\frac{q}{\varepsilon_0}$

(4) $\frac{q}{2\varepsilon_0}6a^2$

45. An α - particle moves in a circular path of radius 0.83 cm in the presence of a magnetic field of 0.25 Wb/m^2. The de Broglie wavelength associated with the particle will be:

(1) 1 Å
(2) 0.1 Å
(3) 10 Å
(4) 0.01 Å

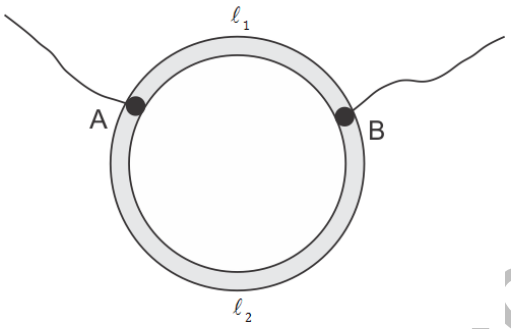
46. The electric field associated with an e.m. wave in vacuum is given by $\vec{E} = \hat{i} \cos (kz - 6 \times 10^8 40 i$, where E, z and t are in volt/m, meter and seconds respectively. The value of wave vector k is:
(1) $2m^{-1}$
(2) $0.5\ m^{-1}$
(3) (3)$6\ m^{-1}$
(4) (4)$3\ m^{-1}$

47. The motion of a particle along a straight line is described by equation : $x = 8 + 12\ t - t^3$ Where x is in metre and t in second. The retardation of the particle when its velocity becomes zero, is:
(1) $24\ ms^{-2}$
(2) Zero
(3) $6\ ms^{-2}$
(4) $12\ ms^{-2}$

48. The magnifying power of a telescope is 9. When it is adjusted for parallel rays the distance between the objective and eyepiece is 20 cm. The focal length of lenses are:
(1) 10 cm, 10 cm
(2) 15 cm, 5 cm
(3) 18 cm, 2 cm
(4) 11 cm, 9 cm

49. Two sources of sound placed close to each other are emitting progressive waves given by $y_1 = 4 \sin 600\ \pi t$ and $y_2 = 5 \sin 608\ \pi t$. An observer located near these two sources of sound will hear:
(1) 4 beats per second with intensity ratio 25: 16 between waxing and waning.
(2) 8 beats per second with intensity ratio 25 : 16 between waxing and waning
(3) 8 beats per second with intensity ratio 81 : 1 between waxing and waning
(4) 4 beats per second with intensity ratio 81 : 1 between waxing and waning

50. A ring is made of a wire having a resistance $R_0 = 12\,\Omega$. Find the points A and B as shown in the figure, at which a current carrying conductor should be connected so that the resistance R of the sub circuit between these points is equal to $\frac{8}{3}\Omega$.



(1) $\frac{\ell_1}{\ell_2} = \frac{5}{8}$

(2) $\frac{\ell_1}{\ell_2} = \frac{1}{3}$

(3) $\frac{\ell_1}{\ell_2} = \frac{3}{8}$

(4) $\frac{\ell_1}{\ell_2} = \frac{1}{2}$

Biology

51. Motile zygote of Plasmodium occurs in :
(1) Gut of female Anolpheles
(2) Salivary glands of Anopheles
(3) Human RBCs
(4) Human liver

52. The human hind brain comprises three parts, one of which is :
(1) Spinal cord
(2) Corpus callosum
(3) Cerebellum
(4) Hypothalamus

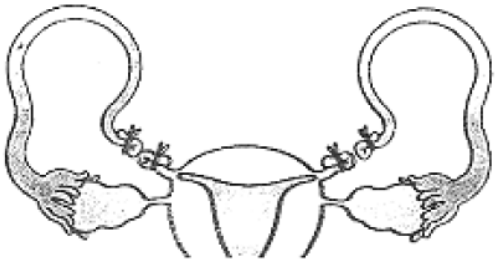
53. Which part of the human ear plays no role in hearing as such but is otherwise very much required ?
(1) Eustachian tube
(2) Organ of corti
(3) Vestibular apparatus
(4) Ear ossicles

54. The most abundant prokaryotes helpful to humans in making curd from milk and in production of antibiotics are the ones categorised as :
(1) Cyanobacteria
(2) Archaebacteria
(3) Chemosynthetic autotrophs
(4) Heterotrophic bacteria

55. Which on of the following statements is false in respect of viability of mamalian sperm?
(1) Sperm is viable for only up to 24 hours.
(2) Survival of sperm depends on the pH of themedium and is more active in alkalinemedium.
(3) Viability of sperm is determined by its motility.
(4) Sperms must be concentrated in a thick suspension

56. Evolution of different species in a given area starting from a point and spreading to other geographical areas is known as :
(1) Adaptive radiation
(2) Natural selection
(3) Migration
(4) Divergent evolution

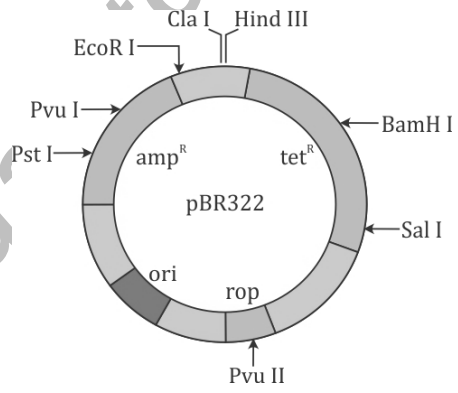
57. What is the figure given below showing in particular?



(1) Ovarian cancer
(2) Uterine cancer
(3) Tubectomy
(4) Vasectomy

58. In an area where DDT had been used extensively, the population of birds declined significantly because:
(1) birds stopped laying eggs
(2) earthy worms in the area got eradicated
(3) cobras were feeding exclusively on birds
(4) many of the birds laid, did not hatch

59. The figure below is the diagrammatic representation of the E.Coli vector pBR 322. Which one of the given options correctly identifies its certain component (s)?



(1) ori - orignal restriction enzyme
(2) rop-reduced osmotic pressure
(3) Hind III, EcoRI - selectablemarkers
(4) ampR, tetR - antibiotic resistance genes

60. The common bottle cork is a product of :
(1) Dermatogen
(2) Phellogen
(3) Xylem
(4) Vascular Cambium

61. Widal Test is carried out to test :
(1) Malaria
(2) Diabetes mellitus
(3) HIV/AIDS
(4) Typhoid fever

62. Which part would be most suitable for raising virus-free plants for micropropagation?
(1) Bark
(2) Vascular tissue
(3) Meristem
(4) Node

63. Which one of the following is a wrong statment ?
(1) Most of the forests have been lost in tropical areas.
(2) Ozone in upper part of atmosphere is harmful to animals.
(3) Greenhouse effect is a natural phenomenon.
(4) Eutrophication is a natural phenomenon in freshwater bodies.

64. Companion cells are closely associated with :
(1) Sieve elements
(2) Vessel elements
(3) Trichomes
(4) Guard cells

65. Common cold differs from pneumonia in, that :
(1) Pneumonia is a communicable disease whereas the common cold is a nutritional deficiency disease.
(2) Pneumonia can be prevented by a live attenuated bacterial vaccine whereas the common cold has noeffective vaccine.
(3) Pneumonia is caused by a virus while the common cold is caused by the bacterium Haemophilus influenzae.
(4) Pneumonia pathogen infects alveoli whereas the common cold affects nose and respiratory passage but not the lungs.

66. Pheretima and its close relatives derive nourishment from :
(1) sugarcane roots
(2) decaying fallen leaves and soil organic matter.
(3) soil insects
(4) small pieces of fresh fallen leaves of maize, etc.

67. Removal of RNA polymerase III from nucleoplasm will affect the synthesis of :
(1) t RNA
(2) hn RNA
(3) m RNA
(4) r RNA

68. A process that makes important difference between C3 and C4 plants is :
(1) Transpiration
(2) Glycolysis
(3) Photosynthesis
(4) Photorespiration

69. PCR and Restriction Fragment Length Polymorphism are the methods for :
(1) Study of enzymes
(2) Genetic transformation
(3) DNA sequencing
(4) Genetic Fingerprinting

70. Best defined function of Manganese in green plants is :
(1) Photolysis of water
(2) Calvin cycle
(3) Nitrogen fixation
(4) Water absorption

71. Measuring Biochemical Oxygen Demand (BOD) is a method used for :
(1) estimating the amount of organic matter in sewage water.
(2) working out the efficiency of oil driven automobile engines.
(3) measuring the activity of Saccharomyces cerevisae in producing curd on a commercial scale.
(4) working out the efficiency of R.B.Cs. about their capacity to carry oxygen

72. Which one -of the following is not a part of a transcription unit in DNA ?
(1) The inducer
(2) Aterminator
(3) Apromoter
(4) The structural gene

73. A certain road accident patient with unknown blood group needs immediate blood transfusion. His one doctor friend at once offers his blood. What was the blood group of the donor?
(1) Blood group B
(2) Blood group AB
(3) Blood group O
(4) Blood group A

74. Consumption of which one of the following foods can prevent the kind of blindness associated with vitamin'A' deficiency?
(1) Flaver Savr' tomato
(2) Canolla
(3) Golden rice
(4) Bt-Brinjal

75. The maximum amount of electrolytes and water (70 - 80 percent) fromthe glomerular filtrate is reabsorbed in which part of the nephron?
(1) Ascending limb of loop of Henle
(2) Distal convoluted tubule
(3) Proximal convoluted tubule
(4) Descending limb of loop of Henle

76. Both, autogamy and geitonogamy are prevented in -
(1) Papaya
(2) Cucumber
(3) Castor
(4) Maize

77. Placentation in tomato and lemon is
(1) Parietal
(2) Free central
(3) Marginal
(4) Axile

78. A person entering an empty room suddenly finds a snake right in front on opening the door. Which one of the following is likely to happen in his neuro-hormonal control system?
(1) Sympathetic nervous system is activated releasing epinephrin and norepinephrin from adrenalmedulla.
(2) Neurotransmitters diffuse rapidly across the cleft and transmit a nerve impulse.
(3) Hypothalamus activates the parasympathetic division of brain.
(4) Sympathetic nervous system is activated releasing epinephrin and norepinephrin from adrenal cortex.

79. Which one of the following is not a gaseous biogeochemical cycle in ecosystem ?
(1) Sulphur cycle
(2) Phosphorus cycle
(3) Nitrogen cycle
(4) Carbon cycle

80. A single strand of nucleic acid tagged with a radioactive molecule is called :
(1) Vector
(2) Selectable marker
(3) Plasmid
(4) Probe

81. Which one of the following options gives one correct example each of convergent evolution and divergent evolution?

	Convergent evolution		Divergent evolution
(1)	Eyes of octopus and mammals		Bones of forelimbs of vertebrates
(2)	Thorns of Bougainvillia and tendrils of Cucurbita		Wings of butterflies and birds
(3)	Bones of forelimbs of vertebrates		Wings of butterfly and birds
(4)	Thorns of Bougainvillia and tendrils Cucurbita		Eyes of Octopus and mammals

82. An organic substance that can withstand environmental extremes and cannot be degraded by any enzyme is :
(1) Cuticle
(2) Sporopollenin
(3) Lignin
(4) Cellulose

83. Cycas andAdiantum resemble each other in having:
(1) Seeds
(2) Motile Sperms
(3) Cambium
(4) Vessels

84. What was the most significant trend in the evolution of modern man (Homo sapiens) from his ancestors?
(1) Shortening of jaws
(2) Binocular vision
(3) Increasing cranial capacity
(4) Upright posture

85. Cymose inflorescence is present in :
(1) Solanurn
(2) Sesbania
(3) Trifolium
(4) Brassica

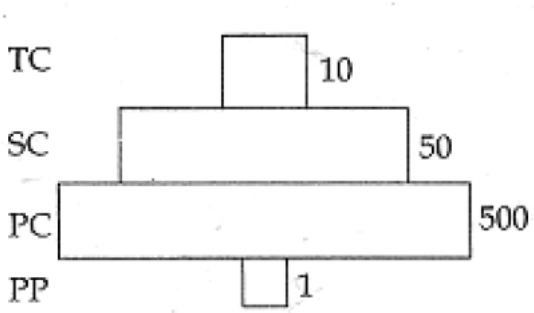
86. Ribosomal RNA is actively synthesized in
(1) Lysosomes
(2) Nucleolus
(3) Nucleoplasm
(4) Ribosomes

87. During gamete formation, the enzyme recombinase participates during
(1) Metaphase - I
(2) Anaphase - II
(3) Prophase - I
(4) Prophase – II

88. Identify the possible link "A" in the following food chain :
Plant $\rightarrow$ insect $\rightarrow$ frog $\rightarrow$ "A" $\rightarrow$ Eagle
(1) Rabbit
(2) Wolf
(3) Cobra
(4) Parrot

89. Phyllode is present in :
(1) Asparagus
(2) Euphorbia
(3) AustralianAcacia
(4) Opuntia

90. Given below is an imaginary pyramid of numbers. What could be one of the possibilities about certain organisms at some of the different levels?



(1) Level PC is "insects" and level SC is "small insectivorous birds".
(2) Level PP is "phytoplanktons" in sea and "Whale" on top level TC
(3) Level one PP is "pipal trees" and the level SC is "sheep".
(4) Level PC is "rats" and level SC is "cats".

91. Monascus purpureus is a yeast used commercially in the production of :
(1) ethanol
(2) streptokinase for removing clots from the blood vessels.
(3) Citric acid
(4) blood cholesterol lowering statins

92. The correct sequence of cell organelles during photorespiration is :
(1) Chloroplast,-Golgibodies,-mitochondria
(2) Chloroplast,-RoughEndoplasmic reticulum, Dictyosomes
(3) Chloroplast,-mitochondria,-peroxisome
(4) Chloroplast,-vacuole,-peroxisome

93. Which one of the following is correctly matched ?
(1) Passive transport of nutrients -ATP
(2) Apoplast - Plasmodesmata
(3) Potassium - Readily immobilisation
(4) Bakane of rice seedlings - F. Skoog

94. A normal– visioned man whose father was colour– blind, marries a woman whose father was also colour– blind. They have their first child as a daughter. what are the chance that this child would be colour– blind ?
(1) 100%
(2) zero percent
(3) 25%
(4) 50 %

95. Signals for parturition originate from :
(1) Both placenta as well as fully developed foetus
(2) Oxytocin released from maternal pituitary
(3) Placenta only
(4) Fully developed foetus only

96. A patient brought to a hospital with myocardial infarction is normally immediately given :
(1) Penicillin
(2) Streptokinase
(3) Cyclosporin-A
(4) Statins

97. Which one of the following is not a property of cancerous cells whereas the remaining three are?
(1) They compete with normal cells for vital nutrients.
(2) They do not remain confined in the area of formation.
(3) They divide in an uncontrolledmanner
(4) They show contact inhibition.

98. The gynoecium consists of many free pistils in flowers of
(1) Aloe
(2) Tomato
(3) Papaver
(4) Michelia

99. Which one of the following is not a functional unit of an ecosystem
(1) Energy flow
(2) Decomposition
(3) Productivity
(4) Stratification

100. In a normal pregnant woman, the amount of total gonadotropin activity was assessed. The result expected was
(1) High level of circulating FSH and LH in the uterus to stimulate implantation of the embyro
(2) High level of circulatting HCG to stimulate endometrial thickening
(3) High level of FSH and LH in uterus to stimulate endometrical thickening
(4) High level of circulating HCG to stimulate estrogen and progesterone synthesis

101. Which one of the following areas in India, is a hotspot of biodiversity
(1) Eastern Ghats
(2) Gangetic Plain
(3) Sunderbans
(4) Western Ghats

102. Which one of the follwing is a correct statement
(1) Pteridophyte gametophyte has a protonemal and leafy stage
(2) In gymnosperms female gametophyte is free-living
(3) Antheridiophores and archegoniophores are present in pteridophytes.
(4) Origin of seed habit can be traced in pteridophytes

103. Which one of the following does not differ in E.coli and Chlamydomonas
(1) Ribosomes
(2) ChromosomalOrganization
(3) Cell wall
(4) Cellmembrane

104. The cycanobacteria are also referred to as
(1) proists
(2) golden algae
(3) Slime moulds
(4) blue green algae

105. The test-tube BabyProgramme employs which one of the following techniques
(1) Intra cytoplasmic sperm injection (ICSI)
(2) Intra uterine insemination (IUI)
(3) Gamete intra fallopian transfer (GIET)
(4) Zygote intra fallopian transfer (ZIFT)

106. Which one of the following is a case of wrong matching
(1) Somatic hybridization - Fusion of two diverse cells
(2) Vector DNA -Site for t-RNA synthesis.
(3) Micropropagation - In vitro production of plants in large numbers.
(4) Callus - Unorganised mass of cell produced in tissue culture

107. The highest number of species in the world is represented by
(1) Fungi
(2) Mosses
(3) Algae
(4) Lichens

108. In which one of the following options the two examples are correctly matched with their particular type of immunity

	Examples	Type of immunity
(1)	Polymorphonuclear leukocytes and mono cytes	Cellular barriers
(2)	Anti-tetanus and anti – snake bite injection	Active immunity
(3)	Saliva in mouth and Tears in eyes	Physical barriers
(4)	Mucus coating of epithelium lining the urnogenital tract and the HCl in stomach	Pysiological barriers

109. Which one of the following is wrong statement
(1) Anabaena and Nostoc are capable of fixing nitrogen in free living state also.
(2) Root nodule forming nitrogen fixers live as aerobes under free-living conditions.
(3) Phosphorus is a constituent of cell membranes, certain nucleic acids and cell proteins.
(4) Nitrosomonas ans Nitrobacter are chemoautotrophs.

110. Anxiety and eating spicy food together in an otherwise normal human, may lead to
(1) Indigestion
(2) Jaundice
(3) Diarrhoea
(4) Vomiting

111. The Leydig cells found in the human body are the secretory source of
(1) Progesterone
(2) intestinal mucus
(3) glucagon
(4) androgens

112. Compared to those of humans, the erythrocytes in frog are
(1) Without nucleus but with haemoglobin
(2) nucleated and with haemoglobin
(3) verymuch smaller and fewer
(4) nucleated and without haemoglobin.

113. In which one of the following the genus name, its two charcters and its phylum are not correctly matched, whereas the remaining three are correct

	Genus name		**Two Characters**	**Phylum**
(1)	Pila	(a)	Body Semented	Mollusca
		(b)	Mouth with Radual	
(2)	Asterias	(a)	Spiny skinned	Echinoermata
		(b)	Water vascular system	
(3)	Sycon	(a)	Pore bearing	Porifera
		(b)	Canal system	
(4)	Periplaneta	(a)	Jointed appendages	Arthropoda
		(b)	Chitinous exoskeleton	

114. What is true about ribosomes
(1) The prodkaryotic ribosomes are 80S, where "S" stands for sedimentation coefficient
(2) These are composed of ribonucleic acid and proteins
(3) These are found only in eukaryotic cells
(4) These are self -splicing introns of some RNAs.

115. Cirrhosis of liver is caused by the chronic intake of
(1) Opium
(2) Alcohol
(3) Tobacco (Chewing)
(4) Cocaine

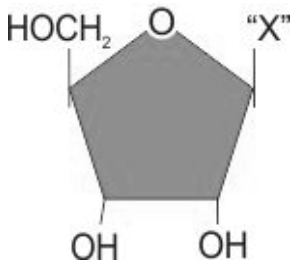
116. Which one is a true statement regarding DNA polymerase used in PCR
(1) It is used to ligate introduced DNA in recipient cell
(2) It serves as a selectable marker
(3) It is isolated from a virus
(4) It remains active at high temperature

117. Which statement is wrong for viruses
(1) All are parasites
(2) All of them have helical symmetry
(3) They have ability ot synthesize nucleic acids and proteins
(4) (4)Antibiotics have no effect on them

118. Which one of the following is correctlymatched
(1) Onion - Bulb
(2) Ginger - Sucker
(3) Chlamydomonas - Conidia
(4) Yeast - Zoospores

119. How many plants in the list given below have composite fruits that develop from an inflorescence
Walnut, poppy, radish, fig, pineapple, apple, tomato, mulberry
(1) Four
(2) Five
(3) Two
(4) Three

120. Given below is the diagrammatic representation of one of the categories of small molecular weight organic compounds in the living tissues. Identify the category shown and the one blank component "X" in it.



	Category	Component
(1)	Cholesterol	Guanin
(2)	Amino acid	NH2
(3)	Nucleotide	Adenine
(4)	Nucleoside	Uracil

121. Which one of the following microbes forms symbiotic association with plants and helps them in their nutrition?
(1) Azotobacter
(2) Aspergillus
(3) Glomus
(4) Trichoderma

122. The extinct human who lived 1,00,000 to 40,000 years ago, in Europe, Asia and parts of Africa, with short stature, heavy eyebrows, retreating fore haeds, large jaws with heavy teeth, stocky bodies, a lumbering gait and stooped posture was
(1) Hamo habilis
(2) Neanderthal human
(3) Cro-magnan humans
(4) Ramapithecus

123. If one strand of DNA has the nitrogenous base sequence at ATCTG, what would be the complementary RNA strand sequence
(1) TTAGU
(2) UAGAC
(3) AACTG
(4) ATCGU

124. Which one of the following pairs of hormones are the examples of those that can easily pass through the cell membrane of the target cell and bind to a receptor inside it (Mostly in the nucleus)
(1) Insulin, glucagon
(2) Thyroxin, insulin
(3) Somatostain, oxytocin
(4) Cortisol, testosterone

125. Nuclear mebrane is absent in
(1) Penicillium
(2) Agaricus
(3) Volvox
(4) Nostoc

126. Which one is the most abundant protein in the animal world
(1) Trypsin
(2) Hemoglobin
(3) Collagen
(4) Insulin

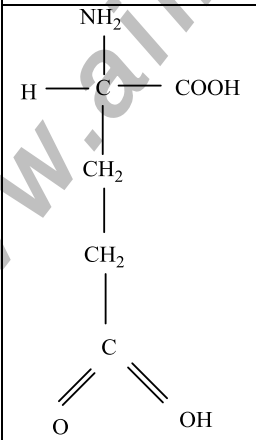
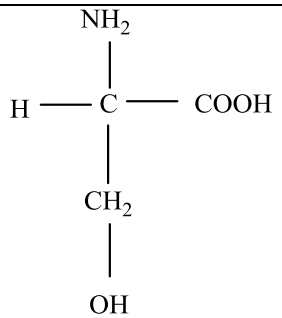
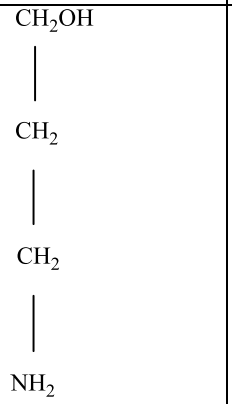
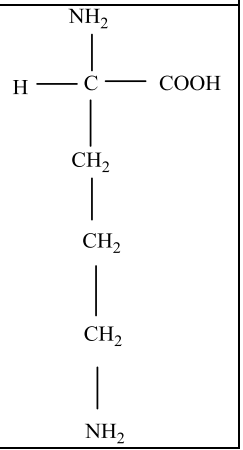
127. Which one of the following is common to multicellular fungi, filamentous algae and protonema of mosses
(1) Diplontic life cycle
(2) Members of kingdom plantae
(3) Mode of Nutrition
(4) Multiplication by fragmentation

128. Which one single organism or the pair of organisms is correctly assigned ot its or their named taxonomic group
(1) Paramecium and Plasmodium belong to the same kingdom as that of Penicillium
(2) Lichen is a composite organism formed form the symbiotic association of an algae and a protozoan
(3) yeast used in making bread and beer is a fungus
(4) Nostoc andAnabaena are examples of protista

129. Even in absence of pollinating agents seed setting is assured in
(1) Commellina
(2) Zostera
(3) Salvia
(4) Fig

130. Yeast is used in the production of
(1) Citric acid and lactic acid
(2) Lipase and pecinase
(3) Bread and beer
(4) Cheese and butter

131. Which one out of A-D given below correctly respresents the structural formula of the basic amino acid

A	B	C	D
			

(1) C
(2) D
(3) A
(4) B

132. The upright pyramid of number is absent in
(1) Pond
(2) Forest
(3) Lake
(4) Grassland

133. What is correct to say about the hormone action in humans
(1) Glucagon is secreted by □ -cells of lslets of Langerhans and stimulates glycogenolysis
(2) Secretion of thymosins is stimulated with aging
(3) In females FSH first binds with specific receptors on ovarian cellmembrane
(4) FSH stimulates the secretion of estrogen and progesterone

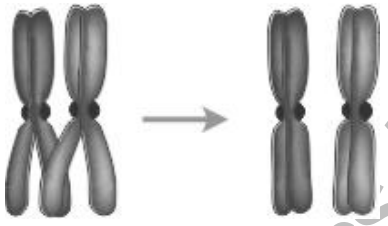
134. Closed vascular bundles lack
(1) Ground tissue
(2) conjunctive tissue
(3) Cambium
(4) Pith

135. Which one of the following is the correct statement for respiration in human
(1) Cigarette smoking may lead of inflammation of bronchi
(2) Neural signals from pneumotaxic centre in pons region of brain can increase the duration of inspiration
(3) Workers in grinding and stone - breaking industries may suffer, from lung fibrosis
(4) About 90%of carbon dioxide (CO2) is carried by haemoglobin as carbamino haemoglobin

136. Removal of introns and joining of exons in a defined order during transcription is called :
(1) Looping
(2) Inducing
(3) Slicing
(4) Splicing

137. F_2 generation in a Mendelian cross showed that both genotypic and phenotypic ratios are same as 1: 2: 1. It represents a case of:
(1) Co-dominance
(2) Dihybrid cross
(3) Monohybrid cross with complete dominance
(4) Monohybrid cross with incomplete dominance

138. Given below is the representation of a certain event at a particular stage of a type of cell division. Which is this stage?



(1) Prophase I during meiosis
(2) Prophase II during meiosis
(3) Prophase of Mitosis
(4) Both prophase and metaphase of mitosis

139. People who have migrated from the planes to an area adjoining Rohatang Pass about six months back :
(1) havemore RBCs and their haemoglobin has a lower binding affinity to O_2.
(2) are not physically fit to play games like football.
(3) suffer from altitude sickness with symptoms like nausea, fatigue, etc.
(4) have the usual RBC count but their haemoglobin has very high binding affinuty to O_2.

140. For transformation,micro-particles coated with DNA to be bombarded with gene gun aremade up of :
(1) Silver or Platinum
(2) Platinum or Zinc
(3) Silicon or Platinum
(4) Gold or Tungsten

141. A nitrogen-fixing microbe associated with Azolla in rice fields is :
(1) Spirulina
(2) Anabaena
(3) Frankia
(4) Tolypothrix

142. Select the correct statement regarding the specific disorder of muscular or skeletal system :-
(1) Muscular dystrophy - age related shortening or muscles.
(2) Osteoporosis - decrease in bone mass and higher chance of fractures with advancing age.
(3) Myasthenia gravis - Auto immune disorder which inhibits sliding of myosin filaments
(4) Gout - inflammation of joints due to extra deposition of calcium.

143. Water containing cavities in vascular bundles are found in :
(1) Sunflower
(2) Maize
(3) Cycas
(4) Pinus

144. Select the correct statement from the following regarding cellmembrane.
(1) Na+ and K+ ions move across cell membrane by passive transport
(2) Proteins make up 60 to 70% of the cell membrane.
(3) Lipids are arranged in a bilayer with polar heads towards the inner part.
(4) Fluid mosaic model of cell membrane was proposed by Singer and Nicolson

145. Gymnosperms are also called soft wood spermatophytes because they lack :
(1) Cambium
(2) Phloem fibres
(3) Thick-walled tracheids
(4) Xylem fibres

146. The coconut water and the edible part of coconut are equivalent to :
(1) Endosperm
(2) Endocarp
(3) Mesocarp
(4) Embryo

147. Vexillary aestivation is characteristic of the family
(1) Fabaceae
(2) (2)Asteraceae
(3) Solanaceae
(4) Brassicaceae

148. Which one of the following is an example of carrying out biological control of pests/diseases using microbes ?
(1) Trichoderma sp. against certain plant pathogens
(2) Nucleopolyhedrovirus against white rust in Brassica
(3) Bt - cotton to increase contton yield
(4) Lady bird beetle against aphids in mustard

149. Select the correct statement from the ones given below with respect to *Periplaneta americana*.
(1) Nervous system located dorsally, consists of segmentally arranged ganglia joined by a pair of longitudinal connectives.
(2) Males bear a pair of short thread like anal styles.
(3) There are 16 very long Malpighian tubules present at the junctions of midgut and hindgut.
(4) Grinding of food is carried out only by the mouth parts.

150. Maximum nutritional diversity is found in the group.
(1) Fungi
(2) Animalia
(3) Monera
(4) Plantae

Chemistry

151. Aluminium is extracted from alumina (Al_2O_3) by electrolysis of a molten mixture of:
(1) $Al_2O_3+HF+NaAlF_4$
(2) $Al_2O_3+CaF_2+NaAlF_4$
(3) $Al_2O_3+Na_3AlF_6+CaF_2$
(4) $Al_2O_3+KF+Na_3AlF_6$

152. pH of a saturated solution of $Ba(OH)_2$ is 12. The value of solubility product (K_{sp}) of $Ba(OH)_2$ is :
(1) 3.3×10^{-7}
(2) 5.0×10^{-7}
(3) 4.0×10^{-6}
(4) 5.0×10^{-6}

153. When Cl_2 gas reacts with hot and concentrated sodium hydroxide solution, the oxidation number of chlorine changes from :
(1) Zero to +1 and zero to -5
(2) Zero to -1 and zero to +5
(3) Zero to -1 and zero to +3
(4) Zero to +1 and zero to -3

154. Maximum number of electrons in a subshell with : l= 3 and n = 4 is :
(1) 14
(2) 16
(3) 10
(4) 12

155. Which one of the following is an outer orbital complex and exhibits paramagnetic behaviour?
(1) $[Ni(NH_3)_6]^{2+}$
(2) $[Zn(NH_3)_6]^{2+}$
(3) $[Cr(NH_3)_6]^{3+}$
(4) $[Co(NH_3)_6]^{3+}$

156. In a reaction, A + B $\rightarrow$ Product, rate is doubled when the concentration of B is doubled, and rate increases by a factor of 8 when the concentrations of both the reactants (A and B) are doubled, rate law for the reaction can be written as :
(1) Rate = $k[A][B]^2$
(2) Rate = $k[A]^2[B]^2$
(3) Rate=k[A][B]
(4) Rate=$k[A]^2[B]$

157. In which of the following reactions, standard reaction entropy change ($\Delta S°$) is Positive and standard Gibbs energy change ($\Delta G°$) decreases sharply with increasing temperature?

(1) $C\ \text{graphite} + \frac{1}{2}O_{2(g)} \rightarrow CO_{(g)}$

(2) $CO_{(g)} + \frac{1}{2}O_{2(g)} \rightarrow CO_{2(g)}$

(3) $Mg_{(s)} + \frac{1}{2}O_{2(g)} \rightarrow MgO_{(s)}$

(4) $\frac{1}{2}C\text{graphite} + \frac{1}{2}O_{2(g)} \rightarrow \frac{1}{2}CO_{2(g)}$

158. Which one of the following is a mineral of iron?

(1) Malachite
(2) Cassiterite
(3) Pyrolusite
(4) Magnetite

159. In Freundlich Adsorption isotherm, the value of 1/n is :

(1) between 0 and 1 in all cases
(2) between 2 and 4 in all cases
(3) 1 in case of physical adsorption
(4) 1 in case of chemisorption

160. Equimolar solutions of the following substances were prepared separately. Which one of these will record the highest pH value?

(1) $BaCl_2$
(2) $AlCl_3$
(3) LiCl
(4) $BeCl_2$

161. 50 mL of each gas A and of gas B takes 150 and 200 seconds respectively for effusing through a pin hole under the similar conditions. If molecular mass of gas B is 36, the molecular mass of gas A will be :

(1) 96
(2) 128
(3) 32
(4) 64

162. The correct set of four quantum numbers for the valence elecron of rubidium atom (Z=37) is :

(1) 5, 1, 1,+ ½

(2) 6,0,0 + ½

(3) 5,0,0 + ½

(4) 5,1,0 + ½

163. In which of the following compounds, nitrogen exhibits highest oxidation state?

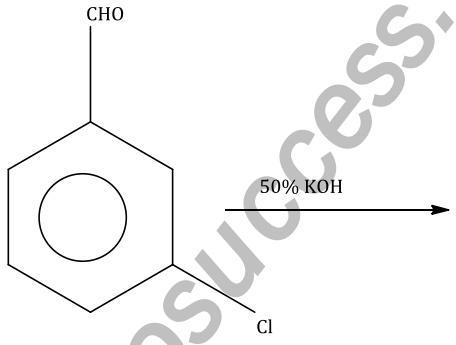
(1) N_2H_4

(2) NH_3

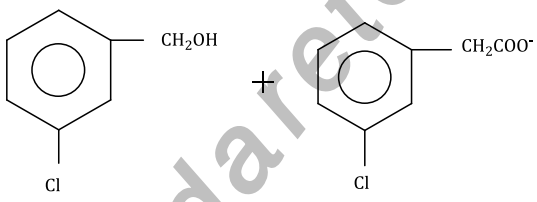
(3) N_3H

(4) NH_2OH

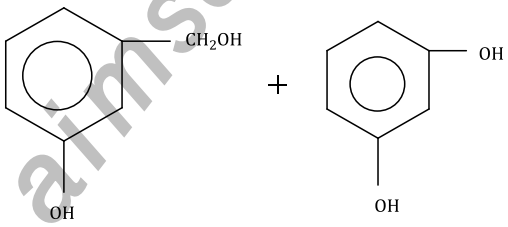
164. Predict the product in the given reaction.



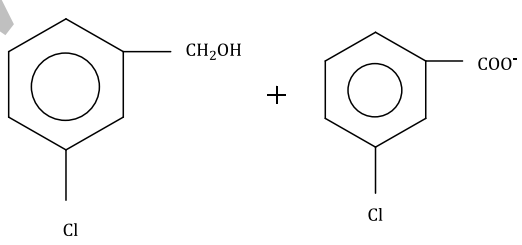
(1)



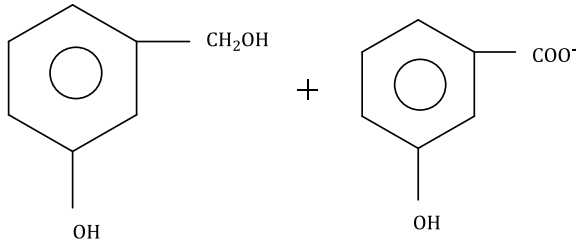
(2)



(3)

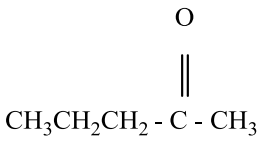


(4)

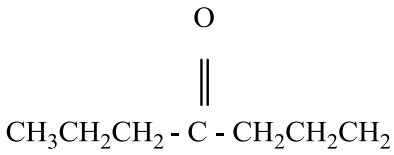


165. Acetone is treated with excess of ethanol in the presence of hydrochloric acid. The product obtained is :

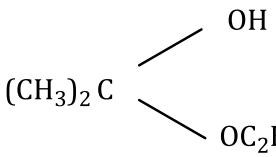
(1)



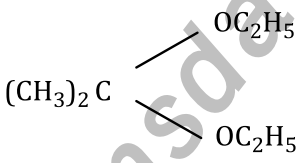
(2)



(3)



(4)



166. A metal crystallizes with a face-centered cubic lattice. The edge of the unit cell is 408 pm. The diameter of the metal atom is:

(1) 288 pm
(2) 408 pm
(3) 144 pm
(4) 204 pm

167. Which one of the following statements is incorrect about enzyme catalysis?

(1) Enzymes are mostly proteinous in nature
(2) Enzyme action is specific
(3) Enzymes are denaturated by ultraviolet rays and at high temperature
(4) Enzymes are least reactive at optimum temperature

168. In a zero- order reaction for every 10° rise of temperature, the rate is doubled. If the temperature is increased from 10°C to 100°C, the rate of the reaction will become :
(1) 256 times
(2) 512 times
(3) 64 times
(4) 128 times

169. Deficiency of vitamin B1 causes the disease
(1) Convulsions
(2) Beri-Beri
(3) Cheilosis
(4) Sterility

170. Among the following compounds the one that is most reactive towards electrophilic nitration is:
(1) Benzoic Acid
(2) Nitrobenzene
(3) Toluene
(4) Benzene

171. Buffer solutions have constant acidity and alkalinity because :
(1) These give unionised acid or base on reaction with added acid or alkali.
(2) Acids and alkalies in these solution are shielded from attack by other ions.
(3) They have large excess of H^+ or OH^- ions.
(4) They have fixed value of pH.

172. The correct order of decreasing acid strength of trichloroacetic acid (A), trifluoroacetic acid (B), acetic acid (C) and formic acid (D) is :
(1) B > A > D > C
(2) B > D > C > A
(3) A > B > C > D
(4) A > C > B > D

173. Which one of the following sets of monosaccharides forms sucrose?
(1) α -D-Galactopyranose and α -D- fructofuranose
(2) α -D-Glucopyranose and β -D-fructofuranose
(3) β -D-Glucopyranose and α -D-fructofuranose
(4) α -D-Glucopyranose and β -D-fructofuranose

174. The enthalpy of fusion of water is 1.435 kcal/mol. The molar entropy change for the melting of ice at 0°C is :
(1) 10.52 cal / (mol K)
(2) 21.04 cal / (mol K)
(3) 5.260 cal / (mol K)
(4) 0.526 cal / (mol K)

175. Which one of the following pairs is isostructural (i.e. having the same shape and hybridization)?
(1) [BCl_3 and $BrCl_3$]
(2) [NH_3 and NO_3^-]
(3) [NF_3 and BF_3]
(4) [BF_4^- and NH_4^+]

176. Bond order of 1.5 is shown by:
(1) O_2^+
(2) O_2^-
(3) O_2^{2-}
(4) O_2

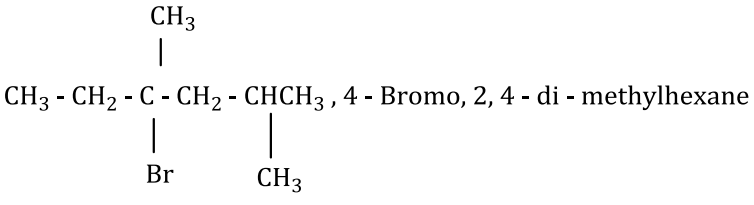
177. Which one of the following is not a condensation polymer?
(1) Melamine
(2) Glyptal
(3) Dacron
(4) Neoprene

178. In the following sequence of reactions

$CH_3\text{-}Br \xrightarrow{KCN} A \xrightarrow{H_3O+} B \xrightarrow[ether]{LiAlH_4} C$, the end product (C) is :

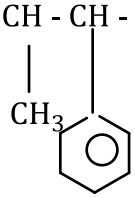
(1) Acetone
(2) Methane
(3) Acetaldehyde
(4) Ethyl alcohol

179. Which nomenclature is not according to IUPAC system?
(1) $Br - CH_2 - CH = CH_2$, 1 – Bromo – prop -2 – ene
(2)



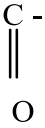
(3)

$CH_3 - CH - CH - CH_2 - CH_3$, 2 - Methyl - 3 - Phenylpentane



(4)

$CH_3 - C - CH_2 - CH_2 - CH_2COOH$ 5 - oxohexanoic acid



180. The number of octahedral void(s) per atom present in a cubic close-packed structure is:

(1) 1
(2) 3
(3) 2
(4) 4

181. In the extraction of copper from its sulphide ore, the metal is finally obtained by the reduction of cuprous oxide with :

(1) Copper (I) sulphide (Cu_2S)
(2) Sulphur dioxide (SO_2)
(3) Iron sulphide (FeS)
(4) Carbon monoxide (CO)

182. Identify the alloy containing a non-metal as a constituent in it.

(1) Invar
(2) Steel
(3) Bell metal
(4) Bronze

183. A mixture of potassium chlorate, oxalic acid and sulphuric acid is heated. During the reaction which element undergoes maximum change in the oxidation number ?

(1) S
(2) H
(3) Cl
(4) C

184. Which one of the alkali metals, forms only, the normal oxide, M_2O on heating in air?
(1) Rb
(2) K
(3) Li
(4) Na

185. The ease of adsorption of the hydrated alkali metal ions on an ion-exchange resins follows the order :
(1) $Li^+ < K^+ < Na^+ < Rb^+$
(2) $Rb^+ < K^+ < Na^+ < Li^+$
(3) $K^+ < Na^+ < Rb^+ < Li^+$
(4) $Na^+ < Li^+ < K^+ < Rb^+$

186. Which one of the following statements regarding photochemical smog is not correct?
(1) Carbon monoxide does not play any role in photochemical smog formation
(2) Photochemical smog is an oxidising agent in character
(3) Photochemical smog is formed through photochemical reaction involving solar energy.
(4) Photochemical smog does not cause irritation in eyes and throat.

187. CH_3CHO and $C_6H_5CH_2CHO$ can be distinguished chemically by :
(1) Benedict test
(2) Iodoform test
(3) Tollen's reagent test
(4) Fehling solution test

188. Which of the statements is **not** true?
(1) On passing H_2S through acidified $K_2Cr_2O_7$ solution, a milky colour is observed
(2) $Na_2Cr_2O_7$ is preferred over $K_2Cr_2O_7$ in volumetric analysis
(3) $K_2Cr_2O_7$ solution in acidic medium is orange
(4) $K_2Cr_2O_7$ solution becomes yellow on increasing the pH beyond 7

189. Standard enthalpy of vapourisation $\Delta_{vap} H^o$ for water at 100°C is 40.66 kJ mol^{-1}. The internal energy of vaporization of water at 100°C (in kJmol–1) is:
(1) +37.56
(2) -43.76
(3) +43.76
(4) +40.66

190. Identify the **wrong** statement in the following :
(1) Amongst isoelectronic species, smaller the positive charge on the cation, smaller is the ionic radius.
(2) Amongst isoelectronic species, greater the negative charge on the anion, larger is the ionic radius.
(3) Atomic radius of the elements increases as one moves down the first group of the periodic table.
(4) Atomic radius of the elements decreases as one moves across from left to right in the 2nd period of the periodic table.

191. Which of the following statements is not valid for oxoacids of phosphorus?
(1) Orthophosphoric acid is used in the manufacture of triple superphosphate
(2) Hypophosphorous acid is a diprotic acid
(3) All oxoacids contain tetrahedral four coordinated phosphorus
(4) All oxoacids contain atleast one P=O unit and one P–OH group

192. The protecting power of lyophilic colloidal sol is expressed in terms of :
(1) Coagulation value
(2) Gold number
(3) Critical miscelle concentration
(4) Oxidation number

193. Sulphur trioxide can be obtained by which of the following reaction:
(1) $CaSO_4 + C \xrightarrow{\Delta}$
(2) $Fe_2(SO_4)_3 \xrightarrow{\Delta}$
(3) $S + H_2SO_4 \xrightarrow{\Delta}$
(4) $H_2SO_4 + PCl_5 \xrightarrow{\Delta}$

194. P_A and P_B are the vapour pressure of pure liquid components, A and B, respectively of an ideal binary solution. If X_A represents the mole fraction of component A, the total pressure of the solution will be.
(1) $P_A + X_A (P_B - P_A)$
(2) $P_A + X_A (P_A - P_B)$
(3) $P_B + X_A (P_B - P_A)$
(4) $P_B + X_A (P_A - P_B)$

195. Which of the following acids does not exhibit optical isomerism?
(1) Maleic acid
(2) α -amino acids
(3) Lactic acid
(4) Tartaric acid

196. Which of the following species contains three bond pairs and one lone pair around the central atom?

(1) H_2O

(2) BF_3

(3) NH_2^-

(4) PCl_3

197. Limiting molar conductivity of NH_4OH $\left(\text{i.e}\,\overset{0}{\Lambda}\text{m}(NH_4OH)\right)$ is equal to:

(1) $\overset{0}{\Lambda}_m(NH_4Cl)+\overset{0}{\Lambda}_m(NaCl)-\overset{0}{\Lambda}_m(NaOH)$

(2) $\overset{0}{\Lambda}_m(NaOH)+\overset{0}{\Lambda}_m(NaCl)-\overset{0}{\Lambda}_m(NH_4Cl)$

(3) $\overset{0}{\Lambda}_m(NH_4OH)+\overset{0}{\Lambda}_m(NH_4Cl)-\overset{0}{\Lambda}_m(HCl)$

(4) $\overset{0}{\Lambda}_m(NH_4Cl)+\overset{0}{\Lambda}_m(NaOH)-\overset{0}{\Lambda}_m(NaCl)$

198. The pair of species with the same bond order is :

(1) O_2^{2-}, B_2

(2) O_2^+, NO^+

(3) NO, CO

(4) N_2, O_2

199. Which of the following statements is false?

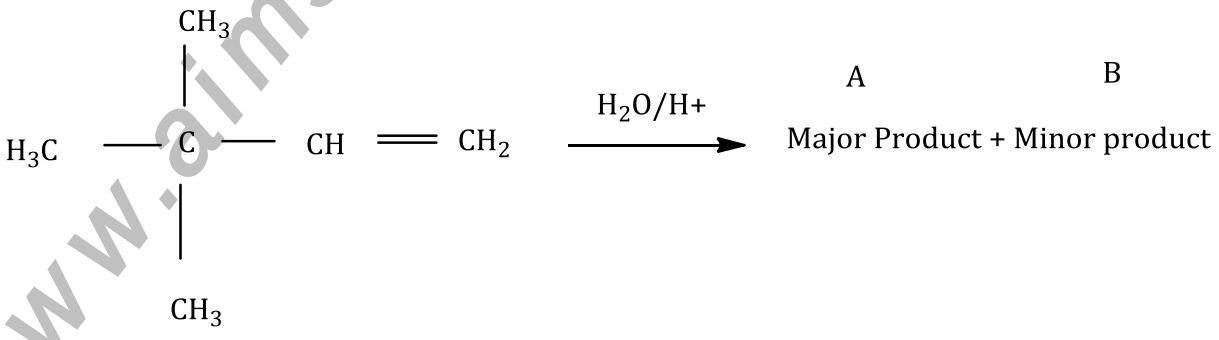
(1) Artificial silk is derived from cellulose.

(2) Nylon-66 is an example of elastomer.

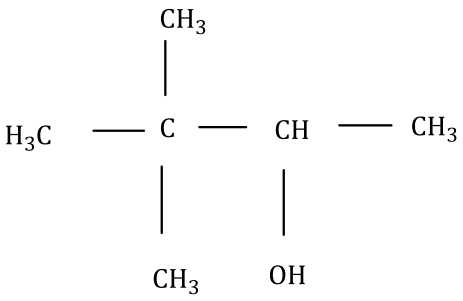
(3) The repeat unit in natural rubber is isoprene.

(4) Both starch and cellulose are polymers of glucose.

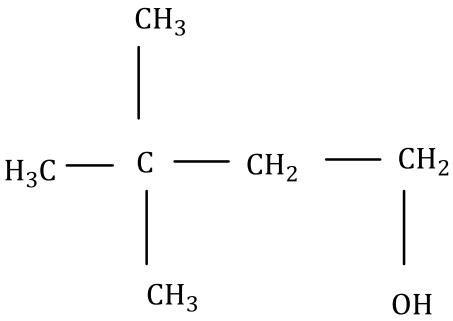
200. In the following reaction :



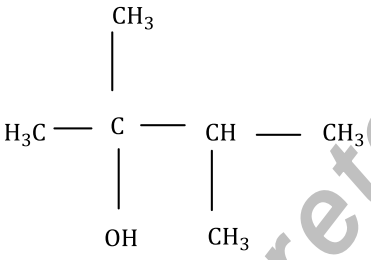
(1)



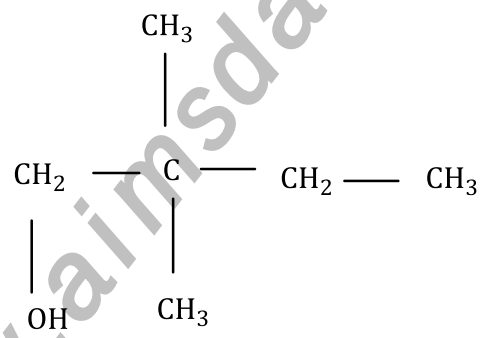
(2)



(3)



(4)



AIPMT - 2012
(Physics, Chemistry and Biology)
Prelims Answer Key and Solution
Code D

Answers

1	(4)	2	(3)	3	(1)	4	(4)	5	(1)	6	(1)	7	(4)	8	(1)	9	(1)	10	(3)
11	(1)	12	(2)	13	(1)	14	(2)	15	(3)	16	(4)	17	(4)	18	(1)	19	(3)	20	(4)
21	(3)	22	(3)	23	(1)	24	(2)	25	(2)	26	(1)	27	(2)	28	(2)	29	(4)	30	(4)
31	(1)	32	(3)	33	(1)	34	(1)	35	(3)	36	(3)	37	(3)	38	(2)	39	(3)	40	(2)
41	(3)	42	(1)	43	(1)	44	(2)	45	(4)	46	(1)	47	(4)	48	(3)	49	(4)	50	(4)
51	(1)	52	(3)	53	(3)	54	(4)	55	(4)	56	(1)	57	(3)	58	(4)	59	(4)	60	(2)
61	(4)	62	(3)	63	(2)	64	(1)	65	(4)	66	(2)	67	(1)	68	(4)	69	(4)	70	(1)
71	(1)	72	(1)	73	(3)	74	(3)	75	(3)	76	(1)	77	(4)	78	(1)	79	(2)	80	(4)
81	(1)	82	(2)	83	(2)	84	(4)	85	(1)	86	(2)	87	(3)	88	(3)	89	(3)	90	(1)
91	(4)	92	(3)	93	(3)	94	(2)	95	(1)	96	(2)	97	(4)	98	(4)	99	(4)	100	(4)
101	(4)	102	(4)	103	(4)	104	(4)	105	(4)	106	(2)	107	(1)	108	(1)	109	(3)	110	(1)
111	(4)	112	(2)	113	(1)	114	(2)	115	(2)	116	(4)	117	(2)	118	(1)	119	(4)	120	(4)
121	(3)	122	(2)	123	(2)	124	(4)	125	(4)	126	(3)	127	(4)	128	(3)	129	(1)	130	(3)
131	(2)	132	(2)	133	(3)	134	(3)	135	(3)	136	(4)	137	(4)	138	(1)	139	(1)	140	(4)
141	(2)	142	(2)	143	(2)	144	(4)	145	(4)	146	(1)	147	(1)	148	(1)	149	(2)	150	(3)
151	(3)	152	(2)	153	(2)	154	(1)	155	(1)	156	(4)	157	(1)	158	(4)	159	(1)	160	(1)
161	(Bonus)	162	(3)	163	(3)	164	(3)	165	(4)	166	(1)	167	(4)	168	(2)	169	(2)	170	(3)
171	(1)	172	(1)	173	(2)	174	(3)	175	(4)	176	(2)	177	(4)	178	(4)	179	(1)	180	(1)
181	(1)	182	(2)	183	(3)	184	(3)	185	(2)	186	(4)	187	(2)	188	(2)	189	(1)	190	(1)
191	(2)	192	(2)	193	(2)	194	(2)	195	(1)	196	(4)	197	(4)	198	(1)	199	(2)	200	(3)

Physics

1. For the third excited state, n = 4; for the second excited state, n = 3 and for the first excited state, n = 2.

When the electron jumps from the third excited state to the second, the energy is

$$\Delta E = \frac{hc}{\lambda_1}$$

Now, using the Rydberg's formula, we get

$$\Delta E = \frac{hc}{\lambda_1} = 13.6\left(\frac{1}{3^2} - \frac{1}{4^2}\right) \quad \text{..... (1)}$$

When the electron jumps from the second excited state to the first, the energy is

$$\Delta E = \frac{hc}{\lambda_2}$$

Now, using the Rydberg's formula, we get

$$\Delta E = \frac{hc}{\lambda_2} = 13.6\left(\frac{1}{2^2} - \frac{1}{3^2}\right) \quad \text{..... (2)}$$

Dividing equations (1) and (2), we get

$$\frac{\lambda_1}{\lambda_2} = \frac{\left(\frac{1}{2^2} - \frac{1}{3^2}\right)}{\left(\frac{1}{3^2} - \frac{1}{4^2}\right)} = \frac{\left(\frac{1}{4} - \frac{1}{9}\right)}{\left(\frac{1}{9} - \frac{1}{16}\right)}$$

$$\therefore \frac{\lambda_1}{\lambda_2} = \frac{\frac{5}{36}}{\frac{7}{144}} = \frac{5}{36} \times \frac{144}{7} = \frac{20}{7}$$

2. The total length of the string is

$$\ell = \ell_1 + \ell_2 + \ell_3 \quad \text{..... (1)}$$

The fundamental frequency of the string is

$$\nu = \frac{1}{2\ell}\sqrt{\frac{T}{\mu}}$$

$$\Rightarrow \nu \propto \frac{1}{\ell} \quad \text{..... (2)}$$

Here, ℓ is the length, T is the tension in the string and μ is the mass per unit length of the string.

Hence, from equations (1) and (2), we get

$$\frac{1}{\nu} = \frac{1}{\nu_1} + \frac{1}{\nu_2} + \frac{1}{\nu_3}$$

3. Let us assume that n photons have been emitted per second.
Hence, the total energy emitted is

$$E = n\frac{hc}{\lambda}$$

Now, energy is related to power as
$P = E/t$
Hence, for t = 1 second,
$P = E$
Now, power of the sodium lamp is 200 W and it is 25% efficient. So, we have

$$n\frac{hc}{\lambda} = 200 \times \frac{25}{100} = 50$$

$$\therefore n = \frac{50 \times \lambda}{hc} = \frac{50 \times 0.6 \times 10^{-6}}{6.63 \times 10^{-34} \times 3 \times 10^{8}}$$

$$\therefore n = 1.5 \times 10^{20}$$

4. The circuit has diode D_1 in forward bias and diode D_2 in reverse bias.
Hence, only D_1 will conduct.

So, the current supplied by the battery is

$$I = \frac{V}{R} = \frac{5}{10} = 0.5 \text{ A}$$

5. The angular momentum of a mass rotating about a fixed point is

$$\vec{L} = \vec{r} \times \vec{p}$$

Hence, the angular momentum will always be directed perpendicular to the radius vector and the momentum vector of the mass.
So, we can say that it is perpendicular to the plane of rotation.

6. The torque of the dipole is

$$\vec{\tau} = \vec{p} \times \vec{E} = pE\sin\theta$$

Similarly, the potential energy of the dipole is

$$\vec{U} = -\vec{p} \cdot \vec{E} = -pE\cos\theta$$

7. It is given that output voltage across the collector is V_o = 2 V.
The resistance across the collector is $R_c = 2\ k\Omega = 2 \times 10^3 \Omega$.

Hence, the current through the collector is

$$V_o = I_c R_c$$

$$\Rightarrow I_c = \frac{V_o}{R_c} = \frac{2}{2 \times 10^3} = 1 \times 10^{-3} \text{ A}$$

Now, it is given that current gain across the transistor is 100. So, we have

$$\beta = \frac{I_c}{I_b}$$

$$\therefore I_b = \frac{I_c}{\beta} = \frac{1\times10^{-3}}{100} = 1\times10^{-5}\ A$$

Therefore, we will get the input voltage as

$$V_i = I_b R_b$$

$$\therefore V_i = 1\times10^{-5}\times1\times10^{3}$$

$$\therefore V_i = 1\times10^{-2}\ V = 10\times10^{-3}\ V = 10\ mV$$

8. The flux linked with the coil is

$$\phi = 50t^2 + 4$$

Now, the emf induced in the coil is

$$\varepsilon = -\frac{d\phi}{dt} = -2\times50t = -100t$$

Hence, the induced current at time t = 2 s is

$$i = \left|\frac{\varepsilon}{R}\right| = \frac{100t}{R} = \frac{100\times2}{400} = 0.5\ A$$

9. The process ABCD is a cyclic process.

Now, the change in internal energy of a cyclic process is zero.

$$\Delta U = 0$$

According to the first law of thermodynamics, we have

$$\Delta Q = \Delta U + \Delta W$$

$$\Rightarrow \Delta Q = \Delta W$$

Now, work done is equal to the area under the curve for the process.

From the graph given, we get

$$\Delta Q = \text{Area under the cycle ABCD}$$

$$= AB\times AD$$

$$= (3V - V)\times(2P - P)$$

$$= 2V\times P$$

$$= 2PV$$

Hence, the heat rejected by the gas during the cycle is 2PV.

10. The nuclear radius in terms of atomic mass number is

$R = R_0 (A)^{\frac{1}{3}}$

It is given that $R\left(^{27}Al\right) = 3.6$ fm

A = 27 for Al and A = 64 for Cu

So, we get

$$\frac{R_{Cu}}{R_{Al}} = \left(\frac{A_{Cu}}{A_{Al}}\right)^{\frac{1}{3}} = \left(\frac{64}{27}\right)^{\frac{1}{3}} = \frac{4}{3}$$

$$\therefore R_{Cu} = \frac{4}{3} R_{Al} = \frac{4}{3} \times 3.6 = 4 \times 1.2 = 4.8 \text{ fm}$$

11. The two coils carrying current I and 2I are placed concentrically perpendicular to each other.

Now, the magnetic field around the current-carrying coil is given by the right-hand thumb rule.

So, both fields will be perpendicular to each other.

Now, the magnetic field at the centre of a coil due to current I flowing in the coil is

$$B_1 = \frac{\mu_0 I}{2R}$$

So, for the other coil with the same radius and current 2I, we have

$$B_2 = \frac{\mu_0 (2I)}{2R}$$

Therefore, the net magnetic field is

$$B = \sqrt{B_1^2 + B_2^2}$$

$$= \sqrt{\left(\frac{\mu_0 I}{2R}\right)^2 + \left(\frac{\mu_0 2I}{2R}\right)^2}$$

$$= \sqrt{\left(\frac{\mu_0}{2R}\right)^2 \left(I^2 + 4I_2\right)}$$

$$= \sqrt{\left(\frac{\mu_0}{2R}\right)^2 \left(5I^2\right)}$$

$$= \frac{\sqrt{5}\ \mu_0 I}{2R}$$

12. The potential energy of a particle is

$$U = \frac{A}{r^2} - \frac{B}{r}$$

Now, for equilibrium, we have

$$\frac{dU}{dr} = 0$$

$$\therefore \frac{-2A}{r^3} + \frac{B}{r^2} = 0$$

$$\Rightarrow \frac{B}{r^2} = \frac{2A}{r^3}$$

$$\therefore r = \frac{2A}{B}$$

For stable equilibrium, the condition which needs to be satisfied is $\frac{d^2U}{dr^2} > 0$.

After differentiating for the second time, it can be seen that $\frac{d^2U}{dr^2} > 0$.

Hence, we have the distance of the particle as $r = \frac{2A}{B}$.

13. From the lens makers formula, we get

$$\frac{1}{f} = \left(\frac{\mu_2}{\mu_1} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

Here, μ_2 is the refractive index of glass and μ_1 is the refractive index of liquid.

It is given that after dipping in the liquid, the biconvex lens acts as a plane glass. So, we have

$$f = \infty$$

$$\Rightarrow \frac{1}{f} = 0$$

$$\therefore \left(\frac{\mu_2}{\mu_1} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) = 0$$

$$\Rightarrow \frac{\mu_2}{\mu_1} - 1 = 0$$

$$\Rightarrow \frac{\mu_2}{\mu_1} = 1$$

$$\Rightarrow \mu_1 = \mu_2$$

14. The horizontal range of the projectile is

$$R = \frac{u^2}{g}\sin 2\theta \qquad \ldots\ldots (1)$$

The height of the projectile is

$$H = \frac{u^2}{2g}\sin^2\theta \qquad \ldots\ldots (2)$$

Dividing equations (1) and (2), we get

$$\frac{H}{R} = \frac{u^2}{2g}\sin^2\theta \times \frac{g}{u^2 \sin 2\theta}$$

$$= \frac{\sin^2\theta}{2\sin 2\theta} = \frac{\sin^2\theta}{4\sin\theta\cos\theta} = \frac{1}{4}\tan\theta$$

Therefore, when H = R, we get

$$\frac{R}{R} = \frac{1}{4}\tan\theta$$

$$\tan\theta = 4$$

$$\theta = \tan^{-1} 4$$

15. When the inductor is removed from the circuit, the phase difference between the resistor and capacitor is given from the phasor diagram as

$$\tan\frac{\pi}{3} = \frac{X_C}{R}$$

$$\Rightarrow X_C = R\tan\frac{\pi}{3}$$

Similarly, when the capacitor is removed from the circuit, the phase difference between the resistor and inductor is given from the phasor diagram as

$$\tan\frac{\pi}{3} = \frac{X_L}{R}$$

$$\Rightarrow X_L = R\tan\frac{\pi}{3}$$

Hence, we see that $X_L = X_C$.
This is the condition of resonance.
Now, the power factor of the circuit is

$$\cos\phi = \frac{R}{Z} = \frac{R}{\sqrt{R^2 + (X_L - X_C)^2}} = \frac{R}{R} = 1$$

16. The rate of energy production is given from Stefan's law as

$Q = \sigma e T^4 \times A$

Now for a black body, we have e = 1.

We also know that $A = 4\pi R^2$.

Therefore, we have

$Q = 4\pi R^2 \sigma T^4$

$\therefore T^4 = \frac{Q}{4\pi R^2 \sigma}$

$\therefore T = \left(\frac{Q}{4\pi R^2 \sigma}\right)^{\frac{1}{4}}$

17. The voltage across an inductance is

$|V| = \left|-L\frac{di}{dt}\right| = L\frac{di}{dt}$

Now, from the graph, it can be seen that $\frac{di}{dt}$ is constant and positive for the first half of the cycle.

So, V is constant and positive.

Similarly, from the graph, it can be seen that $\frac{di}{dt}$ is constant and negative for the second half of the cycle.

So, V is constant and negative.

Hence, the graph will be as shown in option (4).

18. The range of a millivoltmeter is 25 mV. So, we have $V = 25 \times 10^{-3}$ V.

Now, this millivoltmeter is to be converted to an ammeter of range 25 A.

To do this, a shunt is to be connected across the millivoltmeter.

Let the resistance of the millivoltmeter be R and the shunt resistance be S.

Therefore, its resistance should be

$\frac{1}{R_{eq}} = \frac{1}{R} + \frac{1}{S} = \frac{R+S}{RS}$

$\therefore R_{eq} = \frac{RS}{R+S}$

Now, the ammeter will have resistance in accordance to Ohm's law as

$R_{eq} = \frac{V}{I} = \frac{RS}{R+S}$

$\therefore \frac{25\times10^{-3}}{25} = \frac{RS}{R+S} = 0.001$

Now, we know that the shunt to be connected should have a very low resistance as compared to the original resistance.
So, we get

$$S << R$$

$$\therefore \frac{RS}{R+S} \approx \frac{RS}{R}$$

$$\therefore S = 0.001\ \Omega$$

19. The boat is in still water. After the man moves towards the other, there is no net force acting on the boat. Hence, the centre of mass does not shift.

20. The number of nuclei after time t in any given radioactive sample is

$$N = \frac{N_0}{(2)^{\frac{t}{T}}}$$

Here, N_0 is the initial number of nuclei and T is the half-life of the radioactive nuclei.
Hence, we have

$$N_1 = \frac{N_{01}}{(2)^{\frac{t}{20}}}$$

$$N_2 = \frac{N_{02}}{(2)^{\frac{t}{10}}}$$

It is given that $N_{01} = 40$ g, $N_{02} = 160$ g and $N_1 = N_2$.
Therefore, we get

$$N_1 = N_2$$

$$\therefore \frac{N_{01}}{(2)^{\frac{t}{20}}} = \frac{N_{02}}{(2)^{\frac{t}{10}}}$$

$$\therefore \frac{40}{(2)^{\frac{t}{20}}} = \frac{160}{(2)^{\frac{t}{10}}}$$

$$\therefore \frac{(2)^{\frac{t}{10}}}{(2)^{\frac{t}{20}}} = \frac{160}{40} = 4 = 2^2$$

$$\therefore (2)^{\frac{t}{10}-\frac{t}{20}} = 2^2$$

$$\Rightarrow \frac{t}{10} - \frac{t}{20} = 2$$

$$\therefore \frac{2t-t}{20} = 2$$

$$\therefore t = 40\ s$$

21. The electronic configuration of ^{6}C is

$^{6}C = 1s^2, 2s^2 2p^6$

Similarly, the electronic configuration of ^{14}Si is

$^{14}Si = 1s^2, 2s^2 2p^8, 3s^2 3p^2$

From the electronic configuration, we see that although both atoms have 4 bonding electrons, the electrons in C lie in the 2nd orbit and those of Si lie in the 3rd orbit. So, it can be concluded that C is an insulator and Si is an intrinsic semiconductor.

22. The acceleration due to gravity at a height h is

$$g' = \frac{g}{\left(1+\frac{h}{R}\right)^2}$$

$$\therefore mg' = \frac{mg}{\left(1+\frac{h}{R}\right)^2}$$

It is given that $mg = \frac{mg}{16}$

Hence, we get

$$\frac{mg}{16} = \frac{mg}{\left(1+\frac{h}{R}\right)^2}$$

$$\therefore \left(1+\frac{h}{R}\right)^2 = 16$$

$$\therefore 1+\frac{h}{R} = 4$$

$$\therefore \frac{h}{R} = 3$$

$$\therefore h = 3R$$

23. The electron jumps from the 5th energy level to the ground level. A photon is emitted in the process.

Now, the wavelength of the emitted photon for hydrogen atom is

$$\frac{1}{\lambda} = R\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$$

Hence, we get

$$\frac{1}{\lambda} = R\left(\frac{1}{1^2} - \frac{1}{5^2}\right) = R\left(\frac{1}{1} - \frac{1}{25}\right)$$

$$\therefore \frac{1}{\lambda} = R\left(\frac{25-1}{25}\right) = \frac{24R}{25}$$

The de Broglie wavelength of the photon is related to momentum as

$$p = \frac{h}{\lambda} = \frac{24hR}{25}$$

Now, momentum is

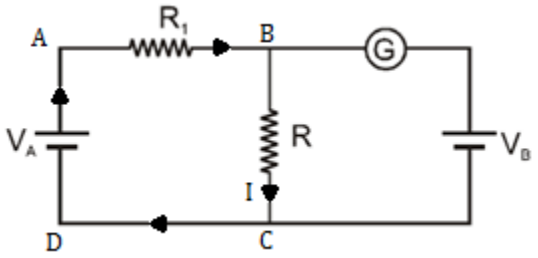
$p = mv$

Hence, the velocity of the atom is

$$v = \frac{p}{m} = \frac{24hR}{25m}$$

24. At the geomagnetic poles, the magnetic field is in the vertical direction.
The needle is however allowed to rotate freely along the horizontal plane only.
Hence, the needle can stay along any direction.

25. The galvanometer shows no deflection when V_A = 12 V, R_1 = 500Ω and R = 100Ω.
Hence, there is no current flowing through the galvanometer.



Therefore, the current through the loop ABCD is

$$I = \frac{V_A}{R_{total}} = \frac{V_A}{R_1 + R}$$

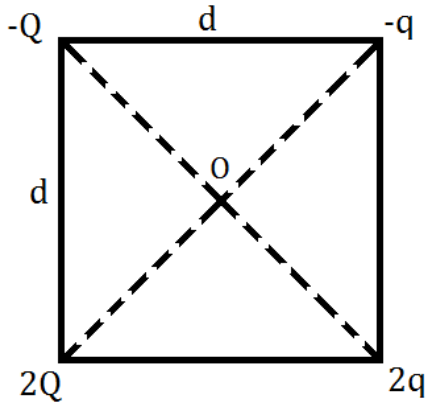
$$\therefore I = \frac{12}{500+100} = \frac{12}{600}\,A$$

So, the voltage across the resistor R will be

$$V_R = IR = \frac{12}{600} \times 100 = 2\ V$$

Now, this voltage will be the same across the supply V_B. So, we have V_B = 2 V.

26. The four charges are placed as shown in the figure below:



The potential at the centre O is zero.
The potential at O will be due to the sum of potentials of four charges.

Now, all the four charges are placed at a distance x such that

$$x^2 + x^2 = d^2$$

$$\therefore x^2 = \frac{d^2}{2}$$

$$\therefore x = \frac{d}{\sqrt{2}}$$

Now, the potential at O is

$$V_O = V_{-Q} + V_{-q} + V_{2q} + V_{2Q}$$

$$0 = \frac{k(-Q)}{x} + \frac{k(-q)}{x} + \frac{k(2q)}{x} + \frac{k(2Q)}{x}$$

$$0 = \frac{k(-Q)}{\frac{d}{\sqrt{2}}} + \frac{k(-q)}{\frac{d}{\sqrt{2}}} + \frac{k(2q)}{\frac{d}{\sqrt{2}}} + \frac{k(2Q)}{\frac{d}{\sqrt{2}}}$$

$$0 = \frac{k\sqrt{2}}{d}(-Q - q + 2q + 2Q)$$

$$0 = \frac{k\sqrt{2}}{d}(Q + q)$$

Therefore, we have

$$Q + q = 0$$

$$\Rightarrow Q = -q$$

27. For a banked road with angle of banking θ, the velocity with which a car can travel safely is

$$\tan\theta = \frac{v^2}{Rg}$$

$$\Rightarrow v = \sqrt{Rg\tan\theta}$$

Here, R is the radius of the banked curve.

Substituting the values, we get

$$v = \sqrt{90\times 10\tan 45}$$

$$= \sqrt{900}$$

$$= 30 \text{ ms}^{-1}$$

28. The cylinder is rolling towards the spring. Hence, its kinetic energy will be

$$KE = \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$$

Now, this cylinder compresses a spring. At maximum compression of the spring, the cylinder will stop. Let the compression be x.

Hence, from the conservation of energy, we get

Loss in kinetic energy of cylinder = gain in potential energy of the spring

$$\frac{1}{2}mv^2 + \frac{1}{2}I\omega^2 = \frac{1}{2}kx^2$$

$$\therefore mv^2 + I\omega^2 = kx^2$$

$$\therefore mv^2 + \frac{mR^2}{2}\left(\frac{v}{R}\right)^2 = kx^2$$

$$\therefore mv^2 + \frac{1}{2}mv^2 = kx^2$$

$$\therefore \frac{3}{2}mv^2 = kx^2$$

$$\therefore x^2 = \frac{3mv^2}{2k} = \frac{3\times 3\times 4^2}{2\times 200} = \frac{144}{400}$$

$$\therefore x = \frac{12}{20} = \frac{6}{10} = 0.6 \text{ m}$$

29. The process starts from A and ends at B.

Now, the first process starts at A and isothermally expands the system from V to 3V. Now, this process is correctly shown in options (2) and (4).

The second process is an isobaric process which is correctly shown in option (4).

30. The sphere A is initially at rest. Hence, its velocity is 0.
Sphere B is initially moving at velocity v along the x axis. So, we have

$v_{A1} = 0$

$v_{B1} = v\hat{x}$

After collision, B moves with velocity v/2 along the perpendicular direction, i.e. along y.
Therefore, we have

$v_{B2} = \frac{v}{2}\hat{y}$

Let A be moving along an angle θ with velocity v_{A2}.
Using the conservation of linear momentum along the x and y axes, respectively, we get

$m_2 v = m_1 v_{A2} \cos\theta$ ..... (1)

$0 = m_1 v_{A2} \sin\theta + m_2 \frac{v}{2}$

$\Rightarrow -m_2 \frac{v}{2} = m_1 v_{A2} \sin\theta$ ..... (2)

Dividing equations (1) and (2), we get

$\frac{m_1 v_{A2} \sin\theta}{m_1 v_{A2} \cos\theta} = \frac{-m_2 \frac{v}{2}}{m_2 v}$

$\therefore \tan\theta = -\frac{1}{2}$

$\therefore \theta = \tan^{-1}\left(-\frac{1}{2}\right)$

Hence, the correct option is (4), i.e. sphere A will move in the direction $\theta = \tan^{-1}\left(-\frac{1}{2}\right)$ to the x axis.

31. Liquid oxygen is initially at 50 K. It is then heated till 300 K. So, its temperature will increase gradually till 300 K. Hence, option (4) is incorrect.
Now, once it reaches 300 K, there will be a change of phase from the liquid to the gaseous state.
This will occur at constant temperature.
After that, the temperature will start increasing again.
So, the correct graph is as represented in option (3).

32. The cyclotron with frequency ν between the dees of radius R is used to accelerate protons of mass m.

The time period of the orbit of protons is

$$T = \frac{1}{\nu} = \frac{2\pi m}{eB}$$

$$\Rightarrow B = \frac{2\pi m\nu}{e} \qquad \text{..... (1)}$$

Here, e is the charge on the proton and B is the magnetic field in the cyclotron.

So, equation (1) is the requisite equation for the magnetic field.
Now, the radius of the dees is related to the magnetic field as

$$R = \frac{mv}{eB}$$

Here, v is the velocity of the proton inside the dees.

Momentum is p = mv, so we get

$$R = \frac{p}{eB}$$

$$\therefore p = eRB \qquad \text{..... (2)}$$

Now, kinetic energy and momentum are related as

$$K = \frac{p^2}{2m} \qquad \text{..... (3)}$$

Substituting equations (1) and (2) in equation (3), we get

$$K = \frac{(eRB)^2}{2m} = \frac{e^2R^2 \times \left(\frac{2\pi m\nu}{e}\right)^2}{2m}$$

$$\therefore K = \frac{e^2R^2 \times 4\pi^2m^2\nu^2}{2me^2} = 2\pi^2mR^2\nu^2$$

Hence, the correct option is (3).

33. The gravitational force on mass m due to planet of mass M_P is given from Newton's law of gravitation as

$$F = \frac{GM_P m}{R_P^2} = \frac{GM_P m}{\left(\frac{D_P}{2}\right)^2} = \frac{4GM_P m}{D_P^2}$$

Now, this force is the weight experienced by the mass. Therefore, we get the acceleration due to gravity as

$$F = mg = \frac{4GM_P m}{D_P^2}$$

$$\therefore g = \frac{4GM_P}{D_P^2}$$

34. The ray of light emerges normally from the second face of the prism.

Hence, the angle of emergence is zero.

$e = 0$

Therefore, $r_2 = 0$.

Now, we know that for a prism

$$A = r_1 + r_2$$

$$\therefore A = r_1 + 0 = r_1$$

The refractive index of the prism will be given from Snell's law as

$$\mu = \frac{\sin i}{\sin r} = \frac{\sin i}{\sin r_1} = \frac{\sin i}{\sin A}$$

Now, for small angles, we know that $\sin\theta \approx \theta$

$$\therefore \mu = \frac{i}{A}$$

$$\therefore i = \mu A$$

35. The damping force on an oscillator is directly proportional to the velocity, i.e.

$$F \propto v$$

$$\Rightarrow F = kv$$

Here, k is the constant of proportionality.

Therefore, we have

$$k = \frac{F}{v} = \frac{ma}{v} = \frac{kg\ ms^{-2}}{ms^{-1}} = kgs^{-1}$$

36. The ray of light is incident from infinity on the convex lens. It has focal length f_2.
So, these rays will refract from the lens and pass through the focus of the lens.

Now, it is given that the rays after reflection through the mirror travel back to infinity.
So, the rays have to emerge parallel from the lens again. For which they need to travel back to the focus of the lens.

This will happen only if the rays after refraction from the lens travel to the mirror and the mirror reflects in the same direction.

A concave mirror reflects light incident on it from the centre of curvature back to the same direction.
So, the total distance between the lens and the mirror combination will be
$d = f_2 + C = f_2 + 2f_1$

37. According to Kepler's third law of planetary motion, the square of the orbital period of a planet is directly proportional to the cube of the radius of its orbit.
$T^2 \propto r^3$

Hence, for the two satellites, we get
$$\frac{T_1^2}{T_2^2} = \frac{r_1^3}{r_2^3}$$

It is given that the first satellite is a geostationary satellite. Hence, T1 = 24 hours.
$r_1 = 5R + R = 6R$ and $r_2 = 2R + R = 3R$

Therefore, we get
$$\frac{24^2}{T_2^2} = \frac{(6R)^3}{(3R)^3}$$
$$\therefore T_2^2 = \frac{24^2 \times (3R)^3}{(6R)^3} = \frac{24^2 \times 27R^3}{216R^3}$$
$$\therefore T_2^2 = \frac{24 \times 24 \times 27}{216} = 72 = 36 \times 2$$
$$\therefore T_2 = 6\sqrt{2} \text{ hours}$$

38. From the characteristic curve, we see that if a transistor is used as a switch, then it will turn ON if operated in region I and turn OFF if operated in region III. That is we can conclude that for transistor as a switch, it has to be used in the cut-off region and the saturation region only. It will work as a regular amplifier in region II.
So, the correct option is (2).

39. The power consumed by the bulb is

$$P = \frac{V^2}{R}$$

Hence, the change in power rating will be

$$\frac{\Delta P}{P} = \frac{2\Delta V}{V} + \frac{\Delta R}{R}$$

Now, because the same bulb is used, the resistance does not change. So, we get

$$\frac{\Delta P}{P} = \frac{2\Delta V}{V} = 2 \times \frac{\Delta V}{V}$$

Hence, the percentage drop will be written as

$$\frac{\Delta P}{P} \times 100 = 2 \times \frac{\Delta V}{V} \times 100 = 2 \times 2.5 = 5\%$$

40. According to the kinematic equation of motion, we get

$$v = u + at$$

In vector notation, we have

$$\vec{v} = \vec{u} + \vec{a}t$$

Substituting the values, we get

$$\vec{v} = \left(2\vec{i} + 3\vec{j}\right) + \left(0.3\vec{i} + 0.2\vec{j}\right) \times 10$$

$$= 2\vec{i} + 3\vec{j} + 3\vec{i} + 2\vec{j}$$

$$= 5\vec{i} + 5\vec{j}$$

Therefore, the magnitude of velocity is

$$v = |\vec{v}| = \sqrt{5^2 + 5^2} = \sqrt{2 \times 5^2} = 5\sqrt{2} \text{ units}$$

41. When an electron jumps from the first excited state to the ground state, a photon of energy equal to the energy difference of the two levels is emitted.

This energy is equal to 10.2 eV.

Now, according to Einstein's photoelectric equation, we have

$$KE = E - \phi$$

Here, KE is the kinetic energy of the emitted photoelectrons,

E is the energy of the photons and

ϕ is the work function of the material.

Hence, we get

$$KE = 10.2 - 3.57$$

$$= 6.63 \text{ eV}$$

$$= 6.63 \times 1.6 \times 10^{19} \text{ J}$$

Therefore, the threshold frequency will be

$$KE = h\nu_0 = 6.63 \times 1.6 \times 10^{19} \text{ J}$$

$$\nu_0 = \frac{KE}{h} = \frac{6.63 \times 1.6 \times 10^{19}}{6.63 \times 10^{-34}} = 1.6 \times 10^{15} \text{ Hz}$$

42. ABC is an equilateral triangle. O is its centre.

Hence, the perpendicular distance from the centre to all the three sides is the same, say 'x'.

Now, considering the counterclockwise torque on the system, we get

$\tau_1 + \tau_2 - \tau_3 = 0$

$\Rightarrow \tau_1 + \tau_2 = \tau_3$

Torque is the product of force and perpendicular distance from the central axis.

$F_1 x + F_2 x = F_3 x$

$\Rightarrow F_1 + F_2 = F_3$

43. From the given output figure, the following truth table can be made.

A (input)	B (input)	C (output)
0	0	0
1	0	1
1	1	1
0	1	1

Judging from the table, we can say that the gate is an OR gate.

44. The charge q is placed at one of the corners of the cube.

Now, this charge q can be surrounded by 8 cubes in all such that it becomes the centre of the larger cube.

Now, the flux through the entire cube will be

$\phi = \frac{q}{\varepsilon_0}$

This flux will be divided into 8 parts. So, the flux through the given small cube is

$\phi = \frac{q}{8\varepsilon_0}$

45. The alpha particle of charge q = 2e moves in a circular orbit of radius R in a magnetic field B.

Now, the radius of the orbit is

$R = \frac{mv}{qB} = \frac{p}{2eB}$

$\therefore p = 2eBR$ ..... (1)

The de Broglie wavelength associated with the alpha particle is

$\lambda = \frac{h}{p}$ ..... (2)

Substituting equation (1) in (2), we get

$$\lambda = \frac{h}{2eBR}$$

$$\therefore \lambda = \frac{6.63\times10^{-34}}{2\times1.6\times10^{-19}\times0.25\times0.83\times10^{-2}}$$

$$\therefore \lambda = 10\times10^{-13}\ m = 10^{-12}\ m = 0.01\times10^{-10}\ m$$

$$\therefore \lambda = 0.01\ \overset{o}{A}$$

46. An electromagnetic wave is represented by the equation

$$\vec{E} = E_0\cos(kz-\omega t)\hat{i}$$

It is given that $\vec{E} = 40\cos(kz-6\times10^8 t)\hat{i}$

Comparing the above two, we get $\omega = 6 \times 10^8$

Now, the wave velocity is

$$v = \frac{\omega}{k}$$

$$\therefore k = \frac{\omega}{v}$$

Substituting the values, we get the wave vector as

$$k = \frac{6\times10^8}{3\times10^8} = 2\ m^{-1}$$

47. The motion of a particle along a straight line is described by equation

$$x = 8+12t-t^3$$

Hence, the velocity of the particle is

$$v = \frac{dx}{dt} = 0+12-3t^2$$

It is given that velocity becomes zero after time t. So, we get

$$0+12-3t^2 = 0$$

$$\therefore 3t^2 = 12$$

$$\therefore t^2 = 4$$

$$\therefore t = 2\ s$$

Hence, after two seconds, the velocity of the particle will be zero.

Therefore, the retardation of the particle will be

$$a = \frac{dv}{dt} = 0-6t = -6t$$

$$\therefore a = -6\times = -12\ ms^{-2}$$

The negative sign indicates retardation, so its magnitude is a = 12 ms^{-2}.

48. The magnifying power of the telescope is

$$m = \frac{\text{Focal length of objective}}{\text{Focal length of eyepiece}} = \frac{f_o}{f_e} = 9$$

$$\Rightarrow f_o = 9f_e$$

It is given that $f_o + f_e = 20$ cm.

Hence, we get

$$f_o + f_e = 20$$

$$\therefore 9f_e + f_e = 20$$

$$\therefore 10f_e = 20$$

$$\therefore f_e = 2 \text{ cm}$$

Hence, the focal length of the objective is

$$f_o = 9f_e$$

$$\therefore f_o = 9 \times 2 = 18 \text{ cm}$$

49. The equation of a progressive wave is

$$y = a\sin\omega t$$

Therefore, for the two progressive waves, we get

$$y_1 = a_1 \sin\omega_1 t$$

$$y_2 = a_2 \sin\omega_2 t$$

The given progressive waves are

$$y_1 = 4\sin 600\pi t$$

$$y_2 = 5\sin 608\pi t$$

Comparing the equations with the given waves, we get

$$\omega_1 = 2\pi f_1 = 600\pi$$

$$\therefore f_1 = \frac{600}{2} = 300 \text{ Hz}$$

$$\omega_2 = 2\pi f_2 = 608\pi$$

$$\therefore f_2 = \frac{608}{2} = 304 \text{ Hz}$$

Hence, the number of beats generated will be

$$\text{Beats} = |f_1 - f_2| = |300 - 304| = 4$$

So, 4 beats will be generated.

Now, the maximum and minimum intensities are related to amplitudes as

$I_{max} = (a_1 + a_2)^2$

$I_{min} = (a_1 - a_2)^2$

Hence, the intensity ratio is

$$\frac{I_{max}}{I_{min}} = \frac{(a_1 + a_2)^2}{(a_1 - a_2)^2}$$

$$\frac{I_{max}}{I_{min}} = \frac{(4+5)^2}{(4-5)^2} = \frac{81}{1}$$

Hence, the correct option is (4).

50. The resistance of a wire depends on its length.

Hence, when two points A and B are considered for connecting a conductor, the length of the upper and lower parts of the ring would be different.

These two parts will be parallel to each other. So, we have

$$R_{eq} = \frac{R_1 R_2}{R_1 + R_2} \quad \text{..... (1)}$$

Now, we know that the resistance of a wire can be given in its resistance per unit length ρ and length ℓ as

$$R = \frac{\text{Resistance}}{\text{Unit length}} \times \text{length} = \rho\ell$$

Therefore, the resistance of the two parts of the wire will be

$R_1 = \rho\ell_1$ ..... (2)

$R_2 = \rho\ell_2$ ..... (3)

Substituting equations (2) and (3) in (1), we get

$$R_{eq} = \frac{\rho\ell_1 \times \rho\ell_2}{\rho\ell_1 + \rho\ell_2} = \rho\frac{\ell_1\ell_2}{\ell_1 + \ell_2}$$

It is given that $R_{eq} = \frac{8}{3}$, so we get

$$R_{eq} = \rho\frac{\ell_1\ell_2}{\ell_1 + \ell_2} = \frac{8}{3} \quad \text{..... (4)}$$

Now, it is given that the initial resistance of the wire is R0 = 12Ω.

That is

$R_0 = \rho\ell_1 + \rho\ell_2 = 12$

$\therefore \rho(\ell_1 + \ell_2) = 12$ ..... (5)

Dividing equations (4) and (5), we get

$$\frac{\rho\frac{\ell_1\ell_2}{\ell_1+\ell_2}}{\rho(\ell_1+\ell_2)}=\frac{\frac{8}{3}}{12}=\frac{8}{36}=\frac{2}{9}$$

$$\therefore \frac{\ell_1\ell_2}{(\ell_1+\ell_2)^2}=\frac{2}{9}$$

$$\therefore \frac{\ell_1\ell_2}{\ell_2^2\left(\frac{\ell_1}{\ell_2}+1\right)^2}=\frac{2}{9}$$

$$\therefore \frac{\ell_1}{\ell_2\left(\frac{\ell_1}{\ell_2}+1\right)^2}=\frac{2}{9}$$

$$\left(\frac{\ell_1}{\ell_2}+1\right)^2=\frac{9}{2}\frac{\ell_1}{\ell_2}$$

Expanding the above equation, we get

$$\left(\frac{\ell_1}{\ell_2}\right)^2+2\frac{\ell_1}{\ell_2}+1-\frac{9}{2}\frac{\ell_1}{\ell_2}=0$$

$$\left(\frac{\ell_1}{\ell_2}\right)^2-\frac{5}{2}\frac{\ell_1}{\ell_2}+1=0$$

This is of the form $ax^2 + bx + c = 0$. Hence, the solution is

$$\frac{\ell_1}{\ell_2}=\frac{\frac{5}{2}\pm\sqrt{\frac{25}{4}-4}}{2}=\frac{\frac{5}{2}\pm\sqrt{\frac{25-16}{4}}}{2}$$

$$\frac{\ell_1}{\ell_2}=\frac{\frac{5}{2}\pm\frac{3}{2}}{2}$$

$$\therefore \frac{\ell_1}{\ell_2}=\frac{\frac{5}{2}+\frac{3}{2}}{2} \quad \text{OR} \quad \frac{\ell_1}{\ell_2}=\frac{\frac{5}{2}-\frac{3}{2}}{2}$$

$$\therefore \frac{\ell_1}{\ell_2}=2 \text{ OR } \frac{1}{2}$$

Hence, the correct option is (4).

Biology

51. Within the Anopheles mosquito, the gametocytes mature into male and female gametes, fertilisation occurs and a motile zygote is formed within the lumen of the mosquito's gut.

52. The hindbrain in humans comprises pons, cerebellum and medulla oblongata.

53. Above the cochlea, receptors such as crista and macula are present in the vestibular apparatus which plays a significant role in maintaining body balance and posture.

54. Heterotrophic bacteria are major decomposers which help in curdling of milk, production of antibiotics and nitrogen fixation.

55. The viability of the sperm is several days, not 24 hours.

56. The process of evolution of different species in a given geographical area starting from a point and radiating to the other area of geography is called adaptive radiation. Examples: Darwin's finches and Australian marsupials

57. The figure shown is tubectomy in which the fallopian tubes are cut and ligated through a small incision in the abdomen or vagina.

58. High concentration of DDT disturbs calcium metabolism in birds which causes thinning of eggshell and their premature breaking.

59. In pBR322,
Ori – site of origin of replication
rop – proteins taking part in replication of plasmid
Hind III, ECORI – recognition sites of restriction endonucleases
amp^R and tet^R – antibiotic-resistant gene part

60. Common bottle cork – *Quercus robur* which contains suberin. Phellogen forms cork towards the outside and phelloderm towards the inside.

61. The Widal test is a test of blood serum which uses an agglutination reaction to diagnose typhoid fever.

62. The apical meristem comprises actively dividing cells which do not have a well-established vascular system for virus movement. The virus cannot move from cell to cell through plasmodesmata So, it is advisable to use the meristem for virus-free plants in micropropagation.

63. The upper part of the atmosphere is the stratosphere which produces a good ozone layer which protects the Earth from harmful ultraviolet radiations from the Sun.

64. Companion cells are connected with sieve elements by complex plasmodesmata.

65. The virus when cause pneumonia infects only the alveoli but common cold affects the nose, throat and sinuses.

66. Pheretima (earthworm) derives nutrition from decaying fallen leaves and soil organic matter.

67. RNA polymerase III forms tRNA in eukaryotes.

68. During daytime, the stomata remain closed in C4 plants. So, photorespiration is absent in C4 plants such as maize, sugarcane and millets.

69. Restriction fragment length polymorphism (RFLP) analysis is used to identify a change in the genetic sequence which occurs at a site where a restriction enzyme cuts.

Polymerase chain reaction (PCR) is used in amplification of DNA.
Both are used in DNA fingerprinting.

70. Adequate manganese (Mn) is required as it facilitates the photolysis of water molecules and provides energy for photosynthesis.

71. Biological oxygen demand (BOD) is a measure of organic matter present in water. It refers to the amount of oxygen consumed by microbes to decompose all the organic matter in one litre of water at 20°C for 5 days.

72. Transcription unit consists of promoter, structural gene and terminator.

73. The doctor friend offered blood group O as an individual with blood group O is a universal donor.

74. Golden rice is a vitamin A-rich variety developed by recombinant DNA technology and used in the treatment of vitamin A deficiency.

75. All the essential nutrients and 70–80% of electrolytes and water are reabsorbed by proximal convoluted tubules.

76. Self-pollination, autogamy and geitonogamy are prevented in dioecious flowers (male and female flowers are present on different plants). Examples: Papaya, mulberry, willow

77. Parietal placentation – Mustard
Free central placentation – Dianthus and Primula
Marginal placentation – Pea
Axial placentation – Tomato, China rose

78. Epinephrine and norepinephrine are secreted by the adrenal medulla in response to stress of any kind and during emergencies and are called emergency hormones or hormones of flight.

79. Phosphorus moves in a cycle through rocks, water, soil and sediments and organisms. Therefore, the phosphorus cycle is a sedimentary cycle.

80. A probe is a 15–30 long radioactive or non-radioactive segment of DNA or RNA which is used in hybridisation with the DNA segment.

81. Divergent evolution produces homologous structures. The bones of forelimbs of vertebrates are homologous structures.
Unrelated animals converging on the same form or structure, because that form is very adaptive in their common environment. This special case of evolution is called convergent evolution. Example: Eyes in octopus and mammals

82. Sporopollenin is the fatty substance present in the pollen wall and provides resistance against extreme conditions such as high temperature, acids and bases.

83. Motile sperms are found in both Cycas and Adiantum. The gymnosperms possess seeds and cambium which are absent in pteridophytes.

84. The significant trend in evolution in modern man is his increasing brain capacity. The brain size has significantly increased from Neanderthal man to modern man.

85. The main axis ends in a flower as the peduncle stops growing in the flowers of Solanum.

The flowers of Sesbania, Trifolium and Brassica show racemose inflorescence in which the main axis shows continuous growth and it does not end with a flower.

86. Ribosomal RNA is synthesised in the nucleolus and is combined with proteins from the cytoplasm which are imported into the nucleolus where they form ribosomes.

87. The enzyme recombinase is involved in the pachytene stage of meiosis I. It catalyses the process of crossing over leading to the recombination of genetic material on the two chromosomes.

88. The food chain has to continue with primary, secondary and tertiary consumers. The primary consumers are herbivores (insects), the secondary consumers are the carnivores frog (consumes insects) and cobra (consumes the frog) and the tertiary consumer is the eagle (consumes the cobra).

89. Phyllode is a modification of leaf (petiole) which bears an axillary bud. Example: *Acacia melanoxylon*

90. The level 'primary consumers' (PC) is 'insects' and the level 'secondary consumers' (SC) is 'small insectivorous birds'.

91. *Monascus purpureus* is yeast used in the production of statins which are blood cholesterol-lowering agents.

92. The first stage of photorespiration involves the formation of glycolate in the chloroplasts. Further reactions of the glycolate pathway occur in the mitochondria and peroxisomes, and eventually, a compound is formed which is returned to the chloroplasts, where the process began.

93. The active transport of nutrients takes place with the utilisation of ATP. The apoplastic movement of water occurs exclusively through the cell wall without crossing any membrane, while the symplastic movement occurs from cell to cell through the plasmodesmata.

94. Man with normal vision – XY
His colour blind father – X^cY
Women's colourblind father – X^cY
In colourblindness, the genes are present on the X chromosome. As males have only one X chromosome, it is expressed in them and the females can be carriers in the heterozygous condition (X^cX) and suffers in the homozygous condition (X^cX^c).

Gametes	X	Y
X^c	X^cX	X^cY
X	XX	XY

Of the two daughters, one is a colourblind carrier (X^cX) and the other is normal (XX). So, the chance of the first daughter or any daughter of this couple being colourblind is 0%.

95. Signals for parturition originate from the fully developed foetus and the placenta involving a complex neuroendocrine mechanism. This is also called the foetal ejection reflex.

96. Myocardial infarction occurs because of thrombosis (blood clotting) which forms inside the coronary artery. The clot-busting medicine streptokinase can be given that eliminates the clots clearing the blood vessel.

97. Cancer cells do not show the property of contact inhibition (the tendency of the cells to end growth and division when in contact with other cells).

98. Michelia flower has several pistils each consisting of a single carpel.

99. Stratification refers to formation or deposition of layers as of rock or sediments. It is not a unit of the ecosystem.

100. Pregnancy can be confirmed by detecting the presence of human chorionic gonadotropin (HCG) in blood or urine of the pregnant woman. The main function of HCG is to maintain the corpus luteum to allow the secretion of progesterone and oestrogen. Progesterone enriches the uterus with a thick lining of blood vessels and capillaries so that it can sustain the growing foetus.

101. There are three biodiversity hotspots in India—Western Ghats, Eastern Himalayas and Indo- Burma region.

102. Bryophytes bear protonemal and leafy stage.
Female gametophyte is not free-living.
Antheridiophores and archegoniophores are present in Marchantia (bryophyte).
Origin of seed habit was first seen in Selaginella.

103. Cell membrane does not differ in *E. coli* and *Chlamydomonas*.

104. Cyanobacteria are said to be blue-green algae because they looked like green algae when they were discovered. Cyanobacteria contain the photosynthetic pigments chlorophyll (green) and photocyanin (blue).

105. Zygote intrafallopian transfer (ZIFT) is an assisted reproductive procedure similar to *in vitro* fertilisation and embryo transfer, the difference being that the fertilised embryo is transferred into the fallopian tube instead of the uterus.

106. Vector DNA – site for cloning

107. The fungus represents about 80,000 known species which include yeast, rust, smut, mildews, moulds and mushrooms.

108. Polymorphonuclear leucocytes and monocytes are examples of cellular barriers providing innate immunity.

109. Phosphorus is a constituent of cell membranes, all nucleic acids and certain proteins.

110. The anxiety of eating and consuming spicy food may result in indigestion.

111. Leydig cells are thought to be a source of androgens. In males, the interstitial cells of Leydig, located in the connective tissue surrounding the sperm-producing tubules of the testes, are responsible for the production and secretion of testosterone.

112. Erythrocytes in mammals are enucleate when mature, i.e. they lack a cell nucleus. In comparison, the erythrocytes of frog do contain a nucleus.

113. Pila (gastropod/snail) are Molluscs which possess radula. All molluscs have an unsegmented body.

114. Ribosomes contain both rRNA and proteins which form 62% RNA and 38% protein formed into two complexes.

115. Cirrhosis is an abnormal liver condition in which there is irreversible scarring of the liver. The main causes are sustained excessive alcohol consumption.

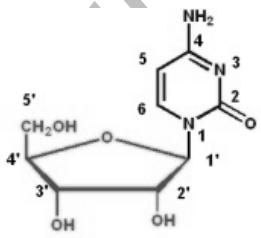
116. DNA polymerase used in PCR is Taq Polymerase obtained from *Thermus aquaticus* which remains active at high temperature inducing denaturation of double-stranded DNA.

117. All viruses do not possess helical symmetry.

118. A short modified underground stem surrounded by usually fleshy modified leaves which contain stored food is the onion bulb.

119. Fig – Developed by hypanthodium inflorescence (The receptacle becomes spherical with a cavity inside. It opens to the outside with a small opening.)
Pineapple – Developed by spike inflorescence (Simple inflorescence which does not have a pedicel.)
Mulberry – Developed by catkin inflorescence (An inflorescence consisting of a spike, usually hanging, of much reduced flowers of either sex.)

120. The given figure is that of a nucleoside (nucleotide + sugar). The figure is a nucleotide and 'X' denotes a sugar. A ribose and nitrogenous base are covalently joined by a glycosidic bond to form a nucleoside molecule:



121. Glomus which is an endomycorrhiza helps in the absorption of nutrition (phosphorus from soil).

122. Neanderthal man who lived 1, 00,000 to 4, 00,000 years ago had short stature, heavy eyebrows, large jaws with heavy teeth and stocky bodies.

123. Sequence of DNA – ATCTG
Sequence of RNA – UAGAC

124. Intracellular receptors are used specifically by steroid hormones such as cortisol, aldosterone, testosterone, oestrogen and progestogen. Steroid hormones are lipid-soluble; therefore, they diffuse through the cell membrane and gain direct access to the cell. Inside, they bind to steroid receptors. This forms a hormone–receptor complex. This complex then binds to parts of DNA in the nucleus of the cell called hormone-responsive elements. The binding process changes the physical shape of the

DNA in the nucleus and means that the pattern of gene expression is altered in that cell.

125. Nuclear membrane is absent in Nostoc as it is a prokaryote. *Penicillium*, *Agaricus* and *Volvox* are eukaryotes.

126. Collagen, a structural protein, is found in multiple tissues in multiple species.

127. The diplontic life cycle is present in all seed-bearing plants (gymnosperms and angiosperms). Mosses have a haplodiplontic life cycle. A multicellular fungus forms a separate kingdom as they are not part of Plantae such as algae and bryophytes (mosses). The multicellular fungi are heterotrophic in nature, whereas others are photosynthetic.

128. Paramoecium and Plasmodium belong to Kingdom Protozoa, whereas Penicillium belongs to Kingdom Fungi (Ascomycetes).
Lichen is a composite organism formed by symbiotic association between algae and fungi.
Saccharomyces cerevisiae is yeast (Baker's yeast) used in making bread and ethanol.
Nostoc and Anabaena are examples of cyanobacteria which help in nitrogen fixation.

129. Seed setting is assured in Commelina without the presence of pollination.

130. Yeast (*Saccharomyces cerevisiae*) is used in making bread and beer by the process of fermentation.

131. The formula of amino acid comprises
(i) a carboxyl group – –COOH
(ii) an amine group – $–NH_2$
(iii) an atom of hydrogen – H
(iv) a variable radical – –R (functional group)
So, an amino acid is a carboxylic acid which has an amine group attached to it.

132. The pyramid of number for a forest is partially upright. In a forest, a limited number of producers support a greater number of herbivores, which in turn support lesser number of carnivores.

133. Glucagon is secreted by the alpha cells of the islets of Langerhans and stimulates glycogenolysis.
Secretion of thymosin is stimulated with the onset of puberty.
FSH binds with specific receptors on the ovarian cell membrane.
FSH stimulates secretion of oestrogen, progesterone and testosterone.

134. Closed bundles lack cambium and are unable to continue growth laterally.

135. Workers in mines are prone to dust from grinding. They suffer from lung fibrosis.

136. As DNA is transcribed into RNA, it needs to be edited to remove non-coding regions or introns and to join the coding regions (exons). This process is called RNA splicing.

137. The F_2 generation with both genotypic and phenotypic ratio of 1:2:1 can be a monohybrid cross with incomplete dominance.
If we cross two heterozygous plants – tall plant (TT), medium (Tt) and short plant (tt), the genotypic ratio will be 1:2:1 (TT – 25%, Tt – 50% and tt – 25%) and the phenotypic ratio will also be 1:2:1.

Parents Tt × Tt

Gametes T t T t

F_1 progeny

	T	t
T	TT	Tt
t	Tt	tt

138. The following diagram shows the stage of Prophase I of Meiosis I. In Prophase I, the duplicated homologous chromosomes pair and crossing over occurs.
Crossing-over is the process which can give rise to genetic recombination. At this point, each homologous chromosome pair is visible as a bivalent (tetrad), each consisting of two sister chromatids. The sites of crossing-over are seen as criss-crossed non-sister chromatids and are called chiasmata.

139. People living at high altitudes develop more RBCs in the bone marrow which reduces oxygen haemoglobin affinity. So, these people will have polycythaemia (more number of RBC in blood) after six months.

140. The particle bombardment method starts with coating tungsten or gold particles (microprojectiles) with plasmid DNA. The coated particles are then coated on a macrocarrier, which is accelerated with air pressure and shot into the plant tissue on a Petri plate.

141. An important source of available nitrogen in flooded rice fields is the water fern Azolla which associates with the cyanobacterium Anabaena. The Azolla–Anabaena association can fix as much as 0.5 kg of atmospheric nitrogen per hectare per day.

142. Muscular dystrophy – appears in infancy and middle age
Osteoporosis – appears at advance age, leading to fractures and decrease in bone mass
Myasthenia gravis – neuromuscular disease characterised by varying degree of weakness of skeletal muscles of the body
Gout – stiffness and swelling of joints because of deposition of uric acid

143. As maize is a monocot plant, the vascular bundles contain water-containing cavities.

144. Na^+ and K^+ ions move across the cell membrane by active transport.
Proteins make up roughly half the cellular mass of the cell membrane.
The phospholipid molecules are arranged in two layers in the plasma membrane with the heads of the molecules facing outwards.
Singer and Nicolson proposed the fluid mosaic model of the cell membrane.

145. Gymnosperms also called softwood spermatophytes because they lack thick walled tracheids or xylem fibres

146. Coconut water and the edible part of the coconut form the inner part of the pericarp, i.e. the endocarp layer which is fleshy and nutritious.

147. Vexillary aestivation is the arrangement of petals in which the standard petal is large and overlaps other petals. This type of aestivation is found in Family Fabaceae (peas, beans etc).

148. Trichoderma species are used to manage certain plant pathogens. Trichoderma is used to treat the spread of fungal and bacterial growth on tree wounds.

149. Male cockroaches (*Periplaneta americana*) possess a pair of short thread-like anal styles.

150. Nutritional consumption or intake is mostly by Monera.

Chemistry

151. Aluminium is extracted from alumina (Al_2O_3) by electrolysis of a molten mixture of $Al_2O_3 + Na_3AlF_6 + CaF_2$

152.

$pH = 12$

$pH + pOH = 14$

$\therefore pOH = 2$

$pOH = -\log_{10}[OH^-]$

$2 = -\log[OH^-]$

$\log[OH^-] = -2$

$\therefore [OH^-] = Al(-2) = 0.01 = 10^{-2}$

Now, $Ba(OH)_2 \rightarrow Ba^{+2} + 2OH^-$

s 2s

$K_{sp} = s \times (2s)^2 = s \times 4s^2 = 4s^3$

$2s = 10^{-2}$

$\therefore s = 5 \times 10^{-3}$

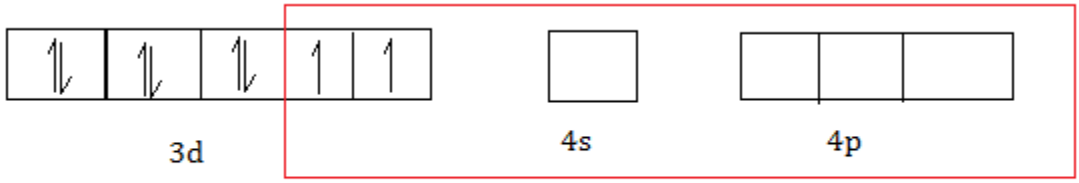
$K_{sp} = 4s^3 = 4(5 \times 10^{-3})^3 = 500 \times 10^{-9} = 5 \times 10^{-7}$

153. $Cl_2 + NaOH \rightarrow NaCl + NaClO_3$

154. Subshell 4f can hold 14 electrons.

155. $_{28}Ni = [Ar]\ 3d^8\ 4s^2$

$Ni^{2+} = [Ar] 3d^8$



sp^3d^2

$[Ni(NH_3)_6]^{2+}$ is a weak ligand with two unpaired electrons.

156. $R = k[A]^x[B]^y$ .....(i)

$2R = k[A]^x[B]^{2y}$.....(ii)

$8R = k[A]^{2x}[B]^{2y}$.....(iii)

From eqns. (ii) and (iii),

$x = 2$

From eqns. (i) and (ii),

$y = 1$

Hence, rate $= k[A]^2[B]^1$

157. Because disorder increases, entropy increases.

$\Delta S = +ve$

The reaction is exothermic, so $\Delta H = -ve$

We also know that

$\Delta G = \Delta H - T\Delta S$

$\Delta G = -ve - T(+ve)$

Hence, as the temperature increases, the value of ΔG decreases.

158. Magnetite is a mineral of iron.

159. In the Freundlich adsorption isotherm, the value of 1/n is always between 0 and 1.

160. The pH value is the highest for $BaCl_2$ solution because it is a salt of the strong acid HCl and the strong base $Ba(OH)_2$. As a result, the aqueous solution of the neutral salt has pH 7.

161.

Using Graham's law of effusion

$$\frac{r_1}{r_2} = \sqrt{\frac{M_{W2}}{M_{W1}}} = \frac{V_B T_A}{T_B . V_A}$$

$$\sqrt{\frac{M_{W2}}{M_{W1}}} = \frac{V_1 x t_2}{t_1 x V_2}$$

$$\sqrt{\frac{36}{M_{W1}}} = \frac{4}{3}$$

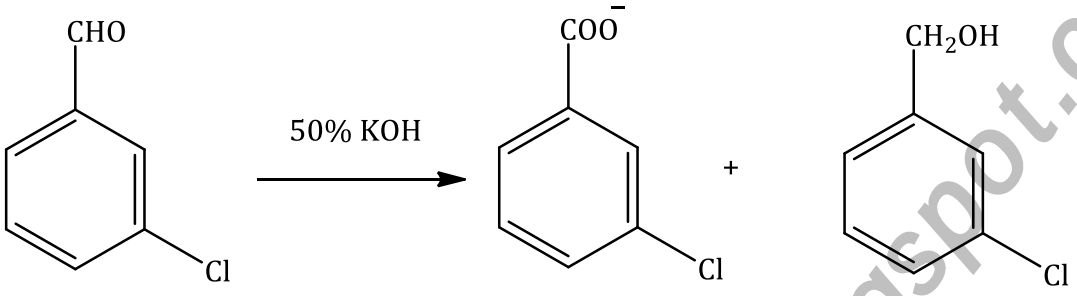
$$M_{W1} = \frac{36x9}{16} = 20.25$$

162. $_{37}Rb = [Kr]5s^1$

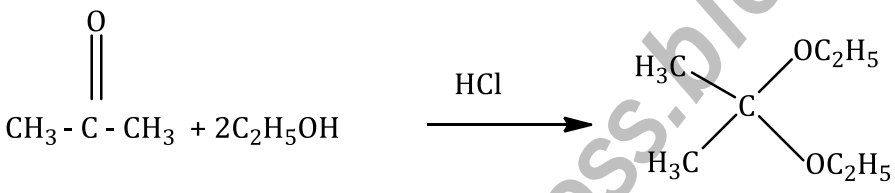
$n = 5, l = 0, m = 0, s = +1/2$

163. In N_3H, the oxidation number of N is $-1/3$.

164.



165.



166. For fcc,

$$r = \frac{a}{2\sqrt{2}}$$

$$\text{So the diameter} = \frac{a}{\sqrt{2}} = \frac{408}{1.414} = 288.5\text{pm}$$

167. Enzymes are the least reactive at optimum temperature.

168. Change in temperature = 100 – 10 = 90°C
Hence, n = 9
So, when the temperature is increased from 10°C to 100°C,
the rate = $2^n = 2^9 = 512$ times.

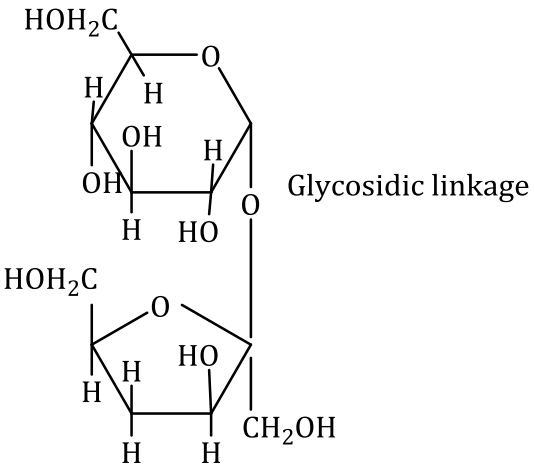
169. Deficiency of vitamin B1 causes beri-beri.

170. Toluene is more reactive towards electrophilic nitration because of the +R effect of the methyl group.

171. Buffer solutions have constant acidity and alkalinity because these give unionised acid or base on reaction with added acid or alkali.

172. $CF_3COOH > CCl_3COOH > HCOOH > CH_3COOH$
The presence of electron-withdrawing group (-I effect) makes the acid more acidic.

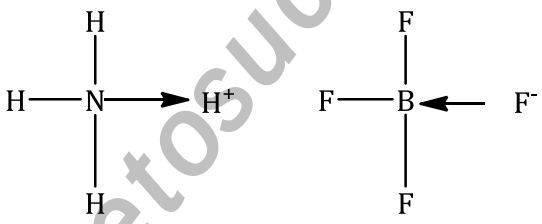
173. α -D-glucopyranose and β -D-fructofuranose



174.

$$\Delta S = \frac{\Delta H}{T} = \frac{1.435 \times 1000}{273} = 5.26 \text{cal/(mol K)}$$

175.



176. Bond order of 1.5 is shown by O_2^-

177. Neoprene is a polymer of chloroprene (CH_2=C(Cl) CH=CH_2). So, it is an addition polymer.

178. CH_3 - Br $\xrightarrow{KCN}$ CH_3CN $\xrightarrow{H_3O+}$ CH_3COOH $\xrightarrow[ether]{LiAlH_4}$ CH_3CH_2OH

179. The correct name should be 3 bromo prop-1-ene.

180. Number of octahedral voids = number of atoms in the closed packed structure
Number of atoms = 1
So, number of octahedral voids = 1

181. $2Cu_2O + Cu_2S \rightarrow 6Cu + SO_2$

182. Steel contains iron and carbon.

183. $C_2O_4H_2 + KClO_3 + H_2SO_4 \rightarrow K_2SO_4 + CO_2 + Cl_2 + H_2O$
Maximum change in oxidation number is observed for chlorine from +5 to 0.

184. Lithium on heating in air forms Li_2O.
$4Li + O_2 \rightarrow 2Li_2O$

185. As the size of alkali metal ions increases, the adsorption of hydrated metal ions on an ion-exchange resin decreases.
So, the ease of adsorption follows the order
$Rb^+ < K^+ < Na^+ < Li^+$

186. Photochemical smog causes irritation in the eyes and throat.

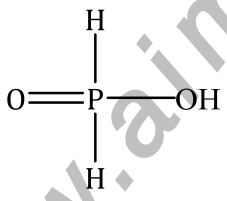
187. $C_6H_5CH_2CHO$ does not give an iodoform test. CH_3CHO on treating with NaOH and I_2 gives yellow crystals of iodoform.
$CH_3CHO + 3I_2 + 4NaOH \rightarrow CHI_3 + HCOONa + 3NaI + 3H_2O$
$C_6H_5CH_2CHO + I_2 + NaOH \rightarrow$ No reaction

188. $Na_2Cr_2O_7$ is not preferred over $K_2Cr_2O_7$ in volumetric analysis because $Na_2Cr_2O_7$ is hygroscopic in nature.

189. $H_2O_{(l)} \rightarrow H_2O_{(g)}$
$\Delta H = \Delta E + \Delta nRT$
$40.66 = \Delta E + 1 \times 8.314 / 1000 \times 373$
$\Delta E = 37.5$ kJ

190. Among isoelectronic species, the ionic radius increases with an increase in –ve charge or decrease in +ve charge.

191.



H_3PO_2 has only one replaceable hydrogen atom, so it is a monoprotic acid.

192. The protecting power of a lyophilic colloidal sol is expressed in gold number.

193. $Fe_2(SO_4)_3 \rightarrow Fe_2O_3 + 3SO_3$

194. $P = P'_A + P'_B$.....(I)
We know $P'_A = P_A X_A$

$P'_B = P_B X_B$

Substituting the values in equation (I),

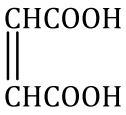
$P = P_A X_A + P_B X_B$

Since $X_A + X_B = 1$

$P = P_A X_A + P_B(1 - X_A) = P_A X_A + P_B - P_B X_A$

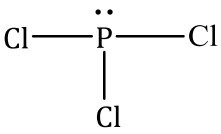
So, $P = P_B + X_A(P_A - P_B)$

195.



Maleic acid has no chiral centre and so is optically inactive. Hence, it does not exhibit optical isomerism.

196. PCl_3 contains three bond pairs and one lone pair.

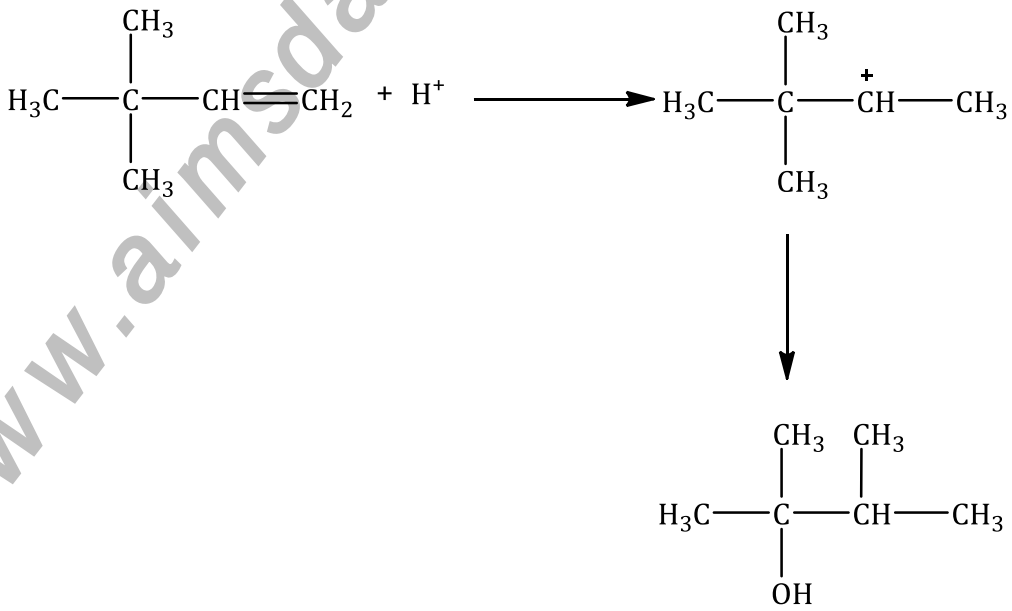


197. $\overset{0}{\Lambda}_m(NH_4Cl) + \overset{0}{\Lambda}_m(NaOH) - \overset{0}{\Lambda}_m(NaCl)$

198. Bond order of O_2^{2-}, B_2 is 1.

199. Nylon-66 is a fibre and not an elastomer.

200.



NEET - 2013
(Physics, Chemistry and Biology)
Code W

Time: 3 hrs **Total Marks: 720**

General Instructions:

1. The Answer sheet is inside this Text booklet. When you are directed to open the text booklet, take out the Answer Sheet and fill in the particulars on side – 1 and side – 2 carefully with blue/black ball point pen only.
2. The test is of 3 hours duration and consists of 180 questions. Each question carries 4 marks. For each correct response the candidate will get 4 marks. For each incorrect response, one mark will be deducted. The maximum marks are 720.
3. Use Blue / Black ball point pen only for writing particulars on this page / marking responses.
4. Rough work is to be done on the space provided for this purpose in the text booklet only.
5. On completion of the test, the candidate must handover the answer sheet to the invigilator in the room/ Hall. The candidates are allowed to take away this text booklet with them.
6. Make sure that the CODE printed on side – 2 of the answer sheet is the same as that on this booklet, In case of discrepancy, the candidate should immediately report the matter to the invigilator for the replacement of both the test Booklet and the Answer Sheet.
7. The candidates should ensure that the Answer sheet is not folded. Do not make any stray marks on the Answer sheet. Do not write your roll no. anywhere else except in the specified space in the Test booklet / Answer Sheet.
8. Use of white fluid for correction is not permissible on the Answer Sheet.

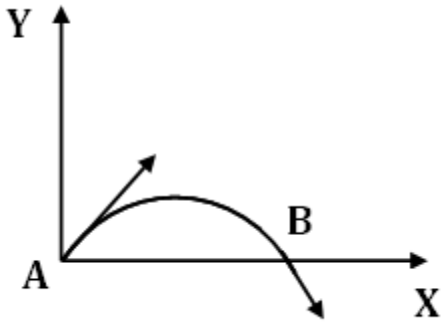
Physics

1. In an experiment four quantities a, b, c and d are measured with percentage error 1%, 2%, 3% and 4% respectively. Quantity P is calculated as follows: $P=\frac{a^2b^2}{cd}$.

% error in P is

(1) 14 %
(2) 10 %
(3) 7%
(4) 4%

2. The velocity of a projectile at the initial point A is $(2\hat{i}+3\hat{j})$ m/s. Its velocity (in m/s) at point B is



(1) $-2\hat{i}-3\hat{j}$

(2) $-2\hat{i}+3\hat{j}$

(3) $2\hat{i}-3\hat{j}$

(4) $2\hat{i}+3\hat{j}$

3. A stone falls freely under gravity. It covers distances h_1, h_2 and h_3 in the first 5 seconds, the next 5 seconds and the next 5 seconds respectively. The relation between h_1, h_2 and h_3 is

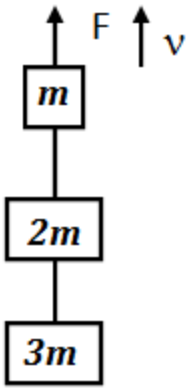
(1) $h_1 = 2h_2 = 3h_2$

(2) $h_1 = \frac{h_1}{3} = \frac{h_3}{5}$

(3) $h_2 = 3h_1$ and $h_3 = 3h_2$

(4) $h_1 = h_2 = h_3$

4. Three blocks with masses m, 2m and 3m are connected by strings, as shown in the figure. After an upward force F is applied on block m, the masses move upward at constant speed v. What is the net force on the block of mass 2 m? (g is the acceleration due to gravity)



(1) Zero
(2) 2 mg
(3) 3 mg
(4) 6 mg

5. The upper half of an inclined plane of inclination θ is perfectly smooth while lower half is 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 lower half of the plane is given by

(1) $\mu=\frac{1}{\tan\theta}$

(2) $\mu=\frac{2}{\tan\theta}$

(3) $\mu = 2\tan\theta$

(4) $\mu = \tan\theta$

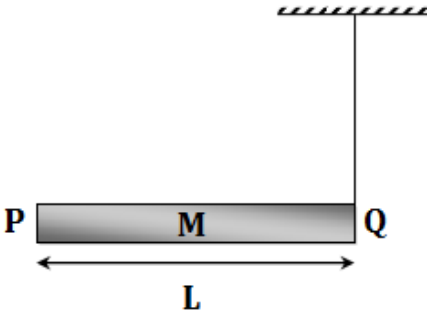
6. A uniform force of $\left(3\hat{i}+\hat{j}\right)$ newton acts on a particle of mass 2 kg. Hence the particle is displaced from position $\left(2\hat{i}+\hat{j}\right)$ metre to position $\left(4\hat{i}+3\hat{j}-k\right)$ metre. The work done by the force on the particle is

(1) 9 J
(2) 6 J
(3) 13 J
(4) 15 J

7. An explosion breaks a rock into three parts in a horizontal plane. Two of them go off at right angles to each other. The first part of mass 1 kg moves with a speed of 12 ms^{-1} and the second part of mass 2 kg moves with 8 ms^{-1} speed. If the third part flies off with 4 ms^{-1} speed, then its mass is

(1) 3 kg
(2) 5 kg
(3) 7 kg
(4) 17 kg

8. A rod PQ of mass M and length L is hinged at end P. The rod is kept horizontal by a massless string tied to point Q as shown in figure. When string is cut, the initial angular acceleration of the rod is



(1) $\frac{3g}{2L}$
(2) $\frac{g}{L}$
(3) $\frac{2g}{L}$
(4) $\frac{2g}{3L}$

9. A small object of uniform density rolls up a curved surface with an initial velocity 'v'. It reaches up to a maximum height of $\frac{3v^2}{4g}$ with respect to the initial position.

The object is

(1) Ring
(2) Solid sphere
(3) Hollow sphere
(4) Disc

10. A body of mass 'm' taken from the earth's surface to the height equal to twice the radius (R) of the earth. The change in potential energy of body will be

(1) Mg2R

(2) $\frac{2}{3}$mgR

(3) 3mgR

(4) $\frac{1}{3}$mgR

11. Infinite number of bodies, each of mass 2 kg is situated on x-axis at distance 1 m, 2 m, 4 m, 8 m, respectively, from the origin. The resulting gravitational potential due to this system at the origin will be

(1) –G

(2) $-\frac{8}{3}$G

(3) $-\frac{4}{3}$G

(4) -4G

12. The following four wires are made of the same material. Which of these will have the largest extension when the same tension is applied?

(1) Length = 50 cm, diameter = 0.5 mm

(2) Length = 100 cm, diameter = 1 mm

(3) Length = 200 cm, diameter = 2 mm

(4) Length = 300 cm, diameter = 3 mm

13. The wettability of a surface by a liquid depends primarily on

(1) Viscosity

(2) Surface tension

(3) Density

(4) Angle of contact between the surface and the liquid

14. The molar specific heats of an ideal gas at constant pressure and volume are denoted by C_p and C_v respectively. If $\gamma = \frac{C_p}{C_\upsilon}$ and R is the universal gas constant, then C_υ is equal to

(1) $\frac{1+\gamma}{1-\gamma}$

(2) $\frac{R}{(\gamma-1)}$

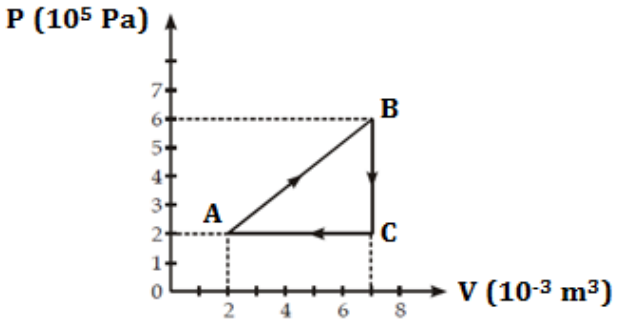
(3) $\frac{(\gamma-1)}{R}$

(4) γR

15. A piece of iron is heated in a flame. It first becomes dull red then becomes reddish yellow and finally turns to white hot. The correct explanation for the above observation is possible by using

(1) Stefan's Law
(2) Wien's displacement Law
(3) Kirchoff's Law
(4) Newton's Law of cooling

16. A gas is taken through the cycle A $\rightarrow$ B $\rightarrow$ C $\rightarrow$ A, as shown. What is the net work done by the gas?

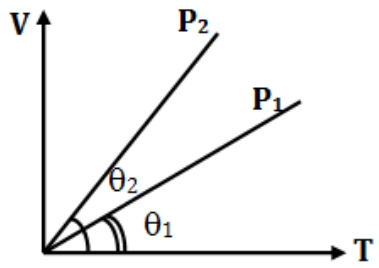


(1) 2000 J
(2) 1000 J
(3) Zero
(4) -2000 J

17. During an adiabatic process, the pressure of a gas is found to be proportional to the cube of its temperature. The ratio of $\frac{C_p}{C_v}$ for the gas is

(1) $\frac{4}{3}$
(2) 2
(3) $\frac{5}{3}$
(4) $\frac{3}{2}$

18. In the given (V – T) diagram, what is the relation between pressures P_1 and P_2?



(1) $P_2 = P_1$
(2) $P_2 > P_1$
(3) $P_2 < P_1$
(4) Cannot be predicted

19. The amount of heat energy required to raise the temperature of 1 g of Helium at NTP, from T_1K to T_2K is

(1) $\frac{3}{8}N_a k_B(T_2-T_1)$

(2) $\frac{3}{2}N_a k_B(T_2-T_1)$

(3) $\frac{3}{4}N_a k_B(T_2-T_1)$

(4) $\frac{3}{4}N_a k_B\left(\frac{T_2}{T_1}\right)$

20. A wave travelling in the +ve x-direction having displacement along y-direction as 1 m, wavelength 2πm and frequency of $\frac{1}{\pi}$ Hz is represented by

(1) $Y = \sin(x - 2t)$
(2) $Y = \sin(2\pi x - 2\pi t)$
(3) $Y = \sin(10\pi x - 20\pi t)$
(4) $Y = \sin(2\pi x - 2\pi t)$

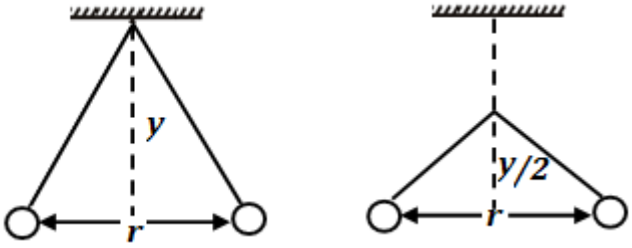
21. If we study the vibration of a pipe open at both ends, then the following statement is not true

(1) Open end will be anti-node
(2) Odd harmonics of the fundamental frequency will be generated
(3) All harmonics of the fundamental frequency will be generated
(4) Pressure change will be maximum at both ends

22. A source of unknown frequency gives 4 beats/s, when sounded with a source of known frequency 250 Hz. The second harmonic of the source of unknown frequency gives five beats per second, when sounded with a source of frequency 513 Hz. The unknown frequency is

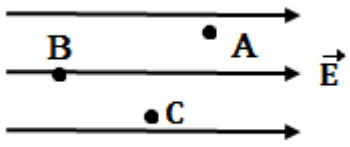
(1) 254 Hz
(2) 246 Hz
(3) 240 Hz
(4) 260 Hz

23. Two pith balls carrying equal charges are suspended from a common point by strings of equal length; the equilibrium separation between them is r. Now the strings are rigidly clamped at half the height. The equilibrium separation between the balls now become



(1) $\left(\frac{1}{\sqrt{2}}\right)^2$
(2) $\left(\frac{r}{\sqrt[3]{2}}\right)$
(3) $\left(\frac{2r}{\sqrt{3}}\right)$
(4) $\left(\frac{2r}{3}\right)$

24. A, B and C are three points in a uniform electric field. The electric potential is



(1) Maximum at A
(2) Maximum at B
(3) Maximum at C
(4) Same at all the three points A, B and C

25. A wire of resistance 4 Ω is stretched to twice its original length. The resistance of stretched wire would be

(1) 2 Ω
(2) 4 Ω
(3) 8 Ω
(4) 16 Ω

26. The internal resistance of a 2.1 V cell which gives a current of 0.2 A through a resistance of 10 Ω is

(a) 0.2 Ω
(b) 0.5 Ω
(c) 0.8 Ω
(d) 1.0 Ω

27. The resistances of the four arms P, Q, R and S in a Wheatstone's bridge are 10 ohm, 30 ohm, 30 ohm and 90 ohm, respectively. The e.m.f. and internal resistance of the cell are 7 volt and 5 ohm respectively. If the galvanometer resistance is 50 ohm, the current drawn from the cell will be

(1) 1.0 A
(2) 0.2 A
(3) 0.1 A
(4) 2.0 A

28. When a proton is released from rest in a room, it starts with an initial acceleration a_0 towards west. When it is projected towards north with a speed v_0 it moves with an initial acceleration $3a_0$ toward west. The electric and magnetic fields in the room are

(1) $\frac{ma_0}{e}$ west, $\frac{2ma_0}{ev_0}$ up

(2) $\frac{ma_0}{e}$ west, $\frac{2ma_0}{ev_0}$ down

(3) $\frac{ma_0}{e}$ east, $\frac{3ma_0}{ev_0}$ up

(4) $\frac{ma_0}{e}$ east, $\frac{3ma_0}{ev_0}$ down

29. A current loop in a magnetic field

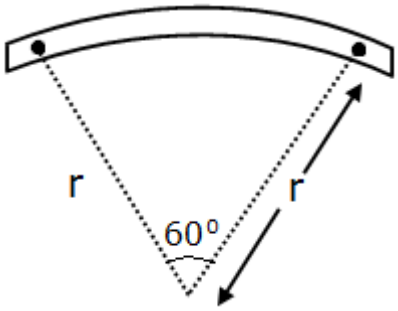
(1) Experiences a torque whether the field is uniform or non uniform in all orientations

(2) Can be in equilibrium in one orientation

(3) Can be in equilibrium in two orientations, both the equilibrium states are unstable

(4) Can be in equilibrium in two orientations, one stable while the other is unstable

30. A bar magnet of length l and magnetic dipole moment M is bent in the form of an arc as shown in figure. The new magnetic dipole moment will be



(1) M

(2) $\frac{3}{\pi}M$

(3) $\frac{2}{\pi}M$

(4) $\frac{M}{2}$

31. A wire loop is rotated in a magnetic field. The frequency of change of direction of the induced e.m.f. is

(1) Once per revolution

(2) Twice per revolution

(3) Four times per revolution

(4) Six times per revolution

32. A coil of self-inductance L is connected in series with a bulb B and an AC source. Brightness of the bulb decreases when

(1) Frequency of the AC source is decreased

(2) Number of turns in the coil is reduced

(3) A capacitance of reactance $X_C = X_L$ is included in the same circuit

(4) An iron rod is inserted in the coil

33. The condition under which a microwave oven heats up a food item containing water molecules most efficiently is

(1) The frequency of the microwaves must match the resonant frequency of the water molecules

(2) The frequency of the microwaves has no relation with natural frequency of water molecules.

(3) Microwaves are heat waves, so always produce heating

(4) Infra-red waves produce heating in a microwave oven

34. Ratio of longest wavelengths corresponding to Lyman and Balmer series in hydrogen spectrum is

(1) $\frac{5}{27}$

(2) $\frac{3}{23}$

(3) $\frac{7}{29}$

(4) $\frac{9}{31}$

35. The half life of a radioactive isotope 'X' is 20 years. It decays to another element 'Y' which is stable. The two elements 'X' and 'Y' were found to be in the ratio 1 : 7 in a sample of a given rock. The age of the rock is estimated to be

(1) 40 years

(2) 60 years

(3) 80 years

(4) 100 years

36. A certain mass of Hydrogen is changed to Helium by the process of fusion. The mass defect in fusion reaction is 0.02866 u. The energy liberated per u is

(given 1 u = 931 MeV)

(1) 2.67 MeV

(2) 26.7 MeV

(3) 6.675 MeV

(4) 13.35 MeV

37. For photoelectric emission from certain metal the cut-off frequency is ν. If radiation of frequency 2ν impinges on the metal plate, the maximum possible velocity of the emitted electron will be (m is the electron mass)

(1) $\sqrt{\frac{h\upsilon}{(2m)}}$

(2) $\sqrt{\frac{h\upsilon}{m}}$

(3) $\sqrt{\frac{2h\upsilon}{m}}$

(4) $2\sqrt{\frac{h\upsilon}{m}}$

38. The wavelength λ_e of an electron and λ_p of a photon of same energy E are related by

(1) $\lambda_p \propto \lambda_e^2$

(2) $\lambda_p \propto \lambda_e$

(3) $\lambda_p \propto \sqrt{\lambda_e}$

(4) $\lambda_p \propto \frac{1}{\sqrt{\lambda_e}}$

39. A plano-convex lens fits exactly into a plano concave lens. Their plane surfaces are parallel to each other. If lenses are made of different materials of refractive indices μ_1 and μ_2 and R is the radius of curvature of the curved surface of the lenses, then the focal length of the combination is

(1) $\frac{R}{2(\mu_1+\mu_2)}$

(2) $\frac{R}{2(\mu_1-\mu_2)}$

(3) $\frac{R}{(\mu_1-\mu_2)}$

(4) $\frac{2R}{(\mu_2-\mu_1)}$

40. For a normal eye, the cornea of eye provides a converging power of 40 D and the least converging power of the eye lens behind the cornea is 20 D. Using this information, the distance between the retina and the cornea - eye lens can be estimated to be
(1) 5 cm
(2) 2.5 cm
(3) 1.67 cm
(4) 1.5 cm

41. In Young's double slit experiment, the slits are 2 mm apart and are illuminated by photons of two wavelengths λ_1 = 12000 Å and λ_2 = 10000 Å. At what minimum distance from the common central bright fringe on the screen 2 m from the slit will a bright fringe from one interference pattern coincide with a bright fringe from the other?
(1) 8 mm
(2) 6 mm
(3) 4 mm
(4) 3 mm

42. A parallel beam of fast moving electrons is incident normally on a narrow slit. A fluorescent screen is placed at a large distance from the slit. If the speed of the electrons is increased, which of the following statements is correct?
(1) Diffraction pattern is not observed on the screen in the case of electrons
(2) The angular width of the central maximum of the diffraction pattern will increase
(3) The angular width of the central maximum will decrease
(4) The angular width of the central maximum will be unaffected

43. In a n-type semiconductor, which of the following statement is true?
(1) Electrons are majority carriers and trivalent atoms are dopants
(2) Electron are minority carriers and pentavalent atoms are dopants
(3) Holes are minority carriers and pentavalent atoms are dopants
(4) Holes are majority carriers and trivalent atoms are dopants

44. In a common emitter (CE) amplifier having a voltage gain G, the transistor used has transconductance 0.03 mho and current gain 25. If the above transistor is replaced with another one with transconductance 0.02 mho and current gain 20, the voltage gain will be

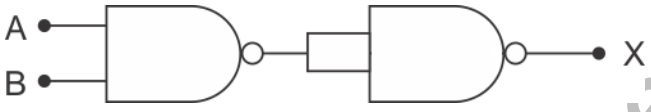
(1) $\frac{2}{3}G$

(2) 1.5 G

(3) $\frac{1}{3}G$

(4) $\frac{5}{4}G$

45. The output (X) of the logic circuit shown in figure will be



(1) $X=\overline{\overline{A}.\overline{B}}$

(2) $X=\overline{A\ B}$

(3) X = A.B

(4) $X=\overline{A+B}$

Chemistry

46. The value of Planck's constant is 6.63×10^{-34} Js. The speed of light is 3×10^{17} nm s^{-1}. Which value is closest to the wavelength in nanometer of a quantum of light with frequency of 6×10^{15} s^{-1}?
(1) 10
(2) 25
(3) 50
(4) 75

47. What is the maximum numbers of electrons that can be associated with the following set of quantum numbers?
n = 3, l = 1 and m = –1
(1) 10
(2) 6
(3) 4
(4) 2

48. What is the activation energy for a reaction if its rate doubles when the temperature is raised from 20°C to 35°C? (R = 8.314 J mol–1 K–1)
(1) 342 kJ mol^{-1}
(2) 269 kJ mol^{-1}
(3) 34.7 kJ mol^{-1}
(4) 15.1 kJ mol^{-1}

49. A hydrogen gas electrode is made by dipping platinum wire in a solution of HCl of pH = 10 and by passing hydrogen gas around the platinum wire at one atm pressure. The oxidation potential of electrode would be
(1) 0.059 V
(2) 0.59 V
(3) 0.118 V
(4) 1.18 V

50. A reaction having equal energies of activation for forward and reverse reactions has
(1) $\Delta S = 0$
(2) $\Delta G = 0$
(3) $\Delta H = 0$
(4) $\Delta H = \Delta G = \Delta S = 0$

51. At 25°C molar conductance of 0.1 molar aqueous solution of ammonium hydroxide is 9.54 $ohm^{-1}\ cm^2\ mol^{-1}$ and at infinite dilution its molar conductance is 238 $ohm^{-1}\ cm^2\ mol^{-1}$. The degree of ionisation of ammonium hydroxide at the same concentration and temperature is

(1) 2.080%
(2) 20.800%
(3) 4.008%
(4) 40.800%

52. Based on equation $E = -2.178 \times 10^{-18}\ J \left(\frac{Z^2}{n^2}\right)$ certain conclusions are written. Which of them is **not** correct?

(1) The negative sign in equation simply means that the energy of electron bound to the nucleus is lower than it would be if the electrons were at the infinite distance from the nucleus.
(2) Larger the value of n, the larger is the orbit radius.
(3) Equation can be used to calculate the change in energy when the electron changes orbit.
(4) For n = 1, the electron has a more negative energy than it does for n = 6 which means that the electron is more loosely bound in the smallest allowed orbit.

53. A button cell used in watches functions as following

$Zn_{(s)} + Ag_2O_{(s)} + H_2O_{(l)} \rightleftharpoons 2Ag_{(s)} + Zn^{2+}_{(aq)} + 2OH^-_{(aq)}$

If half cell potentials are

$Zn^{2+}_{(aq)} + 2e^- \rightarrow Zn_{(s)}; E^o = -0.76\ V$

$Ag_2O_{(s)} + H_2O_{(l)} + 2e^- \rightarrow 2Ag_{(s)} + 2OH^-_{(aq)}$,

$E^o = 0.34\ V$

The cell potential will be

(1) 1.10 V
(2) 0.42 V
(3) 0.84 V
(4) 1.34 V

54. How many grams of concentrated nitric acid solution should be used to prepare 250 mL of 2.0 M HNO_3? The concentrated acid is 70% HNO_3.

(1) 45.0 g conc. HNO_3
(2) 90.0 g conc. HNO_3
(3) 70.0 g conc. HNO_3
(4) 54.0 g conc. HNO_3

55. The number of carbon atoms per unit cell of diamond unit cell is
(1) 4
(2) 8
(3) 6
(4) 1

56. Maximum deviation from ideal gas is expected from
(1) $H_{2(g)}$
(2) $N_{2(g)}$
(3) $CH_{4(g)}$
(4) $NH_{3(g)}$

57. A metal has a fcc lattice. The edge length of the unit cell is 404 pm. The density of the metal is 2.72 g cm^{-3}. The molar mass of the metal is
(N_A Avogadro's constant = 6.02 x 10^{23} mol^{-1})
(1) 40 g mol^{-1}
(2) 30 g mol^{-1}
(3) 27 g mol^{-1}
(4) 20 g mol^{-1}

58. Dipole-induced dipole interactions are present in which of the following pairs?
(1) H_2O and alcohol
(2) Cl_2 and CCl_4
(3) HCl and He atoms
(4) SiF_4 and He atoms

59. A magnetic moment of 1.73 BM will be shown by one among the following
(1) $[Cu(NH_3)_4]^{2+}$
(2) $[Ni(CN)_4]^{2-}$
(3) $TiCl_4$
(4) $[CoCl_6]^{4-}$

60. Roasting of sulphides gives the gas X as a byproduct. This is a colorless gas with choking smell of burnt sulphur and causes great damage to respiratory organs as a result of acid rain. Its aqueous solution is acidic acts as a reducing agent and its acid has never been isolated. The gas X is
(1) H_2S
(2) SO_2
(3) CO_2
(4) SO_3

61. Which is the strongest acid in the following?

(1) H_2SO_4

(2) $HClO_3$

(3) $HClO_4$

(4) H_2SO_3

62. Which of the following is paramagnetic?

(1) CO

(2) O_2^-

(3) CN^-

(4) NO^+

63. Which of the following structure is similar to graphite?

(1) BN

(2) B

(3) B_4C

(4) B_2H_6

64. The basic structural unit of silicates is

(1) SiO^-

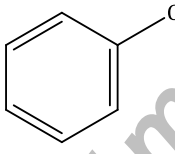
(2) SiO_4^{4-}

(3) SiO_3^{2-}

(4) SiO_4^{2-}

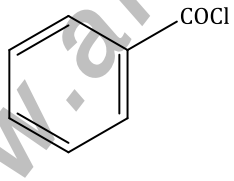
65. Reaction by which Benzaldehyde cannot be prepared?

(1)



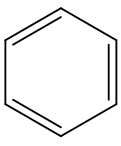
+ CrO_2Cl_2 in CS_2 followed by H_3O^+

(2)



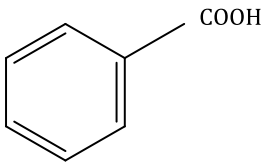
+ H_2 in presence of Pd - $BaSO_4$

(3)



+ CO + HCl in presence of anhydrous $AlCl_3$

(4)



+ Zn/Hg and conc.HCl

66. Which of the following does not give oxygen on heating?
(1) $KClO_3$
(2) $Zn(ClO_3)_2$
(3) $K_2Cr_2O_7$
(4) $(NH_4)_2Cr_2O_7$

67. Which of the following lanthanoid ions is diamagnetic?
(At.no.Ce=58, Sm = 62, Eu = 63, Yb = 70)
(1) Ce^{2+}
(2) Sm^{2+}
(3) Eu^{2+}
(4) Yb^{2+}

68. Identify the correct order of solubility in aqueous medium
(1) CuS > ZnS > Na_2S
(2) ZnS > Na_2S > CuS
(3) Na_2S > CuS > ZnS
(4) Na_2S > ZnS > CuS

69. XeF_2 is isostructural with
(1) TeF_2
(2) ICl_2^-
(3) $SbCl_3$
(4) $BaCl_2$

70. An excess of $AgNO_3$ is added to 100 mL of a 0.01 M solution of dichlorotetraaquachromium(III) chloride. The number of moles of AgCl precipitated would be
(1) 0.001
(2) 0.002
(3) 0.003
(4) 0.01

71. Which of these is least likely to act as a Lewis base?

(1) CO

(2) F^-

(3) BF_3

(4) PF_3

72. $KMnO_4$ can be prepared from K_2MnO_4 as per the reaction:

$$3MnO_4^{2-} + 2H_2O \rightarrow 2MnO_4^- + MnO_2 + 4OH^-$$

The reaction can go completion by removing OH^- ions by adding:

(1) HCl

(2) KOH

(3) CO_2

(4) SO_2

73. Which of the following is electron-deficient?

(1) $(CH_3)_2$

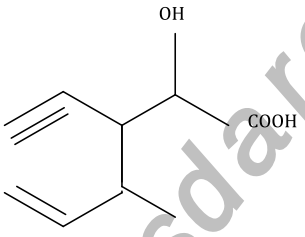
(2) $(SiH_3)_2$

(3) $(BH_3)_2$

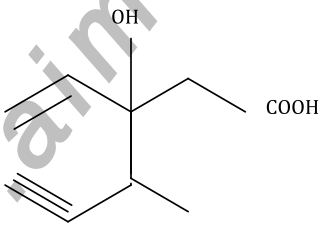
(4) PH_3

74. Structure of the compound whose IUPAC name is 3- Ethyl-2-hydroxy-4-methylhex-3-en-5-ynoic acid is

(1)



(2)



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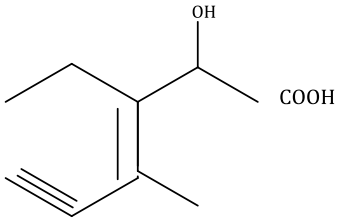

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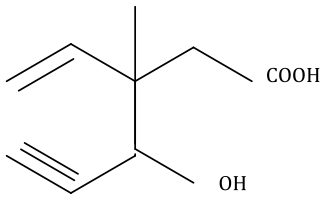


75. Which of these is not a monomer for a high molecular mass silicone polymer?
(1) $MeSiCl_3$
(2) Me_2SiCl_2
(3) Me_3SiCl
(4) $PhSiCl_3$

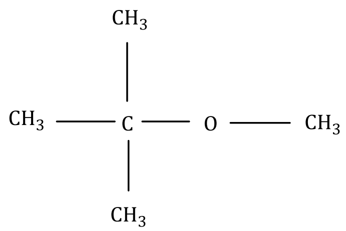
76. Which of the following statements about the interstitial compounds is incorrect?
(1) They retain metallic conductivity
(2) They are chemically reactive
(3) They are much harder than the pure metal
(4) They have higher melting points than the pure metal

77. Which one of the following molecules contains no π bond?
(1) CO_2
(2) H_2O
(3) SO_2
(4) NO_2

78. Antiseptics and disinfectants either kill or prevent growth of microorganisms. Identify which of the following statements is not true
(1) A 0.2% solution of phenol is an antiseptic while 1% solution acts as a disinfectant
(2) Chlorine and Iodine are used as strong disinfectants
(3) Dilute solutions of Boric acid and Hydrogen peroxide are strong antiseptics
(4) Disinfectants harm the living tissues

79. Among the following ethers, which one will produce methyl alcohol on treatment with hot concentrated HI?
(1) $CH_3 - CH_2 - CH_2 - CH_2 - O - CH_3$
(2) $CH_3 - CH_2 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - O - CH_3$

(3)



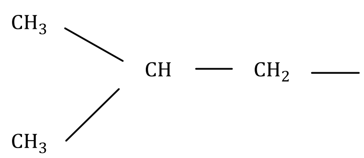
(4) $CH_3 - CH - CH_2 - O - CH_3$
with a CH_3 branch on the CH

80. Nylon is an example of:

(1) Polyester
(2) Polysaccharide
(3) Polyamide
(4) Polythene

81. The structure of isobutyl group in an organic compound is:

(1)

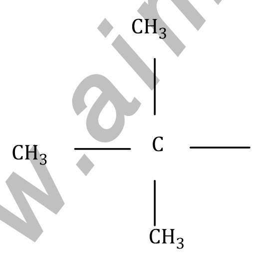


(2)

$CH_3 - CH - CH_2 - CH_3$
with an open bond on the CH

(3) $CH_3 - CH_2 - CH_2 - CH_2 -$

(4)



82. Nitrobenzene on reaction with conc. HNO_3/H_2SO_4 at 80-100°C forms which one of the following products?
(1) 1, 2-Dinitrobenzene
(2) 1, 3-Dinitrobenzene
(3) 1, 4-Dinitrobenzene
(4) 1, 2, 4-Trinitrobenzene

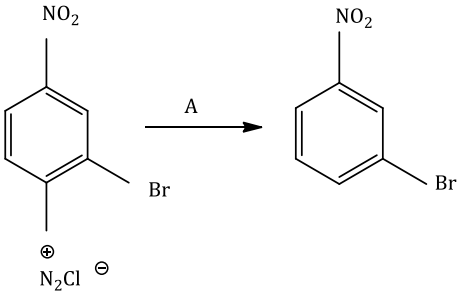
83. Some meta-directing substituents in aromatic substitution are given. Which one is most deactivating?
(1) $-C \equiv N$
(2) $-SO_3H$
(3) $-COOH$
(4) $-NO_2$

84. 6.02×10^{20} molecules of urea are present in 100 mL of its solution. The concentration of solution is
(1) 0.02 M
(2) 0.01 M
(3) 0.001 M
(4) 0.1 M

85. Which of the following is a polar molecule?
(1) BF_3
(2) SF_4
(3) SiF_4
(4) XeF_4

86. Which is the monomer of Neoprene in the following?
(1) $CH_2 = CH - C = CH_2$
(2) $CH_2 = \underset{\displaystyle CH_3}{\underset{|}{C}} - CH = CH_2$
(3) $CH_2 = \underset{\displaystyle Cl}{\underset{|}{C}} - CH = CH_2$
(4) $CH_2 = CH - CH \equiv CH_2$

87. In the reaction



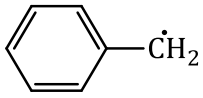
A is

(1) $HgSO_4/H_2SO_4$

(2) Cu_2Cl_2

(3) H_3PO_2 and H_2O

(4) H^+/H_2O

88. The radical  is aromatic because it has

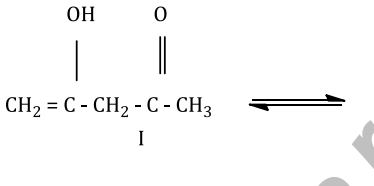
(1) 6 p-orbitals and 6 unpaired electrons

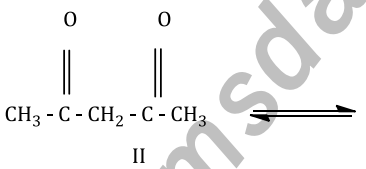
(2) 7 p-orbitals and 6 unpaired electrons

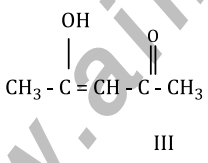
(3) 7 p-orbitals and 7 unpaired electrons

(4) 6 p-orbitals and 7 unpaired electrons

89. The order of stability of the following tautomeric compounds is







(1) I > II > III

(2) III >II > I

(3) II > I > III

(4) II > III > I

90. Which of the following compounds will not undergo Friedal-Craft's reaction easily?

(1) Cumene

(2) Xylene

(3) Nitrobenzene

(4) Toluene

Biology

91. Select the wrong statement:
(1) Isogametes are similar in structure, function and behaviour
(2) Anisogametes differ either in structure, function or behaviour
(3) In Oomycetes female gemete is smaller and motile, while male gamete is larger and nonmotile
(4) Chlamydomomas Exhibits both isogamy and anisogamy and Fucus shows oogamy

92. Which one of the following is not a correct statement?
(1) Herbarium houses dried, pressed and preserved plant specimens
(2) Botanical gardens have collection of living plants for reference.
(3) A museum has collection of photographs of plants and animals.
(4) Key is a taxonomic aid for identification of specimens.

93. Isogamous condition with non-flagellated gametes is found in
(1) *Chlamydomonas*
(2) *Spirogyra*
(3) *Volvox*
(4) *Fucus*

94. Besides paddy fields, cyanobacteria are also found inside vegetative part of
(1) Pinus
(2) Cycas
(3) Equisetum
(4) Psilotum

95. Megasporangium is equivalent to
(1) Embryo sac
(2) Fruit
(3) Nucellus
(4) Ovule

96. Read the following statements (A-E) and answer the question which follows them
(A) In liverworts, mosses, and ferns gametophytes are free-living
(B) Gymnosperms and some ferns are heterosporous
(C) Sexual reproduction in Fucus, Volvox and Albugo is oogamous
(D) The sporophyte in liverworts is more elaboratethan that in mosses
(E) Both, Pinus and Marchantia are dioecious
How many of the above statements are correct ?
(1) One
(2) Two

(3) Three
(4) Four

97. Among bitter gourd, mustard, brinjal, pumpkin, china rose, lupin, cucumber, sunnhemp, gram, guava, bean, chilli, plum, petunia, tomato, rose, withania, potato, onion, aloe and tulip how many plants have hypogynous flower?
(1) Six
(2) Ten
(3) Fifteen
(4) Eighteen

98. Interfascicular cambium develops from the cells of
(1) Medullary rays
(2) Xylem parenchyma
(3) Endodermis
(4) Pericycle

99. In China rose the flowers are
(1) Actinomorphic, hypogynous with twisted aestivation
(2) Actinomorphic, epigynous with valvate aestivation
(3) Zygomorphic, hypogynous with imbricate aestivation
(4) Zygomorphic, epigynous with twisted aestivation

100. Lenticels are involved in
(1) Transpiration
(2) Gaseous exchange
(3) Food transport
(4) Photosynthesis

101. Age of a tree can be estimated by
(1) Its height and girth
(2) Biomass
(3) Number of annual rings
(4) Diameter of its heartwood

102. Seed coat is not thin, membranous in
(1) Maize
(2) Coconut
(3) Groundnut
(4) Gram

103. Transition state structure of the substrate formed during an enzymatic reaction is
(1) Transient but stable
(2) Permanent but unstable
(3) Transient and unstable
(4) Permanent and stable

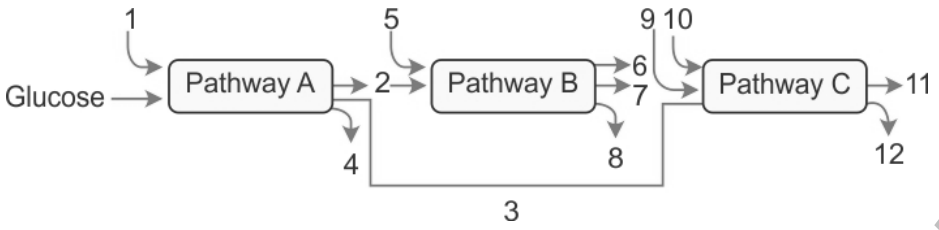
104. A phosphoglyceride is always made up of
(1) Only a saturated fatty acid esterified to a glycerol molecule to which a phosphate group is also attached
(2) Only an unsaturated fatty acid esterified to a glycerol molecule to which a phosphate group is also attached
(3) A saturated or unsaturated fatty acid esterified to a glycerol molecule to which a phosphate group is also attached
(4) A saturated or unsaturated fatty acid esterified to a phosphate group which is also attached to a glycerol molecule

105. Pigment-containing membranous extensions in some cyanobacteria are
(1) Heterocysts
(2) Basal bodies
(3) Pneumatophores
(4) Chromatophores

106. A major site for synthesis of lipids is
(1) RER
(2) SER
(3) Symplast
(4) Nucleoplasm

107. The complex formed by a pair of synapsed homologous chromosomes is called
(1) Equatorial plate
(2) Kinetochore
(3) Bivalent
(4) Axoneme

108. The three boxes in this diagram represent the three major biosynthetic pathways in aerobic respiration. Arrows represent net reactants or products



Arrows numbered 4,8, and 12 can all be
(1) NADH
(2) ATP
(3) H_2O
(4) FAD^+ or $FADH_2$

109. The most abundant intracellular cation is
(1) Na^+
(2) Ca^{++}
(3) H^+
(4) K^+

110. During seed germination its stored food is mobilized by
(1) Ethylene
(2) Cytokinin
(3) ABA
(4) Gibberellin

111. Which of the following criteria **does not** pertain to facilitated transport ?
(1) Requirement of special membrane proteins
(2) High selectivity
(3) Transport saturation
(4) Uphill transport

112. The first stable product of fixation of atmospheric nitrogen in leguminous plants is
(1) NO_2^-
(2) Ammonia
(3) NO_3^-
(4) Glutamate

113. Which of the metabolites is common to respiration mediated breakdown of fats, carbohydrates and proteins?
(1) Glucose-6-phosphate
(2) Fructose 1,6-bisphosphate
(3) Pyruvic acid
(4) Acetyl CoA

114. Which one of the following statements is correct?
(1) Hard outer layer of pollen is called intine
(2) Sporogenous tissue is haploid
(3) Endothecium produces the microspores
(4) Tapetum nourishes the developing pollen

115. Product of sexual reproduction generally generates
(1) Longer viability of seeds
(2) Prolonged dormancy
(3) New genetic combination leading to variation
(4) Large biomass

116. Meiosis takes place in
(1) Meiocyte
(2) Conidia
(3) Gemmule
(4) Megaspore

117. Advantage of cleistogamy is
(1) Higher genetic variability
(2) More vigorous offspring
(3) No dependence on pollinators
(4) Vivipary

118. Monoecious plant of Chara shows occurrence of
(1) Antheridiophore and archegoniophore on the same plant
(2) Stamen and carpel on the same plant
(3) Upper antheridium and lower oogonium on the same plant
(4) Upper oogonium and lower antheridium on the same plant

119. Perisperm differs from endosperm in
(1) Being a haploid tissue
(2) Having no reserve food
(3) Being a diploid tissue
(4) Its formation by fusion of secondary nucleus with several sperms

120. Which of the following statements is not true of two genes that show 50% recombination frequency?
(1) The genes may be on different chromosomes
(2) The genes are tightly linked
(3) The genes show independent assortment
(4) If the genes are present on the same chromosome, they undergo more than one crossovers in every meiosis

121. Variation in gene frequencies within populations can occur by chance rather than by natural selection. This is referred to as
(1) Genetic flow
(2) Genetic drift
(3) Random mating
(4) Genetic load

122. If two persons with 'AB' blood group marry and have sufficiently 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
(1) Codominance
(2) Incomplete dominance
(3) Partial dominance
(4) Complete dominance

123. The process by which organisms with different evolutionary history evolve similar phenotypic adaptations in response to a common environmental challenge, is called
(1) Natural selection
(2) Convergent evolution
(3) Non-random evolution
(4) Adaptive radiation

124. The tendency of population to remain in genetic equilibrium may be disturbed by
(1) Random mating
(2) Lack of migration
(3) Lack of mutations
(4) Lack of random mating

125. Which of the following Bt crops is being grown in India by the farmers?
(1) Maize
(2) Cotton
(3) Brinjal
(4) Soybean

126. A good producer of citric acid is
(1) Aspergillus
(2) Pseudomonas
(3) Clostridium
(4) Saccharomyces

127. DNA fragments generated by the restriction endonucleases in a chemical reaction can be separated by
(1) Centrifugation
(2) Polymerase chain reaction
(3) Electrophoresis
(4) Restriction mapping

128. Which of the following is not correctly matched for the organism and its cell wall degrading enzyme?
(1) Bacteria - Lysozyme
(2) Plant cells - Cellulase
(3) Algae - Methylase
(4) Fungi – Chitinase

129. The colonies of recombinant bacteria appear white in contrast to blue colonies of non-recombinant bacteria because of
(1) Non-recombinant bacteria containing betagalactosidase
(2) Insertional inactivation of alpha-galactosidase in non-recombinant bacteria
(3) Insertional inactivation of alpha-galactosidase in recombinant bacteria
(4) Inactivation of glycosidase enzyme in recombinant bacteria

130. Which of the following are likely to be present in deep sea water?
(1) Archaebacteria
(2) Eubacteria
(3) Blue-green algae
(4) Saprophytic fungi

131. Natural reservoir of phosphorus is
(1) Sea water
(2) Animal bones
(3) Rock
(4) Fossils

132. Secondary productivity is rate of formation of new organic matter by
(1) Producer
(2) Parasite
(3) Consumer
(4) Decomposer

133. Which one of the following is not used for ex situ plant conservation?
(1) Field gene banks
(2) Seed banks
(3) Shifting cultivation
(4) Botanical Gardens

134. Kyoto Protocol was endorsed at
(1) CoP – 3
(2) CoP – 5
(3) CoP – 6
(4) CoP – 4

135. Which of the following represent maximum number of species among global biodiversity?
(1) Algae
(2) Lichens
(3) Fungi
(4) Mosses and Ferns

136. Match the name of the animal (Column I) with one characteristics (Column II) and the phylum/class (column III) to which it belongs.

	Column I	**Column II**	**Column III**
(1)	Petromyzon	Ectoparasite	Cyclostomia
(2)	Ichthy	Terrestial	Reptila
(3)	Limulus	Body Covered by chitinous exoskeleton	Pisces
(4)	Adamsia	Radially symmetrical	Porifera

137. Which of the following are correctly matched with respect to their taxonomic classification?
(1) Flying fish, cuttlefish, silverfish, – Pisces
(2) Centipede, millipede, spider, scorpion – Insecta
(3) House fly, butterfly, tsetsefly, silverfish – Insecta
(4) Spiny anteater, sea urchin, sea cucumber – Echinodermata

138. Which group of animals belong to the same phylum?
(1) Malarial parasite, Amoeba, Mosquito
(2) Earthworm, Pinworm, Tapeworm
(3) Prawn, Scorpion, Locusta
(4) Sponge, Sea anemone, Starfish

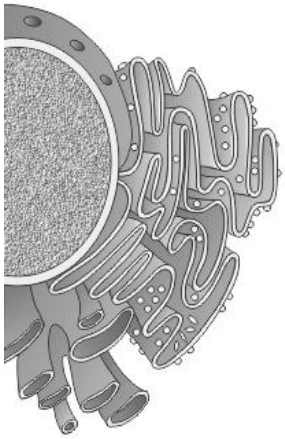
139. One of the representatives of Phylum Arthropoda is
(1) Cuttlefish
(2) Silverfish
(3) Pufferfish
(4) Flying fish

140. The H-zone in the skeletal muscle fibre is due to
(1) The absence of myofibrils in the central portion of A-band
(2) The central gap between myosin filaments in the A-band
(3) The central gap between actin filaments extending through myosin filaments in the A-band
(4) Extension of myosin filaments in the central portion of the A-band

141. What external changes are visible after the last moult of a cockroach nymph?
(1) Mandibles become harder
(2) Anal cerci develop
(3) Both fore wings and hind wings develop
(4) Labium develops

142. The Golgi complex plays a major role
(1) In trapping the light and transforming it into chemical energy
(2) In digesting proteins and carbohydrates
(3) As energy transferring organelles
(4) In post translational modification of proteins and glycosidation of lipid

143. Which one of the following organelle in the figure correctly matches with its function?



(1) Rough endoplasmic reticulum, formation of glycoproteins
(2) Golgi apparatus, protein synthesis
(3) Golgi apparatus, formation of glycolipids
(4) Rough endoplasmic reticulum, protein synthesis

144. Macro molecule chitin is
(1) Nitrogen containing polysaccharide
(2) Phosphorus containing polysaccharide
(3) Sulphur containing polysaccharide
(4) Simple polysaccharide

145. The essential chemical components of many coenzymes are
(1) Proteins
(2) Nucleic acids
(3) Carbohydrates
(4) Vitamins

146. A stage in cell division is shown in the figure. Select the answer which gives correct identification of the stage with its characteristics.

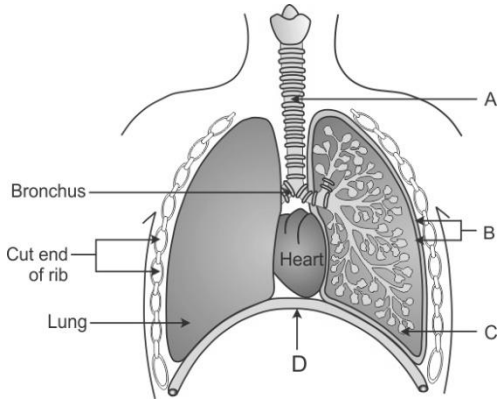
(1)	Telophase	Nuclear envelop reforms golgi complex reforms
(2)	Late Anaphase	Chromosomes move away from equatorial plate, golgi complex not present.
(3)	Cytokinesis	Cell plate formed, mitochondria distributed between two daughtercells.
(4)	Telophase	Endoplasmic reticulum and nucleolus not reformed yet

147. Select the correct match of the digested products in humans given in **column I** with their absorption site and mechanism in **column II**

	Column I	**Column II**
(1)	Glycine, glucose	Small intestine ,active absorption
(2)	Fructose, Na+	Small intestin passive absorption
(3)	Glycerol, fatty acids	Duodenum ,move as chilomicrons
(4)	Cholesterol, maltose	Large intestine ,active absorption

148. A pregnant female delivers a baby who suffers from stunted growth, mental retardation low intelligence quotient and abnormal skin. This is the result of
(1) Deficiency of iodine in diet
(2) Low secretion of growth hormone
(3) Cancer of the thyroid gland
(4) Over secretion of pars distalis

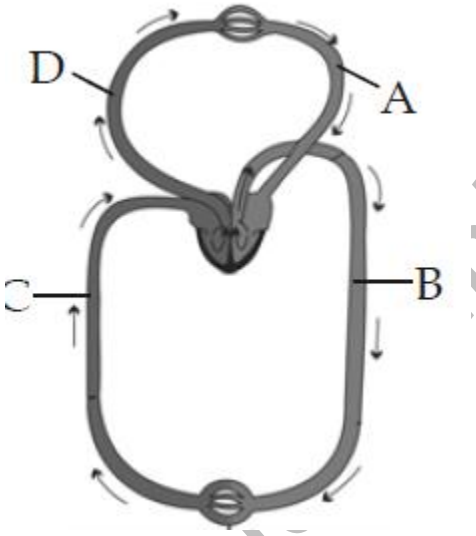
149. The figure shows a diagrammatic view of human respiratory system with labels A, B, C and D. Select the option which gives correct identification and main function and/or characteristic.



(1) A - trachea - long tube supported by complete cartilaginous rings for conducting inspired air

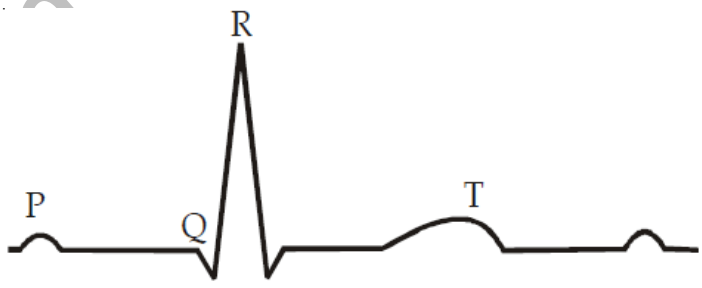
(2) B-pleural membrane - surround ribs on both sides to provide cushion against rubbing
(3) C-Alveoli - thin walled vascular bag like structures for exchange of gases
(4) D-Lower end of lungs - diaphragm pulls it down during inspiration

150. Figure shows schematic plan of blood circulation in humans with labels A to D. Identify the label and give its function/s.



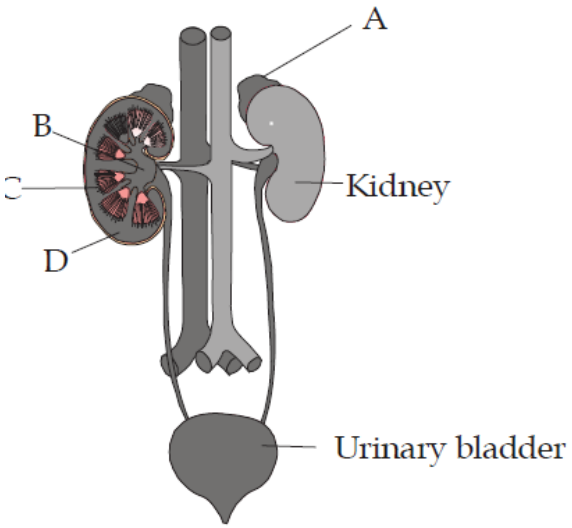
(1) A – Pulmonary vein – takes impure blood from body parts, PO_2 = 60 mm Hg
(2) B – Pulmonary artery – takes blood from heart to lungs, PO_2 = 90 mm Hg
(3) C – Vena Cava – takes blood from body parts to right auricle, PCO_2 = 45 mm Hg
(4) D – Dorsal aorta – takes blood from heart to body parts, PO_2 = 95 mm Hg

151. The diagram given here is the standard ECG of a normal person. The P-wave represents the



(1) Contraction of both the atria
(2) Initiation of the ventricular contraction
(3) Beginning of the systole
(4) End of systole

152. Figure shows human urinary system with structures labelled A to D. Select option which correctly identifies them and gives their characteristics and/ or functions



(1) A-Adrenal gland-located at the anterior part of kidney. Secrete Catecholamines which stimulate glycogen breakdown
(2) B-Pelvis-broad funnel shaped space inner to hilum, directly connected to loops of Henle
(3) C-Medulla - inner zone of kidney and contains complete nephrons
(4) D-Cortex - outer part of kidney and do not contain any part of nephrons

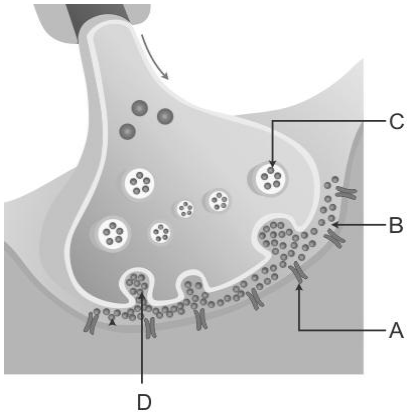
153. Select the correct statement with respect to locomotion in humans
(1) A decreased level of progesterone causes osteoporosis in old people.
(2) Accumulation of uric acid crystals in joints causes their inflammation.
(3) The vertebral column has 10 thoracic vertebrae.
(4) The joint between adjacent vertebrae is a fibrous joint.

154. The characteristics and an example of a synovial joint in humans is

	Characteristics	**Examples**
(1)	Fluid cartilage between two bones, limited movements	Knee joints
(2)	Fluid filled between two joints, provides cushion	Skull bones
(3)	Fluid filled synovial cavity between two bones	Joint between atlas and axis

(4)	Lymph filled between two bones, limited movement	Gliding joint between carpals

155. A diagram showing axon terminal and synapse is given. Identify correctly at least two of A-D



(1) A – Receptor
C - Synaptic vesicles
(2) B - Synaptic connection
D - K^+
(3) A – Neurotransmitter
B - Synaptic cleft
(4) C – Neurotransmitter
D - Ca^{++}

156. Parts A, B, C and D of the human eye are shown in the diagram. Select the option which gives correct identification along with its functions/characteristics
(1) A – Retina – contains photo receptors – rods and cones.
(2) B – Blind spot – has only a few rods and cones.
(3) C – Aqueous chamber – reflects the light which does not pass through the lens.
(4) D – Choroid – its anterior part forms ciliary body.

157. Which of the following statement is correct in relation to the endocrine system?
(1) Adenohypophysis is under direct neural regulation of the hypothalamus.
(2) Organs in the body like gastrointestinal tract, heart, kidney and liver do not produce any hormones.
(3) Non - nutrient chemicals produced by the body in trace amount that act as intercellular messenger are known as hormones.
(4) Releasing and inhibitory hormones are produced by the pituitary gland.

158. Select the answer which correctly matches the endocrine gland with the hormone it secretes and its function/ deficiency symptom

	Endocrine gland	**Hormone**	**Function/deficiency symptoms**
(1)	Anterior pituitary	Oxytocin	Stimulates uterus contraction During child birth
(2)	Posterior pituitary	Growth Hormone (GH)	Oversecretion stimulates Abnormal growth
(3)	Thyroid gland	Thyroxine	Lack of iodine in diet results in goitre
(4)	Corpus luteum	Testosterone	Stimulates spermatogenesis

159. What is the correct sequence of sperm formation?
(1) Spermatid, Spermatocyte, Spermatogonia, Spermatozoa
(2) Spermatogonia, Spermatocyte, Spermatozoa, Spermatid
(3) Spermatogonia, Spermatozoa, Spermatocyte, Spermatid
(4) Spermatogonia, Spermatocyte, Spermatid, Spermatozoa

160. Menstrual flow occurs due to lack of
(1) Progesterone
(2) FSH
(3) Oxytocin
(4) Vasopressin

161. Which one of the following is not the function of placenta? It
(1) Facilitates supply of oxygen and nutrients to embryo.
(2) Secretes estrogen.
(3) Facilitates removal of carbon dioxide and waste material from embryo.
(4) Secretes oxytocin during parturition.

162. One of the legal methods of birth control is
(1) Abortion by taking an appropriate medicine
(2) By abstaining from coitus from day 10 to 17 of the menstrual cycle
(3) By having coitus at the time of day break
(4) By a premature ejaculation during coitus

163. Which of the following cannot be detected in a developing foetus by amniocentesis ?
(1) Klinefelter syndrome
(2) Sex of the foetus
(3) Down syndrome
(4) Jaundice

164. Artificial insemination means
(1) Transfer of sperms of a healthy donor to a test tube containing ova
(2) Transfer of sperms of husband to a test tube containing ova
(3) Artificial introduction of sperms of a healthy donor into the vagina
(4) Introduction of sperms of healthy donor directly into the ovary

165. Which Mendelian idea is depicted by a cross in which the F_1 generation resembles both the parents ?
(1) Incomplete dominance
(2) Law of dominance
(3) Inheritance of one gene
(4) Co-dominance

166. The incorrect statement with regard to Haemophilia is
(1) It is a sex-linked disease
(2) It is a recessive disease
(3) It is a dominant disease
(4) A single protein involved in the clotting of blood is affected

167. If both parents are carriers for thalassemia, which is an autosomal recessive disorder, what are the chances of pregnancy resulting in an affected child?
(1) No chance
(2) 50%
(3) 25%
(4) 100%

168. The diagram shows an important concept in the genetic implication of DNA. Fill in the blanks A to C

(1) A-transcription, B-replication, C-James Watson
(2) A-translation, B-transcription, C-Erevin Chargaff
(3) A-transcription, B-translation, C-Francis Crick
(4) A-translation, B-extension, C-Rosalind Franklin

169. Which enzyme/s will be produced in a cell in which there is a nonsense mutation in the lac Y gene?
(1) β -galactosidase
(2) Lactose permease
(3) Transacetylase
(4) Lactose permease and transacetylase

170. According to Darwin, the organic evolution is due to
(1) Intraspecific competition.
(2) Interspecific competition.
(3) Competition within closely related species.
(4) Reduced feeding efficiency in one species due to the presence of interfering species.

171. The eye of octopus and eye of cat show different patterns of structure, yet they perform similar function. This is an example of
(1) Homologous organs that have evolved due to convergent evolution.
(2) Homologous organs that have evolved due to divergent evolution.
(3) Analogous organs that have evolved due to convergent evolution.
(4) Analogous organs that have evolved due to divergent evolution.

172. Infection of Ascaris usually occurs by
(1) Drinking water containing eggs of Ascaris
(2) Eating imperfectly cooked port
(3) Tse-tse fly
(4) Mosquito bite

173. The cell-mediated immunity inside the human body is carried out by
(1) T-lymphocytes
(2) B-lymphocytes
(3) Thrombocytes
(4) Erythrocytes

174. In plant breeding programmes, the entire collection(of plants/seeds) having all the diverse alleles for all genes in a given crop is called
(1) Selection of superior recombinants
(2) Cross-hybridisation among the selected parents
(3) Evaluation and selection of parents.
(4) Germplasm collection

175. During sewage treatment, biogases are produced which include
(1) Methane, hydrogensulphide, carbon dioxide
(2) Methane, oxygen, hydrogensulphide
(3) Hydrogensulphide, methane, sulphur dioxide
(4) Hydrogensulphide, nitrogen, methane

176. A biologist studied the population of rats in a barn. He found that the average natality was 250, average mortality 240, immigration 20 and emigration 30. The net increase in population is
(1) 10
(2) 15
(3) 05
(4) Zero

177. Which one of the following processes during decomposition is correctly described?
(1) Fragmentation - Carried out by organisms such as earthworm
(2) Humification - Leads to the accumulation of a dark coloured substance humus which undergoes microbial action at a very fast rate
(3) Catabolism - Last step in the decomposition under fully anaerobic condition
(4) Leaching - Water soluble inorganic nutrients rise to the top layers of soil

178. A sedentary sea anemone gets attached to the shell lining of hermit crab. The association is
(1) Ectoparasitism
(2) Symbiosis
(3) Commensalism
(4) Amensalism

179. Global warming can be controlled by
(1) Reducing deforestation, cutting down use of fossil fuel
(2) Reducing reforestation, increasing the use of fossil fuel
(3) Increasing deforestation, slowing down the growth of human population
(4) Increasing deforestation, reducing efficiency of energy usage

180. The Air Prevention and Control of Pollution Act came into force in
(1) 1975
(2) 1981
(3) 1985
(4) 1990a

NEET - 2013
(Physics, Chemistry and Biology)
Code - W
Answer Key and Solution

Answers

1	(1)	2	(3)	3	(2)	4	(1)	5	(3)	6	(1)	7	(2)	8	(1)	9	(4)	10	(2)
11	(4)	12	(1)	13	(4)	14	(2)	15	(2)	16	(2)	17	(4)	18	(3)	19	(1)	20	(1)
21	(4)	22	(1)	23	(2)	24	(2)	25	(4)	26	(2)	27	(2)	28	(2)	29	(4)	30	(2)
31	(2)	32	(4)	33	(1)	34	(1)	35	(2)	36	(3)	37	(3)	38	(1)	39	(3)	40	(3)
41	(2)	42	(3)	43	(3)	44	(1)	45	(3)	46	(3)	47	(4)	48	(3)	49	(2)	50	(3)
51	(3)	52	(4)	53	(1)	54	(1)	55	(2)	56	(4)	57	(3)	58	(3)	59	(1)	60	(2)
61	(3)	62	(2)	63	(1)	64	(2)	65	(4)	66	(4)	67	(4)	68	(4)	69	(2)	70	(1)
71	(3)	72	(3)	73	(3)	74	(2)	75	(3)	76	(2)	77	(2)	78	(3)	79	(3)	80	(3)
81	(1)	82	(2)	83	(4)	84	(2)	85	(2)	86	(3)	87	(3)	88	(1)	89	(2)	90	(3)
91	(3)	92	(3)	93	(2)	94	(2)	95	(4)	96	(3)	97	(2)	98	(1)	99	(1)	100	(2)
101	(3)	102	(2)	103	(3)	104	(3)	105	(4)	106	(2)	107	(3)	108	(1)	109	(4)	110	(2)
111	(4)	112	(2)	113	(4)	114	(4)	115	(3)	116	(1)	117	(3)	118	(4)	119	(3)	120	(2)
121	(2)	122	(1)	123	(2)	124	(4)	125	(2)	126	(1)	127	(3)	128	(3)	129	(4)	130	(1)
131	(3)	132	(3)	133	(3)	134	(1)	135	(3)	136	(1)	137	(3)	138	(3)	139	(2)	140	(3)
141	(3)	142	(4)	143	(4)	144	(1)	145	(4)	146	(1)	147	(1)	148	(1)	149	(3)	150	(3)
151	(1)	152	(1)	153	(2)	154	(3)	155	(1)	156	(1)	157	(3)	158	(3)	159	(4)	160	(1)
161	(4)	162	(1)	163	(4)	164	(3)	165	(3)	166	(3)	167	(3)	168	(3)	169	(1)	170	(1)
171	(3)	172	(1)	173	(1)	174	(4)	175	(1)	176	(4)	177	(1)	178	(3)	179	(1)	180	(2)

Physics

1. Given that $P = \frac{a^2b^2}{cd}$

$$\therefore \frac{\Delta P}{P} = \pm\left[3\frac{\Delta a}{a} + 2\frac{\Delta b}{b} + \frac{\Delta c}{c} + \frac{\Delta d}{d}\right]$$

$\rightarrow$ Percentage error in P, $\frac{\Delta P}{P} \times 100\% = \pm[3\times 1\% + 2\times 2\% + 3\% + 4\%]$

$= \pm[3\% + 4\% + 3\% + 4\%]$

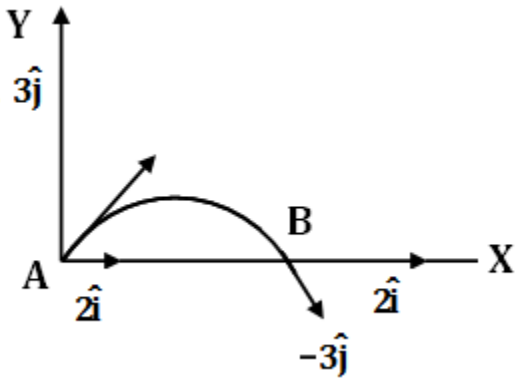
$= \pm 14\%$

Hence, the % error in P is 14%.

2. Given that the velocity of a projectile at the initial point A is $(2\hat{i} + 3\hat{i})$.

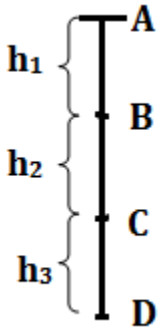
The horizontal component remains the same, while the vertical component changes.

So, the velocity at point B is



Velocity (in m/s) at point B, $v_f = (2\hat{i} - 3\hat{j})$

3.



Let us assume that the stone falls freely from point A.

At A, u = 0

Distance covered in first 5 s is $s_1 = h_1$.

$$h_1 = \frac{1}{2}at^2$$

$$h_1 = \frac{1}{2}a(5)^2$$

$$\rightarrow h_1 = \frac{25a}{2} \text{ ------- (Equation 1)}$$

Distance covered in first 10 s is s_2, i.e. from point A to C.

$$s_2 = 0 + \frac{1}{2}at^2$$

$$s_2 = \frac{1}{2}a(10)^2$$

$$\rightarrow s_2 = \frac{100a}{2} \text{ ------- (Equation 2)}$$

Thus, the distance covered in the next 5 seconds, i.e. from point B to C is

$$h_2 = s_2 - h_1$$

$$= \frac{100a}{2} - \frac{25a}{2}$$

$$h_2 = \frac{75a}{2} \text{------- (Equation 3)}$$

Distance covered in the first 15 s is s_3, i.e. from point A to C.

$$s_3 = 0 + \frac{1}{2}at^2$$

$$s_3 = \frac{1}{2}a(15)^2$$

$$\rightarrow s_3 = \frac{125a}{2} \text{ ------- (Equation 4)}$$

Thus, the distance covered in the next 5 seconds, i.e. from point C to D is

$$h_3 = s_3 - s_2$$

$$= \frac{120a}{2} - \frac{100a}{2}$$

$$h_3 = \frac{20a}{2} \text{------- (Equation 5)}$$

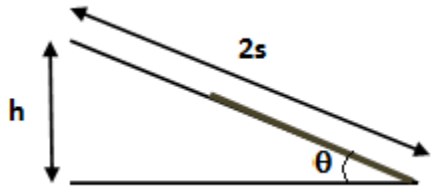
Using equations (1), (3) and (5), we get

$$\frac{h_1}{\frac{25a}{2}} = \frac{h_2}{\frac{75a}{2}} = \frac{h_3}{\frac{125a}{2}}$$

$$\therefore h_1 = \frac{h_2}{3} = \frac{h_3}{5}$$

4. The blocks are moving upward at constant speed 'v'.
This implies that the acceleration 'a' is zero.
We have $F = ma \rightarrow F = 0$
That is $a \rightarrow 0 \Rightarrow F = 0$
Hence, the net force on each block will be zero.

5.



Let the length of the plane inclined at angle θ be 's' and height be 'h'.
The work done is equal to the change in the kinetic energy which is equal to 0.
Work done is equal to the work done against the gravitational force and against the frictional force. That is
Work done = $W_{gravity} + W_{friction} = 0$ ... (Equation 1)
$W_{gravity} = mgh$
$W_{friction} = f.s = -\mu mg\cos\theta s$
Substituting in equation (1), we get
$mgh - \mu mg\cos\theta s = 0$
$mgh = \mu mg\cos\theta s$
$\mu = \frac{h}{s\cos\theta}$ ------- (Eqaution 2)
But from the diagram, we get
$\frac{h}{2s} = \sin\theta$
$\rightarrow \frac{h}{s} = 2\sin\theta$
Substituting in eqaution (2), we get
$\mu = \frac{2\sin\theta}{\cos\theta}$
$\therefore \mu = 2\tan\theta$

6. Given that the particle is displaced from position $\left(2\hat{i}+\hat{j}\right)$ to $\left(4\hat{i}+3\hat{j}-k\right)$.

Displacement 's' is calculated as

$$\vec{s}=\left(4\hat{i}+3\hat{j}-k\right)-\left(2\hat{i}+k\right)$$

$$=4\hat{i}+3\hat{j}-k-2\hat{i}-k$$

$$=2\hat{i}+3\hat{j}-2k$$

Work done, $W=\vec{F}.\vec{s}$

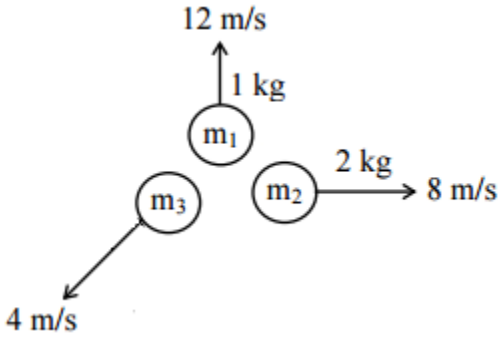
$$=\left(3\hat{i}+\hat{j}\right).\left(2\hat{i}+3\hat{j}-2k\right)$$

$$=(3\times2)+(1\times3)+\left(0\times\left[(-2)\right]\right)$$

$$=6+3+0$$

$$=9\text{J}$$

7.



From the law of conservation of momentum, we get

$$\vec{P_1}+\vec{P_2}+\vec{P_3}=0$$

Given that two of the masses of rock go off at right angles to each other.

Let $\vec{P_1}$ and $\vec{P_2}$ be the momentum of the rocks that go off at right angles to each other.

$$\therefore\left|\vec{P_3}\right|=\sqrt{P_1^2+P_2^2}\quad\text{------- }(\because v_1\perp v_2)$$

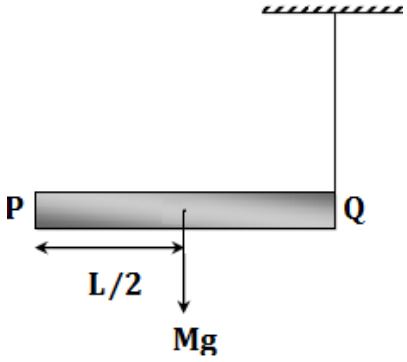
$$m_3v_3=\sqrt{m_1v_1^2+m_2v_2^2}$$

$$m_3\times4=\sqrt{1^2\times12^2+2^2\times8^2}$$

$$m_3\times4=20$$

$$\therefore m_3=5\text{ kg}$$

8.



Torque of the rod PQ can be found using the torque formula of a thin rod. It is

$\tau = I\alpha$

$F.r = I\alpha$

For a rod, $I = \frac{ML^2}{3}$ and $F = Mg$

$\therefore Mg\frac{L}{2} = \frac{ML^2}{3} \times \alpha$

$\therefore \alpha = \frac{3g}{2L}$

9. From the conservation of mechanical energy, we get

$\frac{1}{2}mv^2\left(1 + \frac{K^2}{R^2}\right) = mgh$

Given that, $h = \frac{3v^2}{4g}$

$\Rightarrow \frac{1}{2}mv^2\left(1 + \frac{K^2}{R^2}\right) = mg\left(\frac{3v^2}{4g}\right)$

$\therefore \frac{K^2}{R^2} = \frac{1}{2}$

$\rightarrow K^2 = R^2\frac{1}{2}$

But, $K = \sqrt{\frac{I}{M}}$

$\therefore \frac{I}{M} = R^2\frac{1}{2}$

$\therefore I = \frac{1}{2}MR^2$

So, the given object is a disc.

10. The change in potential energy is the difference between its final and initial potential energy.

$$U_f = \frac{-GMm}{R+2R} = \frac{-GMm}{3R};$$

$$U_i = \frac{-GMm}{R}$$

$$\therefore \Delta U = U_f - U_i$$

$$= \frac{-GMm}{3R} - \frac{-GMm}{R}$$

$$= \frac{GMm}{R}\left(1 - \frac{1}{3}\right)$$

$$= \frac{2}{3}\frac{GMm}{R}$$

$$= \frac{2}{3}\frac{GMm \times R}{R^2}$$

$$= \frac{2}{3}\left(\frac{GM}{R^2}\right)mR$$

$$= \frac{2}{3}gmR$$

$$\text{Or, } \Delta U = \frac{2}{3}mgR$$

11. Given that there are infinite number of bodies, each of mass 2 kg, situated on the x-axis at distances of 1 m, 2 m, 4 m, 8 m, respectively, from the origin.

Gravitation potential is

$$V = \frac{-GM}{R}$$

$$\therefore V = -GM\left[\frac{1}{1} + \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + ...\right]$$

$$V = -G \times 2\left[1 + \frac{1}{2} + \frac{1}{2^2} + \frac{1}{2^3} .....\right]$$

$$V = -2G\frac{1}{\left(1 - \frac{1}{2}\right)}$$

$$\therefore V = -4G$$

12. Young's modulus for a wire is

$$Y = \frac{MgL}{A\Delta L} = Constant$$

$$\therefore \Delta L = \frac{MgL}{AY}$$

$$\Delta L \ \alpha \ \frac{MgL}{AY}$$

$$Or, \ \Delta L \ \alpha \ \frac{L}{A}$$

Among the given options, the ratio of L/A is maximum for L = 50 cm and D = 0.5 mm. Hence, option (1) is correct.

13. Wetting is the ability of a liquid to maintain contact with a solid surface and the degree of wetting is known as wettability. It depends on the angle of contact between the surface and the liquid

14. Difference between two molar specific heats is

$$C_p - C_v = R$$

Dividing both the sides by C_v, we get

$$\frac{C_p}{C_v} - \frac{C_v}{C_v} = \frac{R}{C_v}$$

$$But, \ \frac{C_p}{C_v} = \gamma$$

$$\therefore \gamma - 1 = \frac{R}{C_v}$$

$$\therefore C_v = \frac{R}{\gamma - 1}$$

15. It can be explained using the Wien's displacement law

$$\lambda_{max} = \frac{b}{T}$$

$$Or, \ \lambda_{max} \alpha \frac{1}{T}$$

$$\therefore \lambda_{max} T = constant$$

16. We know that

Net work done by the gas = Area under the P-V curve

$$= \frac{1}{2} \times 4 \times 10^5 \times 5 \times 10^{-3}$$
$$= 10 \times 10^2$$
$$= 1000 \text{ J}$$

17. Given that $P \propto T^3$

But for an adiabatic process, $P \propto T^{\gamma/\gamma-1}$

$$\therefore \frac{\gamma}{\gamma\text{-}1} = 3$$
$$\gamma = 3\gamma - 3$$
$$\therefore \gamma = \frac{3}{2}$$

18. Assuming the graph for a gas of given mass, the ideal gas equation is

$$PV = nRT$$

Or, $\frac{V}{T} \alpha \frac{1}{P}$

Form the garph, the slope = $\frac{V}{T} = \tan\theta$

$$\therefore \frac{1}{P} \alpha \tan\theta$$

Thus, if θ increases, $\tan\theta$ increases and the pressure decreases.

As $\theta_1 < \theta_2 \rightarrow \frac{1}{P_1} < \frac{1}{P_2}$

$$\Rightarrow P_2 < P_1$$

19. The amount of energy required to raise the temperature of 1 g of helium at NTP, from T_1K to T_2K is

$$E = \frac{f}{2} nRT$$

Or, $E = \frac{f}{2} NKT$

But, $N = n.N_A$

$$\therefore E = \frac{f}{2} n.N_A k_B (T_2 - T_1)$$

Where, k_B = Boltzmann constant

$E = \frac{3}{2} n.N_A k_B (T_2 - T_1)$ ------- ($\because$ For He f=3)

For He, 4 gm $\rightarrow$ 1 mole

$\therefore 1 \text{ gm} \rightarrow \frac{1}{4} \text{ mole} = n$

$\therefore E = \frac{3}{8} N_A k_B (T_2 - T_1)$

20. The equation of a wave travelling along the x-axis is

$y = a\sin(\omega t - kx)$

Or, $y = a\sin(kx - \omega t)$

Given that $\lambda = 2\pi m$; $f = \frac{1}{\pi}$ Hz

$\therefore k = \frac{2\pi}{\lambda} = \frac{2\pi}{2\pi} = 1$

$\omega = 2\pi.\nu = 2\pi \times \frac{1}{\pi} = 2$

$\therefore y = \sin(x - 2t)$

$\rightarrow a = 1$

21. In case of the vibration of a pipe open at both ends, the air column can vibrate in several different modes subjected to the boundary condition that there must be an antinode at its open end. Hence, option (1) is correct.

Ratio of frequency is

$\nu : 2\nu : 3\nu : 4\nu : 5\nu$

where $\upsilon = \frac{v}{2L}$

Both odd and even harmonics will be present.

Hence, options (1), (2) and (3) are correct.

The pressure variation is minimum at the antinode.

Hence, option (4) is incorrect.

22. Let the frequency of unknown source be 'x'.

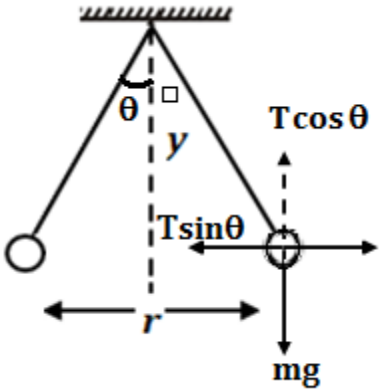
$x = 250 \pm 4 = 246$ Hz or 254 Hz

Second harmonic of this source, $2x = 513 \pm 5 = 508$ Hz or 518.

$\therefore x = 259$ or 254

$\Rightarrow x = 254$ Hz

23.



In the equilibrium position,

$T\cos\theta = mg$;

$T\sin\theta = F_e = \frac{Kq^2}{r^2}$

$\therefore \tan\theta = \frac{Kq^2}{r^2 mg}$

From the diagram, we get $\tan\theta = \frac{r/2}{y}$

$\therefore \frac{r/2}{y} = \frac{Kq^2}{r^2 mg}$

$\rightarrow y = \frac{r^3 mg}{2Kq^2}$

$y \alpha r^3$

Or, $r \alpha y^{1/3}$

The equilibrium separation for (y/2) is given as

$r' \alpha \left(\frac{y}{2}\right)^{1/3}$

$\rightarrow r' \alpha \frac{r}{2^{1/3}}$

24. Electric potential decreases in the direction of the electric field.
The electric field is from high potential to low potential.
i.e. $V_B > V_C > V_P$
So, the potential is maximum at B.

25. Let R_1 be the resistance and l_1 be the length of the wire.

Resistance, $R = \rho\frac{l}{A}$

When volume is constant

$A \alpha \frac{1}{l}$

$R \alpha l^2$

Resistance 'R_2' of the streched wire is given as

$R_2 = 4R_1$

$= 4 \times 4$

$\therefore R_2 = 16\Omega$

26. Given that I = 0.2 V, E = 2.1 V and R = 10 Ω.

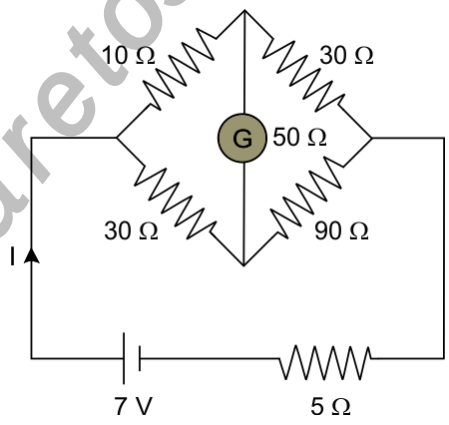
$I = \frac{E}{R + r}$

$0.2 = \frac{2.1}{10 + r}$

$0.2r = 0.1$

$\therefore r = 0.5\ \Omega$

27.



For a balanced Wheatstone's bridge,

$\frac{P}{Q} = \frac{R}{S}$

Equivalent resistance, $R_{eq} = \frac{(10+30)(30+90)}{(10+30+30+90)}$

$= \frac{40 \times 120}{160}$

$= 30\ \Omega$

Now, the effective resistance $R_{eff} = 30 + 5 = 35\ \Omega$

Current, $I = \frac{V}{R_{eff}}$

$= \frac{7}{35}$

$\therefore$ Current, I =0.2 A

28.

Acceleration of charged particle, $\vec{a} = \frac{q}{m}(\vec{E} + \vec{v} \times \vec{B})$

When rested from rest, $\vec{a} = a_o = \frac{q}{m}\vec{E}$

$\therefore \vec{E} = \frac{ma_o}{q} = \frac{ma_o}{e}$ (in west direction)

Magnetic force = $F_m = 3ma_o - ma_o = 2ma_o$ (in the west direction)

$\vec{v} \times \vec{B}$ is directed towards the west.

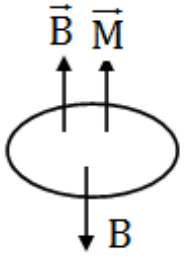
For positive charge, $\vec{v}$ is directed towards the North and $\vec{B}$ is directed vertically down.

$\overrightarrow{F_m} = q\vec{v} \times \vec{B}$

$\therefore 2ma_o = ev_o \times B$

$B = \frac{2ma_o}{ev_o}$ (in vertically downward direction)

29. It is in equilibrium for two orientations (0° and 180°).



θ = 0° stable equilibrium (parallel)

θ = 180° unstable equilibrium (anti-parallel)

30. Let magnetic pole strength be m, then

$M = m\ell$

In the second case,

$$\ell = r\theta = r\left(\frac{\pi}{3}\right)$$

$$r = \frac{3\ell}{\pi}$$

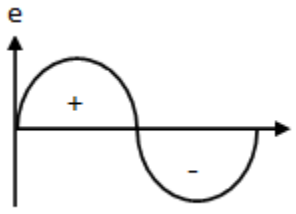
$$\text{Now, } M' = (m)\left(2r\sin\frac{60°}{2}\right)$$

$$\rightarrow M' = 2m\left(\frac{3\ell}{\pi}\right)\left(\frac{1}{2}\right)$$

$$\rightarrow M' = \frac{3m\ell}{\pi}$$

$$\therefore M' = \frac{3M}{\pi}$$

31.



For a rotating coil, $e = N\omega AB\sin\omega t$

The frequency of change of direction of EMF is twice per revolution.

32. Impedance is

$$Z = \frac{\sqrt{R^2 + X_L^2}}{R^2 + (L \times 2\pi f)^2}$$

If the frequency of the AC source is decreased, then the impedance decreases → intensity increases.

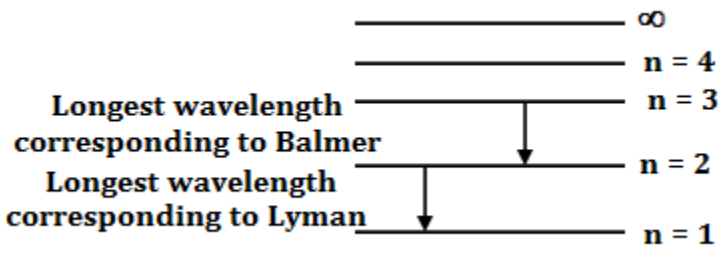
If the number of turns decreases, self-inductance decreases and thus impedance decreases → brightness increases.

At resonance, $X_C = X_L$ and impedance decreases → brightness increases.

When an iron rod is inserted, impedance increases, and hence, current decreases → brightness decreases.

33. In the presence of microwaves, the water molecules oscillate in the electric field of microwaves. This results in the generation of heat. The amplitude of oscillation will be maximum when the frequency of the microwaves matches the resonant frequency of water molecules. Thus, for effective working, the microwaves must operate near the natural frequency of vibration of the water molecules.

34.



Rydberg formula is given as

$$\frac{1}{\lambda} = R\left(\frac{1}{n'^2} - \frac{1}{n^2}\right)$$

For Lyman series,

$$\frac{1}{\lambda_\ell} = R\left(\frac{1}{1^2} - \frac{1}{2^2}\right)$$

$$\frac{1}{\lambda_\ell} = \frac{3R}{4}$$

$$\therefore \lambda_\ell = \frac{4}{3R} \text{ ------- (Equation 1)}$$

For Balmer series,

$$\frac{1}{\lambda_b} = R\left(\frac{1}{2^2} - \frac{1}{3^2}\right)$$

$$\frac{1}{\lambda_\ell} = \frac{5R}{36}$$

$$\therefore \lambda_\ell = \frac{36}{5R} \text{ ------- (Equation 2)}$$

$$\frac{\lambda_\ell}{\lambda_b} = \frac{4}{3R} \times \frac{5R}{36}$$

$$\therefore \frac{\lambda_\ell}{\lambda_b} = \frac{5}{27}$$

35. Given that

Decay equation is

$N = N_o e^{-\lambda t}$

$\frac{N_x}{N_Y} = \frac{1}{7}$

$\Rightarrow \frac{N_x}{N_x + N_Y} = \frac{N}{N_o} = \frac{1}{8} = \frac{1}{2^3}$

$\therefore n = 3$

But, $n = \frac{t}{T}$

Given that T = 20 years

$t = 3 \times 20 = 60 \text{years}$

36. Given that

Mass defect = $\Delta m = 0.02866$ u

Total energy = $E = \Delta mc^2$

$= 0.02866 \times 931$ MeV

$= 26.68$ MeV

Energy liberated per u = $\frac{E}{A}$

$= \frac{26.68}{4}$

$= 6.678$ MeV

37. Cut off frequency = ν

Work function $\phi = h\nu$

Now, E = Kinetic energy + ϕ

$h(2\upsilon) = \frac{1}{2} mv^2 + h\upsilon$

$\frac{1}{2} mv^2 = h\upsilon$

$\therefore v = \sqrt{\frac{2h\upsilon}{m}}$

38. For an electron, the de Broglie's wavelength is

$$\lambda_e = \frac{h}{\sqrt{2mE}}$$

Or, $\lambda_e \propto \frac{1}{\sqrt{E}} \rightarrow \lambda_e^2 \propto \frac{1}{E}$ ------- (Equation 1)

For a photon the wavelength is given as

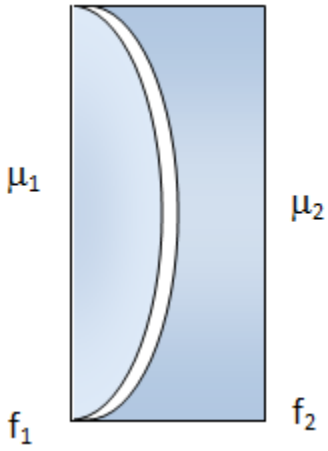
$$\lambda_p = \frac{hc}{E}$$

Or, $\lambda_p \propto \frac{1}{E}$ ------- (Equation 2)

From eqaution (1) and (2), we get

$\lambda_p \propto \lambda_e^2$

39.



Lens maker's formula is

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{\infty} + \frac{1}{R_2}\right)$$

For a plano-convex lens, the formula is given as

$$\frac{1}{f_1} = (\mu_1 - 1)\left(\frac{1}{\infty} - \frac{1}{-R}\right)$$

$$= \frac{\mu_1 - 1}{R}$$ ------- (Equation 1)

For a plano-concave lens, the formula is given as

$$\frac{1}{f_2} = (\mu_2 - 1)\left(-\frac{1}{R} - \frac{1}{\infty}\right)$$

$$\frac{1}{f_2} = \frac{-(\mu_2 - 1)}{R}$$ ------- (Equation 2)

From equation (1) and (2), the net focal length of combination is given as

$$\frac{1}{f}=\frac{1}{f_1}+\frac{1}{f_2}$$

$$=\frac{\mu_1-1}{R}-\frac{\mu_2-1}{R}$$

$$=\frac{\mu_1-1-\mu_2-1}{R}$$

$$=\frac{\mu_1-\mu_2}{R}$$

$$\therefore f=\frac{R}{\mu_1-\mu_2}$$

40.

$$\frac{1}{f}=\frac{1}{f_1}+\frac{1}{f_2}=P_1+P_2$$

lens + cornea forms an image of distance object at retina.

$\therefore$ Converging power= P_1+P_2=(40+20) D = 60 D

$$\therefore \frac{1}{f}=\frac{1}{60}m=\frac{100}{60}cm$$

$$\therefore \frac{1}{f}=1.67\ cm$$

41. For a bright fringe, the fringe width formula is

$$y=\frac{n\lambda D}{d}$$

$$\therefore \frac{n_1\lambda_1 D}{d}=\frac{n_2\lambda_2 D}{d}$$

$$\rightarrow \frac{n_1}{n_2}=\frac{\lambda_2}{\lambda_1}=\frac{10000\,\text{Å}}{12000\,\text{Å}}=\frac{5}{6}$$

$$\therefore n_1=5 \text{ and } n_2=6$$

$$\rightarrow y=\frac{n_1\lambda_1 D}{d}=\frac{5\times 12000\times 10^{-10}\times 2}{2\times 10^{-3}}$$

$$\therefore y=6\times 10^{-3}m=6\ mm$$

42. de Broglie's wavelength is

$$\lambda = \frac{h}{mv}$$

$$\therefore \lambda \propto \frac{1}{v}$$

$\rightarrow$ If the speed of the elctron increases, its de-Broglie wavelength decreases.

Angular width for central minimum is given as

$$\omega = \frac{2\lambda}{d}$$

$$\therefore \omega \propto \lambda$$

$$\rightarrow \omega \propto \lambda \propto \frac{1}{v}$$

$\therefore$ On increasing the speed of electrons, λ decreases, and hence, the angular width of central maximum will decrease.

43. The N-type impurity loses its extra valence electron easily when added to a semiconductor material. In an n-type semiconductor, the pentavalent atoms are dopants, electrons are majority carriers and holes are minority carriers.

44. We know that

$$\text{Voltage gain, } A_v = \beta \frac{R_o}{R_{in}}$$

$$= \frac{I_C}{I_{in}} \frac{R_o}{R_{in}}$$

$$= \frac{I_C R_o}{V_{in}} \text{ ------- } (\because V_{in} = I_{in} R_{in})$$

$$= g_m R_o \text{ ------- (where, } g_m \text{ is the transductance)}$$

$$\therefore A_v \propto g_m$$

$$\therefore \frac{A_{v_1}}{A_{v_2}} = \frac{g_{m_1}}{g_{m_2}} = \frac{0.03}{0.02} = \frac{3}{2}$$

$$\therefore A_{v_2} = \frac{2}{3} A_{v_1}$$

$$\rightarrow \therefore A_{v_2} = \frac{2}{3} G$$

45. The truth table for the combination of logic gates is

A	B	Y	X
0	0	1	0
0	1	1	0
1	0	1	0
1	1	0	1

NAND + NOT = AND

Output, $Y = \overline{\overline{A.B}} = A.B$

Chemistry

46.

We know $c = \lambda\upsilon$

$$\lambda = \frac{c}{\upsilon} = \frac{3\times10^{17}\,nms^{-1}}{6\times10^{15}\,s^{-1}} = 50nm$$

47. The maximum number of electrons which can be associated when n = 3, l = 1 and m = −1 is 2.

48.

$$\log\frac{k_2}{k_1} = \frac{E_a}{2.303R}\left[\frac{T_1 - T_2}{T_1.T_2}\right]$$

$$\log 2 = \frac{E_a}{2.303\times8.314}\left[\frac{293-308}{293\times308}\right]$$

$$Ea = \frac{0.301\times2.303\times8.314\times293\times308}{15} = 34.67kJmol^{-1}$$

49.

The reaction can be represented as

$\frac{1}{2}\,H_{2(g)} \rightarrow H^+ + e^-$

$$E_{ox} = E^o_{oxi} - \frac{0.059}{n}\log\frac{[H^+]}{(P_{H2})^{1/2}}$$

$$Since\,pH = 10, [H^+] = 10^{-10}M$$

$$So, E_{ox} = 0 - \frac{0.059}{1}\log\frac{10^{-10}}{(1)^{1/2}}$$

$$E_{ox} = 0.59V$$

50. In the reaction, $[E_a]_{forward} = [E_a]_{backward}$

So, $\Delta H = 0$

51.

$$We\,know\,degree\,of\,ionization = \frac{\lambda m}{\lambda^{\infty} m}\times100$$

$$= \frac{9.38\times100}{238}$$

$$= 4.008\%$$

52. The electrons closer to the nucleus are more strongly bonded.

53. E°cell = E°cathode − E°anode

$= 0.34 - (-0.76) = 1.1\ V$

54.

$$\text{Moles of } HNO_3 = \frac{W \times 1000}{\text{Molar mass} \times V}$$

$$2 = \frac{W \times 1000}{63 \times 250}$$

$$W = 31.5g$$

Now, 70g is dissolved in 100g of water

So 31.5g HNO3 will be present $= \frac{100 \times}{70} 31.5 = 45g$ of solution

55. The number of atoms present in a diamond cubic unit cell $= \frac{1}{8} \times 8 + \frac{1}{2} \times 6 + 4 = 8$ atoms

56. Maximum deviation from the ideal gas is expected from $NH_{3(g)}$.

57.

$$\rho = \frac{Z \times M}{N_A \times V}$$

$$2.72 = \frac{4 \times M}{6.023 \times 10^{23} \times (4.04 \times 10^{-8})^3}$$

$$M = \frac{2.72 \times (4.04)^3 \times 6.023 \times 10^{-1}}{4} = 27 g/mol$$

58. We know HCl is a polar molecule and thus induces dipole in the He atom.

59.

$$Cu^{+2} = [Ar]3d^9$$

$$\therefore n = 1$$

$$\mu = \sqrt{n(n+2)} = \sqrt{1(1+2)} = \sqrt{3}$$

$$\mu = 1.73 BM$$

60. The gas X is SO_2.

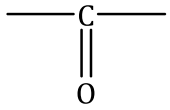
61. $HClO_4$ is the strongest acid.

62. O_2^- contains one unpaired electron and hence is paramagnetic.

63. The BN structure is similar to graphite.

64. The basic structural unit of silicates is SiO_4^{4-}.

65. It is Clemmensen reduction and is used only for:

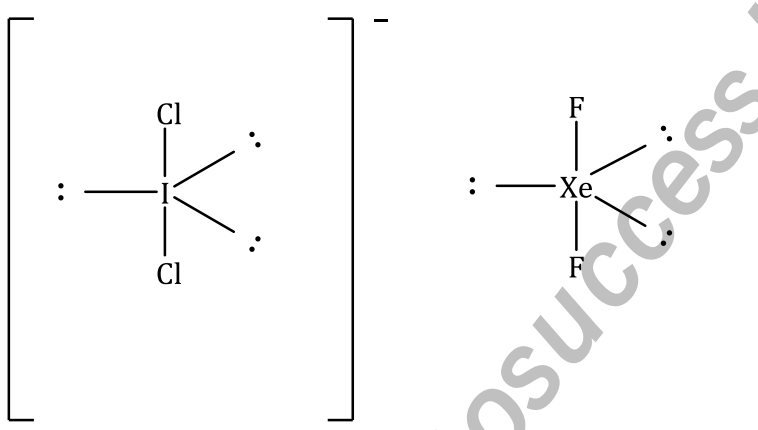


66. $(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} N_2 + Cr_2O_3 + 2H_2O$

67. Yb^{2+} has electronic configuration $4f^{14}$ and hence is diamagnetic.

68. $Na_2S > ZnS > CuS$

69.



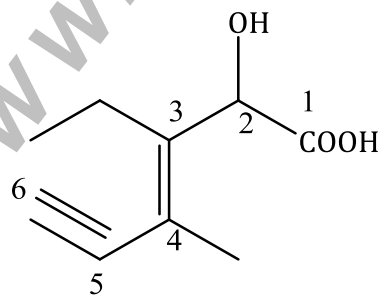
70. $[CrCl_2(H_2O)_4]Cl$
Because 0.01 mole of Cl^- ions are present in 100 ml.
So, in 1000 ml = 0.01 × 0.1 = 0.001

71. BF_3 acts as a Lewis acid because it is electron deficient.

72. The reaction can go to completion by removing OH^- ions by adding CO_2.

73. $(BH_3)_2$ is electron deficient.

74.



3-Ethyl-2-hydroxy-4-methyl hex-3-en-5-ynoic acid

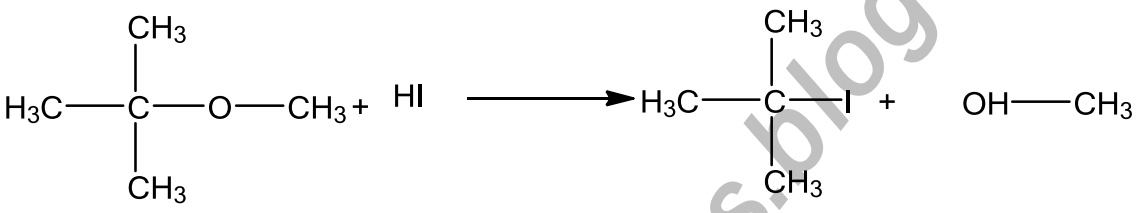
75. Me_3SiCl is not a monomer for a high molecular mass silicone polymer.

76. They are chemically inert.

77. Water does not contain π bond.

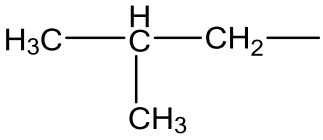
78. Dilute solutions of boric acid and hydrogen peroxide are mild antiseptics.

79.

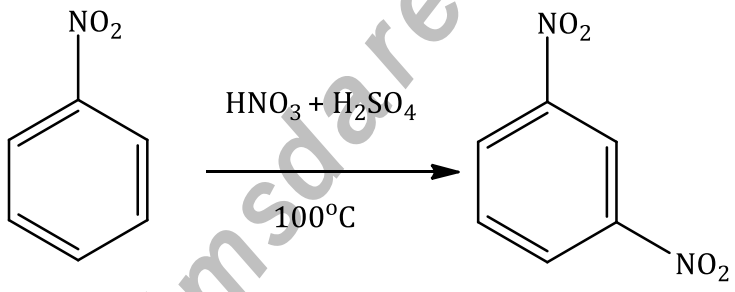


80. Nylon is an example of polyamide.

81.



82.

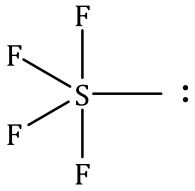


83. $-NO_2$ is the most deactivating.

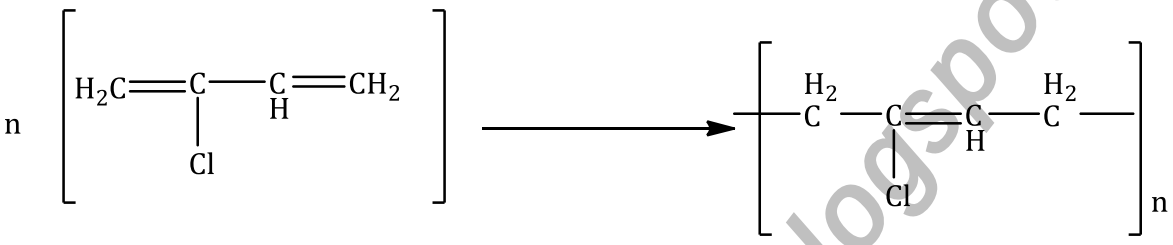
84.

$$M = \frac{\left[\frac{6.02\times10^{20}}{6.02\times10^{23}}\right]}{\frac{100}{1000}} = 0.01M$$

85. $\mu \neq 0$ and is therefore polar.

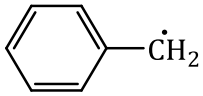


86.



Chloroprene(monomer) Neoprene(polymer

87. H_3PO_2 and H_2O

88. The radical  is aromatic because it has 6 p-orbitals and 6 unpaired electrons.

89. III > II > I

90. $-NO_2$ is a deactivating group, and therefore, nitrobenzene will not undergo Friedel–Crafts reaction.

Biology

91. In oomycetes, the male and female gametes both are non-motile, and the female gamete is large, while the male gamete is small.

92. A museum houses dead remains of animals and plants in the preserved form.

93. *Spirogyra* reproduces by isogamy and produces non-motile gametes. *Volvox* and *Fucus* reproduce by oogamy with the male gamete being motile and the female gamete being non-motile. *Chlamydomonas* reproduces by isogamy, anisogamy and oogamy, and the gametes may be motile or non-motile.

94. Cyanobacteria are found in the coralloid root of the Cycas plant.

95. Megasporangium is equivalent to the ovule.

96. Statements A, B and C are correct.
The sporophyte of moss is more elaborate than liverworts, and *Pinus* is a monoecious plant.

97. Among the given list of plants, mustard, brinjal, China rose, chilli, petunia, tomato, Withania, potato, onion, aloe, tulip, lupin, sunhemp, gram and bean have hypogynous flowers.

98. Interfascicular cambium develops from the cells of the medullary rays.

99. China rose belongs to Family Malvaceae; flowers of plants belonging to this family are actinomorphic showing radial symmetry, hypogynous ovary and with twisted aestivation of petals.

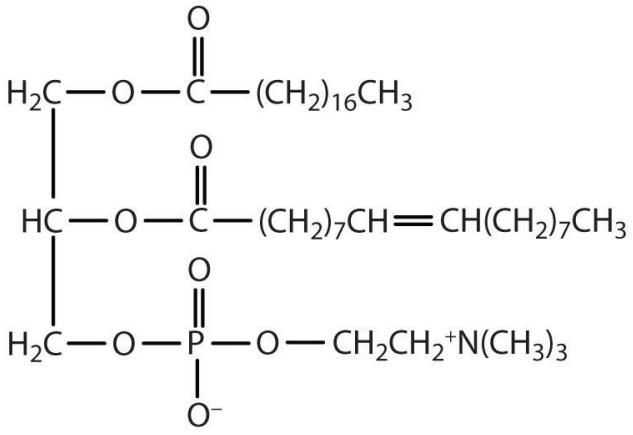
100. Lenticels are involved in gaseous exchange between the plant and the surrounding.

101. In plants, one annual ring is formed every year; thus, the number of annual rings tells the age of the tree.

102. Seed coat of coconut is thick.

103. The transition state structure of the substrate formed during an enzymatic reaction is transient and unstable.

104. A phosphoglyceride molecule consists of a saturated or unsaturated fatty acid esterified to a glycerol molecule to which a phosphate group is also attached.



105. In cyanobacteria, chromatophores are the photosynthetic pigments containing membranous extensions.

106. SER is the major site for lipid synthesis.

107. The complex formed by a pair of synapsed homologous chromosomes is known as a bivalent.

108. Arrows 4, 8 and 12 indicate ATP. Pathway A is glycolysis, where ATP is generated at the substrate level, pathway B is Krebs cycle wherein ATP is again generated at the substrate level and ATP is generated through oxidative phosphorylation in ETS which is pathway C.

109. K^+ is the most abundant ion in the intracellular fluid and Na^+ is abundant in the extracellular fluid.

110. Gibberellin functions in breaking seed dormancy by inducing the aleurone cells to secrete enzymes which break stored food in the seed.

111. Facilitated transport is the transport which is mediated with the help of carrier proteins and may be either uphill or downhill.

112. The first stable product of atmospheric nitrogen fixation in the root nodules of leguminous plants by *Rhizobium* is ammonia.

113. Acetyl CoA is the common metabolite to respiration-mediated breakdown of fats, carbohydrates and proteins.

114. Tapetum is the innermost layer of the anther which provides nourishment to developing pollen.

115. Sexual reproduction leads to new genetic combination which leads to variation as it involves mixing of gametes from two different parents.

116. The cells in which meiosis occurs are called meiocytes.

117. Cleistogamous or closed flowers ensure seed setting even in the absence of any pollinators.

118. *Chara* is a monoecious green alga which shows the presence of an upper oogonium and lower antheridium on the same plant.

119. The perisperm is the remains of the nucellus within the seed and is a diploid structure.

120. Tightly linked genes have 0% recombination frequency.

121. If variation in gene frequencies within the population occurs because of chance, then it is termed genetic drift.

122. When I^A and I^B antigens are present together within the RBCs, they both express their own type of sugar on the surface of RBCs. This phenomenon is called codominance.

123. Convergent evolution occurs in the unrelated group of organisms. It is the development of structures with a similar function in an unrelated group of organisms because of similar environmental conditions in which they live.

124. According to the Hardy–Weinberg principle, allele frequency in a population remains stable or constant from generation to generation.

125. Bt cotton is grown by Indian farmers.

126. *Aspergillus niger* is used for the production of citric acid.

127. DNA fragments generated by restriction endonuclease are separated using gel electrophoresis.

128. In algae, the cell wall is made of cellulose, and thus, cellulase is used for its degradation. Methylase is used for the process of methylation.

129. The colonies of recombinant bacteria appear white in contrast to blue colonies of non-recombinant bacteria because of insertional inactivation of alpha-galactosidase in recombinant bacteria.

130. Archaebacteria flourish in deep sea hydrothermal vents and hot springs where sunlight is scarce. They obtain nutrition through chemosynthesis.

131. The phosphorus cycle is a sedimentary cycle whose main reservoir is rocks.

132. Secondary productivity is the rate of formation of new organic matter by consumers.

133. Shifting cultivation is a type of deforestation and not a conservation strategy.

134. COP (Conference of Parties) occurs before and after the endorsement of the Kyoto Protocol.
CoP-1 – held at Berlin also known as the Berlin Mandate in 1995.
CoP-2 – held at Geneva also known as the Ministerial Declaration.
Cop-3 – held at Kyoto, in 1997, endorsed the Kyoto Protocol.

135. In the plant group, fungi have the highest amount of species diversity.

136. *Petromyzon* is a vertebrate belonging to Cyclostomata which is an ectoparasite on marine fish and turtles.

137. Housefly, butterfly, tsetse fly and silverfish are members of Class Insecta belonging to Phylum Arthropoda.

138. Prawns, scorpions and locusts belong to Phylum Arthropoda.

139. Silverfish belongs to Phylum Arthropoda.

140. In the skeletal muscle, the central gap between actin filaments extending through myosin filaments in the A band is called the H-zone.

141. Cockroach develops from the nymph to the adult form through the process of moulting. The next to last nymphal stage in cockroach shows the presence of wing pads, but only adult cockroaches have wings.

142. The Golgi complex is involved in post-translational modification of proteins and glycosidation of protein and lipid for the formation of glycolipid and glycoprotein, respectively.

143. The rough endoplasmic reticulum is found around the Golgi apparatus and is involved in protein synthesis.

144. Chitin is a polymer of N-acetyl galactosamine and hence is a nitrogen-containing polysaccharide.

145. Coenzymes are enzymes loosely attached to an organic molecule. These organic molecules are generally derivatives of vitamins.

146. The given figure is an illustration of the telophase stage, wherein the nuclear envelope and Golgi complex are reformed.

147. Nutrients (e.g. amino acids and glucose) and electrolytes (e.g. Na^+) are absorbed directly into the blood by active transport.

148. Hypothyroidism in the mother during pregnancy results in defective development and maturation of the growing foetus leading to stunted growth, mental retardation, low IQ and abnormal skin.

149. A – trachea is supported by C-shaped cartilaginous rings.
B – pleural membrane encloses a fluid-filled space and surrounds the lungs.
D – it represents the diaphragm.

150. A – Pulmonary vein takes pure blood from the lungs to the left atria.
B – Dorsal aorta takes blood from the heart to parts of the body.
D – Pulmonary artery takes impure blood from the heart to the lungs.

151. In an ECG, the P wave represents the depolarisation of both atria which leads to their contraction.

152. The adrenal gland is correctly labelled and is concerned with the release of the hormones adrenaline and noradrenaline, collectively known as catecholamine, which stimulate glycogen breakdown during emergency situations.

153. Gouty arthritis is caused by excessive formation of uric acid, and its subsequent deposition in the joints as monosodium salts.

154. The joint between the atlas and the axis is a pivot joint which is an example of a synovial joint. These joints are characterised by the presence of a fluid-filled synovial cavity between the articulating surface of the two bones.

155. A – Receptor
B – Synaptic cleft
C – Synaptic vesicles
D – Ca^{2+}

156. A – Retina
B – Blind spot
C – Aqueous chamber
D – Sclera

157. The adenohypophysis is not directly under neural control; it is under the control of hypothalamic hormones.
Organs in the body such as the gastrointestinal tract, heart, kidneys and liver produce hormones because they contain endocrine cells.
Releasing and inhibitory hormones are produced by the hypothalamus.

158. The thyroid gland synthesises the hormone thyroxine with the help of iodine. Lack of iodine in the diet results in goitre.

159. The correct sequence of spermatogenesis in human males is spermatogonia ⟶ spermatocyte ⟶ spermatid ⟶ spermatozoa.

160. Progesterone functions in maintaining pregnancy. In the absence of progesterone, the endometrium along with blood is shed in the form of menstrual flow.

161. At the time of childbirth, oxytocin is released from the neurohypophysis of the pituitary gland.

162. One of the legal methods of birth control is abortion by taking an appropriate medicine with the prescription of a registered medical practitioner under supervision.

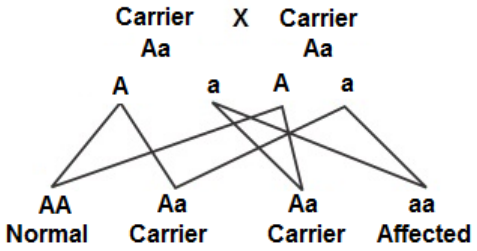
163. Amniocentesis is a test to determine the chromosomal pattern in the amniotic fluid surrounding the developing foetus. Jaundice is not a chromosomal disease and thus cannot be detected by amniocentesis.

164. Introduction of sperms from a healthy donor into the vagina of the female artificially is known as artificial insemination.

165. In co-dominance, the genes from both parents are expressed in the F_1 generation.

166. Haemophilia is a sex-linked recessive disease in which a single clotting factor protein is affected.

167. Thalassaemia is an autosomal recessive disease.



168. A – Transcription
B – Translation
C – Francis Crick
The given schematic represents the central dogma of life.

169. Non-sense mutation is a point mutation which results in a premature stop codon which terminates transcription. Because the non-sense mutation takes place in the *lac Y* gene, all enzymes coded before the *lac Y* gene will be transcribed, and hence, only β-galactosidase will be synthesised.

170. According to Darwinism, competition between two different species is the key factor for organic evolution because it results in divergent evolution.

171. The eyes of octopus and cat are analogous organs because they have a different structure but perform the same function.

172. Infection of *Ascaris* occurs because of the consumption of food and water contaminated with eggs of *Ascaris*.

173. T-lymphocytes are responsible for cell-mediated immunity.

174. An entire collection of plants or seeds having all diverse alleles for all the genes in a given crop plant is known as germplasm collection.

175. During sewage treatment, the biogases produced in the anaerobic sludge digester by anaerobic bacteria include carbon dioxide, hydrogen sulphide and methane.

176. Natality = 250, Immigration = 20, Mortality = 240, Emigration = 30
Therefore, increase in population = [(Natality + Immigration) − (Mortality + Emigration)]
= [(250 + 20) − (240 + 30)]
= 0

177. Fragmentation is one of the steps during decomposition in which detritus is converted to small fragments.

178. The association between sea anemone and hermit crab is symbiosis as both are mutually benefited from the relation.

179. Reducing deforestation and cutting down on the use of fossil fuel will result in the reduction in greenhouse gases such as carbon dioxide.

180. Air (Prevention and Control of Pollution) Act came into existence in 1981.

AIPMT - 2014
(Physics, Chemistry and Biology)
Code P

Time: 3 hrs **Total Marks: 720**

General Instructions:

1. The Answer sheet is inside this Text booklet. When you are directed to open the text booklet, take out the Answer Sheet and fill in the particulars on side – 1 and side – 2 carefully with blue/black ball point pen only.
2. The test is of 3 hours duration and consists of 180 questions. Each question carries 4 marks. For each correct response the candidate will get 4 marks. For each incorrect response, one mark will be deducted. The maximum marks are 720.
3. Use Blue / Black ball point pen only for writing particulars on this page / marking responses.
4. Rough work is to be done on the space provided for this purpose in the text booklet only.
5. On completion of the test, the candidate must handover the answer sheet to the invigilator in the room/ Hall. The candidates are allowed to take away this text booklet with them.
6. Make sure that the CODE printed on side – 2 of the answer sheet is the same as that on this booklet, In case of discrepancy, the candidate should immediately report the matter to the invigilator for the replacement of both the test Booklet and the Answer Sheet.
7. The candidates should ensure that the Answer sheet is not folded. Do not make any stray marks on the Answer sheet. Do not write your roll no. anywhere else except in the specified space in the Test booklet / Answer Sheet.
8. Use of white fluid for correction is not permissible on the Answer Sheet.

Physics

1. If force (F), velocity (V) and time (T) are take As fundamental units, then the dimensions of mass are :

(1) $[F\ V\ T^{-1}]$
(2) $[F\ V\ T^{-2}]$
(3) $[F\ V^{-1}\ T^{-1}]$
(4) $[F\ V^{-1}\ T]$

2. A projectile is fired from the surface of the earth with a velocity of $5 ms^{-1}$ and angle θ with the horizontal. Another projectile fired another planet with a velocity of $3 ms^{-1}$ at the same angle follows a trajectory which is identical with the trajectory of the projectile fired from the earth. The value of the acceleration due to gravity on the planet is (in ms^{-2}) is: (given $g = 9.8 ms^{-2}$)

(1) 3.5
(2) 5.9
(3) 16.3
(4) 110.8

3. A particle is moving such that its position coordinates (x,y)are
(2 m, 3 m) at time t = 0,
(6 m, 7 m) at time t = 2 s and
(13 m, 14 m) at time t = 5s
Average velocity vector $\left(\vec{V}_{av}\right)$ from t = 0 to t = 5 s is:

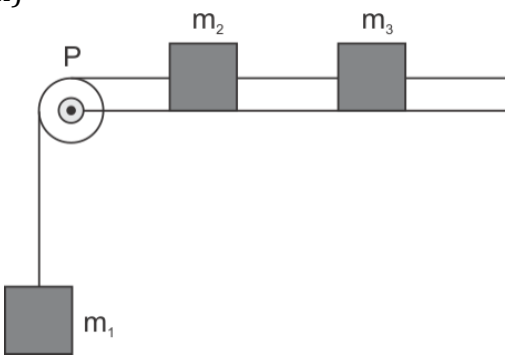
(1) $\frac{1}{5}(13\hat{i}+14\hat{i})$

(2) $\frac{7}{3}(\hat{i}+\hat{i})$

(3) $2(\hat{i}+\hat{i})$

(4) $\frac{11}{5}(\hat{i}+\hat{i})$

4. A system consists of three masses m_1, m_2 and m_3 connected by a strings passing over a pulley P. The mass m1 hangs freely and m_2 and m_3 are on a rough horizontal table (the coefficient of friction = u) the pulley if frictionless and of negligible mass. The downward acceleration of mass m_1 is :
(Assue $m_1 = m_2 = m_3 = m$)



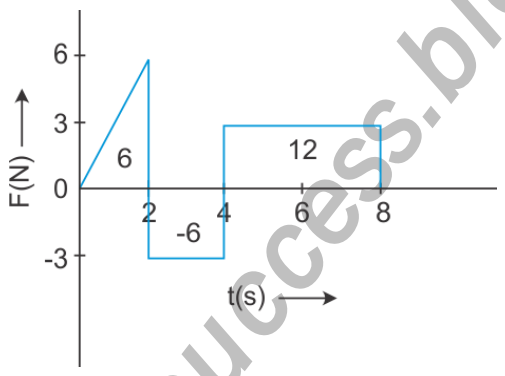
(1) $\frac{g\,(1 - g\mu)}{9}$

(2) $\frac{2g\mu}{3}$

(3) $\frac{g\,(1 - 2\mu)}{3}$

(4) $\frac{g\,(1 - 2\mu)}{2}$

5. The force 'F' acting on a particle of mass 'm' is indicated by the force – time graph shown below. The change in momentum of the particle over the time interval from zero to 8 s is :



(1) 24 Ns
(2) 20 Ns
(3) 12 Ns
(4) 6 Ns

6. A ballon with mass 'm' descending down with an acceleration 'a' (where a < g). how much mass should be removed from its so that it starts moving up with an acceleration 'a' ?

(1) $\frac{2ma}{g + a}$

(2) $\frac{2\ ma}{g - a}$

(3) $\frac{ma}{g + a}$

(4) $\frac{ma}{g - a}$

7. A body of mass (4m) is laying in x-y plane at rest. It suddenly explodes into three pieces. Two pieces each of mass (m) move perpendicular to each other with equal speeds (v). The total kinetic energy generated due to explosion is :

(1) mv^2

(2) $\frac{3}{2}mv^2$

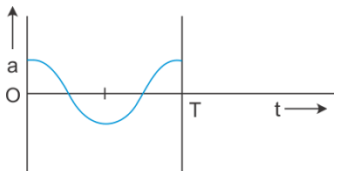
(3) $2\,mv^2$

(4) $4\,mv^2$

8. The oscillation of a body on a smooth horizontal surface is represented by the equation, Where, X = A cos (ωt) ; X = displacement at time t; ω = frequency of oscillation

Which one of the following graphs shows correctly the variation 'a' with 't'?

(1)



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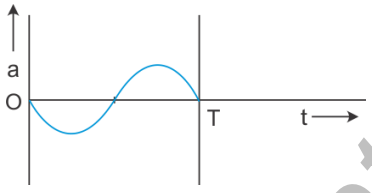

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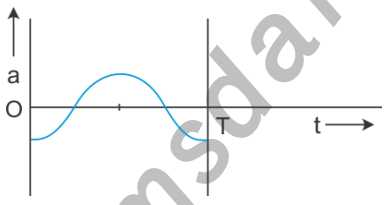

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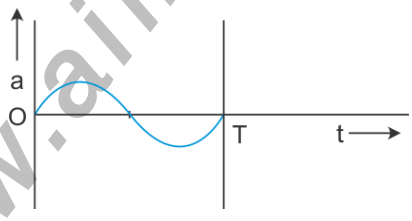


Here a = acceleration at time t

T = time period

9. A solid cylinder of mass 50 g and radius 0.5 m is free to rotate about the horizontal axis. A massless string is wound round the cylinder with one end attached to it and other hanging freely. Tension in the string required to produce an angular acceleration of 2 revolutions s^{-2} is :

(1) 25 N
(2) 50 N
(3) 78.5 N
(4) 157 N

10. The ratio of the accelerations for a solid sphere (mass 'm' and radius 'R' rolling down an incline of angle 'θ' Without slipping and slipping down the incline with rolling is :

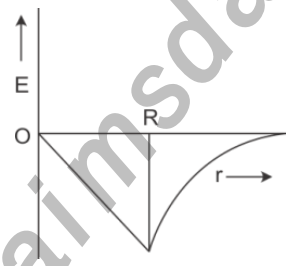
(1) 5 :7
(2) 2:3
(3) 2:5
(4) 7:5

11. A black hole is an object whose gravitational field is so strong that even light cannot escape from it. To what approximate radius would earth (mass = 5.98×10^{24} kg) have to be compressed to be a black hole ?

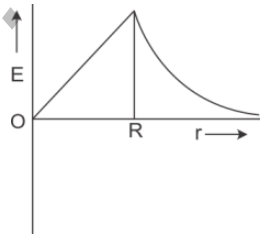
(1) 10^{-9} m
(2) 10^{-6} m
(3) 10^{-2} m
(4) 100 m

12. Dependence of intensity of gravitational field (E) of earth with distance (r) from centre of earth is correctly represented by :

(1)

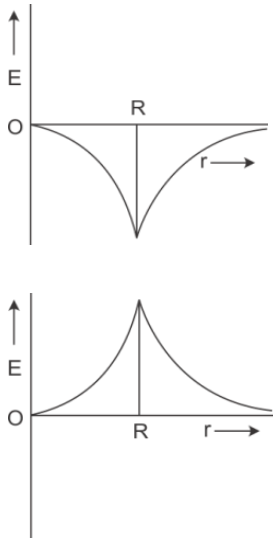


(2)



(3)

(4)



13. Copper of fixed bolume 'V' is drawn into wire of length 'l'. When the wire is subjected to a constant force 'F' the extension produced in the wire is 'Δl' . Which of the following graphs is a straight line?

(1) Δl versus 1/l
(2) Δl versus l^2
(3) Δl versus $1/l^2$
(4) Δl versus l

14. A certain number of spherical drops of liquid of radius 'r' coalesce to form a single drop of radius 'R' and volume 'V'. if 'T' is the surface tension of the liquid, then :

(1) Energy = $4VT\left(\frac{1}{r}-\frac{1}{R}\right)$ is released.

(2) Energy = $3\ VT\left(\frac{1}{r}+\frac{1}{R}\right)$ is absorbed

(3) Energy = $3\ VT\left(\frac{1}{r}-\frac{1}{R}\right)$ is released

(4) Energy is neither released nor absorbed

15. Steam at 100°C is passed into 20 g of water at 10°C. when water acquires a temperature of 80°C the mass of water present will be :

[Take specific heat of water = 1 cal g^{-1} $^oC^{-1}$ and latent heat of steam = 540 cal g^{-1}]

(1) 24 g
(2) 31.5 g
(3) 42.5 g
(4) 22.5 g

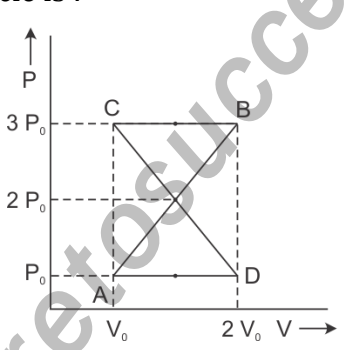
16. Certain quantity of water cools from 70°C to 60°C in the first 5 minutes and to 54°C in the next 5 minutes. The temperature of the surroundings is :

(1) 45°C
(2) 20°C
(3) 42°C
(4) 10°C

17. A monoatomic gas at pressure P, having a volume V expands isothermally to a volume 2V and then adiabatically to a volume 16 V. the final pressure if the gas is : (take γ = 5/3)

(1) 64 P
(2) 32 Po
(3) P/64
(4) 16P

18. A thermodynamic system undergoes cyclic process ABCDA as shown in Fig. the work done by the system in the cycle is :



(1) P_0V_0
(2) 2 P_0V_0
(3) $\frac{P_0V_0}{2}$
(4) Zero

19. The mean free path of molecules of a gas, (radius is inversely proportional to :

(1) r^3
(2) r^2
(3) r
(4) $\sqrt{r}$

20. If n_1, n_2 and n_3 are the fundamental frequencies three segments into which a string is divided, the original fundamental frequency n of the string is given by :

(1) $\frac{1}{n}=\frac{1}{n_1}+\frac{1}{n_2}+\frac{1}{n_3}$

(2) $\frac{1}{\sqrt{n}}=\frac{1}{\sqrt{n_1}}+\frac{1}{\sqrt{n_2}}+\frac{1}{\sqrt{n_3}}$

(3) $\sqrt{n}=\sqrt{n_1}+\sqrt{n_2}+\sqrt{n_3}$

(4) $N = n_1 + n_2 + n_3$

21. The number of possible natural oscillations of column in a pipe closed at one end of length 85 cm whose frequencies lie below 1250 Hz are :

(velocity of sound = 340 ms^1)

(1) 4

(2) 5

(3) 7

(4) 6

22. A speeding motorcyclist sees traffic jam ahead him. He slows down to 36 km/hour. He finds the traffic has eased and a car moving ahead of him 18 km/hour is honking at a frequency of 1392 Hz. The speed of sound is 343 m/s, the frequency of the honk as heard by him will be :

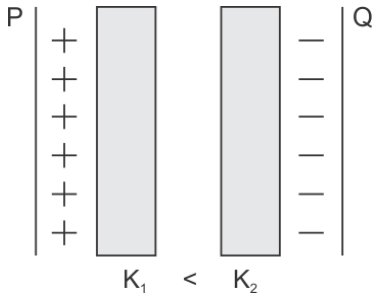
(1) 1332 Hz

(2) 1372 Hz

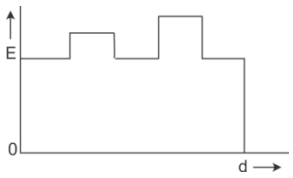
(3) 1412 Hz

(4) 1454 Hz

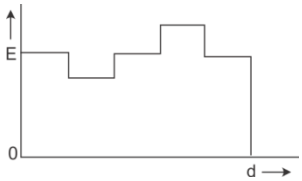
23. Two think dielectric slabs of dielectric constants K1 and K2 (K1<K2) are inserted between plates of a parallel plate capacitor as shown in the figure. The variation of electric field 'E' between the plates with distance 'd' as measured from plate P is correctly shown by :



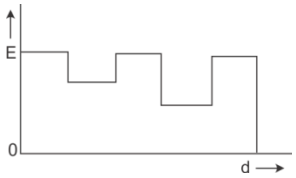
(1)



(2)



(3)



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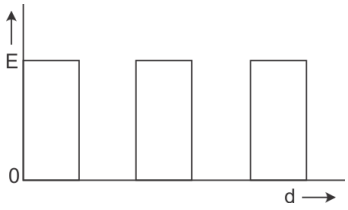


24. A conducting sphere of radius R is given a charge Q. The electric potential and the electric field at the centre of the sphere respectively are

(1) Zero and $\frac{Q}{4\pi\varepsilon_o R^2}$

(2) $\frac{Q}{4\pi\varepsilon_o R}$ and Zero

(3) $\frac{Q}{4\pi\varepsilon_o R}$ *and* $\frac{Q}{4\pi\varepsilon_o R^2}$

(4) Both are zero

25. In a region the potential is represented by V(x,y,z) = 6x – 8xy – 8y + 6yz, where v is in volts and x, y, z are in meters. The electric force experienced by a change of 2 coulomb situated at point (1,1,1) is :

(1) $6\sqrt{5}$ N

(2) 30 N

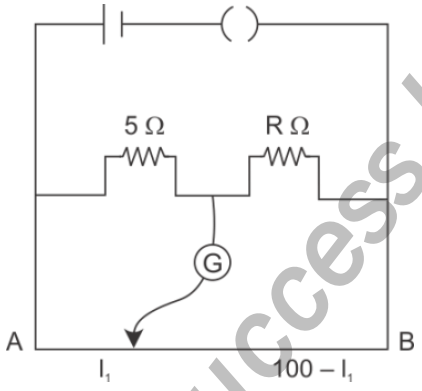
(3) 24 N

(4) $4\sqrt{35}$ N

26. Two cities are 150 km apart. Electric power is sent from one city to another city through copper wires. The fall of potential per km is 8 volt and the average resistance per km is 0.5 Ω. The power loss in the wire is :

(1) 19.2 w
(2) 19.2 kW
(3) 19.2 J
(4) 12.2 kW

27. The resistances in the two arms of the meter bridge are 5 Ω and R Ω respectively, When the resistance. R is shunted with an equal resistance; the new balance point is at $1.6l_1$. the resistance 'R' is:



(1) 10 Ω
(2) 15 Ω
(3) 20 Ω
(4) 25 Ω

28. A potentiometer circuit has been set up for finding the internal resistance of given cell. The main battery, used across the potentiometer wire, has an emf of 2.0 V and a negligible internal resistance. The potentiometer wire itself is 4 m long. When the resistance R connected across the given cell, has values of.

(1) Infinity
(2) 9.5 Ω

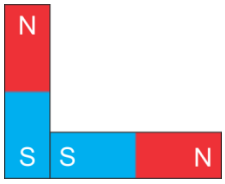
The 'balancing lengths' on the potentiometer wire are found to be 3m and 2.85 m, respectively.

The value of internal resistance of the cell is:

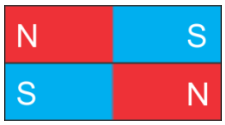
(1) 0.25 Ω
(2) 0.95 Ω
(3) 0.5 Ω
(4) 0.75 Ω

29. Following figures show the arrangement of bar magnets in different configurations. Each magnet has magnetic dipole moment $\vec{m}$. Which configuration has highest net magnetic dipole moment?

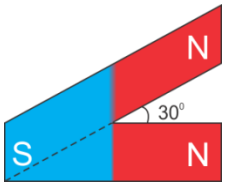
(a)



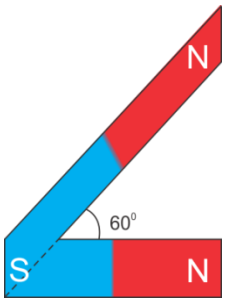
(b)



(c)



(d)



(1) (a)
(2) (b)
(3) (c)
(4) (d)

30. In an ammeter 0.2% of main current passes through the galvanometer. If resistance of galvanometer is G, the resistance of ammeter will be :

(1) $\frac{1}{499}$G

(2) $\frac{499}{500}$G

(3) $\frac{1}{500}$G

(4) $\frac{500}{499}$G

31. Two identical long conducting wires AOB and COD are placed at right angle to each other, with one above other such that 'O' is their common point for the two. The wires carry I_1 and I_2 currents, respectively. Point 'P' is lying at distance'd' from 'O' along a direction perpendicular to the plane containing the wires. The magnetic field at the point 'P' will be :

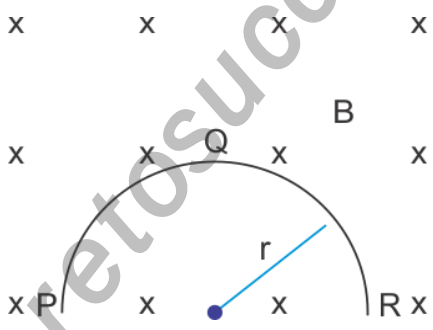
(1) $\frac{\mu_o}{2\pi d}\left(I_1 / I_2\right)$

(2) $\frac{\mu_o}{2\pi d}\left(I_1+I_2\right)$

(3) $\frac{\mu_o}{2\pi d}\left(I_1^2-I_2^2\right)$

(4) $\frac{\mu_o}{2\pi d}\left(I_1^2+I_2^2\right)^{1/2}$

32. A thin semicircular conducting ring (PQR) of radius 'r' is falling with its plane vertical in a horizontal magnetic field B, as shown in figure. The potential difference developed across the ring when its speed is v, is:



(1) Zero

(2) $B v \pi r^2/2$ and P is at higher potential

(3) $\pi r B v$ and R is at higher potential

(4) $2 r B v$ and R is at higher potential

33. A transformer having efficiency of 90% is working on 200 V and 3 kW power supply. If the current in the secondary coil is 6A, the voltage across the secondary coil and the current in the primary coil respectively are :

(1) 300 V, 15 A

(2) 450 V, 15 A

(3) 450 V, 13.5 A

(4) 600 V, 15 A

34. Light with an energy flux of 25 x 10^4 Wm^{-2} falls on a perfectly reflecting surface at normal incidence. If the surface area is 15 cm^2, the average force exerted on the surface is :

(1) 1.25 x 10^{-6} N
(2) 2.50 x 10^{-6}N
(3) 1.20 x 10^{-6} N
(4) 3.0 x 10^{-6} N

35. A beam of light of λ = 600 nm from a distant source falls on a single slit 1 mm wide and the resulting diffraction pattern is observed on a screen 2 m away. The distance between first dark frings on either side of the central bright fringe is :

(1) 1.2 cm
(2) 1.2 mm
(3) 2.4 cm
(4) 2.4 mm

36. In the Young's double – slit experiment, the intensity of light at a point on the screen where the path difference is λ is K, (λ being the wave length of light used). The intensity at point where the path difference is $\lambda/4$ will be:

(1) K
(2) K/4
(3) K/2
(4) Zero

37. If the focal length of objective lens is increased then magnifying power of :

(1) Microscope will increase but that of telescope decrease.
(2) Microscope and telescope both will increase
(3) Microscope and telescope both will decrease
(4) Microscope will decrease but that of telescope will increase.

38. The angle of prism is 'A' One of its refracting surfaces is silvered. Light rays falling at an angle of incidence 2A on the first surface returns back through the same path after suffering reflection at the silvered surface. The refractive index μ of the prism is

(1) 2 sin A
(2) 2 cos A
(3) $\frac{1}{2}\cos A$
(4) Tan A

39. When the energy of the incident radiayion is increased by 20% the kinetic energy of the photoelectrons emitted from a metal surface increased from 0.5 eV to 0.8 eV. The work function of the metal is

(1) 0.65 eV
(2) 1.0 eV
(3) 1.3 eV
(4) 1.5 eV

40. If the kinetic energy of the particle is increased to 16 times its previous value, the percentage change in the de-broglie wavelength of the particle is :

(1) 25
(2) 75
(3) 60
(4) 50

41. Hydrogen atom in ground state is excited by a monochromatic radiation of $\lambda = 975\ \mathring{A}$. Number of spectral lines in the resulting spectrum emitted will be :

(1) 3
(2) 2
(3) 6
(4) 10

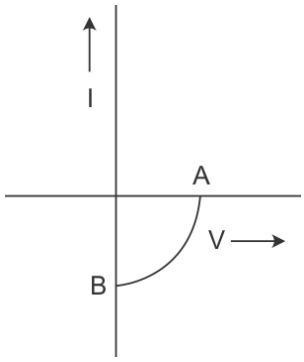
42. The Binding energy per nucleon of $^{7}_{3}Li$ and $^{4}_{2}He$ nuclei are 5.60 MeV and 7.06 MeV respectively. In the nuclear reaction $^{7}_{3}Li + {}^{1}_{1}H \rightarrow {}^{4}_{2}He + {}^{4}_{2}He + Q$, the value of energy Q released is :

(1) 19.6 MeV
(2) -2.4 MeV
(3) 8.4 MeV
(4) 17.3 MeV

43. A radio isotope 'X' with a half life 1.4 x 10^9 years decays to 'Y' which is stable. A sample of the rock from a cave was found to contain 'X' and 'Y' in the ratio 1:7. The age of the rock is :

(1) 1.96 x 10^9 years
(2) 3.92 x 10^9 years
(3) 4.20 x 10^9 years
(4) 8.40 x 10^9 years

44. The given graph represents V – I charachteristics for semincondutor device.



Which of the following statement is correct?

(1) It is V – I characteristics for solar cell where point A represents open circuit voltage and point b short circuit current.

(2) It is for s solar cell and points A and B represent open circuit voltage and current, respectively.

(3) It is for a photodiode and points A and B represent open circuit voltage and current, respectively

(4) It is for LED and points A and B represent open circuit voltage and short circuit current, respectively

45. The barrier potential of a p – n junction depends on :

(a) Type of semi conductor material

(b) Amount of doping

(c) Temperature

Which one of the following is correct?

(1) (a) and (b) only

(2) (b) only

(3) (b) and (c) only

(4) (a),(b) and (c)

Chemistry

46. What is the maximum number of orbitals that can be identified with the following quantum numbers?
n= 3, l = 1, m_l = 0
(1) 1
(2) 2
(3) 3
(4) 4

47. Calculate the energy in joule corresponding to light of wavelength 45 nm : (Planck's constant h = 6.63 x 10^{-34} Js ; speed of light c = 3 x 10^{8} ms^{-1})
(1) 6.67 x 10^{15}
(2) 6.67 x 10^{11}
(3) 4.42 x 10^{-15}
(4) 4.42 x 10^{-18}

48. Equal masses of H_2, O_2 and methane have been taken in a container of volume V at temperature 27°C in identical conditions. The ratio of the volumes of gases H_2 : O_2 : methane would be :
(1) 8 : 16 : 1
(2) 16 : 8 : 1
(3) 16: 1 : 2
(4) 8 : 1 : 2

49. If a is the length of the side of a cube, the distance between the body centered atom and one corner atom in the cube will be
(1) $\frac{2}{\sqrt{3}}a$
(2) $\frac{4}{\sqrt{3}}a$
(3) $\frac{\sqrt{3}}{4}a$
(4) $\frac{\sqrt{3}}{2}a$

50. Which property of colloids is not dependent on the charge on colloidal particles ?
(1) Coagulation
(2) Electrophoresis
(3) Electro – osmosis
(4) Tyndall effect

51. Which of the following salts will give highest pH in water ?
(1) KCl
(2) NaCl
(3) Na_2CO_3
(4) $CuSO_4$

52. Of the following 0.10 aqueous solutions, which one will exhibit the largest freezing point depression?
(1) KCl
(2) $C_6H_{12}O_6$
(3) $Al_2(SO_4)_3$
(4) K_2SO_4

53. When 22.4 litres of $H_{2\,(g)}$ is mixed with 11.2 litres of $Cl_{2(g)}$, each at S.T.P, the moles of $HCl_{\,(g)}$ formed is equal to :
(1) 1 mol of $HCl_{(g)}$
(2) 2 mol of $HCl_{\,(g)}$
(3) 0.5 mol of $HCl_{(g)}$
(4) 1.5 mol of $HCl_{\,(g)}$

54. When 0.1 mol MnO_4^{2-} is oxidised the quantity of electricity required to completely oxidize MnO_4^{2-} to MnO_4^- is :
(1) 96500 C
(2) 2 x 96500 C
(3) 9650 C
(4) 96.50 C

55. Using the Gibbs energy change, $\Delta G^\circ = +63.3$ kJ, for the following reaction,
$Ag_2CO_3\,(s) \rightleftharpoons 2\,Ag^+_{\,(aq)} + CO^{2-)}_{3\,(aq)}$
The K_{sp} of $Ag_2CO_{3(s)}$ in water at 25°C is:
(R = 8.314 J K^{-1} mol^{-1})
(1) 3.2×10^{-26}
(2) 8.0×10^{-12}
(3) 2.9×10^{-3}
(4) 7.9×10^{-2}

56. The weight of silver (at.wt = 108) displaced by a quantity of electricity which displaces 5600 mL of O_2 at STP will be :
(1) 5.4 g
(2) 10.8 g
(3) 54.0 g
(4) 108.0 g

57. Which of the following statements is correct for the spontaneous adsorption of a gas?
(1) ΔS is negative and, therefore, ΔH should be highly positive.
(2) ΔS is negative and therefore, ΔH should be highly negative.
(3) ΔS is positive and therefore, ΔH should be negative.
(4) ΔS is positive and, therefore, ΔH should also be highly positive.

58. For the reversible reaction :
$N_{2\,(g)} + 3H_{2(g)} \rightleftharpoons 2\,NH_{3\,(g)}$ + heat
The equilibrium shifts in forward direction :
(1) By increasing the concentration of $NH_{3(g)}$
(2) By decreasing the pressure
(3) By decreasing the concentration of $N_{2(g)}$ and $H_{2(g)}$
(4) By increasing pressure and decreasing temperature

59. For the reaction :
$X_2O_{4\,(l)} \rightarrow 2\,XO_{2(g)}$
$\Delta U = 2.1$ k cal, $\Delta S = 20$ cal K^{-1} at 300 K
Hence, ΔG is
(1) 2.7 k cal
(2) -2.7 k cal
(3) 9.3 k cal
(4) -9.3 k cal

60. For a given exothermic reaction, K_p and K'_p are the equilibrium constants at temperatures T_1 and T_2, respectively. Assuming that heat of reaction is constant in temperature range between T_1 and T_2, it is readily observed that :
(1) $Kp > K'_p$
(2) $Kp < K'_p$
(3) $K_p = K'_p$
(4) $K_p = \frac{1}{K'_p}$

61. Which of the following orders of ionic radii is correctly represented ?
(1) $H^- > H^+ > H$
(2) $Na^+ > F^- > O^{2-}$
(3) $F^- > O^{2-} > Na^+$
(4) $Al^{3+} > Mg^{2+} > N^{3-}$

62. 1.0 g of magnesium is burnt with 0.56 g O_2 in a closed vessel. Which reactant is left in excess and how much?
(At.wt.Mg = 24; O = 16)
(1) Mg, 0.16 g
(2) O_2 , 0.16 g
(3) Mg, 0.44 g
(4) O_2, 0.28 g

63. The pair of compounds that can exist together is :
(1) $FeCl_3$, $SnCl_2$
(2) $HgCl_2$, $SnCl_2$
(3) $FeCl_2$, $SnCl_2$
(4) $FeCl_3$, KI

64. Be^{2+} is isoelectronic with which of the following ions?
(1) H^+
(2) Li^+
(3) Na^+
(4) Mg^{2+}

65. Which of the following molecules has the maximum dipole moment ?
(1) CO_2
(2) CH_4
(3) NH_3
(4) NF_3

66. Which one of the following species has plane triangular shape?
(1) N_3
(2) NO_3^-
(3) NO_2^-
(4) CO_2

67. Acidity of diprotic acids in aqueous solutions increase in the order
(1) $H_2S < H_2Se < H_2Te$
(2) $H_2Se < H_2S > H_2Te$
(3) $H_2Te < H_2S < H_2Se$
(4) $H_2Se < H_2Te < H_2S$

68. (a) $H_2O_2 + O_3 \rightarrow H_2O + 2O_2$
(b) $H_2O_2 + Ag_2O \rightarrow 2Ag + H_2O + O_2$
Role of hydrogen peroxide in the above reactions is respectively:
(1) Oxidizing in (a) and reducing in (b)
(2) Reducing in (a) and oxidizing in (b)
(3) Reducing in (a) and (b)
(4) Oxidizing in (a) and (b)

69. Artificial sweetner which is stable under cold conditions only is :
(1) Saccharine
(2) Sucralose
(3) Aspartame
(4) Alitame

70. In acidic medium, H_2O_2 changes $Cr_2O_7^{-2}$ to CrO_5 which has two (-O-O-) bonds.
Oxidation state of Cr in CrO_5 is :
(1) +5
(2) +3
(3) +6
(4) -10

71. The reaction of aqueous $KMnO_4$ with H_2O_2 in acidic conditions gives :
(1) Mn^{4+} and O_2
(2) Mn^{2+} and O_2
(3) Mn^{2+} and O_3
(4) Mn^{4+} and MnO_2

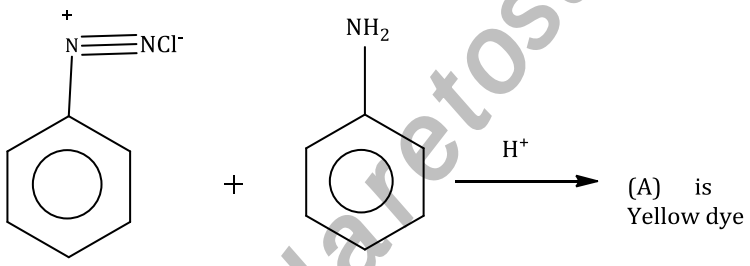
72. Among the following complexes the one which shows zero crystal field stabilization energy (CFSE) is :
(1) $[Mn(H_2O)_6]^{3+}$
(2) $[Fe(H_2O)_6]^{3+}$
(3) $[Co(H_2O)_6]^{2+}$
(4) $[Co(H_2O)_6]^{3+}$

73. Magnetic moment 2.83 BM is given by which of the following ions?
(At.nos. Ti = 22, Cr = 24, Mn = 25, Ni = 28)
(1) Ti^{3+}
(2) Ni^{2+}
(3) Cr^{3+}
(4) Mn^{2+}

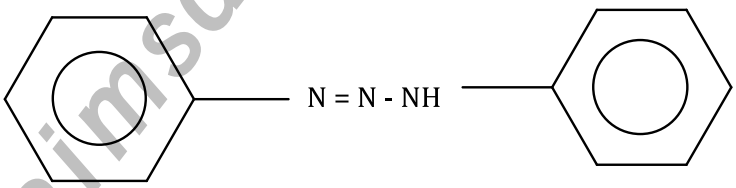
74. Which of the following complexes is used to be as anticancer agent ?
(1) mer – $[Co(NH_3)_3Cl]$
(2) cis – $[Pt Cl_2 (NH_3)_2]$
(3) cis – $K_2[Pt Cl_2 Br_2]$
(4) Na_2CoCl_4

75. Reasons of lanthanoid contraction is :
(1) Negligible screening effect of 'f' orbitals
(2) Increasing Nuclear charge
(3) Decreasing nuclear charge
(4) Decreasing screening effect

76. In the following reaction, the product (A)



(1)



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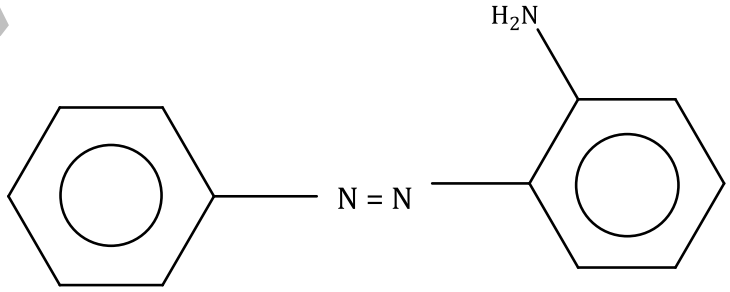

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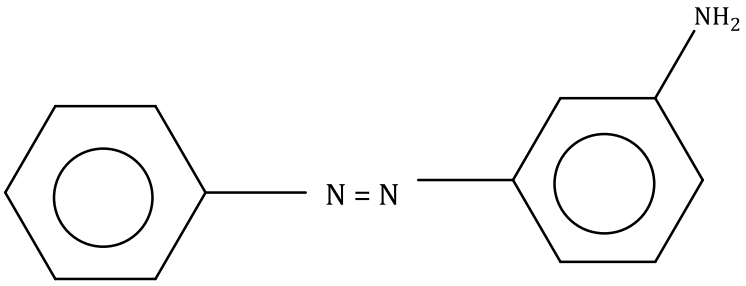

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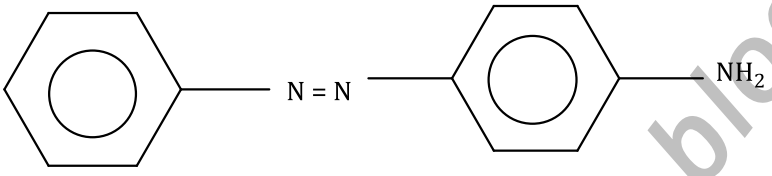


77. Which of the following will be most stable diazonium salt $RN_2^+X^-$?

(1) $CH_3N_2^+X^-$

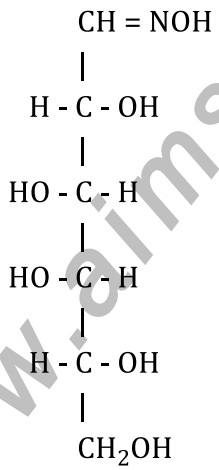
(2) $C_6H_5N_2^+X^-$

(3) $CH_3CH_2N_2^+X^-$

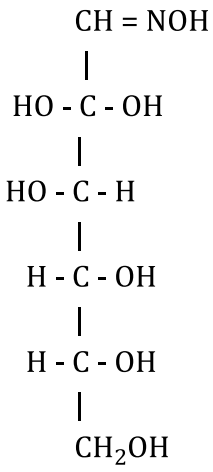
(4) $C_6H_5CH_2N_2^+X^-$

78. D (+) glucose reacts with hydroxyl amine and yields an oxime. The structure of the oxime would be :

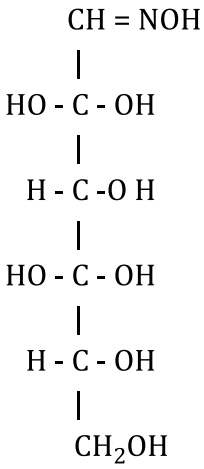
(1)



(2)



(3)



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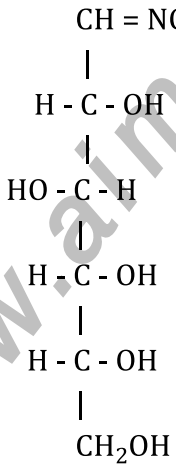
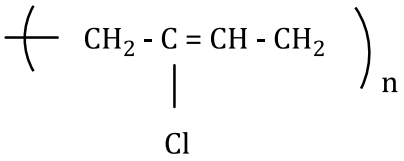


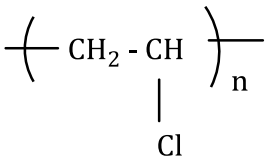
79. Which of the following hormones is produced under the condition of stress which stimulates glycogenolysis in the liver of human beings ?
(1) Thyroxin
(2) Insulin
(3) Adrenaline
(4) Estradiol

80. Which one of the following is an example of a thermosetting polymer?

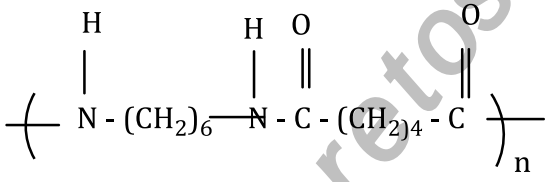
(1)



(2)



(3)



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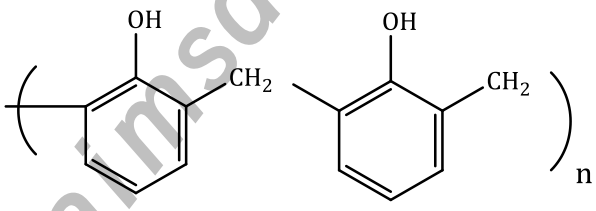
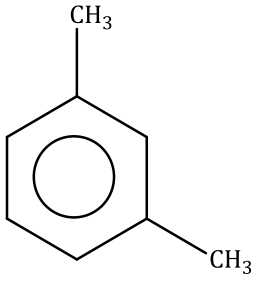


81. Which of the following organic compounds polymerizes to form the polyster Dacron?
(1) Propylene and para HO – (C_6H_4) – OH
(2) Benzoic acid and ethanol
(3) Terephthalic acid and ethyleneglycol
(4) Benzoic acid and para HO –(C_6H_4) – OH

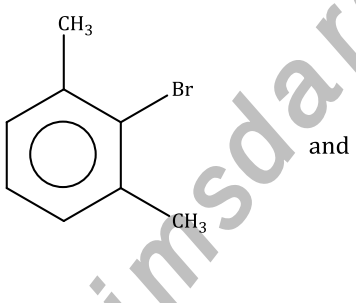
82. Which one of the following is not a common component of phototechemical smog ?
(1) Ozone
(2) Acrolein
(3) Peroxyacetyl nitrate
(4) Chlorofluorocarbons

83. In the Kjeldahl's method for estimation of nitrogen present in a soil sample, ammonia evolved from 0.75 g sample neutralized 10 mL of 1M H_2SO_4. The percentage of nitrogen in the soil is :
(1) 37.33
(2) 45.33
(3) 35.33
(4) 43.33

84. What products are formed when the following compound is treated with Br in the presence of $FeBr_3$?



(1)



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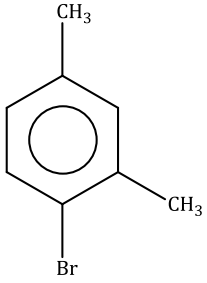

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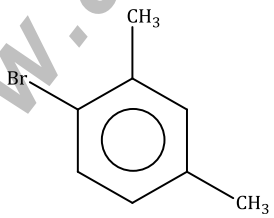

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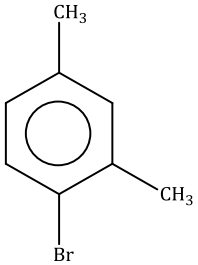

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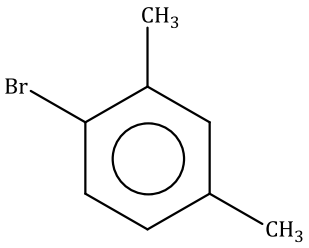

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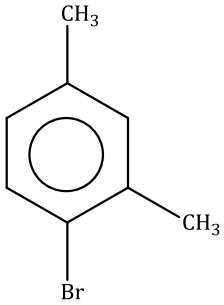

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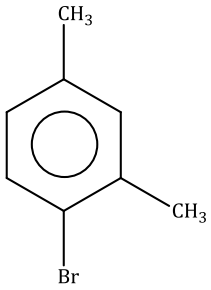

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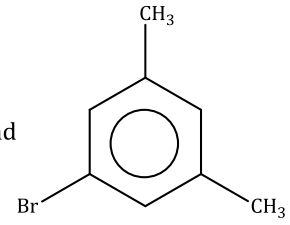
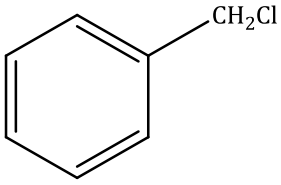


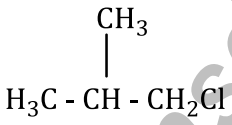
85. Which of the following compounds will undergo racemisation when solution of KOH hydrolyses?

(i)

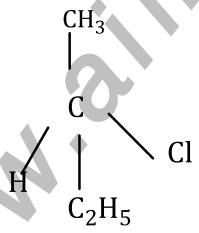


(ii) $CH_3CH_2CH_2Cl$

(iii)



(iv)

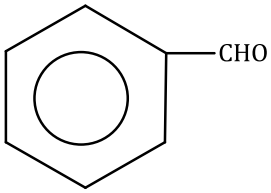


(1) and (ii)
(2) (ii) and (iv)
(3) (iii) and (iv)
(4) (i) and (iv)

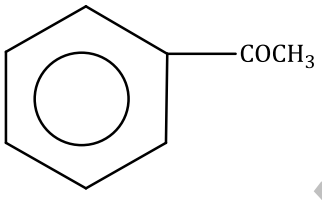
86. Among the following sets of reactants which one produces anisole?
(1) $CH_3CHO;RMgX$
(2) $C_6H_5OH;NaOH;CH_3I$
(3) C_6H_5OH;neutral $FeCl_3$
(4) $C_6H_5 - CH_3;CH_3COCl;AlCl_3$

87. Which of the following will not be soluble in sodium hydrogen carbonate?
(1) 2,4,6 – trinitrophenol
(2) Benzoic acid
(3) o – Nitrophenol
(4) Benzenesulphonic acid

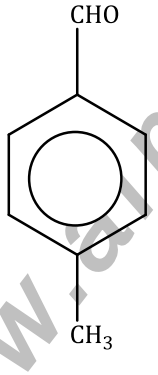
88. Which one is most reactive towards Nucleophilic addition reaction?
(1)



(2)



(3)



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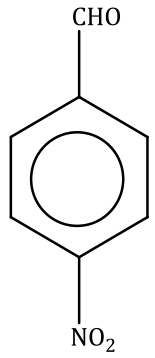


89. Identity Z in the sequence of reactions :

$CH_3CH_2CH = CH_2 \xrightarrow{HBr/H_2O_2} Y \xrightarrow{C_3H_5ONa} Z$

(1) $CH_3 - (CH_2)_3 - O - CH_2CH_3$

(2) $(CH_3)_2CH_2 - O - CH_2CH_3$

(3) $CH_3(CH_2)_4 - O - CH_3$

(4) $CH_3CH_2 - CH\ (CH_3) - O - CH_2CH_3$

90. Which of the following organic compounds has same hybridization as its combustion product – (CO_2)?

(1) Ethane

(2) Ethyne

(3) Ethene

(4) Ethanol

Biology

91. Which one of the following shows isogamy with non – flagellated gamets ?
(1) Sargassum
(2) Eatocarpus
(3) Ulothrix
(4) Spirogyra

92. Five kingdom system of classification suggested by R.H. Whittaker is not based on :
(1) Presence or absence of a well defined nucleus
(2) Mode of reproduction
(3) Mode of nutrition
(4) Complexity of body organization

93. Which one of the following fungi contains hallucinogens ?
(1) Morchella esculenta
(2) Amanita muscaria
(3) Neurospora sp.
(4) Ustilago sp.

94. Archaebacteria differ from eubacteria in :
(1) Cell membrane structure
(2) Mode of nutrition
(3) Cell shape
(4) Mode of reproduction

95. Which one of the following is wrong about chara?
(1) Upper oogonium and lower round antheridium
(2) Globule and nucule present on the same plant
(3) Upper antheridium and lower oogonium
(4) Globule is male reproductive structure

96. Which of the following is responsible for peat formation ?
(1) Marchantia
(2) Riccia
(3) Funaria
(4) Sphagnum

97. Placenta and pericarp are both edible portions in:
(1) Apple
(2) Banana
(3) Tomato
(4) Potato

98. When the margins of sepals or petals overlap one another without any particular direction, the condition is termed as :
(1) Vexillary
(2) Imbricate
(3) Twisted
(4) Valvate

99. You are given a fairly old piece of dicot stem and a dicot root. Which of the following anatomical structures will you use to distinguish between the two?
(1) Secondary xylem
(2) Secondary phloem
(3) Protoxylem
(4) Cortical cells

100. Which one of the following statement is correct ?
(1) The seed in grasses is not endospermic
(2) Mango is parthenocarpic fruit
(3) A proteinaceous aleurnone layer is present in maize grain
(4) A sterile pistil is called a stainamode

101. Tracherids differ from other tracheray elements in :
(1) Having casparian strips
(2) Being imperforate
(3) Lacking nucleus
(4) Being lignified

102. An example of edible underground stem is :
(1) Carrot
(2) Groundnut
(3) Sweet potato
(4) Potato

103. Which structure perform the function of mitochondria in bacteria?
(1) Nucleoid
(2) Ribosomes
(3) Cell wall
(4) Mesosomes

104. The solid linear cyroskeltal elements having a diameter of 6 nm and made up of a single type of monomer are known as :
(1) Microtubules
(2) Micorfilaments
(3) Intermediate filaments
(4) Lamins

105. The osmotic expansion of a cell kept in water is chiefly regulated by:
(1) Mitrochondria
(2) Vacuoles
(3) Plastics
(4) Ribosomes

106. During which phase (s) of cell cycle, amound of DNA in a cell remains at 4C level if the intial amount is denoted as 2C?
(1) G_0 and G_1
(2) G_1 and S
(3) Only G_2
(4) G_2 and M

107. Match the following and select the correct answer :

(a) Centriole		(i) Infoldings in mitochondria		
(b) Chlorophyll		(ii) Thaylakoids		
(c) Cristae		(iii) Nucleic acids		
(d) Ribozymes		(iv) basal body cilia or flagella		
	(a)	(b)	(c)	(d)
(1)	(iv)	(ii)	(i)	(iii)
(2)	(i)	(ii)	(iv)	(iii)
(3)	(i)	(iii)	(ii)	(iv)
(4)	(iv)	(iii)	(i)	(ii)

108. Dr.F went noted that if coleptile were removed and placed on agar for one hour, the agar would produce a bending when placed on one side of freshly- cut – coleptile stumps. Of what significance is this experiment ?
(1) It made possible the isolation and exact identification of auxin
(2) It is the basis for quantitive determination of small amounts of growth – promoting substances
(3) It supports the hypothesis that IAA is auxin
(4) It demonstartaed polar movement of auxins

109. Deficiency symotoms of nitrogen and potassium are visible first in :
(1) Senescent leaves
(2) Young leaves
(3) Roots
(4) Buds

110. In which one of the following processes CO_2 is not released ?
(1) Aerobic respiration in plants
(2) Aerobic respiration in animals
(3) Alcoholic fermimentation
(4) Lactate fermination

111. Anoxygric photosynthesis Is characterstics of :
(1) Rhodospirillum
(2) Spirogyra
(3) Chlamudomonas
(4) Ulva

112. A few normal seedlings of tomato were kept in a dark room. After a few days they were found to have become while – coloured like alinos. Which of the following terms will you use to describe them?
(1) Mutated
(2) Embolised
(3) Etiolated
(4) Defoliated

113. Which one of the following growth regulators is known as ' stress hormone'?
(1) Absciessic acid
(2) Ethyelene
(3) GA_3
(4) Indole acetic acid

114. Geitonogamy involves
(1) Fertilization of a flower by the pollen from another flower of the same plant.
(2) Fertilization of a flower by the pollen from the same flower
(3) Fertilization of a flower by the pollen from a flower of another plant in the same population
(4) Fertilization of a flower by the pollen from a flower of another plant belonging to a distant population

115. Male gametophyte with least number of cells is present in:
(1) Pteris
(2) Funaria
(3) Lilium
(4) Pinus

116. An aggregate fruit is one which develops from:
(1) Multicarpellary syncarpous gynoecium
(2) Multicarpellary apocarpus gynocium
(3) Complete infloroscene
(4) Multicarpellary superior ovary

117. Pollen tablets are available in tha market for:
(1) In vitro fertilization
(2) Breeding programmes
(3) Supplementing food
(4) Ex situ conservation

118. Function of filiform apparatus is to
(1) Recongnize the suitable pollen at stigma
(2) Stimulate division of generative cell
(3) Produce necter
(4) Guide the entry of pollen tube

119. Non – albuminous seed is produced in :
(1) Maize
(2) Castor
(3) Wheat
(4) Pea

120. Which of the following shows coiled RNA strand and capsomers ?
(1) Polio virus
(2) Tobbaco mosaic virus
(3) Measles virus
(4) Retrovirus

121. Which one of the following is wrongely matched
(1) Transcription – Writing information From DNA to t – RNA
(2) Translation – Using information in m – RNA to make protein
(3) Repressor protein – Binds to operator to stop enzyme synthesis
(4) Operon - Structural genes, operator and promoter

122. Transoformation was discovered by :
(1) Meselson and stahl
(2) Hershey and chase
(3) Griffith
(4) Watson and Crick

123. Fruit colour in squash is an example of :
(1) Recessive epistasis
(2) Dominant epistasis
(3) Complemetary genes
(4) Inhibitory genes

124. Viruses here :
(1) DNA enclosed in a protein coat
(2) Prokaryotic nucleus
(3) Single chromosome
(4) Both DNA and RNA

125. The first human hormone produced by recombinant DNA technology is :
(1) Insulin
(2) Estrogen
(3) Thyroxin
(4) Progesterone

126. An analysis of chromosomal DNA using the southern hybridization technique does not use:
(1) Electrophoresis
(2) Blotting
(3) Autoradiography
(4) PCR

127. In vitro propagation in plants is characterized by :
(1) PCR and RAPD
(2) Northern blotting
(3) Electrophoresis and HPLC
(4) Microscopy

128. An alga which can be employed as food for human being is :
(1) Ulothrix
(2) Chlorells
(3) Spirogyra
(4) Polysiphnia

129. Which vector can clone only small fragment of DNA ?
(1) Bacterial artificial chromosome
(2) Yeast artificial chromosome
(3) Plasmid
(4) Cosmid

130. An example of ex situ conservation is :
(1) National park
(2) Seed Bank
(3) Wildlife Sanctuary
(4) Sacred Grove

131. A location with luxuriant growth of lichens on the trees indicates that the
(1) Trees are very healthy
(2) Trees are heavily infested
(3) Location is highly polluted
(4) Location is not polluted

132. Match the following and select the correct option :

(a) Earthworm	(i) Pioneer species
(b) Succession	(ii) Detritivore
(c) Ecosystem service	(iii) Natality
(d) Population growth	(iv) Pollination

	(a)	(b)	(c)	(d)
(1)	(i)	(ii)	(iii)	(iv)
(2)	(iv)	(i)	(iii)	(ii)
(3)	(iii)	(ii)	(iv)	(i)
(4)	(ii)	(i)	(iv)	(iii)

133. A species facing exrtremely high risk of extinction in the immediate fucture is called:
(1) Vulnerble
(2) Endemic
(3) Critically Endangered
(4) Extinct

134. The zone of atmosphere in which the ozone layer is present is called :
(1) Ionosphere
(2) Mesosphere
(3) Stratosphere
(4) Troposphere

135. The organization which publishes the Red list of species is :
(1) ICFRE
(2) IUCN
(3) UNEP
(4) WWF

136. Select the Taxon mentioned that represents both marine and fresh water species :
(1) Echinoderms
(2) Ctenophora
(3) Cephalochordata
(4) Cnidaria

137. Which one of the following living organisms completely lacks of cells wall ?
(1) Cyanobacteria
(2) Sea – Fan (Gorgonia)
(3) Saccharmyces
(4) Blue – Green algae

138. Planaria posses high capacity of :
(1) Metamorphosis
(2) Regeneration
(3) Alteration of generation
(4) Bioluminscene

139. A marine cartilaginous fish that can produce electric current is :
(1) Pristis
(2) Torpedo
(3) Trygon
(4) Scoliodon

140. Choose the correctly matched pair :
(1) Tendon - Specialized connective tissue
(2) Adipose tissue – Dense connective tissue
(3) Areolar tissue – Loose connective tissue
(4) Cartilage – Loose connective tissue

141. Choose the correctly matched pair :
(1) Inner lining of salivary ducts – Ciliated epithelium
(2) Moist surface of buccal cavity - Glandular epithelium
(3) Tubular parts of nephrons – Cuboidal epithelium
(4) Inner surface of bronchioles – squamous epithelium

142. In 's' pahse of the cell cycle
(1) Amount of DNA doubles in each cell
(2) Amount of DNA remains same in each cell.
(3) Chromosome number is increased
(4) Amount of DNA is reduced to half in each cell

143. The motile bacteria are able to move by :
(1) Fimbriae
(2) Flagella
(3) Cilia
(4) Pili

144. Select the option which is not correct with respect to enzyme action :
(1) Substrate binds with enzyme at its active site
(2) Addition of lot of succinate does not reverse the inhibition of succinic dehydrogenase by malonate
(3) A non – competitive inhibitor binds the enzyme at a site distict from that which binds the substrate
(4) Malonate is a competitive inhibitor of succinic dehydrogenase

145. Which one of the following is a non – reducing carbohydrate?
(1) Maltose
(2) Sucrose
(3) Lactose
(4) Ribose 5 – phosphate

146. The enzyme recombines is required at which stage of meiosis :
(1) Pachytene
(2) Zygotene
(3) Diplotene
(4) Daikinesis

147. The intial step in the digestion of milk in human is carried out by ?
(1) Lipase
(2) Trypsin
(3) Rennin
(4) Pepsin

148. Fructose is abosorbed bed into the blood through mucosa cells of intenstine by the process called :
(1) Active transport
(2) Faciliatated transport
(3) Simple diffuision
(4) Co-transport mechanism

149. Approximately seventy percent of carbon – dioxide absorbed by the blood will be transported to the lungs :
(1) As bicarbonate ions
(2) In the form of dissolved gas molecules
(3) By binding to R.B.C
(4) As carbamino – haeoglobin

150. Person with blood group AB is considered as universal recipient because he has :
(1) Both A and B antigens on RBC but no antibodies in the plasma
(2) Both A and B antibodies in the plasma
(3) No antigen on RBC and no antibody in the plasma
(4) Both A and antigens in the plasma but no antibodies

151. How do parasympathetic neural signals affect the working of the heart ?
(1) Reduce both heart rate and cardiac output
(2) Heart rate is increased without affecting the cardiac output.
(3) Both heart rate and cardiac output increase
(4) Heart rate decreases but cardiac output increases.

152. Which of the following causes an increase in sodium reasorption in te distal convoluted tubule ?
(1) Increase in aldosterone levels
(2) Increase in antidieuretic hormone levels
(3) Decrease in aldosterone levels
(4) Decrease in antidiuretic hormone levels

153. Select the correct matching of the type of the joint with the example in human skeletal system :

Type of joint		**Example**
(1) Carilaginous joint	-	Between frontal and paraiental
(2) Pivot joint	-	Between third and fourth cervical Vertebrae
(3) Hinge joint	-	Between humerus and pectoral girdle
(4) Gliding joint	-	Between carpals

154. Stimulation of a muscle fiber by a motor neuron occurs at :
(1) The neuromuscular junction
(2) The transverse tubules
(3) The myofibril
(4) The sacroplasmic reticulum

155. Injury localized to the hypothalamus would most likely disrupt :
(1) Short – term memory
(2) Co- ordination during locomotion.
(3) Executive function, such as decision making
(4) Regulation of body temperature

156. Which one of the following statements is not correct ?
(1) Retinal is the light absorbing portion of visual photo pigments
(2) In retina the rods have the photopigment rhodpsin while cones have three different photopigments
(3) Retinal is a derivative of vitamin C.
(4) Rhodopsin is the purplish red protein present in rods only.

157. Identify the hormone with its correct matching of source and function :
(1) Oxytocin – posterior pituatory, growth and maintenance of mammary glands
(2) Melatonin – pineal gland, regulates the normal rhythm of sleepwake cycle.
(3) Progesterone – corpus – luteum, stimulation of growth and activities of female secondary sex organs
(4) Atrial natriuretic factor – ventricular wall increases the blood pressure.

158. Fight – or – flight reactions cause activation of :
(1) The parathyroid glands, leading to increased metabolic rate.
(2) The kidney, leading tu suppression of reninangiotensin – aldeosterone pathway.
(3) The adrenal medulla, leading to increased secretion of epinephrine and norepinephrene
(4) The pancreas leading to a reduction in the blood sugar levels

159. The shared terminal duct of the productive and urinary syste In the human ale is :
(1) Urethra
(2) Ureter
(3) Vas deferens
(4) Vasa efferentia

160. The main function of mammalian corpus luteum is to produce :
(1) Estrogen only
(2) Progesterone
(3) Human chorionic gonadotropin
(4) Relaxin only

161. Select the correct option describing gonadotropin activity in a normal pregnant female :
(1) High level of FSH and LH stimulates the thickening of endometrium
(2) High level of FSH and LH facilitate implanatation of the embryo
(3) High level of hCG stimulates the synthesis of estrogen and progesterone.
(4) High level of hCG stimulates the thickening of endometrium.

162. Tubectomy is a method of sterilization in which :
(1) Small party of fallopian tube is removed or tied up
(2) Ovaries are removd surgically
(3) Small party of vas deferens is removed or tied up.
(4) Uterus is removed surgically

163. Which of the following is a hormone releasing intra Uterine Device (IUD)
(i) Multiload 375
(ii) LNG – 20
(iii) Cervical cap
(iv) Vault

164. Assisted reproductive technology, IVF involves transfer of :
(1) Ovum into fallopian tube
(2) Zygote into the fallopian tube
(3) Zygote into the uterus
(4) Embryo with 16 blastomeres into the fallopian tube

165. A man whose father was colur blind marries a woman who had a colour bline mother and normal father. What percentage of male children of this couple will be colour blind ?
(1) 25%
(2) 0%
(3) 50%
(4) 75%

166. In a population of 1000 individuals 360 belong to genotype AA, 480 to Aa the and the remaining 160 to aa. Based on this date, the frequency of allele a in the population is :
(1) 0.4
(2) 0.5
(3) 0.6
(4) 0.7

167. A human female with Turner's syndrome :
(1) Has 45 chromosome with XO
(2) Has one additional X chromosome
(3) Exhibits male characters
(4) Is able to produce children with normal husband

168. Select the correct option :

	Direction of RNA Synthesis	Direction of reading of the template DNA strand
(1)	5' – 3'	3' – 5'
(2)	3' – 5'	5' – 3'
(3)	5' – 3'	5' – 3'
(4)	3' – 5'	3' – 5'

169. Commonly used vectors for human genome sequencing are :
(1) T – DNA
(2) BAC and YAC
(3) Expression Vectors
(4) T/A Cloning Vectors

170. Forelimbs of cat, lizard used in walking forelimbs of whale used n swimming and forelimbs of bats used in flying are an example of :
(1) Analogus organs
(2) Adaptive radiation
(3) Homologous organs
(4) Convergent evolution

171. Which one of the following are analogues structures ?
(1) Wings of Bat and wings of Pigeon
(2) Gills of Prawn and Lungs of Man
(3) Thorns of Bouganvillea and Tendrills of Cucurbita
(4) Flippers of Dolphin and Legs of Horse

172. Which is the particular type of drug that is obtained from the plant whose one flowering branch is shown below?

(1) Hallucinogen
(2) Depressant
(3) Stimulant
(4) Pain – killer

173. At which stage of HIV infection does one usually show symtoms of AIDS ?
(1) Within 15 days of sexual contact with an infected person
(2) When the infected retro virus enters host cells
(3) When HIV damages large number of helper T – Lymphocytes.
(4) When the viral DNA is produced by reverse transcriptase

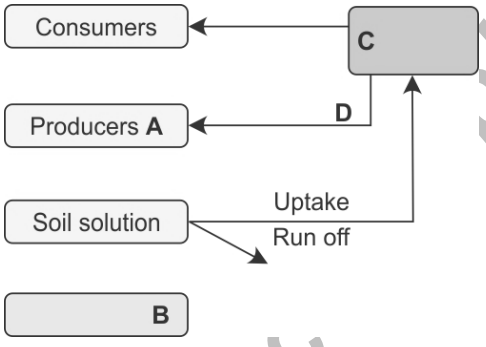
174. To obtain virus – free healthy plants from a diseased one by tissue culture techinique, which part/parts of the diseased plant will be taken?
(1) Apical meristem only
(2) Palisade parenchyma
(3) Both apical and axillary meristem
(4) Epidermis only

175. What gases are produced in anaerobic sludge digesters ?
(1) Methane and CO_2 only
(2) Methane, Hydrogen, sulphide and CO_2
(3) Methane, Hydrogen sulphide and O_2
(4) Hydrogen sulphide and CO_2

176. Just as a person moving from Delhi to shimla to escape the heat for the duration of hot summer, thousands of migratory birds from siberia and other extremely cold northern regions move to :

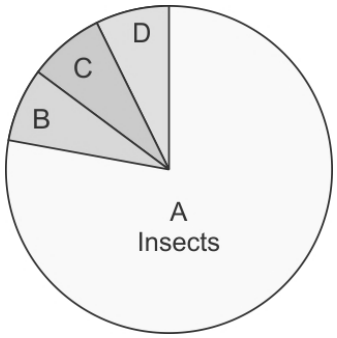
(1) Western Ghat
(2) Meghalaya
(3) Corbett National Park
(4) Keolado National Park

177. Given below is a simplified model of phosphorus cycling in a terrestrial ecosystem with four blanks (A-D) identify the blanks.



	A	B	C	D
(1)	Rock minerals	Detritus	Litter Fall	Producers
(2)	Litter fall	Producers	Rock Minerals	Detritus
(3)	Detritus	Rock minerals	Producer	Litter fall
(4)	Producers	Litter fall	Rock Minerals	Detritus

178. Given below is the representation of the extent of global diversity of invertebrates. What groups the four portions (A-D) represent respectively?



	A	B	C	D
(1)	Insects	Crustaceans	Other animal groups	Molluscs
(2)	Crustaceans	Insects	Molluscs	Other animal groups
(3)	Molluscs	Other animal groups	Crustaceans	Insects
(4)	Insects	Molluscs	Crustaceanus	Other animal groups

179. A scrubber in the exhaust of a chemical industrial plant removes:
(1) Gases like suplhur dioxide
(2) Particulate matter of the size 5 micrometer or above
(3) Gases like ozone and methane
(4) Particulate matter of the size 2.5 micrometer or less

180. If 20 J of energy is trapped at producer level, then how much energy will be available to peacock as food in the following chain?

$$\text{Plant} \rightarrow \text{mice} \rightarrow \text{snake} \rightarrow \text{peacock}$$

(1) 0.02 J
(2) 0.002 J
(3) 0.2 J
(4) 0.0002 J

AIPMT - 2014
(Physics, Chemistry and Biology)
Code - P
Answer Key and Solution

Answers

1	(4)	2	(1)	3	(4)	4	(3)	5	(3)	6	(1)	7	(2)	8	(3)	9	(4)	10	(1)
11	(3)	12	(1)	13	(2)	14	(3)	15	(4)	16	(1)	17	(3)	18	(4)	19	(2)	20	(1)
21	(4)	22	(3)	23	(3)	24	(2)	25	(4)	26	(2)	27	(2)	28	(3)	29	(3)	30	(3)
31	(4)	32	(4)	33	(2)	34	(2)	35	(4)	36	(3)	37	(4)	38	(2)	39	(2)	40	(2)
41	(3)	42	(4)	43	(3)	44	(1)	45	(4)	46	(3)	47	(4)	48	(3)	49	(4)	50	(4)
51	(3)	52	(3)	53	(1)	54	(3)	55	(2)	56	(4)	57	(2)	58	(4)	59	(2)	60	(1)
61	(Bonus)	62	(1)	63	(3)	64	(2)	65	(3)	66	(2)	67	(1)	68	(1)	69	(3)	70	(3)
71	(2)	72	(2)	73	(2)	74	(2)	75	(1)	76	(4)	77	(2)	78	(4)	79	(3)	80	(4)
81	(3)	82	(4)	83	(1)	84	(3)	85	(Bonus)	86	(2)	87	(3)	88	(4)	89	(1)	90	(2)
91	(4)	92	(1)	93	(2)	94	(1)	95	(3)	96	(4)	97	(3)	98	(2)	99	(3)	100	(3)
101	(2)	102	(4)	103	(4)	104	(2)	105	(2)	106	(3)	107	(1)	108	(1)	109	(1)	110	(4)
111	(1)	112	(3)	113	(1)	114	(1)	115	(3)	116	(2)	117	(3)	118	(4)	119	(4)	120	(2)
121	(1)	122	(3)	123	(2)	124	(1)	125	(1)	126	(4)	127	(1)	128	(2)	129	(3)	130	(2)
131	(4)	132	(4)	133	(3)	134	(3)	135	(2)	136	(4)	137	(2)	138	(2)	139	(2)	140	(3)
141	(3)	142	(1)	143	(2)	144	(2)	145	(2)	146	(1)	147	(3)	148	(2)	149	(1)	150	(1)
151	(1)	152	(1)	153	(4)	154	(1)	155	(4)	156	(3)	157	(2)	158	(3)	159	(1)	160	(2)
161	(3)	162	(1)	163	(2)	164	(2)	165	(3)	166	(3)	167	(1)	168	(1)	169	(2)	170	(3)
171	(2)	172	(1)	173	(3)	174	(3)	175	(2)	176	(4)	177	(3)	178	(4)	179	(1)	180	(1)

Physics

1. Let force (F), velocity (V) and time (T) be taken as fundamental units

$$F = M \times \frac{L}{T^2} = \frac{LM}{T^2}$$

$$F = \frac{MV}{T} \quad .$$

$$\Rightarrow M = FTV^{-1}$$

2. Velocity of projectile fired from the surface of the Earth $v_e = 5\ ms^{-1}$.
Velocity of projectile fired from the surface of another planet $v_p = 3\ ms^{-1}$.
The horizontal range of the projectile is

$$R = \frac{v^2}{g}$$

The trajectory of the projectile fired from the surface of another planet is identical with the trajectory of the projectile fired from the Earth. Hence,

$$\frac{v_e^2}{g} = \frac{v_a^2}{a}$$ (a is the acceleration due gravity of other planet)

$$\frac{5^2}{g} = \frac{3^2}{a}$$

$$a = 9.8 \times \frac{9}{25} = 3.5\ m/s^2$$

3. $\vec{r_1} = 2\hat{i} + 2\hat{j}$

$\vec{r_s} = 13\hat{i} + 14\hat{j}$

$\vec{S} = 11\hat{i} + 11\hat{j}$

Average velocity vector, $\vec{v}_{av} = \frac{11\hat{i} + 11\hat{j}}{5}$

4. A system consists of three masses—m_1, m_2 and m_3—connected by a string passing over a pulley P.
According to Newton's 2nd law,

$$3am = mg - 2\mu mg$$

$$a = \frac{g - 2\mu mg}{3m}$$

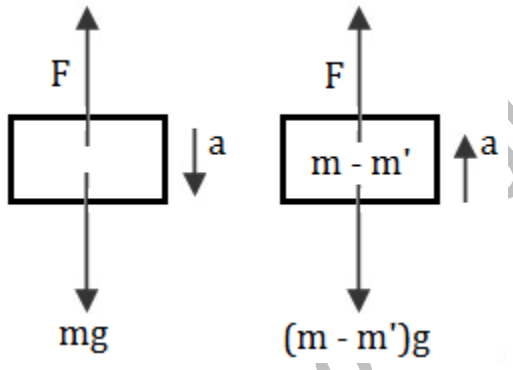
$$a = \frac{g - 2\mu g}{3} = g\left(\frac{1 - 2\mu}{3}\right)$$

5. The force 'F' acting on a particle of mass 'm' is indicated by the force–time graph. The change in momentum of the particle over the time interval from zero to 8 s is

$\Delta P = \left(\frac{1}{2}\right) \times 2 \times 6 - (3 \times 2) + (4^2 \times 3)$

$\Delta P = 6 - 6 + 12 = 12$

6. A balloon with mass 'm' is descending with an acceleration 'a' (where a < g). From the figure, we have



$mg - F = ma$ (i)

When a mass is removed from it, it starts moving up with an acceleration 'a', then we have

$F - (m - m')g = (m - m')a$

From (1), we get,

$F - mg + m'g = ma - m'a$

$mg - ma - mg + m'g = ma - m'a$

$m'(g + a) = 2ma$

$m' = \frac{2ma}{g + a}$

7. From the law of conservation of linear momentum,

Total momentum before the collision (P_i) = Total momentum after the collision (P_f)

$0 = mv\,\hat{i} + mv\,\hat{j} + 2m\vec{v}$

$\vec{v} = -\frac{v}{2}\hat{i} - \frac{v}{2}\hat{j}$

$|\vec{v}| = \frac{v}{\sqrt{2}}$

Kineticn energy, $E = \frac{v}{2}mv^2 + \frac{v}{2}mv^2 + \frac{v}{2}m\left(\frac{v}{\sqrt{2}}\right)^2$

$E = mv^2 + \frac{mv^2}{2} = \frac{3}{2}mv^2$

8. The oscillation of a body on a smooth horizontal surface is represented by the equation,
$X = A \cos \omega t$
Velocity is given as $v = A\omega \sin \omega t$
Acceleration is given as $a = -A\omega \cos^2 \omega t$
From the above three equations, we can say that the correct graph is 3.

9. A solid cylinder of mass 50 kg and radius 0.5 m is free to rotate about the horizontal axis.
Let a massless string be wound round the cylinder with one end attached to it and the other end hanging freely.

Hence, $T \times R = \left(\frac{MR^2}{2}\right) \times \alpha$ (α is angular acceleration)

$$T = \left(\frac{MR}{2}\right) \times \alpha = \left(\frac{50 \times 0.5}{2}\right) \times (2 \times 2\pi)$$

$$T = 157 \text{ N}$$

10. For slipping motion on an inclined plane, the acceleration for a solid sphere making an angle θ is given by

$a_{slipping} = g \sin\theta$

For rolling motion of a sphere without slipping:
The acceleration of a sphere of mass m, radius r and moment of inertia I is

$$a_{rolling} = \frac{g \sin\theta}{1 + \frac{I}{mr^2}}$$

For a uniform sphere, we know that $\frac{I}{mr^2} = \frac{2}{5}$

$$\frac{a_{rolling}}{a_{slipping}} = \frac{\frac{g \sin\theta}{1 + \frac{I}{mr^2}}}{g \sin\theta} = \frac{g \sin\theta}{g \sin\theta \left(1 + \frac{2}{5}\right)} = \frac{5}{7}$$

Hence, we get the ratio 5:7.

11. Escape velocity is

$$v_e = \sqrt{\frac{2GM}{R}} = c$$

$$\Rightarrow R = \frac{2GM}{c^2} = \frac{2 \times 6.67 \times 10^{-11} \times 5.98 \times 10^{24}}{9 \times 10^{16}}$$

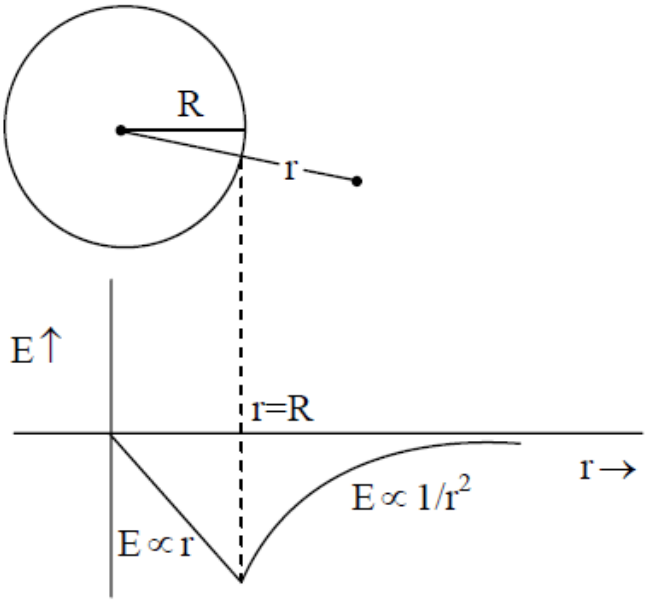
$$\therefore R = 8.8 \times 10^{-3} \approx 10^{-2} \text{ m}$$

12. The gravitational intensity for a solid sphere is

$E = -\frac{GM}{R^3}r$ (for R > r)

$E = -\frac{GM}{R^2}$ (for r = R)

$E = -\frac{GM}{r^2}$ (for r > R)



From the figure, the correct option is (1).

13. Volume V = Al

Young's modulus, $Y = \frac{F/A}{\frac{\Delta l}{l}}$

$\frac{Y\Delta l}{l} = \frac{F}{A}$

$\Delta l = \frac{\Delta l l}{YA} = \frac{F}{Y} \cdot \frac{l^2}{V}$

$\Delta l = \frac{\Delta l}{YV} \times l^2$

$\Delta l \propto l^2$

14. Energy evolved = surface tension × decrease in area

$\Delta U = ST \times \Delta A$

Surface area of a spherical drops = $4\pi r^2 n$

Surface area of a big drop = $4\pi R^2$

Decrease in surface area, $\Delta A = 4\pi r^2 n - 4\pi R^2$

Volume of big drop = Volume of spherical drops

$$\frac{4}{3}\pi R^3 = n \times \frac{4}{3}\pi r^3$$

$$\Rightarrow n = \frac{R^3}{r^3}$$

$$\Delta A = 4\pi\left[\frac{R^3}{r^3} \times r^2 - R^2\right] = 4\pi\left[\frac{R^3}{r^3} - \frac{R^3}{R}\right]$$

$$\Delta A = \left(\frac{4\pi R^3}{r}\right)3\left[\frac{1}{r} - \frac{1}{R}\right]$$

$$\Rightarrow \Delta A = 3V\left[\frac{1}{r} - \frac{1}{R}\right]$$

$$\therefore \Delta U = 3VT\left[\frac{1}{r} - \frac{1}{R}\right]$$

15. $\Delta Q_{gain} = 20 \times 1 \times (70) = 1400$ cal

$\Delta Q_{loss} = mLv + m \times 1 \times (20) = m(540 + 20) = 560\ m$

$560\ m = 1400$ cal

$$m = \frac{1400}{560} = \frac{10}{4} = 2.5 \text{ gm}$$

$$\Rightarrow m_w = 20 + m = 22.5 \text{ gm}$$

16. The average temperature of 70°C to 60°C,

$$T = \frac{70° + 60°}{2} = 65°$$

From netwon's law of cooling

$$\frac{dT}{dt} = -K(T - T_0)$$

For the first condition

$$\frac{(60 - 70)}{5} = -K(65 - T_0) \quad \text{(i)}$$

For the second condition

$$\frac{(54 - 60)}{5} = -K(57 - T_0) \quad \text{(ii)}$$

From (i) and (ii)

$$\frac{-10}{6} = \frac{65 - T_0}{57 - T_0}$$

$$285 - 5T_0 = 195 - 3T_0$$

$$90 = 2T_0$$

$$T_0 = 45°$$

17. Consider a monatomic gas at a pressure P and volume V.

When volume V expands isothermally to volume 2V,

$$PV = P_1 2V$$

$$P_1 = \frac{P}{2}$$

When volume V then expands adiabatically to volume 16V,

$$P_1 (2V)^{\gamma} = P_2 2V$$

$$P_2 = \frac{P}{2}\left(\frac{1}{2^3}\right)^{\frac{5}{3}}$$

$$P_2 = \frac{P}{2}\left(\frac{1}{2^3}\right)^{\frac{5}{3}} = \frac{P}{2 \times 2^5}$$

$$P_2 = \frac{P}{64}$$

18. From the figure, work done in ODA = $\frac{1}{2} \times P_0 \times V_0$

Work done in OBC = $-\frac{1}{2} \times P_0 \times V_0$

Work done in the system = Work done in ODA − Work done in OBC = 0

19. The mean free path of molecules of a gas,

$$\ell = \frac{1}{\sqrt{2}nd^2}$$

$$\text{i.e. } \ell \propto \frac{1}{d^2}$$

$$\Rightarrow \ell \propto \frac{1}{r^2}$$

20. Let n_1, n_2 and n_3 be the fundamental frequencies of three segments.

$$n_1 = \frac{1}{2l_1}\sqrt{\frac{T}{\mu}}$$

$$n_2 = \frac{1}{2l_2}\sqrt{\frac{T}{\mu}}$$

$$n_3 = \frac{1}{2l_3}\sqrt{\frac{T}{\mu}}$$

$$\text{and } n = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$$

$$l = l_1 + l_2 + l_3$$

$$\frac{1}{n} = \frac{1}{n_1} + \frac{1}{n_2} + \frac{1}{n_3}$$

21. Given length l = 85 cm

Velocity of sound = 340 ms^{-1}

Fundamental frequency of a closed organ pipe is $f_1 = f_1 = \frac{V}{4\ell} = \frac{340}{4 \times 0.85} = 100$ Hz

The natural frequencies of the organ pipe will be f = 100 Hz, 300 Hz, 500 Hz, 700 Hz, 900 Hz and 1100 Hz which are below 1250 Hz.

22. As a motorcyclist slows down to 36 km/hour, he finds the traffic has eased and a car moving ahead of him.

Apparent frequency heard by the observer is

$$f' = f_0\left(\frac{V - V_0}{V - V_s}\right)$$

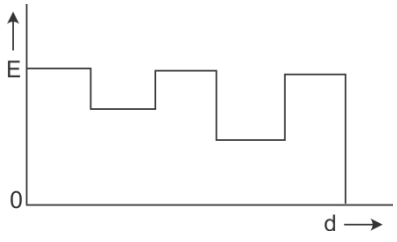
$$f' = 1392 \times \left(\frac{343 - (-10)}{343 - (-5)}\right) = 1412 \text{ Hz}$$

23. We know that $E_V = E_0$

$$E_k = \frac{E_0}{k}$$

$$k_2 > k_1$$

$$E_2 < E_1$$



24. A conducting sphere of radius R is given a charge Q.

For a conducting sphere

Electric field at centre = 0

The electric potential at the centre of the sphere = $\frac{KQ}{R} = \frac{Q}{4\pi\varepsilon_0 R}$

25. In a region, the potential is represented by V(x, y, z) = 6x − 8xy − 8y + 6yz, where V is in volts and x, y, z are in metres.

V(x, y, z) = 6x- 8xy -8y + 6yz

$E_x = -\frac{\partial V}{\partial x} = -6 + 8y$

$E_y = -\frac{\partial V}{\partial y} = 8x + 8 - 6z$

$E_z = -\frac{\partial V}{\partial z} = -6y$

$\vec{E} = (-6 + 8Y)$

$\vec{E} = (-6 + 8y), \hat{i} + (8x + 8- 6z)\ \hat{j} - 6y\ k$

$\vec{E} = 2\hat{i} + 10\vec{j} - 6\vec{k}$

$|\vec{E}| = 2\sqrt{35}\ NC^{-1}$

$F = qE = 2 \times \sqrt{35} = 4\sqrt{35}\ N$

26. Given:

Total resistance of wire R = 0.5 × 150 = 75Ω

Total voltage drop = 150 × 8 = 1200 V

Power loss = $\frac{V^2}{R} = \frac{(1200)2}{75} = 19.2\ KW$

27. From the first condition, we have

$\frac{5}{R} = \frac{l_1}{100 - l_1}$ (i)

From the second condition, we have

$\frac{5}{R/2} = \frac{1.6\, l_1}{100 - 1.6 l_1}$

$\frac{10}{R} = \frac{1.6\, l_1}{100 - 1.6 l_1}$ (ii)

Comparing equations (i) and (ii),

$$\frac{5(100 - l_1)}{l_1} = \frac{10(100 - 1.6l_1)}{1.6l_1}$$

$$= 1.6(100 - l_1) = 2(100 - 1.6l_1)$$

$$\Rightarrow 80 - 0.8l_1 = 100 - 1.6l_1$$

$$\Rightarrow 0.8l_1 = 20$$

$$\therefore l_1 = 25 \text{ cm}$$

Substituting l_1 in equation (i)

$$\frac{5}{R} = \frac{25}{100 - 25}$$

$$R = \frac{75}{5} = 15\ \Omega$$

28. Given:

$l_1 = 3$ m

$l_2 = 2.85$

$R = 9.5\Omega$

Internal resistance of the unknown cell is

$$r = \left(\frac{l_1}{l_2} - 1\right)R$$

$$r = \left(\frac{3}{2.85} - 1\right)9.5$$

$$\therefore\ r = 0.5\ \Omega$$

29.

(a) The magnets are at right angles to each other. Hence, the net magnetic moment

$$M_{net} = \sqrt{m^2 + m^2 + 2mm\cos 90^\circ} = \sqrt{2}m$$

(b) The magnets are parallel to each other. Hence, the net magnetic moment

$$M_{net} = m - m = 0$$

(c) Magnets are at 30° to each other. Hence, the net magnetic moment

$$M_{net} = \sqrt{m^2 + m^2 + 2mm\cos 30^\circ} = m\sqrt{2+\sqrt{3}}$$

(d) Magnets are at 60° to each other. Hence, the net magnetic moment

$$M_{net} = \sqrt{m^2 + m^2 + 2mm\cos 60^\circ} = \sqrt{3}m$$

In configuration (c), θ is the least, so M_{net} is maximum.

30. As (G) and the shunt are in parallel combination:

$i_g R_g = i_s R_s$

$\Rightarrow \left(\frac{i}{500}\right)(G) = \left(\frac{499}{500}\right)(S)$

$\Rightarrow S = \frac{G}{499}$

Hence, equivalent resistance of the ammeter

$\frac{1}{R_{eq}} = \frac{1}{G} + \frac{1}{\frac{G}{499}}$

$\Rightarrow R_{eq} = \frac{G}{500}$

31. Two identical long conducting wires AOB and COD are placed at right angles to each other. Let the wires carry I_1 and I_2 currents, respectively.

$\vec{B}$ due to wire (1) $\vec{B}_1 = \left(\frac{\mu_0 i_1}{2\pi d}\right)\hat{i}$

$\vec{B}$ due to wire (2) $\vec{B}_2 = \left(\frac{\mu_0 i_2}{2\pi d}\right)-\hat{j}$

$|B_{net}| = \frac{\mu_0}{2\pi d}\sqrt{i_1^2 + i_2^2}$

32. When a thin semicircular conducting ring (PQR) of radius 'r' is falling with its plane vertical in a horizontal magnetic field B,

Motional emf e = Bυl

Here, effective length l = 2r

e = Bν × 2r, whereas R is at a higher potential and P is at a lower potential.

33. Given:

V = 200 V

P = 3 kW = 3000 W

i_2 = 6 A

Efficiency of transformer = 90%

Current in primary coil = $\frac{P}{V} = \frac{3000}{200} = 15$ A

$\frac{P_{out}}{P_{in}} = \frac{90}{100}$

$V_2 i_2 = \frac{90}{100} \times (3000)$

$V_2 \times 6 = 2700$

$V_2 = 450$ V

34. Given:

$\phi = 25 \times 10^4 \ \frac{W}{m^2}$

$A = 15 \times 10^{-4} \ m^2$

$F = \frac{-\frac{E}{C} - \frac{E}{C}}{t} = \frac{2E}{Ct}$

$F = \frac{2}{Ct}(\phi \cdot At)$

$F = \frac{2\phi A}{C} = \frac{2 \times 25 \times 10^4 \times 15 \times 10^{-4}}{3 \times 10^8}$

$F = 2.5 \times 10^{-6} \ N$

35. Angular width of 1st maxima

$2\theta = \frac{2\lambda}{a}$

Linear width of 1st maxima = (D) $(2\theta) = \frac{2\lambda D}{a} = \frac{2 \times 600 \times 10^{-9} \times 2}{1 \times 10^{-3}} = 2.4$ mm

36. When a path difference = $\lambda \Rightarrow$ phase difference = 2π

When a path difference = $\lambda/4 \Rightarrow$ phase difference = $\pi/2$

$K = I + I + 2\sqrt{I}\sqrt{I} \cos 2\pi = 4I$

$K' = I + I + 2\sqrt{I}\sqrt{I} \cos\frac{\pi}{2} = 2I = \frac{K}{2}$

37.

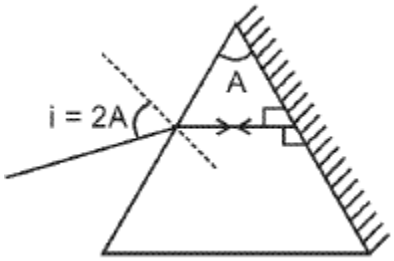
M.P. of microscope = $\left(-\frac{l}{f_0}\right)\left(1+\frac{D}{f_e}\right)$

If f_0 increases, then MP of the microscope will decrease.

MP of telescope = $\left(\frac{f_0}{f_e}\right)$

If f_0 increases, then MP of the telescope will increase.

38.



Applying Snell's rule between the incident ray and the refracted ray, we get

$\mu = \frac{\sin 2A}{\sin A}$

$\mu = \frac{2\sin A \cos A}{\sin A}$

$\Rightarrow \mu = 2\cos A$

39. The work function of the metal is

$KE = h\upsilon - \phi$

$0.5\ eV = h\upsilon - \phi$ (i)

$0.8\ eV = 1.2h\upsilon - \phi$ (ii)

solving (i) and (ii)

$\phi = 1\ eV$

40. de Broglie wavelength of the particle is

$\lambda_1 = \frac{h}{\sqrt{2mk}}$

If the kinetic energy of the particle is increased to 16 times its previous value, then

$\lambda_2 = \frac{h}{\sqrt{2m16k}} = \frac{\lambda_1}{4}$

Percentage change $= \frac{\lambda_2 - \lambda_1}{\lambda_1} \times 100\%$

$= \frac{\left(-\frac{3\lambda_1}{4}\right)}{\lambda_1} \times 100\% = -75\%$

41. Given:

$A = 975\ Å$

Energy of the photon, $E = \frac{hC}{\lambda} = \frac{1240}{97.5} = 12.75\ eV$

This energy is equal to the energy gap between n = 1 (−13.6) and n = 4(−0.85). So, by this energy, the electron will excite from n = 1 to n = 4.

When the electron will fall back, the number of spectral lines emitted =

$\frac{n(n-1)}{2} = \frac{4(4-1)}{2} = 6$

42. ${}^{7}_{3}Li + {}^{1}_{1}H \rightarrow {}^{4}_{2}He + {}^{4}_{2}He + Q$

$Q = -BE_4 + 2BE_{He} = -7 \times 5.60 + 2 \times 7.06 \times 4$

$Q = -39.20 + 14.12 \times 4$

$\Rightarrow Q = -39.20 + 56.48 = 17.28$

43. X:Y = 1:7

X:(X + Y) = 1:8 = $1:2^3$

$\Rightarrow$ 3 half-life

$\therefore \Delta = 3 \times 1.4 \times 10^9$ yrs $= 4.2 \times 10^9$ yrs

44. The given graph is a V–I characteristic curve for a solar cell, where A represents the open circuit voltage of solar cell and B represent short circuit current.

45. The barrier potential depends on the type of semiconductor (for Si V_b = 0.7 volt and for Ge V_b = 0.3 volt), the amount of doping and on the temperature.

Chemistry

46. 3p orbital can have n = 3, l = 1 and $m_l = 0$

47. $E=\frac{hc}{\lambda}=\frac{6.6\times10^{-34}\times3\times10^{8}}{45\times10^{-9}}=0.44\times10^{-17}=4.4\times10^{-18}\text{Joule}$

48.

$$V_{H_2}:V_{O_2}:V_{CH_4}=n_{H_2}:n_{O_2}:n_{CH_4}=\frac{1}{2}:\frac{1}{32}:\frac{1}{16}=16:1:2$$

49. The distance between the body-centred atom and one corner atom in the cube = $\frac{\sqrt{3}a}{2}$

50. Tyndall effect is not dependent on the charge on colloidal particles because it is an optical phenomenon.

51. Sodium carbonate is a salt of a weak acid and a strong base.

52. $\Delta T = iK_f\, m$
van't Hoff factor is the highest for $Al_2(SO_4)_3$.

53.

$$\underset{22.4\,\text{litre}}{H_2} + \underset{11.2\,\text{litre}}{Cl_2} \rightarrow 2HCl$$

1 mole ½ mole

Chlorine is a limiting reagent. Hence, 1 mole HCl is formed.

54.

$$\underset{0.1\text{ mole}}{MnO_4^{2-}} \rightarrow \underset{0.1\text{ mole}}{MnO_4^{-}} + e^-$$

Hence, for 1 mole = 0.1 × 96500 = 9650 C

55. We know

$$\Delta G^{o} = -2.303RT\log K_{sp}$$

$$63.3\times10^{3} = -2.303\times8.314\times298\log K_{sp}$$

$$\log K_{sp} = -11.09$$

$$K_{sp} = 8\times10^{-12}$$

56.

$$n_{O_2} = \frac{5600}{22400} = \frac{1}{4}$$

$$\frac{W_{Ag}}{108} \times 1 = \frac{W_{O_2}}{M_{O_2}} \times 4$$

$$\frac{W_{Ag}}{108} = \frac{1}{4} \times 4 = 108g$$

57. For spontaneous adsorption of a gas, ΔS = −ve, ΔH = −ve.

58. According to the Le Chatelier's principle, the equilibrium shifts in the forward direction by increasing pressure and decreasing temperature.

59. Given:

ΔU = 2.1 kcal

ΔS = 20 cal K^{-1}

T = 300 K

$$\Delta H = \Delta U + \Delta n_g RT$$

$$\Delta H = 2.1 + \frac{2 \times 2 \times 300}{1000} = 3.3kcal$$

$$\Delta G = \Delta H - T\Delta S = 3.3 - 300 \times \frac{20}{1000} = 3.3 - 6 = -2.7kcal$$

60. Assuming $T_2 > T_1$, So, $K_p < K_p'$

61. The given options are not correct.

62. The reaction can be represented as

$$Mg + \tfrac{1}{2}O_2 \rightarrow MgO$$

$$\frac{1.0}{24} \quad \frac{0.56}{32}$$

$$\frac{0.5}{12} \quad \frac{0.07}{4}$$

$$\frac{0.5}{12} - x \quad \frac{0.07}{4} \quad -\frac{x}{2}$$

The limiting agent is oxygen.

$$\frac{0.07}{4} - \frac{x}{2} = 0$$

$$x = \frac{0.07}{2}$$

$$\text{Excess of } Mg = \frac{0.5}{12} - \frac{0.07}{2} \text{ mole}$$

$$\text{Mass of } Mg = 1 - 0.7x12$$

$$= 0.16 \text{ gm}$$

63. $FeCl_2$ and $SnCl_2$. They are reducing agents and have lower oxidation states.

64. $Li^+ = Be^{2+} = 1s^2$

65. NH_3 (μ = 1.47D) has the maximum dipole moment.

66. NO_3^- has triangular planar geometry.

67. $H_2O < H_2S < H_2Se < H_2Te$

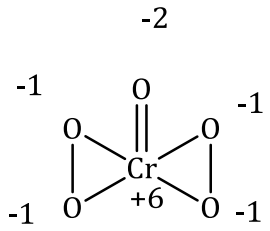
68. H_2O_2 acts as a reducing agent in both reactions.

$H_2O_2 + O_3 \rightarrow H_2O + 2O_2$

$H_2O_2 + Ag_2O \rightarrow 2Ag + H_2O + O_2$

69. The artificial sweetener which is stable under cold conditions only is aspartame.

70. Oxidation state of Cr is +6.



71. $2KMnO_4 + 3H_2SO_4 + 5H_2O_2 \rightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 5O_2$

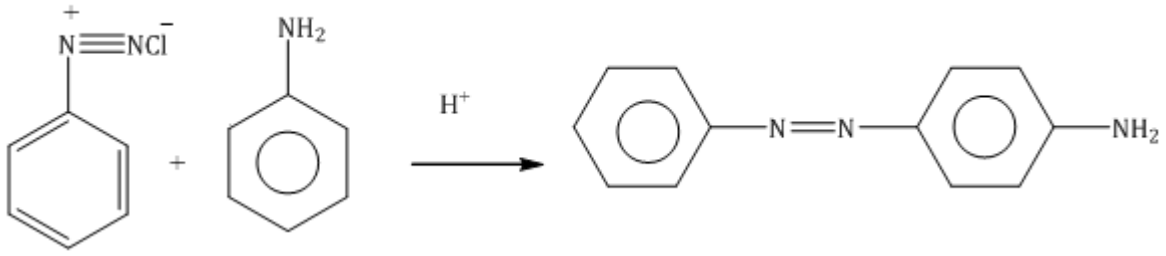
72. $[Fe(H_2O)_6]^{3+}$
$Fe^{2+} = 3d^5(t_{2g}^3, e_g^2)$
Hence, CFSE = 0

73. Since $\mu = 2.83$, $n = 2$
Hence, $Ni^{2+} = 3d^8$

74. Cis-$[PtCl_2(NH_3)_2]$ is used as an anticancer agent.

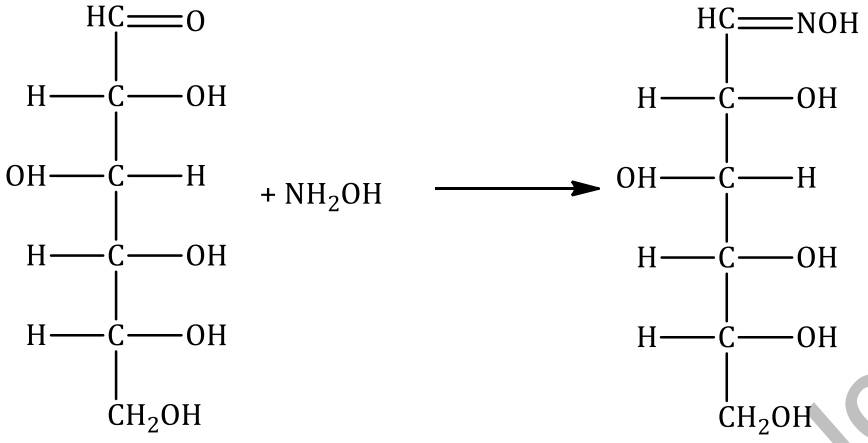
75. Lanthanoid contraction is due to negligible screening of 'f' orbitals.

76.



77. Because of conjugation, benzene diazonium chloride is stable.

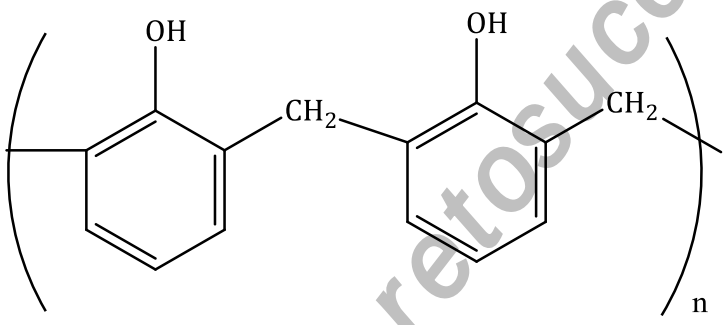
78.



D(+)glucose Oxime

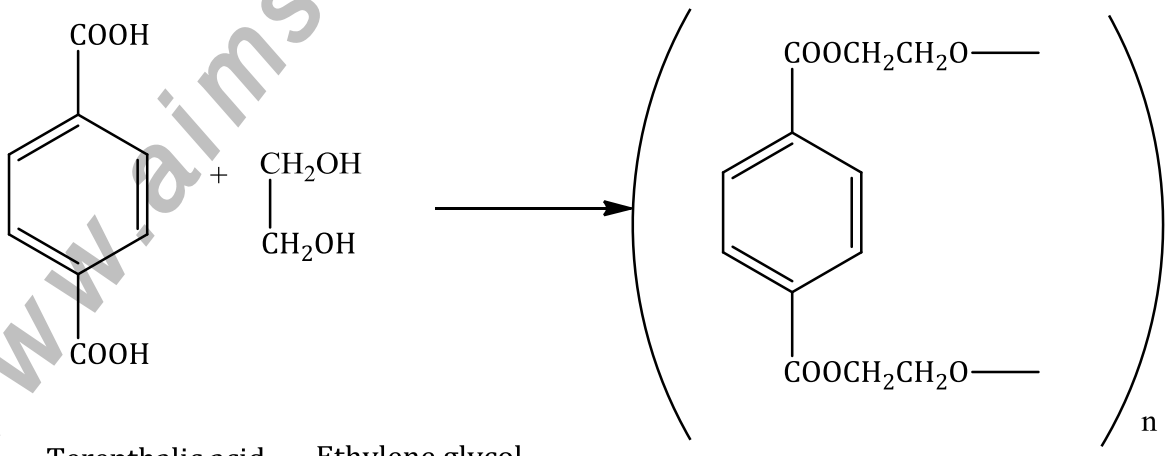
79. Adrenaline hormone is produced under the condition of stress which stimulates glycogenolysis.

80.



Bakelite is an example of thermosetting polymer.

81.

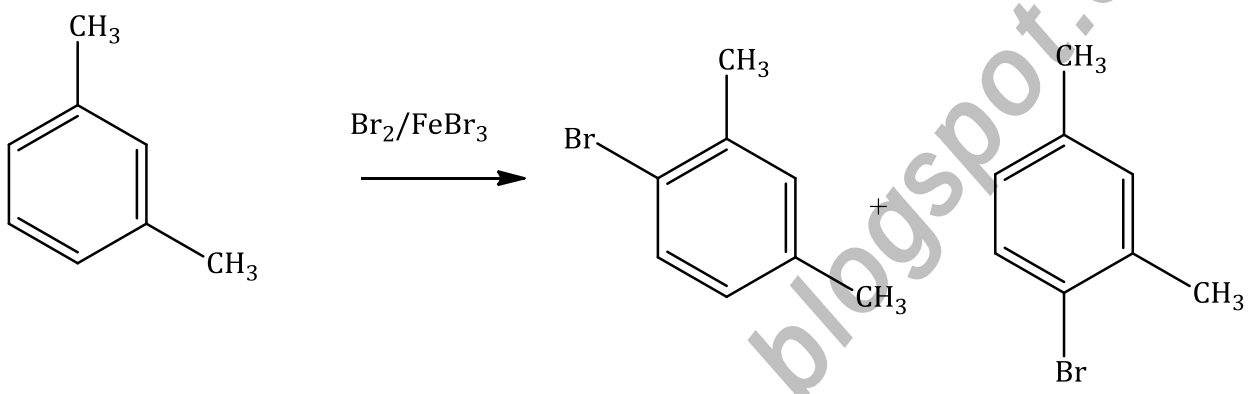


Terepthalic acid Ethylene glycol

82. Chlorofluorocarbon is not a common component of photochemical smog.

83. $\%\ \text{of Nitrogen} = \dfrac{1.4 \times 2 \times 10}{0.75} = 37.33\%$

84.



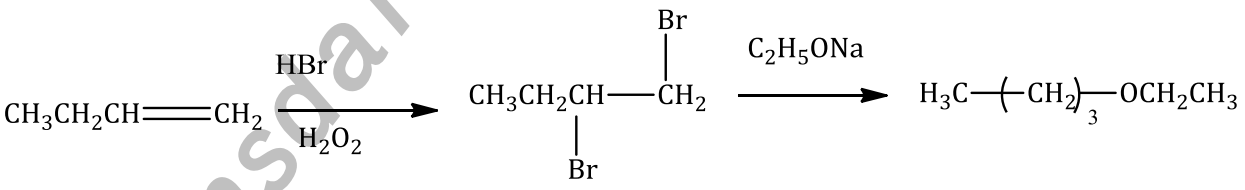
85. The options provided are not correct.

86. $C_6H_5OH + NaOH \rightarrow C_6H_5ONa \xrightarrow[S_N2]{CH_3I} C_6H_5\text{-}OCH_3$

87. o-nitrophenol will not be soluble in sodium hydrogen carbonate. This is because it is a weaker acid than carbonic acid.

88. The nitro group is an electron-withdrawing group and favours nucleophilic attack.

89.



90. Ethyne and CO_2 both have sp-hybridised carbon.

Biology

91. *Spirogyra* shows isogamy and possesses non-flagellated gametes.

92. The main criteria for the five kingdom classification by Whittaker are based on cell type, thallus organisation, nutrition, reproduction and phylogenetic relationship. It does not take into account the presence or absence of a well-defined nucleus.

93. *Amanita muscaria* produces the psychoactive compound muscimol, which is a hallucinogen.

94. The cell membrane of eubacteria is made of peptidoglycan, while that of archaebacteria is made of pseudomurein.

95. In *Chara*, sex organs are developed on the adaxial surface of the lateral branches on almost each node, and the female sex organ is present above the male sex organ.

96. *Sphagnum* (moss) is a source of peat which is used as a fuel.

97. The entire tomato fruit which includes both placenta and pericarp is edible.

98. In imbricate aestivation, the margins of the sepals and petals overlap with one another but not in any particular direction. Example: Gulmohar

99. In the stems of dicot plants, the protoxylem lies towards the centre and the metaxylem lies towards the periphery. This arrangement of the primary xylem is called endarch. While in the roots of dicot plants, the protoxylem lies towards the periphery and the metaxylem lies towards the centre. This arrangement of the primary xylem is called exarch.

100. Mango is a seed-bearing fruit. Sterile stamens are called staminodes. Seeds in grasses are endospermic.

101. The ends of tracheids are not perforated, while the tracheary elements are.

102. Potato is an example of an underground edible stem.

103. Mesosomes help in respiration in bacteria and are thus analogous to mitochondria.

104. Microfilaments are long, cylindrical rods or protein filaments of approximately 6 nm in diameter and made of actin protein.

105. Vacuoles maintain the osmotic expansion of a cell kept in water.

106. During the S phase, the amount of DNA per cell doubles. Thus, at the G_2 phase, the amount of DNA is 4C if the initial amount of DNA in the cell is 2C.

107. The centriole and basal body of cilia or flagella are similar. Chlorophyll pigments are present in thylakoids. Cristae are the infoldings in mitochondria. Ribozyme enzyme is not a protein but a chemzyme having an RNA origin.

108. F. Went isolated auxin from the *Avena* coleoptile tip.

109. The deficiency symptoms of nitrogen, potassium and magnesium are visible first in the senescent leaves, as these are mobile elements in the plant.

110. During lactate fermentation, pyruvic acid is reduced to lactic acid by lactate dehydrogenase. The reducing agent is NADH + H^+ which is oxidised to NAD^+. During this fermentation, CO_2 is not released.

111. In *Rhodospirillum*, photosynthesis is not associated with the release of oxygen as the plant lacks PSII.

112. Etiolation is the process by which seedlings turn pale in the absence of light.

113. Abscisic acid stimulates the stomata to close under various kinds of stresses. Hence, it is called a stress hormone.

114. Transfer of pollen grains from the anther to the stigma of another flower of the same plant is called geitonogamy. Functionally, it is cross-pollination, but genetically, it is self-pollination.

115. In angiosperms like *Lilium*, the male gametophyte is highly reduced and is called pollen grain which is a 3-celled structure.

116. When many small fruits, called fruitlets, develop from a single flower, they are called an etaerio of fruitlets, and such fruitlets develop from a multicarpellary, apocarpous ovary.

117. Pollen grains are rich in nutrients and are used as food supplements in the form of pollen tablets.

118. The filiform apparatus present at the micropylar part of the synergids guides the entry of the pollen tube.

119. Non-albuminous seeds have no residual endosperms because of their complete use during embryo development.

120. RNA serves as the genetic material in tobacco mosaic virus which is enclosed in a protein coat, called capsid, made of capsomeres.

121. Transcription is the process of writing information from DNA to mRNA.

122. F. Griffith, a British medical officer, discovered transformation in 1928 in the microorganism *Streptococcus pneumoniae*.

123. Fruit colour in summer squash is an example of dominant epistasis.

124. Viruses consist of DNA or RNA as the genetic material enclosed within a protein coat.

125. Human insulin was the first human hormone to be synthesised using hybridoma technology.

126. PCR is used for DNA amplification, which is not done in the Southern hybridisation technique.

127. PCR and RAPD technique are used for the characterisation of *in vitro* clonal propagation in plants.

128. Chlorella is rich in protein and is used as a food supplement.

129. Plasmid can clone only a small fragment of DNA, while BACs, YACs and cosmids are used for cloning larger fragments of DNA.

130. Seed bank is a common example of *ex situ* conservation.

131. Lichens are good indicators of pollution; they do not grow well in polluted areas.

132. Earthworms are detritivores. The invading species in a new area in succession are called pioneer species. Pollination is a form of ecosystem service, while natality (birth rate) is related to population growth.

133. A species facing an extremely high risk of extinction in the immediate future is called critically endangered.

134. The ozone layer helps trap harmful ultraviolet radiation from the Sun. It is located in the stratosphere about 10–50 km above the Earth's surface.

135. The International Union of Conservation of Nature and Natural Resources maintains the Red Data Books of threatened species.

136. Cnidaria represents a group of both marine and freshwater organisms.

137. *Gorgonia* belongs to Anthozoa; thus, it is an animal and lacks a cell wall.

138. *Planaria* has the maximum capacity for regeneration.

139. *Torpedo* – or electric ray is an electric fish.

140. Areolar and adipose tissues are loose connective tissues, while cartilage is a specialised connective tissue and tendon is a dense connective tissue.

141. The cells lining the tubular part of the nephron are cuboidal epithelial cells; they increase the surface area for reabsorption in nephron greatly.

142. During the S phase, the DNA replicates and its amount in the cell doubles.

143. Flagella are the locomotory organs in bacteria.

144. Malonate is a competitive inhibitor of succinate for the enzyme succinic dehydrogenase. Increased concentration of succinate removes the inhibitory effect of malonate.

145. Sucrose cannot donate electrons and hence is a non-reducing sugar.

146. Recombination occurs during pachytene, and thus, recombinase is needed during this phase.

147. In humans, the initial step in the digestion of milk is carried out by rennin.

148. Fructose is absorbed with the help of carrier ions such as Na^+. This mechanism is called facilitated transport.

149. Carbon dioxide is mainly transported in the form of bicarbonate dissolved in the plasma.

150. A person with AB blood group has both A and B antigens on RBC but do not possess any antibodies in the plasma.

151. The parasympathetic nervous system secretes acetylcholine which decreases both heart rate and cardiac output.

152. Increased levels of aldosterone help in reabsorption of sodium from the distal convoluted tubules.

153. The joint between carpals is the gliding joint.

154. The neuromuscular junction is the junction between the motor neuron and muscle fibre, where stimulation of muscle fibre takes place by the motor neuron.

155. Hypothalamus is involved in thermoregulation of the body.

156. Retinal is an aldehyde derivative of vitamin A.

157. The pineal gland secretes melatonin and acts as the biological clock of the body. Oxytocin is synthesised by the hypothalamus, atrial natriuretic factor is secreted by the atrial wall of the heart and progesterone maintains pregnancy.

158. In fight or flight mode, the emergency hormones (epinephrine and norepinephrine) are secreted by the adrenal medulla.

159. In human males, the urethra is the common urinogenital duct which carries both urine and sperm.

160. The chief function of the corpus luteum is to secrete progesterone which helps maintain pregnancy.

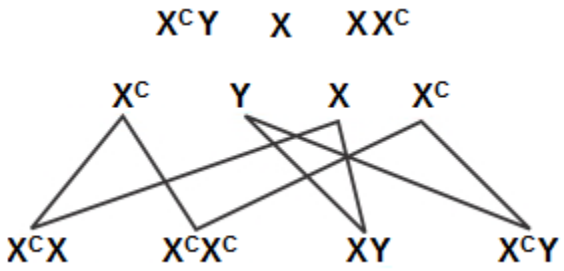
161. In pregnant females, hCG maintains the corpus luteum which secretes oestrogen and progesterone.

162. Tubectomy is a surgical method wherein a small part of the fallopian tube is removed or tied up.

163. LNG-20 is a hormone-releasing IUD which releases progesterone and prevents oogenesis and ovulation.

164. In IVF, the embryo up to the 8-celled stage or the zygote is transferred into the fallopian tube.

165. Of the two male offspring, one is colourblind; thus, 50% of the male children are colourblind.



166. According to the Hardy–Weinberg principle,
$(p + q)^2 = 1$
AA – p^2 = 360 out of 1000 individuals
Therefore, p^2 = 36 out of 100 individuals and q^2 = 16 out of 100 individuals
Hence, $q = \sqrt{0.16} = 0.4$
Since p + q = 1; therefore, p = (1 – 0.4) = 0.6

167. Turner's syndrome is caused by the absence of one of the X chromosomes in females.

168. RNA polymers catalyse polymerisation in one direction, i.e. the 5′ → 3′ direction, and the template strand is read in the 3′ → 5′ direction.

169. BAC and YAC are the commonly used vectors for the human genome sequence as they support larger DNA fragments.

170. Forelimbs of cat, lizard, whale and bat are examples of homologous organs as they have the same bone structure but perform different functions.

171. Gills of prawn and the lungs of man are analogous organs as they perform the same function but are structurally different.

172. The plant in the diagram is *Datura* which has hallucinogenic properties.

173. AIDS symptoms appear only in the late stages when large amounts of helper T cells are destroyed.

174. Even in a virus-infected plant, the meristem (apical and axillary tissues) is free of virus.

175. Bacteria in anaerobic sludge digesters produce a mixture of gases which contain methane, hydrogen sulphide and carbon dioxide.

176. Every winter, thousands of migratory birds coming from Siberia and other cold northern regions visit the Keoladeo National Park in Rajasthan.

177. A – Detritus
B – Rock minerals
C – Producer
D – Litter fall

178. The dominant group of invertebrates is insects, followed by molluscs, crustaceans and finally the other animal groups.

179. A scrubber in the exhaust system of a chemical industrial plant can remove gases such as SO_2 in which the exhaust is passed through a spray of water or lime.

180. 0.02 J of energy will be passed to peacock in the given food chain as only 10% of the total energy is transferred to successive tropic levels.

AIPMT – 2015
(Physics, Chemistry and Biology)
Code – E

Time: 3 hrs **Total Marks: 720**

General Instructions:

1. The Answer sheet is inside this Text booklet. When you are directed to open the text booklet, take out the Answer Sheet and fill in the particulars on side-1 and side-2 carefully with blue/black ball point pen only.
2. The test is of 3 hours duration and consists of 180 questions. Each question carries 3 marks. For each correct response the candidate will get 4 marks. For each incorrect response, one mark will be deducted. The maximum marks are 720.
3. Use Blue/Black ball point pen only for writing particulars on this page/marking responses.
4. Rough work is to be done on the space provided for this purpose in the text booklet only.
5. On completion of the test, the candidate must handover the answer sheet to the invigilator in the room/Hall. The candidates are allowed to take away this text booklet with them.
6. Make sure that the CODE printed on side-2 of the answer sheet is the same as that on this booklet, In case of discrepancy, the candidate should immediately report the matter to the invigilator for the replacement of both the test Booklet and the Answer Sheet.
7. The candidates should ensure that the Answer sheet is not folded. Do not make any stray marks on the Answer sheet. Do not write your roll no. anywhere else except in the specified space in the Test booklet/Answer Sheet.
8. Use of white fluid for correction is not permissible on the Answer Sheet.

1. If force (E), velocity (V) and time (T) are chosen as fundamental quantities, the dimensional formula of surface tension will be

(1) $[E\ V^{-2}\ T^{-1}]$
(2) $[E\ V^{-1}\ T^{-2}]$
(3) $[E\ V^{-2}\ T^{-2}]$
(4) $[E^{-2}\ V^{-1}\ T^{-3}]$

2. A Ship A is moving westwards with a speed of 10 km h^{-1} and a ship B 100 km south of A is moving northwards with a speed of 10 km h^{-1}. The time after which the distance between them becomes shortest is

(1) 0 h
(2) 5 h
(3) $5\sqrt{2}$ h
(4) $10\sqrt{2}$ h

3. A particle of unit mass undergoes one-dimensional motion such that its velocity varies according to

$\upsilon(x)=\beta x^{-2n}$

where β and n are constants and x is the position of the particle. The acceleration of the particle as a function of x is given by

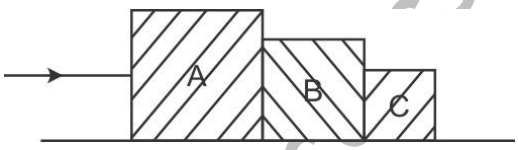
(1) $-2n\beta^2x^{-2n-1}$

(2) $-2n\beta^2x^{-4n-1}$

(3) $-2\beta^2x^{-2n+1}$

(4) $-2n\beta^2e^{-4n+1}$

4. Three blocks A, B and C, of masses 4 kg, 2 kg and 1 kg, respectively, are in contact on a frictionless surface, as shown. If a force of 14 N is applied on the 4 kg block, then the contact force between A and B is



(1) 2 N

(2) 6 N

(3) 8 N

(4) 18 N

5. A block A of mass m_1 rests on a horizontal table. A light string connected to it passes over a frictionless pulley at the edge of table and from its other end another block B of mass m_2 is suspended. The coefficient of kinetic friction between the block and the table is μ_k. When the block A is sliding on the table, the tension in the string is

(1) $\frac{(m_2+\mu_k m_1)g}{(m_1+m_2)}$

(2) $\frac{(m_2-\mu_k m_1)g}{(m_1+m_2)}$

(3) $\frac{m_1m_2(1+\mu_k)g}{(m_1+m_2)}$

(4) $\frac{m_1m_2(1-\mu_k)g}{(m_1+m_2)}$

6. Two similar springs P and Q have spring constants K_P and K_Q. They are stretched, first by the same amount (case a), then y the same force (case b). The work done by the springs W_P and W_Q are related as in case (a) and case (b), respectively:
(1) $W_P = W_Q$; $W_P > W_Q$
(2) $W_P = W_Q$; $W_P = W_Q$
(3) $W_P > W_Q$; $W_Q > W_P$
(4) $W_P < W_Q$; $W_Q < W_P$

7. A block of mass 10 kg, moving in x direction with a constant speed of 10 ms^{-1} is subjected to a retarding force F = 0.1x J/m during its travel from x = 20 m to 30 m. Its final KE will be
(1) 475 J
(2) 450 J
(3) 275 J
(4) 250 J

8. A particle of mass m is driven by a machine that delivers a constant power k watts. If the particle starts from rest the force on the particle at time t is
(1) $\sqrt{\frac{mk}{2}}\ t^{-1/2}$
(2) $\sqrt{mk}\ t^{-1/2}$
(3) $\sqrt{2mk}\ t^{-1/2}$
(4) $\frac{1}{2}\sqrt{mk}\ t^{-1/2}$

9. Two particles of masses m_1, m_2 move with initial velocities u_1 and u_2. On collision, one of the particles get excited to higher level, after absorbing energy ε. If final velocities of particles be v_1 and v_2 then we must have
(1) $m_1^2u_1 + m_2^2u_2 - \varepsilon = m_1^2v_1 + m_2^2v_2$
(2) $\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2 - \varepsilon$
(3) $\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 - \varepsilon = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2$
(4) $\frac{1}{2}m_1^2u_1^2 + \frac{1}{2}m_2u_2^2 - \varepsilon = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2$

10. The rod of weight W is supported by two parallel knife edges A and B and is in equilibrium in a horizontal position. The knives are at a distance d from each other. The centre of mass of the rod is at distance x from A. The normal reaction on A is

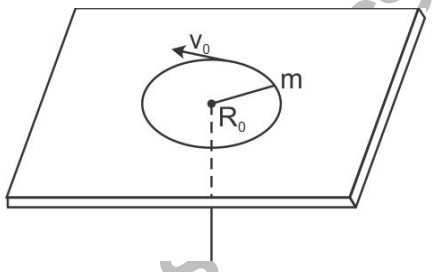
(1) $\frac{Wx}{d}$

(2) $\frac{Wd}{x}$

(3) $\frac{W(d-x)}{x}$

(4) $\frac{W(d-x)}{d}$

11. A mass m moves in a circle on a smooth horizontal plane with velocity v_0 at a radius R_0. The mass is attached to a string which passes through a smooth hole in the plane as shown



The tension in the string is increased gradually and finally m moves in a circle of radius $\frac{R_0}{2}$. The final value of the kinetic energy is

(1) mv_0^2

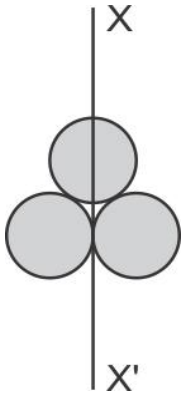
(2) $\frac{1}{4}mv_0^2$

(3) $2\ mv_0^2$

(4) $\frac{1}{2}mv_0^2$

12. Three identical spherical shells, each of mass m and radius r placed as shown in figure. Consider an axis XX' which is touching to two shells and passing through diameter of third shell.

Moment of inertia of the system consisting of these three spherical shells about XX' axis is



(1) $\frac{11}{5}mr^2$

(2) $3\ mr^2$

(3) $\frac{16}{5}mr^2$

(4) $4\ mr^2$

13. Kepler's third law states that square of period of revolution (T) of a planet around the Sun is proportional to third power of average distance r between Sun and planet

i.e. $T^2 = Kr^3$

here K is constant

If the masses of Sun and planet are M and m, respectively, then as per Newton's law of gravitation, force of attraction between them is

$F=\frac{GMm}{r^2}$, here G is gravitational constant . The relation between G and K is described as

(1) $GK = 4\pi^2$

(2) $GMK = 4\pi^2$

(3) $K = G$

(4) $K = \frac{1}{G}$

14. Two spherical bodies of mass M and 5 M and radii R and 2 R 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 before collision is

(1) 2.5 R
(2) 4.5 R
(3) 7.5 R
(4) 1.5 R

15. On observing light from three different starts P, Q and R, it was found that intensity of violet colour is maximum in the spectrum of P, the intensity of green colour is maximum in the spectrum of R and the intensity of red colour is maximum in the spectrum of Q. If T_P, T_Q and T_R are the respective absolute temperatures of P, Q and R, then it can be concluded from the above observation that

(1) $T_P > T_Q > T_R$
(2) $T_P > T_R > T_Q$
(3) $T_P < T_R < T_Q$
(4) $T_P < T_Q < T_R$

16. The approximate depth of an ocean is 2700 m. the compressibility of water is 45.4×10^{-11} Pa^{-1} and density of water is 10^3 kg/m^3. What fractional compression of water will be obtained at the bottom of the ocean?

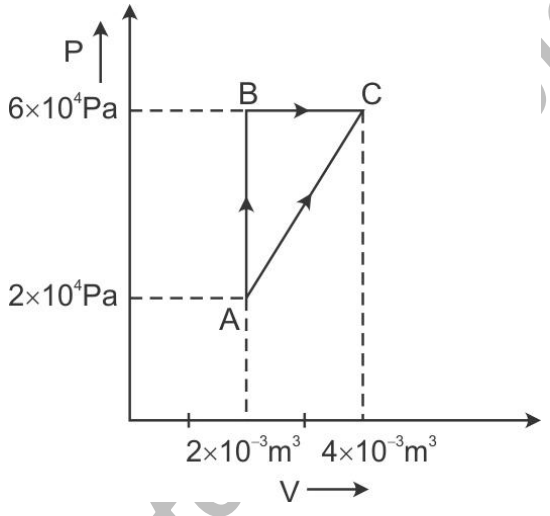
(1) 0.8×10^{-2}
(2) 1.0×10^{-2}
(3) 1.2×10^{-2}
(4) 1.4×10^{-2}

17. The two ends of a metal rod maintained at temperatures 100 °C and 110 °C. The rate of heat flow in the rod is found to be 4.0 J/s. If the ends are maintained at temperatures 200 °C and 210 °C, the rate of heat flow will be

(1) 44.0 J/s
(2) 16.8 J/s
(3) 8.0 J/s
(4) 4.0 J/s

18. A wind with speed 40 m/s blows parallel to the roof of a house. The area of the roof is 250 m^2. Assuming that the pressure inside the house is atmospheric pressure, the force exerted by the wind on the roof and the direction of the force will be
(P_{air} = 1.2 kg/m^3)
(1) 4.8×10^5 N, downwards
(2) 4.8×10^5 N, upwards
(3) 2.4×10^5 N, upwards
(4) 2.4×10^5 N, downwards

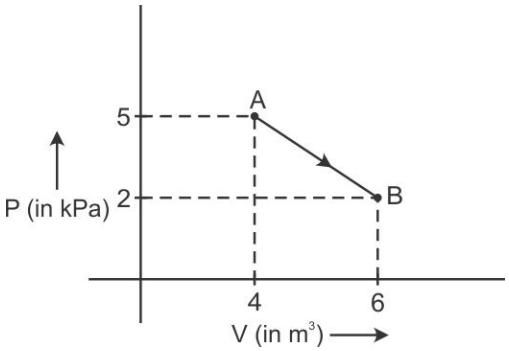
19. Figure below shows two paths that may be taken by a gas to go from a state A to a state C.



In process AB, 400 J of heat is added to the system and in process BC, 100 J of heat is added to the system. The heat absorbed by the system in the process AC will be
(1) 380 J
(2) 500 J
(3) 460 J
(4) 300 J

20. A Carnot engine having an efficiency of $\eta=\frac{1}{10}$ as heat engine is used as a refrigerator. If the work done on the system is 10 J, the amount of energy absorbed from the reservoir at lower temperature is
(1) 100 J
(2) 99 J
(3) 90 J
(4) 1 J

21. One mole of an ideal diatomic gas undergoes a transition from A to B along a path AB as shown in the figure,



The change in internal energy of the gas during the transition is

(1) 20 kJ

(2) -20 kJ

(3) 20 J

(4) -12 kJ

22. The ratio of the specific heats $\frac{C_P}{C_V} = \gamma$ in terms of degrees of freedom (n) is given by

(1) $\left(1+\frac{1}{n}\right)$

(2) $\left(1+\frac{n}{3}\right)$

(3) $\left(1+\frac{2}{n}\right)$

(4) $\left(1+\frac{n}{2}\right)$

23. When two displacements represented by $y_1 = a \sin(\omega t)$ and $y_2 = b \cos(\omega t)$ are superimposed the motion is

(1) Not a simple harmonic

(2) Simple harmonic with amplitude $\frac{a}{b}$

(3) Simple harmonic with amplitude $\sqrt{a^2+b^2}$

(4) Simple harmonic with amplitude $\frac{(a+b)}{2}$

24. A particle is executing SHM along a straight line. Its velocities at distances x_1 and x_2 from the mean position are V_1 and V_2, respectively. Its time period is

(1) $2\pi\sqrt{\frac{x_1^2+x_2^2}{V_1^2+V_2^2}}$

(2) $2\pi\sqrt{\frac{x_2^2-x_1^2}{V_1^2-V_2^2}}$

(3) $2\pi\sqrt{\frac{V_1^2+V_2^2}{X_1^2+X_2^2}}$

(4) $2\pi\sqrt{\frac{V_1^2-V_2^2}{x_1^2-x_2^2}}$

25. The fundamental frequency of a closed organ pipe of length 20 cm is equal to the second overtone of an organ pipe open at both the ends. The length of organ pipe open at both ends is

(1) 80 cm

(2) 100 cm

(3) 120 cm

(4) 140 cm

26. A parallel plate air capacitor of capacitance C is connected to a cell of emf V and then disconnected from it. A dielectric slab of dielectric constant K which can just fill the air gap of the capacitor is now inserted in it. Which of the following is incorrect?

(1) The potential difference between the plates decrease K times

(2) The energy stored in the capacitor decreases K times

(3) The change in energy stored is $\frac{1}{2}CV^2\left(\frac{1}{K}-1\right)$

(4) The charge on the capacitor is not conserved.

27. The electric field in a certain region is acting radially outward and is given by E = Ar. A charge contained in a sphere of radius 'a' centred at the origin of the field, will be given by

(1) $4\pi\varepsilon_0 Aa^2$

(2) $A\,\varepsilon_0 a^2$

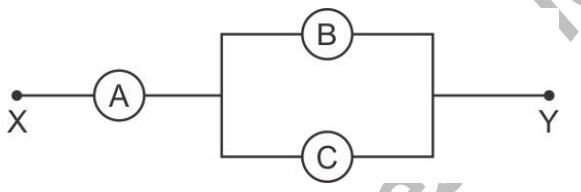
(3) $4\pi\varepsilon_0 Aa^3$

(4) $\varepsilon_0 Aa^3$

28. A potentiometer wire has length 4 m and resistance 8 Ω. The resistance that must be connected in series with the wire and an accumulator of emf 2 V, so as to get a potential gradient 1 mV per cm on the wire is

(1) 32 Ω
(2) 40 Ω
(3) 44 Ω
(4) 48 Ω

29. A, B and C are voltmeters of resistance R, 1.5R and 3R, respectively, as shown in the figure. When some potential difference is applied between X and Y, the voltmeter readings are V_A, V_B and V_C, respectively, then

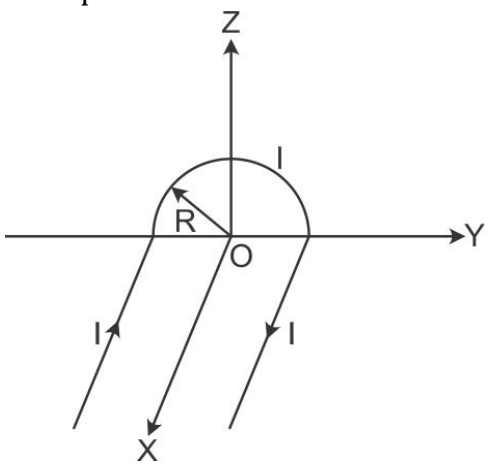


(1) $V_A = V_B = V_C$
(2) $V_A \neq V_B = V_C$
(3) $V_A = V_B \neq V_C$
(4) $V_A \neq V_B \neq V_C$

30. Across a metallic conductor of non-uniform cross section a constant potential difference is applied. The quantity which remains constant along the conductor is

(1) current density
(2) current
(3) drift velocity
(4) electric field

31. A wire carrying current I has the shape as shown in adjoining figure. Linear parts of the wire are very long and parallel to X-axis, while semicircular portion of radius R is lying in Y–Z plane. Magnetic field at point O is



(1) $\vec{B} = \frac{\mu_0}{4\pi}\frac{I}{R}\left(\pi\hat{i}+2\hat{k}\right)$

(2) $\vec{B} = -\frac{\mu_0}{4\pi}\frac{I}{R}\left(\pi\hat{i}-2\hat{k}\right)$

(3) $\vec{B} = -\frac{\mu_0}{4\pi}\frac{I}{R}\left(\pi\hat{i}+2\hat{k}\right)$

(4) $\vec{B} = \frac{\mu_0}{4\pi}\frac{I}{R}\left(\pi\hat{i}-2\hat{k}\right)$

32. An electron moving in a circular orbit of radius r makes n rotations per second. The magnetic field produced at the centre has magnitude:

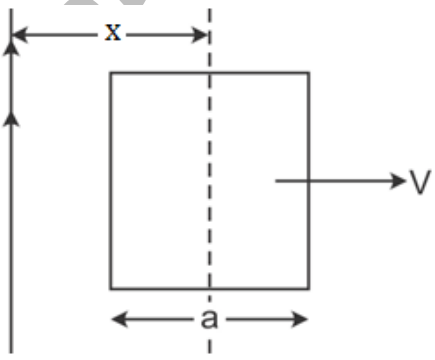
(1) $\frac{\mu_0 ne}{2\pi r}$

(2) Zero

(3) $\frac{\mu_0 n^2 e}{r}$

(4) $\frac{\mu_0 ne}{2r}$

33. A conducting square frame of side 'a' and a long straight wire carrying current I are located in the same plane as shown in the figure. The frame moves to the right with a constant velocity 'V'. The emf induced in the frame will be proportional to



(1) $\frac{1}{x^2}$

(2) $\frac{1}{(2x-a)^2}$

(3) $\frac{1}{(2x+a)^2}$

(4) $\frac{1}{(2x-a)(2x+a)}$

34. A resistance 'R' draws power 'P' when connected to an AC source. If an inductance is now placed in series with the resistance, such that the impedance of the circuit becomes 'Z', the power drawn will be

(1) $P\left(\frac{R}{Z}\right)^2$

(2) $P\sqrt{\frac{R}{Z}}$

(3) $P\left(\frac{R}{Z}\right)$

(4) P

35. A radiation of energy 'E' falls normally on a perfectly reflecting surface. The momentum transferred to the surface is (C = velocity of light):

(1) $\frac{E}{C}$

(2) $\frac{2E}{C}$

(3) $\frac{2E}{C^2}$

(4) $\frac{E}{C^2}$

36. Two identical thin plano–convex glass lenses (refractive index 1.5) each having radius of curvature of 20 cm are placed with their convex surfaces in contact at the centre. The intervening space is filled with oil of refractive index 1.7. The focal length of the combination is

(1) -20 cm

(2) -25 cm

(3) -50 cm

(4) 50 cm

37. For a parallel beam of monochromatic light of wavelength 'λ', diffraction is produced by a single lit whose width 'a' is of the order of the wavelength of the light. If 'D' is the distance of the screen from the slit, the width of the central maxima will be

(1) $\frac{2D\lambda}{a}$

(2) $\frac{D\lambda}{a}$

(3) $\frac{Da}{\lambda}$

(4) $\frac{2Da}{\lambda}$

38. In a double slit experiment, the two slits are 1 mm apart and the screen is placed 1 m away. A monochromatic light of wavelength 500 nm is used. What will be the width of each slit for obtaining ten maxima of double slit within the central maxima of single slit pattern?

(1) 0.2 mm

(2) 0.1 mm

(3) 0.5 mm

(4) 0.02 mm

39. The refracting angle of a prism is A, and refractive index of the material of the prism is cot (A/2). The angle of minimum deviation is

(1) 180° – 3A

(2) 180° – 2A

(3) 90° - A

(4) 180° + 2A

40. A certain metallic surface is illuminated with monochromatic light of wavelength λ. The stopping potential for photo–electric current for this light is $3V_0$. If the same surface is illuminated with light of wavelength 2λ, the stopping potential is V_0. The threshold wavelength for this surface for photo–electric effect is

(1) 6λ

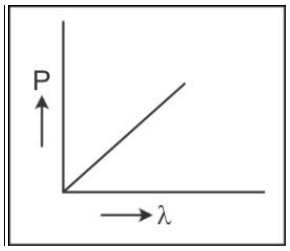
(2) 4λ

(3) $\frac{\lambda}{4}$

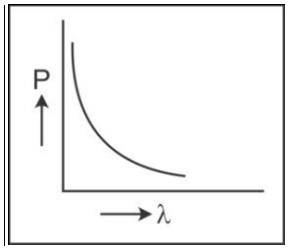
(4) $\frac{\lambda}{6}$

41. Which of the following figures represent the variation of particle momentum and the associated de-Broglie wavelength?

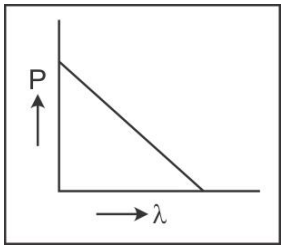
(1)



(2)



(3)



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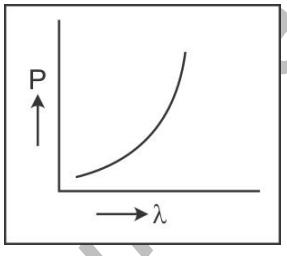


42. Consider 3rd orbit of He^+ (Helium), using non-relativistic approach, the speed of electron in this orbit will be [given K = 9×10^9 constant, Z = 2 and h(Planck's constant) = 6.6×10^{-34} Js]

(1) 2.92×10^6 m/s

(2) 1.46×10^6 m/s

(3) 0.73×10^6 m/s

(4) 3.0×10^8 m/s

43. If radius of the $\frac{27}{13}Al$ nucleus is taken to be R_{Al} then the radius of $\frac{125}{53}Te$ nucleus is nearly:

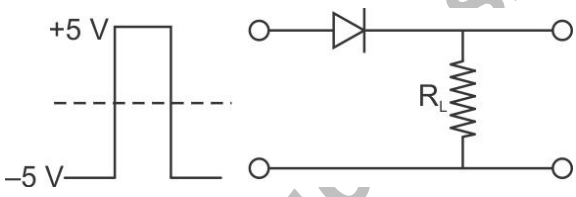
(1) $\left(\frac{53}{13}\right)^{1/3} R_{Al}$

(2) $\frac{5}{3}R_{Al}$

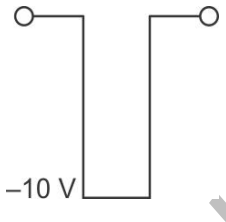
(3) $\frac{3}{5}R_{Al}$

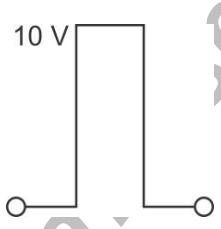
(4) $\left(\frac{13}{53}\right)^{1/3} R_{Al}$

44. If in a p–n junction, a square input signal of 10 V is applied, as shown



Then the output across R_L will be

(1)


(2)


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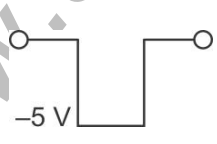
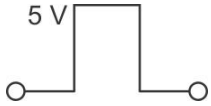
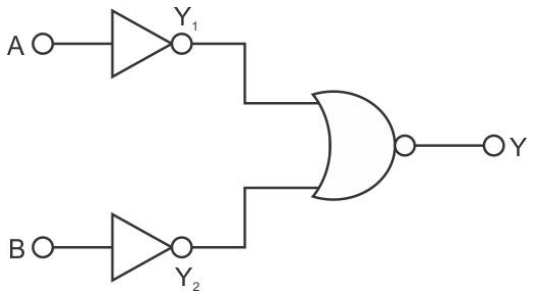


(4)


45. Which logic gate is represented by the following combination of logic gates?



(1) OR
(2) NAND
(3) AND
(4) NOR

46. Which of the following species contains equal number of σ and π-bonds?
(1) HCO_3^-
(2) XeO_4
(3) $(CN)_2$
(4) $CH_2(CN)_2$

47. The species Ar, K^+ and Ca^{2+} contain the same number of electrons. In which order do their radii increase?
(1) $Ar < K^+ < Ca^{2+}$
(2) $Ca^{2+} < Ar < K^+$
(3) $Ca^{2+} < K^+ < Ar$
(4) $K^+ < Ar < Ca^{2+}$

48. The function of ''Sodium pump'' is a biological process operating in each and every cell of all animals. Which of the following biologically important ions is also a constituent of this pump?
(1) Ca^{2+}
(2) Mg^{2+}
(3) K^+
(4) Fe^{2+}

49. "Metals are usually not found as nitrates in their ores". Out of the following two (a and b) reasons which is/are true for the above observation?
(a) Metal nitrates are highly unstable
(b) Metal nitrates are highly soluble in water
(1) a and b are true
(2) a and b are false
(3) a is false but b is true
(4) a is true but b is false

50. Solubility of the alkaline earth's metal sulphates in water decreases in the sequence :
(1) Mg > Ca > Sr > Ba
(2) Ca > Sr > Ba > Mg
(3) Sr > Ca > Mg > Ba
(4) Ba > Mg > Sr > Ca

51. Because of lanthanoid contraction, which of the following pairs of elements have nearly same atomic radii? (Numbers in the parenthesis are atomic numbers).
(1) Ti (22) and Zr (40)
(2) Zr (40) and Nb (41)
(3) Zr (40) and Hf (72)
(4) Zr (40) and Ta (73)

52. Which of the following processes does not involve oxidation of iron?
(1) Rusting of iron sheets
(2) Decolourisation of blue $CuSO_4$ solution by iron
(3) Formation of $Fe(CO)_5$ from Fe
(4) Liberation of H_2 from steam by iron at high temperature

53. Which of the following pairs of ions are isoelectronic and isostructural?
(1) CO_3^{2-}, SO_3^{2-}
(2) ClO_3^-, CO_3^{2-}
(3) SO_3^{2-}, NO_3^-
(4) ClO_3^-, SO_3^{2-}

54. Which of the following options represents the correct bond order?
(1) $O_2^- > O_2 > O_2^+$
(2) $O_2^- < O_2 < O_2^+$
(3) $O_2^- > O_2 < O_2^+$
(4) $O_2^- < O_2 > O_2^+$

55. Nitrogen dioxide and sulphur dioxide have some properties in common. Which property is shown by one of these compounds, but not by the other?
(1) forms 'acid – rain'
(2) is a reducing agent
(3) is soluble in water
(4) is used as a food-preservative

56. Maximum bond angle at nitrogen is present in which of the following
(1) NO_2
(2) NO_2^-
(3) NO_2^+
(4) NO_3^-

57. Magnetic moment 2.84 B.M. is given by:
(At. nos. Ni = 28, Ti = 22, Cr = 24, Co = 27)
(1) Ni^{2+}
(2) Ti^{3+}
(3) Cr^{2+}
(4) Co^{2+}

58. Cobalt (III) Chloride forms several octahedral complexes with ammonia. Which of the following will not give test for chloride ions with silver nitrate at 25°C?
(1) $CoCl_3.3NH_3$
(2) $CoCl_3.4NH_3$
(3) $CoCl_3.5NH_3$
(4) $CoCl_3.6NH_3$

59. Which of these statements about $[Co(CN)_6]^{3-}$ is true?
(1) $[Co(CN)_6]^{3-}$ has no unpaired electrons and will be in a low-spin configuration
(2) $[Co(CN)_6]^{3-}$ has four unpaired electrons and will be in low-spin configuration
(3) $[Co(CN)_6]^{3-}$ has four unpaired electrons and will be in a high-spin configuration
(4) $[Co(CN)_6]^{3-}$ has no unpaired electrons and will e in a high-spin configuration

60. The activation energy of a reaction can be determined from the slope of which of the following graphs?

(1) In K vs. T

(2) $\frac{\text{In K}}{\text{T}}$ vs.T

(3) In K vs. $\frac{1}{\text{T}}$

(4) $\frac{\text{T}}{\text{In K}}$ vs. $\frac{1}{\text{T}}$

61. Which one is not equal to zero for an ideal solution?

(1) ΔH_{mix}

(2) ΔS_{mix}

(3) ΔV_{mix}

(4) $\Delta P = P_{observed} - P_{Raoult}$

62. A mixture of gases contains H_2 and O_2 gases in the ratio of 1:4 (w/w). What is the molar ratio of the two gases in the mixture?

(1) 1:4

(2) 4:1

(3) 16:1

(4) 2:1

63. A given metal crystallizes out with a cubic structure having edge length of 361 pm. If there are four metal atoms in one unit cell, what is the radius of one atom?

(1) 40 pm

(2) 127 pm

(3) 80 pm

(4) 108 pm

64. When initial concentration of a reactant is doubled in a reaction, its half – life period is not affected. The order of the reaction is :

(1) Zero

(2) First

(3) Second

(4) More than zero but less than first

65. If the value of an equilibrium constant for a particular reaction is 1.6×10^{12}, then at equilibrium the system will contain
(1) All reactants
(2) Mostly reactants
(3) Mostly products
(4) Similar amounts of reactants and products

66. A device that converts energy of combustion of fuels like hydrogen and methane, directly into electrical energy is known as :
(1) Fuel cell
(2) Electrolytic cell
(3) Dynamo
(4) Ni–Cd cell

67. The boiling point of 0.2 mol kg^{-1} solution of X in water is greater than equimolal solution of Y in water. Which one of the following statements is true in this case?
(1) X is undergoing dissociation in water
(2) Molecular mass of X is greater than the molecular mass of Y
(3) Molecular mass of X is less than the molecular mass of Y
(4) Y is undergoing dissociation in water, while X undergoes no change

68. Which one of the following electrolytes has the same value of van't Hoff's factor (i) as that of $Al_2(SO_4)_3$ (if all are 100% ionized)?
(1) K_2SO_4
(2) $K_3[Fe(CN)_6]$
(3) $Al(NO_3)_3$
(4) $K_4[Fe(CN)_6]$

69. The number of d-electrons in Fe^{2+} (Z = 26) is not equal to the number of electrons in which one of the following?
(1) s-electrons in Mg (Z = 12)
(2) p-electrons in Cl (Z = 17)
(3) d-electrons in Fe (Z = 26)
(4) p-electrons in Ne (Z = 10)

70. The correct bond order in the following species is:
(1) $O_2^{2+} < O_2^{+} < O_2^{-}$
(2) $O_2^{2+} < O_2^{-} < O_2^{+}$
(3) $O_2^{+} < O_2^{-} < O_2^{2+}$
(4) $O_2^{-} < O_2^{+} < O_2^{2+}$

71. The angular momentum of electron in 'd' orbital is equal to:
(1) $\sqrt{6}\,h$
(2) $\sqrt{2}\,h$
(3) $2\sqrt{3}\,h$
(4) 0 h

72. The K_{sp} of Ag_2CrO_4, AgCl, AgBr and AgI are, respectively, 1.1×10^{-12}, 1.8×10^{-10}, 5.0×10^{-13}, 8.3×10^{-17}. Which one of the following salts will precipitate last if $AgNO_3$ solution is added to the solution containing equal moles of NaCl, NaBr, NaI and Na_2CrO_4
(1) AgI
(2) AgCl
(3) AgBr
(4) $AgCrO_4$

73. Which property of colloidal solution is independent of charge on the colloidal particles?
(1) Coagulation
(2) Electrophoresis
(3) Electro-osmosis
(4) Tyndall effect

74. Which of the following statements is correct for a reversible process in a state of equilibrium?
(1) $\Delta G = -2.30RT\log K$
(2) $\Delta G = 2.30RT\log K$
(3) $\Delta G^{o} = -2.30RT\log K$
(4) $\Delta G^{o} = 2.30RT\log K$

75. Bithional is generally added to the soaps as an additive to function as a/an:
(1) Softener
(2) Dryer
(3) Buffering agent
(4) Antiseptic

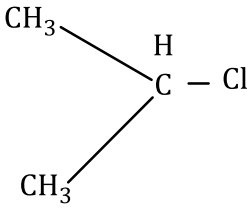
76. The electrolytic reduction of nitrobenzene in strongly acidic medium produces:
(1) P-Aminophenol
(2) Azoxybenzene
(3) Azobenzene
(4) Aniline

77. In Duma's method for estimation of nitrogen 0.25 g of an organic compound gave 40 mL if nitrogen collected at 300 K temperature and 725 mm pressure. If the aqueous tension at 300 K is 25 mm, the percentage of nitrogen in the compound is:

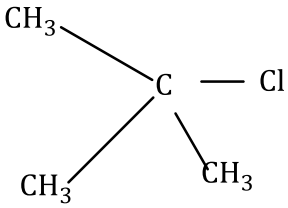
(1) 17.36
(2) 18.20
(3) 16.76
(4) 15.76

78. In which of the following compounds, the C–Cl bond ionization shall give most stable carbonium ion?

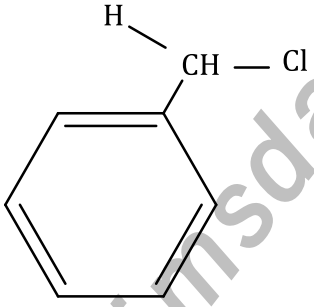
(1)



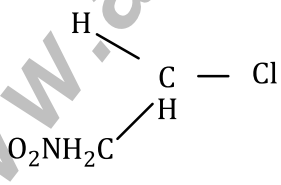
(2)



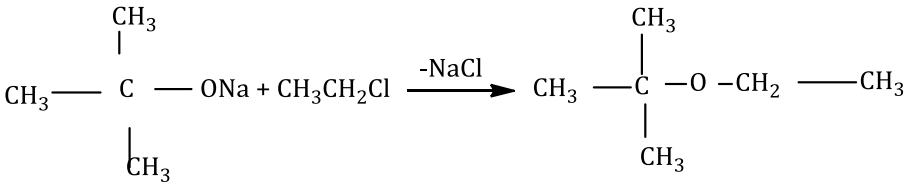
(3)



(4)



79. The reaction



(1) Williamson Synthesis
(2) Williamson continuous etherification process
(3) Etard reaction
(4) Gattterman–Koch reaction

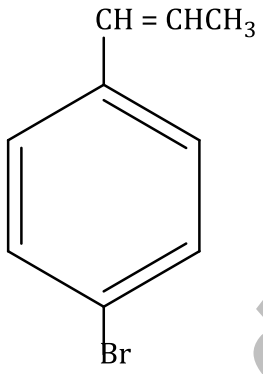
80. The reaction of $C_6H_5CH = CHCH_3$ with HBr produces

(1) $C_6H_5\underset{\displaystyle Br}{\underset{|}{C}}HCH_2CH_3$

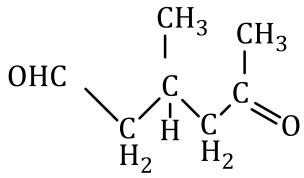
(2) $C_6H_5CH_2\underset{\displaystyle Br}{\underset{|}{C}}HCH_3$

(3) $C_6H_5CH_2CH_2CH_2Br$

(4)

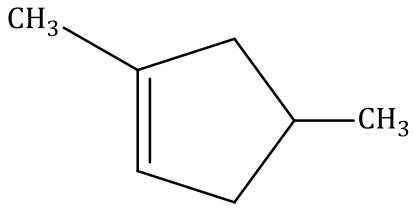


81. A single compound of the structure



is obtainable from ozonolysis of which of the following cyclic compounds

(1)



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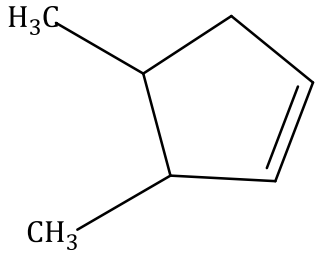
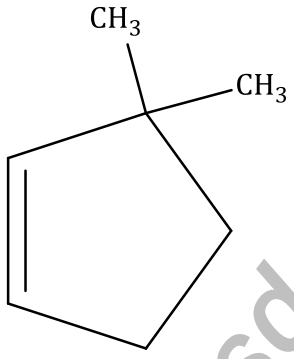
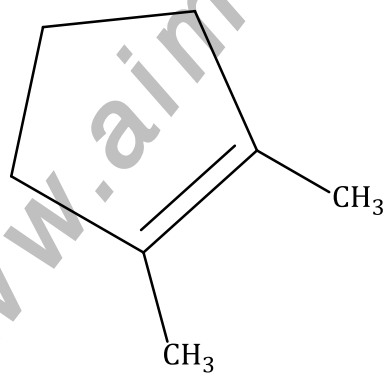
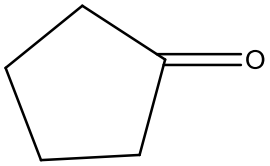


(3)



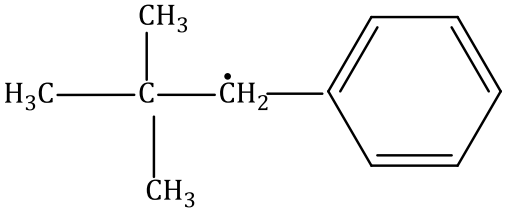
(4)



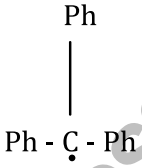
82. Treatment of cyclopentanone  with methyl lithium gives which of the following species?

(1) Cyclopentanonyl anion
(2) Cyclopentanonyl cation
(3) Cyclopentanonyl radical
(4) Cyclopentanonyl biradical

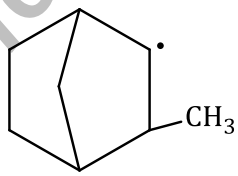
83. Consider the following compounds



(I)



(II)



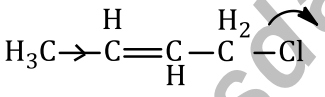
(III)

Hyperconjugation occurs in:

(1) I only
(2) II only
(3) III only
(4) I and III

84. Which of the following is the most correct electron displacement of a nucleophilic reaction to take place

(1)



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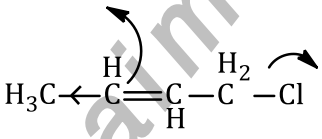

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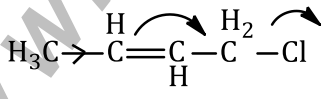
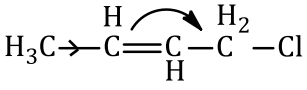
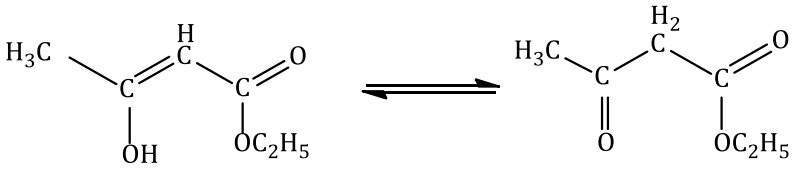


(4)

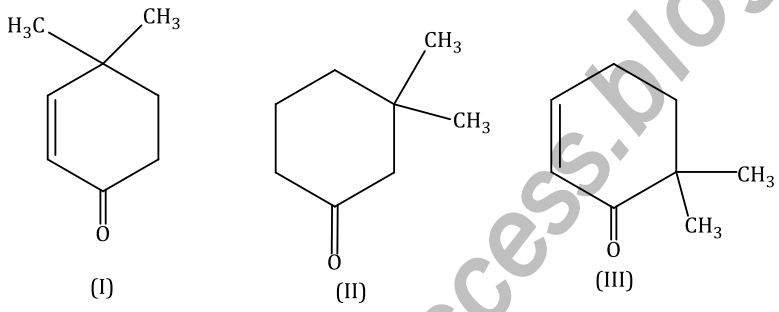


85. The enolic form of ethyl acetoacetate as below has:



(1)18 sigma bonds and 2 pi-bonds
(2)16 sigma bonds and 1 pi-bonds
(3)9 sigma bonds and 2 pi-bonds
(4)9 sigma bonds and 1 pi-bonds

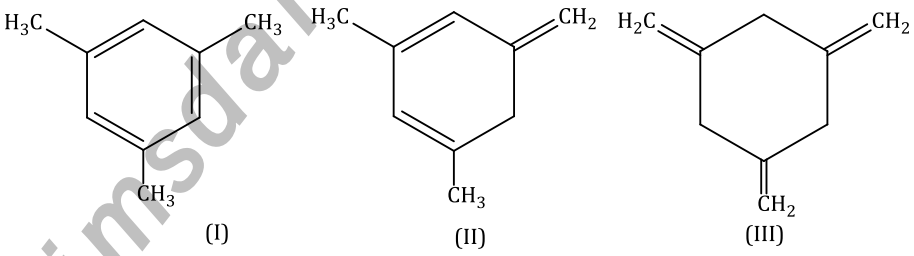
86. Given



(I) (II) (III)

Which of the given compounds can exhibit tautomerism?
(1) I and II
(2) I and III
(3) II and III
(4) I, II and III

87. Given

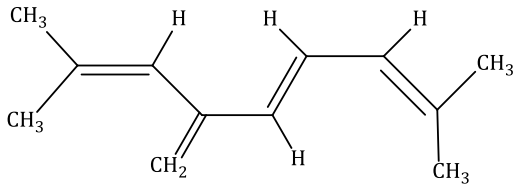


(I) (II) (III)

The enthalpy of hydrogenation of these compounds will be in the order as:
(1) I > II > III
(2) III > II > I
(3) II > III > I
(4) II > I > III

88. Biodegradable polymer which can be produced from glycine and aminocaproic acid is
(1) Nylon 2–nylon 6
(2) PHBV
(3) Buna-N
(4) Nylon 6, 6

89. The total number of π-bond electrons in the following structure is:



(1) 4
(2) 8
(3) 12
(4) 16

90. An organic compound 'X' having molecular formula $C_5H_{10}O$ yields phenyl hydrazone and gives negative response to the lodoform test and Tollens' test. It produces n-pentane on reduction. 'X' could be:
(1) pentanal
(2) 2-pentanone
(3) 3-pentanone
(4) n-amyl alcohol

91. Which one of the following matches is correct?

(1)	*Phytophthora*	Aseptate mycelium	Basidiomycetes
(2)	*Alternaria*	Sexual reproduction absent	Deuteromycetes
(3)	*Mucor*	Reproduction by conjugation	Ascomycetes
(4)	*Agaricus*	Parasitic fungus	Basidiomycetes

92. Read the following five statements (A to E) and select the option with all correct statements:
(A) Mosses and Lichens are the first organisms to colonise a bare rock
(B) *Selaginella* is a homosporous pteridophyte.
(C) Coralloid roots in Cycas have VAM
(D) Main plant body in bryophytes is gametophytic, whereas in pteridophytes is sporophytic
(E) In gymnosperms, male and female gametophytes are present within sporangia located on sporophyte.
(1) (A),(C) and (D)
(2) (B),(C) and (D)
(3) (A),(D) and (E)
(4) (B),(C) and (E)

93. In which of the following gametophyte is not independent free living

(1) *Funaria*
(2) *Marchantia*
(3) *Pteris*
(4) *Pinus*

94. Which one of the following statements is wrong?
(1) Algin and carrageen are products of algae
(2) Agar–agar is obtained from *Gelidium* and *Gracilaria*
(3) *Chlorella* and *Spirulina* are used as space food
(4) Mannitol is stored food in Rhodophyceae

95. The guts of cow and buffalo possess
(1) *Fucus* spp.
(2) *Chlorella* spp.
(3) Methanogens
(4) Cyanobacteria

96. Male gametes are flagellated in
(1) Polysiphonia
(2) anabaena
(3) Ectocarpus
(4) Spirogyra

97. Vascular bundles in monocotyledons are considered closed because
(1) A bundle sheath surrounds each bundle
(2) Cambium is absent
(3) There are no vessels with perforations
(4) Xylem is surrounded all around by phloem

98. $\oplus\male\text{K}_{(5)}\text{C}_{(5)}\overset{\frown}{\text{A}_5}\underline{\text{G}}_{(2)}$ is the floral formula of
(1) Allium
(2) Sesbania
(3) Petunia
(4) Brassica

99. A major characteristic of the monocot root is the presence of
(1) Open vascular bundles
(2) Scattered vascular bundles
(3) Vasculature without cambium
(4) Cambium sandwiched between phloem and xylem along the radius

100. Keel is the characteristic feature of flower of
(1) Tulip
(2) *Indigofera*
(3) Aloe
(4) Tomato

101. Perigynous flowers are found in
(1) Guava
(2) Cucumber
(3) China rose
(4) Rose

102. Leaves become modified into spins in
(1) *Opuntia*
(2) Pea
(3) Onion
(4) Silk Cotton

103. The structures that are formed by stacking of organised flattened membranous sacs in the chloroplasts are
(1) Cristae
(2) Grana
(3) Stroma lamellae
(4) Stroma

104. The chromosomes in which centromere is situated close to one end are
(1) Metacentric
(2) Acrocentric
(3) Telocentric
(4) Sub-metacentric

105. Select the correct matching in the following pairs
(1) Smooth ER – Oxidation of phospholipids
(2) Smooth ER – Synthesis of lipids
(3) Rough ER – Synthesis of glycogen
(4) Rough ER – Oxidation of fatty acids

106. True nucleus is absent in
(1) *Anabaena*
(2) *Mucor*
(3) *Vaucheria*
(4) *Volvox*

107. Which one of the following is not an inclusion body found in prokaryotes?
(1) Phosphate granule
(2) Cyanophycean granule
(3) Glycogen granule
(4) Polysome

108. Transpiration and root pressure cause water to rise in plants by
(1) Pulling it upward
(2) Pulling and pushing it, respectively
(3) Pushing it upward
(4) Pushing and pulling it, respectively

109. Minerals known to be required in large amounts for plant growth include
(1) Phosphorus, potassium, sulphur, calcium
(2) Calcium, magnesium, manganese, copper
(3) Potassium, phosphorus, selenium, boron
(4) Magnesium, sulphur, iron, zinc

110. What causes a green plant exposed to the light on only one side to bend toward the source of light as it grows?
(1) Green plants need light to perform photosynthesis
(2) Green plants seek because they are phototropic
(3) Light stimulates plant cells on the lighted side to grow faster
(4) Auxin accumulates on the shaded side, stimulating greater cell elongation there.

111. In a ring girdled plant
(1) The shoot dies first
(2) The root dies first
(3) The shoot and root die together
(4) Neither root nor shoot will die

112. Typical growth curve in plants is
(1) Sigmoid
(2) Linear
(3) Stair–steps shaped
(4) Parabolic

113. Which one gives the most valid and recent explanation for stomatal movements?
(1) Transpiration
(2) Potassium influx and efflux
(3) Starch hydrolysis
(4) Guard cell photosynthesis

114. The hilum is a scar on the
(1) Seed, where funicle was attached
(2) Fruit, where it was attached to pedicel
(3) Fruit, where style was present
(4) Seed, where micropyle was present

115. Which one of the following may require pollinators, but is genetically similar to autogamy?
(1) Geitonogamy
(2) Xenogamy
(3) Apogamy
(4) Cleistogamy

116. Which one of the following statement is not true?
(1) Pollen grains are rich in nutrients, and they used in the form of tablets and syrups
(2) Pollen grains of some plants cause severe allergies and bronchial afflictions in some people
(3) The flowers pollinated by flies and bats secrete four odour to attract them
(4) Honey is made by bees by digesting pollen collected from flowers

117. Transmission tissue is characteristics feature of
(1) Hollow style
(2) Solid style
(3) Dry stigma
(4) Wet stigma

118. In ginger vegetative propagation occurs through
(1) Rhizome
(2) Offsets
(3) Bulbils
(4) Runners

119. Which of the following are the important floral rewards to the animal pollinators?
(1) Colour and large size of flower
(2) Nectar and pollen grains
(3) Floral fragrance and calcium crystals
(4) Protein pellicle and stigmatic exudates

120. How many pairs of contrasting characters in pea plants were studies by Mendel in his experiments?
(1) Five
(2) Six
(3) Eight
(4) Seven

121. Which is the most common mechanism of genetic variation in the population of a sexually reproducing organism?
(1) Transduction
(2) Chromosomal aberrations
(3) Genetic drift
(4) Recombination

122. A technique of micropropagation is
(1) Somatic hybridisation
(2) Somatic embryogenesis
(3) Protoplast fusion
(4) Embryo rescue

123. The movement of a gene from one linkage group to another is called
(1) Inversion
(2) Duplication
(3) Translocation
(4) Crossing over

124. Multiple alleles are present
(1) On different chromosomes
(2) At different loci on the same chromosome
(3) At the same locus of the chromosome
(4) On non-sister chromatids

125. Which body of the Government of India regulates GM research and safety of introducing GM organisms for public services?
(1) Bio-safety committee
(2) Indian council of agricultural research
(3) Genetic Engineering Approval committee
(4) Research committee on Genetic Manipulation

126. In BT cotton, the BT toxin present in plant tissue as pro-toxin is converted into active toxin due to
(1) Alkaline pH of the insect gut
(2) Acidic pH of the insect gut
(3) Action of gut microorganisms
(4) Presence of conversion factors in insect gut

127. The crops engineered for glyphosate are resistant/tolerant to
(1) Fungi
(2) Bacteria
(3) Insects
(4) Herbicides

128. DNA is not present in
(1) Chloroplast
(2) Ribosomes
(3) Nucleus
(4) Mitochondria

129. Which of the following enhances or induces fusion of protoplasts?
(1) Sodium chloride and potassium chloride
(2) Polyethylene glycol and sodium nitrate
(3) IAA and kinetin
(4) IAA and gibberellins

130. The UN conference of Parties on climate change in the year 2011 was held in
(1) Poland
(2) South Africa
(3) Peru
(4) Qatar

131. Vertical distribution of different species occupying different levels in a biotic community is known as
(1) Divergence
(2) Stratification
(3) Zonation
(4) Pyramid

132. In which of the following both pairs have correct combination?
(1) *In situ* conservation : National Park
Ex situ conservation : Botanical Garden
(2) *In situ* conservation : Cryopreservation
Ex situ conservation : Wildlife sanctuary
(3) *In situ* conservation : Seed Bank
Ex situ conservation : National Park
(4) *In situ* conservation : Tissue culture
Ex situ conservation : Sacred groves

133. Secondary succession takes place on/in
(1) Bare rock
(2) Degraded forest
(3) Newly created pond
(4) Newly cooled lava

134. The mass of living material at a trophic level at a particular time is called
(1) Gross primary productivity
(2) Standing state
(3) Net primary productivity
(4) Standing crop

135. In an ecosystem the rate of production of organic matter during photosynthesis is termed
(1) Net primary productivity
(2) Gross primary productivity
(3) Secondary productivity
(4) Net productivity

136. Which of the following characteristics is mainly responsible for diversification of insects on land?
(1) Segmentation
(2) Bilateral symmetry
(3) Exoskeleton
(4) Eyes

137. Which of the following endoparasites of humans does show viviparity
(1) *Ancylostoma duodenale*
(2) *Enterobius vermicularis*
(3) *Trichinella spiralis*
(4) *Ascaris lumbricoides*

138. Which of the following represents the correct combination without any exception?

	Characteristics	Class
(1)	Mammary gland; hair on body; pinnae; two pairs of limbs	Mammalia
(2)	Mouth ventral : grills without operculum; skin with placoid scales; persistent notochord	Chondrichthyes
(3)	Sucking and circular mouth; Jaws absent integument without scales; paired appendages	Cyclostomata
(4)	Body covered with feathers; skin moist and glandular; forelimbs form wings; lungs with air sacs	Aves

139. Which of the following animals is not viviparous?
(1) Flying fox (bat)
(2) Elephant
(3) Platypus
(4) Whale

140. Erythropoiesis starts in
(1) Kidney
(2) Liver
(3) Spleen
(4) Red bone marrow

141. The terga, sterna and pleura of cockroach body are joined by
(1) Cementing glue
(2) Muscular tissue
(3) Arthrodial membrane
(4) Cartilage

142. Nuclear envelope is a derivative of
(1) Smooth endoplasmic reticulum
(2) Membrane of Golgi complex
(3) Microtubules
(4) Rough endoplasmic reticulum

143. Cytochromes are found in
(1) Matrix of mitochondria
(2) Outer wall of mitochondria
(3) Cristae of mitochondria
(4) Lysosomes

144. Which one of the following statements is incorrect?
(1) A competitive inhibitor reacts reversibly with the enzyme to form an enzyme–inhibitor complex
(2) In competitive inhibition, the inhibitor molecule is not chemically changed by the enzyme
(3) The competitive inhibitor does not affect the rate breakdown of the enzyme–substrate complex
(4) The presence of the competitive inhibitor decreases the Km of the enzyme for the substrate

145. Select the correct option:

	I		II
(a)	Synapsis aligns homologous chromosomes	(i)	Anaphase-II
(b)	Synthesis of RNA and protein	(ii)	Zygotene
(c)	Action of enzyme recombinase	(iii)	G_2-Phase
(d)	Centromeres do not separate but chromatids move toward opposite poles	(iv)	Anaphase-I
		(v)	Pachytene

	(a)	(b)	(c)	(d)
(1)	(ii)	(i)	(iii)	(iv)
(2)	(ii)	(iii)	(v)	(iv)
(3)	(i)	(ii)	(v)	(iv)
(4)	(ii)	(iii)	(iv)	(v)

146. A somatic cell that has just completed the S phase of its cell cycle, as compared to gamete of the same species, has
(1) Twice the number of chromosomes and twice the amount of DNA
(2) Same number of chromosomes but twice the amount of DNA
(3) Twice the number of chromosomes and four times the amount of DNA
(4) Four times the number of chromosomes and twice the amount of DNA

147. Which of the following statements is not correct?
(1) Brunner's glands are present in the submucosa of stomach and secrete pepsinogen
(2) Goblet cells are present in the mucosa of intestine and secrete mucus
(3) Oxyntic cells are present in the mucosa of stomach and secrete HCl
(4) Acini are present in the pancreas and secrete carboxypeptidase

148. Gastric juice of infants contains
(1) Maltase, pepsinogen, rennin
(2) Nuclease, pepsinogen, lipase
(3) Pepsinogen, lipase, rennin
(4) Amylase, rennin, pepsinogen

149. When you hold your breath, which of the following gas changes in blood would first lead to the urge to breathe?
(1) Falling O_2 concentration
(2) Rising CO_2 concentration
(3) Falling CO_2 concentration
(4) Rising CO_2 and falling O_2 concentration

150. Blood pressure in the mammalian aorta is maximum during
(1) Systole of the left atrium
(2) Diastole of the right ventricle
(3) Systole of the left ventricle
(4) Diastole of the right atrium

151. Which one of the following is correct?
(1) Plasma = Blood - Lymphocytes
(2) Serum = Blood + Fibrinogen
(3) Lymph = Plasma + RBC + WBC
(4) Blood = Plasma + RBC + WBC + Platelets

152. Removal of proximal convoluted tubule from the nephron will result in
(1) More diluted urine
(2) More concentrated urine
(3) No change in quality and quantity of urine
(4) No urine formation

153. Sliding filament theory can best explained as
(1) When myofilaments slide pass each other actin filaments shorten, while Myosin filament do not shorten
(2) Actin and Myosin filaments shorten and slide pass each other
(3) Actin and Myosin filaments shorten and slide pass each other
(4) When myofilaments slide pass each other, Myosin filaments shorten, while Actin filaments do not shorten

154. Glenoid cavity articulates
(1) Clavicle with acromion
(2) Scapula with acromion
(3) Clavicle with scapula
(4) Humerus with scapula

155. Which of the following regions of the brain is incorrectly paired with its function?
(1) Medulla oblongata – Homoeostatic control
(2) Cerebellum – Language comprehension
(3) Corpus callosum – Communication between the left and right cerebral cortices
(4) Cerebrum – Calculation and contemplation

156. A gymnast is able to balance his body upside down even in the total darkness because of
(1) Cochlea
(2) Vestibular apparatus
(3) Tectorial membrane
(4) Organ of Corti

157. A chemical signal that has both endocrine and neural roles is
(1) Melatonin
(2) Calcitonin
(3) Epinephrine
(4) Cortisol

158. Which of the following does not favour the formation of large quantities of dilute urine?
(1) Alcohol
(2) Caffeine
(3) Renin
(4) Atrial-natriuretic factor

159. Capacitation refers to changes in the
(1) Sperm before fertilisation
(2) Ovum before fertilisation
(3) Ovum after fertilisation
(4) Sperm after fertilisation

160. Which of these is not an important component of initiation of parturition in humans?
(1) Increase in oestrogen and progesterone ratio
(2) Synthesis of prostaglandins
(3) Release of oxytocin
(4) Release of prolactin

161. Which of the following viruses is not transferred through semen of an infected male?
(1) Hepatitis B virus
(2) Human immunodeficiency virus
(3) Chikungunya virus
(4) Ebola virus

162. Which of the following cells during gametogenesis is normally diploid?
(1) Primary polar body
(2) Spermatid
(3) Spermatogonia
(4) Secondary polar body

163. Hysterectomy is surgical removal of
(1) Uterus
(2) Prostate gland
(3) Vas deferens
(4) Mammary glands

164. Which of the following is not sexually transmitted disease?
(1) Syphilis
(2) Acquired immune deficiency syndrome (AIDS)
(3) Trichomoniasis
(4) Encephalitis

165. An abnormal human baby with 'XXX' sex chromosomes was born due to
(1) Formation of abnormal sperms in the father
(2) Formation of abnormal ova in the mother
(3) Fusion of two ova and one sperm
(4) Fusion of two sperms and one ovum

166. Alleles are
(1) Different phenotype
(2) True breeding homozygotes
(3) Different molecular forms of a gene
(4) Heterozygotes

167. A man with blood group 'A' marries a woman with blood group 'B'. What are all the possible blood groups of their offspring?
(1) A and B only
(2) A, B and AB only
(3) A, B, AB and O
(4) O only

168. Gene regulation governing lactose operon of *E. coli* that involves the lac I gene product is
(1) Positive and inducible because it can be induced by lactose
(2) Negative and inducible because repressor protein prevents transcription
(3) Negative and repressible because repressor protein prevents transcription
(4) Feedback inhibition because excess of β - galactosidase can switch off transcription

169. In sea urchin DNA, which is double stranded, 17% of the bases were shown to be cytosine. The percentages of the other three bases expected to be present in the DNA are
(1) G 34%, A 24.5%, T 24.5%
(2) G 17%, A 16.5%, T 32.5%
(3) G 17%, A 33%, T 33%
(4) G 8.5%, A 50%, T 24.5%

170. Which of the following had the smallest brain capacity?
(1) Homo erectus
(2) Homo sapiens
(3) Homo neanderthalensis
(4) Homo habilis

171. A population will not exist in Hardy–Weinberg equilibrium is
(1) Individuals mate selectively
(2) There are no mutations
(3) There is no migration
(4) The population is large

172. Match each disease with its correct type of vaccine:

(a) Tuberculosis	(i) harmless virus
(b) Whooping cough	(ii) Inactivated toxin
(c) Diphtheria	(iii) Killed bacteria
(d) Polio	(iv) harmless bacteria

	(a)	(b)	(c)	(d)
(1)	(ii)	(i)	(iii)	(iv)
(2)	(iii)	(ii)	(iv)	(i)
(3)	(iv)	(iii)	(ii)	(i)
(4)	(i)	(ii)	(iv)	(iii)

173. HIV that causes AIDS, first starts destroying

(1) B-lymphocytes
(2) Leucocytes
(3) Helper T-lymphocytes
(4) Thrombocytes

174. To active form of *Entamoeba histolytica* feeds upon

(1) Erythrocytes mucosa and submucosa of colon
(2) Mucosa an submucosa of colon only
(3) Food n intestine
(4) Blood only

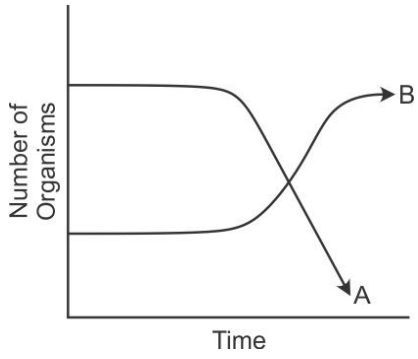
175. High value of BOD (biochemical oxygen demand) indicates that

(1) Water is pure
(2) Water is highly polluted
(3) Water is less polluted
(4) Consumption of organic matter in the water is higher by the microbes

176. Most animals are tree dwellers in a

(1) Coniferous forest
(2) Thorn woodland
(3) Temperate deciduous forest
(4) Tropical rainforest

177. The following graph depicts changes in two populations (A and B) of herbivores in a grassy field. A possible reason for these changes is that



(1) Both plant populations in this habitat decreased
(2) Population B competed more successfully for food than population A
(3) Population A produced more offspring than population B
(4) Population A consumed the members of population B

178. Cryopreservation of gametes of threatened species in viable and fertile condition can be referred to as
(1) In situ conservation of biodiversity
(2) Advanced *ex situ* conservation of biodiversity
(3) In situ conservation by sacred groves
(4) In situ cryo-conservation of biodiversity

179. Rachel Carson's famous book 'Silent spring' is related to
(1) Pesticide pollution
(2) Noise pollution
(3) Population explosion
(4) Ecosystem management

180. Which of the following is not one of the prime health risks associated with greater UV radiation through the atmosphere due to depletion of stratospheric ozone?
(1) Increased skin cancer
(2) Reduced immune system
(3) Damage to eyes
(4) Increased liver cancer

AIPMT – 2015
(Physics, Chemistry and Biology)
Code – E
Answer Key and Solution

Answer Key

1	(3)	2	(2)	3	(2)	4	(2)	5	(3)	6	(3)	7	(1)	8	(1)	9	(3)	10	(4)
11	(3)	12	(4)	13	(2)	14	(3)	15	(2)	16	(3)	17	(4)	18	(4)	19	(3)	20	(3)
21	(2)	22	(3)	23	(3)	24	(2)	25	(3)	26	(4)	27	(3)	28	(1)	29	(1)	30	(2)
31	(3)	32	(4)	33	(4)	34	(1)	35	(2)	36	(3)	37	(1)	38	(1)	39	(2)	40	(2)
41	(2)	42	(2)	43	(2)	44	(4)	45	(3)	46	(2)	47	(3)	48	(3)	49	(3)	50	(1)
51	(3)	52	(3)	53	(4)	54	(2)	55	(4)	56	(3)	57	(1)	58	(1)	59	(4)	60	(3)
61	(2)	62	(2)	63	(2)	64	(2)	65	(3)	66	(1)	67	(1)	68	(4)	69	(2)	70	(4)
71	(1)	72	(4)	73	(4)	74	(3)	75	(4)	76	(1)	77	(3)	78	(3)	79	(1)	80	(1)
81	(1)	82	(1)	83	(3)	84	(3)	85	(1)	86	(4)	87	(2)	88	(1)	89	(2)	90	(3)
91	(2)	92	(3)	93	(4)	94	(4)	95	(3)	96	(3)	97	(2)	98	(3)	99	(3)	100	(2)
101	(4)	102	(1)	103	(2)	104	(2)	105	(2)	106	(1)	107	(4)	108	(2)	109	(1)	110	(4)
111	(2)	112	(1)	113	(2)	114	(1)	115	(1)	116	(4)	117	(2)	118	(1)	119	(2)	120	(4)
121	(4)	122	(2)	123	(3)	124	(3)	125	(3)	126	(1)	127	(4)	128	(2)	129	(2)	130	(2)
131	(2)	132	(1)	133	(2)	134	(4)	135	(2)	136	(3)	137	(3)	138	(2)	139	(3)	140	(2)
141	(3)	142	(4)	143	(3)	144	(4)	145	(2)	146	(3)	147	(1)	148	(3)	149	(2)	150	(3)
151	(4)	152	(1)	153	(3)	154	(4)	155	(2)	156	(2)	157	(3)	158	(3)	159	(1)	160	(4)
161	(3)	162	(3)	163	(1)	164	(4)	165	(2)	166	(3)	167	(3)	168	(2)	169	(3)	170	(4)
171	(1)	172	(3)	173	(3)	174	(1)	175	(2)	176	(4)	177	(2)	178	(2)	179	(1)	180	(4)

Physics

1. $[E\ V^{-2}\ T^{-2}]$

Consider σ to be the surface tension and its fundamental quantities are given as

$\sigma = E^a\ V^b\ T^c$

Equating the dimensions on both sides of the equation, we get

$$\frac{M^1L^1T^{-2}}{L} = \left(M^1L^2T^{-2}\right)^a\left(\frac{L}{T}\right)^b(T)^C$$

$M^1L^0T^{-2} = M^aL^{2a+b}T^{-2a-b+c}$

$\therefore a = 1, -2a - b + c = -2$

$2a + b = 0$

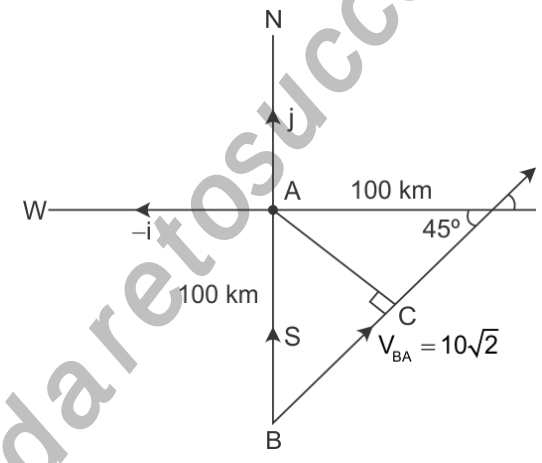
$\therefore b = -2$

and $-2 \times 1 - (-2) + c = -2$

$c = -2$

Hence, the dimensional formula of surface tension will be $[E\ V^{-2}\ T^{-2}]$.

2. 5 h



From the above figure, we see that

Ship A is moving westwards with speed of 10 km/h

Speed of ship A, $\vec{v}_A = 10(-\hat{i})$

Ship B is moving northwards with speed of 10 km/h

Speed of ship B, $\vec{V}_B = 10(\hat{j})$

Relative speed of ship B w.r.t. speed of ship A is given as

$\vec{V}_{BA} = 10\,\hat{j} + 10(-\hat{i})$

$\therefore V_{BA} = \sqrt{10^2 + 10^2} = 10\sqrt{2}$

Distance BC = 100 cos 45° = $50\sqrt{2}$

Because ship B is 100 km south of A, the time after which the distance between them becomes shortest is

$t = \frac{50\sqrt{2}}{10\sqrt{2}} = 5$ h

The time after which the distance between them becomes shortest is 5 h.

3. $-2n\beta^2 x^{-4n-1}$

A particle of unit mass undergoes one-dimensional motion such that its velocity varies according to the equation $v(x) = \beta x^{-2n}$ ..... (1)

where b and n are constants and x is the position of the particle.

Differentiating equation (i) w.r.t. x, we get acceleration of particle as

$a = v\frac{dv(x)}{dx} = \beta x^{-2n}(\beta(-2n)x^{-2n-1})$

$a = -2n\beta^2 x^{-4n-1}$

4. 6 N

$F_{net} = M_{total} \times$ acceleration

$\therefore$ acceleration, $a = \frac{F_{net}}{M_{total}} = \frac{14}{4+2+1} = 2$ m/s^2

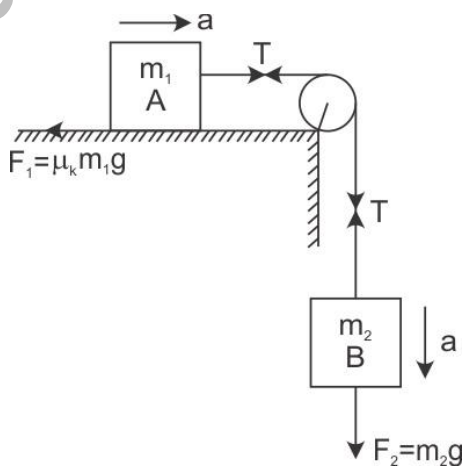
Because a force of 14 N is applied on the 4 kg block, the contact force between A and B will move the 2 kg and 1 kg block with the same acceleration.

F = (2 + 1) × a = 3 × 2 = 6 N

5. $\frac{m_1 m_2(1+\mu_k)g}{m_1 + m_2}$

Mass of the block A, = m_1

Mass of the block B, = m_2



From the figure, we get

$m_2g - T = m_2a$ (i)

$T - \mu_k m_1 g = m_1 a$ (ii)

from (i) and (ii)

$$a = \frac{(m_2 - \mu_k m_1)g}{m_1 + m_2}$$

For the mass of block m_2

$$m_2g - T = m_2 \frac{(m_2 - \mu_k m_1)g}{m_1 + m_2}$$

$$T = m_2g - \left[\frac{(m_2 - \mu_k m_1)}{m_1 + m_2}\right] m_2g = m_2g$$

$$T = \frac{m_1 m_2 (1 + \mu_k)g}{m_1 + m_2}$$

6. $W_P > W_Q$; $W_Q > W_P$

It is given that the spring constants are related as $K_P > K_Q$

Case (a): When stretched by the same amount

$x_1 = x_2 = x$

$$\frac{W_p}{W_Q} = \frac{\frac{1}{2}K_p x^2}{\frac{1}{2}K_Q x^2} = \frac{K_p}{K_Q}$$

$\Rightarrow W_p > W_Q$

Case (b): When stretched by the same force

$F_1 = F_2 = F$

$$W = \frac{F^2}{2K}$$

$$W \propto \frac{1}{K}$$

$$\Rightarrow \frac{W_p}{W_Q} = \frac{K_Q}{K_p}$$

$\therefore W_Q > W_p$

7. 475 J

Mass of block is m = 10 kg

Speed of block is v = 10 ms^{-1}

The retarding force on the block is F = 0.1x J/m.

We know that the work done by a variable force is given as

$$W = -\int_{x_1}^{x_2} F dx$$

Hence, we get

$$W = -\int_{20}^{30} 0.1x dx$$

$$= -0.1\left[\frac{x^2}{2}\right]_{20}^{30}$$

$$= -0.05\left(30^2 - 20^2\right)$$

$$= -0.05(900 - 400)$$

$$= -25 \text{ J}$$

Now, according to the work–energy theorem, we have

$$W = \Delta K.E. = K.E._{final} - K.E._{initial}$$

$$W = K.E._{final} - \frac{1}{2}mv^2$$

$$\therefore K.E._{final} = W + \frac{1}{2}mv^2$$

Substituting the values in the above equation, we get

$$K.E._{final} = -25 + \frac{1}{2} \times 10 \times 10^2$$

$$= -25 + 500$$

$$= 475 \text{ J}$$

8. $\sqrt{\frac{mk}{2}}t^{-\frac{1}{2}}$

We know that power is the rate of work done, i.e. P = W/t

Hence, work done is W = Pt = kt

According to the work–energy theorem, we have

$W = \Delta K.E.$

$W = \frac{1}{2}mv^2 - 0 = \frac{1}{2}mv^2$

Hence, we get

$\frac{1}{2}mv^2 = kt$

$\therefore v^2 = \frac{2kt}{m}$

$\therefore v = \sqrt{\frac{2kt}{m}}$

We know that power is given as product of force and velocity.

Hence, we get

$P = Fv$

$\therefore F = \frac{P}{v} = \frac{k}{v}$

$\therefore F = k\sqrt{\frac{m}{2kt}} = \sqrt{\frac{mk}{2t}} = \sqrt{\frac{mk}{2}}t^{-\frac{1}{2}}$

9. $\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 - \varepsilon = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2$

In any collision, the total energy is always conserved. Hence, we have

Initial kinetic energy = Final kinetic energy + Excitation energy

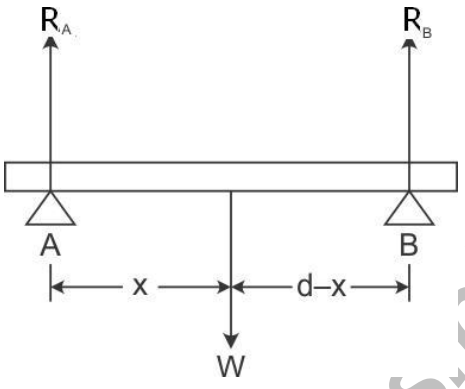
$\therefore \frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2 + \varepsilon$

$\therefore \frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 - \varepsilon = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2$

10. $\frac{W(d-x)}{d}$

Let R_A and R_B be the reactions at the knife edges A and B, respectively.

The moment of forces about the knife must be equal to zero for the rod to be in equilibrium in a horizontal position.



Moment of forces acting at A is given as

$R_A.0 + xW - R_B d = 0$

Or, $R_B d = xW$

$\therefore R_B = \frac{xW}{d}$

Moment of forces acting at B is given as

$R_A d - (d-x)W - R_B.0 = 0$

Or, $R_A d = (d-x)W$

$\therefore R_A = \frac{W(d-x)}{d}$

11. $2\ mv_0^2$

Because the mass moves under a central force, its angular momentum is conserved.

$L_i = L_f$

$\therefore mv_0 R = mv\frac{R}{2}$

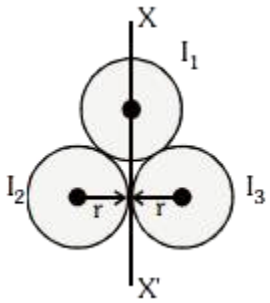
$\therefore v_0 = \frac{v}{2}$

$\therefore v = 2v_0$

Thus, the final kinetic energy is given as

$KE_f = \frac{1}{2}m(2v_0)^2 = 2mv_0^2$

12. $4\ mr^2$



Moment of inertia of a spherical shell of radius r and mass m about its diameter is given as

$I_{diameter} = \frac{2}{3}mr^2$

Thus, $I_1 = \frac{2}{3}mr^2$

Moment of inertia of a spherical shell of radius R and mass m about a tangential axis is given as

$I_{tangent} = \frac{2}{3}mr^2 + mr^2 = \frac{5}{3}mr^2$

Thus, $I_2 = I_3 = \frac{5}{3}mr^2$

So, $I_{total} = I_1 + I_2 + I_3$

$= \frac{2}{3}mr^2 + \frac{5}{3}mr^2 + \frac{5}{3}mr^2$

$= 4mr^2$

Thus, $I_{XX'} = 4\ mr^2$

13. $GMK = 4\pi^2$

Orbital speed of a satellite is given as

$$\upsilon = \sqrt{\frac{GM}{r}}$$

The time period of the satellite is given as

$$T = \frac{2\pi r}{\upsilon} = \frac{2\pi r\sqrt{r}}{\sqrt{GM}}$$

$$\Rightarrow T = \frac{2\pi r^{3/2}}{\sqrt{GM}}$$

Squaring both the sides, we get

$$T^2 = \frac{4\pi^2 r^3}{GM}$$

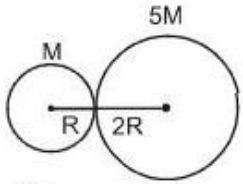
Comparing with $T^2 = Kr^3$, we get

$$K = \frac{4\pi^2}{GM}$$

$$\Rightarrow GMK = 4\pi^2$$

14. 7.5R

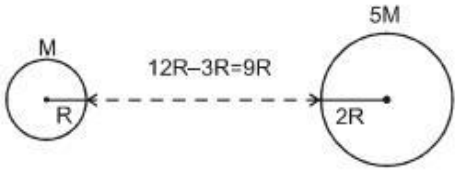
Initially, the distance between the centres of the two spherical bodies is 12R.



The distance between their centres at the time of collision is 3R.

So, the total distance travelled by the two spherical spheres is given as

12R – 3R = 9R



As the bodies move under mutual forces, the centre of mass will remain stationary.

So, we get

$m_1x_1 = m_2x_2$

$Mx = 5M(9R - x)$

$x = 45R - 5x$

$$x = \frac{45}{6}R$$

$\therefore x = 7.5R$

15. From the Wien's displacement law, we have $\lambda_m \alpha \frac{1}{T}$

Thus, according to the sequence of the spectrum

$(\lambda_m)_P < (\lambda_m)_R < (\lambda_m)_Q$

So, $T_P > T_R > T_Q$

16. 1.0×10^{-2}

Bulk modulus is $\beta = \frac{pV}{\Delta V}$

So, $\frac{\Delta V}{V} = \frac{p}{\beta}$ .....(1)

Now, $p = \rho gh$ and compressibility, $K = \frac{1}{\beta}$

Substituting in equation (1), we get

$$\frac{\Delta V}{V} = \rho gh \times K$$

$$= 10^3 \times 9.8 \times 2700 \times 45.4 \times 10^{-11}$$

$$= 1.2 \times 10^{-2}$$

Thus, the fractional compression of the water at the bottom of the ocean is 1.2×10^{-2}.

17. 4.0 J/s

The rate of conduction of heat is directly proportional to the temperature difference.

That is, we have

$$\frac{dQ}{dt} \propto T_2 - T_1$$

The temperature difference between the two ends of the rod is the same, i.e. 10°C in both cases.

Hence, the rate of heat flow will also be the same. So, we have

$$\frac{dQ}{dt} = 4.0 \text{ J/s}$$

18. 2.4×10^5 N, downwards

Let P_1 and P_2 be the pressure and V_1 and V_2 be the velocity of the wind inside and outside the roof of the house, respectively.

Here, $V_2 = 40$ m/s, $V_1 = 0$ and $\rho = 1.2$ kg/m^3

According to the Bernoulli's theorem,

$$P_1 + \frac{1}{2}\rho V_1^2 = P_2 + \frac{1}{2}\rho V_2^2$$

$$P_1 + 0 = P_2 + \frac{1}{2}\rho V_2^2$$

$$P_1 - P_2 = \frac{1}{2}\rho V_2^2$$

$$\rightarrow \text{Pressure difference} = \Delta P = \frac{1}{2}\rho V_2^2$$

$$\Delta P = \frac{1}{2} \times 1.2 \times (40)^2 = 960$$

We know that force, $F = \Delta P \times A$

$$F = 960 \times 250$$

$$= 2.4 \times 10^5 \text{ N}$$

As $V_2 > V_1 \Rightarrow P_2 < P_1$, the force will be in the upward direction.

19. 460 J

For a cyclic process $\Delta U = 0$

Total heat absorbed by the system during the cyclic process = Work done during the cyclic process ABCA

$Q_{ABCA} = W_{ABCA}$

i.e:

$$Q_{AB} + Q_{BC} + Q_{CA} = \text{Area of the curve representing the process}$$

Given that:

$$Q_{AB} = 400 \text{ J}$$

$$Q_{BC} = 100 \text{ J}$$

$$400 \text{ J} + 100 \text{ J} + Q_{CA} = \text{Area of the curve representing the process}$$

$$500 \text{ J} + Q_{CA} = \frac{1}{2} \times BC \times AB$$

$$500 \text{ J} + Q_{CA} = \frac{1}{2} \times (4 \times 10^{-3} - 2 \times 10^{-3}) \times (6 \times 10^4 - 2 \times 10^4)$$

$$500 \text{ J} + Q_{CA} = \frac{1}{2} \times (2 \times 10^{-3}) \times (4 \times 10^4)$$

$$500 \text{ J} - Q_{AC} = 40$$

$$Q_{AC} = 460 \text{ J}$$

20. 90 J

The coefficient of performance of a refrigerator is given by $\beta = \frac{Q_2}{W}$

where Q_2 is the amount of heat drawn from the sink (reservoir at lower temperature) and W is the work done on the system.

Again we have that $\beta = \frac{1-\eta}{\eta}$, η being the efficiency of the carnots engine

$$\Rightarrow \frac{1-\eta}{\eta} = \frac{Q_2}{W}$$

$$\Rightarrow Q_2 = W\left(\frac{1-\eta}{\eta}\right)$$

Given that $\eta = \frac{1}{10}$ and W = 10 J

$$\Rightarrow Q_2 = 10 \times \left(\frac{1-\frac{1}{10}}{\frac{1}{10}}\right)$$

$$\Rightarrow Q_2 = 90 \text{ J}$$

21. –20 kJ

The change in internal energy of gas is given by $\Delta U = nC_v\Delta T$ ..... (1)

But we know that $C_v = \frac{R}{\gamma - 1}$ ..... (2)

From the ideal gas equation, PV=nRT

$$T = \frac{PV}{nR}$$

$$\Delta T = T_2 - T_1 = \frac{P_2V_2 - P_1V_1}{nR}$$ ..... (3)

Substituting (2) and (3) in (1) we get:

$$\Delta U = n \times \frac{R}{\gamma - 1} \times \frac{P_2V_2 - P_1V_2}{nR}$$

$$\Delta U = \frac{P_2V_2 - P_1V_2}{\gamma - 1}$$

$$\Delta U = \frac{\left(5\times10^3\right)\times6 - \left(2\times10\right)^3\times4}{\gamma - 1}$$

$$\Delta U = \frac{\left(2\times10^3\right)\times6 - \left(5\times10\right)^3\times4}{2/5}$$

$$\Delta U = \frac{-8\times10^3}{2/5}$$

$$\Delta U = -20 \text{ kJ}$$

22. $1+\frac{2}{n}$

We know that $\gamma=\frac{C_p}{C_v}$

But $C_p=\left(\frac{n}{2}+1\right)R$

and $C_v=\left(\frac{n}{2}\right)R$

Therefore:

$$\gamma=\frac{\left(\frac{n}{2}+1\right)R}{\left(\frac{n}{2}\right)R}$$

$$\Rightarrow \gamma=\frac{n+2}{n}=1+\frac{2}{n}$$

23. Simple harmonic with amplitude $\sqrt{a^2+b^2}$

Given:

$y_1=a\sin\omega t$

$y_2=b\cos\omega t$

y_2 can also be written as: $y_2=b\sin\left(\omega t+\frac{\pi}{2}\right)$

Both SHM have the same frequency; hence, the resultant motion will also be SHM.

The amplitude of the resultant motion, $A=\sqrt{a_1^2+a_2^2+2a_1a_2\cos\phi}$

$A=\sqrt{a^2+b^2+2\,a\,b\cos\phi}$

But $\phi=\frac{\pi}{2}$

Therefore:

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

Therefore, the resultant motion will be simple harmonic with amplitude $\sqrt{a^2+b^2}$.

24. $T = 2\pi\sqrt{\frac{x_2^2 - x_1^2}{V_1^2 - V_2^2}}$

The velocity of a particle executing SHM is given by $v = \omega\sqrt{a^2 - y^2}$

where a is the amplitude of simple harmonic motion, ω its angular frequency and y is the displacement from the mean position.

Here, the velocities of the particle can be written as

$V_1 = \omega\sqrt{a^2 - x_1^2}$

and

$V_2 = \omega\sqrt{a^2 - x_2^2}$

On squaring the above two equations:

$V_1^2 = \omega^2\left(a^2 - x_1^2\right)$ and $V_2^2 = \omega^2\left(a^2 - x_2^2\right)$

$V_1^2 = \omega^2 a^2 - \omega^2 x_1^2$ ----------(1)

$V_2^2 = \omega^2 a^2 - \omega^2 x_2^2$ ----------(2)

$V_1^2 - V_2^2 = -\omega^2 x_1^2 + \omega^2 x_2^2$

$V_1^2 - V_2^2 = \omega^2 x_2^2 - \omega^2 x_1^2$

$\frac{V_1^2 - V_2^2}{x_2^2 - x_1^2} = \omega^2$

$\omega = \sqrt{\frac{V_1^2 - V_2^2}{x_2^2 - x_1^2}}$ ----------(3)

But angular frequency $\omega = \frac{2\pi}{T}$ ----(4)

$\sqrt{\frac{V_1^2 - V_2^2}{x_2^2 - x_1^2}} = \frac{2\pi}{T}$

Therefore timeperiod, $T = 2\pi\sqrt{\frac{x_2^2 - x_1^2}{V_1^2 - V_2^2}}$

25. 120 cm

Given: Length of the closed organ pipe, L_C = 20 cm

Let the length of the organ pipe open at both ends be L_O.

The fundamental frequency of a closed organ pipe is given by: $\frac{\nu}{4\,L_C}$

The second overtone of an organ pipe open at both ends is given by: $\frac{3\nu}{2L_O}$

$$\frac{\nu}{4\,L_C} = \frac{3\nu}{2L_O}$$

$$L_O = \frac{3 \times 4\,L_C}{2}$$

$$L_O = 6\,L_C$$

$$L_O = 6 \times 20$$

$$L_O = 120 \text{ cm}$$

26. The charge on the capacitor is not conserved.

On charging, the charge of the capacitor, Q = C V.

But the charge remains constant even after disconnecting the capacitor from the cell.

Thus, we can say that the charge on the capacitor is conserved.

The energy stored in the capacitor when connected to cell of emf V, $U_i = \frac{1}{2}CV^2$

When a dielectric slab is placed in between:

The capacity of the capacitor increase, i.e C' = KC

The potential V decreases as, $V' = \frac{V}{K}$

Energy stored in the capacitor decreases.

Then the energy stored becomes, $U_f = \frac{1}{2}C'V'^2 =$

$$U_f = \frac{1}{2}KC \times \left(\frac{V}{K}\right)^2$$

$$U_f - U_i = \frac{1}{2}KC \times \left(\frac{V}{K}\right)^2 - \frac{1}{2}CV^2$$

$$\Delta U = \frac{1}{2}CV^2\left(\frac{1}{K} - 1\right)$$

27. $4\pi\varepsilon_0 Aa^3$

Electric flux linked with a sphere will be $\phi = \vec{E}.\vec{ds}$

Given E = A r

As the electric field is acting radially outwards, we get that:

$\phi = E\ ds$

$\phi = Ar\ 4\pi r^2$

$\phi = Aa\ 4\pi a^2$

$\phi = A4\pi a^3$

According to gauss law:

The electric flux over a closed surface, $\phi = \frac{q}{\varepsilon_0}$

$A4\pi a^3 = \frac{q}{\varepsilon_0}$

$\Rightarrow q = A4\pi a^3\varepsilon_0$

$q = 4\pi\varepsilon_0 Aa^3$

28. 32 Ω

Potential gradient (x) $= 1\frac{mV}{cm} = \frac{10^{-3}\ volt}{10^{-2}\ m} = 0.1\frac{Volt}{m}$

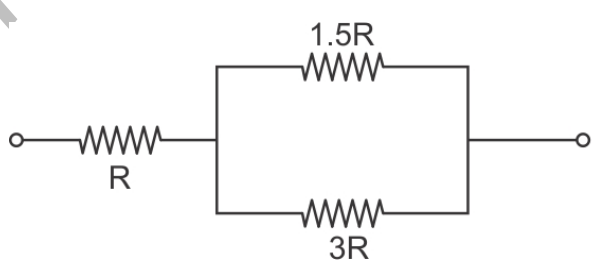
$x = \frac{E}{R+R'} \times \frac{R}{L}$

$0.1 = \frac{2}{8+R'} \times \frac{8}{4}$

$8 + R' = 40$

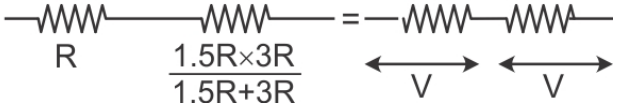
$R' = 32\ \Omega$

29. $V_A = V_B = V_C$



B and C are in parallel combination, so the potential is the same.

$\therefore V_B = V_C$

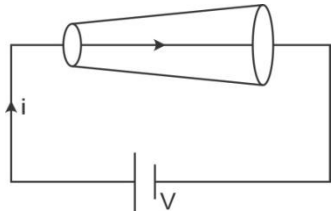


Effective resistance of B and C = $\frac{1.5\times 3R}{1.5R+3R}$

In a series connection, $V\propto R$, so the voltage across A = voltage across B and C

$\therefore V_A = V_B = V_C$

30. Current



With the exception of current, the values of all other quantities depend on the area of cross-section of the conductor. Hence, only current remains constant when it flows through a conductor of non-uniform area of cross-section.

31. $\vec{B}=-\frac{\mu_0 I}{4\pi R}\left(\pi\,\hat{i}+2\,\hat{k}\right)$

Let B be the magnetic field at point O and B_L be the magnetic field because of the straight wires.

The magnetic field due to a straight current carrying wire is given by

$\vec{B}_L=\frac{\mu_0 I}{4\pi R}\left(\sin\,\phi_1+\sin\,\phi_2\right)$

Here we have two straight wires (linear part of the wire) parallel to x-axis

Therefore, $\vec{B}_L=2\times\left[\frac{\mu_0 I}{4\pi R}\left(\sin\,\phi_1+\sin\,\phi_2\right)\right]$

$\vec{B}_L=2\times\left[\frac{\mu_0 I}{4\pi R}\left(\sin\,90+\sin\,0\right)\right]\left(-\hat{k}\right)$

$\vec{B}_L=2\times\left[\frac{\mu_0 I}{4\pi R}\right]\left(-\hat{k}\right)$

Magnetic field due to the semi-circular portion will be, $\vec{B}_S=\frac{1}{2}\left[\frac{\mu_0 I}{2R}\right]\left(-\hat{i}\right)$

Net magnetic field, $\vec{B}=\vec{B}_L+\vec{B}_S$

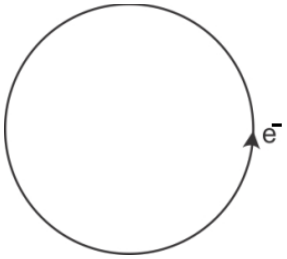
$\vec{B}=2\times\left[\frac{\mu_0 I}{4\pi R}\right]\left(-\hat{k}\right)+\frac{1}{2}\left[\frac{\mu_0 I}{2R}\right]\left(-\hat{i}\right)$

$\vec{B}=-\left[\frac{\mu_0 I}{2\pi R}\right]\hat{k}-\left[\frac{\mu_0 I\pi}{4\pi R}\right]\hat{i}$

$\vec{B}=-\left[\frac{\mu_0 I}{4\pi R}\right]2\,\hat{k}-\left[\frac{\mu_0 I\pi}{4\pi R}\right]\hat{i}$

$\vec{B}=-\frac{\mu_0 I}{4\pi R}\left(\pi\,\hat{i}+2\,\hat{k}\right)$

32. $\frac{\mu_0 ne}{2r}$



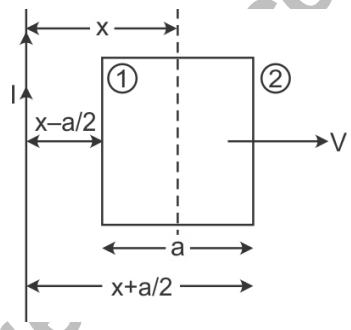
Magnetic field induction B at the centre of a current-carrying coil is

$B = \frac{\mu_0 I}{2r}$

where I = ne

$B = \frac{\mu_0 e}{2rT} = \frac{\mu_0 ne}{2r}$

33. $\frac{1}{(2x-a)(2x+a)}$



The emf induced in the side (1) is given as $\varepsilon_1 = B_1 vl$

The emf induced in the side (2) is given as $\varepsilon_2 = B_2 vl$

Thus, the emf induced in the frame is given as

$\varepsilon = \varepsilon_1 - \varepsilon_2$

$\varepsilon = B_1 vl - B_2 vl$

$\varepsilon = vl\,(B_1 - B_2)$

$\varepsilon \propto (B_1 - B_2)$

But $B \alpha \frac{1}{r}$

So, $\Rightarrow \varepsilon \propto \frac{1}{r}$

$$\Rightarrow \varepsilon \propto \left[\frac{1}{x-\frac{a}{2}} - \frac{1}{x+\frac{a}{2}}\right]$$

$$\Rightarrow \varepsilon \propto \left[\frac{1}{(2x-a)(2x+a)}\right]$$

34. $P\left(\frac{R}{Z}\right)^2$

Power is given as

$P = E_m I_m$

$P = \frac{E_m^2}{R}$

$P' = E_m I_m \cos\varphi$

$P' = E_m \frac{E_m}{Z} \times \frac{R}{Z}$

$P' = (E_m)^2 \times \frac{R}{Z^2}$

$\frac{P}{P'} = \frac{(E_m)^2}{R} \times \frac{Z^2}{R(E_m)^2}$

$\frac{P}{P'} = \frac{Z^2}{R^2}$

$P' = \frac{R^2}{Z^2} P$

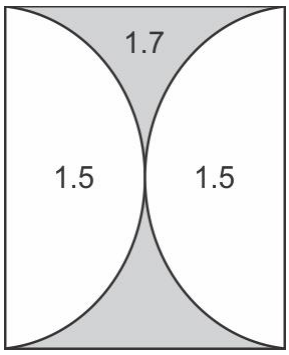
$P' = P\left(\frac{R}{Z}\right)^2$

35. $\frac{2E}{C}$

Momentum transferred to the surface is given as

$\Delta P = \frac{2I}{C} = \frac{2E}{C}$

36. –50 cm



$$\frac{1}{f}=\frac{1}{f_1}+\frac{1}{f_2}+\frac{1}{f_3}$$

By using lens maker formula,

$$\frac{1}{f}=(\mu_3-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$$

$$\frac{1}{f_1}=(1.5-1)\left(\frac{1}{20}-\frac{1}{\infty}\right)$$

$$=0.5\left(\frac{1}{20}\right)=\frac{1}{40}\text{cm}^{-1}$$

$$\frac{1}{f_2}=(1.7-1)\left(-\frac{1}{20}-\frac{1}{20}\right)$$

$$=0.7\left(\frac{-40}{400}\right)=0.7\left(\frac{-1}{10}\right)$$

$$=-\frac{0.7}{10}=-\frac{7}{100}\text{cm}^{-1}$$

$$\frac{1}{f_3}=(1.5-1)\left(\frac{1}{20}-\frac{1}{\infty}\right)$$

$$=0.5\left(\frac{1}{20}\right)=\frac{1}{40}\text{cm}^{-1}$$

Focal length of combination

$$\frac{1}{f}=\frac{1}{40}-\frac{7}{100}+\frac{1}{40}$$

$$=\frac{5-14+5}{200}=\frac{-4}{200}$$

$$=-\frac{1}{50}\text{cm}^{-1}$$

f = -50 cm

37. $\frac{2D\lambda}{a}$

For a single slit diffraction obtained on a screen, the width of the central maxima is given as $\frac{2D\lambda}{a}$.

Here, D is the distance from the slit to the screen,
a is the slit width and
λ is the wavelength of light used.

38. 0.2 mm

Wavelength of light is λ = 500 nm

<u>For double slit experiment:</u>

Distance between two slits is d = 1 mm

Distance to the screen is D = 1 m

Now, the fringe width in double slit experiment is $\frac{\lambda D}{d}$

Hence, fringe width of 10 maxima is $\frac{10\lambda D}{d}$

Now, for a single slit experiment with slit width a, we have the width of central maxima as $\frac{2\lambda D}{a}$

To fit 10 maxima within the central maxima of a single slit, we have

$$\frac{10\lambda D}{d} = \frac{2\lambda D}{a}$$

$$\therefore a = \frac{2\lambda Dd}{10\lambda D} = \frac{d}{5}$$

$$\therefore a = \frac{1}{5} = 0.2 \text{ mm}$$

39. $180° - 2A$

The refractive index of the material of the prism is given in terms of the angle of the prism and the angle of minimum deviation as

$$\mu = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

It is given that $\mu = \cot\left(\frac{A}{2}\right)$. So substituting, we get

$$\cot\left(\frac{A}{2}\right) = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

$$\therefore \frac{\cos\left(\frac{A}{2}\right)}{\sin\left(\frac{A}{2}\right)} = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

$$\therefore \cos\left(\frac{A}{2}\right) = \sin\left(\frac{A+\delta_m}{2}\right)$$

$$\because \cos\theta = \sin(90-\theta)$$

$$\therefore \sin\left(90-\frac{A}{2}\right) = \sin\left(\frac{A+\delta_m}{2}\right)$$

$$\Rightarrow \frac{A+\delta_m}{2} = 90 - \frac{A}{2}$$

$$\therefore A + \delta_m = 180 - A$$

$$\therefore \delta_m = 180 - 2A$$

40. 4λ

According to Einstein's photoelectric equation, we have

$$eV_0 = \frac{hc}{\lambda} - W$$

$$\therefore V_0 = \frac{hc}{\lambda e} - \frac{W}{e}$$

So, for the light of wavelength λ, we get

$$3V_0 = \frac{hc}{\lambda e} - \frac{W}{e} \quad \ldots\ldots (1)$$

And for the light of wavelength 2λ, we get

$$V_0 = \frac{hc}{2\lambda e} - \frac{W}{e} \quad \ldots\ldots (2)$$

Substituting equation (2) in (1), we get

$$\frac{3hc}{2\lambda e}-\frac{3W}{e}=\frac{hc}{\lambda e}-\frac{W}{e}$$

$$\therefore \frac{3hc}{2\lambda e}-\frac{hc}{\lambda e}=\frac{3W}{e}+\frac{W}{e}$$

$$\therefore \frac{hc}{\lambda e}\left(\frac{3}{2}-1\right)=\frac{2W}{e}$$

$$\therefore \frac{hc}{2\lambda e}=\frac{2W}{e}$$

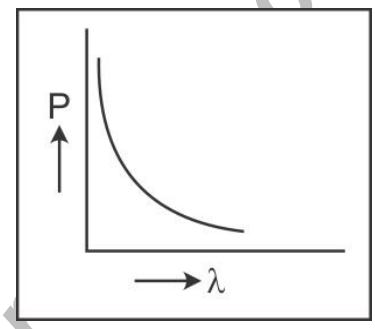
$$\therefore W=\frac{hc}{4\lambda}$$

Now, we know that the threshold wavelength is given as

$$\lambda_0=\frac{hc}{W}$$

$$\therefore \lambda_0=4\lambda$$

41.



The de Broglie wavelength of a particle is given in terms of its momentum as

$$\lambda=\frac{h}{P}$$

$$\therefore \lambda \propto \frac{1}{P}$$

$$\Rightarrow P \propto \frac{1}{\lambda}$$

Hence, we see that the momentum is inversely proportional to the wavelength. So, if the wavelength increases, then the momentum decreases. Also, the graph would be similar to a hyperbola. Hence, the correct option is (2).

42. 1.46×10^6 m/s

The velocity of an electron in an orbit in an atom is given as

$$v_n = \frac{2\pi Ze^2}{4\pi\varepsilon_0 nh} = \left(\frac{Z}{n}\right)\left(\frac{2\pi e^2}{4\pi\varepsilon_0 h}\right) = \left(\frac{Z}{n}\right)\left(\frac{2\pi e^2 K}{h}\right)$$

Substituting the values in the above equation, we get

$$v_n = \left(\frac{Z}{n}\right)\left(\frac{2\pi e^2 K}{h}\right)$$

$$= \left(\frac{Z}{n}\right)\left(\frac{2\times 3.14\times\left(1.6\times 10^{-19}\right)^2\times 9\times 10^9}{6.6\times 10^{-34}}\right)$$

$$= \left(\frac{Z}{n}\right)\times 2.2\times 10^6$$

$$= 2.2\times 10^6 \times \frac{2}{3}$$

$$= 1.46\times 10^6 \text{ m/s}$$

43. $\frac{5}{3}R_{Al}$

We know that the atomic radius is directly proportional to the cube root of the atomic mass number A.

Hence, we get

$$R \propto A^{\frac{1}{3}}$$

$$\therefore \frac{R_{Te}}{R_{Al}} = \left(\frac{A_{Te}}{A_{Al}}\right)^{\frac{1}{3}} = \left(\frac{125}{27}\right)^{\frac{1}{3}} = \frac{125^{\frac{1}{3}}}{27^{\frac{1}{3}}} = \frac{5}{3}$$

$$\therefore R_{Te} = \frac{5}{3}R_{Al}$$

44.

The diode allows only the positive voltage to pass through it. Hence, the circuit acts as a half-wave rectifier. Hence, the correct waveform will be as shown in the option (4).

45. AND

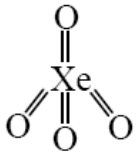
The output of the gate is shown in the following truth table:

A	B	$Y_1 = \overline{A}$	$Y_2 = \overline{B}$	$Y = \overline{\overline{A} + \overline{B}}$
0	0	1	1	0
0	1	1	0	0
1	0	0	1	0
1	1	0	0	1

From the above truth table, one can see that it is similar to that of the AND gate.

Chemistry

46. Structure of XeO_4 is as follows:



σ = 4, π = 4

In the XeO_4 molecule, 4 σ and 4 π bonds are present.

47. $Ca^{2+} < K^{+} < Ar$

$$\text{Size} \propto \frac{1}{\text{Effective nuclear charge}}$$

48. Ionic equilibrium in intracellular and extracellular fluids is maintained by Na^{+}/K^{+} pumps in the plasma membrane of the cells.

49. All nitrates are highly soluble in water because of which their minerals do not exist in the Earth's crust.

50. Solubility is directly proportional to the lattice energy and hydration energy. Lattice energy and hydration energy decrease down the group, so solubility of II A sulphate decreases down the group.

51. Zr and Hf have nearly the same atomic radii because of lanthanoid contraction.

52. In the oxidation of $Fe(CO)_5$ from Fe, the oxidation state of iron remains the same.

53. ClO_3^{-} and SO_3^{2-} both have sp^3 hybridisation and both contain the same number of electrons, i.e. 42.

54. Bond order $O_2^- < O_2 < O_2^+$
1.5 2 2.5

55. Sulphur dioxide is used as a preservative.

56. $NO_2^+ > NO_2 > NO_3^- > NO_2^-$
180° 132° 120° 120°

57.

$\mu = \sqrt{n(n+2)}$

$2.84 = \sqrt{n(n+2)}$

$(2.84)^2 = n(n+2)$

$n^2 + 2n - 8.0656 = 0$

Solving the above quadratic equation, we get

$n = 2$

That means the number of unpaired electrons = 2

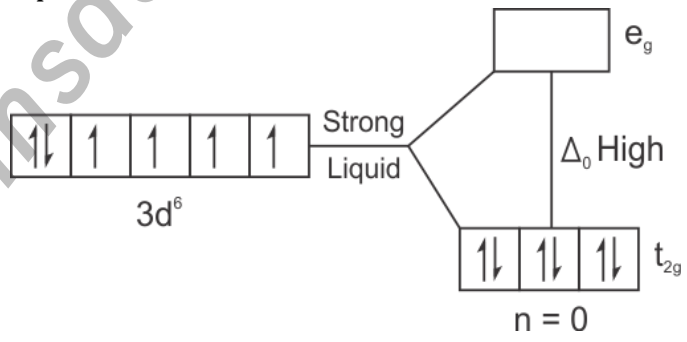
Electronic configuration of Ni^{2+} = $[Ar]3d^8 4s^0$

58. $CoCl_3.3NH_3 \rightarrow [Co(NH_3)_3Cl_3]$

$[Co(NH_3)_3Cl_3] \xrightarrow{AgNO_3}$ no ppt

59. $[Co(CN)_6]^{3-}$

Co^{3+}: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^0 3d^6$



Thus, Co^{3+} in the compound $[Co(CN)_6]^{3-}$ does not contain any unpaired electrons and hence will be in a high-spin configuration.

60. The activation energy of a reaction can be determined from the slope of the graph log K versus 1/T according to Arrhenius theory.

61. According to the condition for an ideal solution, $\Delta S_{mix} \neq 0$

62. Given:
The ratio of the weights of the gases H_2 and O_2 are 1:4 (w/w)
Solution:
Molar masses of H_2 and O_2 are 4 and 32, respectively.
Hence, the mole ratio is as follows:

$$\begin{array}{lccc} & H_2 & : & O_2 \\ \text{Mole ratio} & \frac{1}{2} & : & \frac{4}{32} \\ & \frac{1}{2} & : & \frac{1}{8} \\ & \frac{4}{8} & : & \frac{1}{8} \\ & 4 & : & 1 \end{array}$$

63. Given:
4 metal atoms per unit cell
Edge length 361 pm
Solution:
Z = 4 for FCC unit cell

$$r = \frac{a}{2\sqrt{2}} = \frac{361}{2\sqrt{2}}$$

$$r = 127.6\,pm$$

64. Half-life or $t_{1/2} = \frac{0.693}{k}$ is independent of the concentration of the reactant.

65. For a reaction:

$$A + B \rightleftharpoons C + D$$

$$K_c = \frac{[C][D]}{[A][B]}$$

The value of K_c will be high if the numerator which contains the concentration of products is high. In the given example, the value of equilibrium constant is very high. Hence, the products are mostly present.

66. Galvanic cells which are designed to convert the energy of combustion of fuels such as hydrogen, methane, methanol etc. directly into electrical energy are called fuel cells.

67. Elevation in boiling point, $(\Delta T_b)_{observed} = i\, K_b\, m = i\, (\Delta T_b)_{theoretical}$
But molality is the same; hence, $(\Delta T_b)_{observed}$ will depend on van't Hoff factor, which means colligative property. If the boiling point of the solution containing X solute increases, then it must be undergoing dissociation in water.

68. For 100% ionisation or complete dissociation of solute, van't Hoff factor i = number of particles. For $Al_2(SO4)_3$, i = 5.
From the options, i = 5 is for $K_4[Fe(CN)_6]$.

69. Fe^{2+}: [Ar] $3d^6$ No. of d e^- is = 6

		Electronic configuration	Number of electrons
(1)	Mg (Z = 12)	$1s^2\ 2s^2\ 2p^6\ 3s^2$	No. of s e^- = 6
(2)	Cl (Z = 17)	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$	No. of p e^- = 11
(3)	Fe (Z = 26)	[Ar] $3d^6\ 4s^2$	No. of d e^- = 6
(4)	Ne (Z = 10)	$1s^2\ 2s^2\ 2p^6$	No. of p e^- = 6

Hence, the number of d electrons in Fe^{2+} is not equal to Cl p e^-s.

70. $O_2^{2+}: \sigma 1s^2\, \sigma^* 1s^2\, \sigma 2s^2\, \sigma^* 2s^2\, \sigma 2p_z^2$

$(\pi 2p_x^2 = \pi 2p_y^2)$

$\text{bond order}: \frac{6-0}{2} = 3.0$

$O_2^+: \sigma 1s^2\, \sigma^* 1s^2\, \sigma 2s^2\, \sigma^* 2s^2\, \sigma 2p_z^2$

$(\pi 2p_x^2 = \pi 2p_y^2)(\pi^* 2p_x^1 = \pi^* 2p_y)$

$\text{bond order}: \frac{6-1}{2} = 2.5$

$O_2^-: \sigma 1s^2\, \sigma^* 1s^2\, \sigma 2s^2\, \sigma^* 2s^2\, \sigma 2p_z^2$

$(\pi 2p_x^2 = \pi 2p_y^2)(\pi^* 2p_x^2 = \pi^* 2p_y^1)$

$\text{bond order}: \frac{6-3}{2} = 1.5$

Hence, the correct bond order is $O_2^- < O_2^+ < O_2^{2+}$.

71. Angular momentum $= \sqrt{l(l+1)} \times \hbar$

For d orbital $l = 2$

$$= \sqrt{2(2+1)} \times \hbar$$

$$= \sqrt{6}\,\hbar$$

72. A salt with high solubility will get precipitated very late.

Ag_2CrO_4 is A_2B type salt.

$K_{sp} = 4s^3 = 1.1 \times 10^{-12}$

$\therefore s^3 = \frac{1.1}{4} \times 10^{-12}$

$s_1 = (0.275 \times 10^{-12})^{1/3}$

$s_1 = (275 \times 10^{-15})^{1/3}$

$s_1 = 6.5 \times 10^{-5}$

For AgCl, $K_{sp} = s^2 = 1.8 \times 10^{-10}$

$\therefore s_2 = 1.3 \times 10^{-5}$

For AgBr, $K_{sp} = s^2 = 5 \times 10^{-13}$

$s_3 = (50 \times 10^{-14})^{1/2} = 7 \times 10^{-7}$

For AgI, $K_{sp} = s^2 = 8.3 \times 10^{-17}$

$s_3 = (83 \times 10^{-18})^{1/2} = 9 \times 10^{-9}$

Hence, the answer is Ag_2CrO_4.

73. Tyndall effect is the property of a colloidal solution which is independent of charge on the colloidal particles.

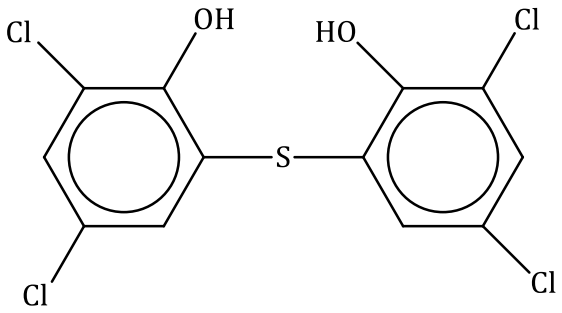
74. Gibbs energy for a reaction in which all reactants and products are in the standard state, $\Delta_r G°$, is related to the equilibrium constant of the reaction as follows:

$0 = \Delta_r G° + RT\ln K$

or $\Delta_r G° = -RT\ln K$

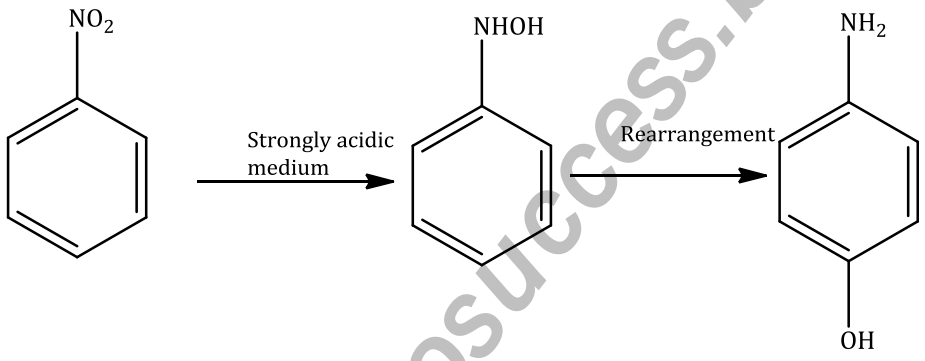
or $\Delta_r G° = -2.303\ RT \log K$

75. Bithionol is added to soaps to impart antiseptic properties.



Bithionol

76. The electrolytic reduction of nitrobenzene in strongly acidic medium produces p-aminophenol.



p-aminophenol

77. $V_1 = 40$ ml

$T_1 = 300$ K

$P_1 = 725 - 25 = 700$ mm of Hg

Mass of organic compound = 0.25 g

Now using,

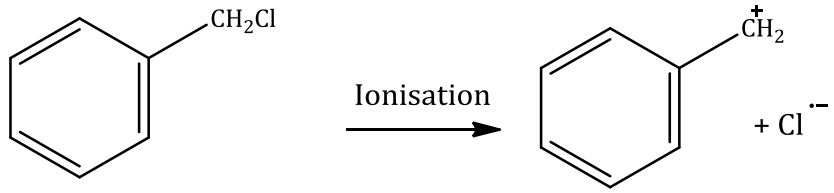
$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$V_2 = \frac{700 \times 40 \times 273}{300 \times 760} = 33.52 \text{ml}$$

$$\% \text{ of N} = \frac{28 \times V \times 100}{22400 \times \text{mass of organic compound}}$$

$$\% \text{ of N} = \frac{28 \times 33.52 \times 100}{22400 \times 0.25} = 16.76$$

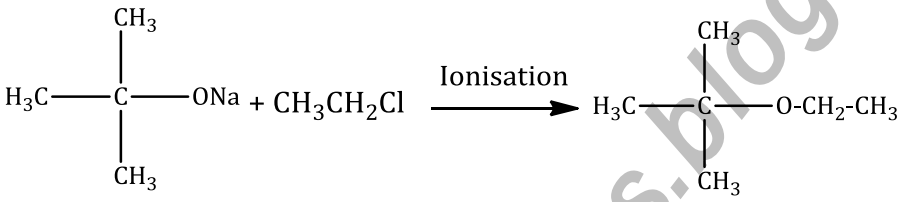
78.



Benzyl carbonium ion

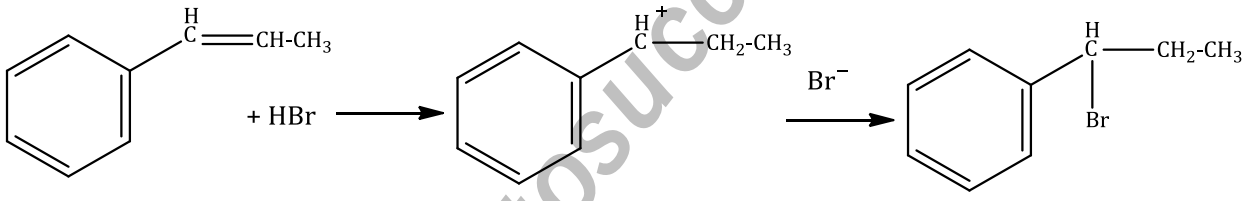
It is most stable because of resonance.

79.

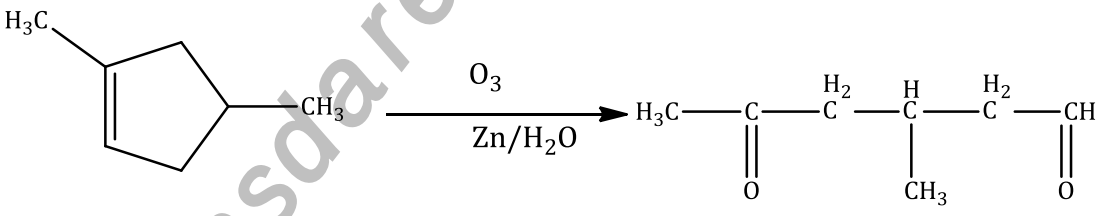


The reaction is Williamson's synthesis which is employed in the preparation of ethers.

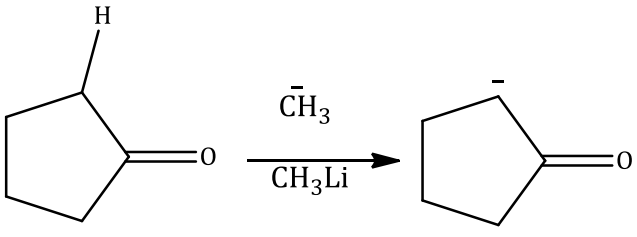
80.

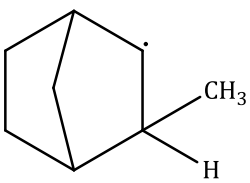


81.



82.



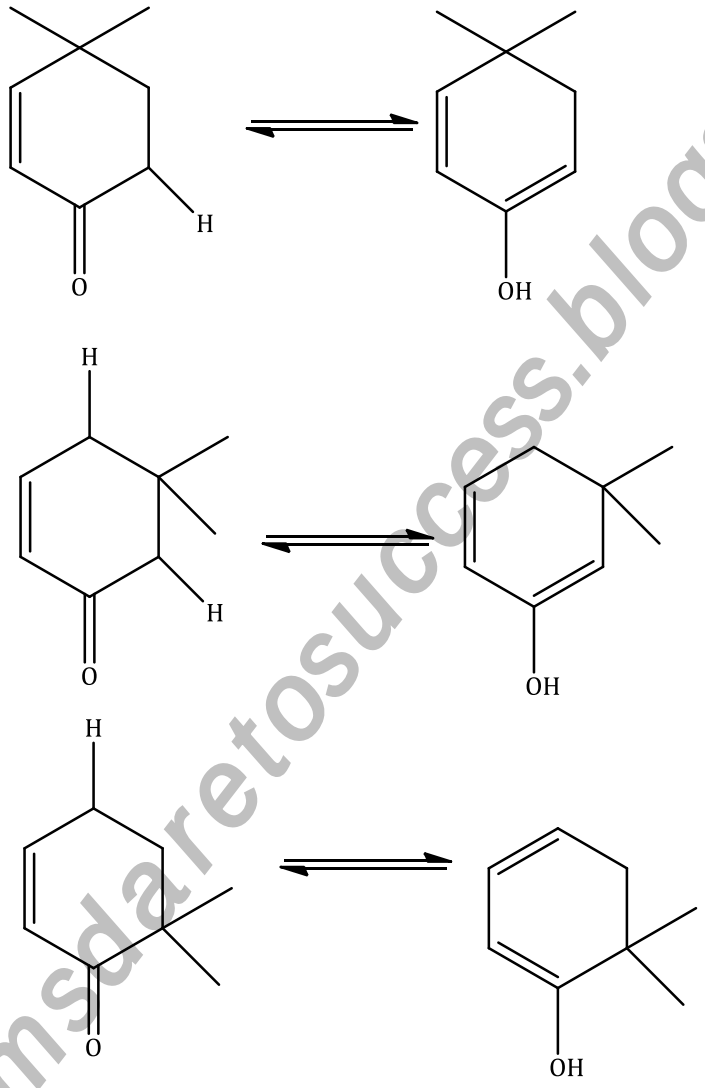


83. Hyperconjugation takes place in because of the presence of α-H.

84. Because Cl shows –I effect and CH_3 group shows +I effect.

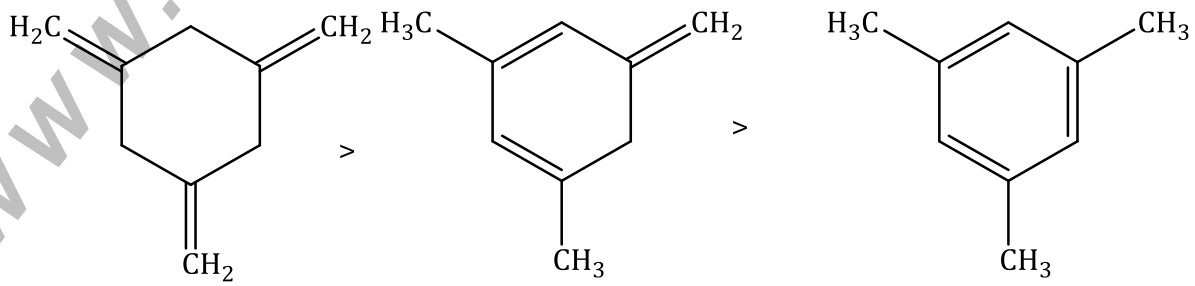
85. The enolic form of ethyl acetoacetate has 18 sigma bonds and 2 pi-bonds.

86.



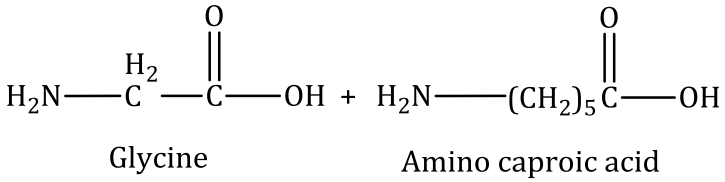
All the three compounds exhibit tautomerism.

87.

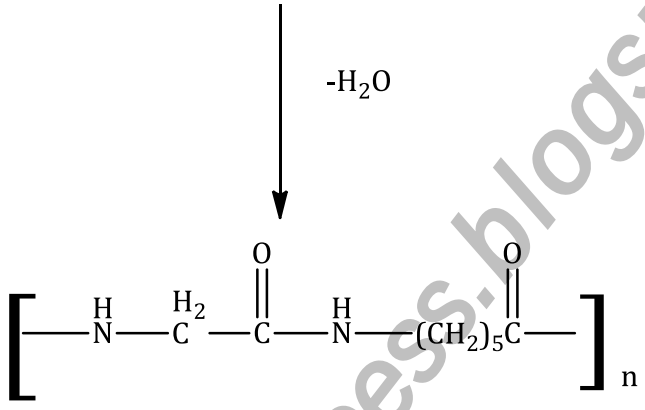


The enthalpy of hydrogenation $\propto$ 1/Stability

88.



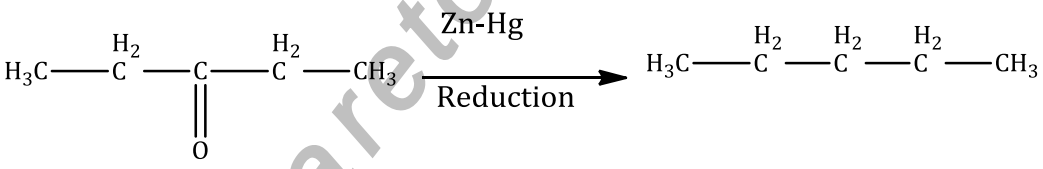
Glycine + Amino caproic acid



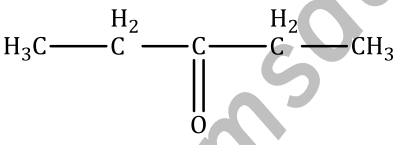
Nylon-2-Nylon-6

89. The total number of Π bonds are 4 and the total number of Π bond electrons are 8.

90.



n-pentane



does not give iodoform and Tollens' test.

Biology

91. *Phytophthora* belongs to Phycomycetes; its mycelium is aseptate.
Mucor belongs to Zygomycetes; it reproduces by conjugation.
Agaricus belongs to Basidiomycetes; it is saprotrophic.

92. Correct statement in case of (B): *Selaginella* is a heterosporous pteridophyte. It produces microspores and megaspores.
Correct statement in case of (C): Coralloid roots of Cycas have cyanobacteria. *Nostoc* and *Anabaena* are present in the cortical region of the roots.

93. *Funaria* and *Marchantia* are bryophytes, and *Pteris* is a pteridophyte.
In bryophytes and pteridophytes, the gametophyte is independent.
Pinus is a gymnosperm; here the sporophyte is independent.

94. Mannitol is stored food in Phaeophyceae (brown algae). In Rhodophyceae (red algae), the food is stored in the form of floridean starch.

95. Methanobacilli present in the gut of cows and buffaloes are responsible for the partial digestion of cellulose.

96. *Polysiphonia* is a red alga which produces non-motile or non-flagellated male gametes.
Anabaena reproduces either by vegetative reproduction or by asexual reproduction by the formation of spores.
Ectocarpus is a brown alga. The male gametes are motile with the presence of two unequal flagella.
Spirogyra exhibits isogamous type of sexual reproduction in which both male and female gametes are non-motile.

97. In monocotyledons, the vascular bundle is of conjoint collateral type. Xylem and phloem combine in the same bundle and the xylem is on the inner side of the bundle. When there is no cambium present between the xylem and phloem, it is called closed because there is no scope for secondary growth.

98. The given floral formula is of the Solanaceae family. Petunia belongs to the Solanaceae family.
Allium belongs to the Liliaceae family, *Sesbania* belongs to the Fabaceae family and *Brassica* belongs to the Brassicaceae family.

99. Monocot roots have vascular bundles without cambium. The monocot root has radial vascular bundles, while the stem has scattered vascular bundles. In dicot stems, the cambium is sandwiched between the phloem and xylem along the radius.

100. The keel is a peculiar feature of vexillary aestivation. In vexillary aestivation, the largest petal, called the standard, overlaps the two lateral petals, called wings, which overlap the two smallest anterior petals called the keel. Vexillary aestivation is the distinguishing feature of the Fabaceae family. *Indigofera* belongs to the Fabaceae family.
Tomato belongs to the Solanaceae family, while Tulip and Aloe belong to the Liliaceae family. Both families exhibit valvate aestivation.

101. Rose is a perigynous flower, i.e.
- Gynoecium is located in the centre.
- Other whorls are located on the rim of the thalamus at the same level of the gynoecium.
- Ovary is half superior and half inferior.

Guava and cucumber have epigynous flowers; China rose is a hypogynous flower.

102. *Opuntia* is a xerophytic plant. To reduce the rate of transpiration, leaves in *Opuntia* are modified into spines.

103. In chloroplasts, there are flattened sacs called thylakoids which are stacked upon one another to form grana.
Stroma is the ground substance and stroma lamellae form bridges between different grana in the chloroplast.
Cristae are the structures present in mitochondria.

104. The chromosome in which the centromere is located close to one end is acrocentric.
Metacentric chromosomes – The centromere is located at the median position (at the centre).
Sub-metacentric chromosome – The centromere is located slightly away from the median position.
Telocentric chromosomes – The centromere is located terminally, i.e. at one end.

105. Smooth ER is the site for lipid and glycogen synthesis.
Rough ER is the site for protein synthesis.

106. Anabaena is a cyanobacterium; it shows the presence of nucleoid, i.e. the nuclear material is not bound by the nuclear membrane.
Mucor is a fungus, while *Vaucheria* and *Volvox* are algae. Fungi and algae are eukaryotes; the true nucleus is the characteristic feature of all eukaryotes.

107. Inclusion bodies are the non-living structures found in prokaryotes. They either store food, pigments, secretions or excretory products.
Polysomes are clusters of ribosomes attached to mRNA at the time of translation.

108. Transpiration, i.e. the loss of water by aerial parts of the plants, pulls water upwards from the xylem components. Root pressure causes water to rise in plants by pushing it upwards through the xylem vessels.

109. Minerals which are required by the plants in larger quantities are called macronutrients, while the minerals which are required by the plants in very small amounts are called micronutrients.
Carbon, hydrogen, oxygen, nitrogen, sulphur, phosphorus, calcium, potassium and magnesium are macronutrients. Iron, manganese, boron, copper, zinc, molybdenum, chlorine and nickel are micronutrients.

110. Auxin is one of the plant growth factors. Its synthesis occurs on the illuminated side of the plant. It is transported at the darker or shaded regions of the plants. It stimulates the growth or elongation of the cells at the shaded region which causes a plant to bend towards the source of light.

111. Ring girdling is the complete removal of the strip of bark. The bark consists of cork, cork cambium and phloem. Because the phloem is removed, the sugar will not be translocated to the roots. Hence, the roots will die first.

112. The sigmoid growth curve is a characteristic of living things growing in a natural environment. It is typical for all cells, tissues etc. However, the curve does not show uniformity in plants because of seasonal activity.

113. Levitt proposed the active potassium transport theory. According to this theory, the stomatal opening and closing depends on the generation of a potassium ion gradient.

114. Hilum is the scar on the seed where the funicle was attached. It is the scar through which the developing seeds are attached to the fruit.

115. Geitonogamy is a kind of cross-pollination which is similar to autogamy because the pollen is transferred from the anther to the stigma of the same plant with the help of a pollinating agent.
In xenogamy, pollen grains are transferred from the anther to the stigma of different plants.
In apogamy, plants are reproduced without any fertilisation.
In cleistogamy, plants reproduce by non-opening, self-pollinating flowers.

116. Honey is the partially digested nectar which consists of minerals, sugar, enzymes and water.

117. The extent of penetration of the pollen tube depends on the length of the style and passage inside the ovary. In a solid style, the pollen tube travels through the solid style by separating cells through the secretion of pectinase.
In case of a hollow style, the pollen tube travels along the lining of the canal.

118. Rhizome is an underground horizontal branching stem.
Offsets are short stout runners terminated by a single bud.
Bulbils are underground, lateral branches. Their ends turn up and produce buds.
Runners are lateral branches which grow rapidly along the ground, producing buds and adventitious roots at intervals.

119. Nectar and pollen grains (certain pollen grains are edible) are used by insects as food. Some flowers also offer a safe place for insects to lay their eggs.

120. Mendel studied seven pairs of contrasting characters—plant height, shape of seeds, colour of seeds, colour of pods, shape of pods position of flowers, colour of flowers.

121. Recombination or crossing over is the most common mechanism of genetic variation in sexually reproducing organisms. Crossing over takes place during gamete formation (meiosis).

122. Micropropagation is the technique of producing thousands of plants through tissue culture. In somatic embryogenesis, embryos are developed from the somatic cells in tissue culture.

123. Inversion – A part of the chromosome segment gets inverted by 180°, i.e. a particular order of genes of a segment of a chromosome gets reversed.
Duplication – An extra chromosome is attached to its normal homologous chromosome so that a gene or a set of genes is represented twice in the same chromosome.
Translocation – A separation of a chromosome segment and its union to a non-homologous chromosome.
Crossing over – The exchange of alleles between two homologous chromosomes during meiosis I.

124. Multiple alleles are present at the same locus of homologous chromosomes. Multiple alleles are more than two forms of a gene. Example: Blood

125. Genetic Engineering Approval Committee (GEAC) regulates GM research and the safety of introducing GM organisms for public services.

126. *Bacillus thuringiensis* forms crystals of insecticidal proteins called Cry proteins. This protein is in the inactive protoxin form. The alkaline pH of the insect gut solubilises the crystals of Cry protein and converts the protein from the inactive form to the active form.

127. Crops engineered for glyphosate are resistant to herbicides. These crops can tolerate a wide range of herbicides which kill the surrounding weeds but do not provide any harm to the crops.

128. Ribosomes are made of proteins and RNA.

129. Polyethylene glycol and sodium nitrate are used for protoplast fusion in somatic hybridisation. This method reduces cytotoxicity and the frequency of fusion is very high.

130. The UN Conference of Parties on Climate Change in 2011 was held in Durban, South Africa. During this conference, a new treaty was established to limit the emission of carbon.

131. Stratification represents the vertical arrangement of the members of the community.

132. *In situ* conservation strategies – National park, sacred groves, wildlife sanctuary
Ex situ conservation strategies – Botanical gardens, seed banks, cryopreservation, tissue culture

133. The sequential, gradual and predictable change in the species composition in an area is called succession or ecological succession. Primary succession begins in areas where no living organisms ever existed. Secondary succession begins in areas where natural biotic communities have been destroyed.
Primary succession – Bare rock, newly created pond, newly cooled lava
Secondary succession – Degraded forest

134. Standing crop – It is the mass of living material at a trophic level at a particular time. It is commonly expressed as the number of organisms per unit area.
Gross primary productivity – It is the rate of synthesis of organic matter by producers per unit area per unit time.
Standing state – It is the amount of all inorganic substances present in an ecosystem per unit area at a given time.
Net primary productivity – It is the rate of organic matter stored by the producers per unit area per unit time.

135. Gross primary productivity – It is the rate of synthesis of organic matter by producers per unit area per unit time.
Net primary productivity – It is the rate of organic matter stored by the producers per unit area per unit time.
Secondary productivity – It is the rate of increase in energy containing biomass by consumers per unit time and area.

136. Chitinous exoskeleton separates the arthropods from other segmented invertebrates. A hard exoskeleton enables arthropods to thrive in extreme conditions in the terrestrial environment.

137. *Trichinella spiralis* is a roundworm. It infects different mammals including humans. The female produces eggs after mating. These eggs hatch inside the uterus, and the female lays living larvae in the small intestine of the host.

138. Mammalia – Whales do not show the presence of pinna.
Cyclostomata – Paired appendages are absent.
Aves – Skin is dry and without glands (Exception: Presence of oil gland).

139. Duck-billed platypus found in Australia is an egg-laying mammal.

140. Erythropoiesis is the formation of new RBCs. It begins in human being in the embryonic stage. It first starts in the yolk sac, followed by the liver, the spleen and the red bone marrow. In adults, it takes place in the red bone marrow. The kidneys in adults release erythropoietin which stimulates erythropoiesis.

141. The arthrodial membrane is a thin, flexible membrane which joins the terga, sterna and pleura of the cockroach body.

142. Vesicles of rough ER accumulate during telophase to re-form the nuclear envelop which was fragmented during prophase.

143. Cytochromes are heme proteins which are associated with the inner mitochondrial membrane. Cytochromes play an important role in the electron transport system during cellular respiration.

144. The presence of a competitive inhibitor will increase the Km of the enzyme for the substrate; the presence of a competitive inhibitor demands more concentration of the substrate to achieve ½Vmax.

145.

I	II
(a) Synapsis aligns homologous chromosomes.	(ii) Zygotene
(b) Synthesis of RNA and proteins	(iii) G_2 Phase
(c) Action of enzyme recombinase	(v) Pachytene
(d) Centromeres do not separate but chromatids move towards opposite poles	(iv) Anaphase-I

146. The somatic cell is a diploid cell. S-phase indicates the replication of DNA; hence, in a diploid cell, the amount of DNA will be double after the S phase. A gamete is a haploid cell with a single set of chromosomes. So, the ration is diploid to haploid. Because the diploid cell here is after the S phase, it will have twice the number of chromosomes and four times the amount of DNA.

147. Brunner's gland is present in the sub-mucosa of the duodenum (small intestine). It secretes an alkaline enzyme-free watery substance.

148. Gastric juice of infants contains pepsinogen, lipase and rennin. These enzymes help break down proteins and fats. Rennin hydrolyses casein of milk into paracasein.

149. Chemoreceptors present in the brain, aortic arch and carotid sinus detect the CO_2 and O_2 levels and the pH of blood. The CO_2 level of blood has more effect on breathing than the level of O_2. Holding breath increases the concentration of CO_2 in the blood. Increase in the concentration of CO_2 in the blood causes increased breathing. Hence, holding breath beyond a point becomes impossible.

150. During the ventricular systole, the left ventricle pumps the blood into the aorta under great force and pressure. Hence, the blood pressure is maximum in the mammalian aorta during the ventricular systole.

151. Blood is a fluid connective tissue. It is made of 55% of plasma and 45% of blood cells. RBCs, WBCs and blood platelets are the blood cells.

152. The proximal convoluted tubule is involved in the obligatory reabsorption mechanism of water. Hence, if it is removed, it will affect the reabsorption of water and more water will be excreted through the urine.

153. The sliding filament theory explains the mechanism of muscle contraction. Actin filaments slide over the myosin filaments which bring about the contraction and relaxation of muscle fibres.

154. The glenoid cavity is the cup-like depression present in the scapula of the pectoral girdle. It articulates with the humerus of the forelimb.
The scapula and clavicle form the pectoral girdle. The acromion is the process present on the scapula.

155. The cerebellum maintains body equilibrium and posture. Language comprehension is carried out by the temporal lobe of the cerebrum.

156. The vestibule is the membranous sac-like structure present in the internal ear. It consists of the utricle and sacculus. It helps to maintain the balance, equilibrium and posture of the body. Hence, even in darkness, the gymnast is able to balance the body upside down.

157. Epinephrine is secreted at the time of emergency in order to face physical stress. Its secretion is stimulated when a nerve impulse reaches the adrenal medulla through the sympathetic nervous system. The hormones act on organs supplied by the sympathetic nerve fibres and produce an effect like sympathetic stimulation. The adrenal medulla and the sympathetic system function as a closely integrated system.

158. Renin is secreted by the juxtaglomerular apparatus of the kidneys which is converts angiotensin to activated angiotensin II. This stimulates the increased reabsorption of sodium and water by the proximal convoluted tubules to bring the blood pressure to normal. Hence, the urine formed is concentrated.

159. The changes which occur in the mammalian sperm to make it ready to fertilise the ovum is called capacitation.

160. Prolactin is secreted by the anterior lobe of the pituitary gland. It stimulates breast development during pregnancy and controls the secretion of milk from the mammary glands after delivery.

161. Hepatitis B virus infection, AIDS caused by human immunodeficiency virus and the ebola disease caused by the ebola virus are sexually transmitted.
The chikungunya virus is transmitted by an infected *Aedes aegypti* mosquito.

162. The germinal epithelium of seminiferous tubules gives rise to spermatogonia which are diploid sperm mother cells. Spermatogonia undergo meiosis to form haploid sperms.

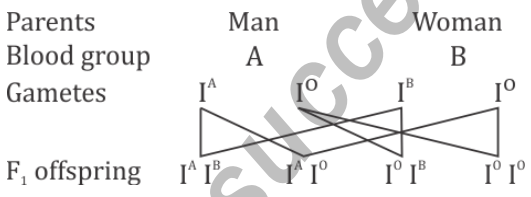
163. 'Hystera' is the Greek word for 'Uterus'; 'Ectomy' is the Greek word for the 'act of cutting'. Hysterectomy is the surgical removal of the uterus.
Prostatectomy – Surgical removal of the prostate gland
Vasectomy – Surgical removal of the vas deferens
Mastectomy – Surgical removal of the mammary glands

164. Encephalitis is the inflammation of the brain. It is a viral infection.
Syphilis, AIDS and trichomoniasis are sexually transmitted diseases.

165. An abnormal baby with 'XXX' sex chromosome is born because of an abnormal ovum with one extra 'X' chromosome, i.e. '22+XXX'. This syndrome is called an X-syndrome.

166. Alleles are two different molecular forms of the same gene responsible for the same character. Alleles are present on the homologous chromosome at the same loci.

167. A cross between a man with blood group 'A' and a woman with blood group 'B':



168. Repressor of the lac operon is synthesised by i gene. The repressor binds to the operator region of the lac operon and prevents RNA polymerase from transcribing the operon. In the presence of lactose (inducer), the repressor is inactivated which allows RNA polymerase to continue with transcription.

169. According to Chargaff's rule, for the double-stranded DNA, the ratios Adenine:Thymine and Cytosine:Guanine are constant and always equal to 1.

$A = T$ and $G = C$

A is 17%, hence, $T = 17\% = 1$

$$\frac{A+T}{G+C} = 1$$

$A + T + G + C = 100$

$\therefore A + T + 17 + 17 = 100$

$\therefore A + T = 100 - 34$

$\therefore A + T = 66$

Since, $A = T$,

$2A = 66$

$$A = \frac{66}{2} = 33\%$$

$$\therefore T = 33\%$$

170.

Human species	Brain capacity
(1) *Homo erectus*	900 cc
(2) *Homo sapiens*	1450 cc
(3) *Homo neanderthalensis*	1400 cc
(4) *Homo habilis*	650–800 cc

171. A population will not exist in Hardy–Weinberg equilibrium if individuals mate selectively. Factors which affect the Hardy–Weinberg principle are mutation, non-random mating and genetic drift. Selective mating of individuals indicates non-random mating.

172.

Disease	Vaccine
(a) Tuberculosis	Attenuated *Mycobacterium tuberculae*
(b) Whooping cough	Killed *Bordetella pertussis* bacteria
(c) Diphtheria	Inactivated toxin of *Corynebacterium diphtheriae*
(d) Polio	Harmless (attenuated) polio virus

173. HIV first starts destroying helper T-cells. Helper T-cells play an important role in immune response. They activate B-cells for the production of antibodies and macrophages for phagocytic activities. They also control the production of cytotoxic T-cells which kill infected cells.

174. *Entamoeba histolytica* invades the colon (part of the large intestine) of the human digestive system. It attacks the mucosa and sub-mucosa of the colon and fresh RBCs.

175. Biological oxygen demand (BOD) is the amount of oxygen required for the breakdown of oxygen by microorganisms. If organic matter is more, then BOD will be high. This indicates a high amount of organic matter in water and that the water is highly polluted.

176. Stratification is complex in tropical rainforests. The vertical subdivision of a tropical rainforest is forest floor, herbs, shrubs and trees. Hence, there are more tree dwellers in the tropical rainforests.

177. The graph shows the number of organisms increasing or decreasing over a period of time. Population A shows stability at the beginning, but there is a sharp decrease later, which indicates a decrease in the population. In population B, there is a gradual increase in the beginning and it accelerates later.
In population A, the number of organisms decreased, and in population B, the number of organisms increased. Hence, population A faced tough competition from population B.

178. Cryopreservation allows the storage of seeds and other parts (such as gametes) of organisms of threatened species at ultra-low temperature in liquid nitrogen. The materials can be stored for long periods in compact and low-refrigeration units.

179. Rachel Carson's book 'Silent Spring' explains the entry of DDT in food chains and its effect on animals of different trophic levels.

180. Depletion of stratospheric ozone leads to greater UV radiation. This may result in mutation, skin cancer, irritation and damage to eye and reduction in immunity. Causes of liver cancer are several, but ozone depletion is not one of them.