

P06-17

Academic Session: 2017-18

CODE - 0

MAJOR TEST-4(MT-4)

(JEE MAIN PATTERN)

Target : JEE (Main+Advanced) 2018

Date: 11-01-2018 | Duration : 3 Hours | Max. Marks: 360

COURSE : VIJETA (01JP)



Please read the last page of this booklet for the instructions.

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DO NOT BREAK THE SEAL WITHOUT BEING INSTRUCTED TO DO SO BY THE INVIGILATOR

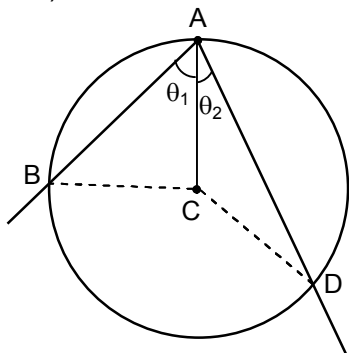
PART – A

SECTION - I

Straight Objective Type

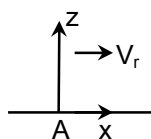
This section contains **25 multiple choice** questions. Each question has 4 choices (1), (2), (3) and (4) for its answer, out of which **ONLY ONE** is correct.

1. The time taken by a particle to slide down along AB and AD path is have ratio (Starting from point A, A is highest point of sphere)



- (1) $\cos^2\theta_1 : \cos^2\theta_2$
 (2) $\sin^2\theta_1 : \sin^2\theta_2$
 (3) $\cos\theta_1 : \cos\theta_2$
 (4) 1 : 1

2. The flow of speed of water varies with the distance from it's straight bank as $V = \sqrt{z}$ m/sec
 Where z is the distance in meter, From the bank
 A swimmer enters the river at a point A on the bank and swims at 2 m/sec in a direction perpendicular to the river flow. What is the drift downstream by the time his perpendicular distance from the bank is 4m.

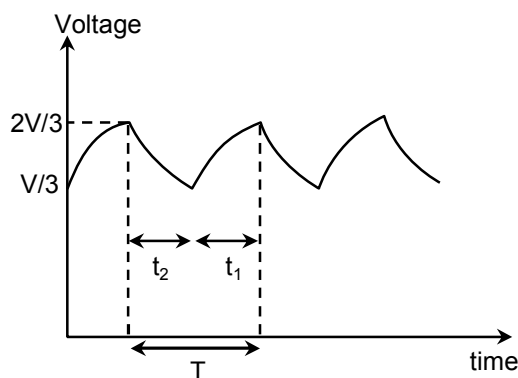
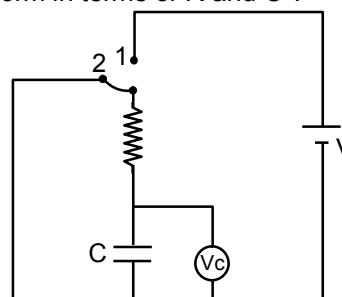


- (1) $\frac{2}{3}$ meter
 (2) $\frac{8}{3}$ meter
 (3) $\frac{4}{3}\sqrt{2}$ meter
 (4) 3 meter

3. A block is kept on a smooth inclined plane, of angle of inclination θ , that moves with constant acceleration so that block does not slide relative to the inclined plane. If the inclined plane stops, the normal contact force offered by the plane on the block changes by a factor.

- (1) $\cos\theta$
 (2) $\tan\theta$
 (3) $\cos^2\theta$
 (4) $\sin^2\theta$

4. The switch in circuit shifts from 1 to 2 when $V_C > 2V/3$ and goes back to 1 from 2 when $V_C < V/3$. The voltmeter reads voltage as plotted. What is the period T of the wave form in terms of R and C ?



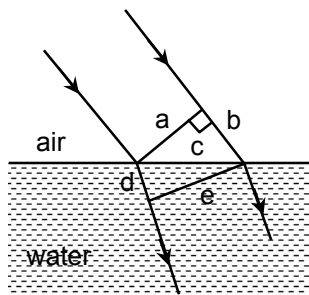
- (1) $RC \ln 3$
 (2) $2RC \ln 2$
 (3) $\frac{RC}{2} \ln 3$
 (4) $\frac{RC}{3} \ln 3$

Space for Rough Work

5. In young's double slit experiment the slits are 0.5 mm apart and the interference is observed on a screen at a distance of 100 cm from the slit. It is found that the 9th bright fringe is at a distance of 7.5mm from the second dark fringe from the center of the fringe pattern of same side. Find the wavelength of the light used.

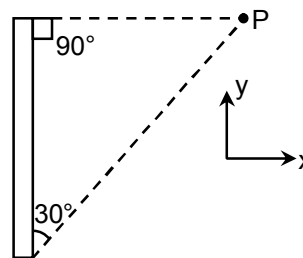
- (1) 7500Å
- (2) 2500Å
- (3) 5000Å
- (4) 500Å

6. Figure shows plane waves refracted from air to water using Huygen's principle (where a, b, c, d, e are length on the diagram). The refractive index of water w.r.t. air is the ratio :



- (1) a/e
- (2) b/e
- (3) b/d
- (4) d/b

7. The direction (θ) of $\vec{E}$ at point P due to uniformly charged finite rod will be :



- (1) at angle 30° from x-axis
- (2) 45° from x-axis
- (3) 60° from x-axis
- (4) None of these

8. An AC source producing e.m.f. $V = V_0 (\sin \omega t + \sin 3\omega t)$ is connected in series with a capacitor and a resistor. The current in the circuit is found to be $i = i_1 \sin (\omega t + \phi_1) + i_2 \sin (3\omega t + \phi_2)$
- (1) $i_1 > i_2$
 - (2) $i_1 = i_2$
 - (3) $i_1 < i_2$
 - (4) any of the above may be true

Space for Rough Work

9. A rod of length ℓ is oscillating as a physical pendulum about one of its end with small angular amplitude α in a crossed magnetic field B . The maximum emf induced in the rod will be :

(1) $B\alpha\sqrt{\frac{1}{2}g\ell^3}$

(2) $B\alpha\sqrt{\frac{3}{8}g\ell^3}$

(3) $B\alpha\sqrt{\frac{1}{8}g\ell^3}$

(4) $B\alpha\sqrt{g\ell^3}$

10. A flexible wire loop in the shape of a circle has a radius that grows linearly with time. There is a magnetic field perpendicular to the plane of the loop that has a magnitude inversely proportional to the distance from the centre of loop i.e. $B(r) \propto \frac{1}{r}$. How does the emf E vary with time ?

(1) $E \propto t^2$

(2) $E \propto t$

(3) $E \propto \sqrt{t}$

(4) E is constant

11. An approximate value of number of seconds in any year is $\pi \times 10^7$. Determine the approximate % error in this value

(1) 0.43%

(2) 4.3%

(3) 8.2%

(4) 15%

12. In a Searle's experiment for determination of Young's Modulus, when a load of 50 kg is added to a 3 meter long wire micrometer screw having pitch 1 mm needs to be given a quarter turn in order to restore the horizontal position of spirit level. Young's modulus of the wire if its cross sectional area is 10^{-5} m^2 is : (Take $g = 10 \text{ m/s}^2$)

(1) $6 \times 10^{11} \text{ N/m}^2$

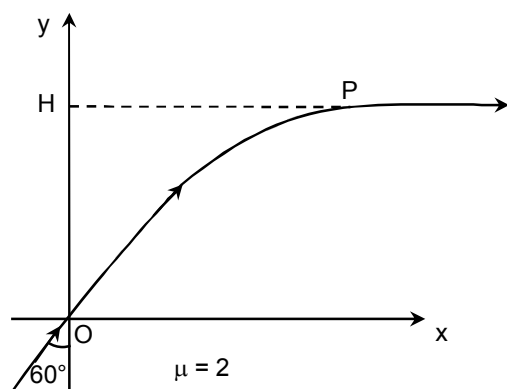
(2) $1.5 \times 10^{11} \text{ N/m}^2$

(3) $3 \times 10^{11} \text{ N/m}^2$

(4) $9 \times 10^{11} \text{ N/m}^2$

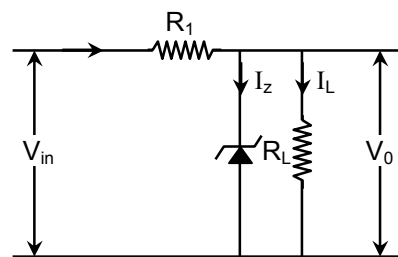
Space for Rough Work

13. A system of coordinates is drawn in a medium whose refractive index varies as $\mu = \frac{2}{1+y^2}$, $0 \leq y \leq 1$ and $\mu = 2$ for $y < 0$ as shown in figure. A ray of light is incident at origin at an angle 60° with y-axis as shown in the figure. At point P ray becomes parallel to x-axis. The value of H is :



- (1) $\left\{ \left(\frac{2}{\sqrt{3}} \right) - 1 \right\}^{1/2}$
- (2) $\left\{ \frac{2}{\sqrt{3}} \right\}^{1/2}$
- (3) $\left\{ (\sqrt{3}) - 1 \right\}^{1/2}$
- (4) $\left(\frac{4}{\sqrt{3}} - 1 \right)^{1/2}$

14. In given figure when input voltage increases,

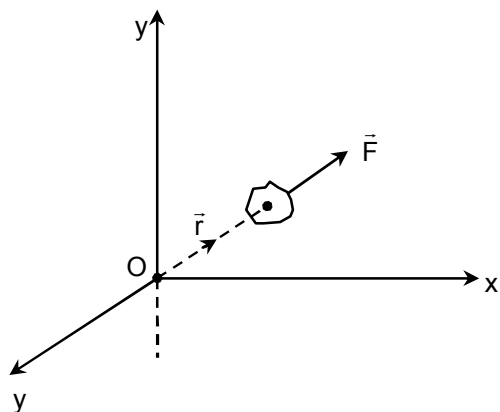


- (1) the current through R_S , R_L and zener increases
 - (2) the current through R_S increases, zener increases but through R_L remains constant
 - (3) the current through R_S increases, through zener decreases, R_L increases
 - (4) the current through R_S increases, through zener remains constant but R_L increases
15. A particle of mass m , attached to a string, describes a horizontal circle of radius r on a rough table at speed v_0 . After completing one full trip around the circle the speed of the particle is halved. What is the coefficient of friction ?

- (1) $\frac{(3v_0^2)}{(8\pi gr)}$
- (2) $\frac{(5v_0^2)}{(16\pi gr)}$
- (3) $\frac{(5v_0^2)}{(8\pi gr)}$
- (4) $\frac{(3v_0^2)}{(16\pi gr)}$

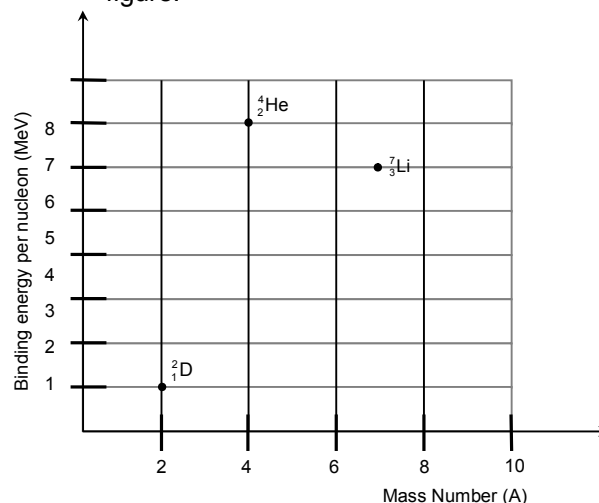
Space for Rough Work

16. A body is free to rotate about an axis parallel to y-axis. A force of $\vec{F} = (3\hat{i} + 2\hat{j} + 6\hat{k})\text{N}$ is acting on the body the position vector of whose point of application is $\vec{r} = (2\hat{i} - 3\hat{j})\text{m}$. The moment of inertia of body about y-axis is 10kg-m^2 . The angular acceleration of body is :

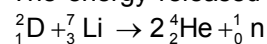


- (1) $(-1.8\hat{i} - 1.2\hat{j} + 1.3\hat{k})\text{rad/s}^2$
 (2) $-1.8\hat{i}\text{ rad/s}$
 (3) $-1.2\hat{j}\text{ rad/s}^2$
 (4) $1.3\hat{k}\text{rad/s}^2$
17. Consider the radiation emitted by large number of singly charged positive ions of a certain element, having even atomic number. The sample emit fifteen types of spectral lines, one of which is same as the first line of lyman series. What is the binding energy in the highest energy state of this configuration?
- (1) 13.6 eV
 (2) 54.4 eV
 (3) 6.4eV
 (4) 1.6 eV

18. The position of ${}^2_1\text{D}$, ${}^4_2\text{He}$ and ${}^7_3\text{Li}$ are shown on the binding energy curve as shown in figure.

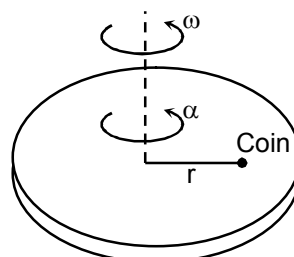


The energy released in the fusion reaction



- (1) 15 MeV
 (2) 13 MeV
 (3) 11 MeV
 (4) 9 MeV

19. A coin moves in a circular path on a rough rotating horizontal disk which has an angular acceleration α . Coin does not slip on disk. Mark the **INCORRECT** statement :



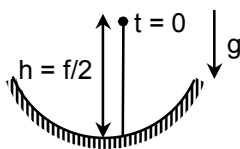
- (1) Power delivered by the friction on the coin is positive.
 (2) Power delivered by centripetal force on the particle is zero.
 (3) Work done by the contacting frictional force on the system (disc + surface) is negative.
 (4) Power is delivered to coin by tangential force only.

Space for Rough Work

20. Three waves A, B and C of frequencies 1600 kHz, 5 MHz and 60 MHz, respectively are to be transmitted from one place to another. Which of the following is the most appropriate mode of communication :

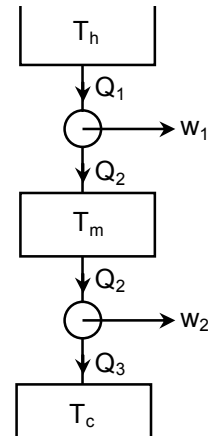
- (1) A is transmitted via space wave while B and C are transmitted via sky wave.
- (2) A is transmitted via ground wave, B via sky wave and C via space wave.
- (3) B and C are transmitted via ground wave while A is transmitted via sky wave.
- (4) B is transmitted via ground wave while A and C transmitted via space wave.

21. A particle is dropped along the axis from a height $\frac{f}{2}$ on a concave mirror of focal length f as shown in figure. The maximum speed of image is :



- (1) ∞
- (2) $\frac{3}{4}\sqrt{3fg}$
- (3) $\frac{3}{2}\sqrt{3fg}$
- (4) None of these

22. Suppose that two heat engines are connected in series, such that the heat exhaust of the first engine is used as the heat input of the second engine as shown in figure. The efficiencies of the engines are η_1 and η_2 , respectively. The net efficiency of the combination is given by :



- (1) $\eta_{\text{net}} = \eta_2 + (1 - \eta_1)\eta_2$
- (2) $\eta_{\text{net}} = \frac{\eta_1}{(1 - \eta_1)\eta_2}$
- (3) $\eta_{\text{net}} = \eta_1 + (1 - \eta_1)\eta_2$
- (4) $\eta_{\text{net}} = \frac{1 - \eta_1}{(1 - \eta_2)\eta_2}$

23. This value of reciprocal of magnetic susceptibility for gadolinium (a ferromagnetic substance) above its Curie point are found to be 10 and 20 corresponding to temperature 720K and 1160 K respectively. Find the Curie constant :

- (1) 44K
- (2) 22K
- (3) 280K
- (4) 56K

Space for Rough Work

24. When a glass capillary tube is immersed in a liquid, the liquid rises to a height of 6mm. The tube is gradually pressed down, until a length of only 4 mm projects outside. The liquid meniscus makes an angles of 60° with the walls of the capillary. Determine the angle of contact for the glass and the liquid pair.

- (1) $\cos^{-1}(3/4)$
(2) $\cos^{-1}(3/7)$
(3) 37°
(4) $\cos^{-1}(1/2)$

25. A rod of negligible heat capacity has length 40 cm, area of cross-section 1.0 cm^2 and thermal conductivity $100 \text{ W/m-}^\circ\text{C}$. The temperature of one end is maintained at 0°C and that of the other end is slowly and linearly varied from 0°C to 60°C in 10 minutes. Assuming no loss of heat through the sides, find the total heat transmitted through the rod in these 10 minutes (in J).

- (1) 112.5
(2) 225
(3) 450
(4) 45

SECTION - II

Integer value correct Type

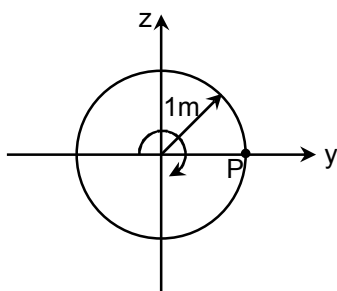
This section contains **5 questions**. The answer to each question is a **single digit integer**, ranging from 0 to 9 (both inclusive).

26. Two tuning forks A and B lying on opposite sides of observer "O" and of natural frequency 85Hz move with velocity 10 m/s relative to stationary observer "O". Fork A moves away from the observer while the fork B moves towards him. A wind with a speed 10 m/s is blowing in the direction of motion of fork A. Find the beat frequency measured by the observer in Hz. [Take speed of sound in air as 340 m/s]

27. Assume that the largest stone of mass 'm' that can be moved by a flowing river depends upon the velocity of flow v , the density d & the acceleration due to gravity g . If 'm' varies as the K^{th} power of the velocity of flow, then find the value of K.

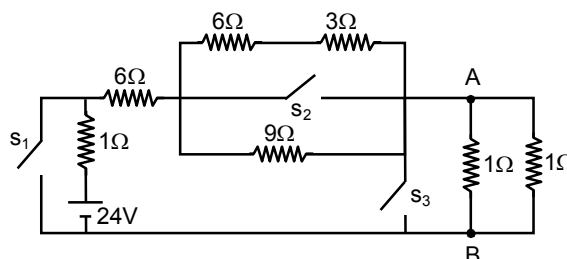
Space for Rough Work

28. A ring rotates about x-axis as shown in figure. The plane of rotation is y-z. At a certain instant the acceleration of the particle P on the ring is $(-9\hat{j} - 6\hat{k})\text{ms}^{-2}$. Find the ratio of tangential acceleration to angular velocity $\left(\omega = \frac{v}{R}\right)$.



29. A 3kg ball is swung in vertical circle at the end of a cord of length $\ell = 0.8\text{m}$. When angular displacement $\theta = 65^\circ$ the tension in the cord is 30N, if the acceleration of the ball (in m/s^2) at that instant is a, find the value of $\frac{a}{2}$.

30. If the switches S_1 , S_2 and S_3 in the figure are arranged such that current through the battery is minimum, find the voltage across points A and B (in volt).



Space for Rough Work

PART – B

Atomic masses : [H = 1, D = 2, Li = 7, C = 12, N = 14, O = 16, F = 19, Na = 23, Mg = 24, Al = 27, Si = 28, P = 31, S = 32, Cl = 35.5, K = 39, Ca = 40, Cr = 52, Mn = 55, Fe = 56, Cu = 63.5, Zn = 65, As = 75, Br = 80, Ag = 108, I = 127, Ba = 137, Hg = 200, Pb = 207]

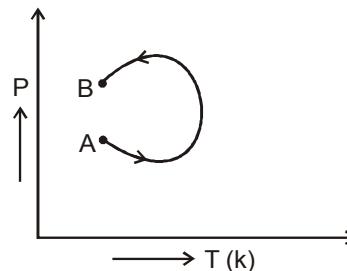
SECTION - I

Straight Objective Type

This section contains **25 multiple choice** questions. Each question has 4 choices (1), (2), (3) and (4) for its answer, out of which **ONLY ONE** is correct.

31. 0.1 molar aqueous solution of NaCl and water are separated by semi-permeable membrane at 27°C. If external pressure of 3 atm is applied on solution side then ($R = \frac{1}{12} \text{ L atm mol}^{-1} \text{ K}^{-1}$):
- Osmosis will stop.
 - Osmosis will continue.
 - Reverse osmosis will occur.
 - Solute will move from solution to solvent.
32. The solubility of MX, MX₂ and MX₃ is 10⁻⁴ mole per litre. Hence their solubility products are respectively:
- 10⁻⁶, 4 × 10⁻⁹, 27 × 10⁻¹²
 - 10⁻⁸, 4 × 10⁻¹², 27 × 10⁻¹⁶
 - 10⁻⁹, 8 × 10⁻⁸, 32 × 10⁻¹²
 - None of these

33.



With reference to the above graph, choose the correct option for fixed amount of an ideal gas in going from A to B.

- $V_A > V_B$
 - Volume firstly decreases
 - $V_B > V_A$
 - $T_A > T_B$
34. Which of the following is incorrectly matched for given species ?
- XeO₃ : Three (pπ-dπ) bonds
 - H₂SO₃ : One (pπ-dπ) bonds
 - SO₃ : Three (pπ-dπ) bonds
 - HClO₃ : Two (pπ-dπ) bonds
35. The value of K_p for the reaction
- $$\text{CO}_2(\text{g}) + \text{C}(\text{s}) \rightleftharpoons 2 \text{CO}(\text{g})$$
- is 3.0 bar at 1000 K. If initially $P_{\text{CO}_2} = 0.48$ bar, $P_{\text{CO}} = 0$ bar and pure graphite is present then determine equilibrium partial pressure of CO and CO₂.
- $P_{\text{CO}} = 0.15$ bar, $P_{\text{CO}_2} = 0.66$ bar
 - $P_{\text{CO}} = 0.66$ bar, $P_{\text{CO}_2} = 0.15$ bar
 - $P_{\text{CO}} = 0.33$ bar, $P_{\text{CO}_2} = 0.66$ bar
 - $P_{\text{CO}} = 0.66$ bar, $P_{\text{CO}_2} = 0.33$ bar

Space for Rough Work

36. The species in which $(n - 1)d_{x^2-y^2}$ orbital take part in hybridization ?

- (1) PCl_5 (2) $[(\text{FeCN})_6]^{-4}$
(3) $[\text{Cr}(\text{NH}_3)_6]^{3+}$ (4) (2) and (3) both

37. Which of the following is correct code ?

(T = true, F = False)

(a) Amongst 1s, 2p, 3d orbitals, 1s orbital have the nature of Ψ_r v/s r graph is different from others

(b) According to Heisenberg uncertainty principle, we can not find trajectories of electrons and other similar particles.

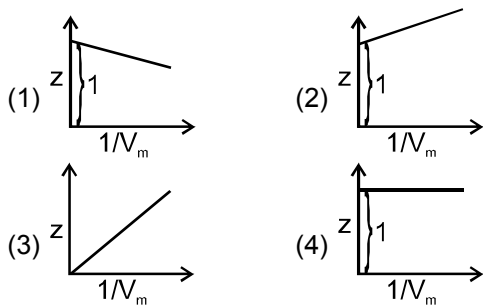
(c) An atomic orbital is the wave function Ψ for an electron in an atom.

- (1) T T T (2) F T T
(3) F T F (4) T T F

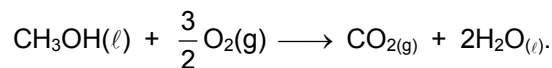
38. Select correct statement regarding $[\text{AlCl}(\text{H}_2\text{O})_5]\text{Cl}_2$:

- (1) It is a paramagnetic compound.
(2) Hybridisation of Al is d^2sp^3
(3) It is coloured.
(4) It can show hydrate isomerism.

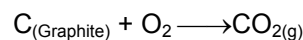
39. For a real gas under low pressure conditions and room temperature, which of the following graph is correct?



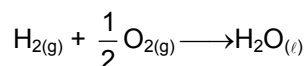
40. Find out standard enthalpy of formation of $\text{CH}_3\text{OH}(\ell)$ from following data.



$$\Delta H^\circ = -726 \text{ kJ/mole}$$



$$\Delta H^\circ = -393 \text{ kJ/mole}$$



$$\Delta H^\circ = -286 \text{ kJ/mole}$$

- (1) -239 kJ/mole
(2) 239 kJ/mole
(3) 47 kJ/mole
(4) -47 kJ/mole

41. Non stoichiometric cuprous oxide Cu_2O can be prepared in laboratory. In this oxide copper to oxygen ratio is slightly less than 2 : 1. Select correct statement ;

- (1) It shows metal deficiency defect.
(2) This substance can act as p-type semiconductor.
(3) In this compound copper exist as +1 & +2 oxidation state.
(4) All of these

42. $\text{XeF}_6 + \text{H}_2\text{O} \longrightarrow \text{A} + \text{B}$

Compound A & B are respectively ;

- (1) XeO_4 , HF
(2) Xe, F_2
(3) XeF_2 , Xe
(4) XeO_3 , HF

Space for Rough Work

43. **Statement-1** : In the extraction of copper from copper pyrite, copper matte is put in silica lined converter (i.e. Bessemer converter).

Statement-2 : Silica removes iron compound remaining in the matte by forming silicate, FeSiO_3 .

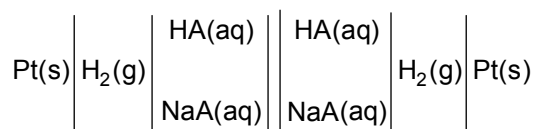
(1) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(2) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.

(3) Statement-1 is True, Statement-2 is False.

(4) Statement-1 is False, Statement-2 is True.

44. In the concentration cell



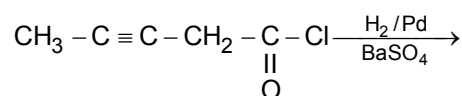
Value of cell potential will not depend on -

- (1) Value of pK_a of HA
- (2) Temperature
- (3) Concentration of HA in two electrodes
- (4) Concentration of NaA in two electrodes

45. When H_2O_2 is added to an acidified solution of $\text{K}_2\text{Cr}_2\text{O}_7$ then :

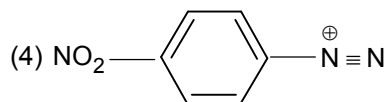
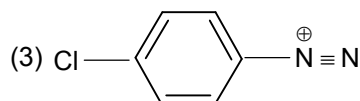
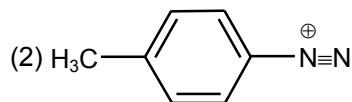
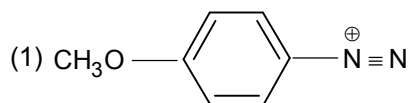
- (1) solution turns green due to formation of Cr_2O_3
- (2) solution turns yellow due to formation of K_2CrO_4
- (3) a blue coloured compound $\text{CrO}(\text{O}_2)_2$ is formed
- (4) solution gives green ppt of $\text{Cr}(\text{OH})_3$

46. Final product of following reaction contains

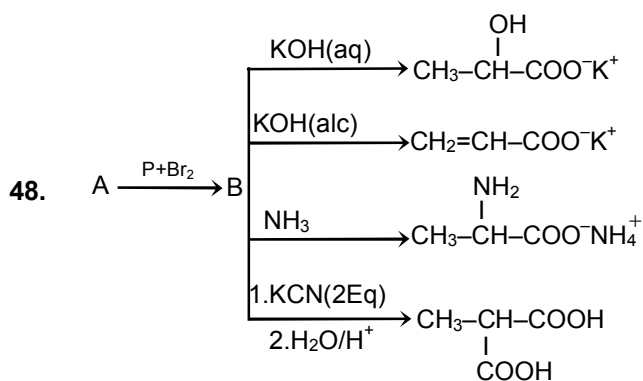


- (1) Only aldehyde group
- (2) Triple bond and alcohol
- (3) Double bond and alcohol
- (4) Double bond and aldehyde

47. Which of the following is most reactive cation in azocoupling reaction with phenol in basic medium.

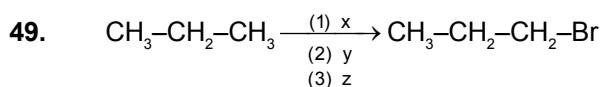


Space for Rough Work



'A' is

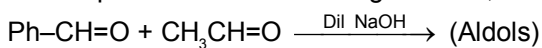
- (1) CH_3-CH_2-CHO
- (2) CH_3CH_2COOH
- (3) $CH_3CH_2CH_2OH$
- (4) $CH_3CH_2CH_2NH_2$



x, y, z are respectively :

- (1) $Br_2 / h\nu$ (1eq), conc. H_2SO_4 , ThO_2 / Δ
- (2) $Cl_2 / h\nu$ (1eq), alc. KOH / Δ , HBr / R_2O_2
- (3) $Cl_2 / h\nu$ (1eq), $tBuO^\bullet / \Delta$, HBr
- (4) $Cl_2 / h\nu$ (1eq), alc. KOH / Δ , MnO_2

50. Identify the option which represents the correct products of the following reaction,



- (I) $Ph-\overset{\overset{OH}{|}}{CH}-CH_2-CH=O$

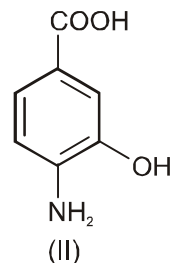
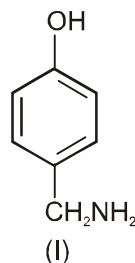
- (II) $CH_3-\overset{\overset{OH}{|}}{CH}-CH_2-CHO$

- (III) $CH_3-\overset{\overset{OH}{|}}{CH}-\overset{\overset{Ph}{|}}{C}=O$

- (IV) $CH_3-\overset{\overset{OH}{|}}{CH}-\overset{\overset{OH}{|}}{CH}-Ph$

- (1) I, II only
- (2) I, II, III only
- (3) III, IV only
- (4) I, III only

51. The labels of two bottles containing compounds I and II were lost. The names of these compounds were available in a register. Following are structures of I and II. Which combination of reagents **cannot** help in distinguishing these compounds :



- (I) $NaHCO_3$

- (II) $NaNO_2 / HCl$

- (III) $CHCl_3 + NaOH$

- (IV) Neutral $FeCl_3$

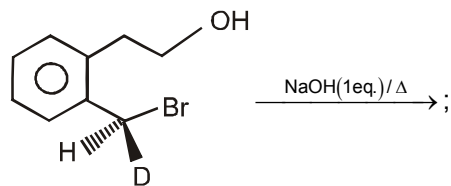
- (1) I and II

- (2) III and IV

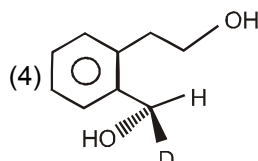
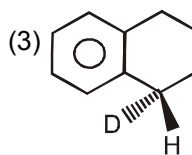
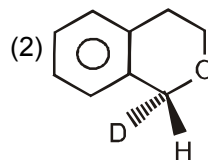
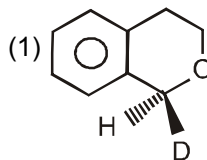
- (3) II and III

- (4) I and IV

52.

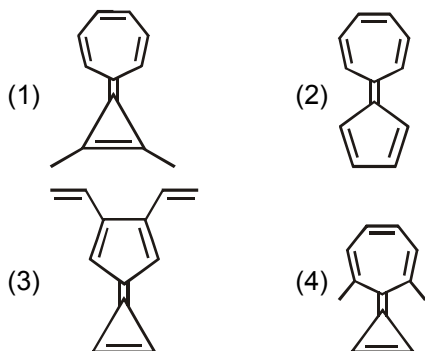


the major product is

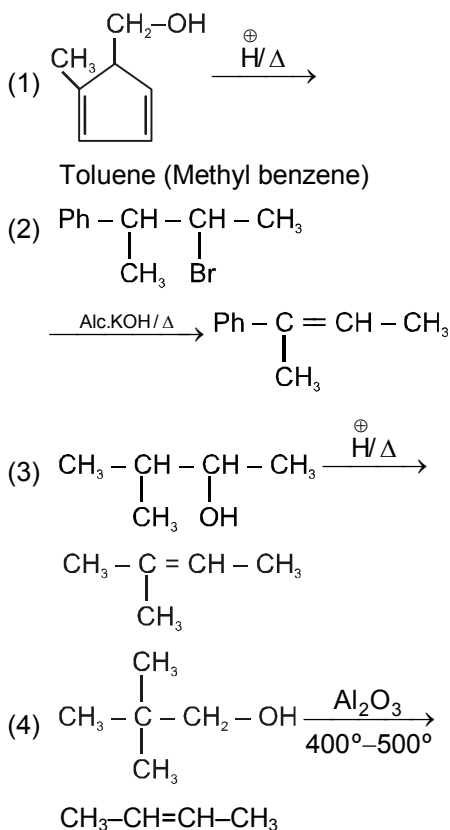


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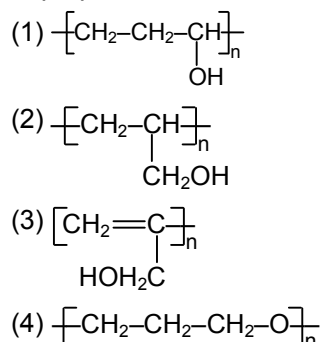
53. $C_{12}H_{10}$ is an aromatic compound which on ozonolysis gives mixture of Glyoxal and 2-Oxopropanedial in ratio 3 : 2. Its structure can be :



54. Which of the following reaction is show incorrect major product ?



55. Which of the following represents a polymer of prop-2-en-1-ol ?



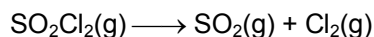
SECTION - II

Integer value correct Type

This section contains **5 questions**. The answer to each question is a **single digit integer**, ranging from 0 to 9 (both inclusive).

56. 100 mL, 0.2 M CH_3COOH is mixed with 100 mL, 0.1 M NaOH find out pH of resulting solution. (Given : $K_a(\text{CH}_3\text{COOH}) = 2 \times 10^{-5}$) ($\log 2 = 0.3$, $\log 3 = 0.48$) Give your answer to the nearest single digit integer.

57. The following data were obtained during the first order thermal decomposition of SO_2Cl_2 at a constant volume

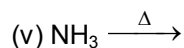
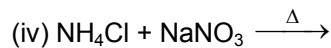
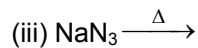
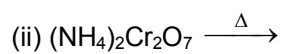
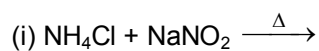


Exp	Time(sec)	Total pressure(atm)
1	0	0.5
2	100	0.6

If rate of reaction (atm sec^{-1}) when total pressure is 0.65 atm is $y \times 10^{-4}$ (Initially only SO_2Cl_2 is taken) then determine the value of y . ($\log 2 = 0.3$, $\log 3 = 0.48$, $\log 4 = 0.6$, $\log 5 = 0.7$)

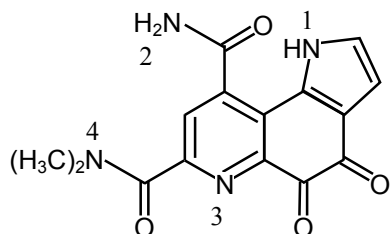
Space for Rough Work

58. In how many of the following reactions nitrogen gas can be obtained?



59. How many isomeric alcohol of molecular formula $\text{C}_5\text{H}_{12}\text{O}$ give blue colour in victor maeyer test finally?

60. Write the number of that nitrogen which represent most basic nitrogen in the following compound?



Space for Rough Work

PART – C

SECTION - I

Straight Objective Type

This section contains **25 multiple choice** questions. Each question has 4 choices (1), (2), (3) and (4) for its answer, out of which **ONLY ONE** is correct.

61. Which of the following is **NOT** true for any two statements p and q ?
(1) $\sim [p \vee (\sim q)] = (\sim p) \wedge q$
(2) $\sim (p \vee q) = (\sim p) \vee (\sim q)$
(3) $q \wedge \sim q$ is a contradiction
(4) $\sim (p \wedge (\sim p))$ is a tautology
62. Let R be the real line, consider the following subsets of the plane $R \times R$
 $S = \{(x, y) : y = [x], 0 < x < 4\}$
 $T = \{(x, y) : x - y \text{ is an integer}\}$
which of the following is true. (Where [.] represent) greatest integer function :
(1) T is equivalence relation on R but S is not
(2) T and S both are equivalence
(3) neither T nor S are equivalence
(4) S is equivalence but not T
63. The complete solution set of $|\sin x| - \sin x < 1$ in $x \in (0, 2\pi)$
(1) $\left(0, \frac{7\pi}{6}\right)$
(2) $(0, \pi) \cup \left(\frac{11\pi}{6}, 2\pi\right)$
(3) $\left(0, \frac{7\pi}{6}\right) \cup \left(\frac{11\pi}{6}, 2\pi\right)$
(4) $(0, \pi) \cup \left(\frac{7\pi}{6}, 2\pi\right)$

64. If $ax + by = 1$ touches $x^2 + y^2 = p^2$ then locus of (a, b) is
(1) parabola of latus-rectum 4p
(2) circle of radius $\frac{1}{p^2}$
(3) ellipse having centre as origin
(4) circle of radius $\frac{1}{p}$
65. If $\int \{x(1-x^2)\}^{1/3} x^{-4} dx = A(x^B - 1)^C + K$ then
(1) $A = \frac{3}{8}$
(2) $B = 2$
(3) $C = -\frac{4}{3}$
(4) $8A + B + 3C + 1 = 0$
66. Equation of circle which cuts the circle $x^2 + y^2 + 2x + 4y - 4 = 0$ and the lines $xy - 2x - y + 2 = 0$ orthogonally, is
(1) $x^2 + y^2 - 2x - 4y - 12 = 0$
(2) $x^2 + y^2 - 2x - 4y - 6 = 0$
(3) $x^2 + y^2 - 2x - 4y + 6 = 0$
(4) $x^2 + y^2 - 2x - 4y - 10 = 0$
67. There are 12 points in a plane of which 5 are collinear. Barring these five points no three are collinear. The number of quadrilaterals one can form using these points is
(1) 7C_3
(2) 7P_3
(3) $10 \cdot {}^7C_3$
(4) 420

Space for Rough Work

68. The first term of an infinite geometric series is 2 and its sum be denoted by S. If $|S - 2| < 1/10$ then the true set of the range of common ratio of the series is
- $\left(\frac{1}{10}, \frac{1}{5}\right)$
 - $\left(-\frac{1}{2}, \frac{1}{2}\right) - \{0\}$
 - $\left(-\frac{1}{19}, \frac{1}{20}\right) - \{0\}$
 - $\left(-\frac{1}{19}, \frac{1}{21}\right) - \{0\}$
69. The two equal sides of an isosceles triangle with fixed base 6 cm. are decreasing at the rate of 3cm/sec. How fast is the area decreasing when two equal sides are equal to the base. (in cm²/sec)
- $3\sqrt{3}$
 - $12\sqrt{3}$
 - $2\sqrt{3}$
 - $6\sqrt{3}$
70. In a complex plane the points A and B are at $z_1 = 5 - 2i$ and $z_2 = 1 + i$. If P(z) moves such that $|z - z_1| = 2|z - z_2|$, then the maximum area of $\triangle PAB$ is
- $\frac{1}{3}$
 - $\frac{25}{3}$
 - $\frac{50}{3}$
 - 5
71. For the system of equations
 $ax + by + cz = q - r$,
 $bx + cy + az = r - p$,
 $cx + ay + bz = p - q$, which of the following is **FALSE** ?
- consistent if $p = q = r$
 - consistent if $a = b = c$ and p, q, r are distinct
 - consistent if a, b, c are distinct and $a + b + c \neq 0$
 - consistent if $a = b = c$
72. If $(x^2 + y^2)dy = xydx$, $y(1) = 1$ and $y(x_0) = e$, then x_0 is
- $\sqrt{3}e$
 - $\sqrt{3}e$
 - $\sqrt{2(e^2 - 1)}$
 - e
73. If $f(x) = (e^{(x-1)})^2 (x-1)^2$, then which of following is **CORRECT** ?
- $f(x)$ has an extremum at $x = \pm 1$.
 - $f'(1) = 0$
 - $f''(1) < 0$
 - $f''(0) > 0$
74. The mean and variance of n observations $x_1, x_2, x_3, \dots, x_n$ are 5 and 0 respectively. If $\sum x_i^2 = 400$, then the value of n is equal to
- 80
 - 16
 - 25
 - 20

Space for Rough Work

75. If $f(x) = \int_1^x \frac{\ln t}{1+t} dt$, then which of the following is **TRUE** ?

(1) $f\left(\frac{1}{x}\right) = -\int_1^x \frac{\ln t}{t(1+t)} dt$

(2) $f\left(\frac{1}{x}\right) = \int_1^x \frac{\ln t}{t(1+t)} dt$

(3) $f(x) + f\left(\frac{1}{x}\right) = 0$

(4) $f(x) + f\left(\frac{1}{x}\right) = (\ln x)^2$

76. If $(1+x)^n = C_0 + C_1x + C_2x^2 + \dots + C_nx^n$, then $C_0C_2 + C_1C_3 + C_2C_4 + \dots + C_{n-2}C_n$ equals (where ${}^nC_r = C_r$)

(1) $\frac{(2n)!}{(n+1)!(n+2)!}$

(2) $\frac{(2n)!}{(n-2)!(n+2)!}$

(3) $\frac{(2n)!}{(n)!(n+2)!}$

(4) $\frac{(2n)!}{(n-1)!(n+2)!}$

77. If $\vec{x}$, $\vec{y}$, $\vec{z}$ are unit vectors such that $\vec{x} + \vec{y} + \vec{z} = \vec{a}$, $(\vec{x} \times \vec{y}) \times \vec{z} = \vec{b}$, $\vec{a} \cdot \vec{x} = \frac{3}{2}$,

$\vec{a} \cdot \vec{y} = \frac{7}{4}$ and $|\vec{a}| = 2$, then which of the following is **FALSE** ?

(1) $\vec{y}$ is perpendicular to $\vec{z}$

(2) $\vec{y}$ is perpendicular to $\vec{b}$

(3) angle between $\vec{x}$, $\vec{y}$ is acute

(4) angle between $\vec{x}$, $\vec{z}$ is obtuse

78. $\int_0^4 \ln(\sqrt{(x-2)^2 + 4} + (x-2)) dx =$

(1) $\ln 2$

(2) $2 \ln 2$

(3) $4 \ln 2$

(4) 0

79. The value of 'a' for which the sum of the squares of the roots of $x^2 - (4a-6)x - (4a+4) = 0$ is least, is

(1) $\frac{5}{2}$

(2) $\frac{5}{4}$

(3) $\frac{5}{8}$

(4) $\frac{5}{16}$

80. Let $f(x) = \begin{cases} \min(x, x^2) & , x \geq 0 \\ \max(2x, x^2 - 1) & , x < 0 \end{cases}$,

then which of the following is **FALSE** ?

(1) $f(x)$ is continuous at $x = 0$

(2) $f(x)$ is differentiable at $x = 1$

(3) $f(x)$ is not differentiable at exactly three points

(4) $f(x)$ is continuous everywhere.

81. The area bounded by the curves

$y = \sqrt{5-x^2}$ and $y = |x-1|$ is

(1) $\left(\frac{5\pi}{4} - 2\right)$ sq.unit

(2) $\left(\frac{5\pi-1}{4}\right)$ sq.unit

(3) $\left(\frac{5\pi-2}{4}\right)$ sq.unit

(4) $\left(\frac{5\pi}{2} - 5\right)$ sq.unit

Space for Rough Work

82. A fair coin is tossed 10 times and the outcomes are listed. Let H_i be the event that the i^{th} outcome is a head and A_m be the event that the list contains exactly m heads, then
- (1) H_3 and A_4 are independent
 - (2) A_1 and H_7 are independent
 - (3) H_2 and A_5 are independent
 - (4) A_1 and A_9 are independent
83. Let $f : \left[-1, -\frac{1}{2}\right] \rightarrow [-1, 1]$ is defined by $f(x) = 4x^3 - 3x$, then $f^{-1}(x) =$
- (1) $\cos\left(\frac{1}{3}\cos^{-1}x\right)$
 - (2) $\cos(3\cos^{-1}x)$
 - (3) $\sin\left(\frac{1}{3}\sin^{-1}x\right)$
 - (4) $\cos\left(\frac{2\pi}{3} + \frac{1}{3}\cos^{-1}x\right)$
84. If $f(x)$ is a continuous function $\forall x \in \mathbb{R} - \{-2\}$ and satisfies, $x^3 - x^2(f(x)+2) - x + 2(2f(x)+1) = 0$, $\forall x \in \mathbb{R} - \{-2\}$, then $f(2)$ is equal to
- (1) 0
 - (2) $\frac{3}{4}$
 - (3) $\frac{1}{4}$
 - (4) undefined
85. Let $f : \mathbb{R} \rightarrow \mathbb{R}$ satisfy relation $f(x)f(y) - f(xy) = x + y \forall x, y \in \mathbb{R}$ and $f(1) > 0$. If $h(x) = f(x)f^{-1}(x)$, then length of longest interval in which $h(\sin x + \cos x)$ is strictly decreasing is.
- (1) π
 - (2) $\frac{\pi}{2}$
 - (3) $\frac{\pi}{4}$
 - (4) $\frac{\pi}{6}$

SECTION - II

Integer value correct Type

This section contains **5 questions**. The answer to each question is a **single digit integer**, ranging from 0 to 9 (both inclusive).

86. If $x + y + 1 = 0$ is a common tangent to the $y^2 = 4x$ and $x^2 = \lambda y$ then λ
87. For some non zero vector $\vec{x}$, if $\vec{x} \cdot \vec{a} = \vec{x} \cdot \vec{b} = \vec{x} \cdot \vec{c} = 0$ then $[\vec{a} \vec{b} \vec{c}] =$
88. A circular sector is formed by a thread of length ℓ , what is ratio of maximum area of sector thus formed to maximum area of rectangle formed by same thread.
89. The value of
$$\lim_{n \rightarrow \infty} \left(\frac{2n}{2n^2 - 1} \cos \left(\frac{n+1}{2n-1} \right) - \frac{n}{1-2n} \times \frac{n}{n^2+1} (-1)^n \right),$$
 ($n \in \mathbb{N}$), is
90. The shortest distance between the skew lines $\frac{x+3}{-4} = \frac{y-6}{3} = \frac{z}{2}$ and $\frac{x+2}{-4} = \frac{y}{1} = \frac{z-7}{1}$ is

Space for Rough Work

Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.

INSTRUCTIONS :**A. General :**

1. This booklet is your Question Paper. Do not break the seals of this booklet before being instructed to do so by the invigilators.
2. Blank spaces and blank pages are provided in the question paper for your rough work. No additional sheets will be provided for rough work.
3. Blank papers, clipboards, log tables, slide rules, calculators, cameras, cellular phones, pagers and electronic gadgets are NOT allowed inside the examination hall.
4. Write your name and roll number in the space provided on the back cover of this booklet.
5. **Using a black ball point pen, darken the bubbles on the upper original sheet.**
6. **DO NOT TAMPER WITH/MUTILATE THE ORS OR THE BOOKLET.**
7. On breaking the seals of the booklet check that it contains all the **90** questions and corresponding answer choices are legible. Read carefully the Instructions printed at the beginning of each section.

B. Filling the ORS

Use only Black ball point pen only for filling the ORS.

8. Write your Roll no. in the boxes given at the top left corner of your ORS with black ball point pen. Also, darken the corresponding bubbles with Black ball point pen only. Also fill your roll no on the back side of your ORS in the space provided (if the ORS is both side printed).
9. Fill your Paper Code as mentioned on the Test Paper and darken the corresponding bubble with Black ball point pen.
10. If student does not fill his/her roll no. and paper code correctly and properly, then his/her marks will not be displayed and 5 marks will be deducted (paper wise) from the total.
11. Since it is not possible to erase and correct pen filled bubble, you are advised to be extremely careful while darken the bubble corresponding to your answer.
12. Neither try to erase / rub / scratch the option nor make the Cross (X) mark on the option once filled. Do not scribble, smudge, cut, tear, or wrinkle the ORS. Do not put any stray marks or whitener anywhere on the ORS.
13. If there is any discrepancy between the written data and the bubbled data in your ORS, the bubbled data will be taken as final.

C. Question Paper Format

The question paper consists of Three parts (**Physics Chemistry and Mathematics**). Each part consists are two section.

14. **Section 1** contains **25 multiple choice questions**. Each question has Four choices (1), (2), (3) and (4) out of which **only ONE is correct**.
15. **Section 2** contains **5 questions**. The answer to each question is a **single-digit integer**, ranging from **0 to 9** (both inclusive).

D. Marking Scheme

16. For each question in **Section 1**, you will be awarded **4 marks** if you darken the bubble corresponding to only the correct answer and **zero mark** if no bubbles are darkened. In all other cases, **minus one (-1) mark** will be awarded.
17. For each question in **Section 2**, you will be awarded **4 marks** if you darken the bubble corresponding to only the correct answer and **zero mark** if no bubbles are darkened. In all other cases, **minus one (-1) mark** will be awarded.

Name of the Candidate :**Roll Number :**

I have read all the instructions and shall abide by them

I have verified all the information filled by the candidate.

.....
Signature of the Candidate

.....
Signature of the Invigilator

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