# JEE (Main)-2025 (Online) Session-2
# Memory Based Question with & Solutions
# (Physics, Chemistry and Mathematics)
# 7th April 2025 (Shift-1)

**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.

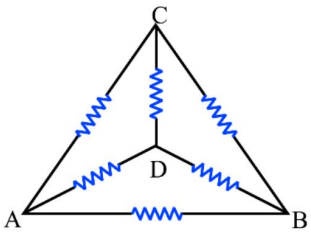
# MEMORY BASED QUESTIONS JEE–MAIN EXAMINATION – APRIL, 2025

**(Held On Monday 7th April, 2025)** **TIME : 9 : 00 AM to 12 : 00 PM**

## PHYSICS

### SECTION-A

**1.** Find equivalent resistance across points A and B for given network. (Each resistor is equal to R)

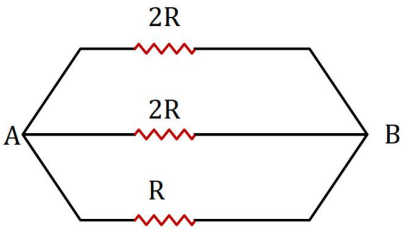



(1) $\frac{R}{2}$ (2) 2R

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

**Ans.** **(1)**

**Sol.**




$\Rightarrow R_{AB} = \frac{R}{2}$

**2.** In a resonance tube closed at one end. Resonance is obtained at length $\ell_1 = 120$ cm and $\ell_2 = 200$ cm. If $V_S = 340$ m/s. Find frequency of sound. :-

(1) 425 Hz (2) 212.5 Hz

(3) 850 Hz (4) 111.25 Hz

**Ans.** **(2)**

**Sol.** $\ell_2 - \ell_1 = \frac{\lambda}{2}$

$f = \frac{v_s}{\lambda} = \frac{340}{1.6}\text{Hz} = 212.5\text{ Hz}$

**3.** 2 Plane polarized light waves combine at a certain point whose "E" components are $E_1 = E_0 \sin\omega t$. $E_2 = E_0 \sin(\omega t + \pi/3)$. Find the Amplitude of Resultant wave.

(1) 0.9 $E_0$ (2) 1.7 $E_0$

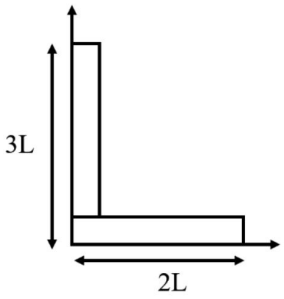
(3) 3.4 $E_0$ (4) 0.5 $E_0$

**Ans.** **(2)**

**Sol.** $E_r^2 = E_0^2 + E_0^2 + 2E_0^2 \cos\frac{\pi}{3}$

$E_r = \sqrt{3}E_0 \approx 1.73E_0$

**4.** Find COM of given figure considering both rods made of same material (L = 10 cm) :-




(1) (2, 9) (2) (4, 9)

(3) (4, 18) (4) (8, 9)

**Ans.** **(2)**

**Sol.** $X_{com} = \frac{2mL + 0}{5m} = \frac{2L}{5}$

$Y_{com} = \frac{0 + 3m\frac{3L}{2}}{5m} = \frac{9L}{10}$

**5.** The dimensions of a physical quantity $\varepsilon_0 \frac{d\phi_E}{dt}$ are similar to [symbols have their usual meanings]

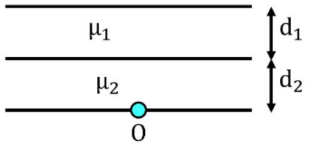
(1) Electric field (2) Electric flux

(3) Electric current (4) magnetic field

**Ans.** **(3)**

**Sol.** Dimension same as electric current

**6.** An object is placed below two parallel layers of thickness $d_1$, $d_2$ are refractive index $\mu_1$, $\mu_2$ respectively. Find apparent depth of the object.




(1) $\frac{d_1\mu_2 - d_2\mu_1}{\mu_1\mu_2}$ (2) $\frac{d_1\mu_2 + d_2\mu_1}{\mu_1\mu_2}$

(3) $\frac{d_1\mu_1 - d_2\mu_2}{\mu_1\mu_2}$ (4) $\frac{d_1\mu_1 + d_2\mu_2}{\mu_1\mu_2}$

**Ans.** **(2)**

**Sol.** $\frac{d_1}{\mu_1}+\frac{d_2}{\mu_2}$ = apparent depth

$\frac{d_1\mu_2+d_2\mu_1}{\mu_1\mu_2}$ = apparent depth

**7.** AC current is represented by $i = 5\sqrt{2} + 10\cos\left(650\pi t + \frac{\pi}{6}\right)$ Amp. The rms value of the current is

(1) 50 Amp (2) 10 Amp

(3) $5\sqrt{2}$ Amp (4) 100 Amp

**Ans.** **(2)**

**Sol.** $I_{rms}^2 = I_{rms_1}^2 + I_{rms_2}^2$

$I_{rms} = 10\,A$

**8.** A composite sound wave is represented by y = A cos ωt . cosω′t. The observed beat frequency is :-

(1) $\frac{\omega'}{2\pi}$ (2) $\frac{\omega'}{\pi}$

(3) $\frac{\omega-\omega'}{2\pi}$ (4) $\frac{\omega-\omega'}{\pi}$

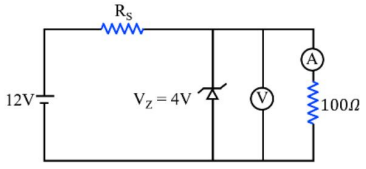
**Ans.** **(2)**

**Sol.** $y = A\cos\omega t\ \cos\omega' t$

$y = \frac{A}{2}\left[\cos(\omega+\omega')t + \cos(\omega-\omega')t\right]$

$\left[f_1 - f_2\right] = \frac{2\omega'}{2\pi} = \frac{\omega'}{\pi}$

**9.** Find reading of ammeter for the given circuit in figure




(1) 80 mA (2) 10 mA

(3) 20 mA (4) 40 mA

**Ans.** **(4)**

**Sol.** $I = \frac{4}{100}A = 40mA$

**10.** A lens having refractive index 1.5 has focal length of 12 cm, when it is in air. Find the focal length of the lens when it is immersed in water (refractive index of water is $\frac{4}{3}$)

(1) 555 mm (2) 355 mm

(3) 655 mm (4) 480 mm

**Ans.** **(4)**

**Sol.** $\frac{1}{12} = \left(\frac{3}{2}-1\right)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$

$\frac{1}{f_2} = \left(\frac{3\times3}{2\times4}-1\right)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$

$f_2 = 480\,mm$

**11.** A block of mass m slides an inclined plane of inclination 60° with an acceleration of g/2 then friction coefficient between block and plane is :-

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

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

**Ans.** **(2)**

**Sol.** $a = g\left(\sin\theta - \mu\cos\theta\right)$

$\frac{g}{2} = g\left(\sin 60° - \mu\cos 60°\right)$

$\mu = \sqrt{3}-1$

**12.** Two rods whose lengths are in ratio of 1 : 3 and of diameter are in ratio of 2 : 1, then ratio of elongations of rod if force applied and material of rods are same :-

(1) 1 : 1 (2) 4 : 1

(3) 1 : 12 (4) 1 : 3

**Ans.** **(3)**

**Sol.** $\Delta\ell = \frac{F\ell}{AY}$

$\frac{\Delta\ell_1}{\Delta\ell_2} = \frac{\frac{F\ell}{4AY}}{\frac{F}{A}\frac{3\ell}{y}} = \frac{1}{12}$

**13.** Two convex lenses of focal length 30 cm and 10 cm are kept 10 cm apart. Principal axis of the lenses is common. Find equivalent power of the lens system.

(1) 13.33 D (2) 6 D

(3) 10 D (4) 5 D

**Ans.** **(3)**

**Sol.** $P_C = \frac{1}{F_C} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{d}{f_1 f_2}$

$P_C = 10D$

**14.** Two particles projected from same point with same speed, at an angle $\left(\frac{\pi}{4} - \alpha\right)$, $\left(\frac{\pi}{4} + \alpha\right)$, on same horizontal ground, calculate ratio of time of flight :-

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

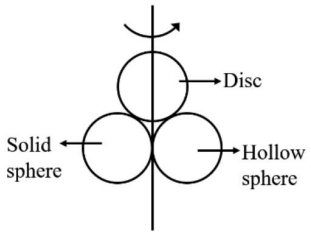
(3) $\frac{tan\alpha}{1+tan\alpha}$ (4) $\frac{1}{1+tan\alpha}$

**Ans.** **(1)**

**Sol.** $\frac{T_1}{T_2} = \frac{2u\sin\left(\frac{\pi}{4} - \alpha\right)}{2u\sin\left(\frac{\pi}{4} + \alpha\right)}$

$= \frac{1 - \tan\alpha}{1 + \tan\alpha}$

**15.** MOI of disc about central axis perpendicular to surface is I then moment of inertia of given assembly is, where each object is of same mass and same radius,




(1) $\frac{199}{30}I$ (2) $\frac{79}{17}I$

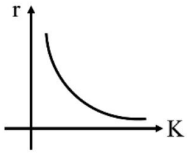
(3) $\frac{209}{30}I$ (4) $\frac{89}{15}I$

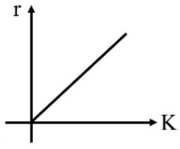
**Ans.** **(1)**

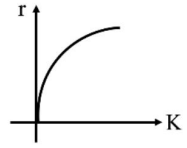
**Sol.** $I' = \frac{mR^2}{4} + \left(\frac{2}{3}mR^2 + mR^2\right) + \left(\frac{2}{5}mR^2 + mR^2\right)$

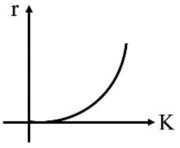
$I' = \frac{199mR^2}{60} = \frac{199}{30}\left(\frac{mR^2}{2}\right) = \frac{199}{30}I$

**16.** A charge particle moves in circular path in uniform magnetic field. The graph of radius of circular path versus its kinetic energy is best represented by

(1) 


(2) 


(3) 


(4) 


**Ans.** **(3)**

**Sol.** $r = \frac{\sqrt{2mk}}{qB}$

$r \propto \sqrt{k}$

**17.** Match the column :-

| Column-I | | Column-II | |
|---|---|---|---|
| (a) | Monoatomic gas | (i) | $\gamma = 7/5$ |
| (b) | Diatomic rigid gas | (ii) | $\gamma = 4/3$ |
| (c) | Diatomic non rigid gas | (iii) | $\gamma = 5/3$ |
| (d) | Triatomic non-linear rigid gas | (iv) | $\gamma = 9/7$ |

(1) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)

(2) (a)-(i), (b)-(iii), (c)-(ii), (d)-(iv)

(3) (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)

(4) (a)-(ii), (b)-(iv), (c)-(i), (d)-(ii)

**Ans.** **(1)**

**Sol.** (a) monoatomic $\gamma = \frac{5}{3}$

(b) diatomic rigid $\gamma = \frac{7}{5}$

(c) diatomic non rigid $\gamma = \frac{9}{7}$

(d) triatomic non linear rigid $\gamma = \frac{4}{3}$

**18.** Let $\lambda_1$ be largest wavelength of Lyman series for hydrogen atom and $\lambda_2$ be largest wavelength of Balmer series then $\frac{\lambda_1}{\lambda_2}$ is

(1) $\frac{4}{9}$ (2) $\frac{1}{4}$

(3) $\frac{3}{4}$ (4) $\frac{5}{27}$

**Ans.** **(4)**

**Sol.** $\frac{1}{\lambda} = RZ^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

$\frac{\lambda_1}{\lambda_2} = \frac{5}{27}$

**19.** Power radiated from cylinder is P, $eA\sigma T^4 = P$, then find emissivity

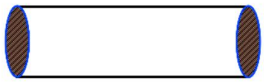
Where

Length = 10 cm

Diameter = 0.5 mm

P = 92.4 watt

Temp. T = 2000 K



(1) 0.2 (2) 0.3

(3) 0.6 (4) 0.9

**Ans.** **(3)**

**Sol.** $P = e\left(\frac{\pi D^2}{4} \times 2 + \pi DL\right)\sigma T^4$

$e \approx 0.64$

**20.** A variable force $\vec{F} = 2t\hat{i} + 3t^2\hat{j}$ acts on a particle of mass 1 kg, which is at rest at time t = 0. Find the power supplied as a function of time.

(1) $t^3 + 5t^4$ (2) $t^3 + 4t^3$

(3) $t^3 + 4t^5$ (4) $2t^3 + 3t^5$

**Ans.** **(4)**

**Sol.** $\vec{F} = 2t\hat{i} + 3t^2\hat{j}$

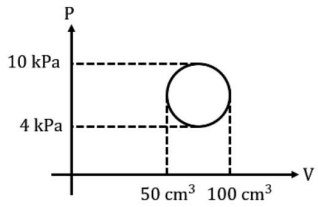
$\vec{a} = 2t\hat{i} + 3t^2\hat{j}$

$\vec{v} = t^2\hat{i} + t^3\hat{j}$

Power = $\vec{F}.\vec{V} = 2t^3 + 3t^5$

## SECTION – B

**1.** Work done for the process shown in figure is $\frac{x\pi}{40}$ J. Then find x :-




**Ans.** **(3)**

**Sol.** Work done = area under graph = πab

## CHEMISTRY

### SECTION-A

**1.** A compound having molecular formula $MX_3$ has Van't Hoff factor of 2. What is the degree of dissociation?

(1) 0.25 (2) 0.5

(3) 0.3 (4) 0.75

**Ans.** **(3)**

**Sol.** $i = 1 + (n - 1)\alpha$

$i = 2$ (given)

$MX_3 \rightarrow M^+ + 3X^-$

$n = 4$

$2 = 1 + (4 - 1)\alpha$

$1 = 3\alpha$

$\alpha = 0.33$

**2.** Matching the list

| List-I | | List-II (Ratio of L.P./B.P.) | |
|---|---|---|---|
| (a) | $ICl_2^-$ | (i) | 1 |
| (b) | $H_2O$ | (ii) | 9/2 |
| (c) | $XeF_4$ | (iii) | 5/4 |
| (d) | $SO_2$ | (iv) | 7/2 |

(1) a → (ii); b → (i); c → (iv); d → (iii)

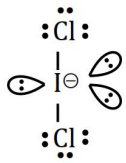
(2) a → (i); b → (ii); c → (iii); d → (iv)

(3) a → (iv); b → (iii); c → (ii); d → (i)

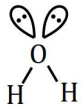
(4) a → (iii); b → (iv); c → (i); d → (ii)

**Ans.** **(1)**

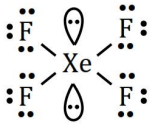
**Sol.**

(a) $ICl_2^{\ominus}$  Lone pair = 9

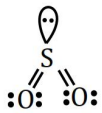
Bond pair = 2

(b) $H_2O$  Lone pair = 2

Bond pair = 2

(c) $XeF_4$  Lone pair = 14

Bond pair = 4

(d) $SO_2$  Lone pair = 5

Bond pair = 4

**3.** Transition metal belonging to 3d series having lowest enthalpy of atomisation in its most stable oxidation state forms oxide MO. Nature of oxide is

(1) Highly acidic (2) Amphoteric

(3) Highly basic (4) Neutral

**Ans.** **(2)**

**Sol.** Lowest enthalpy of atomisation in 3d-series ⇒ Zn

Zn forms ZnO in +2 O.S.(+2 is most stable O.S.of Zn)

ZnO ⇒ amphoteric oxide

**4.** Given below are two statements.

**Assertion (A) :** Sodium on reaction with alcohols liberates $H_2$ gas.

**Reason (R) :** Alcohols are acidic in nature.

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

(1) Both A and R are correct and R explains A.

(2) Both A and R are correct but R does not explains A.

(3) A is correct and R is incorrect.

(4) A is incorrect and R is correct.

**Ans.** **(1)**

**Sol.** $R - OH + Na \rightarrow RONa + H_2 \uparrow$

Active metal react with acid to release Hydrogen gas.

**5.** Which of the following species have lowest enthalpy of atomisation.

(1) Cr (2) Fe

(3) Co (4) Ni

**Ans.** **(1)**

**Sol.** According to NCERT data

| | $\Delta H_a$ (KJ/mol) |
|---|---|
| (a) Cr | 397 |
| (b) Fe | 416 |
| (c) Co | 425 |
| (d) Ni | 430 |

Lowest $\Delta H_a$ is for Cr

**6.** In an electrochemical cell.

$Cu_{(s)}| Cu^{+2}$ (1.5M) || $Ag^{+}$ (0.2 M) | $Ag_{(s)}$

What will be the $E_{cell}$ at 25°C if

$E^{\circ}_{Ag^{+}/Ag} = 0.80$ V

$E^{\circ}_{Cu^{+2}/Cu} = 0.34$ V

(1) 0.413 (2) 0.326

(3) 0.246 (4) 0.451

**Ans.** **(1)**

**Sol.** $Cu_{(s)} + 2Ag^{+}_{(aq)} \longrightarrow Cu^{+2}_{(aq)} + 2Ag_{(s)}$

$$Q = \left[\frac{Cu^{+2}}{\left(Ag^{+}\right)^2}\right]$$

$$E^{\circ}_{Cell} = E^{\circ}_{Cathode} - E^{\circ}_{anode}$$

$$E^{\circ}_{Cell} = 0.80 - 0.34$$

$= 0.46$

Nernst equation

$$E_{Cell} = E^{\circ}_{Cell} - \frac{0.06}{n}\log Q$$

$$E_{Cell} = 0.46 - \frac{0.06}{2}\log\left[\frac{1.5}{(0.2)^2}\right]$$

$$E_{Cell} = 0.46 - 0.03\log\left(\frac{3}{2\times 0.2\times 0.2}\right)$$

$$E_{Cell} = 0.46 - 0.03\log\left(\frac{3}{0.08}\right)$$

$E_{Cell} = 0.413$

**7.** What is maximum wavelength for Lymen series and Balmer series for H-spectrum respectively.

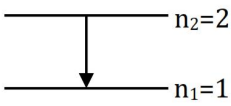
(1) $\left(\frac{4}{3R_H}\right), \left(\frac{36}{5R_H}\right)$ (2) $\left(\frac{36}{5R_H}\right), \left(\frac{4}{3R_H}\right)$

(3) $\left(\frac{36}{7R_H}\right), \left(\frac{3}{4R_H}\right)$ (4) $\left(\frac{3}{4R_H}\right), \left(\frac{36}{7R_H}\right)$

**Ans.** **(1)**

**Sol.**

Lymen Series



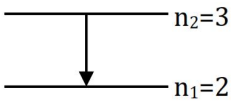

$$\frac{1}{\lambda} = R_H\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]z^2$$

$$\frac{1}{\lambda} = R_H\left[\frac{1}{1} - \frac{1}{4}\right]\times 1$$

$$\frac{1}{\lambda} = \frac{3}{4}R_H$$

$$\lambda = \frac{4}{3R_H}$$

Balmer Series




$$\frac{1}{\lambda} = R_H\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]z^2$$

$$\frac{1}{\lambda} = R_H\left[\frac{1}{4} - \frac{1}{9}\right]$$

$$\lambda = \frac{36}{5R_H}$$

**8.** In a Hydrogen like ion the energy difference between the 2nd excitation energy state and ground state is 108.8eV. The atomic number of the ion is

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

**Ans.** **(4)**

**Sol.** $\Delta E = 108.8$ eV

$$\Delta E = 13.6\ Z^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$\Rightarrow n_1 = 1$ & $n_2 = 3$

$$\Rightarrow 108.8 = 13.6\ Z^2\left(\frac{1}{12} - \frac{1}{3^2}\right)$$

$$\Rightarrow 8 = Z^2\left(\frac{8}{3}\right)$$

$\Rightarrow Z^2 = 9$

$\Rightarrow Z = 3$

**9.** 1 mol of water at 10°C is converted into ice at –10°C. The change in enthalpy for complete conversion is

[Given : $C_p$ of water = x $JK^{-1}$ $mol^{-1}$

$C_p$ of ice = y $JK^{-1}$ $mol^{-1}$

$\Delta H_{fusion}$ = z J]

(1) (–10x – 10y – z)J (2) (10x + 10y + z)J

(3) (x + y – z)J (4) 10(x + y – z)J

**Ans.** **(1)**

**Sol.** $H_2O \rightarrow H_2O \rightarrow H_2O \rightarrow H_2O$

1 mol water | water | ice | ice

10°C | 0°C | 0°C | –10°C

$\Delta H_1$ | $\Delta H_2$ | $\Delta H_3$

$\Delta H_{total} = \Delta H_1 + \Delta H_2 + \Delta H_3$

$-1 \times y \times 10 + (-x) + (-1 \times z \times 10)$

$\Delta H_{Total} = -10y - x - 10z$

**10.** Consider the following sequence of reaction :

$NH_4Cl + NaOH \longrightarrow X(gas)$

$X(gas) + KOH + Y \longrightarrow$ Brown ppt.

Find out X(gas) and compound Y, respectively.

(1) $Cl_2$ and $K_2HgI_4$

(2) $NH_3$ and $K_2HgI_4$

(3) $Cl_2$ and KOH

(4) HCl and HgI

**Ans.** **(2)**

**Sol.** $NH_4Cl + NaOH \longrightarrow NH_3(gas)$

$NH_3(gas) + KOH^+ K_2HgI_4 \longrightarrow$ $[HgO.Hg(NH_2)I]$Brown ppt.

**11.** An aqueous solution of HCl with pH 1.0 is diluted by adding equal volume of water (ignoring dissociation of water). The pH of HCl solution would _____ (Given log2 = 0.30)

(1) Remains same

(2) Increases to 1

(3) Reduces to 0.5

(4) Increases to 1.3

**Ans.** **(4)**

**Sol.** pH = 1

$[H^+] = 10^{-1}$

$$\text{New } [H^+] = \frac{10^{-1}}{2} = 5 \times 10^{-2}$$

$pH = -\log(5 \times 10^{-2})$

$2 - (1 - 0.3) = 1.3$

**12.** Correct order of wavelength of the following colours:

(I) Red (II) Yellow

(III) Blue (IV) Violet

(1) I > II > III > IV

(2) IV > III > II > I

(3) II > I > IV > III

(4) II > I > III > IV

**Ans.** **(1)**

**Sol.**

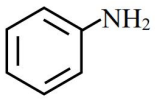
VIBGYOR

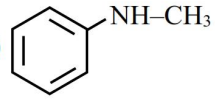
wavelength ↑

Red > Yellow > Blue > Violet

I > II > III > IV

**13.** Which among the following compounds gives positive carbylamine test?

(A) $CH_3 - NH_2$ (B) 

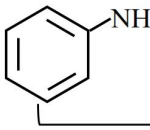
(C)  (D) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{N}}-CH_3$

(1) A and B only (2) B and C only

(3) A and C only (4) B and D only

**Ans.** **(1)**

**Sol.** Positive carbylamine test ⇒

 , $CH_3-NH_2$

1° amine

**14.** What is the IUPAC name of the following compound.

$$CH_3-CH=\underset{\displaystyle CH_3}{\underset{|}{C}}-\underset{\displaystyle Br}{\underset{|}{CH_2}}$$

(1) 1-Bromo-2-methylbut-2-ene

(2) 2-methylbut-1-Bromo-2-ene

(3) 4-Bromo-3-methylbut-2-ene

(4) 2-(Bromomethyl) But-2-ene

**Ans.** **(1)**

**Sol.** $CH_3-CH=\underset{\displaystyle CH_3}{\underset{|}{C}}-\underset{\displaystyle Br}{\underset{|}{CH_2}}$

1-Bromo-2-methylbut-2-ene

**15.** Consider the following statement

Statement I: D–(+)– Glucose and D–(+)–fructose are formed on hydrolysis of sucrose.

Statement II: Sucrose is an invert sugar.

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

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

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

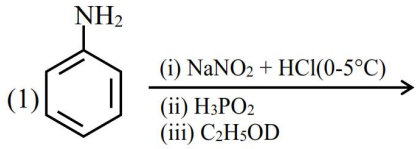
(4) Both Statement are incorrect.

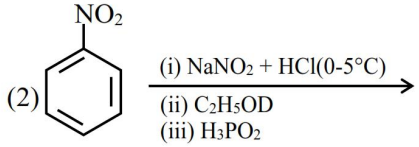
**Ans.** **(3)**

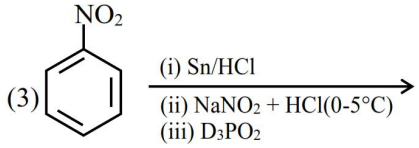
**Sol.** sucrose $\xrightarrow{\text{hydrolysis}}$ D–(+)–Glucose + D–(–)–fructose

$\Rightarrow$ Sucrose is an invert sugar because on hydrolysis sucrose (+66.6°) yields equal amount of glucose (+52.5) and fructose (–92.4°) during hydrolysis the optical rotation of sucrose changes from dextro to levo

**16.** Which one of the following reactions will result in the formation of deuterated benzene ($C_6H_5D$)?

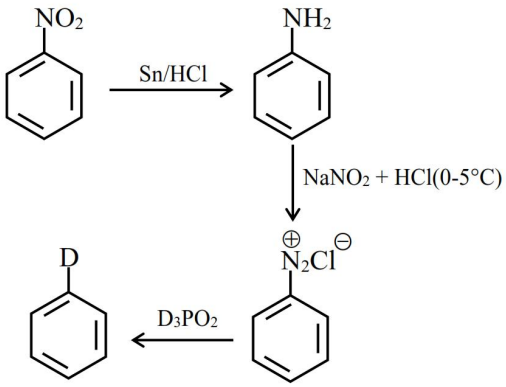
(1) 


(2) 


(3) 


(4) None

**Ans.** **(3)**

**Sol.** 


**17.** Given below are two statements

Statement I: Reductive ozonolysis of but-2-ene gives ethanal

Statement II: Reductive ozonolysis of 3, 6-dimethyl oct-4-ene doesn't give compound with chiral carbon.

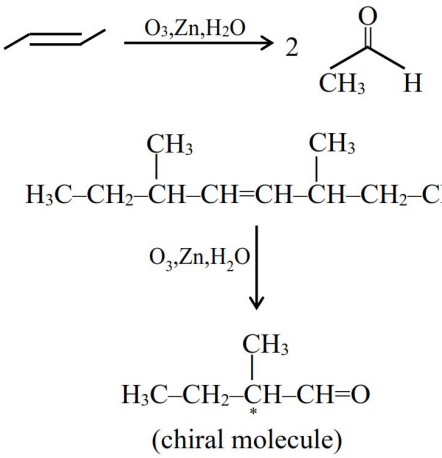
(1) Statement I and Statement II both are correct.

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

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

(4) Both Statement are incorrect.

**Ans.** **(2)**

**Sol.** 


(chiral molecule)

**18.** Consider the following first order reaction

$A(g) \rightarrow 2B(g) + C(g)$

The total pressure at t = 10 min is 160 mmHg & t = ∞ is 240 mm of Hg. Choose correct statement

(1) The reaction will be 100% complete

(2) $k = 1.693\ s^{-1}$

(3) t = 10 min $p_A = 40$ mmHg

(4) At t = 5 min pressure of system is 180 mmHg

**Ans.** **(3)**

**Sol.**

| | $A(g) \rightarrow$ | $2B(g)$ | + $C(g)$ |
|---|---|---|---|
| t = 0 | $P_o$ | | |
| t = t | $P_o - P$ | $2P$ | $P$ |
| t = ∞ | 0 | $2P_o$ | $P_o$ |

$P_o - P + 2P + P = 160$

$P_o + 2P = 160$

$P_o = 80$

$$K = \frac{\ln 2}{t_{1/2}}$$

$$K = \frac{0.693}{10 \times 60} = 0.0011$$

$$t_{1/2} = \frac{\ln 2}{K}$$

$t_{1/2} = 10$ min

$P_A$ at $t_{1/2} = 40$ mmHg

**19.** How many of the following complex ions are paramagnetic and have $d^2sp^3$ hybridization of the central metal ion?

$[FeF_6]^{3-}$, $[Fe(CN)_6]^{3-}$, $[CoF_6]^{3-}$, $[Co(CN)_6]^{3-}$, $[Mn(CN)_6]^{3-}$, $[Co(OX)_3]^{3-}$,

(1) 2 (2) 3 (3) 4 (4) 5

**Ans.** **(1)**

**Sol.**

(i) $[FeF_6]^{3-} \Rightarrow Fe^{+3}$ ($d^5$), $F^- \rightarrow$ WFL, $sp^3d^2$

(ii) $[Fe(CN)_6]^{3-} \Rightarrow Fe^{+3}$ ($d^5$), $CN^- \rightarrow$ SFL, $d^2sp^3$

No. of unpaired electron = 1 (paramagnetic)

(iii) $[CoF_6]^{3-} \Rightarrow Co^{+3}$ ($d^6$), $F^- \rightarrow$ WFL, $sp^3d^2$

(iv) $[Co(CN)_6]^{3-} \Rightarrow Co^{+3}$ ($d^6$), $CN^- \rightarrow$ SFL, $d^2sp^3$

No. of unpaired electron = 0 (Diamagnetic)

(v) $[Mn(CN)_6]^{3-} \Rightarrow Mn^{+3}$ ($d^4$), $CN^- \rightarrow$ SFL, $d^2sp^3$

No. of unpaired electron = 2 (Paramagnetic)

(vi) $[Co(OX)_3]^{3-} \Rightarrow Co^{+3}$ ($d^6$), $OX^- \rightarrow$ SFL, $d^2sp^3$

No. of unpaired electron = 0 (Diamagnetic)

**20.** An octahedral complex having molecular compo sition $Co.5NH_3.Cl.SO_4$ has two isomers A & B. The solution of A gives a white precipitate with $BaCl_2$ solution, the type of isomerism exhibited by the complex is

(1) Linkage isomerism

(2) Geometrical isomerism

(3) Co-ordinate isomerism

(4) Ionization isomerism

**Ans.** **(4)**

**Sol.** $Co.5NH_3.Cl.SO_4$

$[Co(NH_3)_5Cl]SO_4$ & $[Co(NH_3)_5SO_4]Cl$

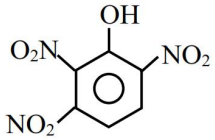
(A) (B)

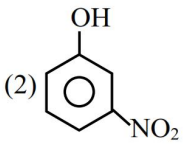
$[Co(NH_3)_5Cl]SO_4 + BaCl_2 \rightarrow [Co(NH_3)_5Cl]^{+2} + BaSO_4\downarrow$

(White)

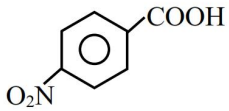
So A & B are Ionisation isomers of each other

**21.** Which of the following molecule will not liberate $CO_2$ gas with $NaHCO_3$

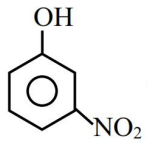
(1) 

(2) 

(3) $NH_4Cl$

(4) 

**Ans.** **(2)**

**Sol.**  $\xrightarrow{NaHCO_3}$ not liberate $CO_2$

**22.** Statement I: Di-methyl ether is almost completely soluble in water.

Statement II: Sodium can be used in dry diethyl ether but not ethyl alcohol.

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

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

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

(4) Both Statement are incorrect.

**Ans.** **(3)**

**Sol.** Di-methyl ether is not soluble in water.

Sodium can be used in dry diethyl ether but not ethyl alcohol

## SECTION-B

**23.** 500 mg of organic compound gives 220 mg of $CO_2$. Find mass % of carbon atoms present in organic compound.

**Ans.** **(12)**

**Sol.** X $\longrightarrow$ $CO_{2(g)} + H_2O_{(l)}$

Organic compound 500 mg — 220 mg

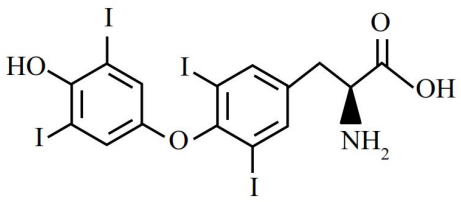
$$\text{m mol of } CO_2 = \frac{220}{44} = 5$$

Carbon m mol = 5

Carbon mass = 5 × 12 mg

$$\%\text{Carbon} = \frac{5\times12}{500}\times100 = 12$$

**24.** Given below is the structure of hormone "Thyroxine". What is the % of I (iodine) in the molecule.



**Ans.** **(65)**

**Sol.** Molecular weight of thyroxine = 776.87 g/mol

Mass of iodine in thyroxine = 4 × 126.9

= 507.6 g

$$\%I = \frac{507.6}{776.87}\times100 = 65\%$$

## MATHEMATICS

**1.** Let A be a set defined as A={2,3,6,9}. Find the number of singular matrices of order 2×2 such that elements are from the set A

**Ans.** **(36)**

**Sol.** $A=\begin{bmatrix} a & b \\ c & d \end{bmatrix} \Rightarrow |A| = ad - bc = 0 \Rightarrow ad = bc$

(i) when all same $a = b = c = d \Rightarrow 4$ cases

(ii) when exactly two same

$$\left.\begin{array}{cc} ad & bc \\ 23 & 23 \\ 23 & 32 \\ 32 & 23 \\ 32 & 32 \end{array}\right\} {}^4C_2 \times 4 = 24$$

(iii) when all distinct $\left.\begin{array}{ccc} ad & = & bc \\ 3.6 & = & 2.9 \end{array}\right\} \rightarrow 4$

$2.9 = 3.6 \rightarrow 4$

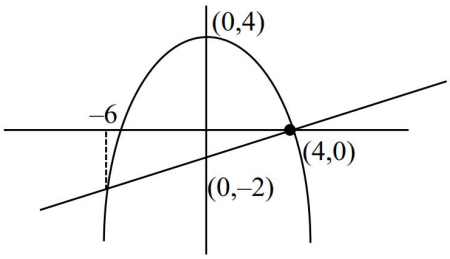
Total cases = 4 + 24 + 4 + 4 = 36 cases.

**2.** Area bounded by the curves $y = 4 - \frac{x^2}{4}$ and $y = \frac{x-4}{2}$ (in square units) is

(1) $\frac{125}{3}$ (2) $\frac{20}{3}$ (3) $\frac{80}{3}$ (4) $\frac{120}{3}$

**Ans.** **(1)**

**Sol.**




Solving the given equations

$$4 - \frac{x^2}{4} = \frac{x-4}{2}$$

$$\Rightarrow 16 - x^2 = 2x - 8$$

$$\Rightarrow x^2 + 2x - 24 = 0$$

$$\Rightarrow x = -6, 4$$

$$A = \int_{-6}^{4} \left(4 - \frac{x^2}{4} - \frac{x-4}{2}\right) dx$$

$$= \frac{1}{4}\int_{-6}^{4}\left(24 - x^2 - 2x\right)dx$$

$$= \frac{1}{4}\left[24x - \frac{x^3}{3} - x^2\right]_{-6}^{4}$$

$$= \frac{1}{4}\left[240 - \frac{64+216}{3} - (16-36)\right] = \frac{125}{3}$$

**3.** If $x_1, x_2, x_3, x_4$ are in G.P, then we subtract 2,4,7,8 from $x_1, x_2, x_3, x_4$respectively, then the resultant numbers are in A.P., then the value of $\frac{1}{24}(x_1 \cdot x_2 \cdot x_3 \cdot x_4)$ is

(1) $\frac{2^4}{3^4}$ (2) $\frac{2^3}{3^9}$ (3) $\frac{2}{3^9}$ (4) $\frac{2}{3^8}$

**Ans.** **(2)**

**Sol.** Let the terms of GP : $\frac{a}{r}, a, ar, ar^2$

Now AP: $\frac{a}{r} - 2, a-4, ar-7, ar^2 - 8$

Given in AP: $a_3 - a_2 = a_2 - a_1$

$$\Rightarrow (ar-7) - (a-4) = (a-4) - \left(\frac{a}{r} - 2\right)$$

$$\Rightarrow a(r-1) - 3 = a\left(1 - \frac{1}{r}\right) - 2$$

$$\Rightarrow a(r-1)r = a(a-1) + r$$

$$\Rightarrow a(r-1)(r-1) = r \qquad \ldots(i)$$

Also,

$$a_4 - a_3 = a_3 - a_2$$

$$\Rightarrow (ar^2 - 8) - (ar-7) = (ar-7) - (a-4)$$

$$\Rightarrow ar(r-1) - 1 = a(r-1) - 3$$

$$\Rightarrow a(r-1)(r-1) = -2 \qquad \ldots(ii)$$

Solving (i) and (ii)

We get,

$r = -2 \Rightarrow a = \frac{-2}{9}$

Now, $\frac{1}{24}(x_1 \cdot x_2 \cdot x_3 \cdot x_4) = \frac{1}{24}(a^4 \cdot r^2)$

$$= \frac{1}{24}\left(\frac{16}{9^4} \times 4\right) = \frac{2^3}{3^9}$$

**4.** The integral $\int_0^{\pi} \frac{(x+3)\sin x}{1+3\cos^2 x}dx$ is equal to

(1) $\frac{\pi}{2\sqrt{3}}(\pi+4)$ (2) $\frac{\pi}{3\sqrt{3}}(\pi+6)$ (3) $\frac{\pi}{\sqrt{3}}(\pi+1)$ (4) $\frac{\pi}{\sqrt{3}}(\pi+2)$

**Ans.** **(2)**

**Sol.** Applying kings

$$I=\frac{\pi+6}{2}\int_0^{\pi}\frac{\sin x}{1+3\cos^2 x}dx$$

cosx = t

–sinxdx =dt

$$I=\left(\frac{\pi+6}{2}\right)-\int_1^{-1}\frac{dt}{1+3t^2}$$

$$=(\pi+6)\frac{\left[\tan^{-1}\sqrt{3}t\right]_0^1}{\sqrt{3}}$$

$$=\frac{\pi+6}{\sqrt{3}}\left(\frac{\pi}{3}\right)=\frac{\pi(\pi+6)}{3\sqrt{3}}$$

**5.** If $f(x)=\left[\frac{x^2}{2}\right]-[\sqrt{x}]\ \forall\ x\in[0,4]$, where [.] denotes the greatest integer function, then number of points of discontinuity of $f(x)$ is

(1) 4 (2) 6 (3) 8 (4) 12

**Ans.** **(3)**

**Sol.** x ∈ [0, 4]

first check for $\left[\frac{x^2}{2}\right]$

$\frac{x^2}{2}\in[0,8]\ \therefore\ \frac{x^2}{2}=0,1,2,3,4,5,6,7,8$

$\Rightarrow x^2 = 0, 2, 4, 6, 8, 10, 12, 14, 16$

$\Rightarrow x=0,\sqrt{2},2,\sqrt{6},\sqrt{8},\sqrt{10},\sqrt{12},\sqrt{14},4$

$\therefore\ \sqrt{x}\in[0,2]\Rightarrow\sqrt{x}=0,1,2\Rightarrow x = 0, 1, 4$

Check for x = 0 $f(0) = 0 – 0 = 0$

& $f(0^+) = [0^+] – [0^+] = 0$

and at x = 4 $f(4) = [8] – [2] = 8 – 2 = 6$

& $f(4^-) = [8^-] – [2^-]$

$= 7 – 1 = 6$

$\therefore$ x = 0, 4 are continuous points.

$\therefore$ total no. of points of discontinuity = 8.

$\therefore x=\sqrt{2},2,\sqrt{6},\sqrt{8},\sqrt{10},\sqrt{12},\sqrt{14}$ & $1\rightarrow 8$ points

**6.** Let the set of all values of $p \in \mathbb{R}$, for which both the roots of the equation $x^2 - (p+2)x + (2p+9) = 0$ are negative real numbers, be the interval $(\alpha, \beta]$, then $\beta - 2\alpha$ is equal to_____.

(1) 9 (2) 5 (3) 0 (4) 20

**Ans.** **(2)**

**Sol.** $p + 2 < 0 \Rightarrow p < -2$

$2p + 9 > 0 \Rightarrow p > \frac{-9}{2}$

$D \geq 0 \Rightarrow (p+2)^2 - 4(2p+9) \geq 0$

$\Rightarrow p^2 + 4p + 4 - 8p - 36 \geq 0$

$\Rightarrow p^2 - 4p + 4 - 36 \geq 0$

$\Rightarrow ((p-2) - 6)(p - 2 + 6) \geq 0$

$\Rightarrow p \in (-\infty, -4] \cup [8, \infty)$

So, $p \in \left[-\frac{9}{2}, -4\right]$

$\alpha = -\frac{9}{2}$ ; $\beta = -4$

So, $\beta - 2\alpha = -4 + 9 = 5$

**7.** Let A be 3×3 matrix such that $\left|adj\left(adj(adjA)\right)\right| = 81$. Let $S = \left\{n \in \mathbb{z} : (|adj(adjA)|)^{\frac{(n-1)^2}{2}} = |A|^{(3n^2-5n-4)}\right\}$ then $\sum_{n \in s} |A^{(n^2+n)}|$ is equal to

(1) 750 (2) 820 (3) 732 (4) 866

**Ans.** **(3)**

**Sol.** |adj (adj (adjA))| = 81

$\left|A\right|^{(n-1)^3} = 81$

$\left|A\right|^8 = 3^4$

$\left|A\right| = \pm\sqrt{3}$

Also, $\left|adj\left(adjA\right)\right|^{\frac{(n-1)^2}{2}} = \left|A\right|^{3n^2-5n-4}$

$\left(\left|A\right|^4\right)^{\frac{(n-1)^2}{2}} = \left|A\right|^{3n^2-5n-4}$

$\Rightarrow 2(n-1)^2 = 3n^2 - 5n - 4$

$\Rightarrow 2n^2 - 4n + 2 = 3n^2 - 5n - 4$

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

$(n-3)(n+2) = 0$

$\Rightarrow n = 3, -2$

So, $\sum_{n \in s} \left|A^{n^n+n}\right|$

$\Rightarrow \sum |A|^{n^2+n}$

$= |A|^{12} + |A|^2 = 3^6 + 3$

$= 732$

**8.** Let $'P'$ be the parabola, whose focus is (-2,1) & directrix is $2x + y + 2 = 0$. Then the sum of the ordinates of the points on P, whose abscissa is -2 is

(1) $\frac{5}{2}$ (2) $\frac{3}{2}$ (3) $\frac{1}{4}$ (4) $\frac{3}{4}$

**Ans.** **(2)**

**Sol.** Let point P(–2, y) is point on parabola

From def. of parabola

PS = PM

$\Rightarrow (y-1)^2 = \frac{(-4+y+2)^2}{5}$

$\Rightarrow 5(y-1)^2 = (y-2)^2$

$\Rightarrow 4y^2 - 6y + 1 = 0$

Sum of roots = $\frac{6}{4} = \frac{3}{2}$

**9.** Let the angle $\theta$, $0 < \theta < \frac{\pi}{2}$ between two unit vectors $\hat{a}$ and $\hat{b}$ be $\sin^{-1}\left[\frac{\sqrt{65}}{9}\right]$. If the vector $\vec{c} = 3\hat{a} + 6\hat{b} + 9(\hat{a} \times \hat{b})$, then the value of $9(\vec{c}.\hat{a}) - 3(\vec{c}.\hat{b})$ is equal to

(1) 27 (2) 24 (3) 29 (4) 31

**Ans.** **(3)**

**Sol.** $\vec{c} \cdot \hat{a} = 3 + 6\hat{a}.\hat{b}$

$\vec{c} \cdot \hat{b} = 3\hat{a} \cdot \hat{b} + 6$

So, $9(\vec{c}.\hat{a}) - 3(\vec{c}.\hat{b}) = 27 - 18 + (54-9)\hat{a} \cdot \hat{b}$

$= 9 + 45\hat{a}.\hat{b}$

$= 9 + 45 \times \frac{\sqrt{81-65}}{9}$

$= 9 + 5\sqrt{16}$

$= 9 + 20 = 29.$

**10.** Let $x = -1$ & $x = 2$ be the critical points of the function $f(x) = x^3 + ax^2 + b\log_e|x| + 1,\ x \neq 0$. Let $m$ and $M$ respectivelybe the absolute minimum and the absolute maximum values of $f$ in the interval $\left[-2, -\frac{1}{2}\right]$. Then $|M + m|$ is equal to $(\log_e 2 = 0.7)$

(1) 19.8 (2) 20.9 (3) 21.1 (4) 22.1

**Ans.** **(3)**

**Sol.** $f'(x) = 3x^2 + 2ax + \frac{b}{x}$

$f'(-1) = 0$ & $f'(2) = 0$

$\Rightarrow 3 - 2a + \frac{b}{-1} = 0$ and $12 + 4a + \frac{b}{2} = 0$

$\Rightarrow 2a + b = 3$ and $24 + 8a + b = 0$

$\Rightarrow$ 8a + b = –24

Solving,

$6a = -27 \Rightarrow a = \frac{-27}{6} = \frac{-9}{2}$

& $b = 3 - 2a = 12$

Now, $f''(x) = 6x + 2a - \frac{b}{x^2}$

$\Rightarrow f''(-1) = -6 + 2a - b < 0$

& $f''(2) = 0$

Also, $f'(x) = \frac{3x^3 + 2ax^2 + b}{x} = \frac{3x^3 - 9x^2 + 12}{x}$

$\Rightarrow f'(x) = \frac{3(x+1)(x-2)^2}{x}$

$f(-2) = -8 + 4a + b\log_e 2 + 1 = -8 - 18 + 12\log_e 2 + 1$

$\Rightarrow f(-2) = 12\log_e 2 - 25 = 8.4 - 25 = -16.6 = m$

& $f(-1) = -1 + a + 1 = a = -4.5 = M$

$f\left(-\frac{1}{2}\right) = \frac{-1}{8} + \frac{a}{4} - b\ell n2 + 1 = \frac{-1}{8} - \frac{9}{8} - 12\ell n2 + 1$

= |m + M| = 21.1

**11.** Consider two statements:

Statement 1: The set $\left\{z \in C - \{-i\}: |z| = 1 \text{ and } \left(\frac{z-i}{z+i}\right) \text{ is purely real}\right\}$ contains exactly two elements and

Statement 2 : The set $\left\{z \in C - \{-1\}: |z| = 1 \text{ and } \left(\frac{z-i}{z+i}\right) \text{ is purely imaginary}\right\}$

contains if infinitely many elements. Then

(1) Statement 1 is correct (2) Statement 2 is correct

(3) Both statements are correct (4) Both statements are incorrect

**Ans.** **(2)**

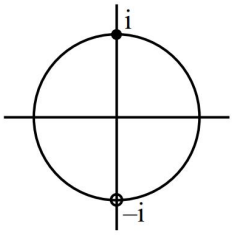
**Sol.** $\frac{z-i}{z+i}=\frac{\bar{z}+i}{\bar{z}-i}$

$\Rightarrow (z-i)(\bar{z}-i)=(z+i)(\bar{z}+i)$

$\Rightarrow z\cdot\bar{z}-\bar{z}i-zi-1=z\bar{z}+zi+\bar{z}i-1$

$\Rightarrow (z+\bar{z})=0 \Rightarrow x=0$

So, statement 1 is false




$\frac{z-i}{z+i}+\frac{\bar{z}+i}{\bar{z}-i}=0$

$\Rightarrow z\bar{z}-1=0 \Rightarrow |z|=1$

Statement II is true.

**12.** Let the line $L$ passes through $(1,\ 1,\ 1)$ & intersects the lines $L_1$& $L_2$

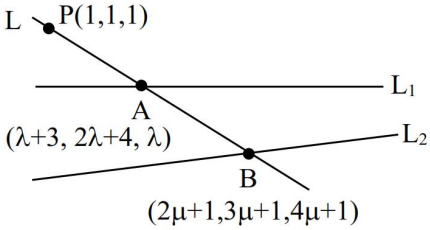
where $L_1:\frac{x-1}{2}=\frac{y+1}{3}=\frac{z-1}{4}$ & $L_2:\frac{x-3}{1}=\frac{y-4}{2}=\frac{z}{1}$,

then which of the following points lies on the line $L$ ?

(1) (5, 4, 3) (2) (4, 22, 7) (3) (7, 15, 13) (4) (10, –29, –50)

**Ans.** **(3)**

**Sol.**




P, A, B are in same line

$\frac{\lambda+2}{2\mu}=\frac{2\lambda+3}{3\mu-2}=\frac{\lambda-1}{4\mu}$

$2\lambda+4=\lambda-1$

$\lambda=-5$

Equation of L

$\frac{x-1}{3}=\frac{y-1}{7}=\frac{z-1}{6}$

Now, check (1), (2), (3), (4)

= (7, 15, 13)

**13.** The mean and standard deviation of 100 observations are 40 and 5.1respectively.

By mistake one observation is taken as 50 instead of 40. If the correct mean and the correct standard deviation are $\mu$ and $\sigma$ respectively, then $10(\mu+\sigma)$ is equal to

(1) 445 (2) 447 (3) 449 (4) 451

**Ans.** **(3)**

**Sol.** $\frac{\sum x_i}{100}=40 \Rightarrow \sum x_i=4000$ and $(5.1)^2=\frac{\sum x_i^2}{100}-(40)^2$

Now $\sum x_i=4000-50+40=3990$

Now $\mu=\frac{3990}{100}=39.90$

Now $\sigma=\sqrt{\frac{\{(5.1)^2+1600\}\times 100-(50)^2+(40)^2}{100}-(39.90)^2}=5$

Now, $10(\mu+\sigma)=10(39.90+5)=449$.

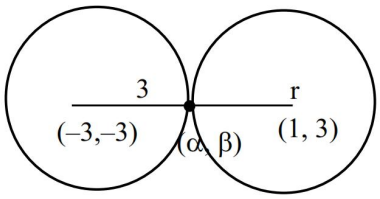
**14.** Let $C_1$ be the circle in the 3rd quadrant of radius 3, that touches bothcoordinate axes.

Let $C_2$ be the circle with centre $(1,\ 3)$ that touches $C_1$externally at the point $(\alpha,\beta)$. If $(\beta-\alpha)^2=\frac{m}{n}$, $\gcd(m,n)=1$, then $m+n$is equal to

(1) 9 (2) 13 (3) 22 (4) 31

**Ans.** **(3)**

**Sol.**




$\sqrt{16+36}=r+3$

$\Rightarrow r+3=\sqrt{52}$

$\Rightarrow r=\sqrt{52}-3$

$\Rightarrow \frac{3-3r}{r+3}=\alpha \quad \beta=\frac{9-3r}{3+r}$

$\Rightarrow \frac{(9-3r-3+3r)^2}{(r+3)^2}$

$=\frac{36}{52}=\frac{9}{13}=\frac{m}{n}$

$\therefore$ m + n = 22