MATRIX

JEE MAIN 2026

Memory Based-Questions and Analysis of 6th April (Shift-1)

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. In AC series circuit supply voltage $V_{(rms)}$ = 100 volts; R = 80 Ω; X_L = 80 Ω and source frequency is f = 50 Hz. Find the power factor

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

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

Answer (1)

Sol. $z = \sqrt{R^2 + X_L^2} = 80\sqrt{2}$

$\cos\theta = \frac{R}{z} = \frac{1}{\sqrt{2}}$

2. An expression of potential energy $= \frac{A\sqrt{x}}{B+x}$ is given. Then dimensions of ($A \cdot B$) will be. (x is position here)

(1) MLT^{-1} (2) $M^{1/2}L^{2/3}T^{-2}$

(3) $ML^{3.5}T^{-2}$ (4) $ML^{1/2}T^{-2}$

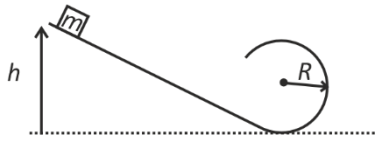
Answer (3)

Sol. $[B] = [L]$

$A\sqrt{L} = UL$

$[A] = ML^2T^{-2}\frac{L}{L^{1/2}} = [ML^{2.5}T^{-2}]$

3. A block of mass m is released from height h on smooth plane. If normal force on top of the circular part is $3mg$. Find h.

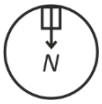


(1) $5R$ (2) $4R$

(3) $3.5R$ (4) $3R$

Answer (2)

Sol.



$N + mg = \frac{mv^2}{R}$

$v^2 = 4gR$

$mg(h-2R) = \frac{1}{2}m \times 4gR$

$h - 2R = 2R$

$h = 4R$

4. Electric field at centre of semi-circular ring of radius 10 cm is 100 v/m. Find charge on the ring if charge distribution is uniform.

(1) $4\varepsilon_0$

(2) $20\varepsilon_0$

(3) $25\varepsilon_0$

(4) $30\varepsilon_0$

Answer (2)

Sol. $E = \frac{\lambda}{2\pi\varepsilon_0 R}$

$= \frac{Q}{2\pi\varepsilon_0 R \cdot \pi R}$

$Q = E\,2\pi^2R^2\varepsilon_0$

$= 100 \times 2 \times 10 \times 10^{-2}\varepsilon_0$

$= 20\,\varepsilon_0$

5. A point charge particle Q = 3C is placed at point $A(0, -2, -5)$ and taken to point $B(2, 1, 3)$ in the electric field $\vec{E} = \left(2x\hat{i} + 3y^2\hat{j} + 4\hat{k}\right)$. Find work done by electric field.

(1) 75 Joule (2) 135 Joule

(3) 89 Joule (4) 105 Joule

Answer (2)

Sol. So $\Delta w = \int q\bar{E}\cdot\bar{dr}$

$\Rightarrow \Delta w = q\int\left(2x\hat{i} + 3y^2\hat{j} + 4\hat{k}\right).\left(dx\hat{i} + dy\hat{j} + dz\hat{k}\right)$

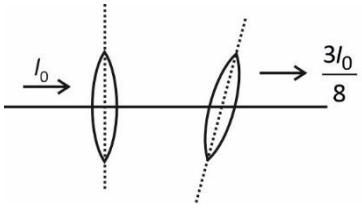
$\Rightarrow \Delta w = q\int\left(2xdx + 3y^2dy + 4dz\right)$

$\Rightarrow \Delta w = q\int x^2 + y^3 + 4z\Big|_{x_1y_1z_1}^{x_2y_2z_2}$

$\Rightarrow \Delta w = 3\left[\left(4+1+12\right) - \left(0-8-20\right)\right]$

$\Rightarrow \Delta w = 3\left(45\right) = 135\,\text{J}$

6. Unpolarized light with intensity I_0 incident on polariser. Find angle between axis of polariser and analyser, so that intensity of emergent light is $\frac{3I_0}{8}$



(1) 45° (2) 60°

(3) 37° (4) 30°

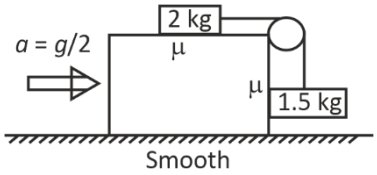
Answer (4)

Sol. $I_{out} = \frac{I_0}{2}\cos^2\theta$

$\cos^2\theta = \frac{3}{4}$

$\cos\theta = \frac{\sqrt{3}}{2}$

7. Find the least value of μ such that system move together without slipping.

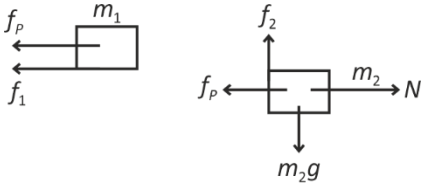


(1) $\frac{2}{11}$ (2) $\frac{3}{2}$

(3) $\frac{1}{7}$ (4) $\frac{5}{7}$

Answer (1)

Sol.



$m_2g = \mu\frac{m_2g}{2} + \frac{m_1g}{2} + \mu m_1g$

$1.5 = \mu\times 0.75 + 1 + \mu\times 2$

$0.5 = 2.75\mu$

$\mu = \frac{0.5}{2.75} = \frac{2}{11}$

8. A small cubical region of side 1 mm is placed at the center of current I = 1A carrying circular loop of radius a = 1 m. Find magnetic energy stored is the cube.

(1) $\pi\times 10^{-15}$ Joule (2) $\Delta u = \frac{\pi}{2}\times 10^{-16}$ Joule

(3) $2\pi\times 10^{-16}$ Joule (4) $\Delta u = 2\pi\times 10^{-15}$ Joule

Answer (2)

Sol. Energy density = $\frac{\beta^2}{2\mu_0}$

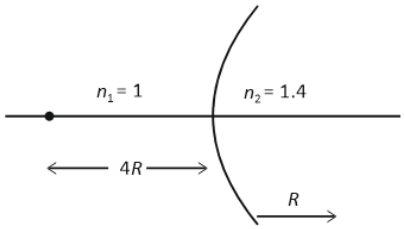
Here $\beta = \frac{\mu_0 I}{2a}$

So $\Delta u = \left(\frac{\mu_0 I}{2a}\right)^2\cdot\frac{1}{2\mu_0}\cdot 1\times 10^{-9}$

$$\Rightarrow \quad \Delta u = \frac{1\times10^{-9}}{4\times2}\frac{\mu_0^2}{\mu_0} = \frac{4\pi\times10^{-7}\times10^{-9}}{8}$$

$$\Rightarrow \quad \Delta u = \frac{\pi}{2}\times10^{-16} \text{ Joule}$$

9. A spherical refracting surface separating the media with refractive index n_1 = 1 and n_2 = 1.4 as shown. Object is placed at 4R from surface and R is curvature radius as shown.



Find magnitude of magnification.

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

(3) $|m| = \frac{3}{5}$ (4) $|m| = \frac{3}{4}$

Answer (1)

Sol. $\frac{n_2}{v} - \frac{n}{u} = \frac{(n_2 - n_1)}{R}$

$$\Rightarrow \frac{1.4}{v} + \frac{1}{4R} = \frac{0.4}{R}$$

$$\Rightarrow \frac{1.4}{v} = \frac{1}{R}\left(\frac{2}{5} - \frac{1}{4}\right) = \frac{3}{20R}$$

$$\Rightarrow v = \frac{1.4\times20R}{3}$$

So $|m| = \left|\frac{n_1 v}{n_2 u}\right| = \frac{1\times1{\cdot}4\times20\,R}{3\times1{\cdot}4\times4R}$

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

10. Ratio of wavelengths of 1st and 2nd line of Balmer series in hydrogen atom spectra is

(1) $\frac{11}{13}$ (2) $\frac{15}{28}$

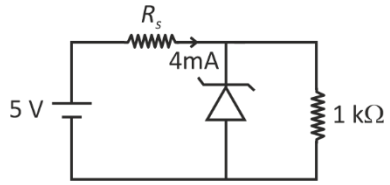
(3) $\frac{20}{27}$ (4) $\frac{13}{17}$

Answer (3)

Sol. $\frac{\lambda_2}{\lambda_1} = \frac{\left\{\frac{1}{4} - \frac{1}{9}\right\}}{\frac{1}{4} - \frac{1}{16}} = \frac{5\times64}{36\times12}$

$$= \frac{5\times4}{9\times3} = \frac{20}{27}$$

11. Power drawn by resistance 1 kΩ is 4mW. Find value of R_S.



(1) 2 kΩ (2) 500 Ω

(3) 1 kΩ (4) 750 Ω

Answer (4)

Sol. i_L = 2 mA

V_L = 2 × 1 = 2 Volt

$R_s = \frac{3}{3\,\text{mA}}$ = 750 Ω

12. Two wires (A & B) of same area are subjected to equal tensile forces gets elongated by same amount. The ratio of young's modulus of two material is $\frac{Y_A}{Y_B} = \frac{20}{11}$.

Find the ratio of lengths of the wire $\frac{l_A}{l_B}$?

(1) $\frac{10}{11}$ (2) $\frac{20}{11}$

(3) $\frac{11}{10}$ (4) $\frac{11}{20}$

Answer (2)

Sol. $\frac{Fl}{A\Delta l} = Y$

$$\Rightarrow \quad l = \frac{AY\Delta l}{F}$$

So, $\frac{l_A}{l_B} = \left(\frac{Y_A}{Y_B}\right).\left(\frac{\Delta l_A}{\Delta l_B}\right)$

$$\Rightarrow \quad \frac{l_A}{l_B} = \frac{20}{11}$$

13. In YDSE, path difference for two points *P* and *Q* are $\frac{\lambda}{3}$ and $\frac{\lambda}{6}$ respectively. Ratio of intensities at *P* and *Q* is

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

(3) 4 (4) 2

Answer (2)

Sol. $\Delta\theta_1 = \frac{2\pi}{\lambda}\frac{\lambda}{3} = 120°$,

$\Delta\theta_2 = \frac{2\pi}{\lambda}\times\frac{\lambda}{6} = 60$

Ratio = $\frac{\cos^2 60}{\cos^2 30} = \frac{1}{3}$

14. A one mole sample of gas undergoes an isothermal process in which volume changes from 3 litre to 1 litre. Find work done on the gas if initial pressure was 3×10^7 Pa.

(1) 270 ln3 (2) 900 ln3

(3) 3000 ln3 (4) 9000 ln3

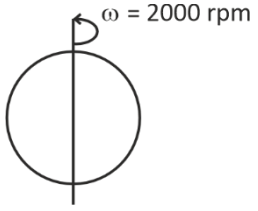
Answer (4)

Sol. $w = nRT \ln 3$

$= 3 \times 10^7 \times 3 \times 10^{-3} \ln 3$

$= 9 \times 10^4 \ln 3$

15. A solid uniform sphere of mass *m* and radius *R* initially rotating with angular speed of ω = 2000 rpm. If it stops in 10 sec when subjected to some constant retarding torque, then find number of revolutions and magnitude of torque.



(1) $200; \frac{8\pi}{3}mR^2$ (2) $500; \frac{10\pi}{3}mR^2$

(3) $\frac{500}{3}; \frac{8\pi}{3}mR^2$ (4) $400; \frac{10\pi}{3}mR^2$

Answer (3)

Sol. $\omega_i = 2000 \text{ rpm} = 2000 \times \frac{2\pi}{60} \text{ rad/sec}$

$= \frac{200}{3}\pi \text{ rad/sec}$

$\alpha = \frac{\Delta\omega}{\Delta t} = \frac{200\pi}{3\times 10} = \frac{20\pi}{3} \text{ rad/sec}$

So, $|\tau| = I\alpha = \frac{2}{5}mR^2 \times \frac{20}{3}\pi = \frac{8}{3}\pi mR^2$

Number of revolution = $\frac{1}{2}\alpha\frac{t^2}{2\pi}$

$\Rightarrow N = \frac{1}{2}\times\frac{20\pi}{3}\times\frac{10\times 10}{2\pi} = \frac{500}{3}$

16. Consider nuclear reaction,

$P + {}^{7}_{3}Li \rightarrow 2{}^{4}_{2}He$

Energy absorbed in the process is

($m_p = 1.0080u$, $m_{L_1} = 7.0173\,u$

$m_{He} = 4.0201\,u$)

(1) 14 MeV (2) 24 MeV

(3) 18 MeV (4) 11 MeV

Answer (1)

Sol. $\Delta E = C^2\Delta m = 0.01486 \times 931.5$

17. Shortest wavelength of Lyman series is λ_0 longest wavelength of Balmer series is λ. Find value of $\frac{\lambda}{\lambda_0}$.

(1) $\frac{36}{5}$ (2) $\frac{18}{5}$

(3) $\frac{4}{9}$ (4) $\frac{3}{7}$

Answer (1)

Sol. $\lambda_0 = \frac{hC}{E_0}$ $\lambda = \frac{36hC}{5E_0}$

$E = E_0\left(\frac{1}{4} - \frac{1}{9}\right)$ $\frac{5\lambda}{\lambda_0} = 36$

$E = \frac{5}{36} = E_0$

18.

19.

20.

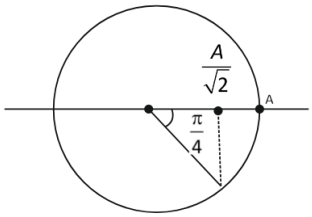
SECTION - B

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. Time period of SHM of a particle is 16 sec. Find minimum time to move from $x = A$ to $x = \frac{A}{\sqrt{2}}$.

Answer (2)

Sol.



$T = \frac{\frac{\pi}{4}}{2\pi}T = \frac{T}{8}$

$T = 2$ sec

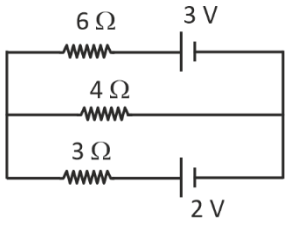
22. Mass and radius of a solid sphere is measured with uncertainty of 1% and 2% respectively uncertainty (in percent) in calculation of density is

Answer (7)

Sol. $\rho = \frac{m}{\frac{4}{3}\pi r^3}$

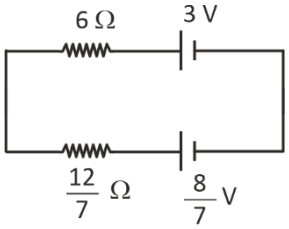
$\frac{\Delta\rho}{\rho} = \frac{\Delta m}{m} + \frac{3\Delta r}{r} = 1 + 6 = 7$

23. Heat dissipation in 6 Ω resistance in 54 sec is $\frac{\alpha}{9}$ J then α is



Answer (169)

Sol.



$i = \frac{3 - \frac{8}{7}}{6 + \frac{12}{7}} = \frac{13}{54}$

$H = Pt = \frac{13}{54} \times \frac{13}{54} \times 6 \times 54 = \frac{169}{9}$

24. A mass of m = 1 kg starts falling with zero initial speed. By the time it falls a height of h = 10 m its speed becomes v = 10 m/s. Find the magnitude of work done (in Joule) by resistive force.

Answer (50)

Sol. $\Delta KE = \Delta w_{gr} + \Delta w_R$

$\frac{1}{2}(1) \times 100 = (1 \times 10 \times 10) + \Delta w_R$

$\Rightarrow \quad \Delta w_R = -50$ Joule

$|\Delta w_R| = 50$ Joule

25.

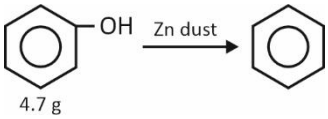
CHEMISTRY

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 reaction :



Find the number of moles of 'P' formed (if yield of reaction is 60 percent).

(1) 0.05

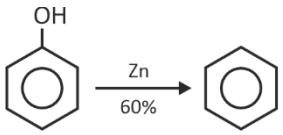
(2) 0.06

(3) 0.03

(4) 0.04

Answer (3)

Sol.

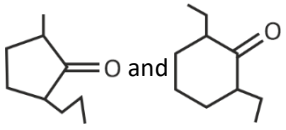


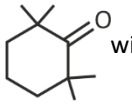
$\frac{4.7\text{ g}}{94}$ $\frac{4.7}{94} \times 0.6$

$= 0.03$ mol

MW of phenol = 77 + 16 + 1 = 94

2. Given below are two statements.

Statement I :  are metamer.

Statement II :  will show tautomerism.

In light of above statements, choose correct option.

(1) Both Statement I and Statement II are correct

(2) Statement I is incorrect, Statement II is correct

(3) Statement I is correct, Statement II is incorrect

(4) Both Statement I and Statement II are incorrect

Answer (4)

Sol. Statement I is incorrect because molecular formula is not same.

Statement II is incorrect because α-H is essential to show tautomerism.

3. Match list-I contain *d*-electronic configuration of tetrahedral complex with their CFSE value in list-II

	List-I		List-II
(A)	d^2	(i)	$-0.6\ \Delta_t$
(B)	d^4	(ii)	$-0.4\ \Delta_t$
(C)	d^6	(iii)	$-1.2\ \Delta_t$
(D)	d^5	(iv)	0

(1) (A)-(iii), (B)-(ii), (C)-(i), (D)-(iv)

(2) (A)-(ii), (B)-(iii), (C)-(i), (D)-(iv)

(3) (A)-(i), (B)-(ii), (C)-(iii), (D)-(iv)

(4) (A)-(ii), (B)-(iii), (C)-(iv), (D)-(i)

Answer (1)

Sol. $d^4 = e^2t_2^2 = -0.4\Delta_t$

$d^2 = e^2 \Rightarrow -1.2\Delta_t$

$d^6 = e^3t_2^3 \Rightarrow -0.6\Delta_t$

$d^5 = e^2t_2^3 = 0$

4. Match the following.

List-I		List-II	
P.	Vitamin – A	I.	Scurvy
Q.	Vitamin – C	II.	Convulsion
R.	Vitamin – B_6	III.	Pernicious anaemia
S.	Vitamin – B_{12}	IV.	Xerophthalmia

(1) P – I, Q – III, R – II, S – IV

(2) P – II, Q – III, R – I, S – IV

(3) P – IV, Q – I, R – II, S – III

(4) P – IV, Q – I, R – III, S – II

Answer (3)

Sol. P – IV, Q – I, R – II, S – III

5. What will be the empirical formula of compound, if compound has 69.9% Fe and rest is oxygen?

(1) Fe_3O_4 (2) Fe_2O_3

(3) FeO (4) FeO_2

Answer (2)

Sol. Fe = 69.9%

O = 30.1%

Let mass of compound = 100 g

Fe = 69.9 g

O = 30.1 g

Mol of Fe = $\frac{69.9}{56} = 1.25$

Mol of O = $\frac{30.1}{16} = 1.88$

Molar ratio of Fe = $\frac{1.25}{1.25} = 1$

Molar ratio of O = $\frac{1.88}{1.25} = 1.5$

EF = Fe_2O_3

6. **Statement I :** 3-phenyl prop-1-ene will react with HBr and give an alkyl halide major product having 1 chiral C-atom.

Statement II : Aryl chloride and aryl cyanide both can be formed by Gattermann and Sandmeyer reaction.

(1) Statement I is correct, Statement II is incorrect

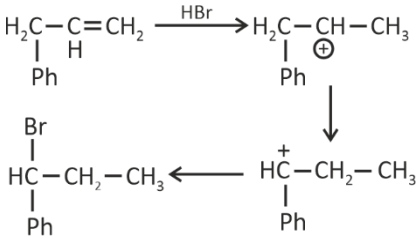
(2) Statement I is incorrect, Statement II is correct

(3) Both Statement I and Statement II are correct

(4) Both Statement I and Statement II are incorrect

Answer (3)

Sol.



7. If the wavelength of first line of Lyman Series for H-atom is x Å. Then the longest wavelength in Balmer series of He^+ ion will be

(1) $\frac{5x}{9}$ (2) $\frac{27x}{20}$

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

Answer (2)

Sol. $\frac{\frac{1}{x} = R(1)^2\left(\frac{1}{1^2} - \frac{1}{2^2}\right)}{\frac{1}{\lambda} = R(2)^2\left(\frac{1}{2^2} - \frac{1}{3^2}\right)} \Rightarrow \frac{\frac{1}{x}}{\frac{1}{\lambda}} = \frac{\frac{3}{4}}{\frac{5\times4}{36}}$

$\frac{\lambda}{x} = \frac{9\times3}{4\times5}$

$\lambda = \frac{27x}{20}$

8. Which of the following can be used to form CH_4 gas?

(1) Kolbe's electrolysis

(2) From CH_3MgBr

(3) By Wurtz reaction

(4) By reduction of CH_3CH_2Cl

Answer (2)

Sol. $CH_3MgBr \xrightarrow{H_3O+} CH_4$

9. Match List-I with List-II and choose the correct option.

	List-I		**List-II**
A.	2s	(i)	One radial node + zero angular node
B.	3s	(ii)	Two radial node + zero angular node
C.	3p	(iii)	One radial node + 1 angular node
D.	3d	(iv)	Zero radial node + 2 angular node

(1) A(i), B(ii), C(iii), D(iv)

(2) A(ii), b(iv), C(iii), D(i)

(3) A(ii), B(i), C(iii), D(iv)

(4) A(iv), B(iii), C(ii), D(i)

Answer (1)

Sol.

	Radial node	**Angular node**
	(n – l – 1)	**(l)**
2s	1	0
3s	2	0
3p	1	1
3d	0	2

10. Arrange the given compounds in increasing order of boiling point.

$\underset{I}{n\text{-}C_4H_9NH_2}$, $\underset{II}{(C_2H_5)_2NH}$, $\underset{III}{C_2H_5-N(CH_3)_2}$, $\underset{IV}{nC_4H_9OH}$

(1) II < III < I < IV

(2) I < II < IV < III

(3) III < II < I < IV

(4) III < I < II < IV

Answer (3)

Sol. I → 350.8 K

$(n\text{-}C_4H_9NH_2)$

II → 329.3 K

$(C_2H_5)_2NH$

III → 310 K

$[C_2H_5N(CH_3)_2]$

IV → 390 K

$[n\text{-}C_4H_9OH]$

11. 0.25 moles of a non-volatile and non-ionisable compound is mixed with 1 mole of solvent. Find the percentage relative lowering in vapour pressure.

(1) 20%

(2) 40%

(3) 60%

(4) 35%

Answer (1)

Sol. $\frac{P^0 - P_s}{P^0} = \frac{n}{n+N} = \frac{0.25}{0.25+1} = \frac{0.25}{1.25} = \frac{1}{5}$

Percentage relative lowering in vapour pressure

$= \frac{1}{5} \times 100$

= 20%

12. Consider the Lewis dot structure in following pair.

(A) SO_3^{2-} and CO_3^{2-} (B) O_2 and F_2

(C) NH_3 and H_3O^+ (D) CN^- and CO

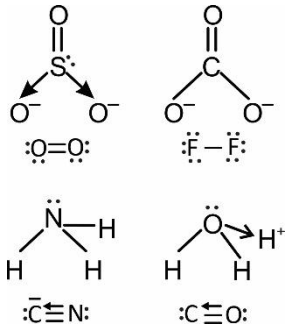
Choose pair which have same structure

(1) A and C only (2) A, C, D only

(3) B, C & D only (4) C & D only

Answer (4)

Sol.



13. Find the limiting molar conductivity of $BaSO_4$.

[Given : $\Lambda_m^o(HCl) = x_1$

$\Lambda_m^o(H_2SO_4) = x_2$

$\Lambda_m^o(BaCl_2) = x_3$]

(1) $x_2 + x_3 - 2x_1$ (2) $2x_2 + x_3 - 2x_1$

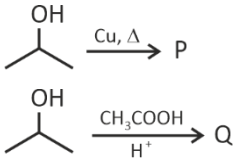
(3) $x_2 + x_3 - x_1$ (4) $x_2 + x_3 + 2x_1$

Answer (1)

Sol. $\Lambda_m^o H_2SO_4 + \Lambda_m^o BaSO_4 - 2(\Lambda_m^o HCl) = \Lambda_m^o BaSO_4$

So, $\Lambda_m^o BaSO_4 = x_2 + x_3 - 2x_1$

14. Consider the following reaction



Compound P and Q are respectively.

(1) CH_3COCH_3, $(CH_3)_2CHOOCCH_3$

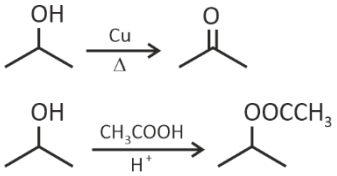
(2) $CH_3COOCH_2CH_2CH_3$, $CH_3 - CH = CH_2$

(3) C_2H_5CHO, $CH_3COOC_2H_5$

(4) $CH_3CH_2CH_3$, $CH_3COOC_3H_7$

Answer (1)

Sol.



15. Consider the following statements :

Statement I : Al is more reducing in nature than Tl.

Statement II : First three ionisation enthalpy of B are high, so it forms covalent compound

(1) Statement I and statement II both correct

(2) Statement I and statement II both incorrect

(3) Statement I correct and statement II incorrect

(4) Statement I incorrect and Statement II correct

Answer (1)

Sol. $E^o_{Al^{3+}/Al} = -1.66$ V

$E^o_{Tl^{3+}/Tl} = +0.72$ V $\quad E^o_{Tl^{3+}/Tl^+} = 1.26$ V

Statement I correct

Due to small size of boron it has extremely high value of $(IE_1 + IE_2 + IE_3)$

Al due to larger size it has lower ionisation energy $(IE_1 + IE_2 + IE_3)$

16. 2-Methyl propene is added into a solvent (mixture of ethyl acetate and ether) and the R_f value is found to be 0.42.

If the same 2-methyl propene is reacted with dilute H_2SO_4 the major product obtained is x. Find the value of x.

(1) 0.12

(2) 0.42

(3) 0.65

(4) 0.84

Answer (1)

Sol. $CH_3-\overset{\overset{CH_3}{|}}{C}=CH_2 \xrightarrow[H_2SO_4]{dil} CH_3-\underset{\underset{CH_3}{|}}{C}-CH_3$

2-Methylpropene is a non-polar hydrocarbon when reacted with dilute H_2SO_4 polar alcohol due to presence of the –OH group, which allows for H-bonding with solvent.

So, a polar alcohol will have a lower R_f value than a non-polar alkene.

For 2-methylpropan-2-ol. R_f value showed be less than 0.42.

17. The correct order of magnitude of work done in the following cases for some volume change and pressure change as mentioned.

Case I : (a) Expansion in single step ($P_1 \rightarrow P_2$)

Case II : (b) Expansion in multistep ($P_1 \rightarrow P_2$)

Case III : (c) Compression in single step ($P_2 \rightarrow P_1$)

Case IV : (d) Compression in multistep ($P_2 \rightarrow P_1$)

(1) $W_C > W_D > W_B > W_A$

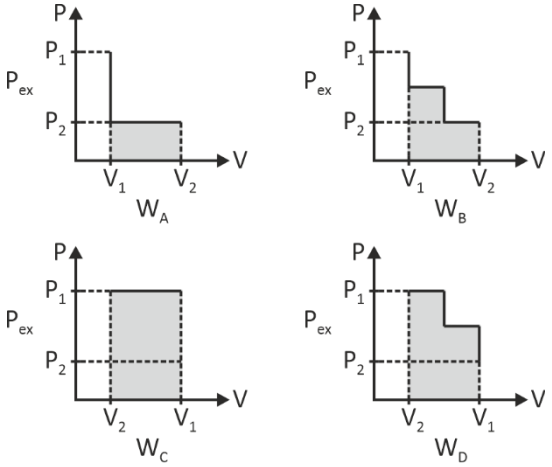
(2) $W_D > W_C > W_B > W_A$

(3) $W_A > W_B > W_D > W_C$

(4) $W_A > W_B > W_C > W_D$

Answer (1)

Sol.



18. He is mixed with a gas A in equimolar ratio at pressure P, total volume is 10 L at 300 K. $\left\{ \underset{(g)}{A} \rightleftharpoons \underset{(g)}{B},\ K_p = 4 \right\}$

The partial pressure of He, A and B at equilibrium is respectively.

(1) 0.5 P, 0.1 P and 0.4 P

(2) 0.2 P, 0.3 P and 0.5 P

(3) 0.5 P, 0.4 P and 0.1 P

(4) 0.5 P, 0.2 P and 0.3 P

Answer (1)

Sol. Initially $p_{He} = p_A$, and $P = p_{He} + p_A$, so $p_{He} = p_A = \frac{P}{2}$

	$A \rightleftharpoons$	$B,\ K_p = 4$
Initially	$\frac{P}{2}$	0
	$-x$	$+x$
At equilibrium	$\left(\frac{P}{2}-x\right)$	x

$4 = \frac{x}{\left(\frac{P}{2}-x\right)}$, on solving x = 0.4 P

So, at equilibrium $p_A = \left(\frac{P}{2}\right) - 0.4\ P = 0.1\ P$

$p_B = 0.4\ P$

$p_{He} = 0.5\ P$

19. Match compounds in column I with column II

	Column-I		**Column-II**
(a)	Lysine	(i)	Hinsberg Test
(b)	Glutamine	(ii)	Hoffmann Bromamide (starting material)
(c)	Serine	(iii)	Ceric ammonium nitrate
(d)	Tyrosine	(iv)	Neutral $FeCl_3$ test

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

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

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

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

Answer (1)

Sol. Lysine $\rightarrow$ Hinsberg test $H_2N–(CH_2)_4–$

Glutamine $\rightarrow$ Starting Hoffmann Bromamide

$H_2NCO–CH_2–CH_2–$

Serine $\rightarrow$ Cerric ammonium nitrate test

$(HO–CH_2–)$

Tyrosine – Neutral $Fecl_3$ test $(p)HO–C_6H_4 – CH_2–$

20. Choose the correct option of order of energy for square planar complex

(1) $dxz = dyz < dx^2 – y^2$

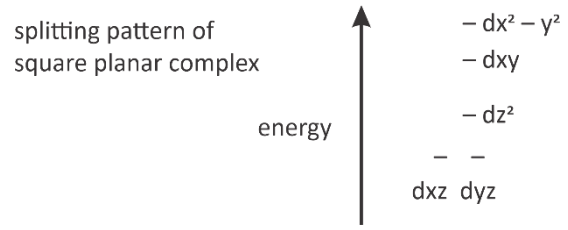
(2) $dxy = dxz > dz^2$

(3) $dxy = dyz = dxz$

(4) $dxy < dz^2 < dx^2 – y^2$

Answer (1)

Sol.



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. Sucrose hydrolyses in acidic medium to form glucose and fructose which follows first order kinetics. If the half life of sucrose is 3 hrs. The % of sucrose left after 6 hrs.

Answer (25)

Sol. $t_{1/2} = 3$ hrs

$$\text{Sucrose}\,[A_0] \xrightarrow{3\,\text{hrs}} \frac{[A_0]}{2} \xrightarrow{3\,\text{hrs}} \frac{[A_0]}{4}$$

% of sucrose left is 25.

22. For the reaction,

$A(g) \rightleftharpoons B(g) + C(g)$

Consider the data

$\log K_p$	3.5	2.5
$\frac{1}{T}\,(K^{-1})$	0.04	0.05

Calculate the value of $\frac{\Delta H}{2.303R}$ (in K) based on above data.

Answer (100)

Sol. $$\log\frac{K_{p_2}}{K_{p_1}} = \frac{\Delta H}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

$$\log K_{p_2} - \log K_{p_1} = \frac{\Delta H}{2.303R}[0.05 - 0.04]$$

$$1 = \frac{\Delta H}{2.303R} \times 0.01$$

$$\boxed{100 = \frac{\Delta H}{2.303R}}$$

23.

24.

25.

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 value of $1^3 - 2^3 + 3^3 - 4^3 + ... + 15^3$ is equal to

(1) 1856 (2) 1854

(3) 1786 (4) 1826

Answer (1)

Sol. $1^3 - 2^3 + 3^3 - 4^3 + ... + 15^3 + (2^3 + 4^3 + ... + 14^3) - (2^3 + 4^3 + ... + 14^3)$

$= (1^3 + 2^3 + 3^3 + ... + 15^3) - 2(2^3 + 4^3 + ... + 14^3)$

$$= \left(\frac{15\times 16}{2}\right)^2 - 2\times 2^3\left(1^3 + 2^3 + ... + 7^3\right)$$

$$= (15\times 8)^2 - 16\left(\left(\frac{7\times 8}{2}\right)^2\right)$$

$= 1856$

2. $\int_{-\pi/4}^{\pi/4} \frac{32\cos^4\theta}{1+e^{\sin\theta}}d\theta$ is equal to

(1) $3\pi + 8$ (2) $3\pi + 4$

(3) $4\pi + 8$ (4) $4\pi + 4$

Answer (1)

Sol. $I = \int_{-\pi/4}^{\pi/4} \frac{32\cos^4\theta}{1+e^{\sin\theta}}d\theta$

$$I = \int_0^{\pi/4}\left(\frac{32\cos^4\theta}{1+e^{\sin\theta}} + \frac{32\cos^4(-\theta)}{1+e^{\sin(-\theta)}}\right)d\theta$$

$$= \int_0^{\pi/4}\left(\frac{32\cos^4\theta}{1+e^{\sin\theta}} + \frac{32\cos^4\theta}{1+e^{-\sin\theta}}\right)d\theta$$

$$= 32\int_0^{\pi/4}\cos^4\theta\left(\frac{1}{1+e^{\sin\theta}} + \frac{1}{1+e^{-\sin\theta}}\right)d\theta$$

$$= 32\int_0^{\pi/4}\cos^4\theta d\theta$$

$$= 32\int_0^{\pi/4}\left(\frac{1+\cos 2\theta}{2}\right)^2 d\theta$$

$$= \frac{32}{4}\int_0^{\pi/4}(1+2\cos 2\theta+\cos^2 2\theta)d\theta$$

$$= \frac{32}{4}\int_0^{\pi/4}\left(1+2\cos 2\theta+\frac{1+\cos 4\theta}{2}\right)d\theta$$

$$= \frac{32}{8}\int_0^{\pi/4}(3+4\cos 2\theta+\cos 4\theta)d\theta$$

$$= 4\left[3\theta + 2\sin 2\theta + \frac{1}{4}\sin 4\theta\right]_0^{\pi/4}$$

$= 3\pi + 8$

3. If $x_1, x_2, ..., x_{25}$ be 25 observations such that $\sum_{i=1}^{25}(x_i+5)^2 = 2500$ and $\sum_{i=1}^{25}(x_i-5)^2 = 1000$. Then, the ratio of Mean and Standard deviation of the given observations is

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

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

Answer (2)

Sol. $\sum_{i=1}^{25}(x_i+5)^2 = 2500$

$$\sum_{i=1}^{25}x_i^2 + 10\sum_{i=1}^{25}x_i + 25\times 25 = 2500$$

$$\sum_{i=1}^{25}x_i^2 + 10\sum_{i=1}^{25}x_i = 1875 \quad ...(1)$$

$$\sum_{i=1}^{25}(x_i-5)^2=1000$$

$$\sum_{i=1}^{25}x_i^2-10\sum_{i=1}^{25}x_i=375 \qquad \ldots(2)$$

$$2\sum_{i=1}^{25}x_i^2=2250$$

$$\sum_{i=1}^{25}x_i^2=1125$$

and $\sum_{i=1}^{25}x_i=75$

Mean = $\frac{\sum_{i=1}^{25}x_i}{25}=\frac{75}{25}=3$

S.D = $\sqrt{\frac{\sum_{i=1}^{25}x_i^2}{25}-(\text{Mean})^2}$

$=\sqrt{36}=6$

$\frac{\text{Mean}}{S.D}=\frac{3}{6}=\frac{1}{2}$

4. In the expansion of $(1+\alpha x)^{26}$ and $(1-\alpha x)^{28}$, the coefficient of middle term is same, then the value of α is

(1) $\frac{7}{22}$ (2) $\frac{7}{27}$

(3) $\frac{5}{27}$ (4) $\frac{5}{22}$

Answer (2)

Sol. $(1+\alpha x)^{26}$

Middle term position $=\frac{26}{2}+1$ = 14th term.

$T_{14}={}^{26}C_{13}(\alpha x)^{13}={}^{26}C_{13}\alpha^{13}x^{13}$

$(1-\alpha x)^{28}$

Middle term : $\frac{28}{2}+1$ = 15th term

$T_{15}={}^{28}C_{14}(-\alpha x)^{14}={}^{28}C_{14}\alpha^{14}x^{14}$

Now,

${}^{26}C_{13}\alpha^{13}={}^{28}C_{14}\alpha^{14}$

$\therefore \alpha=\frac{{}^{26}C_{13}}{{}^{28}C_{14}}=\frac{7}{27}$

5. $a_1, a_2, a_3,\ldots\ldots,a_n$ are in A.P. and sum of first 10 terms is 160. $g_1, g_2, g_3,\ldots\ldots g_n$ are in G.P., were $g_1 + g_2 = 8$. If the first term of A.P. is equal to common ratio of G.P. and first term of G.P. is equal to common difference of A.P., then sum of all possible values of g_1 is equal to

(1) $\frac{34}{9}$ (2) $\frac{28}{9}$

(3) $\frac{23}{3}$ (4) $\frac{28}{5}$

Answer (1)

Sol. $g_1 = d$ and $a_1 = r$....(given)

$160=\frac{10}{2}(2a_1+9d)$.....(given)

$\Rightarrow 160 = 5(2r + 9d)$

$\Rightarrow 2r + 9d = 32$

$g_2 = g_1 \times r \Rightarrow g_2 = dr \quad (g_1 = d)$

$g_1 + g_2 = 8$ …… (given)

$\Rightarrow d(1 + r) = 8$

$\Rightarrow d\left(1+\frac{32-9d}{2}\right)=8$

$\Rightarrow 9d^2 - 34d + 16 = 0$

sum of all possible value of g_1

= sum of all possible value of d

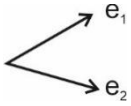
= $\frac{34}{9}$

6. Consider e_1 and e_2 be roots of the equation $x^2 - ax + 2 = 0$. Set of values of a for which e_1 and e_2 are eccentricities of hyperbolas then $a \in [\alpha, \beta)$ and set of values of a for which e_1 and e_2 are eccentricity of a hyperbola and an ellipse is (γ, ∞) then $\alpha^2 + \beta^2 + \gamma^2$ is equal to

(1) 26 (2) 24

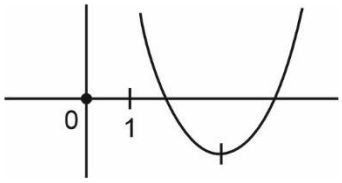
(3) 18 (4) 32

Answer (1)

Sol. $x^2 - ax + 2 = 0$ 

S. 1 $\Rightarrow$ e_1 and e_2 are eccentricity of hyperbola

$\Rightarrow e_1, e_2 > 1$



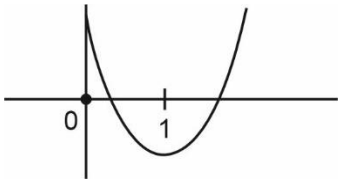
$\Rightarrow f(1) > 0, -\frac{b}{2a} > 1, D \geq 0 \quad \Rightarrow a^2 - 8 \geq 0 \Rightarrow |a| \geq 2\sqrt{2}$

$\Rightarrow \frac{a}{2} > 1 \Rightarrow a > 2$

$1 - a + 2 > 0 \Rightarrow a < 3$

$\Rightarrow a \in [2\sqrt{2}, 3)$

S. 2 $\Rightarrow$ e_1 and e_2 be eccentricity of hyperbola & Ellipse respectively



$\Rightarrow f(1) < 0$ and $D > 0$

$\Rightarrow 1 - a + 2 < 0 \qquad \Rightarrow a > 3$

$a^2 - 8 > 0 \qquad \Rightarrow |a| \geq 2\sqrt{2}$

$\Rightarrow a \in (3, \infty)$

$\Rightarrow \alpha^2 + \beta^2 + r^2 = 8 + 9 + 9 = 26$

7. There are (n + 1) coins. 'n' coins are unbiased coins and one coin has two heads. A coin is randomly chosen and tossed once. If the probability of getting head is $\frac{9}{16}$, then the value of n is

(1) 5 (2) 6

(3) 7 (4) 8

Answer (3)

Sol. There are n unbiased coin, 1 biased coin

E_1 : Biased coin is picked

E_2 : Unbiased coin is picked

H : Output is Head

$$P(H) = P(E_1) \cdot P\left(\frac{H}{E_1}\right) + P(E_2) \cdot P\left(\frac{H}{E_2}\right)$$

$$\frac{9}{16} = \frac{1}{n+1} \times 1 + \frac{n}{n+1} \times \frac{1}{2}$$

$$\Rightarrow \quad \frac{9}{16} = \frac{2+n}{2(n+1)}$$

$\Rightarrow$ $9n + 9 = 16 + 8n$

$\Rightarrow$ $n = 7$

8. The number of 4 letter words which can be made using the letters of the word INCONSEQUINTAL without repetition using 2 vowels and 2 consonants is equal to

(1) 3460 (2) 3600

(3) 4200 (4) 2400

Answer (2)

Sol. Vowels : {A, E, I, O, U}

Consants : {N, C, S, Q, T, L}

Two vowels and two consonants :

$^5C_2 \times {}^6C_2 \times 4!$

= 10 × 15 × 24 = 3600

9. If $\tan^{-1}(1-\alpha)+\tan^{-1}(1-\beta)=\frac{\pi}{4}$ & $\beta=\frac{1}{3\alpha}$ then the value of $6(\alpha+\beta)$ is equal to

(1) 7 (2) 9

(3) 8 (4) 6

Answer (1)

Sol. $\tan^{-1}(1-\alpha)+\tan^{-1}(1-\beta)=\frac{\pi}{4}$

$$\tan^{-1}\left(\frac{1-\alpha+1-\beta}{1-(1-\alpha)(1-\beta)}\right)=\frac{\pi}{4}$$

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

$$\frac{2-(\alpha+\beta)}{\alpha+\beta-\frac{1}{3}}=1$$

$$2-(\alpha+\beta)=\alpha+\beta-\frac{1}{3}$$

$$2(\alpha+\beta)=2+\frac{1}{3}=\frac{7}{3}$$

$$\alpha+\beta=\frac{7}{6}$$

$\therefore\ 6(\alpha+\beta)=7$

10. If $1+\cos x=\sqrt{3}\sin x$ where $x\in(-2\pi,2\pi)$. Then, the sum of all the values of x satisfy the given equation is

(1) 5π (2) $\frac{4\pi}{3}$

(3) 4π (4) $\frac{-4\pi}{3}$

Answer (4)

Sol. $1+\cos x=\sqrt{3}\sin x$

$$\sqrt{3}\sin x-\cos x=1$$

$$\frac{\sqrt{3}}{2}\sin x-\frac{1}{2}\cos x=\frac{1}{2}$$

$$\left(\cos\frac{\pi}{6}\right)\sin x-\left(\sin\frac{\pi}{6}\right)\cos x=\frac{1}{2}$$

$$\sin\left(x-\frac{\pi}{6}\right)=\frac{1}{2}$$

$$x-\frac{\pi}{6}=\frac{\pi}{6}+2n\pi$$

Or $x=\frac{\pi}{6}=\frac{5\pi}{6}+2n\pi$

$$x=\pi,-\pi,\frac{-5\pi}{3},\frac{\pi}{3}$$

$$\sum x=\frac{\pi}{3}+\pi-\pi-\frac{5\pi}{3}\ =\frac{-4\pi}{3}$$

11. Points P and Q lie on the parabola $y^2 = 12x$. The ratio of their y-coordinates is 1 : 2 and the length of line segment PQ is $3\sqrt{13}$. If line PQ makes an angle θ with positive x-axis in anticlockwise direction, $\theta\in(0,\ \pi)$, then $\sin\theta$ is equal to

(1) $\frac{1}{\sqrt{13}}$ (2) $\frac{3}{\sqrt{13}}$

(3) $\frac{2}{\sqrt{13}}$ (4) $\frac{1}{\sqrt{12}}$

Answer (3)

Sol. $y^2 = 12x$

Let $P(3t_1^2,6t_1)$, $Q(3t_2^2,6t_2)$

$$\frac{6t_1}{6t_2}=\frac{1}{2}$$

$\Rightarrow\ \ t_2 = 2t_1$

$$PQ^2=(3t_2^2-3t_1^2)^2+(6t_2-6t_1)^2$$

$$\Rightarrow(3\sqrt{13})^2=9(3t_1^2)^2+36t_1^2$$

$$\Rightarrow 117=81t_1^4+36t_1^2$$

$$\Rightarrow 9t_1^4+4t_1^2-13=0$$

$\Rightarrow (9t_1^2+13)(t_1^2-1)=0$

$\Rightarrow t_1^2=1$

$t_1 = 1,\ t_2 = 2$

$P(3, 6)\quad Q(12, 12) \rightarrow$ Slope: $\tan\theta=\frac{6}{9}=\frac{2}{3}$

$t_1 = -1,\ t_2 = -2$

$P(3, -6)\quad Q(12, -12) \rightarrow$ Slope: $\tan\theta=\frac{-6}{9}=\frac{-2}{3}$

$\sin\theta=\frac{2}{\sqrt{13}}$ in both cases.

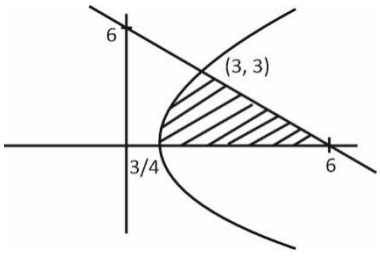
12. If the area (in square units) of the region {(x, y) : $y\le 6-x,\ y^2\le 4x-3,\ x\ge 0,\ y\ge 0$} is

(1) 15 (2) 9

(3) 8 (4) 7

Answer (2)

Sol.



Point of intersection of $y^2=4x-3$ and $y=6-x$ is (3, 3)

Required area = $\int_0^3\left[(6-y)-\left(\frac{y^2+3}{4}\right)\right]dy$

$=\left[6y-\frac{y^2}{2}-\frac{y^3}{12}-\frac{3y}{4}\right]_0^3$

$=\frac{21(3)}{4}-\frac{9}{2}-\frac{27}{12}$

$=\frac{36}{4}$

= 9 sq. units

13. The domains of the function $f(x)=\sin^{-1}\left(\frac{x+[x]}{3}\right)$ is $[\alpha, \beta)$. The value of $\alpha^2+\beta^2$ is equal to

(where [·] represents G.I.F)

(1) 4 (2) 5

(3) 3 (4) 2

Answer (2)

Sol. $\sin^{-1}\left(\frac{x+[x]}{3}\right)\Rightarrow -1\le\frac{x+[x]}{3}\le 1$

$\Rightarrow -3\le x+[x]\le 3$

Case-I: for $x\in[-2,-1)$

$[x] = -2$

$x + [x] \in [-4, -3)$

$\Rightarrow$ (no value of x)

Case-II: $x\in[-1, 0)$

$[x] = -1$

$x + [x] \in [-2, -1) \rightarrow$ all value of $x \in [-1, 0)$

Case-III: $x\in[0, 1)$

$[x] = 0$

$x + [x] \in [0, 1) \rightarrow$ all value of $x \in [0, 1)$

Case-IV: $x\in[1, 2)$

$[x] = 1$

$x + [x] \in [2, 3) \rightarrow$ all value of $x \in [1, 2)$

Case-IV: $x\in[2, 3)$

$[x] = 2$

$x + [x] \in [4, 5) \rightarrow$ no value of x

$\therefore x \in [-1, 2)$

$\alpha^2 + \beta^2 = 5$

14. If the hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1,\ a, b>0$ with eccentricity e passes through point $P(6,\ 4\sqrt{3})$ and $15(e^2+1)=(34)e$ then length of latus rectum of hyperbola $\frac{x^2}{b^2}-\frac{y^2}{2\left(a^2+1\right)}=1$ is

(1) 10 (2) 12

(3) 14 (4) 8

Answer (1)

Sol. $(6,\ \sqrt{48})$ lie on hyperbola,

$\Rightarrow \quad \frac{36}{a^2}-\frac{48}{b^2}=1 \qquad ...(1)$

and $15(e^2+1)=34e$

$\Rightarrow 15e^2-34e+15=0$

$e=\frac{34\pm\sqrt{34^2-4\cdot15^2}}{30}$

$=\frac{34\pm\sqrt{34^2-30^2}}{30}=\frac{34\pm\sqrt{64\times4}}{30}=\frac{34\pm16}{30}$

Since $e>1 \Rightarrow e=\frac{50}{30}=\frac{5}{3}$

$\Rightarrow e^2=\frac{b^2}{a^2}+1=\frac{25}{9}\Rightarrow\frac{b}{a}=\frac{16}{9} \qquad ...(2)$

$\Rightarrow$ solving (1) & (2)

$a^2=9, \quad b^2=16$

Latus rectum $=2\left(\frac{2(a^2+1)}{b}\right)=\frac{4(10)}{4}=10$

15. Consider the circle $x^2+y^2+2gx+2fy+25=0$, where g, $f\in z$. Centre lies on $2x-y=4$ and the area equilateral triangle inscribed within this circle is $27\sqrt{3}$ sq. units. The square of the length of chord whose equation is $x=1$ is equal to

(1) 45 (2) 40

(3) 80 (4) 90

Answer (3)

Sol. $x^2+y^2+2gx+2fy+25=0$

centre: $(-g, -f)$ lies on $2x-y=4$

$-2g+f=4 \Rightarrow f=2g+4$

area $=\frac{3\sqrt{3}}{4}R^2=27\sqrt{3}$

$\Rightarrow \quad R=6$

$36=g^2+f^2-25$

$\Rightarrow \quad g^2+f^2=61$

$\Rightarrow \quad g^2+(2g+4)^2=61$

$\Rightarrow \quad 5g^2+16g-45=0$

$\Rightarrow \quad (5g-9)(g+5)=0$

$\Rightarrow \quad g=\frac{9}{5}, -5$

$\therefore \quad g=-5, f=-6 \qquad \therefore$ centre (5, 6)

Length of chord $=2\sqrt{R^2-d^2}$

$=2\sqrt{36-4^2}=2\sqrt{20}$

$\therefore \quad L^2=80$

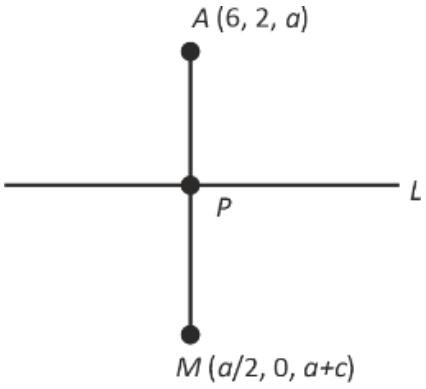
16. If the image of a point $A(6, 2, a)$ with respect to line L : $\frac{x}{1}=\frac{y-1}{2}=\frac{Z-a+1}{b}$ is $\left(\frac{a}{2}, 0, a+c\right)$. Then, the distance of the foot of perpendicular of A on line L from the point (a, b, c) is equal to

(1) $2\sqrt{7}$ (2) $\sqrt{346}$

(3) $\sqrt{421}$ (4) $\sqrt{247}$

Answer (2)

Sol.



$P(\lambda, 2\lambda+1, b\lambda+a-1)$

$\overrightarrow{AP} = (\lambda-6, 2\lambda-1, b\lambda-1)$

$\overrightarrow{AP} \perp L$

$\Rightarrow (\lambda-6)(1)+(2\lambda-1)(2)+b(b\lambda-1)=0$

$\Rightarrow \lambda-6+4\lambda-2+b^2\lambda-b=0$

$\Rightarrow (5+b^2)\lambda = 8+b$

$\Rightarrow \lambda = \dfrac{8+b}{5+b^2}$ ...(1)

$M(2\lambda-6, 4\lambda, 2b\lambda+a-2)$

$2\lambda-6=\dfrac{a}{2}$

$4\lambda=0$ and $2b\lambda+a-2=a+c$

$\Rightarrow \lambda=0$ and $a-2=a+c$

$c=-2$

from (1)

$\boxed{b=-8}$

$Q(a, b, c)=(-12, -8, -2)$

$P(0, 1, -13)$

$PQ=\sqrt{144+81+121} = \sqrt{346}$

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. The value of $\lim\limits_{x\to 0}\dfrac{x^2\sin^2 x}{x^2-\sin^2 x}$ is equal to

Answer (03)

Sol. $$\lim_{x\to 0}\frac{x^2\left(x-\frac{x^3}{3!}+\frac{x^5}{5!}+\ldots\right)^2}{x^2-\left(x-\frac{x^3}{3!}+\frac{x^5}{5!}+\ldots\right)^2}$$

$$= \lim_{x\to 0}\frac{x^4\left(1-\frac{x^2}{3!}+\ldots.\infty\right)}{x^2-x^2+2\cdot\frac{x4}{3!}+\ldots} = \frac{3!}{2} = 3$$

22. Let matrix $A=\begin{bmatrix}-1 & 1 & 1\\ 1 & 0 & 1\\ 0 & 0 & 1\end{bmatrix}$. If $A^2+\alpha(adj(adj(A)))+\beta adj(adj(adj(A)))=\begin{bmatrix}-4 & -4 & 0\\ -4 & 0 & 2\\ 0 & 0 & -2\end{bmatrix}$ then $(\alpha+\beta)^2$ is equal to

Answer (09.00**)**

Sol. adj $(A)=|A|(A^{-1})$

Here, $|A|=-1$

$M_1 = adj(adj(A)) = |A|^{n-2}(A) = -A$

$M_2 = adj(adj(adj(A))) = |A|^{(n-2)(n-1)}(adjA) = (adjA)$

$$\Rightarrow A^2+\alpha M_1+\beta M_2 = \begin{bmatrix}4 & -4 & 0\\ -4 & 0 & 2\\ 0 & 0 & -2\end{bmatrix}$$

$$\begin{bmatrix}2 & -1 & 1\\ -1 & 1 & 2\\ 0 & 0 & 1\end{bmatrix}+\alpha\begin{bmatrix}1 & -1 & -1\\ -1 & 0 & -1\\ 0 & 0 & -1\end{bmatrix}+\beta\begin{bmatrix}0 & -1 & 1\\ -1 & 1 & 2\\ 0 & 0 & -1\end{bmatrix}$$

$$=\begin{bmatrix}4 & -4 & 0\\ -4 & 0 & 2\\ 0 & 0 & -2\end{bmatrix}$$

Comparing

$\alpha=2, \beta=1$

$(\alpha+\beta)^2=9$

23.

24.

25.

❑ ❑ ❑