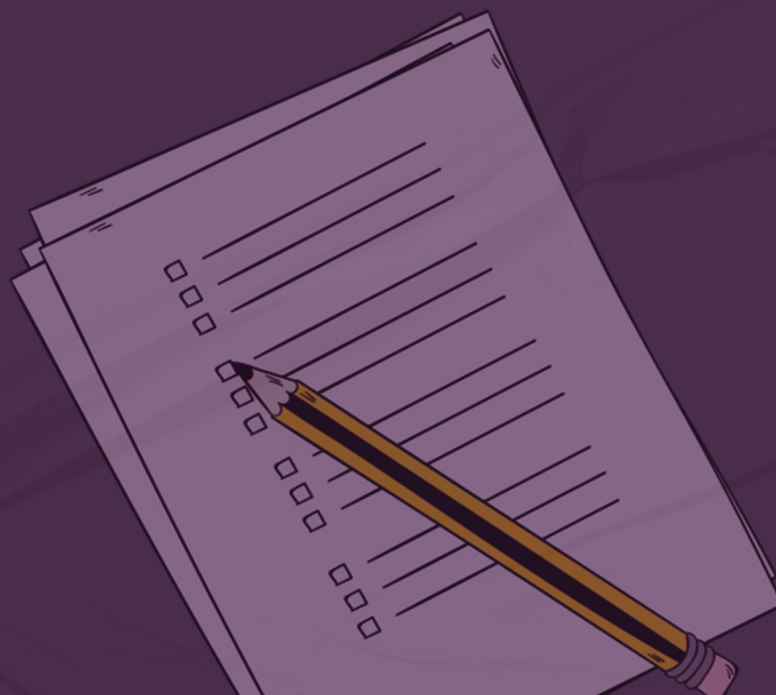


**CAREERS** 360  
**PREPARATION** Series

# JEE Main 2025

Jan 22 Questions with Solution  
by Aakash Byjus (Shift 1 & 2)



22/01/2025

Morning



# Aakash

Medical | IIT-JEE | Foundations

Corporate Office : AESL, 3rd Floor, Incuspaze Campus-2, Plot-13, Sector-18, Udyog Vihar,  
Gurugram, Haryana-122018

## Memory Based Answers & Solutions

Time : 3 hrs.

for

M.M. : 300

## JEE (Main)-2025 (Online) Phase-1

(Physics, Chemistry and Mathematics)

### 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.

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**JEE (Advanced) 2024**

AIR	Name	Classroom
25	Rishi Shekher Shukla	2 Year Classroom
67	Krishna Sai Shishir	2 Year Classroom
78	Abhishek Jain	2 Year Classroom
93	Hardik Aggarwal	2 Year Classroom
95	Ujjwal Singh	2 Year Classroom
98	Rachit Aggarwal	2 Year Classroom

**JEE (Main) 2024**

AIR	Name	Classroom	State
1	Sarvvi Jais	2 Year Classroom	Karnataka
15	M Sai Divya Teja Reddy	2 Year Classroom	Telangana
19	Rishi Shekher Shukla	2 Year Classroom	Telangana



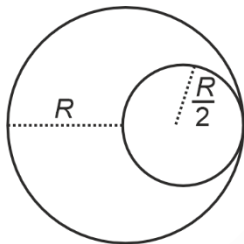
$$\Rightarrow C_1 = \frac{A\epsilon_0 K_1 K_2}{d(K_1 + K_2)}$$

Now  $C_1$  is parallel to  $C_3$

$$\Rightarrow C_{eq} = \frac{A\epsilon_0}{d} \left[ \frac{K_1 K_2}{K_1 + K_2} + \frac{K_3}{2} \right]$$

$$\Rightarrow C_{eq} = \frac{A\epsilon_0}{d} \left[ \frac{2K_1 K_2 + K_2 K_3 + K_3 K_1}{2(K_1 + K_2)} \right]$$

4. From a sphere of mass  $M$  and radius  $R$ , a cavity of radius  $\frac{R}{2}$  is created. Find the moment of inertia about an axis passing through the centre of sphere and cavity.

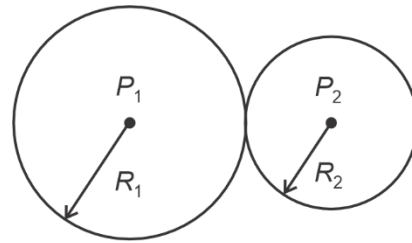


- (1)  $\frac{31}{48} MR^2$
- (2)  $\frac{31}{80} MR^2$
- (3)  $\frac{13}{32} MR^2$
- (4)  $\frac{21}{32} MR^2$

**Answer (2)**

$$\begin{aligned} \text{Sol. } I &= \frac{2}{5} MR^2 - \frac{2}{5} \left( \frac{M}{8} \right) \left( \frac{R}{2} \right)^2 \\ &= \frac{31}{80} MR^2 \end{aligned}$$

5. Find the radius of curvature of the common surface of two bubbles ( $R_1 > R_2$ )



- (1)  $R = \frac{R_1 R_2}{R_1 + R_2}$
- (2)  $R = \frac{2R_1 R_2}{R_1 - R_2}$
- (3)  $R = \frac{R_1 R_2}{R_1 - R_2}$
- (4)  $R = \frac{R_1 R_2}{(R_1 - R_2)}$

**Answer (3)**

$$\text{Sol. } P_1 - P_0 = \frac{4S}{R_1}; P_2 - P_0 = \frac{4S}{R_2}$$

$$\text{So, } P_2 - P_1 = \Delta P = \frac{4S}{R} = 4S \left[ \frac{1}{R_2} - \frac{1}{R_1} \right]$$

$$\text{or } \frac{1}{R} = \frac{R_1 - R_2}{R_1 R_2}$$

6. From the given option, identify the diode connected in forward bias.

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

**Answer (1)**

**Sol.** Only in option (1), the p-side is connected at higher potential than the n-side of the diode.

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7. Radius of electron in ground state for hydrogen is  $a_0$ , then radius of electron in  $\text{He}^+$  ion in  $3^{\text{rd}}$  excited state is  
a. Then  $\frac{a_0}{a}$  is

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

**Answer (4)**

**Sol.**  $r = \frac{n^2}{Z} r_0 \Rightarrow \text{for } H$

$$a_0 = \frac{1}{1} r_0$$

$$a = \frac{4^2}{2} r_0$$

$$\frac{a_0}{a} = \frac{1}{8}$$

8. Ice at  $-10^\circ\text{C}$  is to be converted into steam at  $110^\circ\text{C}$ . Mass of ice is  $10^{-3}$  kg. What amount of heat is required?

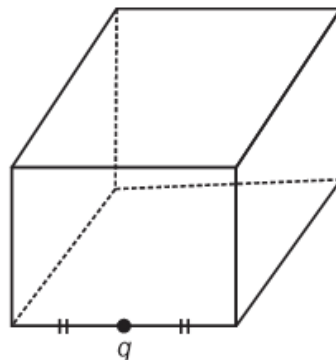
- (1)  $\Delta Q = 730$  cal
- (2)  $\Delta Q = 900$  cal
- (3)  $\Delta Q = 1210$  cal
- (4)  $\Delta Q = 870$  cal

**Answer (1)**

**Sol.**  $-10^\circ\text{C}$  ice to  $0^\circ\text{C}$  ice  $\rightarrow 0^\circ\text{C}$  ice to  $0^\circ\text{C}$  water +  $0^\circ\text{C}$  water to  $100^\circ\text{C}$  water +  $100^\circ\text{C}$  water to  $100^\circ\text{C}$  steam +  $110^\circ\text{C}$  steam.

$$\Rightarrow \Delta Q = \left(1 \times \frac{1}{2} \times 10\right) + (1 \times 80) + (1 \times 1 \times 100) + (1 \times 540) + \left(1 \times \frac{1}{2} \times 10\right) = 730 \text{ cal}$$

9. A charge of value  $q$  is placed at the edge of a imaginary cube of side  $a$  as shown in figure. Find the net flux through the cube



- (1)  $\frac{q}{6\epsilon_0}$
- (2)  $\frac{q}{4\epsilon_0}$
- (3)  $\frac{q}{8\epsilon_0}$
- (4)  $\frac{q}{2\epsilon_0}$

**Answer (2)**

**Sol.**  $\phi_4$  such cubes =  $\frac{q}{\epsilon_0}$

$$\phi_1 \text{ cube} = \frac{q}{4\epsilon_0}$$

10. A closed organ pipe in  $9^{\text{th}}$  harmonic resonates with  $4^{\text{th}}$  harmonic of open organ pipe [ $l_{\text{closed}} = 10$  cm]. Find length of open organ pipe.

- (1)  $L_0 = 15$  cm
- (2)  $L_0 = \frac{100}{9}$  cm
- (3)  $L_0 = \frac{110}{7}$  cm
- (4)  $L_0 = \frac{80}{9}$  cm

**Answer (4)**

**Sol.**  $\frac{9v}{4L_c} = \frac{4v}{2L_0} \Rightarrow L_0 = \frac{8L_c}{9}$

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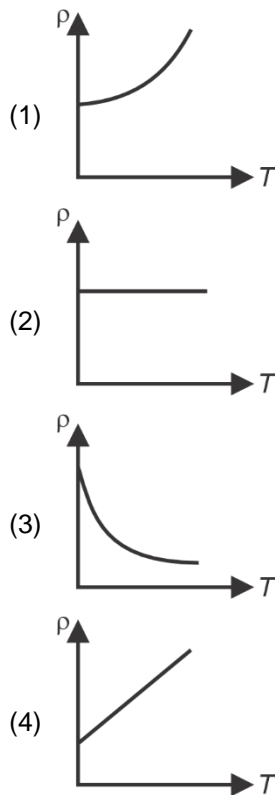
11. A capacitor is charged by battery to charge  $Q_1$ . Now the battery is disconnected and dielectric slab of dielectric constant  $K$  is inserted between the gaps of the plates. Now charge on capacitor is  $Q_2$ . Find  $\frac{Q_1}{Q_2}$ .

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

**Answer (1)**

**Sol.**  $\frac{Q_1}{Q_2} = 1$  (No further charge is supplied)

12. Which of the following graphs correctly represents the variation of resistivity ( $\rho$ ) with temperature ( $T$ ).



**Answer (1)**

**Sol.** The resistivity of conductors increases with increase in temperature non-linearly.

13. If whole YDSE apparatus is immersed in a liquid of refractive index  $\mu$ , then what is the effect on fringe width?

- (1) Fringe width increases  
 (2) Fringe width decreases  
 (3) Fringe width remains unchanged  
 (4) It may increase on one side and decrease on other side

**Answer (2)**

**Sol.**  $\Delta\omega = \frac{\lambda D}{\lambda}$

So, for RI of  $\mu$

$$\Delta\omega' = \frac{\lambda D}{\mu d}$$

14. Two spherical black bodies of radius 0.8 m and 0.2 m are at temperatures of 400 K and 800 K respectively. Find ratio of rate of heat loss.

- (1) 8  
 (2) 4  
 (3) 2  
 (4) 1

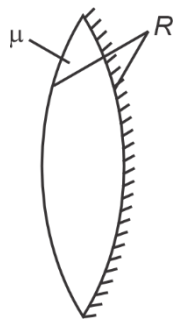
**Answer (4)**

**Sol.**  $P_1 = \sigma 4\pi (0.8)^2 (400)^4$

$P_2 = \sigma 4\pi (0.2)^2 (800)^4$

$$\frac{P_1}{P_2} = \frac{4 \times 4}{2^4} = 1$$

15. The equiconvex lens shown in figure is silvered on one side. For what distance of object from the lens is the image formed on the object itself?



- (1)  $\mu R$                       (2)  $\frac{R}{\mu}$   
 (3)  $\frac{R}{2\mu - 1}$                   (4)  $\frac{R}{2\mu - 2}$

**Answer (3)**

**Sol.** Silvering of lens

$$\frac{1}{F_{eq}} = \frac{1}{f_m} - \frac{2}{f_l} \qquad \frac{1}{f_l} = (\mu - 1) \left( \frac{1}{R} - \left( \frac{1}{-R} \right) \right)$$

$$= \frac{-2}{R} - \frac{4(\mu - 1)}{R} \qquad \frac{1}{f_l} = \frac{2(\mu - 1)}{R}$$

$$= \frac{-2(1 + 2\mu - 2)}{R}$$

$$F = \frac{-R}{2(2\mu - 1)}$$

For object-image to coincide distance should be  $2f$

$$|u| = 2|F|$$

$$= \frac{R}{2\mu - 1}$$

16. Light of wavelength 550 nm is incident on surfaces of cerium and lithium. Work function are respectively 1.9 eV and 2.5 eV. Then electron will be ejected from

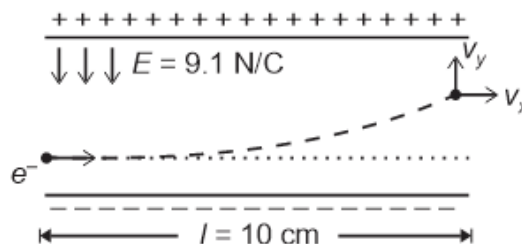
- (1) Cerium only                  (2) Lithium only  
 (3) From both of them        (4) None of them

**Answer (1)**

**Sol.**  $E(\text{eV}) = \frac{1240}{\lambda(\text{nm})} = \frac{1240}{550} = 2.25$

$2.25 > 1.9$  for cerium only

17. The figure shows an electron entering the space between the plates of a parallel plate capacitor with an initial velocity,  $v_x = 10^6$  m/s parallel to the plates. If the length of plates is  $l = 10$  cm and the electric field in the region  $E = 9.1$  N/C, then the value of  $v_y$  when the electron comes out of the plates is (Electronic mass =  $9.1 \times 10^{-31}$  kg)



- (1)  $1.6 \times 10^4$  m/s              (2)  $1.6 \times 10^5$  m/s  
 (3)  $1.6 \times 10^7$  m/s              (4)  $1.6 \times 10^3$  m/s

**Answer (2)**

**Sol.** Time inside the electric field,  $t = \frac{l}{v_x}$

Acceleration of electron along  $y$ -axis,  $a = \frac{eE}{m}$

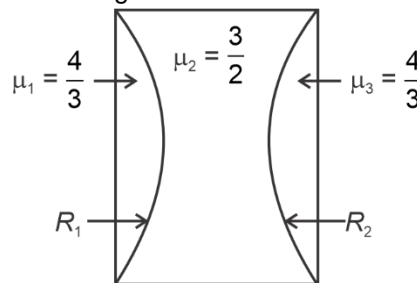
Velocity  $v_y = at$

$$= \frac{eE}{m} \cdot \frac{l}{v_x}$$

$$= \frac{1.6 \times 10^{-19} \times 9.1 \times 10 \times 10^{-2}}{9.1 \times 10^{-31} \times 10^6} \text{ m/s}$$

$$= 1.6 \times 10^5 \text{ m/s}$$

18. Find the equivalent power of the thin lens combination shown in the figure.



- (1)  $+\left(\frac{R_1 + R_2}{R_1 + R_2}\right)$               (2)  $-\left(\frac{R_1 + R_2}{R_1 R_2}\right)$   
 (3)  $-\left(\frac{R_1 + R_2}{6R_1 R_2}\right)$               (4)  $+\left(\frac{R_1 + R_2}{6R_1 R_2}\right)$

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**JEE (Main) 2024**

<b>Karnataka Topper</b> <b>AIR 1</b> Sarvi Jain 2 Year Classroom	<b>Telangana Topper</b> <b>AIR 15</b> M Sai Divya Tuja Reddy 2 Year Classroom	<b>Telangana Topper</b> <b>AIR 19</b> Rishi Shekher Shukla 2 Year Classroom
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Answer (3)

Sol. Net power =  $P_1 + P_2 + P_3$

$$\begin{aligned}
 &= \frac{(\mu_1 - 1)}{R_1} + (\mu_2 - 1) \left( \frac{1}{-R_1} + \frac{1}{-R_2} \right) + \frac{(\mu_3 - 1)}{R_2} \\
 &= \frac{(\mu_1 - \mu_2)}{R_1} + \frac{(\mu_3 - \mu_2)}{R_2} \\
 &= \left( \frac{4}{3} - \frac{3}{2} \right) \frac{1}{R_1} + \left( \frac{4}{3} - \frac{3}{2} \right) \frac{1}{R_2} \\
 &= -\frac{1}{6} \left( \frac{1}{R_1} + \frac{1}{R_2} \right) \\
 &= -\left( \frac{R_1 + R_2}{6R_1R_2} \right)
 \end{aligned}$$

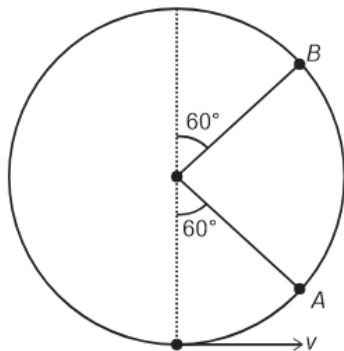
19.

20.

**SECTION - B**

**Numerical Value Type Questions:** This section contains 5 Numerical based questions. The answer to each question should be rounded-off to the nearest integer.

21. The particle shown in figure is just able to complete the vertical circular motion. Find the ratio of kinetic energy at A to the kinetic energy at B.



Answer (2)

Sol.  $v = \sqrt{5gR}$

$$KE_A = \frac{1}{2}mv^2 - mg\frac{R}{2}$$

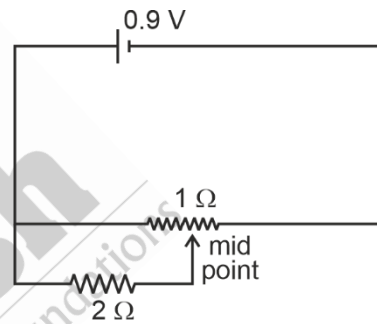
$$KE_A = 2mgR$$

$$KE_B = \frac{1}{2}mv^2 - mg\left(\frac{3R}{2}\right)$$

$$= mgR$$

$$\frac{KE_A}{KE_B} = 2$$

22. The current drawn from battery in the circuit shown below is \_\_\_\_\_ A



Answer (1)

Sol.  $\frac{1}{R_1} = \frac{1}{2} + 2 = \frac{5}{2}$

$$\Rightarrow R_1 = \frac{2}{5} \Omega$$

$$\text{Now, } R = \frac{2}{5} + \frac{1}{2} = \frac{9}{10} \Omega$$

$$\text{So, } I = \frac{9 \times 10}{10 \times 9} = 1A$$

23.

24.

25.

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**JEE (Main) 2024**

<b>Karnataka Topper</b> <b>AIR 1</b> Sarvi Jain 2 Year Classroom	<b>Telangana Topper</b> <b>AIR 15</b> M Sai Divya Tuja Reddy 2 Year Classroom	<b>Telangana Topper</b> <b>AIR 19</b> Rishi Shekher Shukla 2 Year Classroom
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**CHEMISTRY**

**SECTION - A**

**Multiple Choice Questions:** This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

**Choose the correct answer :**

1. For complex ion  $[\text{NiCl}_4]^{2-}$  what is the charge on metal and shape of complex respectively?

- (1) +2, Tetrahedral      (2) +2, Square planar  
(3) +4, Tetrahedral      (4) +4, Square Planar

**Answer (1)**

**Sol.**  $[\text{NiCl}_4]^{2-} \Rightarrow \text{Ni}^{2+} \rightarrow 3d^8$

$\text{Cl}^-$  ligand is weak field ligand and hybridisation is  $sp^3$ . Shape of complex is tetrahedral.

2. Compare boiling point of given solutions

- (i)  $10^{-4}$  M NaCl      (ii)  $10^{-3}$  M NaCl  
(iii)  $10^{-2}$  M NaCl      (iv)  $10^{-4}$  M urea  
(1) I > II > III > IV      (2) III > II > I > IV  
(3) II > I > III > IV      (4) III > I > II > IV

**Answer (2)**

**Sol.** Higher the elevation in boiling point, higher will be the boiling point

$$\Delta T_b \propto i \times m$$

For urea  $i = 1$

For NaCl  $i = 2$

Boiling point order III > II > I > IV

3. The correct decreasing order of electronegativity is

- (1) F > Cl > I > Br      (2) Cl > F > Br > I  
(3) F > Cl > Br > I      (4) Br > F > I > Cl

**Answer (3)**

**Sol.** The correct order is

$$F > Cl > Br > I$$

4. Which of the following has maximum size out of  $\text{Al}^{3+}$ ,  $\text{Mg}^{2+}$ ,  $\text{F}^-$ ,  $\text{Na}^+$ ?

- (1)  $\text{Al}^{3+}$       (2)  $\text{Mg}^{2+}$   
(3)  $\text{F}^-$       (4)  $\text{Na}^+$

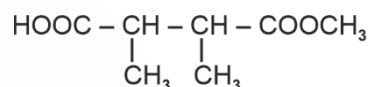
**Answer (3)**

**Sol.** For isoelectronic species, more the negative charge more will be the size, also more the positive charge smaller will be the size.

The correct order of ionic size is :

$$\text{Al}^{3+} < \text{Mg}^{2+} < \text{Na}^+ < \text{F}^-$$

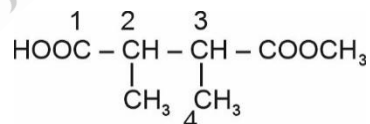
5. The IUPAC name of given specie is



- (1) 2, 3-dimethyl methyl carboxy butanoic acid  
(2) 4-methoxy carbonyl-2, 3-dimethyl propanoic acid  
(3) 3-methoxycarbonyl-2-methyl butanoic acid  
(4) 1-carboxy-2, 3-dimethyl methyl butanoate

**Answer (3)**

**Sol.**



3-methoxycarbonyl-2-methyl butanoic acid

6. Compare crystal field splitting energy ( $\Delta$ ) for given complexes

- (i)  $\text{K}_4[\text{Fe}(\text{CN})_6]$       (ii)  $[\text{Cu}(\text{NH}_3)_4]^{2+}$   
(iii)  $\text{K}_4[\text{Fe}(\text{SCN})_6]$       (iv)  $[\text{Fe}(\text{en})_3]\text{Cl}_3$   
(1) I > II > III > IV      (2) II > I > IV > III  
(3) IV > I > III > II      (4) IV > III > I > II

**Answer (2)**

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**JEE (Advanced) 2024**

**JEE (Main) 2024**

**Karnataka Topper:** Sanvi Jain (AIR 1)

**Telangana Topper:** M Sai Divya Teja Reddy (AIR 15)

**Telangana Topper:** Rishi Shekher Shukla (AIR 19)

**AIR 25:** Rishi Shekher Shukla (2 Year Classroom)

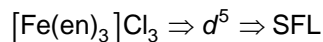
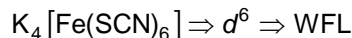
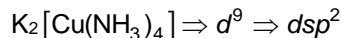
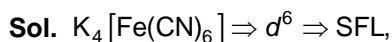
**AIR 67:** Krishna Sai Shishir (2 Year Classroom)

**AIR 78:** Abhishek Jain (2 Year Classroom)

**AIR 93:** Harshik Aggarwal (2 Year Classroom)

**AIR 95:** Ujjwal Singh (2 Year Classroom)

**AIR 98:** Raashit Aggarwal (2 Year Classroom)

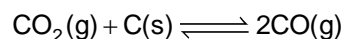


Splitting energy  $\propto$  Strength of ligand  $\propto$  Charge of CA.

$\Delta_{sp} > \Delta_o$

$II > I > IV > III$

7. Consider the given equilibrium reaction

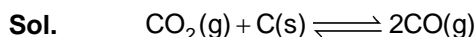


If initial pressure of  $CO_2$  is 0.6 atm and after equilibrium is established, total pressure is 0.8 atm. Then, find  $K_p$ .

(1) 0.4 (2) 0.2

(3) 0.6 (4) 0.8

Answer (1)



$t = 0$  0.6

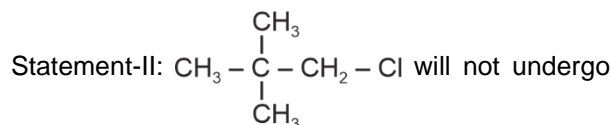
$t = t_{eq}$  0.6 - p 2p

$P_t$  at equilibrium = 0.8 = 0.6 + p

0.2 = p

$K_p = \frac{(p_{CO})^2}{(p_{CO_2})} = \frac{(2p)^2}{0.6 - p} = \frac{4 \times 0.04}{0.6 - 0.2} = \frac{4 \times 0.04}{0.4} = 0.4$

8. Statement-I:  $CH_3 - O - CH_2 - Cl$  will show nucleophilic substitution by  $S_N1$  mechanism in protic medium.



nucleophilic substitution via  $S_N2$  mechanism easily.

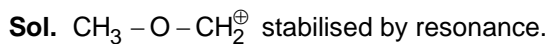
(1) Statement-I and statement-II both are correct

(2) Statement-I and statement-II both are incorrect

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

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

Answer (1)



9. Which of the following acids is also known as vitamin C?

(1) Adipic acid (2) Ascorbic acid

(3) Saccharic acid (4) Aspartic acid

Answer (2)

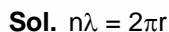
Sol. Ascorbic acid is also known as vitamin C.

10. An electron of  $He^+$  is present in  $3^{rd}$  excited state. Find its de-Broglie wavelength.

(1) 6.64 Å (2) 1.66 Å

(3) 3.32 Å (4) 13.28 Å

Answer (1)



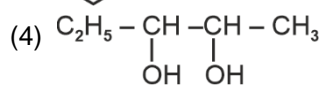
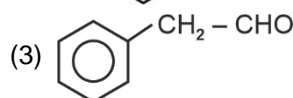
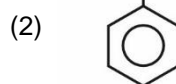
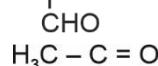
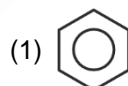
For  $3^{rd}$  excited state,  $n = 4$

$4\lambda = 2 \times \pi \times a_0 \frac{n^2}{Z}$

$4\lambda = 2 \times \pi \times 0.529 \frac{16}{2} \text{ Å}$

$\lambda = 2 \times 3.14 \times 0.529 \times 2 \text{ Å} = 6.64 \text{ Å}$

11. Which of the following will show positive Fehling test?



Answer (3)

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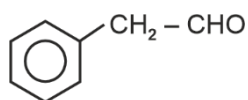
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**Sol.** Fehling test is given by Aldehydes except benzaldehyde

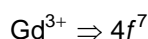


will give +ve Fehling test

12.  $4f^7$  configuration is possible for  
 (a)  $\text{Eu}^{3+}$ , (b)  $\text{Eu}^{2+}$ , (c)  $\text{Gd}^{3+}$ , (d)  $\text{Tb}^{3+}$ , (e)  $\text{Sm}^{2+}$   
 (1) (a) and (c)  
 (2) (b) and (c)  
 (3) (d) and (e)  
 (4) Only (c)

**Answer (2)**

**Sol.** Electronic configuration of:



13. Given :  $\text{NH}_2\text{COONH}_4(\text{s}) \rightleftharpoons 2\text{NH}_3(\text{g}) + \text{CO}_2(\text{g})$   
 If the partial pressure of  $\text{CO}_2$  gas at equilibrium is 0.4 atm and the total pressure is 1 atm, then the value of  $K_p$  at the same temperature is  
 (1) 0.027  $\text{atm}^3$   
 (2) 0.064  $\text{atm}^3$   
 (3) 0.144  $\text{atm}^3$   
 (4) 0.216  $\text{atm}^3$

**Answer (3)**

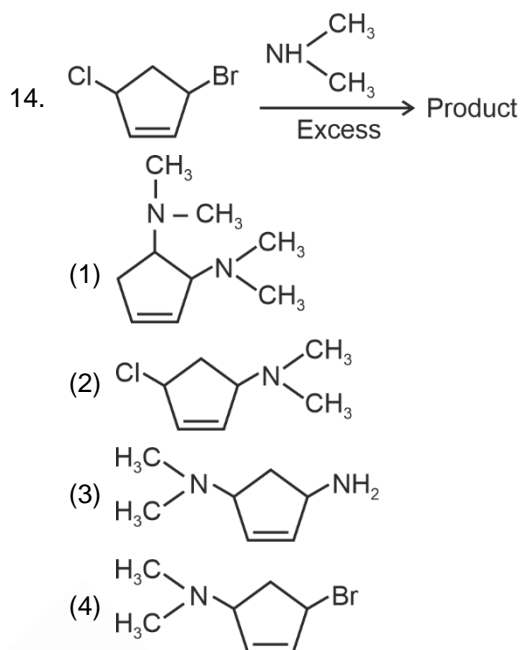
**Sol.**  $\text{NH}_2\text{COONH}_4(\text{s}) \rightleftharpoons 2\text{NH}_3(\text{g}) + \text{CO}_2(\text{g})$

Total pressure at equilibrium = 1.0 atm

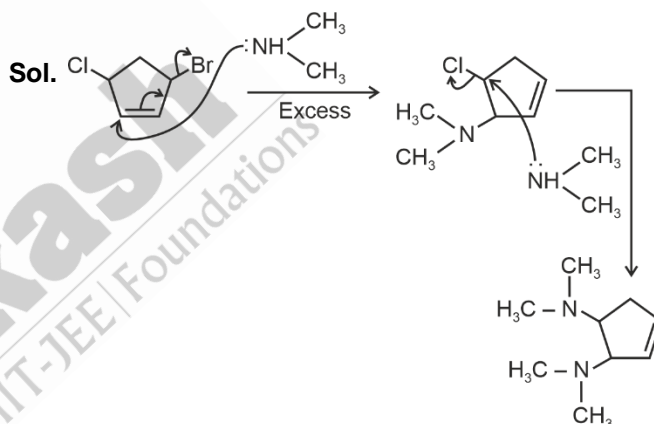
Partial pressure of  $\text{CO}_2$  at equilibrium = 0.4 atm

$\therefore$  Partial pressure of  $\text{NH}_3$  at equilibrium = 0.6 atm

$$\begin{aligned} K_p &= (p_{\text{NH}_3})^2 (p_{\text{CO}_2}) \\ &= (0.6)^2 (0.4) \\ &= 0.144 \text{ atm}^3 \end{aligned}$$



**Answer (1)**



15.  $\text{CO}_2$  gas is taken at 1 atm, 273K. Now it is allowed to pass through 0.1 M  $\text{Ca}(\text{OH})_2$  aq. solution. Excess amount of  $\text{Ca}(\text{OH})_2$  is neutralised with 40 mL of 0.1 M HCl. Then find volume of  $\text{Ca}(\text{OH})_2$  initially taken if 50%  $\text{Ca}(\text{OH})_2$  is react with  $\text{CO}_2$   
 (1) 40 mL  
 (2) 20 mL  
 (3) 80 mL  
 (4) 50 mL

**Answer (1)**

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Sol. g meq of  $\text{Ca}(\text{OH})_2 = 2 \times \text{gm eq of HCl}$

$$0.1 \times \frac{V_{\text{mL}}}{1000} \times 2 = 2 \times 0.1 \times \frac{40}{1000} \times 1$$

$$V_{\text{mL}} = 40 \text{ mL}$$

16. In a closed insulated container, a liquid is stirred with a paddle to increase the temperature, which of the following is true?

- (1)  $w = 0, \Delta E = q \neq 0$     (2)  $\Delta E = w \neq 0, q = 0$   
 (3)  $\Delta E = w = 0, q \neq 0$     (4)  $\Delta E = 0, w = q \neq 0$

Answer (2)

Sol. In closed insulated container a liquid stirred with a paddle to increase the temperature, it behaves as an adiabatic container,  $q = 0$

From FLOT

$$\Delta U = q + w; q = 0$$

$$\Delta E = w \text{ (but not zero)}$$

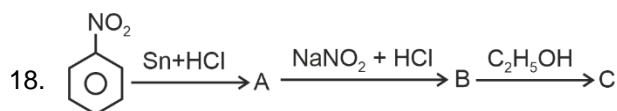
17. Match the column and choose the correct option

	Column-I (Properties)		Column-II (Order)
(A)	Electronegativity	(1)	$B < C < N < O$
(B)	Cationic size	(2)	$\text{Li} > \text{Mg} > \text{Be}$
(C)	Metallic Character	(3)	$\text{K} > \text{Mg} > \text{Al}$
(D)	Electron affinity	(4)	$\text{Cl} > \text{F} > \text{Br} > \text{I}$

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

Answer (1)

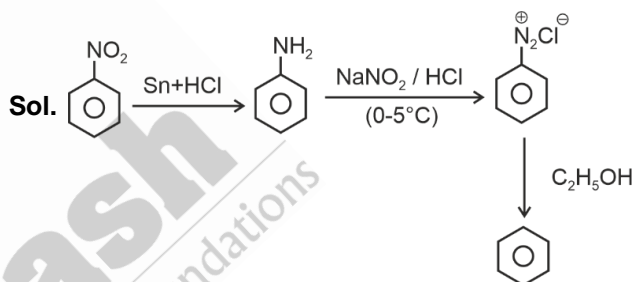
Sol.  $\text{Li}^+ > \text{Mg}^{2+} > \text{Be}^{2+}$   
 $\downarrow \quad \downarrow \quad \downarrow$   
 76 pm    72 pm    31 pm



Identify C.

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

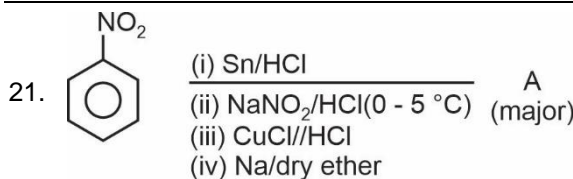
Answer (1)



19.  
20.

SECTION - B

**Numerical Value Type Questions:** This section contains 5 Numerical based questions. The answer to each question should be rounded-off to the nearest integer.



Find molecular weight of (A) in  $\text{g mol}^{-1}$

Answer (154)

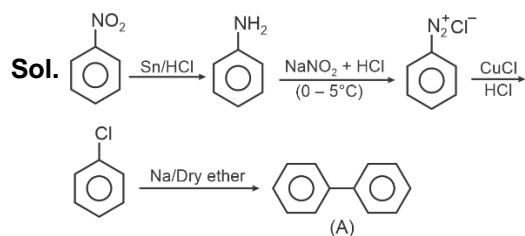
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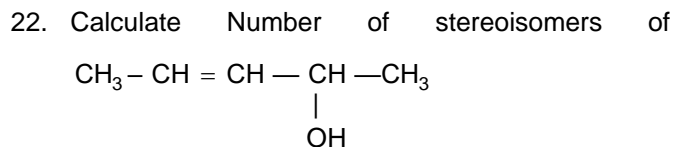
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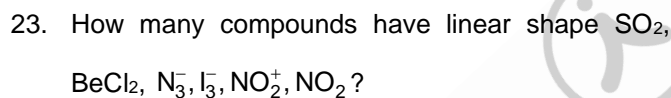
Molecular weight of (A) =  $154 \text{ g mol}^{-1}$



**Answer (4)**

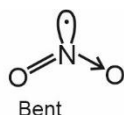
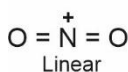
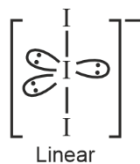
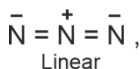
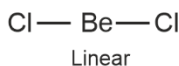
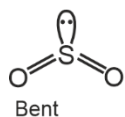
**Sol.** Number of centres which can show stereoisomerism in molecule = 2

Number of isomers =  $2^2 = 4$



**Answer (4)**

**Sol.**



24. In Carius method 180 mg of organic compound gives 143.5 mg of  $\text{AgCl}$ . Find the percentage of Cl in the organic compound. (Nearest integer)

**Answer (20)**

**Sol.** Mass of organic compound = 180 mg

Mass of  $\text{AgCl}$  = 143.5 mg

$$\text{Mass of Cl} = \frac{143.5}{143.5} \times 35.5 \text{ mg} = 35.5 \text{ mg}$$

Percentage of Cl in the organic compound

$$= \frac{35.5 \times 100}{180} = 19.72\% \approx 20\%$$

25. Two ampere current is allowed to pass through molten  $\text{AlCl}_3$  for 30 min. Find the mass (in mg) of aluminium deposited at cathode. (Nearest integer)

**Answer (336)**

**Sol.** Total charge passed =  $2 \times 30 \times 60 \text{ C}$

$$\text{Number of Faradays passed} = \frac{2 \times 30 \times 60}{96500} \text{ F}$$

$$\text{Equivalents of Al deposited} = \frac{36}{965}$$

$$\begin{aligned} \text{Mass of Al deposited} &= \frac{36 \times 9}{965} \text{ g} \\ &= \frac{36 \times 9 \times 1000}{965} \text{ mg} \\ &= 335.75 \text{ mg} \\ &\approx 336 \text{ mg} \end{aligned}$$

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**MATHEMATICS**

**SECTION - A**

**Multiple Choice Questions:** This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

**Choose the correct answer :**

1. The shortest distance between the lines

$$\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-1}{4} \text{ and}$$

$$\frac{x+2}{7} = \frac{y-2}{8} = \frac{z+1}{2} \text{ is}$$

- (1)  $\frac{88}{\sqrt{1277}}$                       (2)  $\frac{78}{\sqrt{1277}}$   
 (3)  $\frac{66}{\sqrt{1277}}$                       (4)  $\frac{55}{\sqrt{1277}}$

**Answer (1)**

**Sol.**  $d = \frac{|(a_2 - a_1) \cdot (b_1 \times b_2)|}{|b_1 \times b_2|}$

$$b_1 \times b_2 = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 3 & 4 \\ 7 & 8 & 2 \end{vmatrix}$$

$$= -26\hat{i} + 24\hat{j} - 5\hat{k}, \quad a_2 - a_1 = 3\hat{i} + 2\hat{k}$$

$$d = \frac{|(3\hat{i} + 2\hat{k}) \cdot (-26\hat{i} + 24\hat{j} - 5\hat{k})|}{\sqrt{26^2 + 24^2 + 5^2}}$$

$$= \frac{|-78 - 10|}{\sqrt{1277}} = \frac{88}{\sqrt{1277}}$$

2. In a bag there are 6 white and 4 black balls two balls are drawn at random, then the probability that both ball are white are

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

**Answer (2)**

**Sol.**  $P(E) = \frac{{}^6C_2}{{}^{10}C_2}$   
 $= \frac{15}{45} = \frac{1}{3}$

3. Let  $A = \{1, 2, 3\}$  number of non-empty equivalence relations from  $A$  to  $A$  are

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

**Answer (2)**

**Sol.** The partitions for a set with 3 elements,  $\{1, 2, 3\}$

- $\{\{1\}, \{2\}, \{3\}\}$  – Every element is in its own subset
- $\{\{1, 2\}, \{3\}\}$  – Two elements are together, one separate
- $\{\{1, 3\}, \{2\}\}$  – Two elements are together, one separate
- $\{\{2, 3\}, \{1\}\}$  – Two elements are together, one separate
- $\{\{1, 2, 3\}\}$  – All elements are together in one subset

$\therefore$  Therefore, total possible equivalence relation = 5

4. If  $f(x) = 16(\sec^{-1} x)^2 + (\operatorname{cosec}^{-1} x)^2$ . Then the maximum and minimum value of  $f(x)$  is

- (1)  $\frac{1001\pi^2}{33}$  and  $\frac{2\pi^2}{9}$                       (2)  $\frac{1105\pi^2}{68}$  and  $\frac{4\pi^2}{17}$   
 (3)  $\frac{1117\pi^2}{59}$  and  $\frac{6\pi^2}{19}$                       (4)  $\frac{1268\pi^2}{27}$  and  $\frac{3\pi^2}{16}$

**Answer (2)**

**Sol.**  $f(x) = (4 \sec^{-1} x)^2 + (\operatorname{cosec}^{-1} x)^2$   
 $= (4 \sec^{-1} x + \operatorname{cosec}^{-1} x)^2 - 8 \sec^{-1} x \operatorname{cosec}^{-1} x$   
 $= \left( 3 \sec^{-1} x + \frac{\pi}{2} \right)^2 - 8 \sec^{-1} x \left[ \frac{\pi}{2} - \sec^{-1} x \right]$

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7. Let  $T_r = \frac{(2r-1)(2r+1)(2r+3)(2r+5)}{64}$ , then

$\lim_{n \rightarrow \infty} \sum_{r=1}^n \frac{1}{T_r}$  is equal to

- (1)  $\frac{22}{45}$  (2)  $\frac{32}{35}$   
 (3)  $\frac{27}{45}$  (4)  $\frac{32}{45}$

Answer (4)

Sol.  $T_r = \frac{(2r-1)(2r+1)(2r+3)(2r+5)}{64}$

$$\Rightarrow \frac{1}{T_r} = \frac{64}{16 \left(r - \frac{1}{2}\right) \left(r + \frac{1}{2}\right) \left(r + \frac{3}{2}\right) \left(r + \frac{5}{2}\right)}$$

$$\Rightarrow \frac{1}{T_r} = \frac{\frac{4}{3} \left[ \left(r + \frac{5}{2}\right) - \left(r - \frac{1}{2}\right) \right]}{\left(r - \frac{1}{2}\right) \left(r + \frac{1}{2}\right) \left(r + \frac{3}{2}\right) \left(r + \frac{5}{2}\right)}$$

$$\Rightarrow \frac{1}{T_r} = \frac{4}{3} \left[ \frac{1}{\left(r - \frac{1}{2}\right) \left(r + \frac{1}{2}\right) \left(r - \frac{3}{2}\right)} - \frac{1}{\left(r + \frac{1}{2}\right) \left(r + \frac{3}{2}\right) \left(r + \frac{5}{2}\right)} \right]$$

$$\lim_{n \rightarrow \infty} \sum_{r=1}^n \frac{1}{T_r} = \frac{4}{3} \left[ \frac{1}{\frac{1}{2} \cdot \frac{3}{2} \cdot \frac{5}{2}} - \frac{1}{\frac{3}{2} \cdot \frac{5}{2} \cdot \frac{7}{2}} \right]$$

$$= \frac{4}{3} \left[ \frac{8}{15} \right] = \frac{32}{45}$$

8. Coefficient of  $x^{2012}$  in  $(1-x)^{2008} (1+x+x^2)^{2007}$

- (1) 0 (2) 1  
 (3) 2 (4) 3

Answer (1)

Sol.  $(1-x) [(1-x)(1+x+x^2)]^{2007}$

$$= (1-x)(1-x^3)^{2007}$$

$$= (1-x^3)^{2007} - x(1-x^3)^{2007}$$

$[(1-x^3)^{2007}$  contains  $3\lambda$  types of exponents while  $x(1-x^3)^{2007}$  will have  $(3\lambda+1)$  type while 2012 is  $(3\lambda+2)$  type] that is not possible  $\Rightarrow 0$

Coefficient of  $x^{2012}$  in  $(1-x^3)^{2007} = 0$

Coefficient of  $x^{2011}$  in  $(1-x^3)^{2007} = 0$

$\Rightarrow$  Coefficient of  $x^{2012}$  in  $(1-x)^{2008} (1+x+x^2)^{2007} = 0$

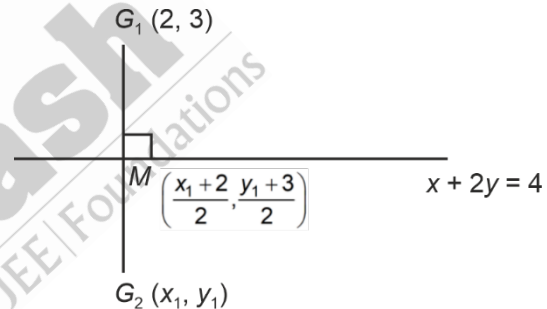
9. If the images of the points  $A(1, 3)$ ,  $B(3, 1)$  and  $C(2, 4)$  in the line  $x+2y=4$  are  $D$ ,  $E$  and  $F$  respectively, then the centroid of the triangle  $DEF$  is

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

Answer (3)

Sol. Centroid of the  $\triangle DEF$  is the mirror image of the centroid of the  $\triangle ABC$  about the line  $x+2y=4$ .

$G_1 =$  Centroid of  $\triangle ABC \equiv (2, 3)$ ,  $G_2 \equiv$  Centroid of  $\triangle DEF$ .



$$\Rightarrow \frac{y_1 - 3}{x_1 - 2} = 2, \quad \frac{x_1 + 2}{2} + (y_1 + 3) = 4$$

$$\Rightarrow x_1 = \frac{2}{5}, y_1 = -\frac{1}{5}$$

$$\Rightarrow G_2 = \left(\frac{2}{5}, -\frac{1}{5}\right)$$

10. If  $A = \{1, 2, 3, \dots, 10\}$ .

$$B = \left\{ \frac{m}{n}, m, n \in A \text{ and } m < n \text{ and } \text{gcd of } (m, n) = 1 \right\}.$$

Then number of elements in set  $B$  is

- (1) 30 (2) 31  
 (3) 28 (4) 29

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**JEE (Main) 2024**

<b>100 PERCENTILE</b> <b>AIR 1</b> Sarvi Jain 2 Year Classroom	<b>100 PERCENTILE</b> <b>AIR 15</b> M Sai Divya Tuja Reddy 2 Year Classroom	<b>100 PERCENTILE</b> <b>AIR 19</b> Rishi Shekher Shukla 2 Year Classroom
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16. Let the parabola  $y = x^2 + px - 3$  cuts the coordinate axes at  $P$ ,  $Q$  and  $R$ . A circle with centre  $(-1, -1)$  passes through  $P$ ,  $Q$  and  $R$ , then the area of triangle  $PQR$ .

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

**Answer (2)**

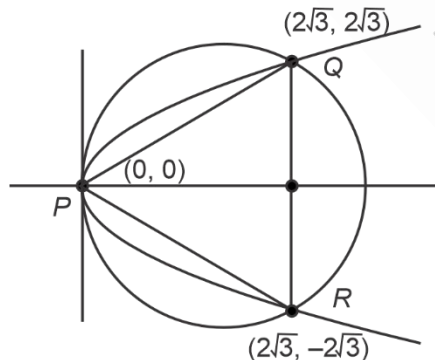
**Sol.** Since at  $x = 0, y = -3$ , parabola cuts the coordinate  $y$ -axis at  $(0, -3)$   
 $\Rightarrow$  Equation of circle will be  
 $(x + 1)^2 + (y + 1)^2 = (-1 - 0)^2 + (-1 + 3)^2$   
 $= 1 + 4 = 5$   
 $x^2 + 2x + y^2 + 2y = -3 = 0$   
 Circle cuts  $x$ -axis at  $y = 0$   
 $\Rightarrow x^2 + 2x - 3 = 0, (x + 3)(x - 1) = 0$   
 $\Rightarrow (-3, 0), (1, 0)$   
 $\Rightarrow$  Area of  $\Delta$   
 $\Rightarrow \frac{1}{2} \begin{vmatrix} -3 & 0 & 1 \\ 0 & -3 & 0 \\ 1 & 0 & 0 \end{vmatrix} = \frac{1}{2}(3) = \frac{3}{2}$

17. If the circle  $(x - 2\sqrt{3})^2 + y^2 = 12$  and parabola  $y^2 = 2\sqrt{3}x$  intersects at  $P$ ,  $Q$  and  $R$ . Then the area of triangle  $PQR$  is

- (1) 10 sq. units                      (2) 12 sq. units  
(3) 14 sq. units                      (4) 16 sq. units

**Answer (2)**

**Sol.** Simply solving both we get  $x = 0, 2\sqrt{3}$



$$\Delta PQR = \frac{1}{2} \times (4\sqrt{3})(2\sqrt{3})$$

18. A hyperbola with foci  $(1, 14)$  and  $(1, -12)$  passes through the point  $(1, 6)$ . The length of the latus rectum of the hyperbola is

- (1)  $\frac{144}{5}$   
(2) 50  
(3)  $\frac{288}{5}$   
(4) 100

**Answer (3)**

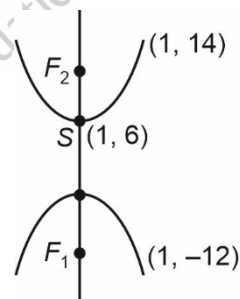
**Sol.**  $|sp - s'p| = 2a, ss' = 2ae$

$$s(1, 14), s'(1, -12), P(1, 6)$$

$$\Rightarrow 2a = |8 - 18|$$

$$\Rightarrow a = 5; 2ae = 26$$

$$\Rightarrow ae = 13$$



$$\begin{aligned} \text{Length of latus rectum} &= \frac{2b^2}{a} = \frac{2a^2(e^2 - 1)}{a} \\ &= \frac{2(169 - 25)}{5} = \frac{288}{5} \end{aligned}$$

19.

20.

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**SECTION - B**

**Numerical Value Type Questions:** This section contains 5 Numerical based questions. The answer to each question should be rounded-off to the nearest integer.

21. If  $A$  be a  $3 \times 3$  square matrix such that  $\det(A) = -2$ . If  $\det(3 \operatorname{adj}(-6 \operatorname{adj}(3A))) = 2^n \cdot 3^m$ , where  $m \geq n$ , then  $4m + 2n$  is equal to

**Answer (104)**

**Sol.** Concept:  $A. \operatorname{adj}(A) = |A|I$ ,  $\det(\lambda A) = \lambda^n \det(A)$

$$\Rightarrow \det(A) = |A|^{n-1}, \text{ where } n \text{ is order}$$

$$\Rightarrow \det(3 \operatorname{adj}(-6 \operatorname{adj}(3A)))$$

$$= 3^3 \cdot \det(\operatorname{adj}(-6 \operatorname{adj}(3A)))$$

$$= 3^3 \cdot (-6 \operatorname{adj}(3A))^2$$

$$= 3^3 \cdot (-6)^6 |3A|^4$$

$$= 3^9 \cdot 2^6 \cdot 3^{12} \cdot (-2)^4$$

$$= 3^{21} \cdot 2^{10}$$

$$\therefore n = 10, m = 21$$

$$\therefore 4m + 2n = 104$$

22. If  $a_1, a_2, a_3, \dots, a_n$  are in geometric progression such that  $a_1 a_5 = 28$ ,  $a_2 + a_4 = 29$ , then the value of  $a_6$  is

(1) 635

(2) 784

(3) 872

(4) 898

**Answer (2)**

**Sol.**  $a_1 a_5 = 28 \Rightarrow a^2 r^4 = 28$

$$a_2 + a_4 = 29 \Rightarrow ar + ar^3 = 29$$

$$ar, ar^3 \text{ are roots of } k^2 - 29k + 28 = 0$$

$$\Rightarrow k = 1, k = 28$$

$$\Rightarrow ar = 1, ar^3 = 28$$

$$\Rightarrow r^2 = 28, a^2 = \frac{1}{28}$$

$$a_6 = ar^5 \Rightarrow a_6^2 = a^2 r^{10} = \frac{1}{28} \times (28)^5 = (28)^4$$

$$\Rightarrow a_6 = (28)^2 = 784$$

23.

24.

25.



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22/01/2025

Evening



# Aakash

Medical | IIT-JEE | Foundations

Corporate Office : AESL, 3rd Floor, Incuspaze Campus-2, Plot-13, Sector-18, Udyog Vihar,  
Gurugram, Haryana-122018

## Memory Based Answers & Solutions

Time : 3 hrs.

for

M.M. : 300

## JEE (Main)-2025 (Online) Phase-1

(Physics, Chemistry and Mathematics)

### 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.

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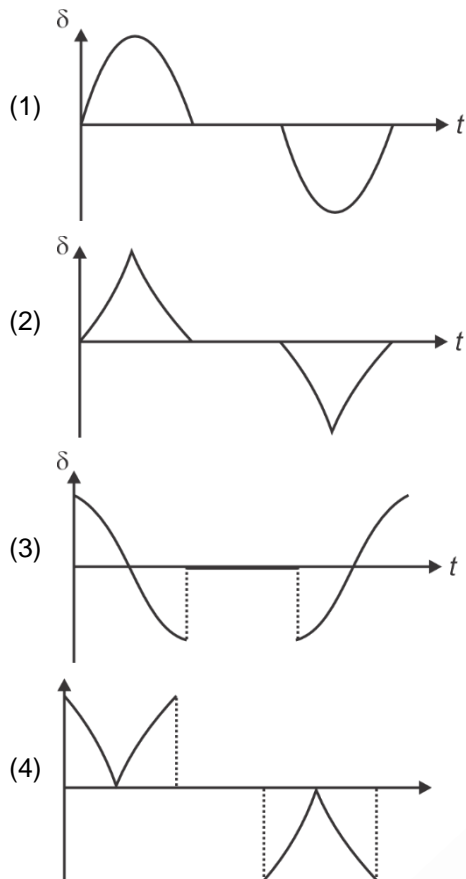
**JEE (Advanced) 2024**

AIR	Name	Classroom
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67	Krishna Sai Shishir	2 Year Classroom
78	Abhishek Jain	2 Year Classroom
93	Hardik Aggarwal	2 Year Classroom
95	Ujjwal Singh	2 Year Classroom
98	Rachit Aggarwal	2 Year Classroom

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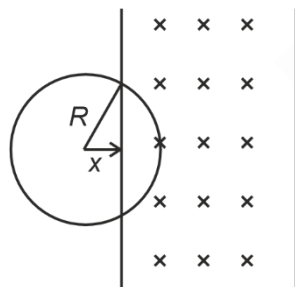
AIR	Name	Classroom	State
1	Sarvvi Jais	2 Year Classroom	Karnataka
15	M Sai Divya Tuja Reddy	2 Year Classroom	Telangana
19	Rishi Shekher Shukla	2 Year Classroom	Telangana





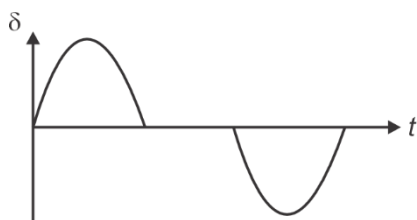
Answer (1)

Sol.



$$\delta = 2Bv\sqrt{R^2 - x^2} \text{ (Equation of an ellipse)}$$

$$x = R - vt$$



6. The displacement of a particle moving under the action of a force  $\vec{F} = 2\hat{i} + b\hat{j} + \hat{k}$  is  $\vec{d} = \hat{i} + \hat{j} + \hat{k}$ . Find the value of  $b$  if the work done by the force is zero.

- (1) 0
- (2) +3
- (3) -3
- (4) -1

Answer (3)

Sol. Work =  $\vec{F} \cdot \vec{s} = (2\hat{i} + b\hat{j} + \hat{k}) \cdot (\hat{i} + \hat{j} + \hat{k})$   
 $= 2 + 1 + 1 = 3 + b = 0$   
 $\Rightarrow b = -3$

7. In a series LCR circuit the maximum amplitude of current is  $I_0$  when the resistance is  $R$ . What is the maximum amplitude of current if the resistor is replaced by a resistor of resistance  $\frac{R}{2}$ .

- (1)  $I_0$
- (2)  $2I_0$
- (3)  $\frac{I_0}{2}$
- (4)  $\frac{2I_0}{3}$

Answer (2)

Sol. Current has maximum amplitude at resonance.

$$I_0 = \frac{\xi_0}{R}$$

$$\Rightarrow I_0' = \frac{\xi_0}{R/2} = \frac{2\xi_0}{R} = 2I_0$$

8. **Statement-I** : Fringe width of red light is more than fringe width of violet light.

**Statement-II** : Fringe width is directly proportional to the wavelength of light used.

Choose the correct option.

- (1) Statement-I is correct and statement-II is incorrect
- (2) Both statement-I and statement-II are correct
- (3) Statement-I is incorrect and statement-II is correct
- (4) Both statement-I and statement-II are incorrect

Answer (2)

Sol. Fringe width ( $\beta$ ) =  $\frac{\lambda D}{d}$

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9. For non-vibrating diatomic gas has adiabatic constant of  $\gamma_1$  & for vibrating diatomic gas has adiabatic constant of  $\gamma_2$  then

- (1)  $\gamma_1 > \gamma_2$                       (2)  $\gamma_1 < \gamma_2$   
(3)  $\gamma_1 = \gamma_2$                         (4) None of these

**Answer (1)**

**Sol.**  $\gamma_1 = 1 + \frac{2}{5} = \frac{7}{5} = 1.4$

$\gamma_2 = 1 + \frac{2}{7} = \frac{9}{7} = 1.28$

Therefore  $\gamma_1 > \gamma_2$

10. A force  $\vec{F} = (\hat{i} + 2\hat{j} - 3\hat{k})N$  acts on point whose position vector is given as  $\vec{r} = (2\hat{i} - 3\hat{j} + 7\hat{k})m$ . Find torque about origin.

- (1)  $(+5\hat{i} - 12\hat{j} + 7\hat{k})N.m$   
(2)  $(-5\hat{i} - 12\hat{j} + 8\hat{k})N.m$   
(3)  $(-5\hat{i} + 13\hat{j} + 7\hat{k})N.m$   
(4)  $(-5\hat{i} + 13\hat{j} - 7\hat{k})N.m$

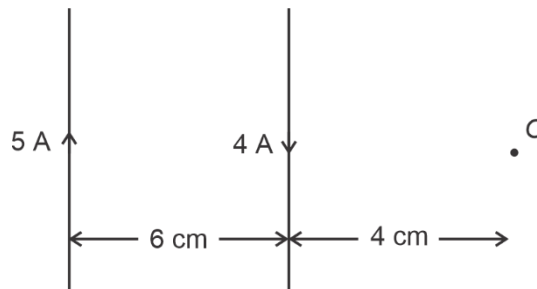
**Answer (3)**

**Sol.**  $\vec{\tau} = \vec{r} \times \vec{F} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & -3 & 7 \\ 1 & 2 & -3 \end{vmatrix}$

$= \hat{i}(9 - 14) - \hat{j}(-6 - 7) + \hat{k}(4 + 3)$

$= (-5\hat{i} + 13\hat{j} + 7\hat{k}) N.m$

11. The net magnetic field at point O due to the two infinite current carrying wires shown in the figure is



- (1)  $1 \times 10^{-5} T$   
(2)  $1.2 \times 10^{-5} T$   
(3)  $1.5 \times 10^{-5} T$   
(4)  $2 \times 10^{-5} T$

**Answer (1)**

**Sol.**  $B_{\text{net}} = \left| \frac{\mu_0 (5 A)}{2\pi(10 \text{ cm})} - \frac{\mu_0 (4 A)}{2\pi(4 \text{ cm})} \right|$   
 $= \frac{25\mu_0}{\pi} = 10^{-5} T$

12. Read the statements and select the correct option.

Statement I : A pendulum is taken from Earth to another planet having mass four times and radius double than earth, then time period of pendulum remain same as on earth.

Statement II : The time period of pendulum only depends on the gravity of the planet.

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

**Answer (1)**

**Sol.** On earth  $T = 2\pi\sqrt{\frac{l}{g}}$

On other planet,  $g' = \frac{G(4M)}{(2R)^2} = g$

So, time period will remain same and her T depends on g as well as l.

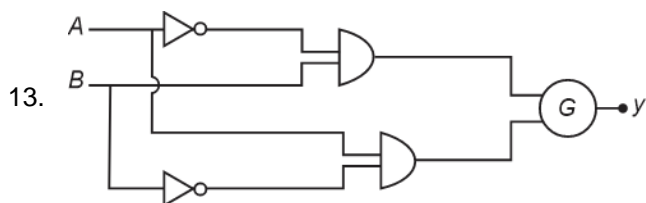
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**JEE (Main) 2024**

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For a given logic circuit truth table is given identify the gate G.

A	B	y
0	0	1
1	0	0
0	1	0
1	1	1

- (1) AND (2) NOR  
(3) NAND (4) OR

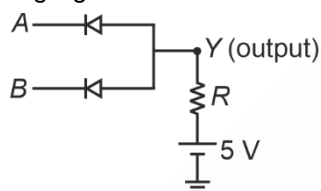
**Answer (2)**

**Sol.** From truth table we know its XNOR gate

i.e.  $y = \overline{AB} + A\overline{B}$

therefore gate G must be NOR gate.

14. Name the logic gate



- (1) OR (2) AND  
(3) NOT (4) NAND

**Answer (2)**

**Sol.** If both A and B are high only then Y is high, otherwise Y is low.

∴ AND Gate.

15. Displacement current in capacitor of area 16 cm<sup>2</sup> is 6 A at an instant. Find displacement current across area 3.2 cm<sup>2</sup>



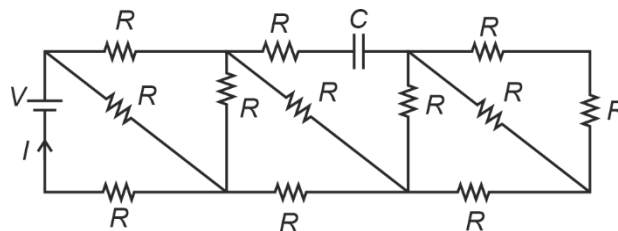
- (1) 1.2 A (2) 1.6 A  
(3) 2.1 A (4) 0.5 A

**Answer (1)**

**Sol.**  $id = \epsilon_0 \frac{d\phi_E}{dt} = \epsilon_0 A \frac{dE}{dt} \Rightarrow id \propto A$

$\Rightarrow i' = \left(\frac{3.2}{16}\right) id$   
 $= 1.2 A$

16. In the RC circuit shown, find I.



- (1)  $\frac{V}{5R}$  (2)  $\frac{5V}{3R}$   
(3)  $\frac{8V}{13R}$  (4)  $\frac{3V}{R}$

**Answer (3)**

**Sol.** At steady state, C behaves as open-circuit

$R_{eq} = \frac{13}{8} R$   
 $I = \frac{V}{R_{eq}} = \frac{8V}{13R}$

17. A glass slab of refractive index  $\mu_g = 1.44$  is coated with a thin film of refractive index  $\mu_f = 2$ . The minimum thickness of the film so that maximum transmission of green light of wavelength  $\lambda = 5000 \text{ \AA}$  (incident normally) takes place is

- (1) 0.500  $\mu\text{m}$  (2) 0.250  $\mu\text{m}$   
(3) 0.125  $\mu\text{m}$  (4) 1.00  $\mu\text{m}$

**Answer (3)**

**Sol.** For maximum transmission of light incident normally

$2\mu_f t = n\lambda$  (n = 1, 2, 3, ...)

$t_{min} = \frac{\lambda}{2\mu_f} = \frac{5000 \times 10^{-10}}{2(2)} \text{ m} = 0.125 \mu\text{m}$

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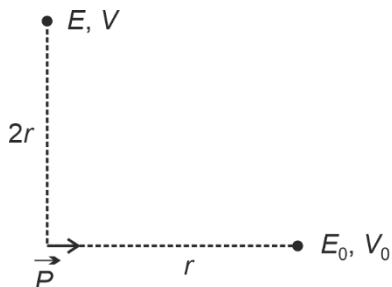
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- AIR 67 Krishna Sai Shishir (2 Year Classroom)
- AIR 78 Abhishek Jain (2 Year Classroom)
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- AIR 95 Ujjwal Singh (2 Year Classroom)
- AIR 98 Rishi Aggarwal (2 Year Classroom)

**JEE (Main) 2024**

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- Telangana Topper: AIR 15 M Sai Divya Tuja Reddy (100 Percentile Score)
- Telangana Topper: AIR 19 Rishi Shekher Shukla (100 Percentile Score)

18. For the electric dipole shown in the figure, the electric field and the electric potential are  $E_0, V_0$  at a distance  $r$  on the axis. Then what is the electric field and the electric potential at a point on the equatorial plane at a distance  $2r$ .



- (1)  $\frac{E_0}{16}, 0$   
 (2)  $\frac{E_0}{4}, 0$   
 (3)  $E_0, V_0$   
 (4)  $\frac{E_0}{8}, 0$

**Answer (1)**

**Sol.**  $E_{\text{axis}} = \frac{2kP}{r^3} = E_0$

$$E_{\text{equatorial}} = \frac{kP}{(2r)^3} = \frac{kP}{8r^3} = \frac{E_0}{16}$$

$$V = \frac{kP \cos \theta}{r^2}$$

$$V_{\text{axis}} = \frac{kP \cos 0^\circ}{r^2} = \frac{kP}{r^2}$$

$$V_{\text{equatorial}} = \frac{kP \cos 90^\circ}{(2r)^3} = 0$$

19.

20.

**SECTION - B**

**Numerical Value Type Questions:** This section contains 5 Numerical based questions. The answer to each question should be rounded-off to the nearest integer.

**Choose the correct answer:**

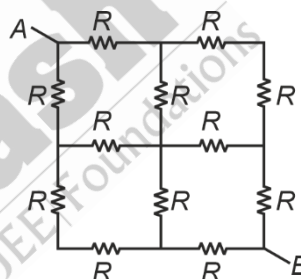
21. A projectile is fired with speed of 20 m/s at angle of  $60^\circ$  with horizontal. The speed at highest point of trajectory is  $x$  m/s then  $x$  is

**Answer (10)**

**Sol.**  $V_H = 4 \cos \theta$

$$= 20 \cos 60^\circ = 10 \text{ m/s}$$

22. If equivalent resistance across AB is  $\frac{NR}{2}$ , find  $N$



**Answer (3)**

**Sol.** Line of symmetry problem

$$R_{\text{eq}} = \frac{3R}{4} \times 2 = \frac{3R}{2}$$

23.

24.

25.

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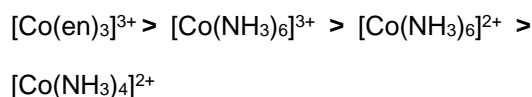


**Sol.** Crystal Field Splitting Energy (CFSE)

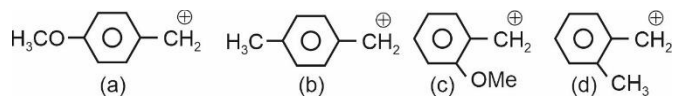
$\propto$  Charge on central metal ion

$\propto$  Ligand field strength

On this basis the correct decreasing order of CFSE



4. What is correct order of stability of carbocation.



- (1)  $a > b > c > d$
- (2)  $c > a > d > b$
- (3)  $a > c > d > b$
- (4)  $c > b > a > d$

**Answer (3)**

**Sol.** Solution stability of  $\text{C}^{\oplus} \propto +M, \text{HC}, +I$

$$\propto \frac{1}{-M, -Z}$$

5. Which of the following anion will not undergo disproportionation?

- (1)  $\text{ClO}_4^-$
- (2)  $\text{ClO}_3^-$
- (3)  $\text{ClO}_2^-$
- (4)  $\text{ClO}^-$

**Answer (1)**

**Sol.** In  $\text{ClO}_4^- \rightarrow$  chlorine is in its highest oxidation state i.e., +7.

Chlorine can exhibit  $-1$  to  $+7$  oxidation state.

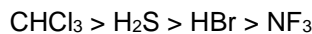
The oxidation states of chlorine which can undergo disproportionation are :  $0, +1, +3$  and  $+5$ .

6. Compare dipole moment of
  - (I)  $\text{NF}_3$
  - (II)  $\text{CHCl}_3$
  - (III)  $\text{H}_2\text{S}$
  - (IV)  $\text{HBr}$
  - (1)  $\text{I} > \text{II} > \text{III} > \text{IV}$
  - (2)  $\text{II} > \text{III} > \text{I} > \text{IV}$
  - (3)  $\text{II} > \text{III} > \text{IV} > \text{I}$
  - (4)  $\text{III} > \text{I} > \text{IV} > \text{II}$

**Answer (3)**

**Sol.**  $\text{NH}_3$      $\text{CHCl}_3$      $\text{H}_2\text{S}$      $\text{HBr}$   
 $\Rightarrow 0.230$      $1.04$      $0.95$      $0.79$

So, order is



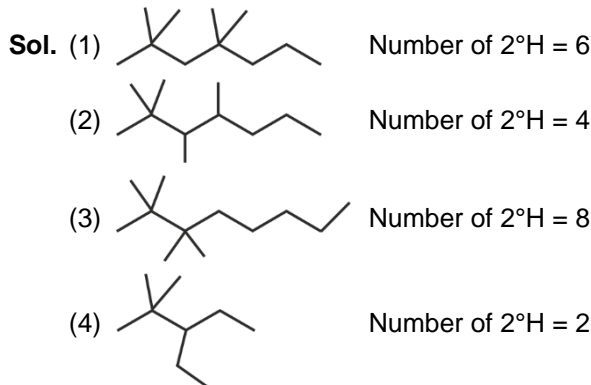
7. Given below are two statements  
 S-I: Lassaigne test is used for detection of Nitrogen, phosphorous, sulphur and Halogens.  
 S-II: Lassaigne extract is made with magnesium metal.  
  - (1) Both S-I and S-II are correct.
  - (2) Both S-I and S-II are incorrect.
  - (3) S-I is correct but S-II is incorrect.
  - (4) S-I is incorrect but S-II is correct

**Answer (3)**

**Sol.** Lassaigne extract is made with sodium metal, and not with magnesium metal.

8. Which one has two secondary Hydrogen atoms?
  - (1) 2, 2, 4, 4-tetramethylheptane
  - (2) 2, 2, 3, 4-tetramethylheptane
  - (3) 2, 2, 3, 3-tetramethyloctane
  - (4) 3-ethyl-2, 2-dimethylpentane

**Answer (4)**



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**JEE (Advanced) 2024**

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**JEE (Main) 2024**

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**Sol.** The E – E bond energies of the elements of group-15 are

N – N	167 kJ mol <sup>-1</sup>
P – P	201 kJ mol <sup>-1</sup>
As – As	146 kJ mol <sup>-1</sup>
Sb – Sb	121 kJ mol <sup>-1</sup>

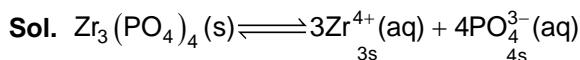
Antimony (Sb) has the weakest E – E bond and its maximum covalency is 5.

14. What is the relation between  $K_{sp}$  and  $S$  of  $Zr_3(PO_4)_4$

$$(1) S = \left(\frac{K_{sp}}{6912}\right)^{\frac{1}{7}} \quad (2) S = \left(\frac{K_{sp}}{144}\right)^{\frac{1}{7}}$$

$$(3) S = \frac{K_{sp}}{6912} \quad (4) \text{None}$$

**Answer (1)**



$$K_{sp} = (3s)^3(4s)^4$$

$$= 27 \times 256 S^7$$

$$K_{sp} = 6912 S^7$$

$$S = \left(\frac{K_{sp}}{6912}\right)^{\frac{1}{7}}$$

15. Match the column and choose the correct option

(A)	$\left(\frac{\partial H}{\partial T}\right)_P$	(P)	$C_P$
(B)	$\left(\frac{\partial G}{\partial P}\right)_T$	(Q)	$C_V$
(C)	$\left(\frac{\partial U}{\partial T}\right)_V$	(R)	$-S$
(D)	$\left(\frac{\partial G}{\partial T}\right)_P$	(S)	$V$

- (1) (A) – (P), (B) – (S), (C) – (Q), (D) – (R)  
 (2) (A) – (P), (B) – (S), (C) – (R), (D) – (Q)  
 (3) (A) – (P), (B) – (R), (C) – (Q), (D) – (S)  
 (4) (A) – (Q), (B) – (S), (C) – (P), (D) – (R)

**Answer (1)**

**Sol.** Heat exchanged at constant pressure is  $\Delta H$

Heat exchanged at constant volume is  $\Delta U$

16. Consider the following statements S-1 and S-2 and choose the correct option.

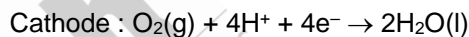
**S-1 :** During corrosion pure metal acts as anode and impure metal acts as cathode.

**S-2 :** Rate of corrosion is more in alkaline medium than in acidic medium.

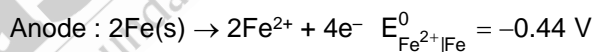
- (1) Both S-1 and S-2 are correct  
 (2) Both S-1 and S-2 are incorrect  
 (3) S-1 is correct but S-2 is incorrect  
 (4) S-1 is incorrect but S-2 is correct

**Answer (2)**

**Sol.** In corrosion, a metal is oxidised by loss of electrons to oxygen. Electron released at anodic spot move through the same metal and go to another spot on the metal and reduce oxygen in the presence of  $H^+$  (which is believed to be available from  $H_2CO_3$  formed due to dissolution of  $CO_2$  from air into water.



$$E^0_{H^+|O_2|H_2O} = 1.23 V$$



$\therefore$  Both the statements S-1 and S-2 are incorrect.

17.  
18.  
19.  
20.

**SECTION - B**

**Numerical Value Type Questions:** This section contains 5 Numerical based questions. The answer to each question should be rounded-off to the nearest integer.

21. In Ru and Nb, if in Ru,  $4d$  electrons are  $x$  and in Nb,  $4d$  electrons are  $y$  then find the sum of  $x$  and  $y$ .

**Answer (11)**

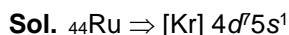
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**JEE (Main) 2024**

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$$x = 7$$



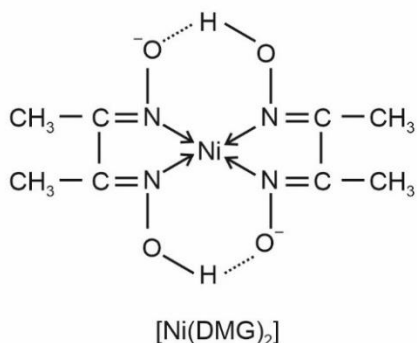
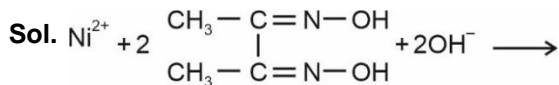
$$y = 4$$

$$x + y = 11$$

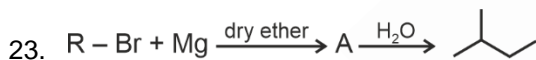


How many hydrogen bonds are present in a molecule of the complex?

**Answer (2)**



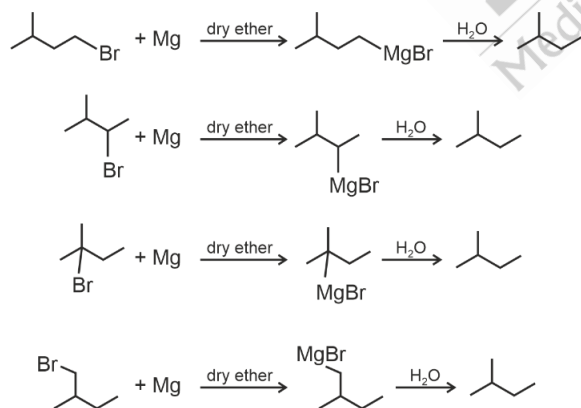
Number of H-bonds in a molecule of [Ni(DMG)<sub>2</sub>]  
= 2



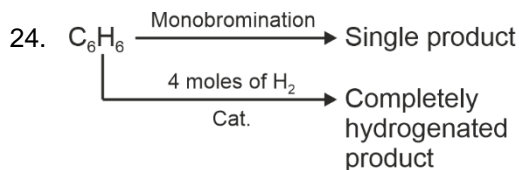
How many R - Br can form isopentane?

**Answer (4)**

Sol.



$\therefore$  Total 4 R-Br can form isopentane in this reaction.

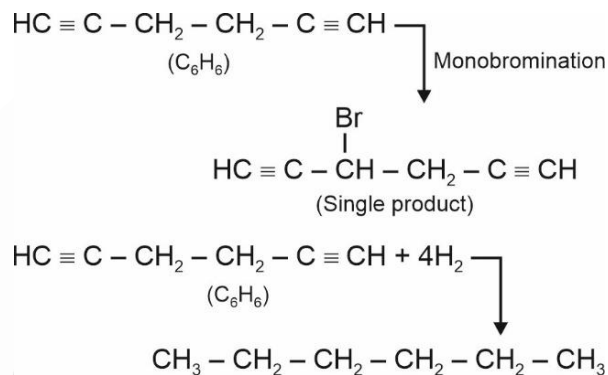


Find the number of  $\pi$ -electrons in  $\text{C}_6\text{H}_6$ .

**Answer (8)**

Sol. Degree of unsaturation of  $\text{C}_6\text{H}_6 = 4$

$\text{C}_6\text{H}_6$  is a symmetrical dialkyne.



Number of  $\pi$ -electrons in  $\text{C}_6\text{H}_6 = 8$

25. Calculate the radius of first excited state of  $\text{He}^+$  ion (in Å)

**Answer (1)**

Sol.  $r = a_0 \frac{n^2}{z}$

$$n = 2$$

$$z = 2$$

$$r = a_0 \frac{4}{2}$$

$$= 2a_0$$

$$= 2 \times 0.529$$

$$= 1.058$$

$$\approx 1$$

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**MATHEMATICS**

**SECTION - A**

**Multiple Choice Questions:** This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

**Choose the correct answer :**

1. If  $2x^2 + (\cos\theta)x - 1 = 0$ ,  $\theta \in [0, 2\pi]$  has roots  $\alpha$  and  $\beta$ . Then the sum of maximum and minimum value of  $\alpha^4 + \beta^4$ .

- (1)  $\frac{25}{16}$
- (2)  $\frac{9}{16}$
- (3)  $\frac{41}{16}$
- (4)  $\frac{8}{17}$

**Answer (1)**

**Sol.**  $\alpha + \beta = \frac{-\cos\theta}{2}$

$\alpha\beta = \frac{-1}{2} \Rightarrow \alpha^2\beta^2 = \frac{1}{4}$

$\Rightarrow \alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta$

$= \frac{\cos^2\theta + 1}{4}$

$\alpha^4 + \beta^4 = (\alpha^2 + \beta^2)^2 - 2\alpha^2\beta^2$

$= \left(\frac{\cos^2\theta + 1}{4}\right)^2 - \frac{1}{2}$

For minimum,  $\cos\theta = 0$

For maximum,  $\cos\theta = 1$

$\Rightarrow \text{Minimum} = 1 - \frac{1}{2} = \frac{1}{2}$

Maximum  $= \frac{25}{16} - \frac{1}{2} = \frac{17}{16}$

$\Rightarrow \text{Sum} = \frac{1}{2} + \frac{17}{16} = \frac{25}{16}$

2. If  $\theta \in [0, 2\pi]$  satisfying the system of equations  $2\sin^2\theta = \cos 2\theta$  and  $2\cos^2\theta = 3\sin\theta$ . Then the sum of all real values of  $\theta$  is

- (1)  $\frac{3\pi}{2}$
- (2)  $\pi$
- (3)  $\frac{\pi}{2}$
- (4)  $\frac{5\pi}{6}$

**Answer (2)**

**Sol.**  $2\sin^2\theta = \cos 2\theta$

$2\cos^2\theta = 3\sin\theta$

$\Rightarrow$  Adding,

$2 = 1 - 2\sin^2\theta + 3\sin\theta$

$\Rightarrow 2\sin^2\theta - 3\sin\theta + 1 = 0$

$2\sin^2\theta - 2\sin\theta - \sin\theta + 1 = 0$

$2\sin\theta(\sin\theta - 1) - 1(\sin\theta - 1) = 0$

$\sin\theta = 1, \frac{1}{2}$  but  $2\sin^2\theta = \cos 2\theta = 2$

but not is not possible

$\Rightarrow \theta = \frac{\pi}{6}, \left(\pi - \frac{\pi}{6}\right)$

$\Rightarrow \text{Sum of all values} = \frac{\pi}{6} + \pi - \frac{\pi}{6} = \pi$

3. Let  $A = \{1, 2, 3, 4\}$  and  $B = \{1, 4, 9, 16\}$ .

If  $f: A \rightarrow B$ , number of many-one functions from  $A$  to  $B$  are

- (1) 24
- (2) 232
- (3) 256
- (4) 252

**Answer (2)**

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10. In the expansion of  $(x + \sqrt{x^3 - 1})^5 + (x - \sqrt{x^3 - 1})^5$ , where  $\alpha$ ,  $\beta$ ,  $\gamma$  and  $\delta$  are the coefficient of  $x$ ,  $x^3$ ,  $x^5$  and  $x^7$  respectively. If  $\alpha u - \beta v = 18$ ,  $\gamma u + \delta v = 20$  then  $u + v$  equal to.

- (1)  $\frac{-14}{15}$                       (2)  $\frac{-13}{15}$   
 (3)  $\frac{-3}{5}$                          (4)  $\frac{-2}{3}$

**Answer (1)**

**Sol.**  $(x + \sqrt{x^3 - 1})^5 + (x - \sqrt{x^3 - 1})^5$

$$\left[ \int_0^3 (x)^5 + \int_1^5 x^4 \sqrt{x^3 - 1} + \int_2^5 x^3 (\sqrt{x^3 - 1})^2 + \dots \right] +$$

$$\left[ \int_0^5 x^5 - \int_1^5 x^4 \sqrt{x^3 - 1} + \int_2^5 x^3 (\sqrt{x^3 - 1})^2 + \dots \right]$$

$$= 2 \left[ x^5 + \int_2^5 x^3 (x^3 - 1) + \int_4^5 x (x^3 - 1)^2 \right]$$

$$= 2[x^5 + 10x^6 - 10x^3 + 5x(x^6 + 1 - 2x^3)]$$

$$= 10x^7 + 20x^6 + 2x^5 - 20x^4 - 20x^3 + 10x$$

Coefficient of  $x = 10 = \alpha$   
 Coefficient of  $x^3 = -20 = \beta$   
 Coefficient of  $x^5 = 2 = \gamma$   
 Coefficient of  $x^7 = 10 = \delta$

$$10u + 20v = 18 \quad \dots(i)$$

$$2u + 10v = 20$$

$$u = \frac{-11}{3}$$

$$v = \frac{41}{15}$$

$$u + v = \frac{41}{15} - \frac{11}{3}$$

$$= \frac{-14}{15}$$

11. Let  $A(6, 8)$ ,  $B(10 \cos \alpha, -10 \sin \alpha)$  and  $C(-10 \sin \alpha, -10 \cos \alpha)$  be 3 points and if orthocentre of the triangle ABC is  $(0, 9)$  then  $100 \sin^2 \alpha$  is equal to

- (1)  $\frac{25}{4}$                               (2) 25  
 (3)  $\frac{15}{4}$                               (4)  $\frac{5}{4}$

**Answer (1)**

**Sol.** Notice, origin is equidistance form A, B and C

$\Rightarrow (0, 0)$  is circumcentre



Since centroid divides orthocentre and circumcentre in 2 : 1 ratio.

$$\Rightarrow \frac{6 + 10 \cos \alpha + (-10 \sin \alpha)}{3} = \frac{2(0) + 1(0)}{3} = 0$$

$$\Rightarrow 15 \sin \alpha - 10 \cos \alpha = 6$$

Alos  $\frac{8 - 10 \sin \alpha - 10 \cos \alpha}{3} = \frac{2(0) + 1(9)}{3} = 3$

$$\Rightarrow 8 - 10 \sin \alpha - 10 \cos \alpha = 9$$

$$10(\sin \alpha + \cos \alpha) = -1$$

$$10(\sin \alpha - \cos \alpha) = -6$$

$$20 \sin \alpha = 5$$

$$10 \sin \alpha = \frac{5}{2}$$

$$100 \sin^2 \alpha = \frac{25}{4}$$

12. If  $z$  be a complex number such that  $|z - 3| \leq 1$ , then the equation of line with largest slope passing through origin and  $z$

- (1)  $x - 2\sqrt{2}y = 0$                       (2)  $x + 2\sqrt{2}y = 0$   
 (3)  $2\sqrt{2}x + y = 0$                       (4)  $2\sqrt{2}x - y = 0$

**Answer (1)**

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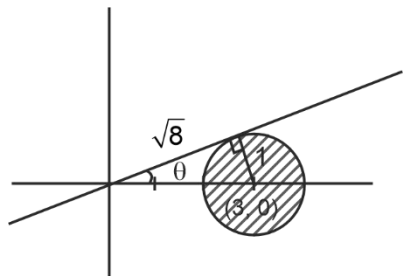
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Sol.



$$\tan\theta = \frac{1}{\sqrt{8}} = \frac{1}{2\sqrt{2}}$$

Therefore, equation of line with maximum slope is

$$(y - 0) = \frac{1}{2\sqrt{2}}(x - 0)$$

$$\Rightarrow y = \frac{x}{2\sqrt{2}}$$

13. A relation  $R$  is defined on set  $A$ ,  $A = \{1, 2, 3\}$  and  $R = \{(1, 2), (2, 3)\}$ . Elements are added such that  $R$  becomes reflexive and transitive but not symmetric. Find the number of such relations.

- (1) 3  
(2) 4  
(3) 2  
(4) 9

**Answer (1)**

**Sol.** Transitivity

$$(1, 2) \in R, (2, 3) \Rightarrow (1, 3) \in R$$

$$(1, 1), (2, 2), (3, 3) \in R$$

$$(2, 1) \quad (3, 2) \quad (3, 1)$$

$(3, 1)$  cannot be taken.

- $(2, 1)$  taken and  $(3, 2)$  not taken.
- $(3, 2)$  taken and  $(2, 1)$  not taken.
- Both not taken.

Therefore 3 relations are possible.

14.  
15.  
16.  
17.  
18.

19.

20.

**SECTION - B**

**Numerical Value Type Questions:** This section contains 5 Numerical based questions. The answer to each question should be rounded-off to the nearest integer.

21. Let  $\vec{a}$  and  $\vec{b}$  be two unit vectors such that angle between  $\vec{a}$  and  $\vec{b}$  is  $\frac{\pi}{3}$ . If  $\lambda\vec{a} + 3\vec{b}$  and  $2\vec{a} + \lambda\vec{b}$  are perpendicular to each other, then the product of all possible values of  $\lambda$  is \_\_\_\_\_

**Answer (6)**

**Sol.**  $|\vec{a}| = 1, |\vec{b}| = 1$

$$\vec{a} \cdot \vec{b} = |\vec{a}| |\vec{b}| \cos \frac{\pi}{3} = \frac{1}{2}$$

$\lambda\vec{a} + 3\vec{b}$  and  $2\vec{a} + \lambda\vec{b}$  are perpendicular

$$\Rightarrow (\lambda\vec{a} + 3\vec{b}) \cdot (2\vec{a} + \lambda\vec{b}) = 0$$

$$\Rightarrow 2\lambda + 3\lambda + (\lambda^2 + 6)\vec{a} \cdot \vec{b} = 0$$

$$\Rightarrow 5\lambda + (\lambda^2 + 6)\left(\frac{1}{2}\right) = 0$$

$$\Rightarrow 10\lambda + \lambda^2 + 6 = 0$$

$$\Rightarrow \lambda^2 + 10\lambda + 6 = 0$$

Product of possible values of  $\lambda = 6$

22. If  $A$  is the  $3 \times 3$  matrix of order  $3 \times 3$ , such that  $\det(A) = \frac{1}{2}$ ,  $\text{tr}(A) = 10$  and  $B$  be another matrix of order  $3 \times 3$  and defined as  $B = \text{adj}(\text{adj}(2A))$ , then  $\det(B) + \text{tr}(B)$  is equal to (where  $\text{tr}(A)$  denotes trace of matrix  $A$ )

**Answer (336)**

**Sol.**  $B = \text{adj}(\text{adj}(2A))$

$$B = |2A|^{n-2} (2A), [\text{Using } \text{adj}(\text{adj } P) = |P|^{n-2} \cdot P],$$

for  $n = 3$

$$= |2A|(2A)$$

$$= 2^3|A|(2A)$$

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Telangana Topper	100 PERCENTILE	AIR 19	Rishi Shekher Shukla 2 Year Classroom

$$= 8 \times \frac{1}{2}(2A)$$

$$= 4(2A)$$

$$B = 8A$$

$$|B| = |8A|$$

$$= 8^3|A|$$

$$|B| = 8^3 \times \frac{1}{2} = 256$$

$$B = 8A$$

[each element is multiplied 8 times]

$$\text{tr}(B) = 8\text{tr}(A)$$

$$= 80$$

$$|B| + \text{tr}(B) = 256 + 80$$

$$= 336$$

23. Consider two curves  $E_1: \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$  with eccentricity  $e_1$  and  $E_2: \frac{x^2}{A^2} + \frac{y^2}{B^2} = 1$  with eccentricity  $e_2$ . If  $\frac{e_1}{e_2} = \frac{1}{3}$  and distance between foci of both curves is  $2\sqrt{3}$  and  $a - A = 4$ , then the sum of lengths of latus rectum of both curves is

**Answer (12)**

**Sol.** Since, distance between foci

for  $E_1 = 2ae_1$ , for  $E_2 = 2Ae_2$

$$\Rightarrow 2ae_1 = 2\sqrt{3} = 2Ae_2$$

$$\Rightarrow ae_1 = Ae_2$$

$$\Rightarrow \frac{e_1}{e_2} = \frac{A}{a} = \frac{1}{3} \Rightarrow a = 3A$$

$$\text{Also } a - A = 4 \Rightarrow A = 2, a = 6$$

$$\text{Now, } 2(6)e_1 = 2\sqrt{3} \Rightarrow e_1 = \frac{\sqrt{3}}{6}$$

$$2(2)e_2 = 2\sqrt{3} \Rightarrow e_2 = \frac{\sqrt{3}}{2}$$

$$e_1^2 = \frac{1-b^2}{a^2} = \frac{3}{36} = \frac{1-b^2}{36} \Rightarrow \frac{b^2}{36} = \frac{33}{36}$$

$$b^2 = 33$$

$$e_2^2 = \frac{1-B^2}{A^2} = \frac{3}{4} = \frac{1-B^2}{4} \Rightarrow B^2 = 1$$

$$\text{Length of latus rectum of } E_1 = \frac{2b^2}{a}$$

$$\text{Length of latus rectum of } E_2 = \frac{2B^2}{A}$$

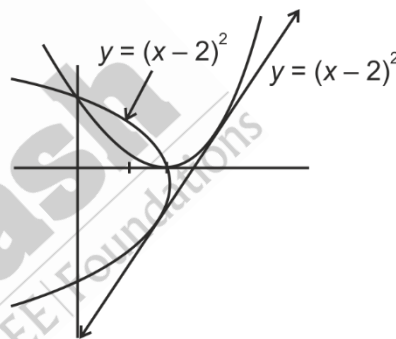
$\Rightarrow$  Sum of lengths of latus rectum

$$= \frac{2(33)}{6} + \frac{2(1)}{2} = 11 + 1 = 12$$

24. The number of maximum number of common tangents to the curves  $y = (x - 2)^2$  and  $y^2 = 16 - 8x$  is

**Answer (1)**

**Sol.**



Clearly, one tangent is possible. Based on the graphs of these parabola.

25. Let  $P(10, -2, -1)$  and  $Q$  be the point of perpendicular drawn from point  $R(1, 7, 6)$  on the line joining the points  $(2, -5, 11)$  and  $(-6, 7, -5)$ . Then the length  $PQ$  is

**Answer (13)**

$$\text{Sol. } L_1: \frac{x-2}{8} = \frac{y+5}{-12} = \frac{z-11}{16}$$

$$L_1: \frac{x-2}{2} = \frac{y+5}{-3} = \frac{z-11}{4}$$

**Delivering Champions Consistently**

JEE (Advanced) 2024						JEE (Main) 2024		
AIR 25	AIR 67	AIR 78	AIR 93	AIR 95	AIR 98	100 Percentile Rank	100 Percentile Rank	100 Percentile Rank
2 Year Classroom	2 Year Classroom	2 Year Classroom	2 Year Classroom	2 Year Classroom	2 Year Classroom	1 Year Classroom	2 Year Classroom	2 Year Classroom

Avg point of  $L_1$  be  $A(2\lambda + 2, -3\lambda - 5, 4\lambda + 11)$

$R(1, 7, 6)$

$$RA \cdot (2\hat{i} - 3\hat{j} + 4\hat{k}) = 0$$

$$((2\lambda + 1)\hat{i} + (-3\lambda - 12)\hat{j} + (4\lambda + 5)\hat{k}) \cdot (2\hat{i} - 3\hat{j} + 4\hat{k}) = 0$$

$$4\lambda + 2 + 9\lambda + 36 + 16\lambda + 20 = 0$$

$$29\lambda = -58$$

$$\lambda = -2$$

$\therefore$  Foot of perpendicular =  $(-2, 1, 3)Q$

$$PQ = \sqrt{(10+2)^2 + (1+2)^2 + (3+1)^2}$$

$$= \sqrt{144 + 9 + 16}$$

$$= 13$$



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**JEE (Advanced) 2024**

<b>AIR 25</b> Rishi Shekher Shukla 2 Year Classroom	<b>AIR 67</b> Krishna Sai Shishir 2 Year Classroom	<b>AIR 78</b> Abhishek Jain 2 Year Classroom	<b>AIR 93</b> Hardik Aggarwal 2 Year Classroom	<b>AIR 95</b> Ujjwal Singh 2 Year Classroom	<b>AIR 98</b> Rachit Aggarwal 2 Year Classroom
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**JEE (Main) 2024**

<b>1</b> Karnataka Topper Sarvi Jais 100 Percentile Rank 2 Year Classroom	<b>15</b> Telangana Topper M Sai Divya Teja Reddy 100 Percentile Rank 2 Year Classroom	<b>19</b> Telangana Topper Rishi Shekher Shukla 100 Percentile Rank 2 Year Classroom
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