

JEE (Main)-2025 (Online) Session-2
Memory Based Question with & Solutions
(Physics, Chemistry and Mathematics)
7th April 2025 (Shift-2)

Time: 3 hrs.

M.M.: 300

IMPORTANT INSTRUCTIONS:

- (1) The test is of 3 hours duration.
- (2) This test paper consists of 75 questions. Each subject (PCM) has 25 questions. The maximum marks are 300.
- (3) This question paper contains Three Parts. Part-A is Physics, Part-B is Chemistry and Part-C is Mathematics. Each part has only two sections: Section-A and Section-B.
- (4) Section - A : Attempt all questions.
- (5) Section - B : Attempt all questions.
- (6) Section - A (01 - 20) 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.
- (7) Section - B (21 – 25) contains 5 Numerical value based questions. The answer to each question should be rounded off to the nearest integer. Each question carries +4 marks for correct answer and -1 mark for wrong answer.

MEMORY BASED QUESTIONS JEE–MAIN EXAMINATION – APRIL, 2025

(Held On Monday 7th April, 2025)

TIME : 3 : 00 PM to 6 : 00 PM

PHYSICS

SECTION-A

1. Given below are two statements. One is labelled as Assertion (A) and the other is labelled as reason (R)

Assertion (A): Refractive index of glass is more than air

Reason (R): Optical density of a medium is directly related to its mass density.

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

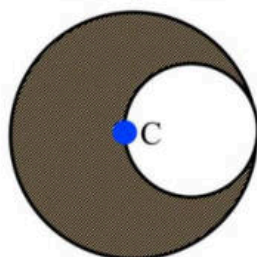
- (1) Both (A) and (R) are true and (R) is correct explanation of (A)
- (2) Both (A) and (R) are true but (R) is NOT the correct explanation of (A)
- (3) (A) is true but (R) is false
- (4) (A) is false but (R) is true

Ans. (3)

Sol. Assertion → True

Reason → False

2. The figure shows a circular portion of radius $\frac{R}{2}$ removed from a disc of mass m and radius R . The moment of inertia about an axis passing through the centre C of the disc and perpendicular to the plane is



- (1) $\frac{11}{64} mR^2$
- (2) $\frac{mR^2}{16}$
- (3) $\frac{mR^2}{2}$
- (4) $\frac{13}{32} mR^2$

Ans. (4)

Sol.
$$I = \frac{MR^2}{2} + \frac{\left(-\frac{M}{4}\right)\left(\frac{R}{2}\right)^2}{2} + \left(-\frac{M}{4}\right)\left(\frac{R}{2}\right)^2$$

$$= \frac{mR^2}{2} - \frac{mR^2}{32} - \frac{mR^2}{16}$$

$$= \frac{16mR^2 - mR^2 - 2mR^2}{32}$$

$$= \frac{13}{32} mR^2$$

3. Which of the following quantity has same dimensions as $\sqrt{\frac{\mu_0}{\epsilon_0}}$?

- (1) Resistance
- (2) Voltage
- (3) Capacitance
- (4) Inductance

Ans. (1)

Sol. Ampere's law $B\ell : \mu_0 i$

Gauss' law $\frac{q}{\epsilon_0} = EA$

$$\sqrt{\frac{\mu_0}{\epsilon_0}} = \left(\frac{1}{\sqrt{\mu_0 \epsilon_0}} \right) \mu_0 = C \times \frac{B}{ni}$$

$$= \frac{C(EL)}{Cni} = \frac{V}{Ni} = R$$

4. Give below are two statements. One is labelled as Statement-I and the other is labelled as Statement-II.

Statement-I: A magnetic monopole does not exist.

Statement-II : Magnetic lines are continuous and form closed loops.

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

- (1) Statement-I is correct, statement-II is correct and statement-II is correct explanation of statement-I.
- (2) Statement-I is correct, statement-II is correct and statement-II is not the correct explanation of statement-I.
- (3) Statement-I is correct and statement-II is incorrect.
- (4) Statement-I is incorrect and statement-II is correct.

Ans. (1)

Sol. $\oint \mathbf{B} \cdot d\mathbf{A} = 0$

5. Potential energy is not defined for which of the force :-

- (1) Gravitational force (2) Restoring force
(3) Friction (4) Electrostatic force

Ans. (3)

Sol. Frictional force is Non conservative force

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

- (1) 20 cm (2) 5.0 cm
(3) 2.5 cm (4) 10 cm

Ans. (2)

Sol. $y = \sin [20\pi x + 10\pi t]$

$$\omega = 10\pi$$

$$k = 20\pi$$

$$\Delta\phi = \frac{2\pi}{\lambda} \Delta x$$

$$\pi = 20\pi \Delta x$$

$$\Delta x = \frac{1}{20} \text{ m} = 5 \text{ cm}$$

7. For a given physical expression $\sqrt{\frac{2I}{C\epsilon_0}}$ which of the unit matches :-

- (1) N/C (2) m/s C
(3) Amp./m (4) N m/C

Ans. (1)

Sol. $I = \frac{W}{m^2}$

$$C = \text{m/s}$$

$$\epsilon_0 = \frac{C^2}{\text{Nm}^2}$$

$$\sqrt{\frac{2I}{\epsilon_0 C}} = \sqrt{\frac{W/m^2}{\frac{C^2}{\text{Nm}^2} \times \text{m/s}}} = \frac{\text{N}}{\text{C}}$$

8. Match the following :-

- (a) Power (P) $[\text{ML}^{-3}\text{T}^0]$
(b) Mass density (Q) $[\text{ML}^2\text{T}^{-3}]$
(c) Angular Impulse (R) $[\text{ML}^2\text{T}^{-1}]$
(S) $[\text{ML}^3\text{T}^{-2}]$

(1) (a)-(Q), (b)-(P), (c)-(R)

(2) (a)-(Q), (b)-(P), (c)-(S)

(3) (a)-(S), (b)-(P), (c)-(R)

(4) (a)-(P), (b)-(Q), (c)-(R)

Ans. (1)

Sol. (a) Power = $[\text{ML}^2\text{T}^{-3}]$
(b) Mass density = $[\text{ML}^{-3}\text{T}^0]$
(c) Angular Impulse = $[\text{ML}^2\text{T}^{-1}]$

9. A helicopter is moving 2 km above the ground horizontally with a speed of 360 km/hr. A packet is dropped from helicopter, find distance between the points where the packet was released to the point where packet lands on the ground

- (1) $\sqrt{2}$ km (2) $2\sqrt{2}$ km
(3) 2 km (4) $\frac{1}{\sqrt{2}}$ km

Ans. (2)

Sol. $R = \sqrt{\frac{2h}{g}} \times u$
 $= 350 \times \frac{5}{18} \times \sqrt{\frac{2 \times 2000}{10}}$
 $= 100 \times 20 = 2000 \text{ m}$
 $= 2 \text{ km}$

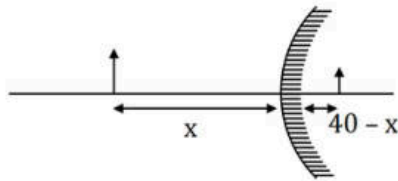
Distance between the points = $2\sqrt{2}$ km

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

- (1) 12.7 cm (2) 15 cm
(3) 10 cm (4) 10.7 cm

Ans. (4)

Sol.



$$m = -\left(\frac{40-x}{-x}\right) = \frac{1}{4}$$

$$160 - 4x = x$$

$$x = 32$$

$$\frac{1}{8} - \frac{1}{32} = \frac{1}{f}$$

$$f = \frac{32}{3} \text{ cm}$$

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

- (1) 5 N (2) 6 N
(3) 8 N (4) 4 N

Ans. (4)

Sol. $v = 4\sqrt{x}$

$$a = v \frac{dv}{dx}$$

$$= 4\sqrt{x} \cdot \frac{2}{\sqrt{x}} = 8$$

$$F = 4 \text{ N}$$

12. A capillary tube is put in water which is having tube radius of 0.1 mm. Find capillary rise in the tube, If angle of contact = 30° , surface tension of liquid 70 dyne/cm, $\rho_{\text{water}} = \frac{1 \text{ gram}}{\text{cm}^3}$, $g = 9.8 \text{ m/sec}^2$

- (1) 21.35 cm (2) 12.37 cm
(3) 15.35 cm (4) 11.37 cm

Ans. (2)

Sol.
$$h = \frac{2T \cos \theta}{\rho g r} = \frac{2 \times 70 \times \frac{\sqrt{3}}{2}}{1 \times 980 \times 0.01} = \frac{1.732}{0.14} = 12.37 \text{ cm}$$

13. Flux through a plane parallel to x-z plane is 6 SI units. Find area of plane if electric field in the region is $\vec{E} = (\hat{i} + 4\hat{j} + \hat{k}) 10^3 \text{ N/C}$.

- (1) $2.5 \times 10^{-2} \text{ m}^2$ (2) $2 \times 10^{-3} \text{ m}^2$
(3) $2.5 \times 10^{-3} \text{ m}^2$ (4) $1.5 \times 10^{-3} \text{ m}^2$

Ans. (4)

Sol. $\phi = \vec{E} \cdot \vec{A}$

$$6 = (2\hat{i} + 4\hat{j} + 6\hat{k}) \cdot (A\hat{j}) \times 10^3$$

$$6 = 4A \times 10^3$$

$$\Rightarrow A = 1.5 \times 10^{-3} \text{ m}^2$$

14. **Assertion :** Aeroplane is made of metal to prevent from lighting strike.

Reason : Electric field in cavity inside conductor at equilibrium remain zero.

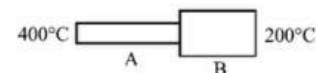
- (1) Both Assertion and Reason are correct
(2) Assertion is correct but Reason incorrect
(3) Assertion is incorrect and Reason is correct
(4) Both are incorrect.

Ans. (1)

Sol. Assertion $\rightarrow$ Correct

Reason $\rightarrow$ Correct

15. If $\frac{L_A}{L_B} = 2$, $\frac{K_A}{K_B} = 2$, $\frac{R_A}{R_B} = \frac{1}{2}$, where L = length of Rod, K = thermal conductivity, R = Radius of cross-section of Rod.



Find temperature of Junction.

- (1) 280°C (2) 300°C
(3) 240°C (4) 320°C

Ans. (3)

Sol. $R_A = \frac{L_A}{K_A \pi R_A^2}$

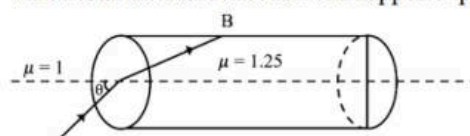
$$R_B = \frac{L_B}{K_B \pi R_B^2}$$

$$\frac{R_A}{R_B} = \frac{L_A}{L_B} \times \frac{K_B}{K_A} \times \frac{R_B^2}{R_A^2} = 2 \times \frac{1}{2} \times 4 = 4$$

$$\text{Drop across A} = \frac{4}{5} \times 200 = 160^\circ\text{C}$$

$$T = 400 - 160 = 240^\circ\text{C}$$

16. The maximum value of θ (as shown in figure) for which total internal reflection can happen at point B is



- (1) $\sin^{-1}\left(\frac{3}{4}\right)$ (2) $\cot^{-1}\left(\frac{3}{4}\right)$
 (3) $\cos^{-1}\left(\frac{3}{4}\right)$ (4) $\tan^{-1}\left(\frac{4}{3}\right)$

Ans. (1)

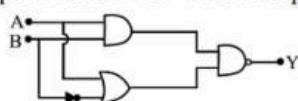
Sol. $\sin\theta_c = \frac{1}{\mu} = \frac{1}{5/4}$

$\theta_c = 53^\circ$

$1 \sin\theta = \frac{5}{4} \times \sin i$

$\sin\theta = \frac{5}{4} \times \sin 37^\circ = \frac{5}{4} \times \frac{3}{5} = \frac{3}{4}$

17. Find input A and B for which output Y is zero



- (1) A = 1, B = 1 (2) A = 0, B = 0
 (3) A = 0, B = 1 (4) A = 1, B = 0

Ans. (1)

Sol. A → 1
 B → 1

18. Distance between plates of capacitor is 0.5 mm, potential difference between plates is 5 volt. Now a dipole is placed between plates of capacitor, having its dipole moment parallel to electric field. Magnitude of one charge of dipole is $2 \mu\text{C}$ and distance between charges is $0.5 \mu\text{m}$. Now dipole is tilted at an angle $\theta = 30^\circ$, then torque acting on the dipole is

- (1) $5 \times 10^{-8} \text{ Nm}$ (2) $5 \times 10^{-9} \text{ Nm}$
 (3) $5 \times 10^{-10} \text{ Nm}$ (4) None of these

Ans. (2)

Sol. $E = \frac{5 \times 10}{0.5 \times 10^{-3}} = 10^4 \text{ V/m}$

$\tau = PE \sin 30^\circ = (2 \times 10^{-6} \times 0.5 \times 10^{-6}) \times 10^4 \times \frac{1}{2}$

$\tau = 5 \times 10^{-9} \text{ Nm}$

19. A photon of wavelength λ_1 is incident on a photo-sensitive surface of threshold wavelength λ_0 . The de-Broglie wavelength of fastest photoelectron is :-

- (1) $\lambda_1 - \lambda_0$ (2) $\sqrt{\lambda_1^2 - \lambda_0^2}$
 (3) $\sqrt{\frac{h}{2mc} \left(\frac{1}{\lambda_1} - \frac{1}{\lambda_0} \right)}$ (4) $\sqrt{\frac{h}{2mc \left(\frac{1}{\lambda_1} - \frac{1}{\lambda_0} \right)}}$

Ans. (4)

Sol. $\text{KE}_{\text{max}} = \frac{hc}{\lambda_1} - \frac{hc}{\lambda_0} = hc \left(\frac{1}{\lambda_1} - \frac{1}{\lambda_0} \right)$

$\lambda = \frac{h}{\sqrt{2m\text{KE}}} = \frac{h}{\sqrt{2mhc \left(\frac{1}{\lambda_1} - \frac{1}{\lambda_0} \right)}}$

$\lambda = \sqrt{\frac{h}{2mhc \left(\frac{1}{\lambda_1} - \frac{1}{\lambda_0} \right)}}$

SECTION - B

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

Ans. (1)

Sol. $P = VI \cos \Delta\phi$

$Z = \sqrt{100^2} = 100\Omega$

$I_{\text{rms}} = \frac{10}{100} = \frac{1}{10} \text{ A}$

$\tan \Delta\phi = \frac{X_C - X_L}{R} = 0$

$P_{\text{avg}} = 1\text{W}$

CHEMISTRY

SECTION-A

1. Which of the following is correct order of acidic character of oxides of vanadium?

- (1) $V_2O_5 > VO_2 > V_2O_3$
 (2) $V_2O_3 > VO_2 > V_2O_5$
 (3) $V_2O_5 > V_2O_3 > VO_2$
 (4) $VO_2 > V_2O_3 > V_2O_5$

Ans. (1)

Sol. For oxides of same element

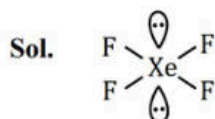
As. O.S. increases, acidic character increases

So acidic character order $V_2O_5 > VO_2 > V_2O_3$

2. Which of the following is the correct Hybridisation of XeF_4 ?

- (1) sp^3d (2) sp^3
 (3) sp^3d^2 (4) sp^3d^3

Ans. (3)



Steric Number = B.P. + I.P.

$$= 4 + 2 = 6$$

No. of hybrid orbitals formed = 6

Hybridization = sp^3d^2

3. Consider the following species

- (i) $\underline{S}O_2$ (ii) $\underline{N}_3^-$ (iii) $\underline{N}O_2^-$

Find the hybridization of underlined atom.

- (1) (i) sp^2 (ii) sp^2 (iii) sp^2
 (2) (i) sp^2 (ii) sp (iii) sp^2
 (3) (i) sp^3 (ii) sp (iii) sp^2
 (4) (i) sp (ii) sp^2 (iii) sp^3

Ans. (2)

Sol. (i) $SO_2 \rightarrow sp^2$

(ii) $\underline{N}_3^- \rightarrow sp$

(iii) $\underline{NO}_2^- \rightarrow sp^2$

4. Match the following

	Complex	Primary Valency		Secondary Valency
(A)	$[Co(en)_2Cl_2]Cl$	(I)	3	6
(B)	$[Pt(NH_3)_2Cl(NO_2)]$	(II)	3	4
(C)	$[Co(SCN)_4]^{-1}$	(III)	2	6
(D)	$[Mg(EDTA)]^2$	(IV)	2	4

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

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

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

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

Ans. (4)

Sol.

(A) $[Co(en)_2Cl_2]Cl \Rightarrow$ Primary valency = 3

Sec. Valency = 6

(B) $[Pt(NH_3)_2Cl(NO_2)] \Rightarrow$ Primary valency = 2

Sec. Valency = 4

(C) $[Co(SCN)_4]^{-1} \Rightarrow$ Primary valency = 3

Sec. Valency = 4

(D) $[Mg(EDTA)]^{2-} \Rightarrow$ Primary valency = 2

Sec. Valency = 6

5. Among the given order, the incorrect order of atomic radii is

- (1) $r_{Rb} < r_{Cs}$ (2) $r_{Mg} < r_{Al}$
 (3) $r_{Cl} < r_{Br}$ (4) $r_K < r_{Rb}$

Ans. (2)

Sol. (1) $r_{Rb} < r_{Cs}$ correct

(2) $r_{Mg} < r_{Al}$ incorrect

(3) $r_{Cl} < r_{Br}$ correct

(4) $r_K < r_{Rb}$ correct

6. If $P_A^0 = 350$ torr and $P_B^0 = 750$ torr and the two volatile liquids (A) and (B) form an ideal solution. X_A and X_B are the respective mole fraction of (A) and (B) in solution and Y_A and Y_B are the respective mole fraction of (A) and (B) in the vapour phase. Which one of the following relation is correct?

$$(1) \frac{Y_A}{Y_B} = \frac{X_A}{X_B} \quad (2) \frac{Y_A}{Y_B} < \frac{X_A}{X_B}$$

$$(3) \frac{Y_A}{Y_B} > \frac{X_A}{X_B} \quad (4) \frac{Y_A}{Y_B} = \frac{X_B}{X_A}$$

Ans. (2)

Sol. $P_A = P_A^0 X_A = P_T \times Y_A \dots (1)$

$P_B = P_B^0 X_B = P_T \times Y_B \dots (2)$

Dividing eq. (1) by (2)

$$\frac{P_A^0 X_A}{P_B^0 X_B} = \frac{Y_A}{Y_B}$$

$$\frac{350 \times X_A}{750 \times X_B} = \frac{Y_A}{Y_B}$$

$$\frac{X_A}{X_B} > \frac{Y_A}{Y_B}$$

7. Match List-I with List-II and select the correct option.

List-I (Solution)		List-II (Properties)	
(A)	Benzene + Toluene	(P)	Show +ve deviation
(B)	Aniline + CH_3COOH	(Q)	$\Delta V_{\text{mix}} = 0$
(C)	Water + ethanol	(R)	$\Delta H_{\text{mix}} = -\text{ve}$
(D)	Acetone + CHCl_3	(S)	Form minimum boiling Azeotrope.

(1) $A \rightarrow Q; B \rightarrow R; C \rightarrow P, S; D \rightarrow R$

(2) $A \rightarrow S; B \rightarrow Q; C \rightarrow P, S; D \rightarrow R$

(3) $A \rightarrow Q; B \rightarrow P, S; C \rightarrow R; D \rightarrow P$

(4) $A \rightarrow P; B \rightarrow S; C \rightarrow P; D \rightarrow R$

Ans. (1)

Sol.

(A) Benzene + Toluene $\Rightarrow$ Ideal solution ($\Delta V_{\text{mix}} = 0$)

(B) Aniline + $\text{CH}_3\text{COOH} \Rightarrow$ Negative deviation
($\Delta H_{\text{mix}} = \text{negative}$)

(C) Water + ethanol $\Rightarrow$ Positive deviation
(Form minimum boiling Azeotrope.)

(D) Acetone + $\text{CHCl}_3 \Rightarrow$ Negative deviation
($\Delta H_{\text{mix}} = \text{negative}$)

8. List-I mentions thermodynamic process of List-II mention property

List-I		List-II	
(A)	Isothermal	(I)	$q = 0$
(B)	Adiabatic	(II)	$\Delta T = 0$
(C)	Isobaric	(III)	$\Delta V = 0$
(D)	Isochoric	(IV)	$\Delta P = 0$

(1) $A \rightarrow \text{II}; B \rightarrow \text{I}; C \rightarrow \text{IV}; D \rightarrow \text{III}$

(2) $A \rightarrow \text{I}; B \rightarrow \text{II}; C \rightarrow \text{III}; D \rightarrow \text{IV}$

(3) $A \rightarrow \text{I}; B \rightarrow \text{IV}; C \rightarrow \text{III}; D \rightarrow \text{II}$

(4) $A \rightarrow \text{II}; B \rightarrow \text{I}; C \rightarrow \text{III}; D \rightarrow \text{IV}$

Ans. (1)

Sol. (A) Isothermal $\Rightarrow \Delta T = 0$

(B) Adiabatic $\Rightarrow q = 0$

(C) Isobaric $\Rightarrow \Delta P = 0$

(D) Isochoric $\Rightarrow \Delta V = 0$

9. In electrolysis of aqueous solution of AgNO_3 , $\text{Cu}(\text{NO}_3)_2$, $\text{Hg}(\text{NO}_3)_2$ and $\text{Au}(\text{NO}_3)_3$ is carried out, then correct order of deposition of metal cathode give

Metal ion	SRP(V)
Ag^+/Ag	0.79
Cu^{2+}/Cu	0.34
Hg^{2+}/Hg	0.85
Au^{3+}/Au	1.4

(1) $\text{Au} > \text{Hg} > \text{Ag} > \text{Cu}$

(2) $\text{Au} > \text{Hg} > \text{Cu} > \text{Ag}$

(3) $\text{Au} > \text{Ag} > \text{Hg} > \text{Cu}$

(4) $\text{Cu} > \text{Ag} > \text{Hg} > \text{Au}$

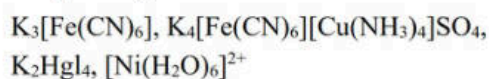
Ans. (1)

Sol.

Metal ion	SRP(V)
Ag^+/Ag	0.79
Cu^{2+}/Cu	0.34
Hg^{2+}/Hg	0.85
Au^{3+}/Au	1.4

Higher the SRP higher the tendency to get reduced on cathode.

10. How many of the following coordination compounds having same coordination number and paramagnetic in nature?



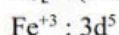
(1) 2 (2) 3 (3) 1 (4) 4

Ans. (1)

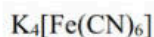
Sol. C.No.



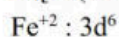
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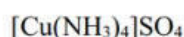
Paramagnetic



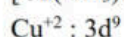
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Diamagnetic



4

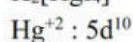


Square planar

Paramagnetic



4

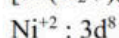


tetrahedral

diamagnetic



6



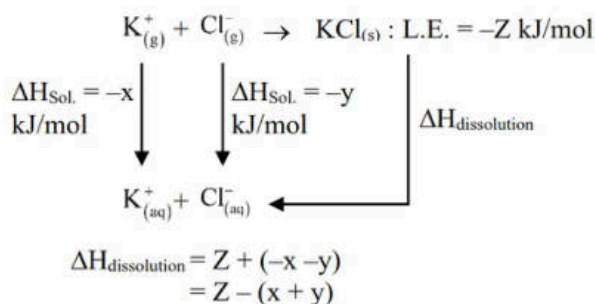
Paramagnetic

11. Hydration energy of K^+ is $-x$ kJ/mol and of Cl^- is $-y$ kJ/mol and lattice energy of KCl is $-Z$ kJ/mol then what is the heat of dissolution of KCl?

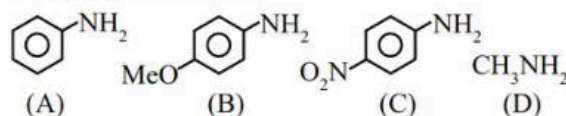
(1) $Z - (x + y)$ (2) $-Z - (x + y)$
 (3) $Z + x + y$ (4) $-Z + (x + y)$

Ans. (1)

Sol



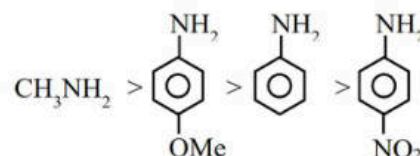
12. The correct order to basic strength of the following molecules is



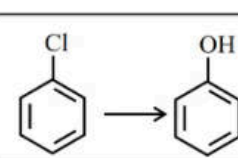
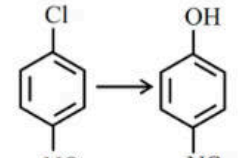
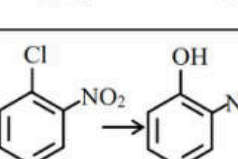
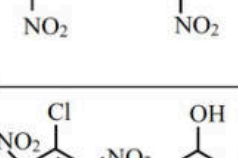
(1) $A > B > C > D$ (2) $B > C > D > A$
 (3) $D > B > A > C$ (4) $B > A > C > D$

Ans. (3)

Sol. Basic strength



13. Match the following List-I with List-II:

List-I (Reactions)		List-II (Reaction Temperature)	
(A)		(I)	Slight Warming
(B)		(II)	368 K
(C)		(III)	443 K
(D)		(IV)	623 K

Choose the correct answer from the options given below:

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

Ans. (2)

Sol.

(Reactions)	
(A)	
(B)	
(C)	
(D)	

14. Assertion : has more dipole moment

than

Reason : has more boiling point

than

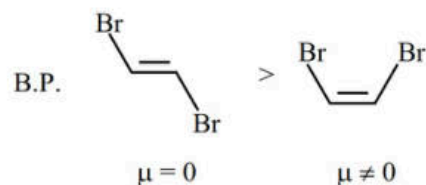
Choose the correct option.

- (1) Both Assertion and Reason are correct, Reason is correct explanation of Assertion.
- (2) Both Assertion and Reason are correct, Reason is not correct explanation of Assertion.
- (3) Assertion is correct, Reason is incorrect.
- (4) Assertion is incorrect, Reason is correct.

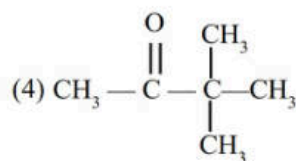
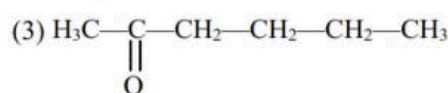
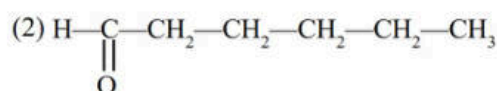
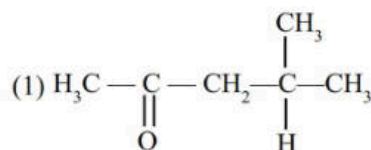
Ans. (3)

Sol. Dipole moment >

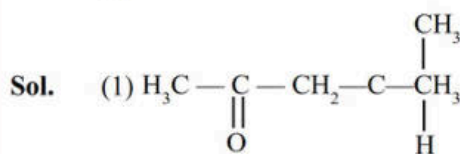
Due to more E.N. of Cl as compare to Br:



15. Which of the following compounds molecular formula $C_6H_{12}O$. Positively to 2,4-DNP test and Tollen's reagent test

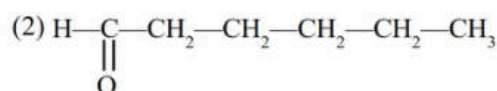


Ans. (2)



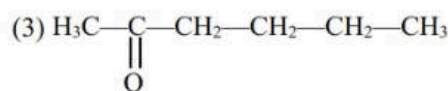
Positive 2,4-DNP

Negative Tollen's test



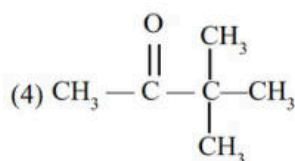
Positive 2,4-DNP

Positive Tollen's test



Positive 2,4-DNP

Negative Tollen's test



Positive 2,4-DNP

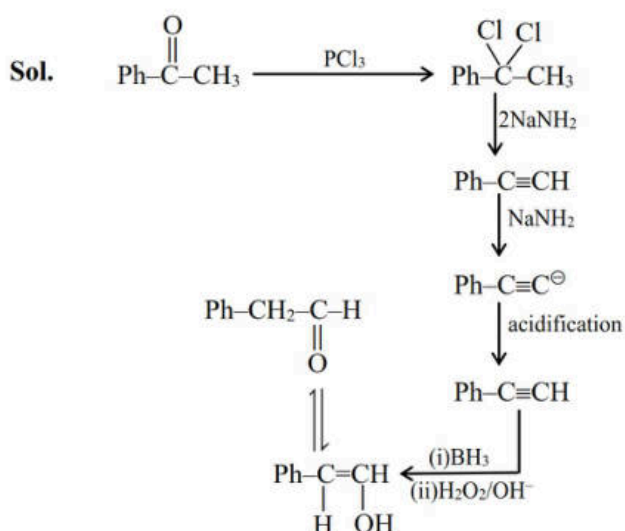
Negative Tollen's test

SECTION-B

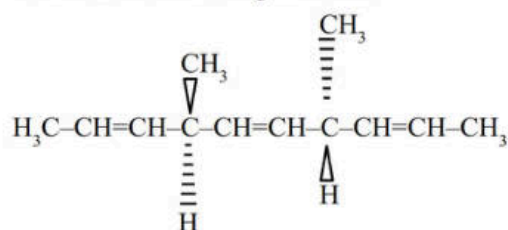
16. Find the number of sp^2 carbons in the final product 's'.



Ans. (7)

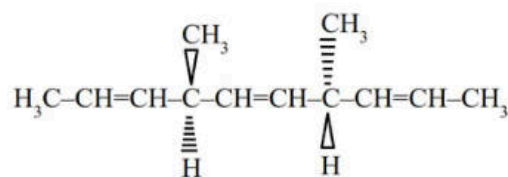


17. Consider the following molecule

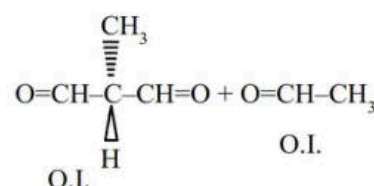
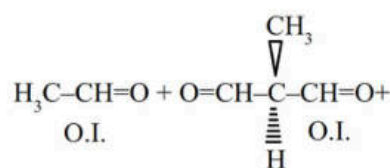


Number of optically active molecule(s) formed after complete reductive ozonolysis of above compound is

Ans. (0)



↓ reductive ozonolysis



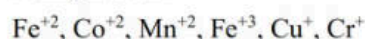
Sol.

18. Consider the following oxides
 V_2O_5 , Cr_2O_3 , Mn_2O_7 , V_2O_3
 Number of oxides which are acidic is x.
 Consider the following complex compound
 $[\text{Co}(\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2)_3]_2(\text{SO}_4)_3$
 The primary valency of complex is y
 The value of x + y is

Ans. (4)

Sol. Acidic oxide $\Rightarrow \text{Mn}_2\text{O}_7$
 Amphoteric oxide $\Rightarrow \text{V}_2\text{O}_5$, Cr_2O_3
 Basic oxide $\Rightarrow \text{V}_2\text{O}_3$
 $x = \text{no. of acidic oxide} = 1$
 $[\text{Co}(\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2)_3]_2(\text{SO}_4)_3 \Rightarrow \text{CO}^{3+}$
 Primary valency = oxidation state of CMA = 3
 $y = 3$
 $x + y = 1 + 3 = 4$

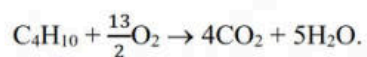
19. Total number of ions having $3d^5$ electronic configuration.



Ans. (3)

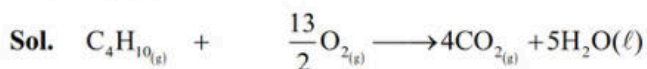
Sol. Mn^{+2} , Fe^{+3} , Cr^{+}

20. Consider the reaction given below:



If 174 g of butane reacts with 320 g of O_2 . Find the volume of H_2O formed in ml. (given density of H_2O is 1 g/ml)

Ans. (138)



$$n_{\text{C}_4\text{H}_{10}} = \frac{174}{58} = 3 \quad n_{\text{O}_2} = \frac{320}{32} = 10$$

Stoichiometric ratio

$$\frac{3}{1} \quad \frac{10}{\frac{13}{2}} = \frac{20}{13} = 1.53$$

L.R.

$$\frac{13}{2} \text{ mol O}_2 \text{ produces moles of H}_2\text{O} = 5$$

$$1 \text{ mol O}_2 \text{ produces moles of H}_2\text{O} = \frac{5}{13/2} = \frac{10}{13}$$

$$10 \text{ mol O}_2 \text{ produces moles of H}_2\text{O} = \frac{10}{13} \times 10 = \frac{100}{13}$$

$$\text{Mass of H}_2\text{O produced} = \frac{100}{13} \times 18 = 138.46 \approx 138$$

$$\begin{aligned} \text{Volume of H}_2\text{O produced} &= 138 \times 1 \text{ ml} \\ &= 138 \text{ ml} \end{aligned}$$

MATHEMATICS

1. If $x|x-3|+3|x-2|+1=0$, then the number of real solution is

- (1) 1 (2) 2 (3) 4 (4) 6

Ans. (1)

Sol. $x|x-3|+3|x-2|+1=0$



In $(-\infty, 2)$

$$-x^2 + 3x - 3(x-2) + 1 = 0$$

$$-x^2 + 7 = 0$$

$$x = \pm\sqrt{7} \text{ but } x = -\sqrt{7} \text{ only}$$

In $[2, 3]$

$$-x(x-3) + 3(x-2) + 1 = 0$$

$$-x^2 + 3x + 3x - 5 = 0$$

$$x^2 - 6x + 5 = 0$$

$$x = 1, 5$$

Hence no solution in $[2, 3]$

In $(3, \infty)$

$$x(x-3) + 3(x-2) + 1 = 0$$

$$x^2 - 5 = 0$$

$$x = \pm\sqrt{5}$$

Hence no solution in $(3, \infty)$

2. $\operatorname{Re}\left(\frac{2z+i}{z+i}\right) + \operatorname{Re}\left(\frac{2\bar{z}-i}{\bar{z}-i}\right) = 2$ is a circle of radius r and centre (a, b) , then $\frac{15ab}{r^2}$ is equal to

Ans. (0)

Sol. Since $\operatorname{Re}(z) + \operatorname{Re}(\bar{z}) = 2\operatorname{Re}(z)$

$$\text{hence } 2\operatorname{Re}\left(\frac{2z+i}{z+i}\right) = 2$$

$$\frac{2x^2 + (2y+1)(y+1)}{x^2 + (y+1)^2} = 1$$

$$2x^2 + 2y^2 + 3y + 1 = x^2 + 2y + 1 + y^2$$

$$x^2 + y^2 + y = 0$$

$$\text{centre } \left(0, -\frac{1}{2}\right)$$

$$\begin{aligned} & \frac{2z+i}{z+i} \\ &= \frac{2x+i(2y+1)}{x+i(y+1)} \\ &= \frac{2x^2+(2y+1)(y+1)}{x^2+(y+1)^2} \\ & \frac{15ab}{r^2} = 0 \end{aligned}$$

3. Let $\vec{a}$ and $\vec{b}$ be the vectors of the same magnitude such that $\frac{|\vec{a}+\vec{b}|+|\vec{a}-\vec{b}|}{|\vec{a}+\vec{b}|-|\vec{a}-\vec{b}|} = \sqrt{2} + 1$,

then the value of $\frac{|\vec{a} + \vec{b}|^2}{|\vec{a}|^2}$ is equal to

Ans. $2 + \sqrt{2}$

Sol. $\frac{|\vec{a} + \vec{b}| + |\vec{a} - \vec{b}|}{|\vec{a} + \vec{b}| - |\vec{a} - \vec{b}|} = \frac{\sqrt{2} + 1}{1}$

Using componendo and dividendo

$$\Rightarrow \frac{2|\vec{a} + \vec{b}|}{2|\vec{a} - \vec{b}|} = \frac{\sqrt{2} + 2}{\sqrt{2}}$$

$$\Rightarrow |\vec{a} + \vec{b}| = |1 + \sqrt{2}| |\vec{a} - \vec{b}|$$

$$\Rightarrow \frac{|\vec{a} + \vec{b}|^2}{|\vec{a} - \vec{b}|^2} = (1 + \sqrt{2})^2$$

$$= 3 + 2\sqrt{2}$$

$$\Rightarrow \frac{a^2 + a^2 + 2a^2 \cos \theta}{a^2 + a^2 - 2a^2 \cos \theta} = 3 + 2\sqrt{2}$$

$$\Rightarrow \frac{4}{4 \cos \theta} = \frac{4 + 2\sqrt{2}}{2 + 2\sqrt{2}}$$

$$\Rightarrow \cos \theta = \frac{1}{\sqrt{2}}$$

$$\Rightarrow \frac{|\vec{a} + \vec{b}|^2}{|\vec{a}|^2} = \frac{a^2 + a^2 + 2a^2 \frac{1}{\sqrt{2}}}{a^2}$$

$$= 2 + \sqrt{2}$$

4. Let $f(x) = \frac{5-x}{x^2-3x+2}$, if range of $f(x)$ is $(-\infty, \alpha] \cup [\beta, \infty)$. Then $\alpha^2 + \beta^2$ equals to

Ans. (194)

Sol. $y = \frac{5-x}{x^2-3x+2}$
 $\Rightarrow x^2y - 3xy + 2y - 5 + x = 0$
 $\Rightarrow x^2y + x(1-3y) + 2y - 5 = 0$
 solution must satisfy $y \neq 0$ and $D \geq 0$
 $D \geq 0 \Rightarrow (1-3y)^2 - 4y(2y-5) \geq 0$
 $\Rightarrow 1 + 9y^2 - 6y - 8y^2 + 20y \geq 0$
 $\Rightarrow y^2 + 14y + 1 \geq 0$
 solution for $y^2 + 14y + 1 = 0$ are $\frac{-14 \pm \sqrt{192}}{2} = \frac{-14 \pm 8\sqrt{3}}{2}$
 $= -7 \pm 4\sqrt{3}$
 So, $y \in (-\infty - 7 - 4\sqrt{3}] \cup [-7 + 4\sqrt{3}, \infty)$
 So, $\alpha^2 + \beta^2 = (-7 - 4\sqrt{3})^2 + (-7 + 4\sqrt{3})^2 = 194$.

5. Let $f(x)$ be a polynomial of degree 4 such that it has $x = 4, 5$ as extremas. If $\lim_{x \rightarrow 0} \frac{f(x)}{x^2} = 5$, then $f(2) =$

Ans.

Sol. $\lim_{x \rightarrow 0} \frac{f(x)}{x^2} = 5$
 $\lim_{x \rightarrow 0} \frac{f(x)}{x^2} = \lim_{x \rightarrow 0} \frac{ax^4 + bx^3 + cx^2 + dx + e}{x^2}$
 $\Rightarrow c = 5$ and $d = e = 0$
 $f(x) = ax^4 + bx^3 + 5x^2$
 $f'(x) = 4ax^3 + 3bx^2 + 10x = 0$
 $\Rightarrow x(4ax^2 + 3bx + 10) = 0$
 $\Rightarrow x \left(\frac{x^2}{2} - \frac{9x}{2} + 10 \right) = 0$
 $\Rightarrow a = \frac{1}{8}$ and $b = \frac{-3}{2}$
 So, $f(2) = \frac{1}{8}(2)^4 - \frac{3}{2}(2)^3 + 5(2)^2$
 $= 2 - 12 + 20 = 10$

6. Let p denote no. of Δ 's possible from the vertices of n sided regular polygon & q denote no. of quadrilateral possible from the same. If $p + q = 126$, then eccentricity of $\frac{x^2}{16} + \frac{y^2}{n} = 1$ is

Ans. $\frac{1}{\sqrt{2}}$

Sol. According to question

$${}^nC_3 + {}^nC_4 = 126$$

$$\Rightarrow {}^{n+1}C_4 = 126 \Rightarrow {}^9C_4 \Rightarrow n+1 = 9 \Rightarrow n = 8$$

So, the ellipse is $\frac{x^2}{16} + \frac{y^2}{8} = 1$

$$e = \sqrt{1 - \frac{8}{16}} = \frac{1}{\sqrt{2}}$$

7. A box contains 19 unbiased coins and 1 biased coin with both faces head. If a coin is randomly chosen out of this box and tossed, if the head appears, then the probability that the unbiased coin was selected

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

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

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

(4) $\frac{19}{21}$

Ans. (4)

Sol. Required probability = $\frac{\frac{19}{20} \times \frac{1}{2}}{\frac{19}{20} \times \frac{1}{2} + \frac{1}{20} \times 1} = \frac{19}{21}$

8. If $f(\theta) = \frac{\tan(\tan \theta) - \tan(\sin \theta)}{\tan \theta - \sin \theta}$ is continuous at $\theta = 0$, then the value of $f(\theta)$ at $\theta = 0$ is equal to

Ans. (1)

Sol. $f(0) = \lim_{\theta \rightarrow 0} f(\theta) = \lim_{\theta \rightarrow 0} \frac{\tan(\tan \theta) - \tan(\sin \theta)}{\tan \theta - \sin \theta}$
 $= \lim_{\theta \rightarrow 0} \frac{\sin(\tan \theta - \sin \theta)}{\cos(\tan \theta) \cdot \cos(\sin \theta)} = 1$

9. Let a random variable X take values 0, 1, 2, 3 with $P(X = 0) = P(X = 1) = p$ and

$P(X = 2) = P(X = 3)$ and $E(X^2) = 2E(X)$, then the value of $8p - 1$ is equal to

Ans. (2)

Sol. $2p + 2q = 1$

$$p + q = \frac{1}{2}$$

$$E(X^2) = \sum_{i=0}^3 x_i^2 P(x_i) = 0 \cdot p + 1 \cdot p + 4 \cdot q + 9 \cdot q = p + 13q$$

$$E(X) = \sum_{i=0}^3 x_i P(x_i) = 0 \cdot p + 1 \cdot p + 2 \cdot q + 3 \cdot q = p + 5q$$

$$\Rightarrow p + 13q = 2(p + 5q)$$

$$\Rightarrow p = 3q$$

$$\text{So, } q = \frac{1}{8} \text{ \& } p = \frac{3}{8}$$

$$\text{So, } 8p - 1 = 2$$

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

Ans. (64)

Sol. $S_n = 700 \Rightarrow \frac{n}{2}[2a + (n-1)d] = 700 \quad \dots(i)$

$$a_6 = 7 \Rightarrow a + 5d = 7 \quad \dots(ii)$$

$$S_7 = 7 \Rightarrow \frac{7}{2}[2a + 6d] = 7$$

$$\Rightarrow 2a + 6d = 2 \quad \dots(iii)$$

Solving (ii) & (iii)

$$a = -8, d = 3$$

$$\frac{n}{2}[-16 + 3n - 3] = 700$$

$$\Rightarrow 3n^2 - 19n - 1400 = 0$$

$$\Rightarrow (3n + 56)(n - 25) = 0$$

$$\therefore n = 25$$

$$\therefore a_{25} = a + 24d$$

$$= -8 + 24 \times 3$$

$$= -8 + 72$$

$$= 64$$

11. Let $y = y(x)$ and $(1 + x^2)y' - 2xy = (x^4 + 2x^2 + 1) \cos x$. If $y(0) = 1$, then $\int_{-3}^3 y(x) dx$ is equal to
 (1) 10 (2) 15 (3) 20 (4) 24

Ans. (4)

Sol. $(1 + x^2)y' - 2xy = (x^2 + 1)^2 \cos x$

$$y' - \frac{2x}{1+x^2} y = (1+x^2) \cos x$$

$$P = \frac{-2x}{1+x^2}, Q = (1+x^2) \cos x$$

$$\text{I.F.} = e^{-\int \frac{2x}{1+x^2} dx} = e^{-\ln(1+x^2)} = \frac{1}{1+x^2}$$

$$y \times \frac{1}{1+x^2} = \int \cos x dx$$

$$\frac{y}{1+x^2} = \sin x + c \Rightarrow y = (1+x^2)(\sin x + c)$$

$$c = 1$$

$$y = (1+x^2)(\sin x + 1)$$

$$I = \int_{-3}^3 \{(1+x^2) \sin x + (1+x^2)\} dx$$

$$= 2 \int_0^3 (1+x^2) dx = 2 \left(\frac{x^3}{3} + x \right) \Big|_0^3$$

$$= 2(9+3) = 24$$

12. The sum of series ${}^2C_1 \cdot (1 \times 2) + {}^3C_2 \cdot (2 \times 3) + {}^4C_3 \cdot (3 \times 4) + \dots + {}^{19}C_{18} \cdot (18 \times 19)$ is S , then $\frac{S}{295}$ is equal to

(1) 103 (2) 104 (3) 107 (4) 114

Ans. (4)

Sol. $S = 2 \cdot (1 \times 2) + 3(2 \times 3) + 4(3 \times 4) + \dots + 19(18 \times 19)$

$$S = \sum_{r=1}^{18} r(r+1)^2 \Rightarrow S = \sum_{r=1}^{18} r(r+1)(r+2-1)$$

$$\Rightarrow S = \sum_{r=1}^{18} r(r+1)(r+2) - \sum_{r=1}^{18} r(r+1)$$

$$\Rightarrow S = \frac{1}{4} \sum_{r=1}^{18} [r(r+1)(r+2)(r+3-(r-1))] - \frac{1}{3} \sum_{r=1}^{18} r(r+1)(r+2-(r-1))$$

$$= \frac{1}{4} \times 18 \times 19 \times 20 \times 21 - \frac{1}{3} \times 18 \times 19 \times 20$$

$$S = 18 \times 19 \times 20 \left[\frac{21}{4} - \frac{1}{3} \right]$$

$$S = 18 \times 19 \times 20 \times \frac{59}{12} = 6 \times 19 \times 295$$

$$\frac{S}{295} = 6 \times 19 = 114$$

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

Ans. (126)

Sol. $\frac{2b^2}{a} = 10 \Rightarrow b^2 = 5a$

$$e = f(t) \Big|_{\min} = t^2 + t + \frac{11}{12} \Big|_{t=-\frac{1}{2}} = \frac{1}{4} - \frac{1}{2} + \frac{11}{12}$$

$$= \frac{3-6+11}{12} = \frac{8}{12}$$

$$\Rightarrow \sqrt{1 - \frac{b^2}{a^2}} = \frac{2}{3}$$

$$\Rightarrow 1 - \frac{b^2}{a^2} = \frac{4}{9} \Rightarrow \frac{b^2}{a^2} = \frac{5}{9} \Rightarrow b^2 = \frac{5a^2}{9}$$

$$\Rightarrow 5a = \frac{5a^2}{9} \Rightarrow a = 9; \text{ So, } b^2 = 45$$

$$\text{Hence, } a^2 + b^2 = 81 + 45 = 126.$$

14. Let α and β be roots of the equation $\left[(t+2)^{\frac{1}{7}} - 1\right]x^2 + \left[(t+2)^{\frac{1}{6}} - 1\right]x + \left((t+2)^{\frac{1}{21}} - 1\right) = 0$.

If $\lim_{t \rightarrow -1} \alpha = a$ and $\lim_{t \rightarrow -1} \beta = b$, then $72(a+b)^2$ is equal to

(1) 36

(2) 49

(3) 75

(4) 98

Ans. (4)

Sol.
$$a+b = \lim_{x \rightarrow -1} - \frac{\left[(t+2)^{\frac{1}{6}} - 1\right]}{\left[(t+2)^{\frac{1}{7}} - 1\right]}$$

$$= \lim_{h \rightarrow 0} - \frac{\left[(1+h)^{\frac{1}{6}} - 1\right]}{\left[(1+h)^{\frac{1}{7}} - 1\right]}$$

$$= \lim_{h \rightarrow 0} - \frac{\left[\frac{h}{6}\right]}{\frac{h}{7}} = \frac{-7}{6}$$

So, $72(a+b)^2 = 72 \times \frac{49}{36} = 98$

15. If the equation of the line passing through the point $\left(0, -\frac{1}{2}, 0\right)$ and Perpendicular to the lines

$$\vec{r} = \lambda(\hat{i} + a\hat{j} + b\hat{k}) \text{ and } \vec{r} = (\hat{i} - \hat{j} - 6\hat{k}) + \mu(-b\hat{i} + a\hat{j} + 5\hat{k}) \text{ is } \frac{x-1}{-a} = \frac{y+4}{d} = \frac{z-c}{-4},$$

then $a+b+c+d$ is equal to

(1) 10

(2) 12

(3) 13

(4) 14

Ans. (4)

Sol. $\vec{\ell} = (1, a, b) \times (-b, a, 5)$

$$= (5a - ab, -b^2 - 5, a + ab)$$

$$\Rightarrow \frac{5a - ab}{-a} = \frac{-b^2 - 5}{d} = \frac{a + ab}{-4}$$

$$\Rightarrow \frac{b-5}{1} = \frac{-b^2-5}{d} = \frac{a+ab}{-4}$$

$$\text{So, } 20 - 4b = a + ab \Rightarrow 20 = a + ab + 4b \quad \dots(i)$$

$$\Rightarrow \frac{0-1}{-a} = \frac{-\frac{1}{2}+4}{d} = \frac{0-c}{-4} \Rightarrow \frac{1}{a} = \frac{7}{2d} = \frac{c}{4} \quad \dots(ii)$$

$$\text{So, } d = \frac{7}{2}a \quad b-5 = \frac{-b^2-5}{\frac{7a}{2}} \Rightarrow 7ab = 35a - 2b^2 - 10 \quad \dots(iii)$$

$$\Rightarrow a = \frac{20-4b}{1+b}$$

$$\Rightarrow b-5 = \frac{-b^2-5}{\frac{7a}{2}} \Rightarrow b-5 = \frac{-2b^2+5}{7a}$$

$$\Rightarrow 7a = -2 \frac{(b^2+5)}{b-5} = \frac{2b^2+10}{5-b}$$

On solving $b = 3, a = 2, d = 7, c = 2$

$$\Rightarrow a + b + c + d = 14$$

16. Let $A = \{(\alpha, \beta) \in \mathbb{R} \times \mathbb{R} : |\alpha - 1| \leq 4 \text{ and } |\beta - 5| \leq 6\}$ and

$B = \{(\alpha, \beta) \in \mathbb{R} \times \mathbb{R} : 16(\alpha - 2)^2 + 9(\beta - 6)^2 \leq 144\}$, then

(1) Neither $A \subset B$ nor $B \subset A$

(2) $A \subset B$

(3) $A \cup B = \{(x, y) : -4 \leq x \leq 4, -1 \leq y \leq 1\}$

(4) $B \subset A$

Ans. (2)

Sol. For α

$$-4 \leq \alpha - 1 \leq 4$$

$$-3 \leq \alpha \leq 5$$

For β

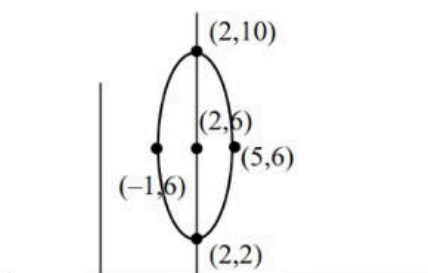
$$|\beta - 5| \leq 6$$

$$\Rightarrow -6 \leq \beta - 5 \leq 6$$

$$-1 \leq \beta \leq 11$$

$$16(\alpha - 2)^2 + 9(\beta - 6)^2 \leq 144$$

$$\Rightarrow \frac{(\alpha - 2)^2}{9} + \frac{(\beta - 6)^2}{16} \leq 1$$



We can understand from the figure that $B \subset A$

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

(1) 46

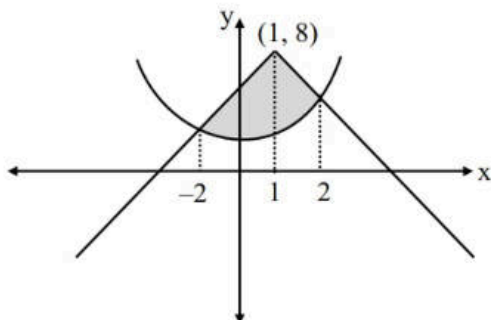
(2) 47

(3) 49

(4) 50

Ans. (4)

Sol.



$$x + 7 = 11 - 3x$$

$$\Rightarrow x = 1$$

$$\text{and } 1 + x^2 = x + 7$$

$$\Rightarrow x^2 - x - 6 = 0$$

$$\Rightarrow (x + 5)(x - 2) = 0$$

$$x = -5, 2$$

$$\text{Area} = \int_{-2}^1 (7 - x^2 + x) dx + \int_1^2 (11 - 3x - x^2 - 1) dx = \frac{50}{3}$$

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

Ans. (7)

Sol. $\cos 2\theta \cos \left(\frac{\theta}{2}\right) + \cos \frac{5\theta}{2} = 2 \cos^3 \frac{5\theta}{2}$

$$\Rightarrow \frac{1}{2} \left(2 \cos 2\theta \cos \frac{\theta}{2} \right) + \cos \frac{5\theta}{2} = \frac{1}{2} \left(\cos \frac{15\theta}{2} + 3 \cos \frac{5\theta}{2} \right)$$

On solving,

$$\Rightarrow \cos \frac{3\theta}{2} = \cos \frac{15\theta}{2}$$

$$\Rightarrow \frac{3\theta}{2} = 2n\pi \pm \frac{15\theta}{2}$$

$$\Rightarrow \cos \frac{15\theta}{2} - \cos \frac{3\theta}{2} = 0$$

$$\Rightarrow 2 \sin 3\theta \sin \frac{9\theta}{2} = 0$$

$$3\theta = n\pi \quad \text{and} \quad \frac{9\theta}{2} = m\pi$$

$$\Rightarrow \theta = \frac{n\pi}{3} \quad \text{and} \quad \theta = \frac{2m\pi}{9}$$

$$\Rightarrow -\frac{\pi}{3}, \frac{\pi}{3}, 0 \quad \text{and} \quad -\frac{4\pi}{9}, -\frac{2\pi}{9}, \frac{4\pi}{9}, \frac{2\pi}{9}$$