JEE-MAIN EXAMINATION – JANUARY 2025

(HELD ON THURSDAY 23rd JANUARY 2025)

TIME: 3:00 PM TO 6:00 PM

MATHEMATICS

SECTION-A

- 1. If in the expansion of $(1 + x)^p (1 x)^q$, the coefficients of x and x^2 are 1 and -2, respectively, then $p^2 + q^2$ is equal to :
 - (1)8

- (2) 18
- (3) 13
- (4) 20

Ans. (3)

2. Let $A = \{(x, y) \in \mathbf{R} \times \mathbf{R} : |x + y| \ge 3\}$ and

 $B = \{(x, y) \in \mathbf{R} \times \mathbf{R} : |x| + |y| \le 3\}.$

If $C = \{(x, y) \in A \cap B : x = 0 \text{ or } y = 0\}$, then

 $\sum_{(x,y)\in C} |x+y|$ is :

- (1) 15
- (2) 18
- (3)24
- (4) 12

Ans. (4)

3. The system of equations

x + y + z = 6,

x + 2y + 5z = 9

 $x + 5y + \lambda z = \mu$

has no solution if

- (1) $\lambda = 17$, $\mu \neq 18$
- (2) $\lambda \neq 17$, $\mu \neq 18$
- (3) $\lambda = 15$, $\mu \neq 17$
- (4) $\lambda = 17$, $\mu = 18$

Ans. (1)

4. Let $\int x^3 \sin x dx = g(x) + C$, where C is the constant of integration.

If
$$8\left(g\left(\frac{\pi}{2}\right)+g'\left(\frac{\pi}{2}\right)\right)=\alpha\pi^3+\beta\pi^2+\gamma$$
, α , β , $\gamma\in Z$,

Then $\alpha + \beta - \gamma$ equals :

- (1)55
- (2)47
- (3)48
- (4)62

Ans. (1)

TEST PAPER WITH ANSWER

- A rod of length eight units moves such that its ends A and B always lie on the lines x y + 2 = 0 and y + 2 = 0, respectively. If the locus of the point P, that divides the rod AB internally in the ratio 2: 1 is $9(x^2 + \alpha y^2 + \beta xy + \gamma x + 28 y) 76 = 0$, then $\alpha \beta \gamma$ is equal to:
 - (1)24
- (2)23

(3) 21

(4) 22

Ans. (2)

6. The distance of the line $\frac{x-2}{2} = \frac{y-6}{3} = \frac{z-3}{4}$ from the point (1, 4, 0) along the line $\frac{x}{1} = \frac{y-2}{2} = \frac{z+3}{3}$

is:

- (1) $\sqrt{17}$
- (2) $\sqrt{14}$
- (3) $\sqrt{15}$
- (4) $\sqrt{13}$

Ans. (2)

7. Let the point A divide the line segment joining the points P(-1, -1, 2) and Q(5, 5,10) internally in the ratio $r: 1 \ (r > 0)$. If O is the origin and $\left(\overrightarrow{OQ}.\overrightarrow{OA}\right) - \frac{1}{5}\left|\overrightarrow{OP}\times\overrightarrow{OA}\right|^2 = 10$, then the value of r

is:

- (1) 14
- (2) 3
- (3) $\sqrt{7}$
- (4)7

Ans. (4)

8. If the area of the region

 $\{(x, y): -1 \le x \le 1, 0 \le y \le a + e^{|x|} - e^{-x}, a > 0\}$ is

 $\frac{e^2 + 8e + 1}{e}$, then the value of a is:

(1)7

(2) 6

(3) 8

(4) 5

Ans. (4)

9. A spherical chocolate ball has a layer of ice-cream of uniform thickness around it. When the thickness of the ice-cream layer is 1 cm, the ice-cream melts at the rate of 81 cm³/min and the thickness of the ice-cream layer decreases at the rate of

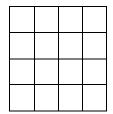
 $\frac{1}{4\pi}$ cm/min. The surface area (in cm²) of the

chocolate ball (without the ice-cream layer) is:

- (1) 225 π
- (2) 128π
- (3) 196π
- (4) 256 π

Ans. (4)

10. A board has 16 squares as shown in the figure :



Out of these 16 squares, two squares are chosen at random. The probability that they have no side in common is:

- $(1) \frac{4}{5}$
- $(2) \frac{7}{10}$

- (3) $\frac{3}{5}$
- $(4) \frac{23}{30}$

Ans. (1)

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

$$y = \left(x - y \frac{dx}{dy}\right) \sin\left(\frac{x}{y}\right), y > 0 \text{ and } x(1) = \frac{\pi}{2}.$$

Then cos(x(2)) is equal to :

- $(1) 1 2(\log_2 2)^2$
- $(2) 2(\log_2 2)^2 1$
- $(3) 2(\log_{2} 2) 1$
- $(4) 1 2(\log_{2} 2)$

Ans. (2)

12. Let the range of the function

$$f(x) = 6 + 16 \cos x \cdot \cos\left(\frac{\pi}{3} - x\right) \cdot \cos\left(\frac{\pi}{3} + x\right).$$

 $\sin 3x \cdot \cos 6x$, $x \in R$ be $[\alpha, \beta]$. Then the distance of the point (α, β) from the line 3x + 4y + 12 = 0 is :

- (1) 11
- (2) 8

(3) 10

(4) 9

Ans. (1)

13. Let the shortest distance from (a, 0), a > 0, to the parabola $y^2 = 4x$ be 4. Then the equation of the circle passing through the point (a, 0) and the focus of the parabola, and having its centre on the axis of the parabola is:

(1)
$$x^2 + y^2 - 6x + 5 = 0$$

(2)
$$x^2 + y^2 - 4x + 3 = 0$$

(3)
$$x^2 + y^2 - 10x + 9 = 0$$

(4)
$$x^2 + y^2 - 8x + 7 = 0$$

Ans. (1)

14. Let $X = R \times R$. Define a relation R on X as:

$$(a_1, b_1) R (a_2, b_2) \Leftrightarrow b_1 = b_2$$

Statement-I: R is an equivalence relation.

Statement-II: For some $(a, b) \in X$, the set $S = \{(x, y) \in X : (x, y) \ R \ (a, b)\}$ represents a line parallel to y = x.

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

- (1) Both **Statement-I** and **Statement-II** are false.
- (2) Statement-I is true but Statement-II is false.
- (3) Both **Statement-I** and **Statement-II** are true.
- (4) Statement-II is false but Statement-II is true.

- 15. The length of the chord of the ellipse $\frac{x^2}{4} + \frac{y^2}{2} = 1$, whose mid-point is $\left(1, \frac{1}{2}\right)$, is:
 - $(1) \frac{2}{3}\sqrt{15}$
- (2) $\frac{5}{3}\sqrt{15}$
- (3) $\frac{1}{3}\sqrt{15}$
- $(4) \sqrt{15}$

Ans. (1)

- 16. Let $A = \begin{bmatrix} a_{ij} \end{bmatrix}$ be a 3 \times 3 matrix such that $A \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$, $A \begin{bmatrix} 4 \\ 1 \\ 3 \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}$ and $A \begin{bmatrix} 2 \\ 1 \\ 2 \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$, then
 - a₂₃ equals
 - $(\tilde{1})$ $-\tilde{1}$

(2) 0

(3) 2

(4) 1

Ans. (1)

- 17. The number of complex numbers z, satisfying |z| = 1 and $\left| \frac{z}{\overline{z}} + \frac{\overline{z}}{z} \right| = 1$, is:
 - (1)6

- (2)4
- (3) 10
- (4) 8

Ans. (4)

18. If the square of the shortest distance between the lines $\frac{x-2}{1} = \frac{y-1}{2} = \frac{z+3}{-3}$ and $\frac{x+1}{2} = \frac{y+3}{4} = \frac{z+5}{-5}$ is $\frac{m}{2}$, where m, n are coprime numbers, then m + n

is equal to:

(1)6

- (2)9
- (3)21
- (4) 14

Ans. (2)

19. If $I = \int_{0}^{\frac{\pi}{2}} \frac{\sin^{\frac{3}{2}} x}{\sin^{\frac{3}{2}} x + \cos^{\frac{3}{2}} x} dx$,

then $\int_{0}^{21} \frac{x \sin x \cos x}{\sin^4 x + \cos^4 x} dx$ equals:

- (1) $\frac{\pi^2}{16}$
- (2) $\frac{\pi^2}{4}$
- (3) $\frac{\pi^2}{8}$
- (4) $\frac{\pi^2}{12}$

Ans. (1)

- 20. $\lim_{x\to\infty} \frac{(2x^2-3x+5)(3x-1)^{\frac{x}{2}}}{(3x^2+5x+4)\sqrt{(3x+2)^x}}$ is equal to:
 - (1) $\frac{2}{\sqrt{3e}}$
- (2) $\frac{2e}{\sqrt{3}}$
- (3) $\frac{2e}{3}$
- (4) $\frac{2}{3\sqrt{e}}$

Ans. (4)

SECTION-B

21. The number of ways, 5 boys and 4 girls can sit in a row so that either all the boys sit together or no two boys sit together, is _____.

Ans. (17280)

22. Let α , β be the roots of the equation $x^2 - ax - b = 0$ with $Im(\alpha) < Im(\beta)$. Let $P_n = \alpha^n - \beta^n$. If $P_3 = -5\sqrt{7}i, \quad P_4 = -3\sqrt{7}i, \quad P_5 = 11\sqrt{7}i \quad \text{and}$ $P_6 = 45\sqrt{7}i, \text{ then } \left|\alpha^4 + \beta^4\right| \text{ is equal to } \underline{\hspace{1cm}}.$

Ans. (31)

23. The focus of the parabola $y^2 = 4x + 16$ is the centre of the circle C of radius 5. If the values of λ , for which C passes through the point of intersection of the lines 3x - y = 0 and $x + \lambda y = 4$, are λ_1 and λ_2 , $\lambda_1 < \lambda_2$, then $12\lambda_1 + 29\lambda_2$ is equal to _____.

Ans. (15)

24. The variance of the numbers 8, 21, 34, 47, ..., 320, is _____.

Ans. (8788)

25. The roots of the quadratic equation $3x^2 - px + q = 0$ are 10^{th} and 11^{th} terms of an arithmetic progression with common difference $\frac{3}{2}$. If the sum of the first 11 terms of this arithmetic progression is 88, then q - 2q is equal to _____.

Ans. (474)

JEE-MAIN EXAMINATION – JANUARY 2025

(HELD ON THURSDAY 23rd JANUARY 2025)

TIME: 3:00 PM TO 6:00 PM

PHYSICS

SECTION-A

- **26.** A ball having kinetic energy KE, is projected at an angle of 60° from the horizontal. What will be the kinetic energy of ball at the highest point of its flight?
 - $(1) \frac{(KE)}{8}$
- $(2) \frac{(KE)}{4}$
- $(3)\frac{(KE)}{16}$
- (4) $\frac{(KE)}{2}$

Ans. (2)

- 27. Two charges 7 μc and 4 μc are placed at (– 7 cm, 0, 0) and (7 cm, 0, 0) respectively. Given, $∈_0 = 8.85 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$, the electrostatic potential energy of the charge configuration is :
 - (1) 1.5 J
- (2) 2.0 J
- (3) 1.2 J
- (4) 1.8 J

Ans. (4)

- 28. The refractive index of the material of a glass prism is $\sqrt{3}$. The angle of minimum deviation is equal to the angle of the prism. What is the angle of the prism?
 - $(1) 50^{\circ}$
- $(2) 60^{\circ}$
- $(3) 58^{\circ}$
- $(4) 48^{\circ}$

Ans. (2)

- **29.** The equation of a transverse wave travelling along a string is $y(x, t) = 4.0 \sin [20 \times 10^{-3} x + 600t]$ mm, where x is in the mm and t is in second. The velocity of the wave is:
 - (1) + 30 m/s
- (2) 60 m/s
- (3) 30 m/s
- (4) + 60 m/s

Ans. (3)

- **30.** The energy of a system is given as $E(t) = \alpha^3 e^{-\beta t}$, where t is the time and $\beta = 0.3 \text{ s}^{-1}$. The errors in the measurement of α and t are 1.2% and 1.6%, respectively. At t = 5 s, maximum percentage error in the energy is :
 - (1) 4%
- (2) 11.6%
- (3) 6%
- (4) 8.4%

Ans. (3)

31. In photoelectric effect an em-wave is incident on a metal surface and electrons are ejected from the surface. If the work function of the metal is 2.14 eV and stopping potential is 2V, what is the wavelength of the em-wave?

TEST PAPER WITH ANSWER

(Given hc = 1242 eVnm where h is the Planck's constant and c is the speed of light in vaccum.)

- (1) 400 nm
- (2) 600 nm
- (3) 200 nm
- (4) 300 nm

Ans. (4)

32. A circular disk of radius R meter and mass M kg is rotating around the axis perpendicular to the disk. An external torque is applied to the disk such that $\theta(t) = 5t^2 - 8t$, where $\theta(t)$ is the angular position of the rotating disc as a function of time t.

How much power is delivered by the applied torque, when t = 2s?

- $(1) 60 MR^2$
- (2) 72 MR²
- (3) 108 MR²
- (4) 8 MR²

Ans. (1)

- 33. Water flows in a horizontal pipe whose one end is closed with a valve. The reading of the pressure gauge attached to the pipe is P_1 . The reading of the pressure gauge falls to P_2 when the valve is opened. The speed of water flowing in the pipe is proportional to
 - $(1) \sqrt{P_1 P_2}$
- $(2) (P_1 P_2)^2$
- $(3) (P_1 P_2)^4$
- (4) $P_1 P_2$

Ans. (1)

34. Match List-II with List-II.

(A) Permeability of free space (I) $[M L^2 T^{-2}]$

List-I

- (B) Magnetic field
- (II) $[M T^{-2} A^{-1}]$
- (C) Magnetic moment
- (III) $[M L T^{-2} A^{-2}]$

List-II

- (D) Torsional constant
- $(IV) [L^2 A]$

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

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

Ans. (4)

35. If a satellite orbiting the Earth is 9 times closer to the Earth than the Moon, what is the time period of rotation of the satellite? Given rotational time period of Moon = 27 days and gravitational attraction between the satellite and the moon is neglected.

- (1) 1 day
- (2) 81 days
- (3) 27 days
- (4) 3 days

Ans. (1)

Two point charges $-4 \mu c$ and $4 \mu c$, constituting an **36.** electric dipole, are placed at (-9, 0, 0) cm and (9, 0, 0) cm in a uniform electric field of strength 10⁴ NC⁻¹. The work done on the dipole in rotating it from the equilibrium through 180° is:

- (1) 14.4 mJ
- (2) 18.4 mJ
- (3) 12.4 mJ
- (4) 16.4 mJ

Ans. (1)

37. A galvanometer having a coil of resistance 30 Ω need 20 mA of current for full-scale deflection. If a maximum current of 3 A is to be measured using this galvanometer, the resistance of the shunt to be added to the galvanometer should be $\frac{30}{Y}\Omega$, where

X is

- (1)447
- (2)298
- (3) 149
- (4)596

Ans. (3)

38. The width of one of the two slits in Young's double slit experiment is d while that of the other slit is xd. If the ratio of the maximum to the minimum intensity in the interference pattern on the screen is 9:4 then what is the value of x?

> (Assume that the field strength varies according to the slit width.)

(1) 2

(2)3

(3)5

(4)4

Ans. (3)

Given below are two statements. One is labelled as **39. Assertion** (A) and the other is labelled as Reason (R).

> **Assertion (A):** The binding energy per nucleon is found to be practically independent of the atomic number A, for nuclei with mass numbers between 30 and 170.

Reason (R): Nuclear force is long range.

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

- (1) (A) is false but (R) is true
- (2) (A) is true but (R) is false
- (3) Both (A) and (R) are true and (R) is the correct explanation of (A)
- (4) Both (A) and (R) are true but (R) is NOT the correct explanation of (A)

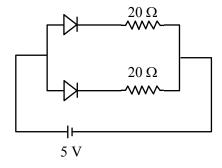
Ans. (2)

40. Water of mass m gram is slowly heated to increase the temperature from T₁ to T₂. The change in entropy of the water, given specific heat of water is $1 \text{ Jkg}^{-1} \text{K}^{-1}$, is:

- (1) zero
- $(2) m (T_2 T_1)$
- (3) $m l n \left(\frac{T_1}{T_2}\right)$ (4) $m l n \left(\frac{T_2}{T_1}\right)$

Ans. (4)

What is the current through the battery in the 41. circuit shown below?



- (1) 1.0 A
- (2) 1.5 A
- (3) 0.5 A
- (4) 0.25 A

Ans. (3)

- 42. A plane electromagnetic wave of frequency 20 MHz travels in free space along the +x direction. At a particular point in space and time, the electric field vector of the wave is $E_v = 9.3 \text{ Vm}^{-1}$. Then, the magnetic field vector of the wave at that point is-
 - (1) $B_z = 9.3 \times 10^{-8} \text{ T}$
- (2) $B_z = 1.55 \times 10^{-8} \text{ T}$
- (3) $B_z = 6.2 \times 10^{-8} \text{ T}$ (4) $B_z = 3.1 \times 10^{-8} \text{ T}$

Ans. (4)

43.

Using the given P-V diagram, the work done by an ideal gas along the path ABCD is-

- $(1) 4 P_0 V_0$
- (2) $3 P_0 V_0$
- $(3) 4 P_0 V_0$
- $(4) 3 P_0 V_0$

Ans. (4)

- A concave mirror of focal length f in air is dipped 44. in a liquid of refractive index μ . Its focal length in the liquid will be:
- $(2) \frac{f}{(\mu-1)}$
- $(3) \mu f$
- (4) f

Ans. (4)

- 45. A massless spring gets elongated by amount x_1 under a tension of 5N. Its elongation is x, under the tension of 7N. For the elongation $(5x_1 - 2x_2)$, the tension in the spring will be,
 - (1) 15 N
- (2) 20 N
- (3) 11 N
- (4) 39 N

Ans. (3)

SECTION-B

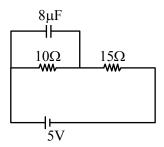
An air bubble of radius 1.0 mm is observed at a 46. depth of 20 cm below the free surface of a liquid having surface tension 0.095 J/m² and density 10³ kg/m³. The difference between pressure inside the bubble and atmospheric pressure N/m^2 . (Take $g = 10 \text{ m/s}^2$)

Ans. (2190)

A satellite of mass $\frac{M}{2}$ is revolving around earth in 47. a circular orbit at a height of $\frac{R}{3}$ from earth surface. The angular momentum of the satellite is $M\sqrt{\frac{GMR}{x}}$. The value of x is _____, where M and R are the mass and radius of earth, respectively. (G is the gravitational constant)

Ans. (3)

At steady state the charge on the capacitor, as 48. shown in the circuit below, is μ C.



Ans. (16)

49. A time varying potential difference is applied between the plates of a parallel plate capacitor of capacitance 2.5 µF. The dielectric constant of the medium between the capacitor plates is 1. It produces an instantaneous displacement current of 0.25 mA in the intervening space between the capacitor plates, the magnitude of the rate of change of the potential difference will be Vs^{-1} .

Ans. (100)

In a series LCR circuit, a resistor of 300 Ω , a **50.** capacitor of 25 nF and an inductor of 100 mH are used. For maximum current in the circuit, the angular frequency of the ac source is $___ \times 10^4$ radians s⁻¹.

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TEST PAPER WITH ANSWER

TIME: 3:00 PM TO 6:00 PM

CHEMISTRY

SECTION-A

51. The effect of temperature on spontaneity of reactions are represented as:

	ΔΗ	ΔS	Temperature	Spontaneity
(A)	+	_	any T	Non
				spontaneous
(B)	+	+	low T	spontaneous
(C)	_	_	low T	Non
				spontaneous

- (D) + any T spontaneous
 - (1) (B) and (D) only
 - (2) (A) and (D) only
 - (3) (B) and (C) only
 - (D) (A) and (C) only

Ans. (3)

52. Standard electrode potentials for a few half cells are mentioned below:

$$E_{\text{Cu}^{2+}/\text{Cu}}^{\text{o}} = 0.34\text{V}, E_{\text{Zn}^{2+}/\text{Zn}}^{\text{o}} = -0.76\text{V}$$

$$E_{Ag^+/Ag}^{o} = 0.80V, E_{Mg^{2+}/Mg}^{o} = -2.37V$$

Which one of the following cells gives the most negative value of ΔG^o ?

- $(1) \ Zn|Zn^{2^{+}} (1M)||Ag^{+}(1M) \ | \ Ag$
- $(2) \ Zn|Zn^{2^{+}} (1M)||Mg^{2^{+}} (1M) \ | \ Mg$
- $(3) \ Ag|Ag^{^{+}}(1M)||Mg^{2^{+}}(1M) \ | \ Mg$
- (4) $Cu \mid Cu^{2+}(1M) || Ag^{+}(1M) || Ag$

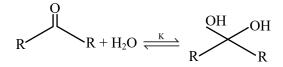
Ans. (1)

Ans. (3)

- 53. The α Helix and β Pleated sheet structures of protein are associated with its:
 - (1) quaternary structure
 - (2) primary structure
 - (3) secondary structure
 - (4) tertiary structure
- (4) tertiary sure

54. Given below are two statements:

Consider the following reaction



Statement (I): In the case of formaldehyde

(H H), K is about 2280, due to small substituents, hydration is faster.

Statement (II): In the case of trichloro

acetaldehyde
$$\begin{pmatrix} O \\ II \\ C \\ Cl \end{pmatrix}$$
 , K is about 2000

due to -I effect of -Cl.

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

- (1) Statement I true but Statement II is false
- (2) Both Statement I and Statement II are true
- (3) Statement I is false but Statement II is true
- (4) Both Statement I and Statement II are false

Ans. (2)

55. Consider the reaction

$$X_2Y(g) \rightleftharpoons X_2(g) + \frac{1}{2}Y_2(g)$$

The equation representing correct relationship between the degree of dissociation (x) of $X_2Y(g)$ with its equilibrium constant Kp is _____. Assume x to be very very small.

$$(1) x = \sqrt[3]{\frac{2Kp}{p}}$$

$$(2) x = \sqrt[3]{\frac{2Kp^2}{p}}$$

$$(3) x = \sqrt[3]{\frac{Kp}{2p}}$$

$$(4) x = \sqrt[3]{\frac{Kp}{p}}$$

56. Identify A, B and C in the given below reaction sequence

- (1) PbCl₂, PbSO₄, PbCrO₄
- (2) PbS, PbSO₄, PbCrO₄
- (3) PbS, PbSO₄, Pb(CH₃COO)₂
- $(4) \text{ PbCl}_2, \text{ Pb}(SO_4)_2, \text{ PbCrO}_4$

Ans. (2)

57. Given below are two statements:

Statement (I): The boiling points of alcohols and phenols increase with increase in the number of C-atoms. **Statement (II):** The boiling points of alcohols and phenols are higher in comparison to other class of compounds such as ethers, haloalkanes.

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

- (1) Both **Statement I** and **Statement II** are false
- (2) Statement I is false but Statement II is true
- (3) Statement I is true but Statement II is false
- (4) Both **Statement I** and **Statement II** are true

Ans. (4)

58. When a non-volatile solute is added to the solvent, the vapour pressure of the solvent decreases by 10 mm of Hg. The mole fraction of the solute in the solution is 0.2. What would be the mole fraction of the solvent if decrease in vapour pressure is 20 mm of Hg?

(1) 0.6

(2) 0.4

(3) 0.2

(4) 0.8

Ans. (1)

59. Given below are two statements:

Statement (I): For a given shell, the total number of allowed orbitals is given by n^2 .

Statement (II): For any subshell, the spatial orientation of the orbitals is given by -l to +l values including zero.

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

- (1) Statement I is true but Statement II is false
- (2) Statement I is false but Statement II is true
- (3) Both Statement I and Statement II are true
- (4) Both **Statement I** and **Statement II** are false

Ans. (3)

60. The ascending order of relative rate of solvolysis of following compounds is

$$Br$$
 Br Br Br

(C)

(D)

(A) (B) (1) (D) < (A) < (B) < (C)

(2) (C) < (B) < (A) < (D)

(3)(D) < (B) < (A) < (C)

(4) (C) < (D) < (B) < (A)

Ans. (1)

61. Match List - I with List - II.

T	List - I	List - II		
	omers of	(Ozonolysis product)		
$C_{10}H_{14}$)				
(A)		(I)	H 3 H	
(B)		(II)	0 4 0 0 0	
(C)		(III)	H O O O	
(D)		(IV)	H 4 0 0	

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

below:

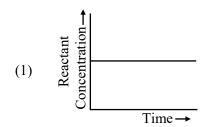
(1) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)

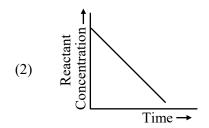
(2) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

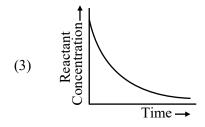
(3) (A)-(III), (B)-(II), (C)-(I), (D)-(IV)

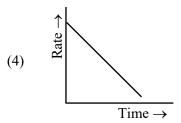
(4) (A)-(I), (B)-(IV), (C)-(III), (D)-(II)

62. Which of the following graphs most appropriately represents a zero order reaction?









Ans. (2)

63. Match List - I with List - II.

List - I		List - II	
(A)	Bronze	(I)	Cu, Ni
(B)	Brass	(II)	Fe, Cr, Ni, C
(C)	UK silver coin	(III)	Cu, Zn
(D)	Stainless Steel	(IV)	Cu, Sn

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

below:

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

Ans. (2)

- **64.** Identify the coordination complexes in which the central metal ion has d⁴ configuration.
 - (A) $[FeO_4]^{2-}$
 - (B) $[Mn(CN)_6]^{3-}$
 - (C) $[Fe(CN)_6]^3$

O | | | | (D)
$$Cr_2(O - C - Me)_4 (H_2O)_2$$

(E) $[NiF_6]^{2-}$

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

- (1) (C) and (E) only
- (2) (B), (C) and (D) only
- (3) (B) and (D) only
- (4) (A), (B) and (E) only

Ans. (3)

- **65.** Given below are the atomic numbers of some group 14 elements. The atomic number of the element with lowest melting point is:
 - (1) 14
- (2)6
- (3)82
- (4) 50

Ans. (4)

- **66.** pH of water is 7 at 25°C. If water is heated to 80°C, it's pH will:
 - (1) Decrease
 - (2) Remains the same
 - (3) H⁺ concentration increases, OH⁻ concentration decreases
 - (4) Increase

Ans. (1)

67. Identify the products [A] and [B], respectively in the following reaction :

$$\begin{array}{c}
C1 \\
(i) \text{ NaOH, 623K, 300 atm} \\
(ii) \text{ H}^{+} \\
\end{array} = [A] \xrightarrow{\text{Na}_{2}\text{Cr}_{2}\text{O}_{7}} [B]$$

Ans. (3)

- 68. Consider a binary solution of two volatile liquid components 1 and 2 x_1 and y_1 are the mole fractions of component 1 in liquid and vapour phase, respectively. The slope and intercept of the linear plot of $\frac{1}{x_1}vs\frac{1}{v_1}$ are given respectively as :
 - $(1) \frac{P_1^0}{P_2^0}, \frac{P_2^0 P_1^0}{P_2^0} \qquad (2) \frac{P_2^0}{P_2^0}, \frac{P_1^0 P_2^0}{P_2^0}$
 - (3) $\frac{P_1^0}{P_2^0}, \frac{P_1^0 P_2^0}{P_2^0}$ (4) $\frac{P_2^0}{P_2^0}, \frac{P_2^0 P_1^0}{P_2^0}$

Ans. (1)

69. Given below are two statements about X-ray spectra of elements:

> **Statement (I)**: A plot of \sqrt{v} (v = frequency of X-rays emitted) vs atomic mass is a straight line.

> **Statement (II)**: A plot of v(v = frequency of v)X-rays emitted) vs atomic number is a straight line. In the light of the above statements choose the **correct** answer from the options given below:

- (1) Statement I is true but Statement II is false
- (2) Both Statement I and Statement II are true
- (3) Both **Statement I** and **Statement II** are false
- (4) Statement I is false but Statement II is true

Ans. (3)

70. Consider the following reactions

$$K_2Cr_2O_7 \xrightarrow{\quad KOH \\ \quad -H_2O} [A] \xrightarrow{\quad H_2SO_4 \\ \quad -H_2O} [B] + K_2SO_4$$

The products [A] and [B], respectively are:

- (1) $K_2Cr(OH)_6$ and Cr_2O_3
- (2) K₂CrO₄ and Cr₂O₃
- (3) K₂CrO₄ and K₂Cr₂O₇
- (4) K₂CrO₄ and CrO

Ans. (3)

SECTION-B

71. 0.01 mole of an organic compound (X) containing 10% hydrogen, on complete combustion produced $0.9 \text{ g H}_2\text{O}$. Molar mass of (X) is _____ g mol⁻¹.

Ans. (100)

72. Consider the following sequence of reactions.

$$(i) \begin{tabular}{l} NaNO_2, HCl \\ 0-5^{\circ}C \\ \hline \\ CH_2 \\ CH_3 \\ \hline \end{tabular} (A) \begin{tabular}{l} OH \\ ii) \begin{tabular}{l} NaOH \\ (ii) \begin{tabular}{l} HCl \dil. \\ (Molecular \ formula) \\ C_{14}H_{14}N_2O_2 \\ (i) \begin{tabular}{l} NaOH \\ (ii) \begin{tabular}{l} H_3CCH_2Br \\ (C) \\ (Molecular \ formula) \\ (C_{16}H_{18}N_2O_2 \\ \end{array} \end{tabular}$$

Total number of sp³ hybridised carbon atoms in the major product C formed is .

Ans. (4)

73. When 81.0 g of aluminium is allowed to react with 128.0 g of oxygen gas, the mass of aluminium oxide produced in grams is . (Nearest integer) Given:

> Molar mass of Al is 27.0 g mol⁻¹ Molar mass of O is 16.0 g mol⁻¹

Ans. (153)

74. The bond dissociation enthalpy of X_2 ΔH_{bond}^o calculated from the given data is kJ mol⁻¹. (Nearest integer)

$$M^{+}X^{-}(s) \rightarrow M^{+}(g) + X^{-}(g) \Delta H^{\circ}_{lattice} = 800 \text{ kJ mol}^{-1}$$
 $M(s) \rightarrow M(g) \Delta H^{\circ}_{sub} = 100 \text{ kJ mol}^{-1}$
 $M(g) \rightarrow M^{+}(g)^{-} + e^{-}(g) \Delta H^{\circ}_{i} = 500 \text{ kJ mol}^{-1}$

$$X(g) + e^{-}(g) \rightarrow X^{-}(g) \Delta H^{\circ}_{eg} = -300 \text{ kJ mol}^{-1}$$

$$M(s) + \frac{1}{2} X_2(g) \rightarrow M^+ X^-(s) \Delta H^{\circ}_{f} = -400 \text{ kJ mol}^{-1}$$

[Given: M⁺X⁻ is a pure ionic compound and X forms a diatomic molecule X₂ is gaseous state]

(200)Ans.

75. A compound 'X' absorbs 2 moles of hydrogen and 'X' upon oxidation with KMnO₄ | H⁺ gives

The total number of σ bonds present in the compound 'X' is _____.