JEE Main 2025 Jan 29 Shift 1 Question Paper

Time Allowed :3 Hour	**Maximum Marks :**300	**Total Questions :**75

General Instructions

Read the following instructions very carefully and strictly follow them:

1. The test is of 3 hours duration.
2. The question paper consists of 75 questions. The maximum marks are 300.
3. There are three parts in the question paper consisting of Physics, Chemistry and Mathematics having 25 questions in each part of equal weightage.
4. Each part (subject) has two sections.
   (i) Section-A: This section contains 20 multiple choice questions which have only one correct answer. Each question carries 4 marks for correct answer and –1 mark for wrong answer.
   (ii) Section-B: This section contains 5 questions. The answer to each of the questions is a numerical value. Each question carries 4 marks for correct answer and –1 mark for wrong answer. For Section-B, the answer should be rounded off to the nearest integer.

Mathematics

Section - A

1. Let $\vec{a} = \hat{i} + 2\hat{j} + \hat{k}$ and $\vec{b} = 2\hat{i} + 7\hat{j} + 3\hat{k}$. Let $L_1 : \vec{r} = (-\hat{i} + 2\hat{j} + \hat{k}) + \lambda\vec{a}, \lambda \in R$ and $L_2 : \vec{r} = (\hat{j} + \hat{k}) + \mu\vec{b}, \mu \in \mathbb{R}$ be two lines. If the line L_3 passes through the point of intersection of L_1 and L_2, and is parallel to $\vec{a} + \vec{b}$, then L_3 passes through the point:

(1) $(-1, -1, 1)$

(2) $(5, 17, 4)$

(3) $(2, 8, 5)$

(4) $(8, 26, 12)$

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2. Define a relation R on the interval $[0, \frac{\pi}{2}]$ by xRy if and only if $\sec^2 x - \tan^2 y = 1$. Then R is:

(1) both reflexive and transitive but not symmetric

(2) both reflexive and symmetric but not transitive

(3) reflexive but neither symmetric nor transitive

(4) an equivalence relation

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3. The integral

$$\int_0^{\pi/4} (\sin\theta + \cos\theta)(9 + 16\sin^2\theta)\, d\theta$$

is equal to:

(1) $6\log 4$

(2) $2\log 3$

(3) $4\log 3$

(4) $3\log 4$

---

4. Let the area of the region $\{(x, y) : 2y \le x^2 + 3,\ y + |x| \le 3,\ y \ge |x - 1|\}$ be A. Then $6A$ is equal to:

(1) 16

(2) 18

(3) 14

(4) 12

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5. Let ABC be a triangle formed by the lines $7x - 6y + 3 = 0$**,** $x + 2y - 31 = 0$**, and** $9x - 2y - 19 = 0$**. Let the point** (h, k) **be the image of the centroid of** $\triangle ABC$ **in the line** $3x + 6y - 53 = 0$**. Then** $h^2 + k^2 + hk$ **is equal to:**

(1) 47

(2) 36

(3) 40

(4) 37

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6. Let P be the set of seven-digit numbers with the sum of their digits equal to 11. If the numbers in P are formed by using the digits 1, 2, and 3 only, then the number of elements in the set P is:

(1) 158

(2) 173

(3) 161

(4) 164

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

$$\cos(x \log(\cos x))^2 \, dy + (\sin x - 3 \sin x \log(\cos x)) \, dx = 0, \quad x \in \left(0, \frac{\pi}{2}\right)$$

If $y\left(\frac{\pi}{4}\right) = -1$**, then** $y\left(\frac{\pi}{6}\right)$ **is equal to:**

(1) $1 - \log 4$

(2) $2 \log 3 - \log 4$

(3) $-1 \log 4$

(4) $1 \log 3 - \log 4$

---

8. Let $A = \begin{bmatrix} \log_5 128 & \log_4 5 \\ \log_5 8 & \log_4 25 \end{bmatrix}$**. If** A_{ij} **is the cofactor of** a_{ij}**,** $C_{ij} = \sum_{k=1}^{2} a_{ik}A_{jk}$**, and** $C = [C_{ij}]$**, then** $8|C|$ **is equal to:**

(1) 242

(2) 222

(3) 262

(4) 288

---

9. Let the ellipse $E_1 : \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$**,** $a > b$ **and** $E_2 : \frac{x^2}{A^2} + \frac{y^2}{B^2} = 1$**,** $A < B$**, have the same eccentricity** $\sqrt{\frac{1}{3}}$**. Let the product of their lengths of latus rectums be** $\sqrt{\frac{32}{3}}$ **and the distance between the foci of** E_1 **be 4. If** E_1 **and** E_2 **meet at** A**,** B**,** C**, and** D**, then the area of the quadrilateral ABCD equals:**

(1) $18\sqrt{6}$

(2) $6\sqrt{6}$

(3) $12\sqrt{6}$

(4) $24\sqrt{6}$

---

10. Let M **and** m **respectively be the maximum and the minimum values of**

$$f(x) = 1 + \sin^2 x \cos^2 x + \frac{4 \sin 4x}{\sin^2 x \cos^2 x}$$

for $x \in \mathbb{R}$**. Then** $M^4 - m^4$ **is equal to:**

(1) 1215

(2) 1040

(3) 1295

(4) 1280

---

11. Consider an A.P. of positive integers, whose sum of the first three terms is 54 and the sum of the first twenty terms lies between 1600 and 1800. Then its 11th term is:

(1) 122

(2) 84

(3) 90

(4) 108

---

12. The number of solutions of the equation

$$9\sqrt{x} - 9\sqrt{x} + 2 = 2x - 7\sqrt{x} + 3 = 0$$

is:

(1) 3

(2) 1

(3) 2

(4) 4

---

13. Let $\vec{a} = 2\hat{i} - \hat{j} + 3\hat{k}$, $\vec{b} = 3\hat{i} - 5\hat{j} + \hat{k}$, and $\vec{c}$ be a vector such that $\vec{a} \times \vec{c} = \vec{a} \times \vec{b}$ and $(\vec{a} + \vec{c}) \cdot (\vec{b} + \vec{c}) = 168$. Then the maximum value of $|\vec{c}|^2$ is:

(1) 462

(2) 77

(3) 308

(4) 154

---

14. Let the line $x + y = 1$ meet the circle $x^2 + y^2 = 4$ at the points A and B. If the line perpendicular to AB and passing through the midpoint of the chord AB intersects the circle at C and D, then the area of the quadrilateral ABCD is equal to:

(1) $\sqrt{14}$

(2) $5\sqrt{7}$

(3) $3\sqrt{7}$

(4) $2\sqrt{14}$

---

15. Let $|z_1 - 8 - 2i| \leq 1$ and $|z_2 - 2 + 6i| \leq 2$, where $z_1, z_2 \in \mathbb{C}$. Then the minimum value of $|z_1 - z_2|$ is:

(1) 13

(2) 7

(3) 10

(4) 3

---

16. The least value of n for which the number of integral terms in the Binomial expansion of $\left(\sqrt{7}+\sqrt{11}\right)^n$ is 183, is:

(1) 2196

(2) 2172

(3) 2184

(4) 2148

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17. Two parabolas have the same focus (4, 3) and their directrices are the x-axis and the y-axis, respectively. If these parabolas intersect at points A and B, then $(AB)^2$ is equal to:

(1) 392

(2) 192

(3) 96

(4) 384

---

18. The value of

$$\lim_{n\to\infty}\sum_{k=1}^{n}\frac{k^3+6k^2+11k+5}{(k+3)!}$$

is:

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

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

(3) 2

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

---

19. Let $x_1, x_2, \ldots, x_{10}$ be ten observations such that

$$\sum_{i=1}^{10}(x_i-2)=30, \quad \sum_{i=1}^{10}(x_i-\beta)^2=98, \quad \beta\geq 2,$$

and their variance is $\frac{4}{5}$. If μ and σ^2 are respectively the mean and the variance of

$$2(x_1 - 1) + 4B, 2(x_2 - 1) + 4B, \ldots, 2(x_{10} - 1) + 4B,$$

then $B\mu\sigma^2$ is equal to:

(1) 100

(2) 110

(3) 90

(4) 120

---

20. Let $L_1 : \frac{x-1}{1} = \frac{y-2}{-1} = \frac{z-1}{-1}$ and $L_2 : \frac{x+1}{1} = \frac{y-2}{2} = \frac{z-2}{2}$ be two lines. Let L_3 be a line passing through the point (α, β, γ) and be perpendicular to both L_1 and L_2. If L_3 intersects L_1 where $5x - 11y - 8z = 1$, then $5x - 11y - 8z$ equals:

(1) 13

(2) 7

(3) 10

(4) 3

Q.21 Let $[t]$ be the greatest integer less than or equal to t. Then the least value of $p \in \mathbb{N}$ for which

$$\lim_{x\to\infty} \left(x\left([1/x] + [2/x] + \cdots + [p/x]\right) - x^2\left(\frac{1}{x^2} + \frac{2}{x^2} + \cdots + \frac{p^2}{x^2}\right)\right) \geq 1$$

(1) 1

(2) 2

(3) 3

(4) 4

Q.22 Let $S = \{x : \cos^{-1} x = \pi + \sin^{-1} x + \sin^{-1}(2x + 1)\}$. Then

$$\sum_{x\in S}(2x - 1)^2 \text{ is equal to:}$$

(1) 4

(2) 9

(3) 16

(4) 25

Q.23 Let $f : (0, \infty) \to \mathbb{R}$ be a twice differentiable function. If for some $a \neq 0$,

$$\int_0^a f(x)\,dx = f(a), \quad f(1) = 1, \quad f(16) = \frac{1}{8}, \quad \text{then } 16 - f^{-1}\left(\frac{1}{16}\right) \text{ is equal to:}$$

(1) 4

(2) 3

(3) 5

(4) 6

Q.24 The number of 6-letter words, with or without meaning, that can be formed using the letters of the word "MATHS" such that any letter that appears in the word must appear at least twice is:

(1) 5

(2) 10

(3) 15

(4) 20

Q.25 Let $S = \{m \in \mathbb{Z} : Am^2 + A^n = 31 - A^6\}$, where $A = \begin{bmatrix} 2 & -1 \\ 1 & 0 \end{bmatrix}$. $Thenn(S)$ is equal to:

(1) 20

(2) 30

(3) 40

(4) 50

Physics

Section - A

Q.26 A coil of area A and N turns is rotating with angular velocity ω in a uniform magnetic field B about an axis perpendicular to B. Magnetic flux ϕ and induced emf ε across it, at an instant when B is parallel to the plane of the coil, are:

(1) $\phi = AB, \varepsilon = 0$

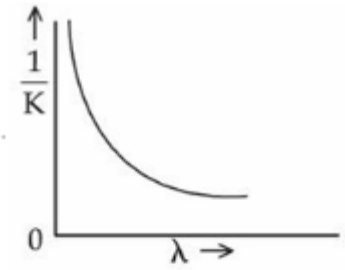
(2) $\phi = 0, \varepsilon = 0$

(3) $\phi = 0, \varepsilon = NAB\omega$

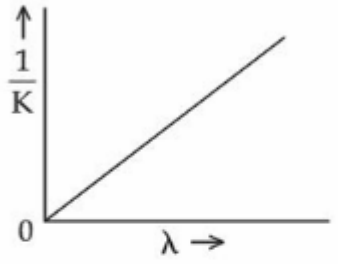
(4) $\phi = AB, \varepsilon = NAB\omega$

Q.27 If λ and K are de Broglie wavelength and kinetic energy, respectively, of a particle with constant mass. The correct graphical representation for the particle will be:

(1)



(2)



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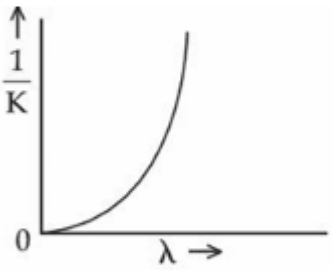

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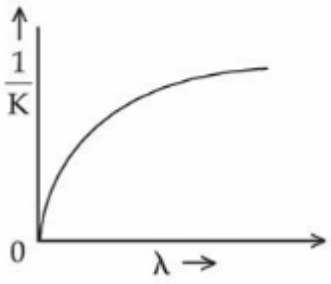


Q.28 The pair of physical quantities not having the same dimensions is:

(1) Torque and energy

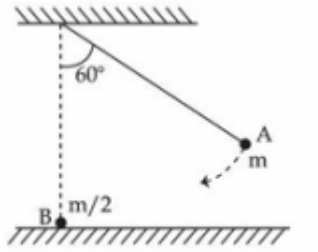
(2) Pressure and Young's modulus

(3) Angular momentum and Planck's constant

(4) Surface tension and impulse

Q.29 As shown below, bob A of a pendulum having a massless string of length R is released from 60° to the vertical. It hits another bob B of half the mass that is at rest on a frictionless table in the center. Assuming elastic collision, the magnitude of the

velocity of bob A after the collision will be (take g as acceleration due to gravity):



(1) $\frac{1}{3}\sqrt{Rg}$

(2) $\sqrt{Rg}$

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

(4) $\frac{4}{3}\sqrt{Rg}$

Q.30 At the interface between two materials having refractive indices n_1 and n_2, the critical angle for reflection of an EM wave is θ_c. The n_1 material is replaced by another material having refractive index n_3, such that the critical angle at the interface between n_1 and n_3 materials is θ_{c3}. If $n_1 > n_2 > n_3$, $\frac{n_2}{n_3} = \frac{2}{5}$, and $\sin\theta_{c2} - \sin\theta_{c1} = \frac{1}{2}$, then θ_{c1} is:

(1) $\sin^{-1}\left(\frac{5}{6n_1}\right)$

(2) $\sin^{-1}\left(\frac{2}{3n_1}\right)$

(3) $\sin^{-1}\left(\frac{1}{3n_1}\right)$

(4) $\sin^{-1}\left(\frac{1}{6n_1}\right)$

Q.31 The work done in an adiabatic change in an ideal gas depends upon:

(1) change in its pressure

(2) change in its volume

(3) change in its specific heat

(4) change in its temperature

Q.32 Two projectiles are fired with the same initial speed from the same point on the ground at angles of $(45^\circ - \alpha)$ and $(45^\circ + \alpha)$, respectively, with the horizontal direction. The ratio of their maximum heights attained is:

(1) $\frac{1-\tan\alpha}{1+\tan\alpha}$

(2) $\frac{1-\sin 2\alpha}{1+\sin 2\alpha}$

(3) $\frac{1+\sin 2\alpha}{1-\sin 2\alpha}$

(4) $\frac{1+\sin\alpha}{1-\sin\alpha}$

Q.33 The fractional compression $\frac{\Delta V}{V}$ of water at the depth of 2.5 km below the sea level is:

(1) 1.5

(2) 1.0

(3) 1.75

(4) 1.25

Q.34 Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): Choke coil is simply a coil having a large inductance but a small resistance. Choke coils are used with fluorescent mercury-tube fittings. If household electric power is directly connected to a mercury tube, the tube will be damaged.

Reason (R): By using the choke coil, the voltage across the tube is reduced by a factor $\frac{R}{\sqrt{R^2+\omega^2L^2}}$, where ω is the frequency of the supply across resistor R and inductor L. If the choke coil were not used, the voltage across the resistor would be the same as the applied voltage.

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

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

(2) (A) is false but (R) is true

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

(4) (A) is true but (R) is false

Q.35 Consider I_1 and I_2 are the currents flowing simultaneously in two nearby coils 1 and 2, respectively. If L_1 = self-inductance of coil 1, M_{12} = mutual inductance of coil 1

with respect to coil 2, then the value of induced emf in coil 1 will be:

(1) $e_1 = -L_1\frac{dI_1}{dt} + M_{12}\frac{dI_2}{dt}$

(2) $e_1 = -L_1\frac{dI_1}{dt} + M_{12}\frac{dI_1}{dt}$

(3) $e_1 = -L_1\frac{dI_1}{dt} - M_{12}\frac{dI_2}{dt}$

(4) $e_1 = -L_1\frac{dI_1}{dt} + M_{12}\frac{dI_1}{dt}$

Q.36 For the circuit shown above, the equivalent gate is:

(1) AND gate

(2) OR gate

(3) NAND gate

(4) NOT gate

Q.37 Let u and v be the distances of the object and the image from a lens of focal length f. The correct graphical representation of u and v for a convex lens when $|u| > f$, is:

(1) Linear graph

(2) Inverse graph

(3) Parabolic graph

(4) Hyperbolic graph

Q.38 Consider a long straight wire of a circular cross-section (radius a) carrying a steady current I. The current is uniformly distributed across this cross-section. The distances from the center of the wire's cross-section at which the magnetic field (inside the wire, outside the wire) is half of the maximum possible magnetic field, anywhere due to the wire, will be:

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

(2) $\frac{a}{2}, 2a$

(3) $\frac{a}{4}, 2a$

(4) $\frac{a}{4}, \frac{3a}{2}$

Q.39 An electric dipole of mass m, charge q, and length l is placed in a uniform electric field $E = E_0\hat{i}$. When the dipole is rotated slightly from its equilibrium position and released, the time period of its oscillations will be:

(1) $\frac{2\pi}{\frac{qml}{qE_0}}$

(2) $\frac{1}{2\pi}\frac{q^2ml}{qE_0}$

(3) $\frac{1}{2\pi}\frac{qml}{2qE_0}$

(4) $2\pi\frac{qml}{2qE_0}$

Q.40 A body of mass m connected to a massless and unstretchable string goes in a vertical circle of radius R under gravity g. The other end of the string is fixed at the center of the circle. If velocity at the top of the circular path is $v = \sqrt{ngR}$, where $n \geq 1$, then the ratio of kinetic energy of the body at bottom to that at top of the circle is:

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

(2) $\frac{n}{n+4}$

(3) $\frac{n+4}{n}$

(4) $\frac{n^2+4}{n^2}$

Q.41 Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): Time period of a simple pendulum is longer at the top of a mountain than that at the base of the mountain.

Reason (R): Time period of a simple pendulum decreases with increasing value of acceleration due to gravity and vice-versa.

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

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

(2) (A) is false but (R) is true

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

(4) (A) is true but (R) is false

Q.42 Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): Electromagnetic waves carry energy but not momentum.

Reason (R): Mass of a photon is zero.

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

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

(2) (A) is false but (R) is true

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

(4) (A) is true but (R) is false

Q.43 Match List - I with List - II:

List - I: (A) Electric field inside (distance $r > 0$ from center) of a uniformly charged spherical shell with surface charge density σ, and radius R.

(B) Electric field at distance $r > 0$ from a uniformly charged infinite plane sheet with surface charge density σ.

(C) Electric field outside (distance $r > 0$ from center) of a uniformly charged spherical shell with surface charge density σ, and radius R.

(D) Electric field between two oppositely charged infinite plane parallel sheets with uniform surface charge density σ.

List - II: (I) $\frac{\sigma}{\epsilon_0}$

(II) $\frac{\sigma}{2\epsilon_0}$

(III) 0

(IV) $\frac{\sigma}{\epsilon_0 r^2}$

Choose the correct answer from the options given below:

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

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

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

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

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44. The expression given below shows the variation of velocity v with time t:

$$v = \frac{At^2 + Bt}{C + t}$$

The dimension of A, B, and C is:

(1) $[ML^2T^{-3}]$

(2) $[MLT^{-3}]$

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

(4) $[MLT^{-2}]$

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45. Given below are two statements: one is labelled as Assertion (A) and the other one is labelled as Reason (R). Assertion (A): Emission of electrons in the photoelectric effect can be suppressed by applying a sufficiently negative electron potential to the photoemissive substance.

Reason (R): A negative electric potential, which stops the emission of electrons from the surface of a photoemissive substance, varies linearly with the frequency of incident radiation.

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

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

(2) (A) is true but (R) is false

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

(4) (A) is false but (R) is true

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46. The coordinates of a particle with respect to origin in a given reference frame is $(1, 1, 1)$ meters. If a force of $\mathbf{F} = \hat{i} - \hat{j} + \hat{k}$ acts on the particle, then the magnitude of torque (with respect to origin) in the z-direction is:

(1) 1

(2) 2

(3) 3

(4) 4

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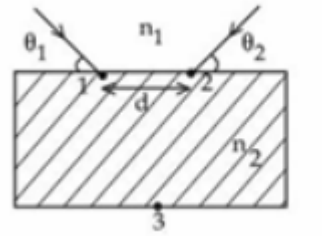
47. Two light beams fall on a transparent material block at point 1 and 2 with angle θ_1 and θ_2, respectively, as shown in the figure. After refraction, the beams intersect at

point 3 which is exactly on the interface at the other end of the block. Given: the distance between 1 and 2, $d = 4/3$ **cm and** $\theta_1 = \theta_2 = \cos^{-1}\frac{n_2}{2n_1}$**, where** n_2 **is the refractive index of the block and** n_1 **is the refractive index of the outside medium, then the thickness of the block is cm.**



(1) 1 cm

(2) 2 cm

(3) 3 cm

(4) 4 cm

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48. A container of fixed volume contains a gas at 27°C. To double the pressure of the gas, the temperature of the gas should be raised to °C.

(1) 327°C

(2) 327 K

(3) 527°C

(4) 527 K

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49. The maximum speed of a boat in still water is 27 km/h. Now this boat is moving downstream in a river flowing at 9 km/h. A man in the boat throws a ball vertically upwards with speed of 10 m/s. Range of the ball as observed by an observer at rest on the river bank is cm. (Take g = 10 m/s²).

(1) 50 cm

(2) 100 cm

(3) 200 cm

(4) 300 cm

---

50. In a hydraulic lift, the surface area of the input piston is 6 cm^2 and that of the output piston is 1500 cm^2. If 100 N force is applied to the input piston to raise the output piston by 20 cm, then the work done is kJ.

(1) 0.01 kJ

(2) 0.1 kJ

(3) 1 kJ

(4) 10 kJ

Section - Chemistry

Section - A

51. The correct increasing order of stability of the complexes based on Δ value is:

(1) IV ¡ III ¡ II ¡ I

(2) I ¡ II ¡ IV ¡ III

(3) III ¡ II ¡ IV ¡ I

(4) II ¡ III ¡ I ¡ IV

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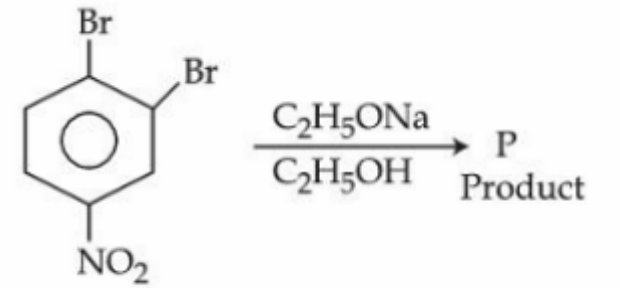
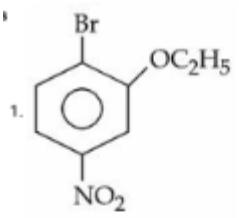
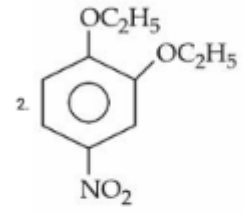
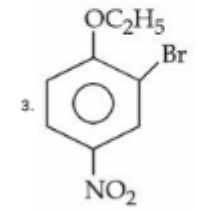
52. In the following substitution reaction:

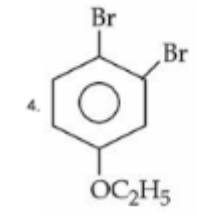


product 'P' formed is :

1. 

2. 

3. 

4. 

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53. Total number of nucleophiles from the following is:

$NH_3, PhSH, (H_3C_2S)_2, H_2C = CH_2, OH, H_3O+, (CH_3)_2CO, NCH_3$

(1) 6

(2) 5

(3) 4

(4) 7

---

54. The molar conductivity of a weak electrolyte when plotted against the square root of its concentration, which of the following is expected to be observed?

(1) A small decrease in molar conductivity is observed at infinite dilution.

(2) A small increase in molar conductivity is observed at infinite dilution.

(3) Molar conductivity increases sharply with increase in concentration.

(4) Molar conductivity decreases sharply with increase in concentration.

55. Given below are two statements:

Statement (I): The radius of isoelectronic species increases in the order:

$$Mg^{2+} < Na^{+} < F^{-} < O^{2-}$$

Statement (II): The magnitude of electron gain enthalpy of halogens decreases in the order:

$$Cl > F > Br > I$$

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

(1) Both Statement I and Statement II are correct.

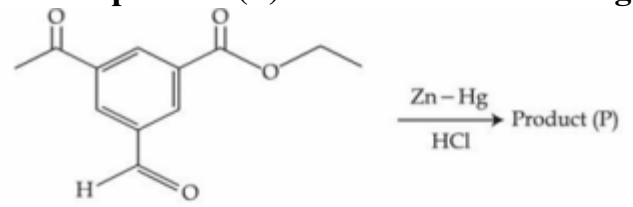
(2) Statement I is incorrect but Statement II is correct.

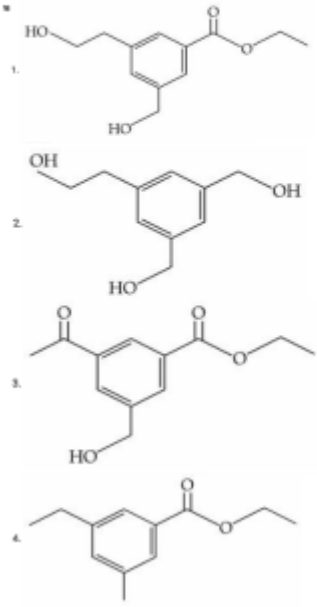
(3) Statement I is correct but Statement II is incorrect.

(4) Both Statement I and Statement II are incorrect.

---

56. The product (P) formed in the following reaction is:





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57. Match List - I with List - II:

List - I:

(A) $[MnBr_4]^{2-}$

(B) $[FeF_6]^{3-}$

(C) $[Co(C_2O_4)_3]^{3-}$

(D) $[Ni(CO)_4]$

List - II:

(I) d^2sp^3 diamagnetic

(II) sp^2d^2 paramagnetic

(III) sp^3 diamagnetic

(IV) sp^3 paramagnetic

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

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

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

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

---

58. At temperature T, compound AB2 dissociates as $AB_2 \rightleftharpoons A + \frac{1}{2}B_2$, having degree of dissociation x (small compared to unity). The correct expression for x in terms of K_p and p is:

(1) $\frac{p}{K_p p}$

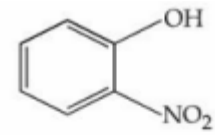
(2) $\frac{2K_p}{p}$

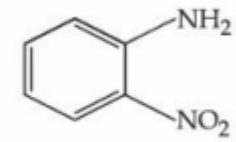
(3) $\frac{2K_p}{p}$

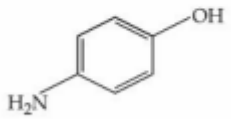
(4) $\frac{2K_p^2}{p}$

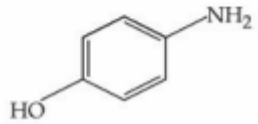
---

59. The steam volatile compounds among the following are:

(A) 

(B) 

(C) 

(D) 

(1) (A) and (B) Only

(2) (A),(B) and (C) Only

(3) (B) and (D) Only

(4) (A) and (C) Only

---

60. For a Mg|$Mg^{2+}(aq)$||$Ag^{+}(aq)$|Ag, the correct Nernst Equation is:

(1) $E_{\text{cell}} = E^{\circ}_{\text{cell}} + \frac{RT}{2F} \ln\left(\frac{[Ag^{+}]}{[Mg^{2+}]}\right)$

(2) $E_{\text{cell}} = E^{\circ}_{\text{cell}} - \frac{RT}{2F} \ln\left(\frac{[Ag^{+}]}{[Mg^{2+}]}\right)$

(3) $E_{\text{cell}} = E^{\circ}_{\text{cell}} - \frac{RT}{2F} \ln\left(\frac{[Mg^{2+}]}{[Ag^{+}]}\right)$

(4) $E_{\text{cell}} = E^{\circ}_{\text{cell}} + \frac{RT}{2F} \ln[Ag^{+}]^2$

---

61. An element 'E' has the ionisation enthalpy value of 374 kJ mol^{-1}. 'E' reacts with elements A, B, C, and D with electron gain enthalpy values of 328, 349, 325, and 295 kJ mol^{-1}, respectively. The correct order of the products EA, EB, EC, and ED in terms of ionic character is:

(1) EA ¿ EB ¿ EC ¿ ED

(2) ED ¿ EC ¿ EA ¿ EB

(3) ED ¿ EC ¿ EB ¿ EA

(4) EB ¿ EA ¿ EC ¿ ED

---

62. If a_0 is denoted as the Bohr radius of the hydrogen atom, then what is the de-Broglie wavelength λ of the electron present in the second orbit of the hydrogen atom?

(1) $4na_0$

(2) $\frac{8\pi a_0}{n}$

(3) $\frac{4\pi a_0}{n}$

(4) $\frac{2a_0}{n\pi}$

---

63. The standard reduction potential values of some of the p-block ions are given below. Predict the one with the strongest oxidizing capacity.

(1) $E^{\circ}_{I^-/I_2} = +1.26\,V$

(2) $E^{\circ}_{Al^{3+}/Al} = -1.66\,V$

(3) $E^{\circ}_{Pb^{4+}/Pb^{2+}} = +1.67\,V$

(4) $E^{\circ}_{Sn^{4+}/Sn^{2+}} = +1.15\,V$

---

64. Match List - I with List - II:

List - I:

(A) Amylase

(B) Cellulose

(C) Glycogen

(D) Amylopectin

List - II:

(I) -C1-C4 plant

(II) -C1-C4 animal

(III) -C1-C4 -C1-C6 plant

(IV) -C1-C4 plant

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

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

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

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

---

65. Match List - I with List - II:

Structure	IUPAC Name
(A) $C_6H_{13}CH = CH_2$	(I)$4-$ Methylpent-1-ene
(B) $(CH_3)_2C(C_5H_3)$	(II)$4,4-$ Dimethylheptane
(C) $CH_3CH_2C(CH_3)CH_2$	(III)$3-$ Ethyl-5-methylheptane
(D) $CH_2CH_2C(CH_3)C = CH_2$	(IV)$2-$ Methyl-1,3-pentadiene

Choose the correct answer from the options given below:

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

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

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

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

---

66. 1.24 g of

AX_2(molar mass 124 g mol^{-1}) is dissolved in 1 kg of water to form a solution with boiling point of

(1) AX and AY (both) are fully ionised.

(2) AX is fully ionised while AY is completely unionised.

(3) AX and AY (both) are completely unionised.

(4) AX is completely unionised while AY is fully ionised.

---

67. The reaction $A_2 + B_2 \rightarrow 2AB$ follows the mechanism:

$$A_2 \xrightarrow{k_1} A + A \text{ (fast)}, \quad A + B_2 \xrightarrow{k_2} AB + B \text{ (slow)}, \quad A + B \rightarrow AB \text{ (fast)}.$$

The overall order of the reaction is:

(1) 3

(2) 1.5

(3) 2.5

(4) 2

---

68. The correct option with order of melting points of the pairs (Mn, Fe), (Tc, Ru) and (Re, Os) is:

(1) Fe ¡ Mn, Ru ¡ Tc and Re ¡ Os

(2) Mn ¡ Fe, Tc ¡ Ru and Os ¡ Re

(3) Mn ¡ Fe, Tc ¡ Ru and Re ¡ Os

(4) Fe ¡ Mn, Ru ¡ Tc and Os ¡ Re

---

69. Choose the correct statements:

(A) Weight of a substance is the amount of matter present in it.

(B) Mass is the force exerted by gravity on an object.

(C) Volume is the amount of space occupied by a substance.

(D) Temperatures below 0°C are possible in Celsius scale, but in Kelvin scale negative temperature is not possible.

(E) Precision refers to the closeness of various measurements for the same quantity.

Choose the correct answer from the options given below:

(1) (A), (B) and (C) Only

(2) (B), (C) and (D) Only

(3) (C), (D) and (E) Only

(4) (A), (D) and (E) Only

---

70. 500 J of energy is transferred as heat to 0.5 mol of Argon gas at 298 K and 1.00 atm. The final temperature and the change in internal energy respectively are: Given $R = 8.3\,\mathbf{J\ K^{-1}mol^{-1}}$**.**

(1) 348 K and 300 J

(2) 378 K and 500 J

(3) 378 K and 300 J

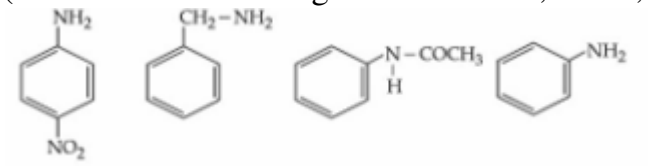
(4) 368 K and 500 J

---

71. Given below are some nitrogen containing compounds:

Each of them is treated with HCl separately. 1.0 g of the most basic compound will consume ..... mg of

(Given Molar mass in g mol^{-1}: C = 12, H = 1, O = 16, Cl = 35.5.)



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72. If A_2

---

73. The sum of sigma () and pi () bonds in Hex-1,3-dien-5-yne is:

(1) 17

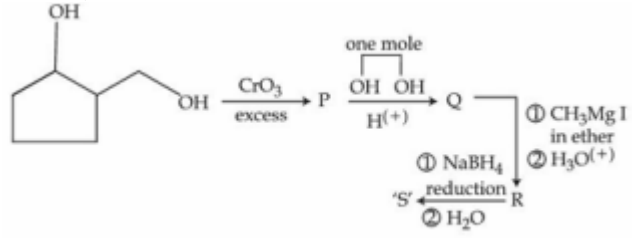
(2) 16

(3) 18

(4) 19

---

74. 0.1 mole of compound S will weigh ..... g, (given the molar mass in g mol^{-1} C = 12, H = 1, O = 16)



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75. The molar mass of the water insoluble product formed from the fusion of chromite ore $FeCr_2O_4$ with Na_2CO_3 in presence of O_2 is ..... g mol^{-1}:

(1) 196 g mol^{-1}

(2) 198 g mol^{-1}

(3) 200 g mol^{-1}

(4) 202 g mol^{-1}
