

JEE Main 2024 Paper 1 (B.E./B.Tech) 1

February 2024 Shift 1 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) 2024 - Session 1**, conducted by the National Testing Agency (NTA) in Computer Based Test (CBT) mode on 1 February 2024, Shift 1. The total duration is **3 hours**.
- (ii) The paper has **90 questions**, of which **75 are to be attempted**, and a maximum of **300 marks**: Mathematics, Physics and Chemistry carry 30 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 **10 numerical value questions**; attempt **any 5** of them.
- (iv) **All Section A questions are compulsory**. Attempt only the specified number of Section B questions. 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 unanswered 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. A bag contains 8 balls, whose colours are either white or black. 4 balls are drawn at random without replacement and it was found that 2 balls are white and other 2 balls are black. The probability that the bag contains equal number of white and black balls is :

- (A) $\frac{2}{5}$ (B) $\frac{2}{7}$
(C) $\frac{1}{7}$ (D) $\frac{1}{5}$

2. The value of the integral $\int_0^{\pi/4} \frac{x \, dx}{\sin^4(2x) + \cos^4(2x)}$ equals :

- (A) $\frac{\sqrt{2}\pi^2}{8}$ (B) $\frac{\sqrt{2}\pi^2}{16}$
(C) $\frac{\sqrt{2}\pi^2}{32}$ (D) $\frac{\sqrt{2}\pi^2}{64}$

3. If $A = \begin{bmatrix} \sqrt{2} & 1 \\ -1 & \sqrt{2} \end{bmatrix}$, $B = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}$, $C = ABA^T$ and $X = A^T C^2 A$, then $\det X$ is equal to :

- (A) 243 (B) 729
(C) 27 (D) 891

4. If $\tan A = \frac{1}{\sqrt{x(x^2+x+1)}}$, $\tan B = \frac{\sqrt{x}}{\sqrt{x^2+x+1}}$ and $\tan C = (x^{-3} + x^{-2} + x^{-1})^{1/2}$, $0 < A, B, C < \frac{\pi}{2}$, then $A + B$ is equal to :

- (A) C (B) $\pi - C$
(C) $2\pi - C$ (D) $\frac{\pi}{2} - C$

5. If n is the number of ways five different employees can sit into four indistinguishable offices where any office may have any number of persons including zero, then n is equal to :

- (A) 47 (B) 53
(C) 51 (D) 43

6. Let $S = \{z \in \mathbb{C} : |z - 1| = 1 \text{ and } (\sqrt{2} - 1)(z + \bar{z}) - i(z - \bar{z}) = 2\sqrt{2}\}$. Let $z_1, z_2 \in S$ be such that $|z_1| = \max_{z \in S} |z|$ and $|z_2| = \min_{z \in S} |z|$. Then $|\sqrt{2}z_1 - z_2|^2$ equals :

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

7. Let the median and the mean deviation about the median of 7 observation 170, 125, 230, 190, 210, a , b be 170 and $\frac{205}{7}$ respectively. Then the mean deviation about the mean of these 7 observations is :

- (A) 31 (B) 28
(C) 30 (D) 32

8. Let $\vec{a} = -5\hat{i} + \hat{j} - 3\hat{k}$, $\vec{b} = \hat{i} + 2\hat{j} - 4\hat{k}$ and $\vec{c} = (((\vec{a} \times \vec{b}) \times \hat{i}) \times \hat{i}) \times \hat{i}$. Then $\vec{c} \cdot (-\hat{i} + \hat{j} + \hat{k})$ is equal to :

- (A) -12 (B) -10
(C) -13 (D) -15

9. Let $S = \{x \in \mathbb{R} : (\sqrt{3} + \sqrt{2})^x + (\sqrt{3} - \sqrt{2})^x = 10\}$. Then the number of elements in S is :

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

10. The area enclosed by the curves $xy + 4y = 16$ and $x + y = 6$ is equal to :

- (A) $28 - 30 \log_e 2$ (B) $30 - 28 \log_e 2$
(C) $30 - 32 \log_e 2$ (D) $32 - 30 \log_e 2$

11. Let $f : \mathbb{R} \rightarrow \mathbb{R}$ and $g : \mathbb{R} \rightarrow \mathbb{R}$ be defined as $f(x) = \begin{cases} \log_e x, & x > 0 \\ e^{-x}, & x \leq 0 \end{cases}$ and $g(x) = \begin{cases} x, & x \geq 0 \\ e^x, & x < 0 \end{cases}$. Then, $g \circ f : \mathbb{R} \rightarrow \mathbb{R}$ is :

- (A) one-one but not onto (B) neither one-one nor onto
(C) onto but not one-one (D) both one-one and onto

12. If the system of equations

$$2x + 3y - z = 5$$

$$x + \alpha y + 3z = -4$$

$$3x - y + \beta z = 7$$

has infinitely many solutions, then $13\alpha\beta$ is equal to :

- (A) 1110 (B) 1120
(C) 1210 (D) 1220

13. For $0 < \theta < \pi/2$, if the eccentricity of the hyperbola

$x^2 - y^2 \operatorname{cosec}^2 \theta = 5$ is $\sqrt{7}$ times eccentricity of the ellipse $x^2 \operatorname{cosec}^2 \theta + y^2 = 5$, then the value of θ is :

- (A) $\frac{\pi}{6}$ (B) $\frac{5\pi}{12}$
(C) $\frac{\pi}{3}$ (D) $\frac{\pi}{4}$

14. Let $y = y(x)$ be the solution of the differential equation

$$\frac{dy}{dx} = 2x(x+y)^3 - x(x+y) - 1, y(0) = 1.$$

Then, $\left(\frac{1}{\sqrt{2}} + y\left(\frac{1}{\sqrt{2}}\right)\right)^2$ equals :

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

15. Let $f : \mathbf{R} \rightarrow \mathbf{R}$ be defined as :

$$f(x) = \begin{cases} \frac{a-b\cos 2x}{x^2}; & x < 0 \\ x^2 + cx + 2; & 0 \leq x \leq 1 \\ 2x + 1; & x > 1 \end{cases}$$

If f is continuous everywhere in $\mathbf{R}$ and m is the number of points where f is NOT differential then $m + a + b + c$ equals :

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

16. Let $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1, a > b$ be an ellipse, whose eccentricity is $\frac{1}{\sqrt{2}}$ and the length of the latusrectum is $\sqrt{14}$. Then the square of the eccentricity of $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ is :

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

17. Let $3, a, b, c$ be in A.P and $3, a-1, b+1, c+9$ be in G.P. Then, the arithmetic mean of a, b and c is :

- (A) -4 (B) -1
(C) 13 (D) 11

18. Let $C : x^2 + y^2 = 4$ and $C' : x^2 + y^2 - 4\lambda x + 9 = 0$ be two circles. If the set of all values of λ so that the circles C and C' intersect at two distinct points, is $\mathbf{R} - [a, b]$, then the point $(8a + 12, 16b - 20)$ lies on the curve :

- (A) $x^2 + 2y^2 - 5x + 6y = 3$
(B) $5x^2 - y = -11$
(C) $x^2 - 4y^2 = 7$
(D) $6x^2 + y^2 = 42$

19. If $5f(x) + 4f\left(\frac{1}{x}\right) = x^2 - 2, \forall x \neq 0$ and $y = 9x^2 f(x)$, then y is strictly increasing in :

- (A) $\left(0, \frac{1}{\sqrt{5}}\right) \cup \left(\frac{1}{\sqrt{5}}, \infty\right)$
(B) $\left(-\frac{1}{\sqrt{5}}, 0\right) \cup \left(\frac{1}{\sqrt{5}}, \infty\right)$
(C) $\left(-\frac{1}{\sqrt{5}}, 0\right) \cup \left(0, \frac{1}{\sqrt{5}}\right)$
(D) $\left(-\infty, \frac{1}{\sqrt{5}}\right) \cup \left(0, \frac{1}{\sqrt{5}}\right)$

20. If the shortest distance between the lines $\frac{x-\lambda}{-2} = \frac{y-2}{1} = \frac{z-1}{1}$ and $\frac{x-\sqrt{3}}{1} = \frac{y-1}{-2} = \frac{z-2}{1}$ is 1, then the sum of all possible values of λ is :

- (A) 0 (B) $2\sqrt{3}$
(C) $3\sqrt{3}$ (D) $-2\sqrt{3}$

21. If $x = x(t)$ is the solution of the differential equation $(t+1)dx = (2x + (t+1)^4) dt$, $x(0) = 2$, then, $x(1)$ equals _____.

22. The number of elements in the set

$$S = \{(x, y, z) : x, y, z \in \mathbf{Z}, x + 2y + 3z = 42, x, y, z \geq 0\}$$

equals _____.

23. If the Coefficient of x^{30} in the expansion of $(1 + \frac{1}{x})^6 (1 + x^2)^7 (1 - x^3)^8$; $x \neq 0$ is α , then $|\alpha|$ equals _____.

24. Let $3, 7, 11, 15, \dots, 403$ and $2, 5, 8, 11, \dots, 404$ be two arithmetic progressions. Then the sum, of the common terms in them, is equal to _____.

25. Let $\{x\}$ denote the fractional part of x and $f(x) = \frac{\cos^{-1}(1-\{x\}^2) \sin^{-1}(1-\{x\})}{\{x\} - \{x\}^3}$, $x \neq 0$. If L and R respectively denotes the left hand limit and the right hand limit of $f(x)$ at $x = 0$, then $\frac{32}{\pi^2} (L^2 + R^2)$ is equal to _____.

26. Let the line $L : \sqrt{2}x + y = \alpha$ pass through the point of the intersection P (in the first quadrant) of the circle $x^2 + y^2 = 3$ and the parabola $x^2 = 2y$. Let the line L touch two circles C_1 and C_2 of equal radius $2\sqrt{3}$. If the centres Q_1 and Q_2 of the circles C_1 and C_2 lie on the y -axis, then the square of the area of the triangle PQ_1Q_2 is equal to _____.

27. Let $P = \{z \in \mathbb{C} : |z + 2 - 3i| \leq 1\}$ and $Q = \{z \in \mathbb{C} : z(1+i) + \bar{z}(1-i) \leq -8\}$. Let in $P \cap Q$, $|z - 3 + 2i|$ be maximum and minimum at z_1 and z_2 respectively. If $|z_1|^2 + 2|z_2|^2 = \alpha + \beta\sqrt{2}$, where α, β are integers, then $\alpha + \beta$ equals _____.

28. If $\int_{-\pi/2}^{\pi/2} \frac{8\sqrt{2} \cos x \, dx}{(1+e^{\sin x})(1+\sin^4 x)} = \alpha\pi + \beta \log_e(3 + 2\sqrt{2})$, where α, β are integers, then $\alpha^2 + \beta^2$ equals :

29. Let the line of the shortest distance between the lines

$$L_1 : \vec{r} = (\hat{i} + 2\hat{j} + 3\hat{k}) + \lambda(\hat{i} - \hat{j} + \hat{k}) \text{ and}$$

$$L_2 : \vec{r} = (4\hat{i} + 5\hat{j} + 6\hat{k}) + \mu(\hat{i} + \hat{j} - \hat{k})$$

intersect L_1 and L_2 at P and Q respectively. If (α, β, γ) is the mid point of the line segment PQ, then $2(\alpha + \beta + \gamma)$ is equal to _____.

30. Let $A = \{1, 2, 3, \dots, 20\}$. Let R_1 and R_2 two relation on A such that

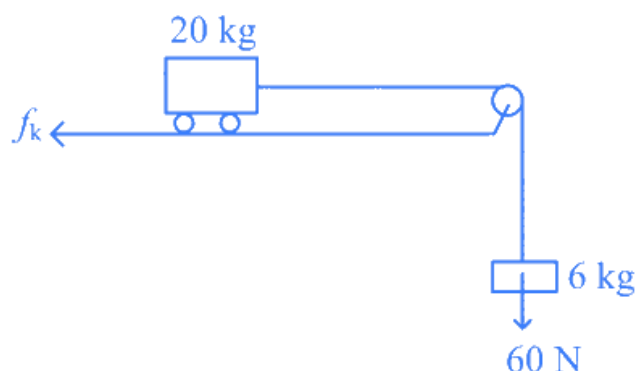
$$R_1 = \{(a, b) : b \text{ is divisible by } a\}$$

$$R_2 = \{(a, b) : a \text{ is an integral multiple of } b\}.$$

Then, number of elements in $R_1 - R_2$ is equal to _____.

31. Consider a block and trolley system as shown in figure. If the coefficient of kinetic friction between the trolley and the surface is 0.04, the acceleration of the system in ms^{-2} is :

(Consider that the string is massless and un-stretchable and the pulley is also massless and frictionless) :



- (A) 1.2 (B) 4
(C) 3 (D) 2

32. If R is the radius of the earth and the acceleration due to gravity on the surface of earth is $g = \pi^2 \text{ m/s}^2$, then the length of the second's pendulum at a height $h = 2R$ from the surface of earth will be, :

- (A) $\frac{1}{9} \text{ m}$ (B) $\frac{8}{9} \text{ m}$
(C) $\frac{2}{9} \text{ m}$ (D) $\frac{4}{9} \text{ m}$

33. 10 divisions on the main scale of a Vernier calliper coincide with 11 divisions on the Vernier scale. If each division on the main scale is of 5 units, the least count of the instrument is :

- (A) $\frac{5}{11}$ (B) $\frac{10}{11}$
(C) $\frac{50}{11}$ (D) $\frac{1}{2}$

34. Two moles of a monoatomic gas is mixed with six moles of a diatomic gas. The molar specific heat of the mixture at constant volume is :

- (A) $\frac{3}{2}R$ (B) $\frac{7}{4}R$
(C) $\frac{5}{2}R$ (D) $\frac{9}{4}R$

35. The dimensional formula of angular impulse is :

- (A) $[\text{ML}^2 \text{T}^{-2}]$ (B) $[\text{ML}^{-2} \text{T}^{-1}]$
(C) $[\text{ML}^2 \text{T}^{-1}]$ (D) $[\text{MLT}^{-1}]$

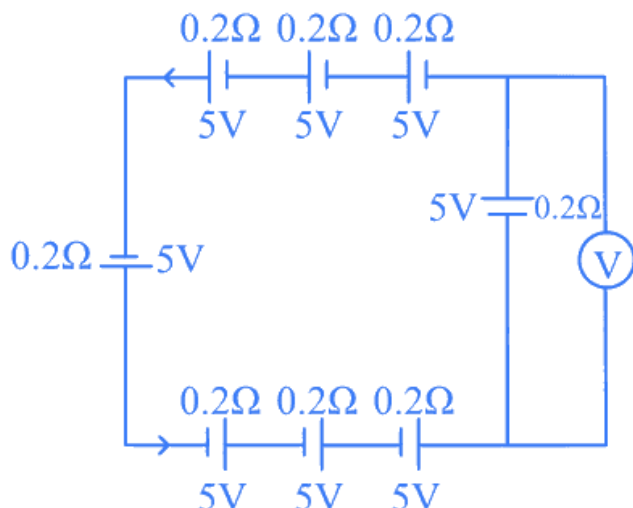
36. A monochromatic light of wavelength $6000 \text{ \AA}$ is incident on the single slit of width 0.01 mm . If the diffraction pattern is formed at the focus of the convex lens of focal length 20 cm , the linear width of the central maximum is :

- (A) 12 mm (B) 24 mm
(C) 60 mm (D) 120 mm

37. A ball of mass 0.5 kg is attached to a string of length 50 cm . The ball is rotated on a horizontal circular path about its vertical axis. The maximum tension that the string can bear is 400 N . The maximum possible value of angular velocity of the ball in rad/s is, :

- (A) 1600 (B) 20
(C) 40 (D) 1000

38. The reading in the ideal voltmeter (V) shown in the given circuit diagram is :



- (A) 3 V (B) 10 V
(C) 5 V (D) 0 V

39. A galvanometer has a resistance of $50\ \Omega$ and it allows maximum current of $5\ \text{mA}$. It can be converted into voltmeter to measure upto $100\ \text{V}$ by connecting in series a resistor of resistance :

- (A) $19500\ \Omega$ (B) $5975\ \Omega$
(C) $20050\ \Omega$ (D) $19950\ \Omega$

40. The minimum energy required by a hydrogen atom in ground state to emit radiation in Balmer series is nearly :

- (A) $13.6\ \text{eV}$ (B) $1.5\ \text{eV}$
(C) $12.1\ \text{eV}$ (D) $1.9\ \text{eV}$

41. A parallel plate capacitor has a capacitance $C = 200\ \text{pF}$. It is connected to $230\ \text{V}$ ac supply with an angular frequency $300\ \text{rad/s}$. The rms value of conduction current in the circuit and displacement current in the capacitor respectively are :

- (A) $14.3\ \mu\text{A}$ and $143\ \mu\text{A}$ (B) $13.8\ \mu\text{A}$ and $13.8\ \mu\text{A}$
(C) $13.8\ \mu\text{A}$ and $138\ \mu\text{A}$ (D) $1.38\ \mu\text{A}$ and $1.38\ \mu\text{A}$

42. The de Broglie wavelengths of a proton and an α particle are λ and 2λ respectively. The ratio of the velocities of proton and α particle will be :

- (A) $8 : 1$ (B) $1 : 2$
(C) $1 : 8$ (D) $4 : 1$

43. The radius (r), length (l) and resistance (R) of a metal wire was measured in the laboratory as

$$r = (0.35 \pm 0.05)\ \text{cm}$$

$$R = (100 \pm 10)\ \text{ohm}$$

$$l = (15 \pm 0.2)\ \text{cm}$$

The percentage error in resistivity of the material of the wire is :

- (A) 37.3% (B) 25.6%
(C) 35.6% (D) 39.9%

44. Two identical capacitors have same capacitance C . One of them is charged to the potential V and other to the potential $2V$. The negative ends of both are connected together. When the positive ends are also joined together, the decrease in energy of the combined system is :

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

45. A simple pendulum of length 1 m has a wooden bob of mass 1 kg. It is struck by a bullet of mass 10^{-2} kg moving with a speed of $2 \times 10^2 \text{ ms}^{-1}$. The bullet gets embedded into the bob. The height to which the bob rises before swinging back is. (use $g = 10 \text{ m/s}^2$)

- (A) 0.20 m (B) 0.40 m
(C) 0.30 m (D) 0.35 m

46. The pressure and volume of an ideal gas are related as $PV^{\frac{3}{2}} = K$ (Constant). The work done when the gas is taken from state $A(P_1, V_1, T_1)$ to state $B(P_2, V_2, T_2)$ is :

- (A) $2(P_2\sqrt{V_2} - P_1\sqrt{V_1})$
(B) $2(\sqrt{P_1}V_1 - \sqrt{P_2}V_2)$
(C) $2(P_2V_2 - P_1V_1)$
(D) $2(P_1V_1 - P_2V_2)$

47. In series LCR circuit, the capacitance is changed from C to $4C$. To keep the resonance frequency unchanged, the new inductance should be:

- (A) increased by 2 L (B) reduced by $\frac{1}{4}$ L
(C) reduced by $\frac{3}{4}$ L (D) increased to 4 L

48. A particle moving in a circle of radius R with uniform speed takes time T to complete one revolution.

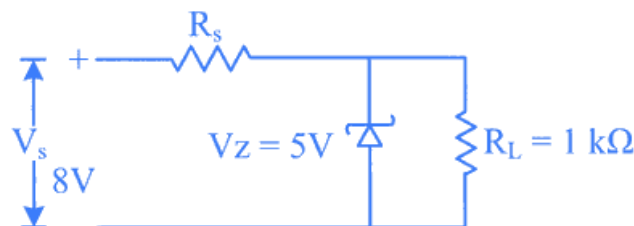
If this particle is projected with the same speed at an angle θ to the horizontal, the maximum height attained by it is equal to $4R$. The angle of projection θ is then given by :

- (A) $\sin^{-1} \left[\frac{2gT^2}{\pi^2 R} \right]^{\frac{1}{2}}$ (B) $\sin^{-1} \left[\frac{\pi^2 R}{2gT^2} \right]^{\frac{1}{2}}$
(C) $\cos^{-1} \left[\frac{\pi R}{2gT^2} \right]^{\frac{1}{2}}$ (D) $\cos^{-1} \left[\frac{2gT^2}{\pi^2 R} \right]^{\frac{1}{2}}$

49. With rise in temperature, the Young's modulus of elasticity :

- (A) changes erratically (B) increases
(C) decreases (D) remains unchanged

50. In the given circuit if the power rating of Zener diode is 10 mW, the value of series resistance R_s to regulate the input unregulated supply is :



- (A) $10\text{k}\Omega$
(B) 10Ω
(C) $1\text{k}\Omega$
(D) $\frac{3}{7}\text{k}\Omega < R_s < \frac{3}{5}\text{k}\Omega$

51. A rectangular loop of sides 12 cm and 5 cm, with its sides parallel to the x -axis and y -axis respectively, moves with a velocity of 5 cm/s in the positive x axis direction, in a space containing a variable magnetic field in the positive z direction. The field has a gradient of 10^{-3} T/cm along the negative x direction and it is decreasing with time at the rate of 10^{-3} T/s. If the resistance of the loop is $6\text{ m}\Omega$, the power dissipated by the loop as heat is $\text{_____} \times 10^{-9}$ W.

52. A plane is in level flight at constant speed and each of its two wings has an area of 40 m^2 . If the speed of the air is 180 km/h over the lower wing surface and 252 km/h over the upper wing surface, the mass of the plane is _____ kg. (Take air density to be 1 kg m^{-3} and $g = 10\text{ ms}^{-2}$)

53. Two identical charged spheres are suspended by strings of equal lengths. The strings make an angle θ with each other. When suspended in water the angle remains the same. If density of the material of the sphere is 1.5 g/cc , the dielectric constant of water will be _____ . (Take density of water = 1 g/cc)

54. A particle is moving in one dimension (along x axis) under the action of a variable force. Its initial position was 16 m right of origin. The variation of its position (x) with time (t) is given as $x = -3t^3 + 18t^2 + 16t$, where x is in m and t is in s.

The velocity of the particle when its acceleration becomes zero is _____ m/s.

55. The radius of a nucleus of mass number 64 is 4.8 fermi. Then the mass number of another nucleus having radius of 4 fermi is $\frac{1000}{x}$, where x is _____ .

56. A regular polygon of 6 sides is formed by bending a wire of length 4π meter.

If an electric current of $4\pi\sqrt{3}$ A is flowing through the sides of the polygon, the magnetic field at the centre of the polygon would be $x \times 10^{-7}$ T.

The value of x is _____ .

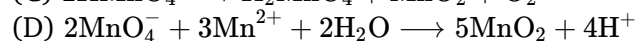
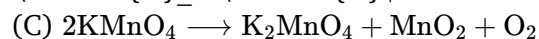
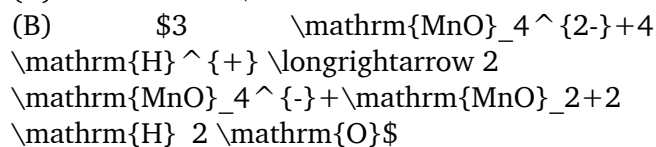
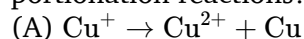
57. The distance between object and its 3 times magnified virtual image as produced by a convex lens is 20 cm. The focal length of the lens used is _____ cm.

58. Three identical spheres each of mass $2M$ are placed at the corners of a right angled triangle with mutually perpendicular sides equal to 4 m each. Taking point of intersection of these two sides as origin, the magnitude of position vector of the centre of mass of the system is $\frac{4\sqrt{2}}{x}$, where the value of x is _____ .

59. A tuning fork resonates with a sonometer wire of length 1 m stretched with a tension of 6 N. When the tension in the wire is changed to 54 N, the same tuning fork produces 12 beats per second with it. The frequency of the tuning fork is _____ Hz.

60. The current in a conductor is expressed as $I = 3t^2 + 4t^3$, where I is in Ampere and t is in second. The amount of electric charge that flows through a section of the conductor during $t = 1\text{ s}$ to $t = 2\text{ s}$ is _____ C.

61. Which of the following reactions are disproportionation reactions?



Choose the correct answer from the options given below :

(A) (A), (B)

(B) (A), (D)

(C) (B), (C), (D)

(D) (A), (B), (C)

62. Choose the correct option for free expansion of an ideal gas under adiabatic condition from the following :

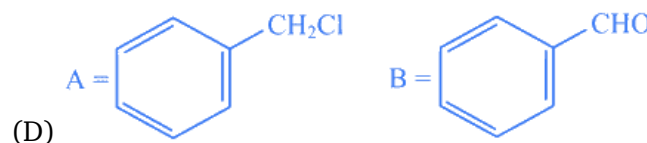
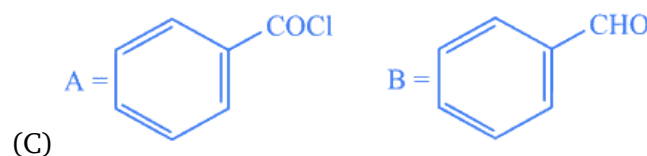
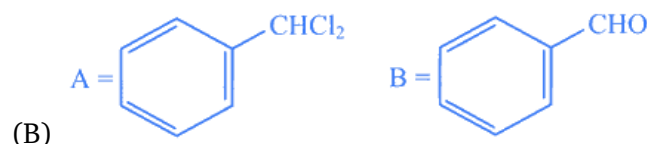
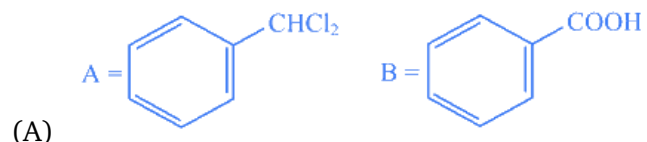
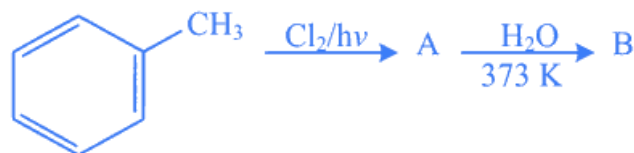
(A) $q = 0, \Delta T = 0, w = 0$

(B) $q = 0, \Delta T \neq 0, w = 0$

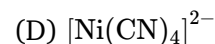
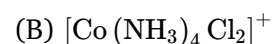
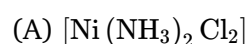
(C) $q \neq 0, \Delta T = 0, w = 0$

(D) $q = 0, \Delta T < 0, w \neq 0$

63. Identify A and B in the following sequence of reaction



64. Which of the following complex is homoleptic?



65. In Kjeldahl's method for estimation of nitrogen, CuSO_4 acts as :

(A) catalytic agent

(B) hydrolysis agent

(C) reducing agent

(D) oxidising agent

66. Given below are two statements :

Statement (I) : Potassium hydrogen phthalate is a primary standard for standardisation of sodium hydroxide solution.

Statement (II) : In this titration phenolphthalein can be used as indicator.

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

67. In case of isoelectronic species the size of F^- , Ne and Na^+ is affected by :

- | | |
|---|--|
| (A) Nuclear charge (z) | (B) None of the factors because their size is the same |
| (C) Electron-electron interaction in the outer orbitals | (D) Principal quantum number (n) |

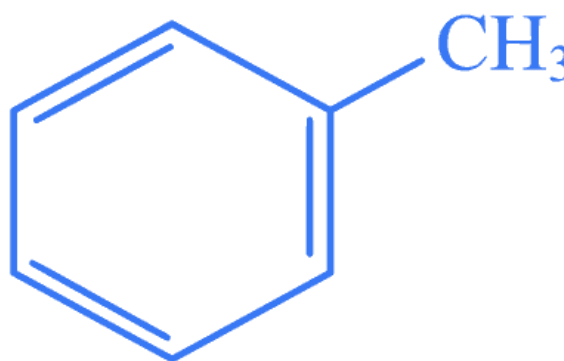
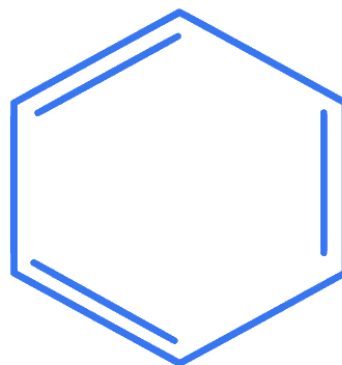
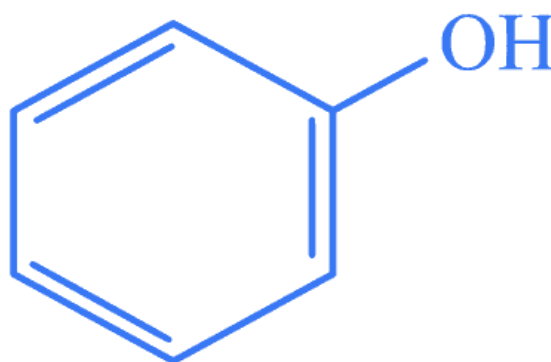
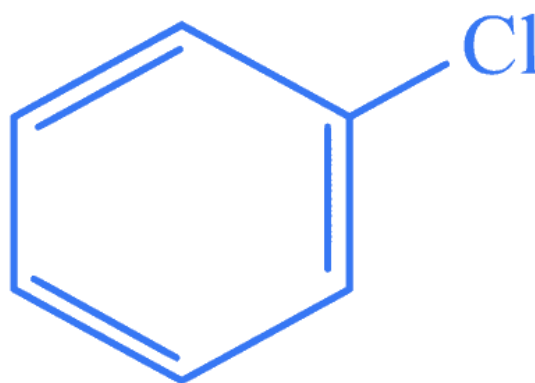
68. Ionic reactions with organic compounds proceed through :

- (A) homolytic bond cleavage
- (B) heterolytic bond cleavage
- (C) free radical formation
- (D) primary free radical
- (E) secondary free radical

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

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

69. Which of the following compound will most easily be attacked by an electrophile?



70. Given below are two statements :

Statement (I) : A solution of $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ is green in colour.

Statement (II) : A solution of $[\text{Ni}(\text{CN})_4]^{2-}$ is colourless.

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

71. We have three aqueous solutions of NaCl labelled as ' A ', ' B ' and ' C ' with concentration 0.1M, 0.01M and 0.001M, respectively. The value of van 't Hoff factor(i) for these solutions will be in the order :

- | | |
|-----------------------|-----------------------|
| (A) $i_A < i_C < i_B$ | (B) $i_A < i_B < i_C$ |
| (C) $i_A > i_B > i_C$ | (D) $i_A = i_B = i_C$ |

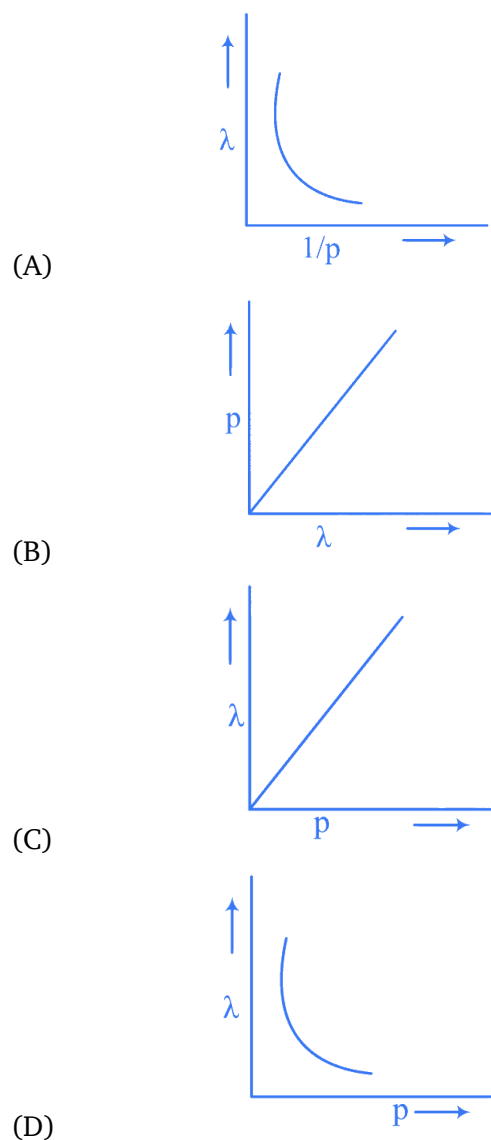
72. Given below are two statements :

Statement (I) : The NH_2 group in Aniline is ortho and para directing and a powerful activating group.

Statement (II) : Aniline does not undergo Friedel-Craft's reaction (alkylation and acylation). 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) Both Statement I and Statement II are incorrect |
| (C) Statement I is correct but Statement II is incorrect | (D) Statement I is incorrect but Statement II is correct |

73. According to the wave-particle duality of matter by de-Broglie, which of the following graph plot presents most appropriate relationship between wavelength of electron (λ) and momentum of electron (p)?



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

Assertion (A): PH_3 has lower boiling point than NH_3 .

Reason (R) : In liquid state NH_3 molecules are associated through vander Waal's forces, but PH_3 molecules are associated through hydrogen bonding.

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) |
-

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

Assertion (A) : Haloalkanes react with KCN to form alkyl cyanides as a main product while with AgCN form isocyanide as the main product.

Reason (R) : KCN and AgCN both are highly ionic compounds.

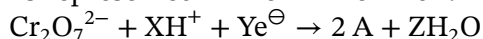
In the light of the above statements, choose the **most appropriate** answer from the options given below :

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

76. If one strand of a DNA has the sequence ATGCTTCA, sequence of the bases in complementary strand is :

- | | |
|--------------|--------------|
| (A) CATTAGCT | (B) TACGAAGT |
| (C) ATGCGACT | (D) GTACTTAC |
-

77. In acidic medium, $K_2Cr_2O_7$ shows oxidising action as represented in the half reaction:



X, Y, Z and A are respectively are :

- (A) 14, 7, 6 and Cr^{3+} (B) 14, 6, 7 and Cr^{3+}
 (C) 8, 4, 6 and Cr_2O_3 (D) 8, 6, 4 and Cr_2O_3

78. Given below are two statements :

Statement (I) : Aminobenzene and aniline are same organic compounds.

Statement (II) : Aminobenzene and aniline are different organic compounds.

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 incorrect but Statement II is correct
 (C) Statement I is correct but Statement II is incorrect (D) Both Statement I and Statement II are incorrect

79. Match List - I with List - II.

List I (Reactions)	List II (Reagents)
(A) $CH_3(CH_2)_8 - \overset{\overset{O}{\parallel}}{C} - OC_2H_5 \rightarrow CH_3(CH_2)_8CHO$	(I) CH_3MgBr, H_2O
(B) $C_6H_5COC_6H_5 \rightarrow C_6H_5CH_2C_6H_5$	(II) $Zn(Hg)$ and conc. HCl
(C) $C_6H_5CHO \rightarrow C_6H_5CH(OH)CH_3$	(III) $NaBH_4, H^+$
(D) $CH_3COCH_2COOC_2H_5 \rightarrow \begin{array}{c} CH_3C(OH)CH_2COOC_2H_5 \\ \\ H \end{array}$	(IV) DIBAL-H, H_2O

Choose the correct answer from the options given below :

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

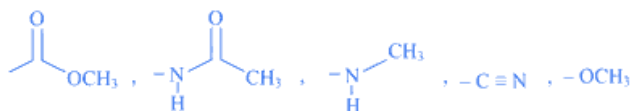
80. Arrange the bonds in order of increasing ionic character in the molecules. LiF, K_2O, N_2, SO_2 and ClF_3 :

- (A) $N_2 < SO_2 < ClF_3 < K_2O < LiF$
 (B) $ClF_3 < N_2 < SO_2 < K_2O < LiF$
 (C) $LiF < K_2O < ClF_3 < SO_2 < N_2$
 (D) $N_2 < ClF_3 < SO_2 < K_2O < LiF$

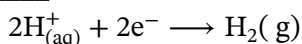
81. The number of white coloured salts, among the following is

- SrSO_4
- $\text{Mg}(\text{NH}_4)\text{PO}_4$
- BaCrO_4
- $\text{Mn}(\text{OH})_2$
- PbSO_4
- PbCrO_4
- AgBr
- PbI_2
- CaC_2O_4
- $[\text{Fe}(\text{OH})_2(\text{CH}_3\text{COO})]$

82. Total number of deactivating groups in aromatic electrophilic substitution reaction among the following is _____.



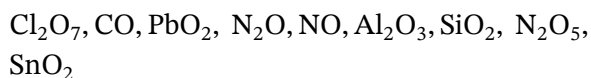
83. The potential for the given half cell at 298 K is (-) _____ $\times 10^{-2}$ V



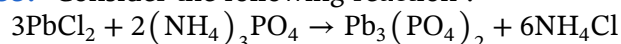
$$[\text{H}^+] = 1\text{M}, P_{\text{H}_2} = 2\text{atm}$$

(Given : $2.303RT/F = 0.06\text{ V}$, $\log 2 = 0.3$)

84. Among the following oxides of p-block elements, number of oxides having amphoteric nature is _____.

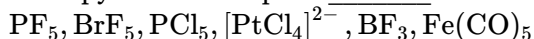


85. Consider the following reaction :



If 72 mmol of PbCl_2 is mixed with 50 mmol of $(\text{NH}_4)_3\text{PO}_4$, then the amount of $\text{Pb}_3(\text{PO}_4)_2$ formed is _____ mmol (nearest integer).

86. The number of molecules/ion/s having trigonal bipyramidal shape is _____.



87. The lowest oxidation number of an atom in a compound A_2B is -2. The number of electrons in its valence shell is _____.

88. K_a for CH_3COOH is 1.8×10^{-5} and K_b for NH_4OH is 1.8×10^{-5} . The pH of ammonium acetate solution will be _____.

89. Number of optical isomers possible for 2-chlorobutane _____.

90. The ratio of $\frac{^{14}\text{C}}{^{12}\text{C}}$ in a piece of wood is $\frac{1}{8}$ part that of atmosphere. If half life of ^{14}C is 5730 years, the age of wood sample is _____ years.

- End of Question Paper -