

22/01/2026

Morning



# Aakash

Medical | IIT-JEE | Foundations

Corporate Office : AESL, 3rd Floor, Incuspaze Campus-2, Plot-13, Sector-18, Udyog Vihar,  
Gurugram, Haryana-122015

## Memory Based Answers & Solutions

Time : 3 hrs.

for

M.M. : 300

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## PHYSICS

### 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. Two disc having same moment of inertia about their axis. Thickness is  $t_1$  and  $t_2$  and they have same density. If  $\frac{R_1}{R_2} = \frac{1}{2}$ , then find  $\frac{t_1}{t_2}$ .

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

**Answer (2)**

**Sol.**  $\pi R^2 t \rho \frac{R^2}{2} = I$

So  $\frac{I_1}{I_2} = \frac{t_1 \rho R_1^4}{t_2 \rho R_2^4}$

$\Rightarrow \frac{t_1}{t_2} = \left(\frac{R_2}{R_1}\right)^4 = 16$

2. In series R-L circuit, voltage of battery is 10 V. Resistance & inductance are  $10 \Omega$  and 10 mH respectively. Find energy stored in the inductor when current reaches  $\frac{1}{e}$

times of maximum value

- (1) 0.67 mJ (2) 1.33 mJ  
(3) 0.33 mJ (4) 0.50 mJ

**Answer (1)**

**Sol.**  $\varepsilon = \frac{L i_0^2}{2 e^2}$

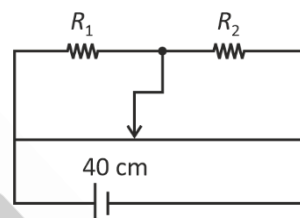
$i_0 = \frac{\varepsilon}{R} = 1 \text{ A}$

$= \frac{1}{2} \times 10^{-2} \times \frac{1}{e^2}$

$= 10^{-2} \times 0.067$

$= 0.67 \text{ mJ}$

3. In a potentiometer null point for two resistances  $R_1$  and  $R_2$  is at 40 cm as shown. If  $16 \Omega$  is connected in parallel to  $R_2$  then null point is at 50 cm then  $R_1$  and  $R_2$  are respectively



- (1)  $16 \Omega, 48 \Omega$  (2)  $32 \Omega, \frac{32}{3} \Omega$   
(3)  $\frac{16}{3} \Omega, 16 \Omega$  (4)  $\frac{32}{5} \Omega, 32 \Omega$

**Answer (3)**

**Sol.**  $\frac{R_1}{R_2} = \frac{40}{60} = \frac{2}{3}$

$3R_1 = 2R_2$

$\frac{R_1(R_2 + 16)}{16R_2} = \frac{1}{1}$

$R_1 = \frac{R_2 \cdot 16}{R_2 + 16} = \frac{2R_2}{3}$

$48 = 2R_2 + 32$

$R_2 = 8$

$R_1 = \frac{16}{3}$

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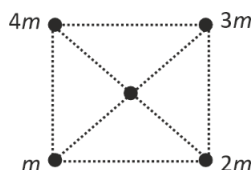


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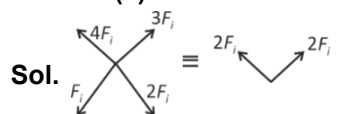
4. In the given situation force at center on 1 kg mass is  $F_1$ . Now if  $4m$  and  $3m$  is interchanged the force is  $F_2$ .

Given :  $\frac{F_1}{F_2} = \frac{2}{\sqrt{\alpha}}$ . Find  $\alpha$ .

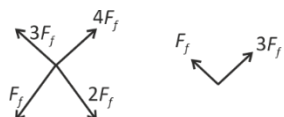


- (1)  $\alpha = 5$  (2)  $\alpha = 3$   
(3)  $\alpha = 7$  (4)  $\alpha = 1$

**Answer (1)**



$$F_1 = \frac{2\sqrt{2}Gm}{a^2}$$



$$F_2 = \sqrt{10}F_f = \sqrt{10} \frac{Gm^2}{a^2}$$

$$\frac{F_2}{F_1} = \sqrt{\frac{10}{8}} = \frac{\sqrt{5}}{2}$$

5. Match the column

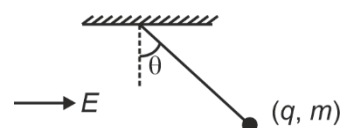
|     | Column-I             |     | Column-II              |
|-----|----------------------|-----|------------------------|
| (A) | Thermal Conductivity | (P) | $[ML^2T^{-2}K^{-1}]$   |
| (B) | Boltzmann Constant   | (Q) | $[M^1L^{-1}T^{-2}]$    |
| (C) | Spring constant      | (R) | $[M^1L^1T^{-3}K^{-1}]$ |
| (D) | Surface tension      | (S) | $[M^1L^0T^{-2}]$       |
|     |                      | (T) | $[M^1L^2T^{-3}K^{-1}]$ |
|     |                      | (U) | $[ML^2T^{-2}]$         |

- (1)  $A \rightarrow R ; B \rightarrow P ; C \rightarrow S ; D \rightarrow S$   
(2)  $A \rightarrow T ; B \rightarrow P ; C \rightarrow U ; D \rightarrow S$   
(3)  $A \rightarrow R ; B \rightarrow T ; C \rightarrow Q ; D \rightarrow Q$   
(4)  $A \rightarrow T ; B \rightarrow U ; C \rightarrow S ; D \rightarrow Q$

**Answer (1)**

**Sol.** Theoretical

6. A simple pendulum with bob (mass  $m$  & charge  $q$ ) is in equilibrium in presence of horizontal electric field  $E$  then tension in thread is



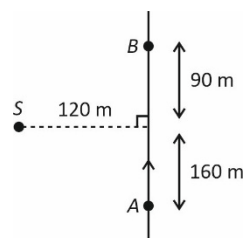
- (1)  $mg + qE$  (2)  $\sqrt{m^2g^2 + q^2E^2}$   
(3)  $\sqrt{mg + qE}$  (4)  $mg + qE \tan \theta$

**Answer (2)**

**Sol.**  $\vec{T} + \vec{mg} + \vec{qE} = \vec{0}$

$$T = (\vec{mg} + \vec{qE}) = \sqrt{m^2g^2 + q^2E^2}$$

7. Detector D moves from A to B and observe the frequencies are differing by 10 Hz. Source is emitting frequency  $f_0$  as shown: Speed of detector is 35 times less than speed of sound. Then  $f_0$  is



- (1) 400 Hz (2) 350 Hz  
(3) 250 Hz (4) 150 Hz

**Answer (3)**

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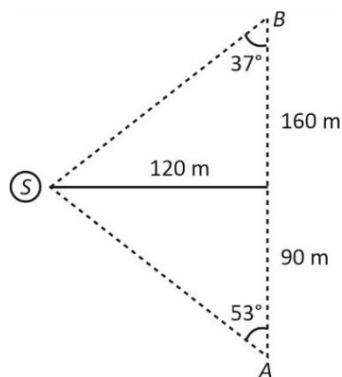
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Sol.

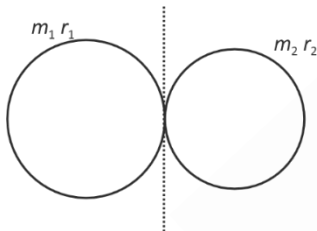


$$f_0 \left\{ \frac{C + V \cos 53^\circ}{C} - \frac{C - V \cos 37^\circ}{C} \right\} = 10$$

$$f_0 \left\{ \frac{V}{C} \right\} \left\{ \frac{7}{5} \right\} = 10$$

$$f_0 = \frac{50}{7} \times \frac{C}{V} = 250 \text{ Hz}$$

8. Disk  $m_1 = 5 \text{ kg}$  & radius  $r_1 = 10 \text{ cm}$  and disk  $m_2 = 10 \text{ kg}$  & radius  $r_2 = 50 \text{ cm}$  are arranged as shown in figure. Find moment of inertia about an axis through common tangent and parallel to the plane of the disk.



(1)  $\frac{31}{8} \text{ kg m}^2$

(2)  $\frac{57}{64} \text{ kg m}^2$

(3)  $\frac{41}{8} \text{ kg m}^2$

(4)  $\frac{51}{16} \text{ kg m}^2$

Answer (4)

Sol.  $\left( \frac{m_1 r_1^2}{4} + m_1 r_1^2 \right) + \left( \frac{m_2 r_2^2}{4} + m_2 r_2^2 \right) = I$

$$\Rightarrow \left( \frac{1}{100} \times \frac{5}{4} \times 5 \right) + \frac{1}{4} \left( \frac{5}{4} \times 10 \right) = I$$

$$\Rightarrow \frac{1}{16} + \frac{50}{16} = \frac{51}{16} \text{ kg m}^2$$

9. In adiabatic process the temperature reduces to  $\frac{1}{4}$ th and volume increases to 8 times. Find adiabatic constant of the gas.

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

(2)  $\frac{5}{7}$

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

(4)  $\frac{8}{5}$

Answer (3)

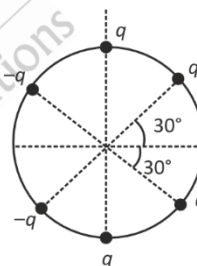
Sol.  $TV^{\gamma-1} = \text{Constant}$

$$\Rightarrow TV^{\gamma-1} = \frac{T}{4}(8V)^{\gamma-1}$$

$$\Rightarrow TV^{\gamma-1} = \frac{T \cdot V^{\gamma-1}}{4}(8)^{\gamma-1}$$

$$\Rightarrow (2)^2 = (2)^{3\gamma-3} \Rightarrow \gamma = \frac{5}{3}$$

10. Six charges (four  $+q$ , two  $-q$ ) are present at circle of radius  $r$  and centred at origin as shown. Electric field at origin is



(1)  $\frac{\sqrt{3}q}{4\pi\epsilon_0 r^2} \hat{i}$

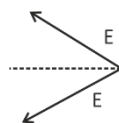
(2)  $\frac{\sqrt{3}q}{4\pi\epsilon_0 r^2} (-\hat{i})$

(3)  $\frac{\sqrt{3}q}{2\pi\epsilon_0 r^2} (-\hat{i})$

(4)  $\frac{\sqrt{3}q}{\pi\epsilon_0 r^2} (\hat{i})$

Answer (3)

Sol.



$$E = \frac{2kq}{r^2} \Rightarrow E_{\text{net}} = E\sqrt{3}$$

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11. An  $\alpha$ -particle with KE 7.9 MeV is projected towards a stationary target nucleus of  $Z = 79$ . Find the distance of closest approach.

- (1)  $1.44 \times 10^{-14}$  (2)  $2.88 \times 10^{-14}$   
 (3)  $1.44 \times 10^{-15}$  (4)  $2.88 \times 10^{-15}$

**Answer (2)**

**Sol.**  $KE = \frac{KZe \times 2e}{d} = 7.9 \times 10^6$

$$d = \frac{9 \times 10^9 \times 2 \times 1.6 \times 10^{-19}}{10^5} = 2.88 \times 10^{-14}$$

12. A planet 'A' having density  $\rho$  and radius  $R$  has escape velocity = 10 km/sec. Find the escape velocity of a planet B having density and radius both 10% that of planet A.

- (1)  $\frac{1}{\sqrt{10}}$  (2)  $\frac{1}{\sqrt{20}}$   
 (3)  $\frac{1}{\sqrt{30}}$  (4)  $\frac{1}{\sqrt{50}}$

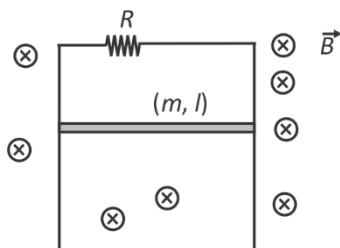
**Answer (1)**

**Sol.**  $v_e = \sqrt{\frac{Gm \times 2}{R}} = \sqrt{G\rho \frac{8}{3} \pi R^2}$

$$\frac{v_A}{v_B} = \sqrt{\frac{\rho_A}{\rho_B} \left( \frac{R_A}{R_B} \right)} = \sqrt{10} \times 10$$

$$v_B = \frac{v_A}{10\sqrt{10}} = \frac{1}{\sqrt{10}}$$

13. A conducting rod of mass  $m$  and length  $l$  is moving on a infinite pair of conducting rails as shown. Conducting rails are connected to a resistance  $R$  at one end. Motion is in vertical plane and horizontal magnetic field in the region is  $B$ . Find terminal speed of rod.



$$(1) v_0 = \frac{3mgR}{2B^2 l^2}$$

$$(2) v_0 = \frac{mgR}{2B^2 l^2}$$

$$(3) v_0 = \frac{mgR}{B^2 l^2}$$

$$(4) v_0 = \frac{2mgR}{B^2 l^2}$$

**Answer (3)**

**Sol.** Let  $v_0$  is the terminal speed then power dissipated is

$$\left( \frac{v_0 B l}{R} \right)^2 \cdot R = \frac{v_0^2 B^2 l^2}{R}$$

and power delivered gravity is  $mgv_0$

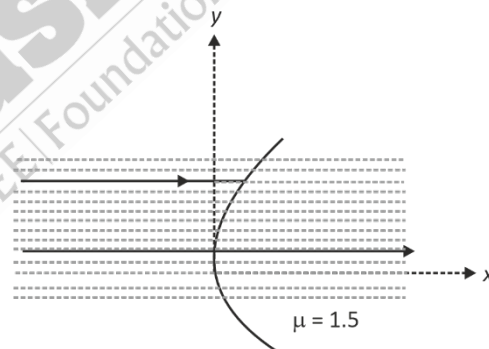
$$\text{So, } mgv_0 = \frac{B^2 l^2}{R} \cdot v_0^2$$

$$\Rightarrow \frac{mgR}{B^2 l^2} = v_0$$

14. A ray parallel to x axis (principal axis of curved surface.

The x co-ordinate where ray cuts x-axis (in m) is :

(The radius of curvature is 50 cm)



- (1) 1.5 (2) 0.5  
 (3) 1 (4) 2

**Answer (1)**

**Sol.**  $\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R} \Rightarrow \frac{1.5}{v} = \frac{0.5}{0.5}$

$$V = 1.5$$

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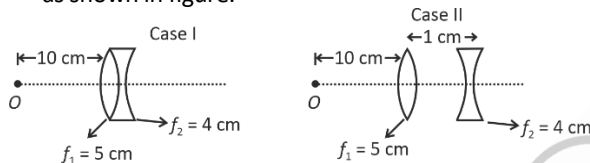


15. A sinusoidal EMW is given by  $\vec{E} = 20 \sin\left(\frac{2}{300}x - 10^6 t\right)$  propagating in a non-magnetic material. Dielectric constant of material is
- (1)  $9 \times 10^4$  (2)  $3 \times 10^2$   
(3) 4 (4) 2

**Answer (3)**

**Sol.**  $K = \frac{\omega}{V} \Rightarrow \frac{2}{300} = \frac{10^6}{V}$   
 $V = \frac{3 \times 10^8}{2}$   
 $\mu = \frac{C}{V} \Rightarrow \mu = 2$   
 $\frac{C}{V} = \sqrt{\frac{\mu \epsilon}{\mu_0 \epsilon_0}} \Rightarrow \sqrt{\mu} = 2$

16. Combination of lenses are arranged in case I and case II as shown in figure.



Magnification in two cases are  $m_1$  and  $m_2$ . Find  $\left|\frac{m_1}{m_2}\right|$ .

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

**Answer (1)**

**Sol.** For Case I

$$\frac{1}{f_a} = \frac{1}{5} - \frac{1}{4} = \frac{-1}{20}$$

$$\text{So } \frac{1}{v} + \frac{1}{10} = \frac{-1}{20} \Rightarrow \frac{1}{v} = \frac{-1}{20} - \frac{1}{10} = \frac{-3}{20}$$

$$\text{So } |m_1| = \frac{20}{3 \times 10} = \frac{2}{3}$$

For case II

$$\text{For 1st lens } \frac{1}{v_1} + \frac{1}{f_0} = \frac{1}{5}$$

$$\Rightarrow v_1 = 10 \text{ so, } m'_2 = \frac{10}{-10} = -1$$

So 2<sup>nd</sup> lens

$$\frac{1}{v_2} - \frac{1}{9} = \frac{-1}{4} \Rightarrow \frac{1}{v_2} = \frac{1}{9} - \frac{1}{4} = \frac{-5}{36}$$

$$\text{So } m''_2 = \left(\frac{36}{-5}\right) \frac{-4}{9} = \frac{-4}{5}$$

$$\text{So } m_2 = m'_2 \cdot m''_2 = \left(\frac{4}{5}\right) \times (1) = \frac{4}{5}$$

$$\text{So } \left|\frac{m_1}{m_2}\right| = \frac{2 \times 5}{3 \times 4} = \frac{5}{6}$$

17. Match the column-I with the correct numerical values of energy/heat in column-II ( $R$  is universal gas constant)

|     | Column-I                                                                                                        |     | Column-II |
|-----|-----------------------------------------------------------------------------------------------------------------|-----|-----------|
| (A) | 1 mole of monoatomic ideal gas undergoes polytropic process $pV^{-1/2}$ with $\Delta T = 320$ K find $\Delta U$ | (P) | 650 R     |
| (B) | Find heat supplied to 2 moles of gas having heat capacity as $\frac{5}{2}R$ and $\Delta T = 130$ K              | (Q) | 800 R     |
| (C) | Find the $\Delta U$ for 1 mole diatomic gas for $\Delta T = 230$ K                                              | (R) | 480 R     |

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

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

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

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

**Answer (1)**

**Sol.**  $\Delta U$  for any process  $nC_V \Delta T$

(A)  $\Delta U = 1 \times \frac{3R}{2} \times 320 = 480 R$

(B)  $\Delta Q = n C_{\text{process}} \Delta T = 2 \times \frac{5R}{2} \times 130 = 650 R$

(C)  $\Delta U = 1 \times \frac{5}{2} R \times 320 = 800 R$

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18. Statement-I : Fluid exerts pressure on the surface of a solid in contact with it.

Statement-II : The excess potential energy of molecules at the surface of a liquid leads to surface tension.

- (1) Both are true and statement-II B correct explanation of Statement-I
- (2) Both are true but statement-II is not correct explanation of Statement-I
- (3) Statement-I is true but Statement-II is false
- (4) Statement-II is true but statement-I is false

**Answer (2)**

**Sol.** Theoretical

19. For an object revolving around a planet of mass  $M$  and radius  $R_0$  at a distance  $r$  from the center of the planet. If area velocity of the object is  $10 \text{ km}^2/\text{sec}$ . Now if density of the planet increases by +10% and radius of planet increases by +10% then find new area velocity at same orbital radius.

- (1)  $12.1 \text{ km}^2/\text{sec}$       (2)  $10 \text{ km}^2/\text{sec}$
- (3)  $15.5 \text{ km}^2/\text{sec}$       (4)  $8.5 \text{ km}^2/\text{sec}$

**Answer (1)**

**Sol.**  $T^2 = \frac{4\pi^2 r^3}{GM}$

$$\text{So } V_{\text{Area}}^2 = \frac{\pi r^2 \cdot \pi r^2 GM}{4\pi^2 r^3} = \frac{GMr}{4}$$

$$\text{So } V_{\text{Area}}^2 = \frac{G}{4} \cdot r \cdot \frac{4}{3} \pi R^3 \rho = \frac{\pi}{3} R^3 \rho Gr$$

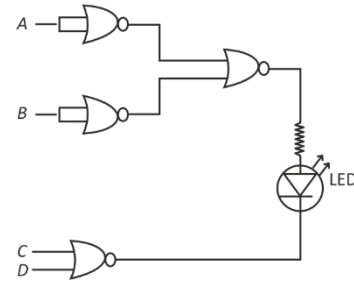
Since  $r$  is constant so

$$\frac{V_{2(\text{Area})}^2}{V_{1(\text{Area})}^2} = \frac{\frac{110\rho \left(\frac{11}{10}\right)^3 \cdot R^3}{100}}{\rho R^3}$$

$$\Rightarrow V_{2(\text{Area})}^2 = \left(\frac{11}{10}\right)^4 \times 100$$

$$\Rightarrow V_{2(\text{Area})} = 12.1 \text{ km}^2/\text{sec}$$

20. In the given logic circuit shown in the figure, inputs  $A$ ,  $B$ ,  $C$ , and  $D$  are applied as shown. An LED is connected at the output. In which of the following combinations will the LED glow.



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

**Answer (4)**

**Sol.**  $\overline{A+B}$   $\overline{C+D}$  are two terminals

$AB$   $\overline{C+D}$  LED glows when forward bias

### 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.
- 22.
- 23.
- 24.
- 25.

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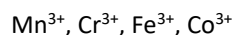
## CHEMISTRY

## 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 :**

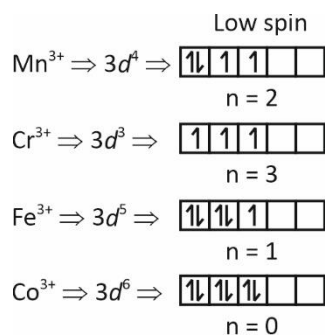
1. Consider the given central metal ions of low spin complex and choose the correct increasing order of unpaired electrons



- (1)  $\text{Co}^{3+} < \text{Fe}^{3+} < \text{Mn}^{3+} < \text{Cr}^{3+}$
- (2)  $\text{Co}^{3+} < \text{Mn}^{3+} < \text{Fe}^{3+} < \text{Cr}^{3+}$
- (3)  $\text{Cr}^{3+} < \text{Mn}^{3+} < \text{Cr}^{3+} < \text{Fe}^{3+}$
- (4)  $\text{Cr}^{3+} < \text{Mn}^{3+} < \text{Co}^{3+} < \text{Fe}^{3+}$

**Answer (1)**

**Sol.**



2. Match the following and choose the correct option.

## List-I

- (a)  $[\text{Ag}(\text{NH}_3)_2]^+$
- (b)  $\text{Zn-Hg/HCl}$
- (c)  $\text{NH}_2 - \text{NH}_2/\text{KOH}$
- (d)  $\text{Cu}^{2+}/\text{OH}^-$

## List-II

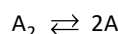
- (i) Fehling's solution
- (ii) Clemmensen reduction
- (iii) Tollens reagent
- (iv) Wolff-Kishner reduction

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

**Answer (3)**

**Sol.** a(iii), b(ii), c(iv), d(i)

3. For the reaction given below at  $25^\circ\text{C}$



Find  $\ln K_p$

Given  $(\Delta G_f^\circ)_A = -50.384 \text{ kJ/mol}$

$$(\Delta G_f^\circ)_{\text{A}_2} = -100 \text{ kJ/mol}$$

- (1) 0.43
- (2) 0.23
- (3) 0.31
- (4) 0.53

**Answer (3)**

**Sol.**  $\text{A}_2 \rightarrow 2\text{A}$

$$(\Delta G_f^\circ)_{\text{rxn}} = -2 \times 50.384 + 100$$

$$= -0.768 \text{ kJ}$$

$$\Delta G^\circ = -RT \ln K_p$$

$$-\frac{\Delta G^\circ}{8.3 \times 298} = \ln K_p$$

$$\frac{0.768 \times 1000}{8.3 \times 298} = \ln K_p = 0.31$$

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4. **Statement-I** : Sucrose is dextrorotary and upon hydrolysis it becomes laevorotatory.

**Statement-II** : Sucrose on hydrolysis gives glucose and fructose such that the laevorotation of glucose is more than dextrorotation of fructose.

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

**Answer (3)**

**Sol.** Sucrose  $\rightleftharpoons$  Glucose + Fructose

| D(+ ) glucose | D(-) Fructose |
|---------------|---------------|
| +52.5°        | -92.4°        |

5. Which of the following is the correct order of the reactivity of given nucleophiles when treated with  $\text{CH}_3\text{Br}$  in methanol?

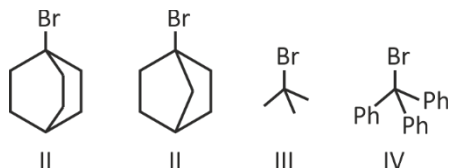
$\text{F}^-$ ,  $\text{I}^-$ ,  $\text{C}_2\text{H}_5\text{O}^-$ ,  $\text{C}_6\text{H}_5\text{O}^-$

- (1)  $\text{I}^- > \text{C}_2\text{H}_5\text{O}^- > \text{C}_6\text{H}_5\text{O}^- > \text{F}^-$
- (2)  $\text{I}^- > \text{F}^- > \text{C}_2\text{H}_5\text{O}^- > \text{C}_6\text{H}_5\text{O}^-$
- (3)  $\text{I}^- > \text{C}_2\text{H}_5\text{O}^- > \text{F}^- > \text{C}_6\text{H}_5\text{O}^-$
- (4)  $\text{C}_6\text{H}_5\text{O}^- > \text{F}^- > \text{I}^- > \text{C}_2\text{H}_5\text{O}^-$

**Answer (1)**

**Sol.** Nucleophilicity order of :  $\text{I}^- > \text{C}_2\text{H}_5\text{O}^- > \text{C}_6\text{H}_5\text{O}^- > \text{F}^-$   
Greater the size of anion, greater polarisation, greater nucleophilicity.

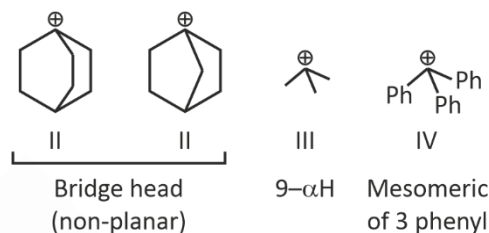
6. Reactivity of following on the basis of  $\text{S}_{\text{N}}1$  mechanism.



- (1)  $\text{IV} > \text{III} > \text{I} > \text{II}$
- (2)  $\text{II} > \text{IV} > \text{II} > \text{I}$
- (3)  $\text{III} > \text{IV} > \text{I} > \text{II}$
- (4)  $\text{IV} > \text{III} > \text{II} > \text{I}$

**Answer (1)**

**Sol.** For  $\text{S}_{\text{N}}1$ , more stable carbocation means higher reactivity



$\text{IV} > \text{III} > \text{I} > \text{II}$

II is less stable than I due to higher strain.

7. Given below are two statements.

**Statement I** :  $\text{HX}$  bond length is higher in  $\text{HCl}$  than  $\text{HF}$ .

**Statement II** : The lowest boiling point in hydride of group 15 element is having covalency 4.

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

**Answer (3)**

**Sol.** Bond length :  $\text{HCl} > \text{HF}$   
127.4 pm    91.7 pm

B.P. =  $\text{BiH}_3 > \text{SbH}_3 > \text{NH}_3 > \text{AsH}_3 > \text{PH}_3$   
290 K    254.6 K    238.5 K    210.6 K    185.5 K

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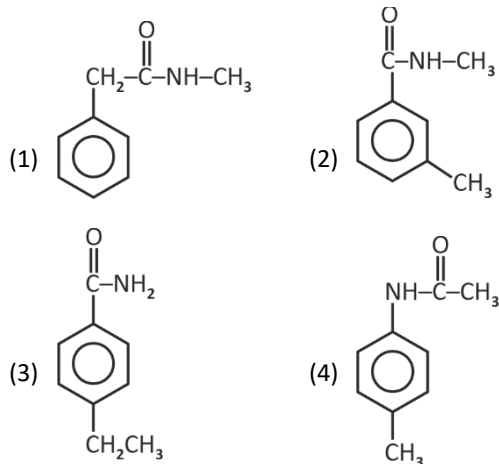
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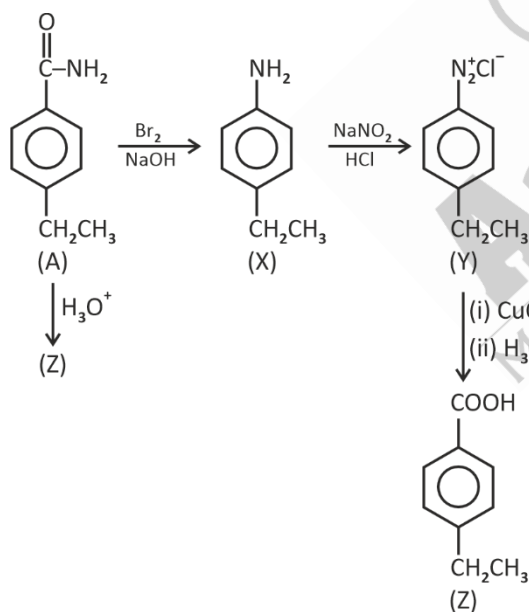


8. A compound 'A' with molecular formula  $C_9H_{11}NO$  reacts with  $Br_2/NaOH$  to give (X). (X) on reaction with  $NaNO_2$  in dil. HCl gives compounds (Y). When (Y) is treated with  $CuCN$ , followed by hydrolysis gives (Z). The compound (A) on hydrolysis also gives compound (Z). Identify compound (A)



**Answer (3)**

**Sol.**



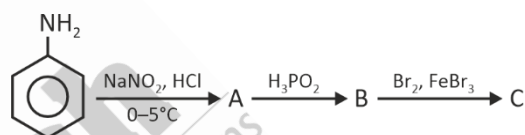
9. Which of the following statement is correct regarding the nature and directive influence of  $-NO_2$  group in nitrobenzene.

- (1) It is an activating group and ortho/para director
- (2) It is a deactivating group and ortho/para director
- (3) It is a deactivating group and meta director
- (4) It is an activating group and meta director

**Answer (3)**

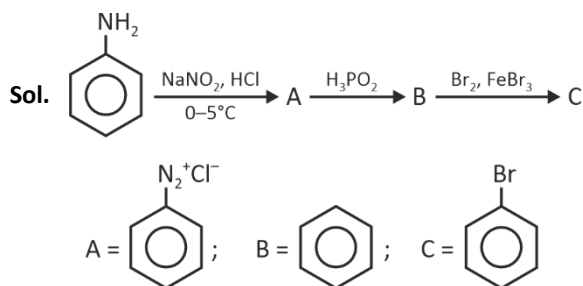
**Sol.**  $-NO_2$  group is a deactivating group and meta director.

10. Consider the following sequence of reaction and identify A, B and C respectively.



- (1)  $C_6H_5OH$ ,  $C_6H_6$ ,  $C_6H_4Br_2$
- (2)  $C_6H_5N_2^+Cl^-$ ,  $C_6H_6$ ,  $C_6H_5Br$
- (3)  $C_6H_5NO_2$ ,  $C_6H_5OH$ ,  $C_6H_5Br$
- (4)  $C_6H_5Cl$ ,  $C_6H_5OH$ ,  $C_6H_6$

**Answer (2)**



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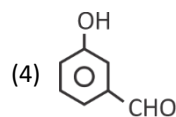
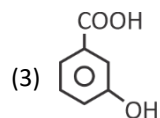
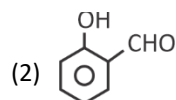
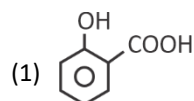
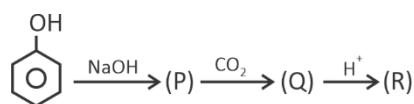
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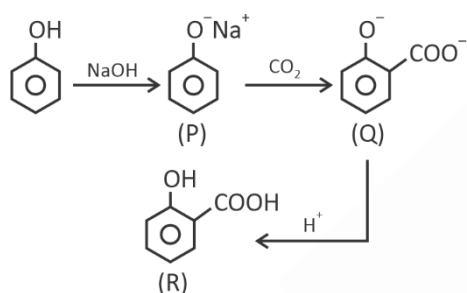


11. In the following reaction sequence, identify compound (R).



**Answer (1)**

**Sol.**



12. Given below are two statements

Statement-I :  $K_H$  is constant with change in concentration of gas till solution is dilute at given temperature.

Statement-II : According to Henry's Law, partial pressure of gas in vapour phase is inversely proportional to mole fraction of gas in solution.

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

**Answer (3)**

**Sol.** According to Henry's Law

$$P_{\text{gas}} \propto X_{\text{gas}}$$

Statement-II is incorrect

$K_H$  is dependent on temperature

Statement-I is correct

13. Consider a first order reaction:

$A \rightarrow \text{products}$

3 different solutions are taken and the rate of reaction of

Solution 1 : 100mL 10M 'A'  $\rightarrow r_1$

Solution 2 : 200mL 10M 'A'  $\rightarrow r_2$

Solution 3 : 100mL 10M 'A' + 100mL water  $\rightarrow r_3$

The correct order of the rates of reactions is,

(1)  $r_1 = r_2 = r_3$

(2)  $r_1 = r_2 < r_3$

(3)  $r_1 = r_2 > r_3$

(4)  $r_1 < r_2 = r_3$

**Answer (3)**

**Sol.** For a first order reaction

$$-\frac{dA}{dt} = k[A]$$

As  $[A]$  decreases rate of reaction decreases

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14. Bohr's radius of H-atom is  $2.12 \times 10^{-10}$  m. Calculate the energy of electron at this level.

- (1)  $-5.44 \times 10^{-19}$  J  
(2)  $-2.176 \times 10^{-18}$  J  
(3)  $-54.4 \times 10^{-19}$  J  
(4)  $-2.3 \times 10^{-19}$  J

**Answer (1)**

**Sol.**  $r_n = a_0 \frac{n^2}{Z}$

$$2.12 \times 10^{-10} = 0.529 \times 10^{-10} \frac{n^2}{1}$$

$$n^2 = 4$$

$$n = 2$$

$$E_n = -13.6 \frac{Z^2}{n^2} \text{ eV}$$

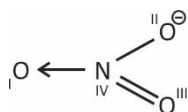
$$E_n = -13.6 \frac{1}{2^2} \text{ eV}$$

$$= -3.4 \text{ eV}$$

$$= -3.4 \times 1.6 \times 10^{-19} \text{ J}$$

$$= -5.44 \times 10^{-19} \text{ J}$$

15. Find the formal charge of  $\overset{\text{I}}{\text{O}}$ ,  $\overset{\text{II}}{\text{O}}$ ,  $\overset{\text{III}}{\text{O}}$  and  $\overset{\text{IV}}{\text{N}}$  respectively

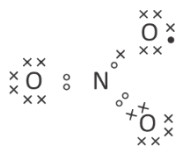


- (1) 0, +1, -1, +2  
(2) -1, -1, 0, +1  
(3) -1, 0, +2, +1  
(4) +1, -1, 0, -1

**Answer (2)**

**Sol.** Formal charge = Valence  $e^-$  - Non-bonding  $e^-$  -  $\frac{1}{2}$

(Bonding  $e^-$ )

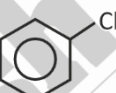


$$\text{F.C. on O(I)} \Rightarrow 6 - 6 - \frac{1}{2}(2) = -1$$

$$\text{F.C. on O(II)} \Rightarrow 6 - 6 - \frac{1}{2}(2) = -1$$

$$\text{F.C. on O(III)} \Rightarrow 6 - 4 - \frac{1}{2}(4) = 0$$

$$\text{F.C. on N(IV)} \Rightarrow 5 - 0 - \frac{1}{2}(8) = +1$$

16. For , the incorrect statement is,

'P'

- (1) 'P' is less reactive than benzyl chloride towards nucleophilic substitution reaction.  
(2) In 'P', C-Cl bond has partial double bond character  
(3) 'Cl' is an ortho-para directing group towards electrophilic aromatic substitution  
(4) 'P' can undergo nucleophilic substitution reaction at normal conditions

**Answer (4)**

**Sol.** Chlorobenzene (P) does not undergo  $S_N$  reaction under normal conditions.

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17. Which of the following statement is correct regarding element having atomic number 79.

- (1) It's first ionisation enthalpy is maximum in its group
- (2) It's first ionisation enthalpy is minimum in its group
- (3) It belongs to group 10 of periodic table
- (4) It belongs to 5<sup>th</sup> period of periodic table

**Answer (1)**

|                             |     |     |     |
|-----------------------------|-----|-----|-----|
| <b>Sol.</b> $IE_1$ (kJ/mol) | Cu  | Ag  | Au  |
|                             | 745 | 730 | 890 |

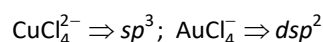
Au belongs to Group-11 and it is a 6<sup>th</sup> period element.

18. An element from 1<sup>st</sup> transition series and another element of 3<sup>rd</sup> transition series (same group) do not liberate  $H_2$  gas from dilute acids like HCl. Both form halides. The hybridisation state of metal ion halide respectively are

- (1) Both  $sp^3$
- (2) Both  $dsp^2$
- (3)  $sp^3$  and  $dsp^2$
- (4)  $dsp^2$  and  $sp^3$

**Answer (3)**

**Sol.** Cu and Au do not liberate  $H_2$  gas with dilute acid.



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. Sodium extract of organic compound of 0.1 g is treated with chlorine water and  $CCl_4$  which dissolves in organic solvent to produce a violet colour. Upon treatment with  $AgNO_3$  a yellow ppt. of 0.12 g is produced. Calculate the percentage of halide in organic compound.

**Answer (65)**

**Sol.** Layer test confirms the presence of iodine in the organic compound on treatment with  $AgNO_3$ , AgI precipitate is formed.

$$n_{AgI} = \frac{0.12}{235} = 5.1 \times 10^{-4} \text{ mol}$$

$$\text{mass of I} = 5.1 \times 10^{-4} \times 127$$

$$= 0.0648 \text{ g}$$

$$\% \text{ of I} = \frac{0.0648}{0.1} \times 100 = 64.77 \approx 65\%$$

22.

23.

24.

25.

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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 sum of first 4 terms of an A.P is 6 and sum of first 6 terms is 4, then sum of first 12 terms of an A.P is

- (1) -22 (2) -21  
(3) -23 (4) -24

**Answer (1)**

**Sol.**  $S_4 = \frac{4}{2}[2a + 3d] = 6$

$\Rightarrow 2a + 3d = 3 \quad \dots(i)$

$S_6 = \frac{6}{2}[2a + 5d] = 4$

$\Rightarrow 2a + 5d = \frac{4}{3} \quad \dots(ii)$

Solving (i) & (ii)

$a = \frac{11}{4}$

$d = \frac{-5}{6}$

$S_{12} = 6 \left[ 2 \times \frac{11}{4} + 11 \times \left( -\frac{5}{6} \right) \right]$

$= -22$

2. The coefficient of  $x^{48}$  in the expansion of  $1 \cdot (1+x) + 2 \cdot (1+x)^2 + 3 \cdot (1+x)^3 + \dots + 100 \cdot (1+x)^{100}$  is

- (1)  $^{101}C_{46} - 100$   
(2)  $100(^{101}C_{49}) - ^{101}C_{50}$   
(3)  $100(^{101}C_{46}) - ^{101}C_{47}$   
(4)  $^{101}C_{47} - ^{101}C_{46}$

**Answer (2)**

**Sol.** Let  $y = 1 \cdot (1+x) + 2 \cdot (1+x)^2 + 3 \cdot (1+x)^3 + \dots + 100 \cdot (1+x)^{100}$

$\therefore (1+x)y = (1+x)^2 + 2 \cdot (1+x)^3 + \dots + 100(1+x)^{101}$

$-x \cdot y = (1+x) + (1+x)^2 + (1+x)^3 + \dots + (1+x)^{100} - 100(1+x)^{101}$

$y = \frac{1}{x} \left\{ 100(1+x)^{101} - \frac{(1+x)(1+x)^{100} - 1}{1+x-1} \right\}$

$y = \frac{1}{x} \left\{ 100(1+x)^{101} - \frac{1}{x} \left( (1+x)^{101} - (1+x) \right) \right\}$

$\therefore \text{Coeff. of } x^{48} = 100 \cdot ^{101}C_{49} - ^{101}C_{50}$

3. If the domain of the function

$\frac{1}{\ln(10-x)} + \sin^{-1} \left( \frac{x+2}{2x+3} \right)$

is  $(-\infty, -a] \cup (-1, b) \cup (b, c)$ , then  $(b+c+3a)$  is equal to

- (1) 22  
(2) 24  
(3) 23  
(4) 21

**Answer (2)**

**Sol.** Domain of  $\frac{1}{\ln(10-x)}$

$\Rightarrow \ln(10-x) \neq 0$

$\Rightarrow 10-x \neq 1 \quad x \neq 9$

$10-x > 0 \quad x < 10$

Domain of  $\sin^{-1} \left( \frac{x+2}{2x+3} \right) \Rightarrow -1 \leq \frac{x+2}{2x+3} \leq 1$

$\Rightarrow \frac{-x-1}{2x+3} \leq 0 \Rightarrow \frac{x+1}{2x+3} \geq 0$

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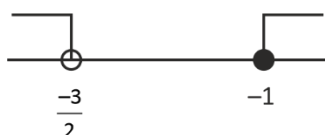
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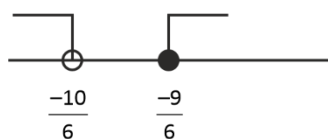
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$$\frac{3x+5}{2x+3} \geq 0$$



and



$$\Rightarrow x \in \left( \left( -\infty, -\frac{3}{2} \right) \cup [-1, \infty) \right) \cap \left( \left( -\infty, -\frac{10}{6} \right] \cup \left( -\frac{9}{6}, \infty \right) \right)$$

$$\Rightarrow x \in \left( -\infty, -\frac{10}{6} \right] \cup \left[ -\frac{9}{6}, \infty \right)$$

$$x \in \left( -\infty, -\frac{5}{3} \right] \cup [-1, \infty)$$

$$\Rightarrow \text{domain of } \frac{1}{\ln(10-x)} + \sin^{-1}\left(\frac{x+2}{2x+3}\right)$$

$$x \in \left( -\infty, -\frac{5}{3} \right] \cup [-1, 10) - \{9\}$$

$$x \in \left( -\infty, -\frac{5}{3} \right] \cup [-1, 9) \cup (9, 10)$$

4. Let  $M = \{1, 2, 3, \dots, 16\}$  and  $R$  be a relation on  $M$  defined by  $xRy$  if and only if  $4y = 5x - 3$ . Then, the number of elements required to be added in  $R$  to make it symmetric is

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

**Answer (1)**

**Sol.**  $R = \{(3, 3), (7, 8), (11, 13)\}$  Number of pairs to be added to  $R$  to make it symmetric are = 2. Which are  $(8, 7), (13, 11)$

5. The solution of the differential equation  $xdy - ydx = \sqrt{x^2 + y^2} dx$  is (where  $c$  is integration constant)

$$(1) \sqrt{x^2 + y^2} = cx^2 - y \quad (2) \sqrt{x^2 + y^2} = cx^2 + y$$

$$(3) \sqrt{x^2 + y^2} = cx - y \quad (4) \sqrt{x^2 + y^2} = cx + y$$

**Answer (1)**

**Sol.**  $xdy - ydx = \sqrt{x^2 + y^2}$

divide by  $x^2$  both sides

$$\frac{xdy - ydx}{x^2} = d\left(\frac{y}{x}\right) = \sqrt{1 + \left(\frac{y}{x}\right)^2} \cdot \frac{1}{x} dx$$

$$\Rightarrow \frac{d\left(\frac{y}{x}\right)}{\sqrt{1 + \left(\frac{y}{x}\right)^2}} = \frac{1}{x} dx$$

$$\Rightarrow \log\left(\left(\frac{y}{x}\right) + \sqrt{1 + \left(\frac{y}{x}\right)^2}\right) = \ln(x) + c$$

$$= \ln x + \ln k$$

$$\frac{y}{x} + \sqrt{1 + \left(\frac{y}{x}\right)^2} = xk$$

$$\Rightarrow y + \sqrt{x^2 + y^2} = x^2 k$$

6. The number of values of  $x$  satisfying  $\tan^{-1}(4x) + \tan^{-1}(6x)$

$$= \frac{\pi}{6} \text{ and } x \in \left[ -\frac{1}{2\sqrt{6}}, \frac{1}{2\sqrt{6}} \right] \text{ is}$$

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

**Answer (1)**

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Sol.  $\tan^{-1} \left[ \frac{4x+6x}{1-24x^2} \right] = \frac{\pi}{6}$

$$\frac{10x}{1-24x^2} = \frac{1}{\sqrt{3}}$$

$$\Rightarrow 24x^2 + 10\sqrt{3}x - 1 = 0$$

$$x = \frac{-10\sqrt{3} \pm \sqrt{300+96}}{48}$$

$$= \frac{-10\sqrt{3} \pm \sqrt{396}}{48}$$

$$= \frac{-10\sqrt{3} \pm 2\sqrt{99}}{48}$$

$$= \frac{-5\sqrt{3} \pm \sqrt{99}}{24}$$

$$\frac{-5\sqrt{3} - \sqrt{99}}{24} \text{ (rejected) as } x \in \left[ -\frac{1}{2\sqrt{6}}, \frac{1}{2\sqrt{6}} \right]$$

$$\Rightarrow x = \frac{-5\sqrt{3} + \sqrt{99}}{24}$$

7. The value of  $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \frac{1}{[x]+4} dx$  is

Where  $[.]$  denotes greatest integer function.

(1)  $\frac{\pi}{20} + \frac{7}{20}$

(2)  $\frac{7\pi}{20} - \frac{7}{60}$

(3)  $\frac{7\pi}{20} - \frac{1}{60}$

(4)  $\frac{7\pi}{20} + \frac{1}{60}$

Answer (2)

Sol.  $\int_{-\frac{\pi}{2}}^{-1} \frac{1}{2} dx + \int_{-1}^0 \frac{1}{3} dx + \int_{0}^1 \frac{1}{4} dx + \int_{1}^{\frac{\pi}{2}} \frac{1}{5} dx$

$$\left[ \frac{1}{2}x \right]_{-\frac{\pi}{2}}^{-1} + \left[ \frac{1}{3}x \right]_{-1}^0 + \left[ \frac{1}{4}x \right]_0^1 + \left[ \frac{1}{5}x \right]_1^{\frac{\pi}{2}}$$

$$\frac{1}{2} \left[ -1 + \frac{\pi}{2} \right] + \frac{1}{2} (0 - (-1)) + \frac{1}{4} (1 - 0) + \frac{1}{5} \left( \frac{\pi}{2} - 1 \right)$$

$$-\frac{1}{2} + \frac{\pi}{4} + \frac{1}{3} + \frac{1}{4} + \frac{\pi}{10} - \frac{1}{5}$$

$$\frac{7\pi}{20} - \frac{7}{60}$$

8. If  $\frac{\cos^2 48^\circ - \sin^2 12^\circ}{\sin^2 24^\circ - \sin^2 6^\circ} = \frac{\alpha + \sqrt{5}\beta}{2}$ . Then, the value of  $(\alpha + \beta)$  is

(1) 3

(2) 2

(3) 4

(4) 1

Answer (3)

Sol.  $\frac{\cos^2 48^\circ - \sin^2 12^\circ}{\sin^2 24^\circ - \sin^2 6^\circ} = \frac{\cos(48^\circ + 12^\circ)\cos(48^\circ - 12^\circ)}{\sin(24^\circ + 6^\circ)\sin(24^\circ - 6^\circ)}$

$$= \frac{\cos 60^\circ \cos 36^\circ}{\sin 30^\circ \sin 18^\circ} = \frac{\cos 36^\circ}{\sin 18^\circ}$$

$$= \frac{\sqrt{5}+1}{4} = \frac{\sqrt{5}+1}{\sqrt{5}-1} \times \frac{\sqrt{5}+1}{\sqrt{5}+1}$$

$$= \frac{5+1+2\sqrt{5}}{4} = \frac{6+2\sqrt{5}}{4}$$

$$= \frac{3+\sqrt{5}}{2}$$

$$\alpha = 3, \beta = 1$$

$$\alpha + \beta = 4$$

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9. If  $\int (\cos x)^{-5/2} (\sin x)^{-11/2} dx$
- $$= \frac{p_1}{q_1} (\cot x)^{9/2} + \frac{p_2}{q_2} (\cot x)^{5/2} + \frac{p_3}{q_3} (\cot x)^{1/2} - \frac{p_4}{q_4} (\cot x)^{-3/2} + c$$
- (where  $c$  is constant of integration), then value of  $\frac{15p_1p_2p_3p_4}{q_1q_2q_3q_4}$  is
- (1) 14  
(2) 16  
(3) 10  
(4) 9

Answer (2)

Sol.  $\int (\cos x)^{-5/2} (\sin x)^{-11/2} dx$

$$= \int \frac{1}{(\cos x)^{5/2} (\sin x)^{11/2}} dx$$

$$= \int \frac{1}{(\cot x)^{5/2} \sin^8 x} dx$$

$$= \int \frac{\operatorname{cosec}^2 x}{(\sin^6 x)(\cot x)^{5/2}} dx$$

= Let  $\cot x = t \Rightarrow -\operatorname{cosec}^2 x dx = dt$

=  $1 + \cot^2 x = \operatorname{cosec}^2 x = (1 + t^2)$

$$\Rightarrow \int \frac{(1+t^2)^3 (-dt)}{t^{5/2}}$$

$$\Rightarrow \int \frac{(t^6 + 3t^4 + 3t^2 + 1)(-dt)}{t^{5/2}}$$

$$\Rightarrow - \int (t^{7/2} + 3t^{3/2} + 3t^{1/2} + t^{-5/2}) dt$$

$$\Rightarrow - \left( \frac{t^{9/2}}{9/2} + \frac{3t^{5/2}}{5/2} + \frac{3t^{3/2}}{3/2} + \frac{t^{-3/2}}{-3/2} \right) + c$$

$$= - \frac{2}{9} \cot x^{9/2} - \frac{9}{5} \cot x^{5/2} - 6 \cot x^{3/2} + \frac{2}{3} (\cot x)^{-3/2} + c$$

$$\Rightarrow 15 \left( -\frac{2}{9} \times -\frac{6}{5} \times 6 \times \frac{2}{3} \right) = 16$$

10. The value(s) of  $\alpha$  for which the line  $\alpha x + 2y = 1$  never touches the hyperbola  $\frac{x^2}{9} - \frac{y^2}{1} = 1$  is/are

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

Answer (3)

Sol.  $\frac{x^2}{9} - \frac{y^2}{1} = 1$

Line  $\alpha x + 2y = 1$

$T: y = mx \pm \sqrt{9m^2 - 1}$

$T: 2y = -\alpha x - 1$

$\frac{1}{2} = -\frac{m}{\alpha} = \frac{\sqrt{9m^2 - 1}}{-1}$

$\frac{1}{4} = 9m^2 - 1$

$\frac{5}{36} = m^2 \Rightarrow m = \pm \frac{\sqrt{5}}{6}$

$-2m = \alpha$

$\alpha = \pm \frac{\sqrt{5}}{3}$

For  $\alpha = \pm \frac{\sqrt{5}}{3}$ , the  $\alpha x + 2y = 1$  will become tangent.

$\therefore$  The value of  $\alpha$  for which line will not become tangent

is  $R - \left\{ \pm \frac{\sqrt{5}}{3} \right\}$ .

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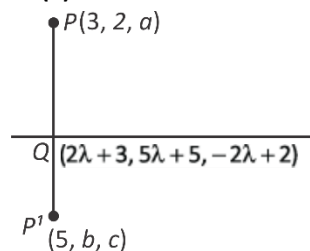


11. If the image of the point  $P(3, 2, a)$  reflected about the line  $\frac{x-3}{2} = \frac{y-5}{5} = \frac{z-2}{-2}$  is  $(5, b, c)$ . Then the value of  $a^2 + b^2 + c^2$  is

- (1)  $\frac{4849}{8}$  (2)  $\frac{4245}{4}$   
(3)  $\frac{3947}{8}$  (4)  $\frac{2429}{4}$

**Answer (1)**

**Sol.**



Q is the mid-point of  $PP'$

$$\therefore \frac{5+3}{2} = 2\lambda + 3 \Rightarrow \lambda = \frac{1}{2}$$

$$\frac{b+2}{2} = 5\lambda + 5 = \frac{5}{2} + 5 = \frac{15}{2}$$

$$\Rightarrow b = 3$$

$$\frac{a+c}{2} = -2\lambda + 2 = 1$$

$$\Rightarrow a + c = 2 \quad \dots(i)$$

Now,

$$2(5-3) + 5(b-2) + (-2)(c-a) = 0$$

$$\Rightarrow c - a = \frac{59}{2} \quad \dots(ii)$$

From (i) & (ii)

$$c = \frac{63}{4}, a = \frac{-55}{4}$$

$$\therefore a^2 + b^2 + c^2 = \frac{4849}{8}$$

12. If probability distribution is given by

|      |   |                 |                 |  |                     |    |   |   |   |
|------|---|-----------------|-----------------|--|---------------------|----|---|---|---|
| x    | 0 | 1               | 2               |  | 3                   | 4  | 5 | 6 | 7 |
| P(x) | k | 2k <sup>2</sup> | 6k <sup>2</sup> |  | 2k <sup>2</sup> + k | 4k | k | k | k |

Then, the value of  $P(3 < x \leq 6)$  is

- (1) 0.6 (2) 0.8  
(3) 0.4 (4) 0.2

**Answer (1)**

$$\text{Sol. } 10k^2 + 9k = 1$$

$$10k^2 + 9k - 1 = 0$$

$$10k^2 + 10k - k - 1 = 0$$

$$10k(k+1) - 1(k+1) = 0$$

$$k = \frac{1}{10}, \boxed{k = -1} \rightarrow \text{Not possible}$$

$$\Rightarrow \boxed{k = \frac{1}{10}}$$

$$P(3 < x \leq 6) = P(x=4) + P(x=5) + P(x=6)$$

$$= \frac{4}{10} + \frac{1}{10} + \frac{1}{10}$$

$$= \frac{6}{10} = \frac{3}{5}$$

$$= 0.6$$

13.

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. If  $A = \begin{bmatrix} 2 & 3 \\ 3 & 5 \end{bmatrix}$ , then the value of  $|A^{2025} - 3A^{2024} + A^{2023}|$  is

**Answer (16)**

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Sol.  $|A|^{2023} |A^2 - 3A + I|$

$$|A| = 1$$

Now,

$$|(A^2 - 3A + I)|$$

$$\Rightarrow \begin{bmatrix} 13 & 21 \\ 21 & 34 \end{bmatrix} - 3 \begin{bmatrix} 2 & 3 \\ 3 & 5 \end{bmatrix} + \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

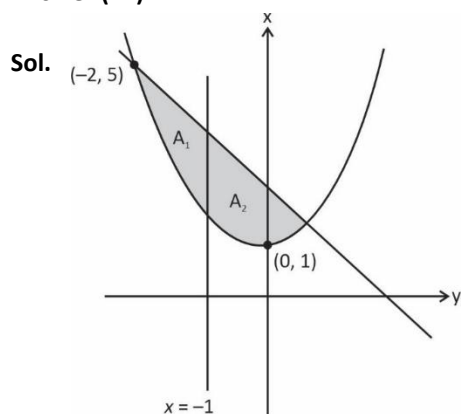
$$\Rightarrow \begin{bmatrix} 8 & 12 \\ 12 & 20 \end{bmatrix}$$

$$= 8 \times 20 - 12 \times 12$$

$$= 16$$

22. If the area of the region  $\{(x, y): x^2 + 1 \leq y \leq 3 - x\}$  is divided by the line  $x = -1$  in the ratio  $m : n$  (where  $m$  and  $n$  are coprime natural numbers). Then, the value of  $m + n$  is

Answer (27)



$$y = 3 - x$$

$$y = x^2 + 1$$

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

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

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

$$\Rightarrow x = -2, 1$$

$$A_1 = \int_{-2}^{-1} ((3 - x) - (x^2 + 1)) dx$$

$$A_1 = \int_{-2}^{-1} (3 - x - x^2 - 1) dx$$

$$A_1 = \frac{7}{6}$$

$$A_2 = \int_{-1}^1 ((3 - x) - (x^2 + 1)) dx$$

$$A_2 = \frac{10}{3} \Rightarrow A_1 : A_2 = \frac{\frac{7}{6}}{\frac{10}{3}} = \frac{7}{20}$$

$$\Rightarrow m + n = 27$$

23. The number of solution(s) of equation  $x|x + 4| + 3|x + 2| + 3 = 0$  is/are equal to

Answer (3.00)

Sol. If  $x \geq -2$

$$\text{Then } x(x + 4) + 3(x + 2) + 3 = x^2 + 7x + 9$$

$$\Rightarrow x = \frac{-7 \pm \sqrt{49 - 36}}{2}$$

$$= \frac{-7 \pm \sqrt{13}}{2} \Rightarrow x = \frac{-7 + \sqrt{13}}{2}$$

$$\text{If } -4 \leq x < -2$$

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

$$\Rightarrow x = \frac{-1 \pm \sqrt{1 + 12}}{2} = \frac{-1 \pm \sqrt{13}}{2}$$

$$\text{in } x \in (-4, -2), x = \frac{-1 - \sqrt{13}}{2}$$

$$\text{If } x \in (-\infty, -4)$$

$$x(-x - 4) + 3(-x - 2) + 3 = -x^2 - 7x - 3$$

$$= -(x^2 + 7x + 3) = x = \frac{-7 \pm \sqrt{37}}{2}$$

$$\Rightarrow x = \frac{-7 - \sqrt{37}}{2}$$

$$\Rightarrow 3$$

24.

25.



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