Jee Main 2024 Feb 1 Shift I Question Paper

Question 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:

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

(2) $\frac{2}{7}$

(3) $\frac{1}{7}$

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

Question 2: The value of the integral

$$\int_0^{\frac{\pi}{4}} \frac{x\,dx}{\sin^4(2x) + \cos^4(2x)} \text{ equals:}$$

(1) $\frac{\sqrt{2}\pi^2}{8}$

(2) $\frac{\sqrt{2}\pi^2}{16}$

(3) $\frac{\sqrt{2}\pi^2}{32}$

(4) $\frac{\sqrt{2}\pi^2}{64}$

Question 3: If

$$A = \begin{bmatrix} \sqrt{2} & 1 \\ -1 & \sqrt{2} \end{bmatrix}, \quad B = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}, \quad C = ABA^T \text{ and } X = A^T C^2 A,$$

then det(X) is equal to:

(1) 243

(2) 729

(3) 27

(4) 891

Question 4: If $\tan A = \frac{1}{\sqrt{x(x^2+x+1)}}$, $\tan B = \frac{\sqrt{x}}{\sqrt{x^2+x+1}}$

and

$\tan C = \left(x^3 + x^2 + x\right)^{\frac{1}{2}}$, $0 < A, B, C < \frac{\pi}{2}$, **then**

$A + B$ is equal to:

$$(1)\ C\ (2)\ \pi - C\ (3)\ 2\pi - C\ (4)\ \frac{\pi}{2} - C$$

Q5: 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:

(1) 47

(2) 53

(3) 51

(4) 43

Question 6: Let $S = \{z \in \mathbb{C} : |z-1| = 1$ **and** $(\sqrt{2}-1)(z+\bar{z}) = (\bar{z}-z) = 2\sqrt{2}\}$. **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** $\sqrt{|z_1 - z_2|^2}$ **equals:**

(1) 1

(2) 4

(3) 3

(4) 2

Question 7: Let the median and the mean deviation about the median of 7 observations

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:

(1) 31

(2) 28

(3) 30

(4) 32

Question 8: Let $\vec{a} = -5\vec{i} + 3\vec{j} - 3\vec{k}$, $\vec{b} = \vec{i} + 2\vec{j} - 4\vec{k}$ **and**

$$\vec{c} = \left(\left((\vec{a} \times \vec{b}) \times \vec{i} \right) \times \vec{i} \right)$$

Then $\vec{c} \cdot \left(-\vec{i} + \vec{j} + \vec{k} \right)$ is equal to:

(1) -12

(2) -10

(3) -13

(4) -15

Question 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:

(1) 4

(2) 0

(3) 2

(4) 1

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

(1) $28 - 30 \log 2$

(2) $30 - 28 \log 2$

(3) $30 - 32 \log 2$

(4) $32 - 30 \log 2$

Question 11: Let $f : \mathbb{R} \to \mathbb{R}$ **and** $g : \mathbb{R} \to \mathbb{R}$ **be defined as**

$$f(x) = \begin{cases} \log_e x, & x > 0 \\ e^{-x}, & x \leq 0 \end{cases} \quad \text{and} \quad g(x) = \begin{cases} x, & x \geq 0 \\ e^x, & x < 0 \end{cases}$$

Then $g \circ f : \mathbb{R} \to \mathbb{R}$ is:

(1) one-one but not onto

(2) neither one-one nor onto

(3) onto but not one-one

(4) both one-one and onto

Question 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:

(1) 1110

(2) 1120

(3) 1210

(4) 1220

Question 13: For $0 < \theta < \frac{\pi}{2}$**, if the eccentricity of the hyperbola** $x^2 - y^2 cosec^2\theta = 5$ **is** $\sqrt{7}$ **times the eccentricity of the ellipse** $x^2 cosec^2\theta + y^2 = 5$**, then the value of** θ **is:**

(1) $\frac{\pi}{6}$

(2) $\frac{5\pi}{12}$

(3) $\frac{\pi}{3}$

(4) $\frac{\pi}{4}$

Question 14: Let $y = y(x)$ **be the solution of the differential equation**

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

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

(1) $\frac{4}{4+\sqrt{e}}$

(2) $\frac{3}{3-\sqrt{e}}$

(3) $\frac{2}{1+\sqrt{e}}$

(4) $\frac{1}{2-\sqrt{e}}$

Question 15: Let $f : \mathbb{R} \to \mathbb{R}$ **be defined as**

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

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

(1) 1

(2) 4

(3) 3

(4) 2

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

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

(2) $\frac{7}{2}$

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

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

Question 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, c **is:**

(1) -4

(2) -1

(3) 13

(4) 11

Question 18: Let $C_1 : x^2 + y^2 = 4$ **and** $C_2 : x^2 + y^2 - 4x + 9 = 0$ **be two circles. If the set of all values of** x **so that the circles** C_1 **and** C_2 **intersect at two distinct points lies in the interval** $R = [a, b]$**, then the point** $(8a + 12, 16b - 20)$ **lies on the curve:**

(1) $x^2 + 2y^2 - 5x + 6y = 3$

(2) $5x^2 - y = -11$

(3) $x^2 - 4y^2 = 7$

(4) $6x^2 + y^2 = 42$

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

(1) $\left(0, \frac{1}{\sqrt{5}}\right) \cup \left(\frac{1}{\sqrt{5}}, \infty\right)$

(2) $\left(-\frac{1}{\sqrt{5}}, 0\right) \cup \left(\frac{1}{\sqrt{5}}, \infty\right)$

(3) $\left(0, \frac{1}{\sqrt{5}}\right) \cup \left(0, \frac{1}{\sqrt{5}}\right)$

(4) $\left(-\infty, \frac{1}{\sqrt{5}}\right) \cup \left(0, \frac{1}{\sqrt{5}}\right)$

Question 20: If the shortest distance between the lines

$$\frac{x - \lambda}{2} = \frac{y - 2}{1} = \frac{z - 1}{1}$$

and

$$\frac{x - \frac{1}{\sqrt{3}}}{1} = \frac{y - 1}{-2} = \frac{z - 2}{1}$$

is 1, then the sum of all possible values of λ is:

(1) 0

(2) $2\sqrt{3}$

(3) $3\sqrt{3}$

(4) $-2\sqrt{3}$

Question 21: If $x = x(t)$ is the solution of the differential equation

$$(t+1)dx = (2x + (t+1)^4)dt, \quad x(0) = 2$$

then, $x(1)$ equals:

Question 22: The number of elements in the set

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

Question 23: If the coefficient of x^{30} in the expansion of

$$\left(1 + \frac{1}{x}\right)^6 \left(1 + x^2\right)^7 \left(1 - x^3\right)^8$$

is α, then $|\alpha|$ equals:

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

Question 25: Let $\{x\}$ denote the fractional part of x and

$$f(x) = \cos^{-1}(1 - \{x\}^2)\sin^{-1}(1 - \{x\}), \quad x \neq 0.$$

If L and R respectively denote 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 __.

Question 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 $2\sqrt{5}$. If the centers 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 _____.

Question 27: Let $P = \{z \in \mathbb{C} : |z + 2 - 3i| \leq 1\}$ and $Q = \{z \in \mathbb{C} : |z - (1 - 5i)| < 8\}$. Let in $P \cap Q$, $|z - 3 + 2i|$ be maximum and minimum at z_1 and z_2 respectively. If $|z_1|^2 + |z_2|^2 = \alpha + \beta\sqrt{5}$, where α, β are integers, then $\alpha + \beta$ equals ___.

Q28: If
$$\int_0^{\frac{\pi}{2}} \frac{8\sqrt{2}\cos x \, dx}{(1 + e^{\sin x})(1 + \sin^4 x)} = \alpha x + \beta \log(3 + 2\sqrt{2}),$$
where α, β are integers, then $\alpha^2 + \beta^2$ equals __.

Question 29: Let the line of the shortest distance between the lines

$$L_1 : \mathbf{r} = (1 + 2j + 3k) + \lambda(i - j + k) \quad \textbf{and} \quad L_2 : \mathbf{r} = (-4i + 5j + 6k) + \mu(i + j - k)$$

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

Question 30: Let $A = \{1, 2, 3, \ldots, 20\}$. Let R_1 and R_2 be two relations on A such that

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

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

Then, the number of elements in $R_1 - R_2$ is equal to:

Question 31: How does the Young's modulus of elasticity change with an increase in temperature?

(1) Varies unpredictably

(2) Decreases

(3) Increases

(4) Remains constant

Question 32: If the radius of the Earth is R and the acceleration due to gravity on the Earth's surface is $g = \pi^2 \, \text{m/s}^2$, what will be the length of the second's pendulum at a height $h = 2R$ from the surface?
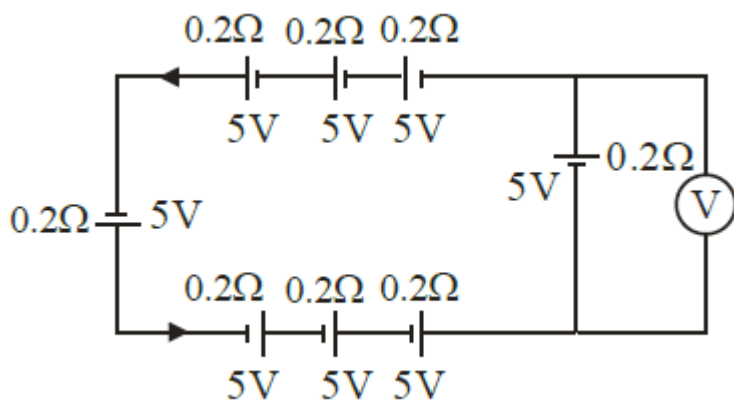
(1) $\frac{2}{9}$ m

(2) $\frac{1}{9}$ m

(3) $\frac{4}{9}$ m

(4) $\frac{8}{9}$ m

Question 33: In the circuit shown, if the power rating of the Zener diode is 10 mW, what is the value of the series resistance R_s required to regulate the input unregulated supply?
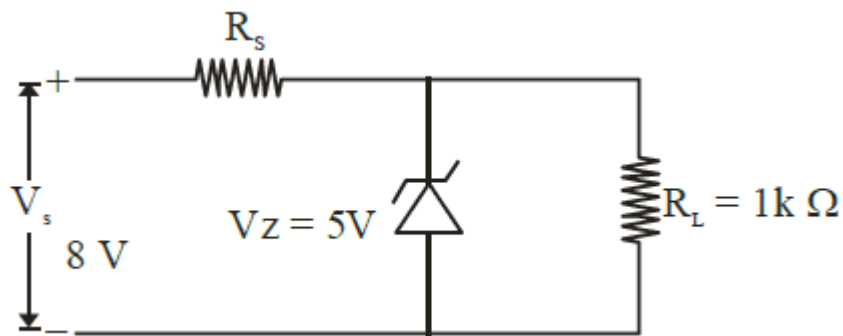
(1) $5\,\Omega$

(2) $10\,\Omega$

(3) $3\,\text{k}\Omega$

(4) $10\,\text{k}\Omega$

Question 34: The reading on the ideal voltmeter (V) shown in the circuit diagram is:

(1) 5V

(2) 10V

(3) 0V

(4) 3V

Question 35: Two identical capacitors have the same capacitance C. One is charged to a potential V, and the other to $2V$. When the negative ends of both are connected, and their positive ends are also joined, the decrease in energy of the system is:

(1) $\frac{CV^2}{4}$

(2) $2CV^2$

(3) $\frac{CV^2}{2}$

(4) $\frac{3CV^2}{4}$

Question 36: A mixture of two gases contains two moles of a monatomic gas and six moles of a diatomic gas. The molar specific heat at constant volume for this mixture is:

(1) $\frac{9}{4}R$

(2) $\frac{7}{4}R$

(3) $\frac{3}{2}R$

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

Question 37: A ball of mass 0.5 kg is attached to a string of length 50 cm. The ball is rotated in a horizontal circle about its vertical axis. The maximum tension that the string

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can bear is 400 N. What is the maximum possible angular velocity of the ball in rad/s?

(1) 1600

(2) 40

(3) 1000

(4) 20

Question 38: A parallel plate capacitor has a capacitance of $C = 200\,\text{pF}$. It is connected to a 230 V AC supply with an angular frequency of 300 rad/s. What are the rms values of the conduction current and displacement current in the circuit?

(1) 13.8 µA and 13.8 µA

(2) 14.3 µA and 14.3 µA

(3) 13.8 µA and 143 µA

(4) 13.8 µA and 13.8 µA

Question 39: The pressure and volume of an ideal gas are related as $PV^{3/2} = K$ (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:

(1) $2(P_1V_1 - P_2V_2)$

(2) $2(P_2V_2 - P_1V_1)$

(3) $\left(\sqrt{P_1V_1} - \sqrt{P_2V_2}\right)$

(4) $2\left(\sqrt{P_2V_1} - \sqrt{P_1V_2}\right)$

Question 40: A galvanometer with a resistance of $50\,\Omega$ and a maximum current of 5 mA is to be converted into a voltmeter to measure up to 100 V. What is the required series resistance?

(1) $5975\,\Omega$

(2) $2005\,\Omega$

(3) $19950\,\Omega$

(4) $19500\,\Omega$

Question 41: The de Broglie wavelengths of a proton and an α-particle are λ_p and λ_α, respectively. What is the ratio of their velocities?

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(1) 1:8

(2) 1:2

(3) 4:1

(4) 8:1

Question 42: The least count of a Vernier caliper is determined when 10 divisions on the main scale coincide with 11 divisions on the Vernier scale. If each division on the main scale is 5 units, what is the least count?

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

(2) $\frac{10}{11}$

(3) $\frac{50}{11}$

(4) $\frac{5}{11}$

Question 43: In a series LCR circuit, the capacitance is changed from C to $4C$. To maintain the resonance frequency, the new inductance should be:

(1) reduced by $\frac{1}{4}L$

(2) increased by $2L$

(3) reduced by $\frac{3}{4}L$

(4) increased to $4L$

Question 44: A metal wire has a radius r, length l, and resistance R. The measured values are: $r = (0.35 \pm 0.05)\,\text{cm}$, $R = (100 \pm 10)\,\Omega$, and $l = (15 \pm 0.2)\,\text{cm}$. What is the percentage error in the resistivity of the wire material?

(1) 25.6%

(2) 39.9%

(3) 37.3%

(4) 35.6%

Question 45: The dimensional formula of angular impulse is:

(1) $[ML^{-1}T^{-1}]$

(2) $[MLT]$

(3) $[MLT]$

(4) $[ML^2T^{-1}]$

Question 46: 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 2×10^2 ms^{-1}. The bullet gets embedded into the bob. The height to which the bob rises before swinging back is:

(1) 0.30 m

(2) 0.20 m

(3) 0.35 m

(4) 0.40 m

Question 47: 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:

(1) $\sin^{-1}\left(\sqrt{\frac{2gT^2}{\pi^2 R}}\right)$

(2) $\sin^{-1}\left(\sqrt{\frac{\pi^2 R}{2gT^2}}\right)$

(3) $\cos^{-1}\left(\sqrt{\frac{2gT^2}{\pi^2 R}}\right)$

(4) $\cos^{-1}\left(\sqrt{\frac{\pi^2 R}{2gT^2}}\right)$

Question 48: Consider a block and trolley system as shown in the figure. If the coefficient of kinetic friction between the trolley and the surface is 0.04, what is the acceleration of the system?
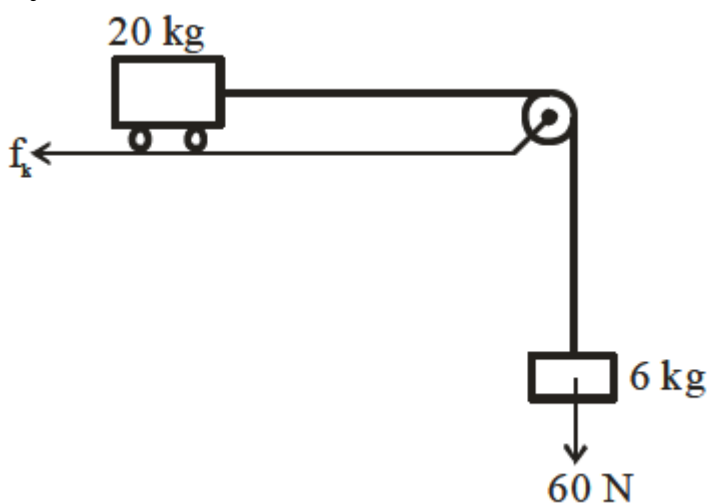
(1) 3

(2) 4

(3) 2

(4) 1.2

Question 49: The minimum energy required by a hydrogen atom in ground state to emit radiation in the Balmer series is nearly:

(1) 1.5 eV

(2) 13.6 eV

(3) 19 eV

(4) 12.1 eV

Question 50: A monochromatic light of wavelength 6000 Å 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:

(1) 60 mm

(2) 24 mm

(3) 120 mm

(4) 12 mm

Question 51: A regular polygon with 6 sides is formed by bending a wire of length 4 m. If an electric current of 4 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:

(1) 20

(2) 25

(3) 72

(4) 80

Question52: 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^{-7} T/m along the negative x direction and it is decreasing with time at the rate of 10^{-7} T/s. If the resistance of the loop is 6 Ω, the power dissipated by the loop as heat is:

Question 53: The distance between the 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:

Question 54: 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 the density of the material of the sphere is 1.5 g/cc, the dielectric constant of water will be:

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

Question 56: The 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 the point of intersection of these two sides as the origin, the magnitude of the position vector of the center of mass of the system is $\frac{4\sqrt{2}}{x}$, where the value of x is:

Question 57: 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:

Question 58: 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:

Question 59: The current in a conductor is expressed as $I = 3t^2 + 4t$, where I is in Amperes and t is in seconds. The amount of electric charge that flows through a section of the conductor during $t = 1$ s to $t = 2$ s is:

(1) 10 C

(2) 15 C

(3) 22 C

(4) 30 C

Question 60: A particle is moving in one dimension (along the 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:

Question 61: If one strand of a DNA has the sequence ATGCTTCA, the sequence of the bases in the complementary strand is:

Question 62: 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 statement, choose the most appropriate answer from the options given below:

(1) (A) is correct but (R) is not correct

(2) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

(3) (A) is not correct but (R) is correct

(4) Both (A) and (R) are correct and (R) is the correct explanation of (A)

Question 63: In acidic medium, $K_2Cr_2O_7$ shows oxidising action as represented in the half-reaction:

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$$Cr_2O_7^{2-} + XH^+ + Ye^- \rightarrow 2A + ZH_2O$$
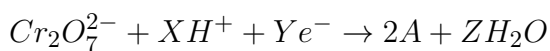
X, Y, Z, and A are respectively:

(1) 8, 4, 6, and Cr_2O_3

(2) 14, 7, 6, and Cr^{3+}

(3) 8, 4, 6, and Cr^{3+}

(4) 14, 6, 7, and Cr^{3+}

Question 64: Which of the following reactions are disproportionation reactions?

(A) $Cu^+ \rightarrow Cu^{2+} + Cu$

(B) $3MnO_4^- + 4H^+ \rightarrow 2MnO_2 + MnO_4^{2-} + 2H_2O$

(C) $2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2$

(D) $2MnO_4^- + 3Mn^{2+} + 2H_2O \rightarrow 5MnO_2 + 4H^+$

Choose the correct answer from the options given below:

(1) (A), (B)

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

(3) (A), (D)

(4) (A), (C)

Question 65: In case of isoelectronic species, the size of F^-, Ne, and Na^+ is affected by:

(1) Principal quantum number (n)

(2) None of the factors because their size is the same

(3) Electron-electron interaction in the outer orbitals

(4) Nuclear charge (Z)

Question 66: According to the wave-particle duality of matter by de-Broglie, which of the following graph plots presents the most appropriate relationship between wavelength of electron (λ) and momentum of electron (p)?

Question 67: Given below are two statements:

Statement (I): A solution of $[Ni(H_2O)_6]^{2+}$ is green in colour.

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

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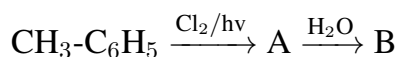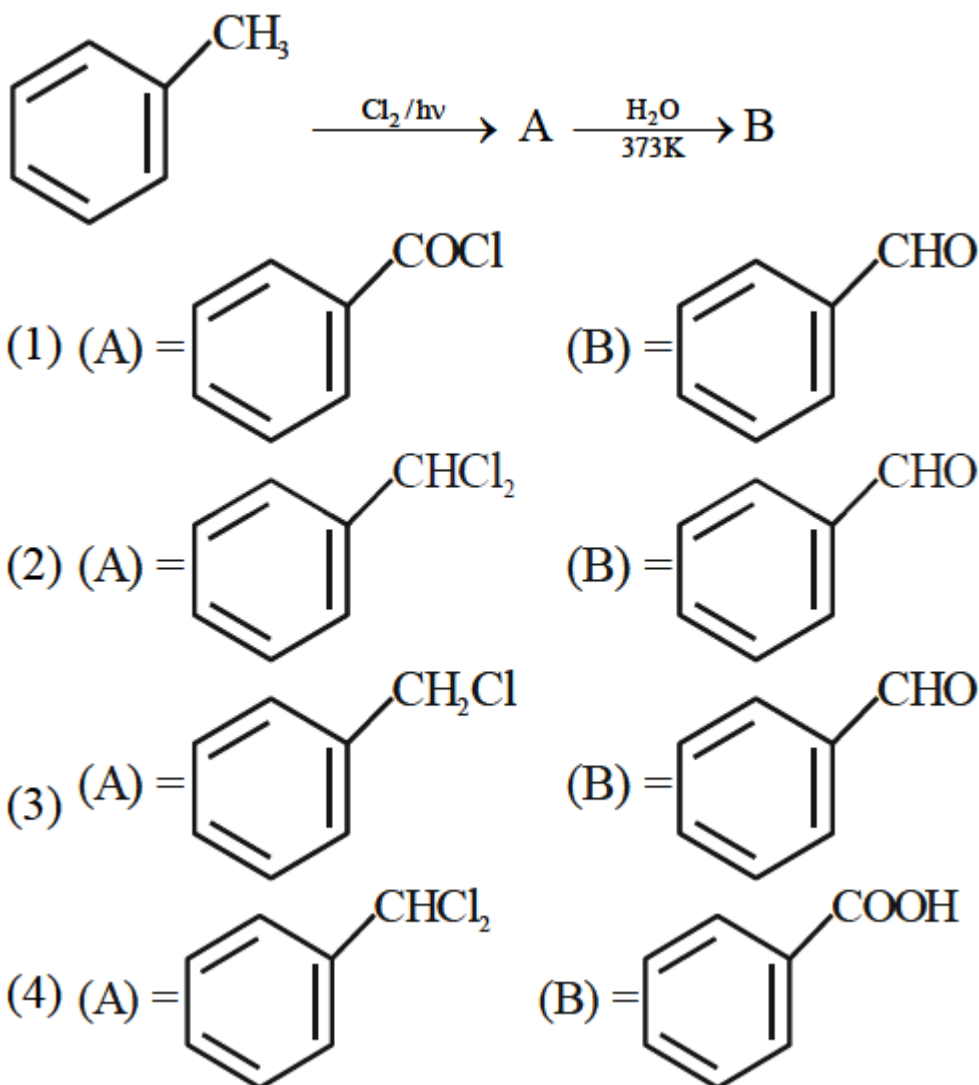
given below:

Question 68: **Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).**

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

Reason (R): In liquid state NH_3 molecules are associated through van der Waals' 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:

Question 69: Identify A and B in the following sequence of reaction:

$$CH_3\text{-}C_6H_5 \xrightarrow{Cl_2/h\nu} A \xrightarrow{H_2O} B$$

Question 70: Given below are two statements:

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

Statement (II): Aminobenzene and aniline are different organic compounds.
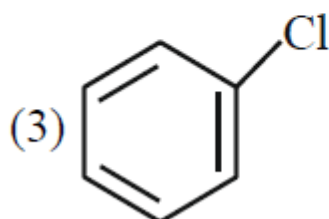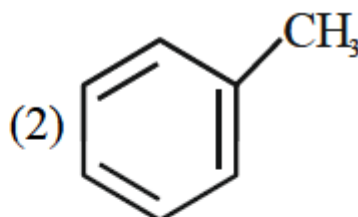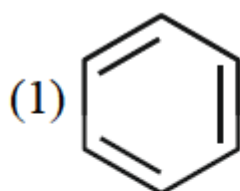
In the light of the above statements, choose the most appropriate answer from the options given below:

Question 71: Which of the following complex is homoleptic?

(1) $[Ni(CN)_4]^{2-}$

(2) $[Ni(NH_3)_6]Cl_2$

(3) $[Fe(NH_3)_4Cl_2]^+$

(4) $[Co(NH_3)_4Cl_2]^+$
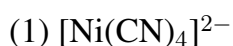
Question 72: Which of the following compounds will most easily be attacked by an electrophile?
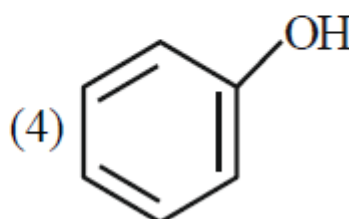
Question 73: Ionic reactions with organic compounds proceed through:

(A) Homolytic bond cleavage

(B) Heterolytic bond cleavage

(C) Free radical formation

(D) Primary free radical

(E) Secondary free radical

Question 74: Arrange the bonds in order of increasing ionic character in the molecules: LiF, K_2O, N_2, SO_2, and ClF_3.

(1) $ClF_3 < N_2 < SO_2 < K_2O < LiF$

(2) $LiF < K_2O < ClF_3 < SO_2 < N_2$

(3) $N_2 < SO_2 < ClF_3 < K_2O < LiF$

(4) $N_2 < ClF_3 < SO_2 < K_2O < LiF$

Question 75: We have three aqueous solutions of NaCl labelled as 'A', 'B', and 'C' with concentrations 0.1 M, 0.01 M, and 0.001 M, respectively. The value of van't Hoff factor (i) for these solutions will be in the order:

(1) $i_A < i_B < i_C$

(2) $i_A < i_C < i_B$

(3) $i_A = i_B = i_C$

(4) $i_A > i_B > i_C$

Question 76: In Kjeldahl's method for estimation of nitrogen, $CuSO_4$ acts as:

(1) Reducing agent

(2) Catalytic agent

(3) Hydrolysis agent

(4) Oxidising agent

Question 77: 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:

Question 78: Match List – I with List – II.

	List – I (Reactions)		List – II (Reagents)
(A)	$CH_3(CH_2)_5-\overset{\overset{\displaystyle O}{\|}}{C}-OC_2H_5 \rightarrow CH_3(CH_2)_5CHO$	(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)	$CH_3COCH_2COOC_2H_5 \rightarrow CH_3\underset{H}{C}(OH)CH_2COOC_2H_5$	(IV)	DIBAL-H, H_2O

Choose the correct answer from options given below:

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

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

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

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

Question 79: Choose the correct option for free expansion of an ideal gas under adiabatic condition from the following:

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

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

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

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

Question 80: 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-Crafts reaction (alkylation and acylation).

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

(1) Both Statement I and Statement II are correct

(2) Both Statement I and Statement II are incorrect

(3) Statement I is incorrect but Statement II is correct

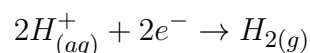(4) Statement I is correct but Statement II is incorrect

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Question 81; Number of optical isomers possible for 2-chlorobutane is:

Question 82: The potential for the given half-cell at 298K is:

$$(-)\ldots\ldots\ldots \times 10^{-2}V$$

$$2H^+_{(aq)} + 2e^- \rightarrow H_{2(g)}$$

$$[H^+] = 1M, \quad P_{H_2} = 2 \text{ atm}$$

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

Question 83: The number of white colored salts among the following is: (A) SrSO$_4$, (B) Mg(NH$_4$)PO$_4$, (C) BaCrO$_4$, (D) Mn(OH)$_2$, (E) PbSO$_4$, (F) PbCrO$_4$, (G) AgBr, (H) PbI$_2$, (I) CaC$_2$O$_4$, (J) [Fe(OH)$_2$(CH$_3$COO)]

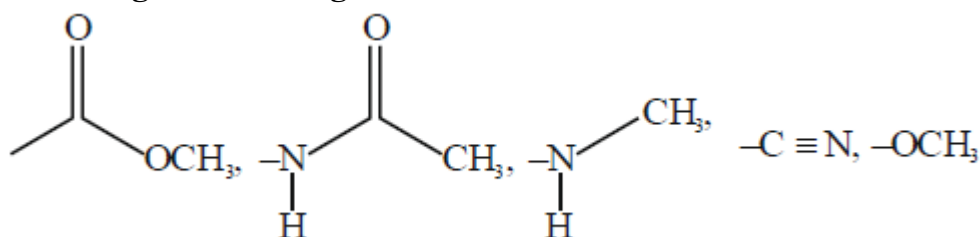
Question 84: The ratio of $^{14}C/^{12}C$ in a piece of wood is $\frac{1}{8}$ part that of the atmosphere. If the half-life of ^{14}C is 5730 years, the age of the wood sample is $\cdots$ years.

Question 85: The number of molecules/ions having trigonal bipyramidal shape is:

PF_5, BrF_5, PCl_5, $[PtCl_4]^{2-}$, BF_3, $Fe(CO)_5$

Question 86: Total number of deactivating groups in aromatic electrophilic substitution reaction among the following is:

$$CH_3-\overset{O}{\overset{\|}{C}}-OCH_3, \quad -\overset{H}{\underset{N}{|}}-\overset{O}{\overset{\|}{C}}-CH_3, \quad -\overset{H}{\underset{N}{|}}-CH_3, \quad -C\equiv N, \quad -OCH_3$$

Question 87: Lowest Oxidation number of an atom in a compound A_2B is -2. The number of an electron in its valence shell is

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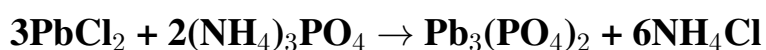**Question 88:** Among the following oxide of p - block elements, number of oxides having amphoteric nature is

Cl_2O_7, CO, PbO_2, N_2O, NO, Al_2O_3, SiO_2, N_2O_5, SnO_2

Question 89: Consider the following reaction:

$3PbCl_2 + 2(NH_4)_3PO_4 \rightarrow Pb_3(PO_4)_2 + 6NH_4Cl$

If 72 mmol of $PbCl_2$ is mixed with 50 mmol of $(NH_4)_3PO_4$, then amount of $Pb_3(PO_4)_2$ formed is $\cdots$ mmol (nearest integer).

Question 90: K_a **for CH$_3$COOH is** 1.8×10^{-5} **and** K_b **for NH$_4$OH is** 1.8×10^{-5}**.**

The pH of ammonium acetate solution will be: