

JEE Main 2025 Paper 1 (B.E./B.Tech) 7 April 2025 Shift 2 Question Paper



Conducted by the National Testing Agency (NTA)

Time Allowed: 3 Hours

Paper 1: B.E./B.Tech.

Maximum Marks: 300

General Instructions

- (i) This paper is **Paper 1 (B.E./B.Tech.)** of **JEE (Main) 2025 - Session 2**, conducted by the National Testing Agency (NTA) in Computer Based Test (CBT) mode on 7 April 2025, Shift 2. The total duration is **3 hours**.
- (ii) The paper has **75 questions** and a maximum of **300 marks**: Mathematics, Physics and Chemistry carry 25 questions (100 marks) each, in that order.
- (iii) Each subject has **two sections**. **Section A** has **20 multiple choice questions** (MCQs) with four options each. Select the most appropriate answer. **Section B** has **5 numerical value questions**.
- (iv) **All questions are compulsory**. For Section B, the answer is an integer value; the answer should be **rounded off to the nearest integer**. Use only the constants given in the question while calculating.
- (v) **Marking scheme** (Sections A and B): **+4** for a correct answer, **–1** for an incorrect answer, and **0** for an unanswred or marked-for-review question.
- (vi) All calculations and rough work are to be done on the rough sheets only. Calculators, log tables, slide rules and electronic gadgets are not allowed.

1. Let $f: \mathbb{R} \rightarrow \mathbb{R}$ be a polynomial function of degree four having extreme values at $x = 4$ and $x = 5$. If $\lim_{x \rightarrow 0} \frac{f(x)}{x^2} = 5$, then $f(2)$ is equal to :

- (A) 8 (B) 10
(C) 12 (D) 14

2. Let $y = y(x)$ be the solution of the differential equation $(x^2 + 1)y' - 2xy = (x^4 + 2x^2 + 1) \cos x$, $y(0) = 1$. Then $\int_{-3}^3 y(x) dx$ is :

- (A) 36 (B) 24
(C) 18 (D) 30

3. If the locus of $z \in \mathbb{C}$, such that $\operatorname{Re}\left(\frac{z-1}{2z+i}\right) + \operatorname{Re}\left(\frac{\bar{z}-1}{2\bar{z}-i}\right) = 2$, is a circle of radius r and center (a, b) , then $\frac{15ab}{r^2}$ is equal to :

- (A) 16 (B) 24
(C) 12 (D) 18

4. Let a_n be the n^{th} term of an A.P. If $S_n = a_1 + a_2 + a_3 + \dots + a_n = 700$, $a_6 = 7$ and $S_7 = 7$, then a_n is equal to :

- (A) 65 (B) 56
(C) 70 (D) 64

5. A bag contains 19 unbiased coins and one coin with head on both sides. One coin drawn at random is tossed and head turns up. If the probability that the drawn coin was unbiased, is $\frac{m}{n}$, $\gcd(m, n) = 1$, then $n^2 - m^2$ is equal to :

- (A) 64 (B) 80
(C) 60 (D) 72

6. If the range of the function $f(x) = \frac{5-x}{x^2-3x+2}$, $x \neq 1, 2$, is $(-\infty, \alpha] \cup [\beta, \infty)$, then $\alpha^2 + \beta^2$ is equal to :

- (A) 188 (B) 192
(C) 190 (D) 194

7. The number of real roots of the equation $x|x-2| + 3|x-3| + 1 = 0$ is :

- (A) 4 (B) 3
(C) 2 (D) 1

8. Let the length of a latus rectum of an ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ be 10. If its eccentricity is the minimum value of the function $f(t) = t^2 + t + \frac{11}{12}$, $t \in \mathbb{R}$, then $a^2 + b^2$ is equal to :

- (A) 115 (B) 120
(C) 125 (D) 126

9. Let e_1 and e_2 be the eccentricities of the ellipse $\frac{x^2}{b^2} + \frac{y^2}{25} = 1$ and the hyperbola $\frac{x^2}{16} - \frac{y^2}{b^2} = 1$, respectively. If $b < 5$ and $e_1 e_2 = 1$, then the eccentricity of the ellipse having its axes along the co-ordinate axes and passing through all four foci (two of the ellipse and two of the hyperbola) is :

- (A) $\frac{4}{5}$ (B) $\frac{3}{5}$
(C) $\frac{\sqrt{7}}{4}$ (D) $\frac{\sqrt{3}}{2}$

10. If the equation of the line passing through the point $(0, -\frac{1}{2}, 0)$ and perpendicular to the lines $\vec{r} = \lambda(\hat{i} + a\hat{j} + b\hat{k})$ and $\vec{r} = (\hat{i} - \hat{j} - 6\hat{k}) + \mu(-b\hat{i} + a\hat{j} + 5\hat{k})$ is $\frac{x-1}{-2} = \frac{y+4}{d} = \frac{z-c}{-4}$, then $a + b + c + d$ is equal to :

- (A) 13 (B) 14
(C) 12 (D) 10

11. If the sum of the second, fourth and sixth terms of a G.P of positive terms is 21 and the sum of its eighth, tenth and twelfth terms is 15309, then the sum of its first nine terms is :

- (A) 757 (B) 755
(C) 750 (D) 760

12. If the area of the region $\{(x, y) : 1 + x^2 \leq y \leq \min\{x + 7, 11 - 3x\}\}$ is A , then $3A$ is equal to :

- (A) 50 (B) 46
(C) 49 (D) 47

13. The number of solutions of the equation $\cos 2\theta \cos \frac{\theta}{2} + \cos \frac{5\theta}{2} = 2 \cos^3 \frac{5\theta}{2}$ in $[-\frac{\pi}{2}, \frac{\pi}{2}]$ is :

- (A) 5 (B) 7
(C) 6 (D) 9

14. Consider the lines $L_1: x - 1 = y - 2 = z$ and $L_2: x - 2 = y = z - 1$. Let the feet of the perpendiculars from the point $P(5, 1, -3)$ on the lines L_1 and L_2 be Q and R respectively. If the area of the triangle PQR is A , then $4A^2$ is equal to :

- (A) 151 (B) 147
(C) 139 (D) 143

15. Let $A = \{(\alpha, \beta) \in \mathbb{R} \times \mathbb{R} : |\alpha - 1| \leq 4 \text{ and } |\beta - 5| \leq 6\}$ and $B = \{(\alpha, \beta) \in \mathbb{R} \times \mathbb{R} : 16(\alpha - 2)^2 + 9(\beta - 6)^2 \leq 144\}$. Then

- (A) $A \subset B$
(B) $B \subset A$
(C) neither $A \subset B$ nor $B \subset A$
(D) $A \cup B = \{(x, y) : -4 \leq x \leq 4, -1 \leq y \leq 11\}$

16. Let $\vec{a}$ and $\vec{b}$ be the vectors of the same magnitude such that

$$\frac{|\vec{a} + \vec{b}| + |\vec{a} - \vec{b}|}{|\vec{a} + \vec{b}| - |\vec{a} - \vec{b}|} = \sqrt{2} + 1. \text{ Then } \frac{|\vec{a} + \vec{b}|^2}{|\vec{a}|^2} \text{ is :}$$

- (A) $2 + \sqrt{2}$ (B) $2 + 4\sqrt{2}$
(C) $4 + 2\sqrt{2}$ (D) $1 + \sqrt{2}$

17. Let p be the number of all triangles that can be formed by joining the vertices of a regular polygon P of n sides and q be the number of all quadrilaterals that can be formed by joining the vertices of P . If $p + q = 126$, then the eccentricity of the ellipse $\frac{x^2}{16} + \frac{y^2}{n} = 1$ is :

- (A) $\frac{1}{\sqrt{2}}$ (B) $\frac{1}{2}$
(C) $\frac{\sqrt{7}}{4}$ (D) $\frac{3}{4}$

18. Let a random variable X take values 0, 1, 2, 3 with $P(X=0)=P(X=1)=p$, $P(X=2)=P(X=3)$ and $E(X^2)=2E(X)$. Then the value of $8p-1$ is :

- (A) 2 (B) 0
(C) 3 (D) 1

19. Let the system of equations

$$x + 5y - z = 1$$

$$4x + 3y - 3z = 7$$

$$24x + y + \lambda z = \mu$$

$\lambda, \mu \in \mathbb{R}$, have infinitely many solutions. Then the number of the solutions of this system, if x, y, z are integers and satisfy $7 \leq x + y + z \leq 77$, is :

- (A) 4 (B) 5
(C) 3 (D) 6

20. If the orthocenter of the triangle formed by the lines $y = x + 1$, $y = 4x - 8$ and $y = mx + c$ is at $(3, -1)$, then $m - c$ is :

- (A) 0 (B) 2
(C) -2 (D) 4

21. The sum of the series

$$2 \times 1 \times {}^{20}C_4 - 3 \times 2 \times {}^{20}C_5 + 4 \times 3 \times {}^{20}C_6 - 5 \times 4 \times {}^{20}C_7 + \dots + 18 \times 17 \times {}^{20}C_{20}$$

, is equal to _____.

22. If the function $f(x) = \frac{\tan(\tan x) - \sin(\sin x)}{\tan x - \sin x}$ is continuous at $x = 0$, then $f(0)$ is equal to _____.

23. If

$$\int \left(\frac{1}{x} + \frac{1}{x^3} \right) \left(\sqrt[23]{3x^{-24} + x^{-26}} \right) dx$$

$$x = -\frac{\alpha}{3(\alpha+1)} \left(3x^\beta + x^\gamma \right)^{\frac{\alpha+1}{\alpha}} + C, x > 0, (\alpha, \beta,$$

$$\gamma \in \mathbf{Z})$$

, where C is the constant of integration, then $\alpha + \beta + \gamma$ is equal to _____.

24. Let the lengths of the transverse and conjugate axes of a hyperbola in standard form be $2a$ and $2b$, respectively, and one focus and the corresponding directrix of this hyperbola be $(-5, 0)$ and $5x + 9 = 0$, respectively. If the product of the focal distances of a point $(\alpha, 2\sqrt{5})$ on the hyperbola is p , then $4p$ is equal to _____.

25. For $t > -1$, let α_t and β_t be the roots of the equation

$$\left((t+2)^{1/7} - 1 \right) x^2 + \left((t+2)^{1/6} - 1 \right) x + \left((t+2)^{1/21} - 1 \right) = 0. \text{ If } \lim_{t \rightarrow -1^+} \alpha_t = a \text{ and } \lim_{t \rightarrow -1^+} \beta_t = b,$$

then $72(a+b)^2$ is equal to _____.

26. The dimension of $\sqrt{\frac{\mu_0}{\epsilon_0}}$ is equal to that of:
(μ_0 = Vacuum permeability and ϵ_0 = Vacuum permittivity)

- (A) Voltage (B) Inductance
(C) Resistance (D) Capacitance

27. A photoemissive substance is illuminated with a radiation of wavelength λ_i so that it releases electrons with de-Broglie wavelength λ_e . The longest wavelength of radiation that can emit photoelectron is λ_o . Expression for de-Broglie wavelength is given by:

(m: mass of the electron, h: Planck's constant and c: speed of light)

- (A) $\lambda_e = \frac{\sqrt{h\lambda_i}}{\sqrt{2mc}}$ (B) $\lambda_e = \frac{h}{\sqrt{2mc\left(\frac{1}{\lambda_i} - \frac{1}{\lambda_o}\right)}}$
(C) $\lambda_e = \sqrt{\frac{h}{2mc\left(\frac{1}{\lambda_i} - \frac{1}{\lambda_o}\right)}}$ (D) $\lambda_e = \sqrt{\frac{h\lambda_o}{2mc}}$

28. A helicopter flying horizontally with a speed of 360 km/h at an altitude of 2 km, drops an object at an instant. The object hits the ground at a point O, 20 s after it is dropped. Displacement of 'O' from the position of helicopter where the object was released is :

(use acceleration due to gravity $g = 10 \text{ m/s}^2$ and neglect air resistance)

- (A) 7.2 km (B) $2\sqrt{5}$ km
(C) $2\sqrt{2}$ km (D) 4 km

29. Given below are two statements: one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

Assertion (A): Refractive index of glass is higher than that of air.

Reason (R): Optical density of a medium is directly proportionate to its mass density which results in a proportionate refractive index.

In the light of the above statements, choose the **most appropriate answer** from the options given below:

- (A) Both (A) and (R) are correct and (R) is the correct explanation of (A) (B) (A) is correct but (R) is not correct
(C) (A) is not correct but (R) is correct (D) Both (A) and (R) are correct but (R) is **not** the correct explanation of (A)

30. Which one of the following forces cannot be expressed in terms of potential energy?

- (A) Frictional force (B) Coulomb's force
(C) Restoring force (D) Gravitational force

31. Match **List - I** with **List - II**.

List - I	List - II
(A) Mass density	(I) $[\text{ML}^2\text{T}^{-3}]$
(B) Impulse	(II) $[\text{MLT}^{-1}]$
(C) Power	(III) $[\text{ML}^2\text{T}^0]$
(D) Moment of inertia	(IV) $[\text{ML}^{-3}\text{T}^0]$

Choose the **correct** answer from the options given below :

- (A) (A)-(IV), (B)-(II), (C)-(III), (D)-(I) (B) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)
(C) (A)-(IV), (B)-(III), (C)-(I), (D)-(II) (D) (A)-(IV), (B)-(II), (C)-(I), (D)-(III)

32. The helium and argon are put in the flask at the same room temperature (300 K). The ratio of average kinetic energies (per molecule) of helium and argon is:

(Give: Molar mass of helium = 4 g/mol, Molar mass of argon = 40 g/mol)

- (A) $1 : \sqrt{10}$ (B) $10 : 1$
(C) $1 : 10$ (D) $1 : 1$

33. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): The radius vector from the Sun to a planet sweeps out equal areas in equal intervals of time and thus areal velocity of planet is constant.

Reason (R): For a central force field the angular momentum is a constant.

In the light of the above statements, choose the most appropriate answer from the options given below:

- (A) (A) is not correct but (R) is correct (B) Both (A) and (R) are correct but (R) is not the correct explanation of (A)
(C) Both (A) and (R) are correct and (R) is the correct explanation of (A) (D) (A) is correct but (R) is not correct

34. The unit of $\sqrt{\frac{2I}{\epsilon_0 c}}$ is :

(I = intensity of an electromagnetic wave, c = speed of light)

- (A) Vm (B) NC^{-1}
(C) NC (D) Nm

35. A dipole with two electric charges of $2 \mu\text{C}$ magnitude each, with separation distance $0.5 \mu\text{m}$, is placed between the plates of a capacitor such that its axis is parallel to an electric field established between the plates when a potential difference of 5 V is applied. Separation between the plates is 0.5 mm. If the dipole is rotated by 30° from the axis, it tends to realign in the direction due to a torque. The value of torque is:

- (A) $2.5 \times 10^{-9} \text{ Nm}$ (B) $2.5 \times 10^{-12} \text{ Nm}$
(C) $5 \times 10^{-3} \text{ Nm}$ (D) $5 \times 10^{-9} \text{ Nm}$

36. Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

Assertion (A) : The outer body of an aircraft is made of metal which protects persons sitting inside from lightning strikes.

Reason (R) : The electric field inside the cavity enclosed by a conductor is zero.

In the light of the above statements, choose the most appropriate answer from the options given below :

- (A) Both (A) and (R) are correct but (R) is not the correct explanation of (A) (B) (A) is correct but (R) is not correct
(C) Both (A) and (R) are correct and (R) is the correct explanation of (A) (D) (A) is not correct but (R) is correct

37. A mirror is used to produce an image with magnification of $\frac{1}{4}$. If the distance between object and its image is 40 cm, then the focal length of the mirror is _____.

- (A) 10 cm (B) 12.7 cm
(C) 10.7 cm (D) 15 cm

38. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : The density of the copper ($^{64}_{29}\text{Cu}$) nucleus is greater than that of the carbon ($^{12}_6\text{C}$) nucleus.

Reason (R) : The nucleus of mass number A has a radius proportional to $A^{1/3}$.

In the light of the above statements, choose the most appropriate answer from the options given below :

- (A) (A) is correct but (R) is not correct (B) Both (A) and (R) are correct but (R) is **not** the correct explanation of (A)
(C) (A) is not correct but (R) is correct (D) Both (A) and (R) are correct and (R) is the correct explanation of (A)

39. A capillary tube of radius 0.1 mm is partly dipped in water (surface tension 70 dyn/cm and glass water contact angle $\approx 0^\circ$) with 30° inclined with the vertical. The length of water risen in the capillary is _____ cm. (Take $g = 9.8 \text{ m/s}^2$)

- (A) $\frac{82}{5}$ (B) $\frac{68}{5}$
(C) $\frac{57}{2}$ (D) $\frac{71}{5}$

40. Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

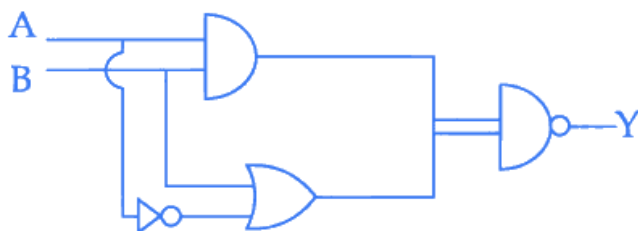
Assertion (A): Magnetic monopoles do not exist.

Reason (R): Magnetic field lines are continuous and form closed loops.

In the light of the above statements, choose the **most appropriate answer** from the options given below:

- (A) Both (A) and (R) are correct and (R) is the correct explanation of (A)
(B) (A) is not correct but (R) is correct
(C) (A) is correct but (R) is not correct
(D) Both (A) and (R) are correct but (R) is **not** the correct explanation of (A)

41. Consider the following logic circuit.



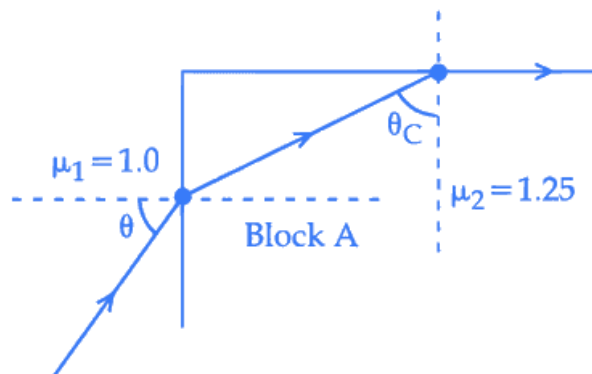
The output is $Y = 0$ when :

- (A) $A = 1$ and $B = 0$ (B) $A = 0$ and $B = 0$
(C) $A = 1$ and $B = 1$ (D) $A = 0$ and $B = 1$

42. The equation of a wave travelling on a string is $y = \sin[20\pi x + 10\pi t]$, where x and t are distance and time in SI units. The minimum distance between two points having the same oscillating speed is :

- (A) 10 cm (B) 2.5 cm
(C) 20 cm (D) 5.0 cm

43. A transparent block A having refractive index $\mu = 1.25$ is surrounded by another medium of refractive index $\mu = 1.0$ as shown in the figure. A light ray is incident on the flat face of the block with incident angle θ as shown in the figure. What is the maximum value of θ for which light suffers total internal reflection at the top surface of the block?



- (A) $\tan^{-1}(4/3)$ (B) $\sin^{-1}(3/4)$
(C) $\tan^{-1}(3/4)$ (D) $\cos^{-1}(3/4)$

44. Match **List - I** with **List - II**.

List - I	List - II
(A) Isothermal	(I) ΔW (work done) = 0
(B) Adiabatic	(II) ΔQ (supplied heat) = 0
(C) Isobaric	(III) ΔU (change in internal energy) $\neq 0$
(D) Isochoric	(IV) $\Delta U = 0$

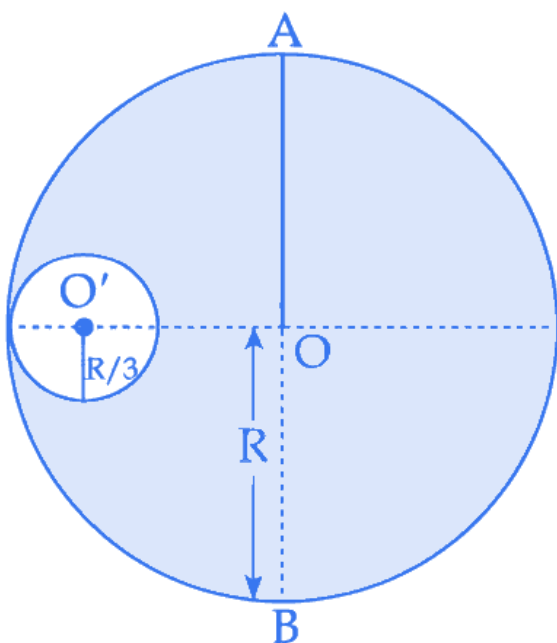
Choose the **correct** answer from the options given below :

- (A) (A)-(III), (B)-(II), (C)-(I), (D)-(IV) (B) (A)-(II), (B)-(IV), (C)-(I), (D)-(III)
(C) (A)-(IV), (B)-(II), (C)-(III), (D)-(I) (D) (A)-(IV), (B)-(I), (C)-(III), (D)-(II)

45. An object with mass 500 g moves along x -axis with speed $v = 4\sqrt{x}$ m/s. The force acting on the object is :

- (A) 8 N (B) 4 N
(C) 5 N (D) 6 N

46. M and R be the mass and radius of a disc. A small disc of radius $R/3$ is removed from the bigger disc as shown in figure. The moment of inertia of remaining part of bigger disc about an axis AB passing through the centre O and perpendicular to the plane of disc is $\frac{4}{x}MR^2$. The value of x is _____.



47. Two cylindrical rods A and B made of different materials, are joined in a straight line. The ratios of lengths, radii and thermal conductivities of these rods are: $\frac{L_A}{L_B} = \frac{1}{2}$, $\frac{r_A}{r_B} = 2$ and $\frac{K_A}{K_B} = \frac{1}{2}$. The free ends of rods A and B are maintained at 400 K, 200 K, respectively. The temperature of rods interface is _____ K, when equilibrium is established.

48. The electric field in a region is given by $\vec{E} = (2\hat{i} + 4\hat{j} + 6\hat{k}) \times 10^3 \text{ N/C}$. The flux of the field through a rectangular surface parallel to $x - z$ plane is $6.0 \text{ Nm}^2\text{C}^{-1}$. The area of the surface is _____ cm^2 .

49. An inductor of reactance 100Ω , a capacitor of reactance 50Ω , and a resistor of resistance 50Ω are connected in series with an AC source of 10 V, 50 Hz. Average power dissipated by the circuit is _____ W.

50. A parallel plate capacitor has charge $5 \times 10^{-6}\text{C}$. A dielectric slab is inserted between the plates and almost fills the space between the plates. If the induced charge on one face of the slab is $4 \times 10^{-6}\text{C}$ then the dielectric constant of the slab is _____.

51. Match List - I with List - II.

List - I (Complex)	List - II (Primary valency and Secondary valency)
(A) $[\text{Co}(\text{en})_2\text{Cl}_2]\text{Cl}$	(I) 3, 6
(B) $[\text{Pt}(\text{NH}_3)_2\text{Cl}(\text{NO}_2)]$	(II) 3, 4
(C) $\text{Hg} [\text{Co}(\text{SCN})_4]$	(III) 2, 6
(D) $[\text{Mg} (\text{EDTA})]^{2-}$	(IV) 2, 4

Choose the **correct** answer from the options given below :

- (A) (A)-(I), (B)-(III), (C)-(II), (D)-(IV) (B) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)
- (C) (A)-(I), (B)-(IV), (C)-(II), (D)-(III) (D) (A)-(III), (B)-(I), (C)-(II), (D)-(IV)

52. The correct statements from the following are :

- (A) Tl^{3+} is a powerful oxidising agent
 (B) Al^{3+} does not get reduced easily
 (C) Both Al^{3+} and Tl^{3+} are very stable in solution
 (D) Tl^{1+} is more stable than Tl^{3+}
 (E) Al^{3+} and Tl^{1+} are highly stable

Choose the **correct** answer from the options given below :

- (A) (A), (B), (D) and (E) only (B) (A), (C) and (D) only
- (C) (A), (B), (C) and (E) (D) (B), (D) and (E) only

53. Given below are two statements :

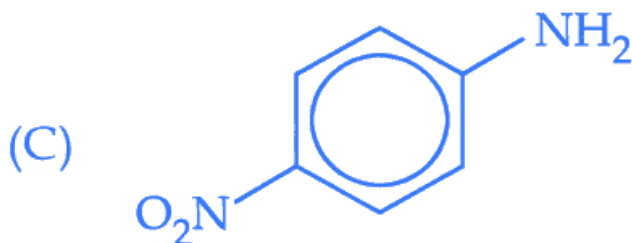
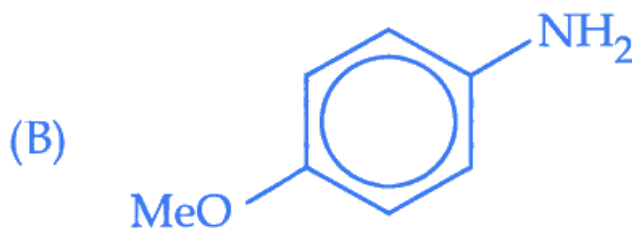
Statement (I) : On hydrolysis, oligo peptides give rise to fewer number of α -amino acids while proteins give rise to a large number of β -amino acids.

Statement (II) : Natural proteins are denatured by acids which convert the water soluble form of fibrous proteins to their water insoluble form.

In the light of the above statements, choose the **most appropriate answer** from the options given below :

- (A) **Statement I** is incorrect but **Statement II** is correct (B) Both **Statement I** and **Statement II** are incorrect
- (C) Both **Statement I** and **Statement II** are correct (D) **Statement I** is correct but **Statement II** is incorrect

54. The descending order of basicity of the following amines is :



- (D) CH_3NH_2
(E) $(\text{CH}_3)_2\text{NH}$

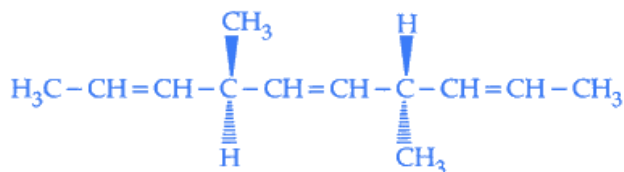
Choose the **correct** answer from the options given below :

- (A) $\text{E} > \text{A} > \text{D} > \text{C} > \text{B}$ (B) $\text{E} > \text{D} > \text{A} > \text{B} > \text{C}$
(C) $\text{E} > \text{D} > \text{B} > \text{A} > \text{C}$ (D) $\text{B} > \text{E} > \text{D} > \text{A} > \text{C}$

55. In SO_2 , NO_2^- and N_3^- , the hybridizations at the central atom are respectively :

- (A) sp^2 , sp^2 and sp^2 (B) sp , sp^2 and sp
(C) sp^2 , sp and sp (D) sp^2 , sp^2 and sp

56. The number of optically active products obtained from the complete ozonolysis of the given compound is :

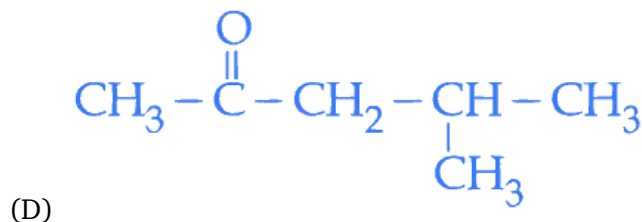
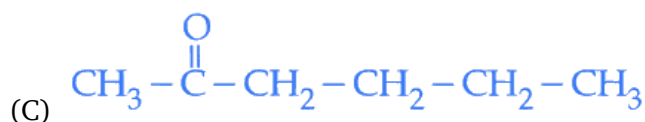
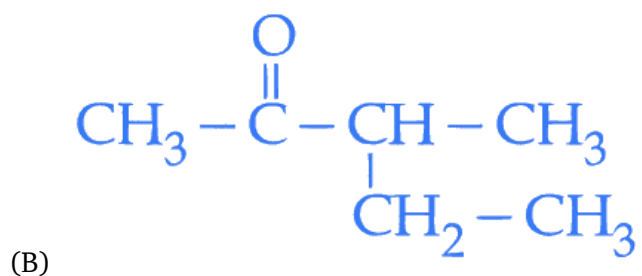
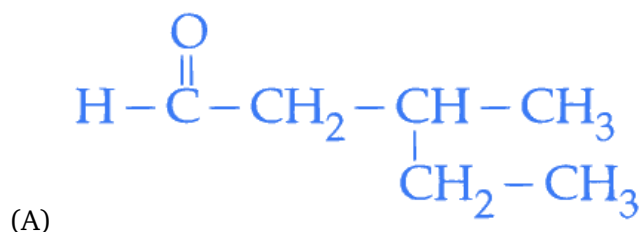


- (A) 4 (B) 0
(C) 2 (D) 1

57. A mixture of 1 g each of chlorobenzene, aniline, and benzoic acid is dissolved in 50 mL ethyl acetate and placed in a separating funnel. 5 M NaOH (30 mL) was added in the same funnel. The funnel was shaken vigorously and then kept aside. The ethyl acetate layer in the funnel contains :

- (A) chlorobenzene and aniline (B) benzoic acid and aniline
(C) benzoic acid (D) benzoic acid and chlorobenzene

58. "P" is an optically active compound with molecular formula $\text{C}_6\text{H}_{12}\text{O}$. When "P" is treated with 2, 4-dinitrophenylhydrazine, it gives a positive test. However, in presence of Tollens reagent, "P" gives a negative test. Predict the structure of "P".



59. Given below are two statements :

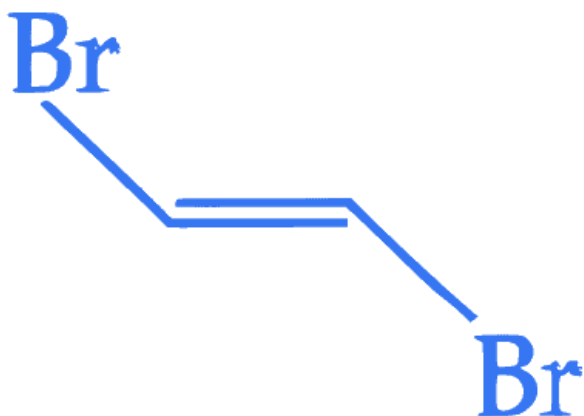
Statement (I) :



is more polar than



Statement (II) : Boiling point of



is lower than

59. (continued)



but it is more polar than



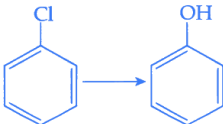
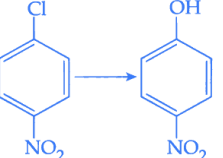
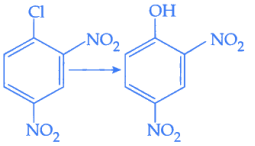
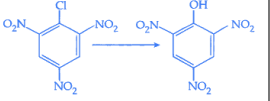
In the light of the above statements, choose the **most appropriate answer** from the options given below :

- | | |
|---|--|
| (A) Both Statement I and Statement II are correct | (B) Statement I is correct but Statement II is incorrect |
| (C) Both Statement I and Statement II are incorrect | (D) Statement I is correct but Statement II is incorrect |

60. Choose the incorrect trend in the atomic radii (r) of the elements.

- (A) $r_{\text{Rb}} < r_{\text{Cs}}$ (B) $r_{\text{At}} < r_{\text{Cs}}$
 (C) $r_{\text{Br}} < r_{\text{K}}$ (D) $r_{\text{Mg}} < r_{\text{Al}}$

61. Match List - I with List - II.

List - I (Conversion)	List - II (Reagents, Conditions used)
(A) 	(I) Warm H_2O
(B) 	(II) (a) NaOH , 368K; (b) H_3O^+
(C) 	(III) (a) NaOH , 443K; (b) H_3O^+
(D) 	(IV) (a) NaOH , 623K, 300 atm; (b) H_3O^+

Choose the **correct** answer from the options given below :

- (A) (A)-(II), (B)-(III), (C)-(I), (D)-(IV) (B) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)
 (C) (A)-(IV), (B)-(III), (C)-(I), (D)-(II) (D) (A)-(IV), (B)-(III), (C)-(II), (D)-(I)

62. Liquid A and B form an ideal solution. The vapour pressures of pure liquids A and B are 350 and 750 mm Hg respectively at the same temperature. If x_A and x_B are the mole fraction of A and B in solution while y_A and y_B are the mole fraction of A and B in vapour phase, then,

- (A) $(x_A - y_A) < (x_B - y_B)$
 (B) $\frac{x_A}{x_B} = \frac{y_A}{y_B}$
 (C) $\frac{x_A}{x_B} < \frac{y_A}{y_B}$
 (D) $\frac{x_A}{x_B} > \frac{y_A}{y_B}$

63. Match List - I with List - II.

List - I	List - II
(A) Solution of chloroform and acetone	(I) Minimum boiling azeotrope
(B) Solution of ethanol and water	(II) Dimerizes
(C) Solution of benzene and toluene	(III) Maximum boiling azeotrope
(D) Solution of acetic acid in benzene	(IV) $\Delta V_{\text{mix}} = 0$

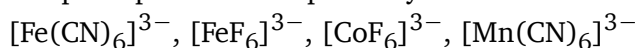
Choose the **correct answer** from the options given below :

- (A) (A)-(III), (B)-(I), (C)-(IV), (D)-(II) (B) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)
 (C) (A)-(II), (B)-(I), (C)-(IV), (D)-(III) (D) (A)-(II), (B)-(IV), (C)-(I), (D)-(III)

64. The hydration energies of K^+ and Cl^- are $-x$ and $-y$ kJ/mol respectively. If the lattice energy of KCl is $-z$ kJ/mol, then the heat of solution of KCl is :

- (A) $x + y + z$ (B) $z - (x + y)$
 (C) $-z - (x + y)$ (D) $x - y - z$

65. The number of unpaired electrons responsible for the paramagnetic nature of the following complex species are respectively :



- (A) 1, 5, 4, 2 (B) 1, 4, 4, 2
(C) 1, 5, 5, 2 (D) 1, 1, 4, 2

66. $\text{A(g)} \rightarrow \text{B(g)} + \text{C(g)}$ is a first order reaction.

Time	t	∞
P_{system}	P_t	P_{∞}

The reaction was started with reactant A only. Which of the following expressions is correct for rate constant k?

- (A) $k = \frac{1}{t} \ln \frac{P_{\infty}}{P_t}$ (B) $k = \frac{1}{t} \ln \frac{P_{\infty}}{2(P_{\infty} - P_t)}$
(C) $k = \frac{1}{t} \ln \frac{2(P_{\infty} - P_t)}{P_t}$ (D) $k = \frac{1}{t} \ln \frac{P_{\infty}}{(P_{\infty} - P_t)}$

67. Given below are two statements :

1 M aqueous solutions of each of $\text{Cu}(\text{NO}_3)_2$, AgNO_3 , $\text{Hg}_2(\text{NO}_3)_2$, $\text{Mg}(\text{NO}_3)_2$ are electrolysed using inert electrodes. Given: $E^0_{\text{Ag}^+/\text{Ag}} = 0.80 \text{ V}$, $E^0_{\text{Hg}_2^{2+}/\text{Hg}} = 0.79 \text{ V}$, $E^0_{\text{Cu}^{2+}/\text{Cu}} = 0.24 \text{ V}$ and $E^0_{\text{Mg}^{2+}/\text{Mg}} = -2.37 \text{ V}$.

Statement (I) : With increasing voltage, the sequence of deposition of metals on the cathode will be Ag, Hg and Cu.

Statement (II) : Magnesium will not be deposited at the cathode instead oxygen gas will be evolved at the cathode.

In the light of the above statements, choose the most appropriate answer from the options given below :

- (A) Both **Statement I** and **Statement II** are incorrect
(B) **Statement I** is incorrect but **Statement II** is correct
(C) **Statement I** is correct but **Statement II** is incorrect
(D) Both **Statement I** and **Statement II** are correct

68. The extra stability of half-filled subshell is due to :

- (A) Symmetrical distribution of electrons
(B) Smaller coulombic repulsion energy
(C) The presence of electrons with the same spin in non-degenerate orbitals
(D) Larger exchange energy
(E) Relatively smaller shielding of electrons by one another

Identify the correct statements :

- (A) (B), (D) and (E) only (B) (A), (B), (D) and (E) only
(C) (B), (C) and (D) only (D) (A), (B) and (D) only

69. 'X' is the number of acidic oxides among VO_2 , V_2O_3 , CrO_3 , V_2O_5 and Mn_2O_7 . The primary valency of cobalt in

$[\text{Co}(\text{H}_2\text{NCH}_2\text{CH}_2\text{NH}_2)_3]_2(\text{SO}_4)_3$ is Y. The value of X + Y is _____.

- (A) 3 (B) 4
(C) 2 (D) 5

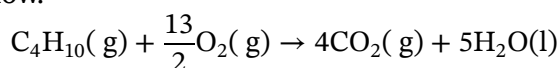
70. The correct statement amongst the following is :

- (A) The standard state of a pure gas is the pure gas at a pressure of 1 bar and temperature 273 K.
(B) $\Delta_f H_{500}^\circ$ is zero for $\text{O}_2(\text{g})$.
(C) $\Delta_f H_{298}^\circ$ is zero for $\text{O}(\text{g})$.
(D) The term 'standard state' implies that the temperature is 0°C .

Chemistry - Section B · Numerical Value Questions

71. In Dumas' method 292 mg of an organic compound released 50 mL of nitrogen gas (N_2) at 300 K temperature and 715 mm Hg pressure. The percentage composition of 'N' in the organic compound is _____ % (Nearest integer) (Aqueous tension at 300 K = 15 mmHg)

72. Butane reacts with oxygen to produce carbon dioxide and water following the equation given below.



If 174.0 kg of butane is mixed with 320.0 kg of O_2 , the volume of water formed in liters is

_____. (Nearest integer)

[Given : (a) Molar mass of C, H, O are 12, 1, 16 g mol⁻¹ respectively, (b) Density of water = 1 g mL⁻¹]

73. The number of paramagnetic metal complex species among $[Co(NH_3)_6]^{3+}$, $[Co(C_2O_4)_3]^{3-}$, $[MnCl_6]^{3-}$, $[Mn(CN)_6]^{3-}$, $[CoF_6]^{3-}$, $[Fe(CN)_6]^{3-}$ and $[FeF_6]^{3-}$ with same number of unpaired electrons is _____.

74. One litre buffer solution was prepared by adding 0.10 mol each of NH_3 and NH_4Cl in deionised water. The change in pH on addition of 0.05 mol of HCl to the above solution is _____ $\times 10^{-2}$.

(Nearest integer)

Given : pK_b of NH_3 = 4.745 and $\log_{10} 3$ = 0.477

75. Identify the structure of the final product (D) in the following sequence of the reactions :



Total number of sp^2 hybridised carbon atoms in product D is _____.

- End of Question Paper -