02/04/2025
Evening

Aakash
Medical | IIT-JEE | Foundations

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for

JEE (Main)-2025 (Online) Phase-2

(Physics, Chemistry and Mathematics)

Time : 3 hrs. **M.M. : 300**

IMPORTANT INSTRUCTIONS:

(1) The test is of **3 hours** duration.

(2) This test paper consists of 75 questions. Each subject (PCM) has 25 questions. The maximum marks are 300.

(3) This question paper contains **Three Parts**. **Part-A** is Physics, **Part-B** is Chemistry and **Part-C** is **Mathematics**. Each part has only two sections: **Section-A** and **Section-B**.

(4) **Section - A :** Attempt all questions.

(5) **Section - B :** Attempt all questions.

(6) **Section - A (01 – 20)** contains 20 multiple choice questions which have **only one correct answer**. Each question carries **+4 marks** for correct answer and **–1 mark** for wrong answer.

(7) **Section - B (21 – 25) contains** 5 **Numerical value** based questions. The answer to each question should be rounded off to the **nearest integer**. Each question carries **+4 marks** for correct answer and **–1 mark** for wrong answer.

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. What is the dimensional formula of $\frac{1}{\mu_0\varepsilon_0}$ (where μ_0 is permeability and ε_0 is permittivity of free space).

(1) LT^{-1} (2) L^2T^{-2}

(3) MLT^{-1} (4) ML^2T^{-2}

Answer (2)

Sol. $\frac{1}{\sqrt{\mu_0\varepsilon_0}} = C$

$\frac{1}{\mu_0\varepsilon_0} = C^2$

2. An equilateral prism is made of a material of refractive index $\sqrt{2}$. Find angle of incidence for minimum deviation of the light ray.

(1) 60° (2) 30°

(3) 37° (4) 45°

Answer (4)

Sol. $\mu = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\frac{A}{2}}$

$\frac{60° + \delta_m}{2} = 45°$

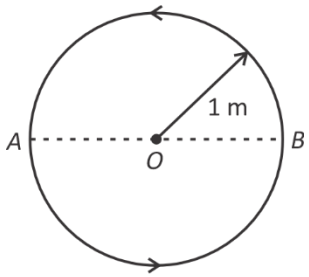
$\delta_m = 30°$

$\delta_m = i + e - A$

$30 = 2i - 60$ $(i = e)$

$i = 45°$

3. A particle moves on a circular path of radius 1 m. Find its displacement when it moves from $A \to B \to A \to B$. Also its distance as it moves from $A \to B \to A \to B \to A$.



(1) Distance = 2 m, displacement = 4π m

(2) Distance = 2 m, displacement = 5π m

(3) Distance = 4π m, displacement = 2 m

(4) Distance = 5π m, displacement = 2 m

Answer (3)

Sol. Displacement = Shortest distance between find and initial positions = 2 m (One and half cycle)

Distance = Total path length covered

= 4π m (Two cycles)

4. The moment of inertia of a ring of mass M and radius R about an axis passing through tangential point in the plane of ring is

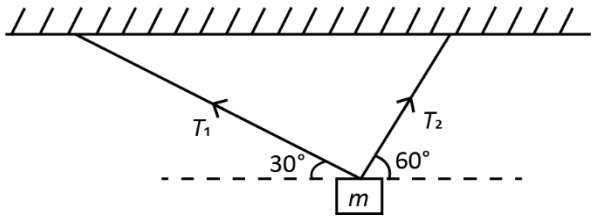
(1) $\frac{5MR^2}{2}$ (2) $\frac{3MR^2}{2}$

(3) $\frac{4MR^2}{3}$ (4) $\frac{2MR^2}{3}$

Answer (2)

Sol. It $= \frac{MR^2}{2} + MR^2 = \frac{3MR^2}{2}$

5. A block of mass m is suspended in a vertical plane with the help of two light strings as shown. Find the ratio of tensions $\frac{T_1}{T_2}$



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

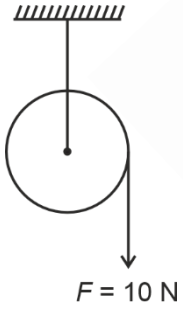
(3) $\frac{1}{\sqrt{3}}$ (4) $\sqrt{3}$

Answer (3)

Sol. $T_1\cos30° = T_2\cos60°$

$$\frac{T_1}{T_2} = \frac{\cos60°}{\cos30°} = \frac{1}{\sqrt{3}}$$

6. A disc of mass M and radius 2 m is hinged keeping axis horizontal. If angular acceleration of disc is 2rad/s^2. Find moment of inertia



(1) 10 kg m^2 (2) 5 kg m^2

(3) 6 kg m^2 (4) 20 kg m^2

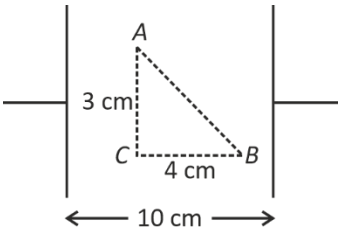
Answer (1)

Sol. $\tau = I\alpha$

$10 \times 2 = 2I$

$I = 10$ kg m^2

7. The figure shows the plates of a parallel plate capacitor with a separation 10 cm and charged to a potential difference V. Find the potential difference between B and A.



(1) $\frac{2V}{5}$

(2) $\frac{V}{2}$

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

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

Answer (1)

Sol. $V = E$ (10 cm)

$V' = E$ (4 cm)

$$V' = \frac{2}{5}V$$

8. Binding energy per nucleon in ^2_1H is x and for ^4_2He is y. Find energy released in the given reaction

$$^2_1H + {}^4_2He \rightarrow {}^4_2He$$

(1) $2x - 2y$

(2) $-4x + 4y$

(3) $4x - 4y$

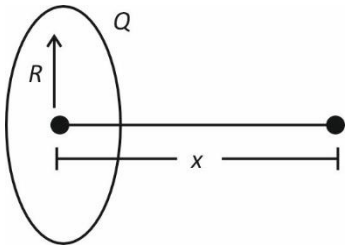
(4) $2y - 4x$

Answer (2)

Sol. $BE = 4y - (2x + 2x)$

$= 4y - 4x$

9. Figure shows a uniformly charged ring having charge Q and radius R. Find the distance from the centre on the axis of the ring where electric field is maximum



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

(3) $2R$ (4) R

Answer (2)

Sol. $E=\frac{kQx}{\left(R^2+x^2\right)^{3/2}}$

$\frac{dE}{dx}=0$

$x=\frac{R}{\sqrt{2}}$

10. Two identical drops of radius R and surface tension 'T' coalesce to form a bigger drop. The change in surface energy in this process is

(1) $4\pi R^2T\left[1-2^{-\frac{1}{3}}\right]$ (2) $8\pi R^2T\left[1+2^{\frac{1}{3}}\right]$

(3) $4\pi R^2T\left[1+2^{\frac{1}{3}}\right]$ (4) $8\pi R^2T\left[2^{-\frac{1}{3}}-1\right]$

Answer (4)

Sol. Volume of bigger drop = $\frac{4}{3}\pi R_1^3=2\left(\frac{4}{3}\pi R^3\right)$

$R_1=R(2)^{\frac{1}{3}}$

Initial energy = $(4\pi R^2T)\times 2$

Final energy = $4\pi R^2(2)^{\frac{2}{3}}T$

11. Two galvanometers G_1 and G_2 are having resistors $R_1 = 5\Omega$ and $R_2 = 7\Omega$, number of turns $N_1 = 21$, $N_2 = 15$, magnetic fields $B_1 = 0.25$ T, $B_2 = 0.50$ T and area of coil $A_1 = 3.6 \times 10^{-3}$ cm^2 and $A_2 = 1.8 \times 10^{-3}$ cm^2. Find the ratio of their voltage sensitivity

(1) $\frac{49}{25}$ (2) $\frac{7}{5}$

(3) $\frac{5}{7}$ (4) $\frac{49}{20}$

Answer (1)

Sol. $\tau = NIAB = K\theta$

$\frac{\theta}{V}=\frac{\theta}{RI}=\frac{NAB}{LKR}$

Ratio of voltage sensitivity $=\left(\frac{N_1A_1B_1}{N_2A_2B_2}\right)\frac{R_2}{R_1}$

$=\frac{21}{15}\times\frac{3.6}{1.8}\times\frac{0.25}{0.50}\times\frac{7}{5}$

$=\frac{49}{25}$

12. Match the List-I with the List-II

(i)	Heat capacity	(a)	J kg^{-1} K^{-1}
(ii)	Specific heat capacity	(b)	J K^{-1}
(iii)	Latent heat	(c)	W m^{-1} K^{-1}
(iv)	Thermal conductivity	(d)	J kg^{-1}

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

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

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

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

Answer (4)

13. In a system of measurement, electric charge (Q), permeability (μ_0) and electric current (i) are considered as fundamental quantity. The dimension of linear momentum in this system is

(1) $\left[Q^2\mu_0^2 i\right]$ (2) $\left[Q\mu_0 i\right]$

(3) $\left[Q\mu_0 i^2\right]$ (4) $\left[Q^2\mu_0 i\right]$

Answer (2)

Sol. Let $P \propto (Q)^a (\mu_0)^b (i)^c$

$$\left[MLT^{-1}\right] = K\left[M^b L^b T^{a-2b} A^{a-2b+c}\right]$$

$a = 1, b = 1, c = 1$

14. Which of the following items (labelled i, ii, iii, iv and v) are true

When an ideal gas undergoes adiabatic process, (symbols have their usual meaning)

(i) $\Delta U = 0$

(ii) $w = -\Delta U$

(iii) PV = Constant

(iv) VT = Constant

(v) $W \alpha |T_2 - T_1|$

(1) (i), (ii), (iv)

(2) (ii) and (v)

(3) (ii), (iii), (v)

(4) (i), (ii), (v)

Answer (2)

Sol. $\Delta Q = O$

$\Rightarrow W = -\Delta U$

$= -nC_v(T_2 - T_1)$

15. A wave is travelling along a string. The wavelength (λ) of the wave is 7.5 m and amplitude is 2 cm. At $t = 0$, there is a crest at $x = 0$ and in 0.3 seconds it travels a distance of 12 cm in +ve x-direction. The equation of the wave is

(1) $2\sin\left(\frac{2\pi}{15}x + \frac{6\pi}{25}t\right)$ cm (2) $2\cos\left(\frac{4\pi}{15}x - \frac{8\pi}{75}t\right)$ cm

(3) $2\cos\left(\frac{4\pi}{15}x + \frac{6\pi}{25}t\right)$ cm (4) $2\sin\left(\frac{4\pi}{15}x - \frac{8\pi}{75}t\right)$ cm

Answer (2)

Sol. $\lambda = 7.5$

$$k = \frac{2\pi}{\lambda} = \frac{2\pi}{7.5} = \frac{4\pi}{15}$$

$$v = \frac{12}{0.3} = 40 \text{ cm/s}$$

$$\frac{\omega}{k} = 40 \text{ cm/s}$$

$$\omega = \frac{40}{100} \times \frac{4\pi}{15} = \frac{40\pi}{375} = \frac{8\pi}{75}$$

$$y = 2\cos\left(\frac{4\pi}{15}x - \frac{8\pi}{75}t\right) \text{ cm}$$

16. An equiconvex lens of radius $R = \frac{1}{6}$ m is having power P. Another Bi convex lens of radii R_1 and R_2 is having same power P, then

(1) $R_1 = \frac{1}{9}$m, $R_2 = \frac{1}{3}$ m (2) $R_1 = \frac{1}{6}$m, $R_2 = \frac{1}{3}$ m

(3) $R_1 = \frac{1}{9}$m, $R_2 = \frac{1}{4}$ m (4) $R_1 = \frac{1}{4}$m, $R_2 = \frac{1}{5}$ m

Answer (1)

Sol. $$\frac{1}{f_1} = (\mu - 1)\left(\frac{2}{R}\right) = (\mu - 1)12$$

$$\frac{1}{f_2} = (\mu - 1)\left(\frac{1}{R_1} + \frac{1}{R_2}\right) = (\mu - 1)12$$

$$\frac{1}{R_1} + \frac{1}{R_2} = 12$$

17. The area of a solenoid is A, length is L, magnetic field inside is B_0 and the relative permeability of medium is 2. The energy stored due to the magnetic field is

(1) $\frac{B_0^2AL}{2\mu_0}$ (2) $\frac{B_0^2AL}{4\mu_0}$

(3) $\frac{4B_0^2AL}{\mu_0}$ (4) $\frac{2B^2AL}{\mu_0}$

Answer (2)

Sol. $E=\frac{B^2}{2\mu}\times AL$

$=\frac{B_0^2AL}{4\mu_0}$

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. The radius of first Bohr orbit of Li^{2+} is $\frac{a_0}{X}$, where a_0 is the radius of the first Bohr orbit of H. Find X

Answer (3)

Sol. $r=a_0\frac{n^2}{\not{Z}}$

For Li^{2+} is ground state $n = 1$ and $\not{Z}=3$

$\Rightarrow r=a_0\frac{(1)^2}{3}=\frac{a_0}{3}$

22. The length of the string in 104 m when the tension in it is 5 N. The length becomes 1.56 m when the tension in it is 7 N. The natural length of the string is ____ m.

Answer (1)

Sol. $T = k(l - l_0)$

$\Rightarrow 5 = k(1.4 - l_0)$

$\Rightarrow 7 = k(1.56 - l_0)$

$\Rightarrow 7(1.4 - l_0) = 5(1.56 - l_0)$

$l_0=\frac{7(1.4)-5(1.56)}{2}=1\text{ m}$

23. A concave mirror and a convex mirror of same focal length are given. A real object is placed in front of the mirror at a distance equal to half the focal length. The ratio of lateral magnification in the image produced by concave mirror to that produced by the convex mirror is

Answer (3)

Sol. $m=\frac{f}{f-u}$

$m_{concave}=\frac{-f}{-f-\left(-\frac{f}{2}\right)}=2$

$m_{convex}=\frac{+f}{+f-\left(-\frac{f}{2}\right)}=\frac{2}{3}$

$\frac{m_{concave}}{m_{convex}}=3$

24.

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. Given below are the electronic configurations

(a) $1s^2 2s^2 2p^3$ (b) $1s^2 2s^2 2p^4$

(c) $1s^2 2s^2 2p^5$ (d) $1s^2 2s^2 2p^6$

The correct order of electronegativity is

(1) a > b > c > d

(2) c > b > a > d

(3) d > c > b > a

(4) c > b > d > a

Answer (2)

Sol. $1s^2 2s^2 2p^3$ = N

$1s^2 2s^2 2p^4$ = O

$1s^2 2s^2 2p^5$ = F

$1s^2 2s^2 2p^6$ = Ne

Electronegativity order : F > O > N > Ne

2. In 3,3-dimethylhex-1-en-4-yne, the number of *sp*, sp^2 and sp^3 carbon atoms, respectively are

(1) 2, 2, 4

(2) 2, 2, 2

(3) 4, 2, 2

(4) 2, 4, 2

Answer (1)

Sol.  ⇒ 3,3-dimethylhex-1-en-4-yne, $2sp^2$ hybridised, 2-*sp* hybridised and $4sp^3$ hybridised carbon atoms are present.

3. Nature of compounds TeO_2 and TeH_2 is ____ and ____ respectively

(1) Oxidising and reducing

(2) Highly acidic and highly basic

(3) Reducing and basic

(4) Basic and oxidising

Answer (1)

Sol. TeO_2 is oxidising in nature

TeH_2 is reducing in nature

4. **Statement-I :** Melting point of neopentane is greater than that of n-pentane.

Statement-II : Neopentane gives only one monosubstituted product.

(1) Both **Statement-I** and **Statement-II** are correct

(2) Both **Statement-I** and **Statement-II** are incorrect

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

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

Answer (1)

Sol.
- Melting point of neopentane (256.4 K) > n-pentane (143.3 K) because of symmetry
- All H-atoms of Neopentane are equivalent. Hence only 1 monosubstituted product is formed.

5. Sodium nitroprusside test is used for detection of which of the following species in organic compounds?

(1) SO_4^{2-}

(2) S^{2-}

(3) Na^+

(4) PO_4^{3-}

Answer (2)

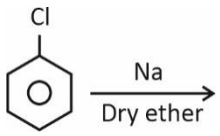
Sol. $2\,Na + S \longrightarrow Na_2S$

(from organic compound)

$$Na_2S + Na_2\left[Fe^{II}(CN)_5NO\right] \longrightarrow Na_4\left[Fe(CN)_5NOS\right]$$

Violet colour

6. Match the reactions given in List-I with the name of the reaction given in List-II and select the correct option.

	List-I		List-I
A	$RX + Na \xrightarrow[\text{ether}]{\text{Dry}}$	I	Fittig reaction
B	$RCOOH \xrightarrow[\Delta]{NaOH + CaO}$	II	Lucas test
C	$ROH \xrightarrow[\text{conc.HCl}]{\text{anhy. } ZnCl_2}$	III	Wurtz reaction
D		IV	Soda lime Decarboxylation reaction

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

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

Answer (2)

Sol. A-III, B-IV, C-II, D-I

7. Which of the following is the correct order of enthalpy of atomisation of 3d-series?

(1) Ni > Cu > Mn > Zn

(2) Zn > Cu > Mn > Ni

(3) Cu > Mn > Ni > Zn

(4) Mn > Ni > Cu > Zn

Answer (1)

Sol. The enthalpy of atomisation of

Ni = 430 kJ/mol

Cu = 339 kJ/mol

Mn = 281 kJ/mol

Zn = 186 kJ/mol

8. Which one of the following has at least one lone pair at the central atom and different bond lengths?

(1) XeF_4

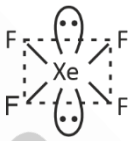
(2) XeF_2

(3) SF_4

(4) PF_5

Answer (3)

Sol. XeF_4 : Hybridisation of Xe : sp^3d^2

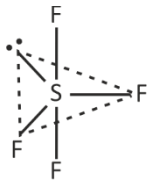


All the Xe – F bond lengths are same but Xe has two lone pairs.

XeF_2 : Hybridisation of Xe : sp^3d

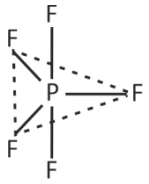
All the Xe – F bond lengths are same but Xe has three lone pairs.

SF_4 : Hybridisation of S : sp^3d



Axial S – F bond length is different from equatorial S – F bond length and S has one lone pair.

PF_5 :Hybridisation of P : sp^3d



P has no lone pair.

9. In adiabatic process, the magnitude of work done in case of one step & ∞ steps follows order :-

(1) $|W_{rev}|_{expansion} > |W_{irr}|_{expansion}$

(2) $|W_{rev}|_{expansion} < |W_{irrev}|_{expansion}$

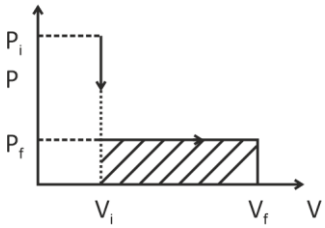
(3) $|W_{rev}|_{expansion} = |W_{irrev}|_{expansion}$

(4) Can't be predicted

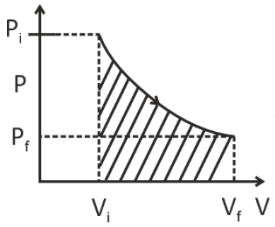
Answer (1)

Sol. $|W|$ = Area under PV curve

For single step (Expansion) process



For infinite steps process (Expansion)



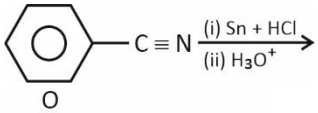
From above graph

$|W_{rev}|_{expansion} > |W_{irr}|_{expansion}$

10. Which of the following reactions gives carboxylic acid?

(1) $RCN \xrightarrow{H^+/H_2O}$

(2) $RCH_2OH \xrightarrow{PCC}$

(3) 

(4) $R-\underset{\underset{O}{\|}}{C}-Cl \xrightarrow{Pd\text{-}BaSO_4,\ H_2}$

Answer (1)

Sol. $R-CN \xrightarrow{H^+/H_2O} R-COOH$

$RCH_2-OH \xrightarrow{PCC} R-CHO$

$Ph-CN \xrightarrow[(ii)\ H_3O^+]{(i)\ Sn+HCl} Ph-CHO$

$R-\underset{\underset{O}{\|}}{C}-Cl \xrightarrow[H_2]{Pd+BaSO_4} R-\underset{\underset{O}{\|}}{C}-H$

11. Which of the following complexes has the highest CFSE value neglecting pairing energy (Magnitude)

(1) $[CoF_6]^{3-}$ (2) $[Mn(H_2O)_6]^{2+}$

(3) $[Zn(H_2O)_6]^{2+}$ (4) $[Co(en)_3]^{3+}$

Answer (4)

Sol. $CFSE = (-0.4 \times t_{2g}e^- + 0.6 \times e_g e^-)\Delta_o$

$[CoF_6]^{3-} \Rightarrow Co^{3+}$ WFL $\Rightarrow t_{2g}^4 e_g^2$

$CFSE = [4 \times -0.4 + 0.6 \times 2]\Delta_o$

$= -0.4\Delta_o$

$[Mn(H_2O)_6]^{2+} \Rightarrow Mn^{2+} \Rightarrow 3d^5$

$H_2O \Rightarrow$ WFL $\Rightarrow t_{2g}^3 e_g^2$

$CFSE = [3 \times (-0.4) + 2 \times (0.6)]\Delta_o$

$= 0$

$[Zn(H_2O)_6]^{2+}$

$Zn^{2+} \Rightarrow 3d^{10}$

$H_2O \Rightarrow$ WFL $\Rightarrow t_{2g}^6 e_g^4$

$CFSE = [6 \times (-0.4) + 4 \times (0.6)]\Delta_o$

$= 0$

$[Co(en)_3]^{3+} \Rightarrow Co^{3+} \Rightarrow 3d^6$

$en \Rightarrow$ SFL

$\Rightarrow t_{2g}^6 e_g^0$

$CFSE = 6 \times (-0.4)\Delta_o$

$= -2.4\Delta_o$

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

	List-I (Pair of molecules)		List-I (Purification method)
A	Glycerol and spent-lye	I	Steam distillation
B	Water and Aniline	II	Fractional distillation
C	Petrol and Diesel	III	Distillation under reduced pressure
D	Aniline and $CHCl_3$	IV	Distillation

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

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

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

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

Answer (04)

Sol. Boiling point of aniline is 547 K and B.P of $CHCl_3$ is 334 K

So they are separated by simple distillation.

$\therefore$ A-III, B-I, C-II, D-IV

13. The four different amino acids are given, A, B, C and D. Calculate the number of tetrapeptides formed including all the four amino acids.

(1) 8

(2) 16

(3) 24

(4) 32

Answer (3)

Sol. Total 24 tetrapeptides are formed. The 24 tetrapeptides formed including all the four amino acids are

ABCD BACD CABD DABC
ABDC BADC CADB DACB
ACBD BDAC CBAD DBAC
ACDB BDCA CBDA DBCA
ADBC BCAD CDAB DCAB
ADCB BCDA CDBA DCBA

Total 24

14. For the reversible reaction $A(g) \rightleftharpoons B(g) + C(g)$. The degree of dissociation is α at pressure P_T, then

(1) If $P_T >> K_P$, then $\alpha \approx 1$

(2) If P_T increases, then α decreases

(3) If P_T increases, then α increases

(4) If $K_P >> P_T$, then α tend to 0

Answer (2)

Sol.

	A(g)	$\rightleftharpoons$	B(g)	+	C(g)
$t = 0$	P_0		0		0
$t = t_{eq}$	$P_0(1-\alpha)$		$P_0\alpha$		$P_0\alpha$

$P_T = P_0 + P_0\alpha$

$$\frac{P_T}{1+\alpha} = P_0$$

$$K_p = \frac{(p_B)(p_C)}{(p_A)} = \frac{P_0\alpha \cdot P_0\alpha}{P_0(1-\alpha)}$$

$$K_P = \frac{P_0\alpha^2}{1-\alpha}$$

$$K_P = \frac{P_T\alpha^2}{1-\alpha^2}$$

α tends to zero if $P_T >> K_P$

If P_T increases, then α decreases (According To Le-Chatelier Principle).

15. The number of unpaired electrons and hybridisation of $[Mn(CN)_6]^{3-}$, respectively are :-

(1) 4 and d^2sp^3

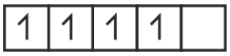
(2) 4 and sp^3d^2

(3) 2 and d^2sp^3

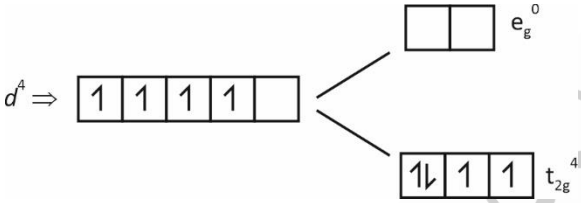
(4) 2 and sp^3d^2

Answer (3)

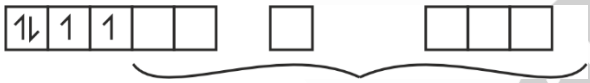
Sol. $[Mn(CN)_6]^{3-} \Rightarrow$ Mn in +3 oxidation state

$Mn^{3+} \Rightarrow 3d^4 \Rightarrow$  $\Rightarrow$ pairing will take place.

CN^- ion in presence of Mn^{3+} ion, acts as strong field ligand.



Inner orbital complex is formed, with 2 unpaired e^-



Total 2 unpaired e^- are present in $[Mn(CN)_6]^{3-}$.

Its hybridisation will be d^2sp^3.

16. Consider the following statements

(A) Value of l gives shape of orbital

(B) ψ represent wave function of an electron

(C) Electron density of p_x orbital in xy plane is zero

(D) $2p_x$ orbital is 

The correct statement(s) are

(1) (A) and (D) only

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

(3) (A), (B) and (D) only

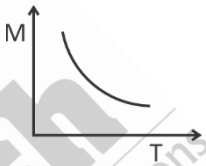
(4) (A), (B), (C) and (D)

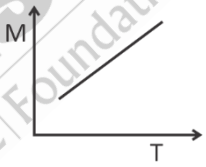
Answer (3)

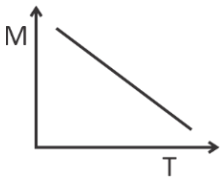
Sol. $2p_x$ orbital is 

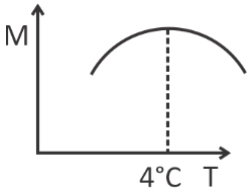
For $2p_x$ orbital, yz is the nodal plane.

17. 1 M NaCl solution is prepared at 0°C in H_2O. Now it is heated. Then find correct graph between molarity and temperature.

(1) 

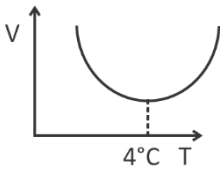
(2) 

(3) 

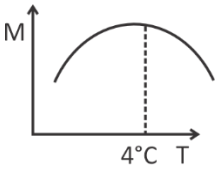
(4) 

Answer (4)

Sol. Volume of water vs temperature



$$\text{Molarity} = \frac{\text{Moles of solute}}{\text{Volume of solution}}$$



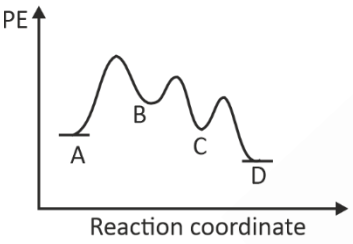
Volume is minimum at 4°C, so molarity will be maximum at 4°C.

18. Consider the following reaction:

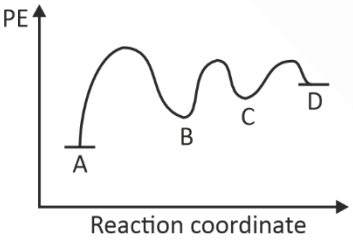
$$A \xrightarrow[\text{slow}]{\Delta H > 0} B \xrightarrow[\text{fast}]{\Delta H < 0} C \xrightarrow[\text{fast}]{\Delta H < 0} D$$

Then correct graph will be

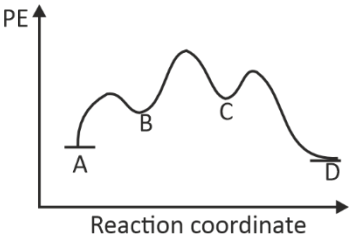
(1)



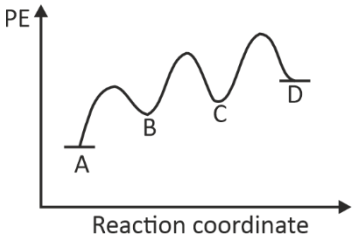
(2)



(3)



(4)



Answer (1)

Sol. First step is slowest and endothermic

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. 0.5 g of organic compound is heated with CuO in a CO_2 atmosphere at 300 K. The volume of N_2 gas collected over H_2O is 60 mL. If aqueous tension is 15 mm Hg at 300 K and pressure recorded is 715 mm Hg, then calculate percentage of nitrogen in organic compound

Answer (13)

Sol. Pressure of N_2 gas = (715 – 15) = 700 mmHg

$$n_{N_2} = \frac{PV}{RT}$$

$$n_{N_2} = \frac{700 \times 60 \times 10^{-3}}{760 \times 0.0821 \times 300}$$

$$= 2.24 \times 10^{-3} \text{ mol}$$

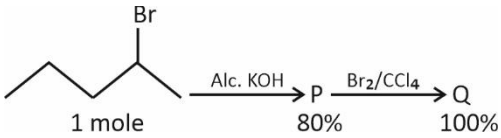
Mass of $N_2 = 2.24 \times 10^{-3} \times 28$ g

$$= 0.06272 \text{ g}$$

$$\% N_2 = \frac{0.06272}{0.5} \times 100$$

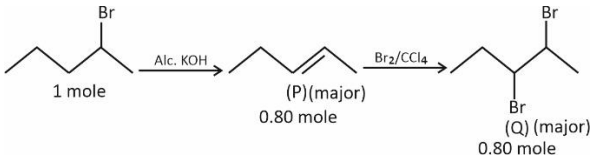
$$= 12.544\% \simeq 13\%$$

22. Consider the following reaction sequence with percentage yield of each product formed. Calculate mass(in g) of major product Q



Answer (184)

Sol.



Molecular mass of Q = 230 g mol^{-1}

Mass of Q = 0.8 × 230

= 184 g

23. If the percentage w/v for NaOH is 0.2 and resistivity is 870 milliohm metre. Then, calculate $\wedge_m$ (in S cm^2 mol^{-1})

Answer (230)

Sol. $\kappa = \frac{1}{R}\frac{l}{A} = \frac{1}{\rho}$

$= \frac{1}{0.87}\ ohm^{-1}m^{-1}$

= 1.15 $ohm^{-1}m^{-1}$

= 0.0115 $ohm^{-1}cm^{-1}$

We have % w/v of NaOH = 0.2

Means 0.2 g of NaOH present in 100 mL of solution

$M = \frac{0.2}{40 \times 0.1}$

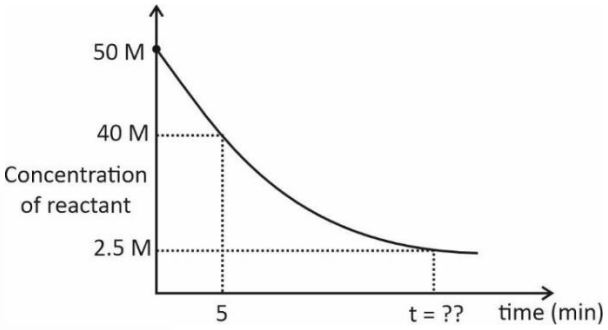
= 0.05 M

$\wedge_m = \frac{\kappa \times 1000}{M}$

$= \frac{1.15 \times 10^{-2} \times 1000}{0.05}$

= 230 S cm^2mol^{-1}

24. Concentration of reactant vs time graph for first order reaction is given below



Find out time required for concentration to become 2.5 M (in min) (Given: log 5 = 0.7 and log 4 = 0.6)

Answer (65)

Sol. $k = \frac{2.303}{5}\log\frac{50}{40}$

$k = \frac{2.303}{5}\log\frac{5}{4}$

$t = \frac{2.303}{k}\log\frac{50}{2.5}$

$= \frac{2.303 \times 5}{2.303\ \log\frac{5}{4}} \times \log 20$

$= \frac{5 \times 1.30}{0.1}$

= 65 min

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. If the domain of the function $f(x)=\frac{1}{\sqrt{3x+10-x^2}}+\frac{1}{\sqrt{x+|x|}}$ is (a, b) then $(1 + a)^2 + b^2$ is equal to

(1) 25 (2) 16

(3) 24 (4) 26

Answer (4)

Sol. $x+|x|=\begin{cases}2x, & x\geq 0\\ 0, & x<0\end{cases}$

$\Rightarrow \frac{1}{\sqrt{x+|x|}}$, domain is $x > 0$, as $2x \neq 0$

Similarly,

$\frac{1}{\sqrt{3x+10-x^2}}$ is defined when $3x + 10 – x^2 > 0$

$\Rightarrow x^2 – 3x – 10 < 0$

$(x – 5)(x + 2) < 0$

$\Rightarrow x \in (–2, 5)$

$\Rightarrow$ Domain will be $(0, \infty) \cap (–2, 5) = (0, 5)$

$\Rightarrow (1 + a)^2 + b^2 = 1 + 25 = 26$

2. Find the eccentricity of the ellipse in which length of minor axis is equal to one-fourth of the distance between their foci.

(1) $\frac{4}{\sqrt{17}}$ (2) $\frac{2}{\sqrt{17}}$

(3) $\frac{7}{\sqrt{17}}$ (4) $\frac{8}{\sqrt{17}}$

Answer (1)

Sol. $2b=\frac{1}{4}(ae)\Rightarrow 4b=ae$

$b^2=a^2-a^2e^2$

$b^2=a^2-16b^2$

$17b^2=a^2$

$e=\sqrt{\frac{1-b^2}{a^2}}=\sqrt{\frac{1-1}{17}}=\frac{4}{\sqrt{17}}$

3. If two vectors $\vec{a}$ and $\vec{b}$ is given by $\vec{a}=\hat{i}+2\hat{j}+3\hat{k}$ and $\vec{b}=-\hat{i}+4\hat{j}+8\hat{k}$ and the vectors $\vec{c}$ and $\vec{d}$ are related as $(\vec{a}-\vec{c})\times\vec{b}=5\hat{i}-2\hat{j}+3\hat{k}$ and $\vec{b}\times\vec{c}=\vec{d}$. Then $|\vec{a}\cdot\vec{d}|$ is equal to

(1) 12 (2) 8

(3) 10 (4) 7

Answer (3)

Sol. $(\vec{a}-\vec{c})\times\vec{b}=5\hat{i}-2\hat{j}+3\hat{k}$

$\vec{a}\times\vec{b}-\vec{c}\times\vec{b}=5\hat{i}-2\hat{j}+3\hat{k}$

$\vec{a}\times\vec{b}+\vec{d}=5\hat{i}-2\hat{j}+3\hat{k}$ (as $\vec{b}\times\vec{c}=\vec{d}$)

dot with $\vec{a}$

$\vec{a}\cdot(\vec{a}\times\vec{b})+\vec{a}\cdot\vec{d}=\vec{a}\cdot(5\hat{i}-2\hat{j}+3\hat{k})$

$= 5 \times 1 + (–2)(2) + (3)(3)$

$= 5 – 4 + 9 = 10$

4. Evaluate $\int_{-2}^{2}\frac{9x^2}{1+5^x}dx$

(1) 12 (2) 24

(3) 30 (4) 15

Answer (2)

Sol. $I=\int_{-2}^{2}\frac{9x^2}{1+5^x}dx$ ...(1)

$I=\int_{-2}^{2}\frac{9x^2}{1+5^{-x}}dx$ ...(2)

Adding (1) and (2)

$2I=\int_{-2}^{2}\left(\frac{9x^2}{1+5^x}+\frac{5^x\cdot 9x^2}{1+5^x}\right)dx$

$2I=\int_{-2}^{2}\frac{9x^2}{1+5^x}\left(1+5^x\right)dx$

$2I=\int_{-2}^{2}9x^2dx$

$2I=9\left(\frac{x^3}{3}\right)^2$

$2I=9\left(\frac{8}{3}+\frac{8}{3}\right)=48$

$I = 24$

5. If the mean and variance of eight observations a, b, 8, 12, 10, 6, 4, 15, is 9 and 9.25 respectively. Then $a + b + ab$ is equal to

(1) 76

(2) 83

(3) 79

(4) 93

Answer (4)

Sol. $\text{Mean}=9=\frac{a+b+8+12+10+6+4+15}{8}$

$\Rightarrow$ a + b + 55 = 72 $\Rightarrow$ a + b = 17

$\frac{a^2+b^2+64+144+100+36+16+225}{8}-9^2=9.25$

$a^2 + b^2 + 585 - 8.9^2 = 74$

$\Rightarrow$ $a^2 + b^2 = 137$

$\Rightarrow$ $(a + b)^2 - 2ab = 137$

$\Rightarrow$ $2ab = 289 - 137 \Rightarrow ab = 76$

$\Rightarrow$ a + b + ab = 17 + 76 = 93

6. $4\int_0^1\frac{1}{\sqrt{3+x^2}+\sqrt{1+x^2}}dx-3\ln\sqrt{3}$ is equal to

(1) $3-\sqrt{2}+\ln\left(\sqrt{2}+1\right)$ (2) $2+\sqrt{2}-\ln\left(\sqrt{3}+1\right)$

(3) $2-\sqrt{2}-\ln\left(\sqrt{2}+1\right)$ (4) $2-\sqrt{3}-\ln\left(\sqrt{3}+1\right)$

Answer (3)

Sol. $I=4\int_0^1\frac{1}{\sqrt{3+x^2}+\sqrt{1+x^2}}dx$

$=2\int_0^1\sqrt{3+x^2}-\sqrt{1+x^2}\,dx$

$=2\left[\int_0^1\sqrt{3+x^2}\,dx-\int_0^1\sqrt{1+x^2}\,dx\right]$

$=2\left[\left(\frac{1}{2}x\sqrt{x^2+3}+\frac{3}{2}\ln\left|\sqrt{3+x^2}+x\right|\right)-\left(\frac{1}{2}x\sqrt{1+x^2}+\frac{1}{2}\ln\left|\sqrt{1+x^2}+x\right|\right)\right]_0^1$

$=2\left[\left(1+\frac{3}{2}\ln 3-\frac{3}{2}\ln\sqrt{3}\right)-\left(\frac{\sqrt{2}}{2}+\frac{1}{2}\ln\left(\sqrt{2}+1\right)\right)\right]$

$=2\left(1+\frac{3}{4}\ln 3-\frac{1}{\sqrt{2}}-\frac{1}{2}\ln\left(\sqrt{2}+1\right)\right)$

$=3\ln\sqrt{3}+2-\sqrt{2}-\ln\left(\sqrt{2}+1\right)$

$I-3\ln\sqrt{3}=2-\sqrt{2}-\ln\left(\sqrt{2}+1\right)$

7. If $y=\cos\left(\frac{\pi}{3}+\cos^{-1}\left(\frac{x}{2}\right)\right)$, then which of the following is true.

(1) $x^2 - 2xy + 8y^2 = 2$

(2) $x^2 - 2xy + 4y^2 = 3$

(3) $x^2 - 3xy + 4y^2 = 3$

(4) $x^2 - 5xy + 4y^2 = 8$

Answer (2)

Sol. $\therefore y=\cos\left(\frac{\pi}{3}+\cos^{-1}\frac{x}{2}\right)$

$$y=\cos\frac{\pi}{3}\cdot\cos\left(\cos^{-1}\frac{x}{2}\right)-\sin\frac{\pi}{3}\cdot\sin\left(\cos^{-1}\frac{x}{2}\right)$$

$$y=\frac{1}{2}\cdot\frac{x}{2}-\frac{\sqrt{3}}{2}\cdot\sqrt{1-\frac{x^2}{4}}$$

$$4y=x-\sqrt{3}\sqrt{4-x^2}$$

$$(4y-x)^2=3\left(4-x^2\right)$$

$16y^2 + x^2 - 8xy = 12 - 3x^2$

$4x^2 - 8xy + 16y^2 = 12$

$\therefore \quad x^2 - 2xy + 4y^2 = 3$

8. The image of the point (1, 0, 3) about the line passing through $\vec{a}=3\hat{i}+2\hat{j}-\hat{k}$ and whose direction ratios are $\vec{r}=4\hat{i}+2\hat{j}-\hat{k}$ is

(1) $\left(\frac{-23}{21},\frac{20}{21},\frac{-73}{21}\right)$ (2) $\left(\frac{1}{21},\frac{-23}{21},\frac{-31}{21}\right)$

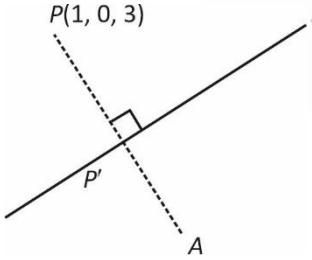
(3) $\left(\frac{1}{21},\frac{21}{23},\frac{-30}{21}\right)$ (4) $\left(\frac{3}{21},\frac{7}{21},\frac{-5}{21}\right)$

Answer (1)

Sol. $\vec{a}:3\hat{i}+2\hat{j}-\hat{k}$

Dr: $4\hat{i}+2\hat{j}-\hat{k}$

$$L:\frac{x-3}{4}=\frac{y-2}{2}=\frac{z+1}{-1}$$



Any point on line L: $P'\ (4\lambda+3, 2\lambda+2, -\lambda-1)$

$PP'\cdot\vec{n}=0$

$\Rightarrow 4(4\lambda+2)+2(2\lambda+2)+(-\lambda-4)(-1)=0$

$16\lambda+8+4\lambda+4\lambda+4=0$

$21\lambda+16=0$

$$\lambda=\frac{-16}{21}$$

$$\therefore\ P'\left(\frac{-1}{21},\frac{10}{21},\frac{-5}{21}\right)$$

Let image of point P be $[a, b, c]$

$$\therefore\ \frac{a+1}{2}=\frac{-1}{21}\Rightarrow a=\frac{-23}{21}$$

$$\frac{b+0}{2}=\frac{10}{21}\Rightarrow b=\frac{20}{21}$$

$$\frac{c+3}{2}=\frac{-5}{21}\Rightarrow c=\frac{-73}{21}$$

$\therefore$ image will be $\left(\frac{-23}{21},\frac{20}{21},\frac{-73}{21}\right)$

9. If the curve $x^2 = 4y$ intersects the line $y = 2(x + 6)$ at (a, b) in 2nd quadrant, then $\int_a^b \frac{x^4}{1+5^x}\,dx$ is

(1) $\frac{512}{5}$ (2) $\frac{1024}{5}$

(3) $\frac{32}{5}$

(4) $\frac{16}{5}$

Answer (2)

Sol. $x^2 = 4y$

$y = 2(x + 6)$

$x^2 = 8(x + 6)$

$x^2 - 8x - 48 = 0$

$(x + 4)(x - 12) = 0$

$\Rightarrow \quad x = -4 (\because x < 0)$

$\therefore \quad y = 4$

$\Rightarrow \quad (a, b) \equiv (-4, 4)$

$$I=\int_a^b\frac{x^4}{1+5^x}dx$$

$$=\int_{-4}^{4}\frac{x^4}{1+5^x}dx$$

$$=\int_0^4\left(\frac{x^4}{1+5^x}+\frac{x^4}{1+5^{-x}}\right)dx$$

$$=\int_0^4 x^4dx=\frac{x^5}{5}=\frac{4^5}{5}=\frac{1024}{5}$$

10. If $\lim\limits_{x\to0}\frac{\cos2x+a\cos^4x-b}{x^4}=L$ (finite)

then $a+b$ equals to

(1) –1 (2) 0

(3) 2 (4) 3

Answer (1)

Sol. $\lim\limits_{x\to0}\frac{\cos2x+a\cos^4x-b}{x^4}=L$

$\lim\limits_{x\to0}\frac{2\cos^2x-1+a\cos^4x-b}{x^4}=L$ ...(1)

To get the finite value,

1 + a – b = 0

$\Rightarrow$ a = b – 1 ...(2)

Apply *L* Hospital

$\lim\limits_{x\to0}\frac{4\cos x(-\sin x)+4a\cos^3x(-\sin x)}{4x^3}$

$\lim\limits_{x\to0}\frac{4\cos x+4a\cos^3x}{4x^3}\left(\frac{-\sin x}{x}\right)$

To get the finite value, a = –1

Also from (1)

$b = 0$

$\therefore$ $a+b=-1$

11. If the sum of series $\frac{1}{1+4.1^4}+\frac{2}{1+4.2^4}+\frac{3}{1+4.3^4}+...+\frac{10}{1+4.10^4}$ is $\frac{m}{n}$, where m and n are natural coprime numbers, then $(m+n)$ is

(1) 289 (2) 276

(3) 225 (4) 389

Answer (2)

Sol. $T_r=\frac{r}{1+4\cdot r^4}=\frac{r}{4r^4+4r^2+1-4r^2}=$

$$\frac{r}{\left(2r^2+1\right)^2-(2r)^2}=\frac{r}{\left(2r^2-2r+1\right)\left(2r^2+2r+1\right)}$$

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

$$=\frac{1}{4}\left[\frac{1}{r^2+(r-1)^2}-\frac{1}{r^2+(r+1)^2}\right]$$

$$\sum_{r=1}^{10}T_r=\frac{1}{4}\left[\frac{1}{0^2+1^2}-\frac{1}{1^2+2^2}+\frac{1}{1^2+2^2}-\frac{1}{2^2+3^2}+\frac{1}{9^2+10^2}-\frac{1}{10^2+11^2}\right]$$

$$=\frac{1}{4}\left[\frac{1-1}{221}\right]=\frac{220}{4\times221}=\frac{55}{221}$$

12. A bag is Randomly selected, If drawn ball is red, then probability that ball is selected from bag-I is p. If ball drawn is green then probability that ball is selected from bag-III is q. Then $\frac{1}{p}+\frac{1}{q}$ equals to

	Red	Blue	Green
Bag-I	3	3	4
Bag-II	4	3	3
Bag-III	5	2	3

(1) $\frac{22}{3}$ (2) $\frac{22}{5}$

(3) $\frac{11}{3}$ (4) $\frac{11}{5}$

Answer (1)

Sol. $p(B_1/R)=\frac{p(B_1)\cdot p(R/B_1)}{p(R)}$

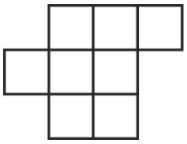
$$=\frac{\frac{1}{3}\times\frac{3}{10}}{\frac{1}{3}\times\frac{3}{10}+\frac{1}{3}\times\frac{4}{10}+\frac{1}{3}\times\frac{5}{10}}=\frac{1}{4}=p$$

$$p(B_3 / G) = \frac{p(B_3) \cdot p(G / B_3)}{p(G)}$$

$$= \frac{\frac{1}{3} \times \frac{3}{10}}{\frac{1}{3} \times \frac{3}{10} + \frac{1}{3} \times \frac{3}{10} + \frac{1}{3} \times \frac{4}{10}} = \frac{3}{10} = q$$

$$\frac{1}{p} + \frac{1}{q} = 4 + \frac{10}{3} = \frac{22}{3}$$

13. In the given figure, number of ways to fill *a, b, c, d* and *e* into boxes such that no row is empty and at most one letter is filled in one box, is



(1) 5670

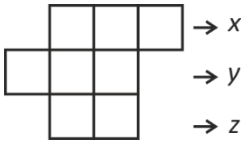
(2) 5760

(3) 5880

(4) 720

Answer (2)

Sol.



Let *x, y, z* be the number of box which are filled

$\Rightarrow$ $1 \le x \le 3, 1 \le y \le 3, 1 \le z \le 2$

x	*y*	*z*	Number of ways
3	1	1	${}^3C_3 \cdot {}^3C_1 \cdot {}^2C_1 = 6$
2	2	1	${}^3C_2 \cdot {}^3C_2 \cdot {}^2C_1 = 18$
1	3	1	${}^3C_1 \cdot {}^3C_3 \cdot {}^2C_1 = 6$
2	1	2	${}^3C_2 \cdot {}^3C_1 \cdot {}^2C_2 = 9$
1	2	2	${}^3C_1 \cdot {}^3C_2 \cdot {}^2C_2 = 9$

Total ways = (48) to fill boxes

Now to arrange *a, b, c, d* and *e*

Number of ways will be 48.5! = 5760

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. Total number of terms in an AP are even. Sum of odd terms is 24 and sum of even terms is 30. Last term exceeds the first term by $\frac{21}{2}$. Then the total number of terms is

Answer (8)

Sol. Let the number of terms be 2n

$$T_1 + T_3 + T_5 \ldots T_{2n-1} = 24$$
$$T_2 + T_4 + T_6 \ldots T_{2n} = 30$$
$$\overline{T_2 - T_1) + (T_4 - T_3) + \ldots (T_{2n} - T_{2n-1}) = 6}$$

$nd = 6$

$(a + (2n + 1)d) - a = \frac{21}{2}$

$\Rightarrow$ $2nd - d = \frac{21}{2}$

$\Rightarrow$ $12 - \frac{21}{2} = d$

$\Rightarrow$ $d = \frac{3}{2}$

$\therefore$ $n = 4$

$\therefore$ Total terms = 8

22. If $\frac{dy}{dx} + 2y\sec^2 x = 2\sec^2 x + 3\tan x \sec^2 x$ and $f(0) = \frac{5}{4}$. Then the value of $12\left(y\left(\frac{\pi}{4}\right) - \frac{1}{e^2}\right)$ equal to

Answer (21)

Sol. $\frac{dy}{dx} + 2y\sec^2 x = 2\sec^2 x + 3\tan x\sec^2 x$

I.F. = $e^{\int 2\sec^2 x dx}$

I.F. = $e^{2\tan x}$

$y \cdot e^{2\tan x} = \int e^{2\tan x}(2 + 3\tan x)\sec^2 x dx$

Put $\tan x = u$

$\sec^2 x dx = du$

$y \cdot e^{2u} = \int e^{2u}(2 + 3u)\, du$

$y \cdot e^{2u} \Rightarrow \frac{2e^{2u}}{2} + 3\int e^{2u} \cdot u\, du$

$y \cdot e^{2u} = e^{2u} + 3\left[\frac{ue^{2u}}{2} - \int \frac{e^{2u}}{2}\right]$

$ye^{2u} = e^{2u} + 3\left[\frac{ue^{2u}}{2} - \frac{e^{2u}}{4}\right] + C$

$ye^{2\tan x} = e^{2\tan x} + 3\left[\frac{\tan x e^{2\tan x}}{2} - \frac{e^{2\tan x}}{4}\right] + C$

$F(0) = \frac{5}{4}$

$\frac{5}{4} = 1 - \frac{3}{4} + C$

$\frac{5}{4} - \frac{1}{4} = C$

$1 = C$

$y = 1 + 3\left(\frac{\tan x}{2} - \frac{1}{4}\right) + 1 \cdot e^{-2\tan x}$

$y\left(\frac{\pi}{4}\right) = 1 + 3\left(\frac{1}{2} - \frac{1}{4}\right) + \frac{1}{e^2}$

$y\left(\frac{\pi}{4}\right) = \frac{7}{4} + \frac{1}{e^2}$

$12\left(y\left(\frac{x}{4}\right) - \frac{1}{e^2}\right) = 12\left(\frac{7}{4} + \frac{1}{e^2} - \frac{1}{e^2}\right) = 21$

23. If the non-zero 3 × 3 matrix A satisfies $A^2(A - 4I) - 4(A - I) = 0$ and if $A^5 = \alpha A^2 + \beta A + \gamma I$, where I is 3 × 3 identity matrix, then $\alpha + \beta + \gamma$ is equal to

Answer (76)

Sol. $A^2(A - 4I) - 4(A - I) = 0$

$A^3 - 4A^2 - 4A + 4I = 0$

Multiple by A

$A^4 = 4A^3 + 4A^2 - 4A$

$= 4(4A^2 + 4A - 4I) + 4A^2 - 4A$

$= 20A^2 + 12A - 16I$

Multiple again by A

$\Rightarrow A^5 = 20A^3 + 12A^2 - 16A$

$= 20(4A^2 + 4A - 4I) + 12A^2 - 16A$

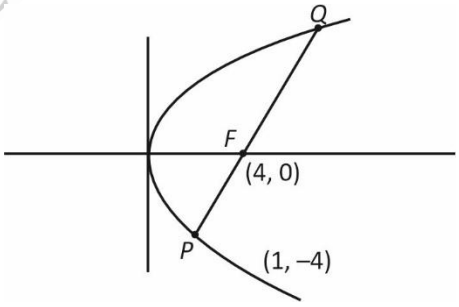
$= 92A^2 + 64A - 80I = \alpha A^2 + \beta A + \gamma I$

$\Rightarrow \alpha = 92, \beta = 64, \gamma = -80 \Rightarrow \alpha + \beta + \gamma = 76$

24. If PQ be the focal chord of a parabola $y^2 = 16x$ such that $P(1, -4)$ and $\frac{PF}{QF} = \frac{m}{n}$, ($F$ is focus) where m and n are coprime natural numbers, then $m^2 + n^2$ is

Answer (17)

Sol.



$y^2 = 16x$

$\Rightarrow 4a = 16 \Rightarrow a = 4$

$Q \equiv (at_2^2, 2at_2)$

$\equiv (4t_2^2, 8t_2)$

$P \equiv \left(4t_1^2, 8t_1\right)$

$4t_1^2 = 1,\ 8t_1 = -4 \Rightarrow t_1 = \dfrac{-1}{2}$

since P and Q are ends points of focal chord

$t_1t_2 = 1 \Rightarrow t_2 = 2$

$\Rightarrow\ Q \equiv (16, 16)$

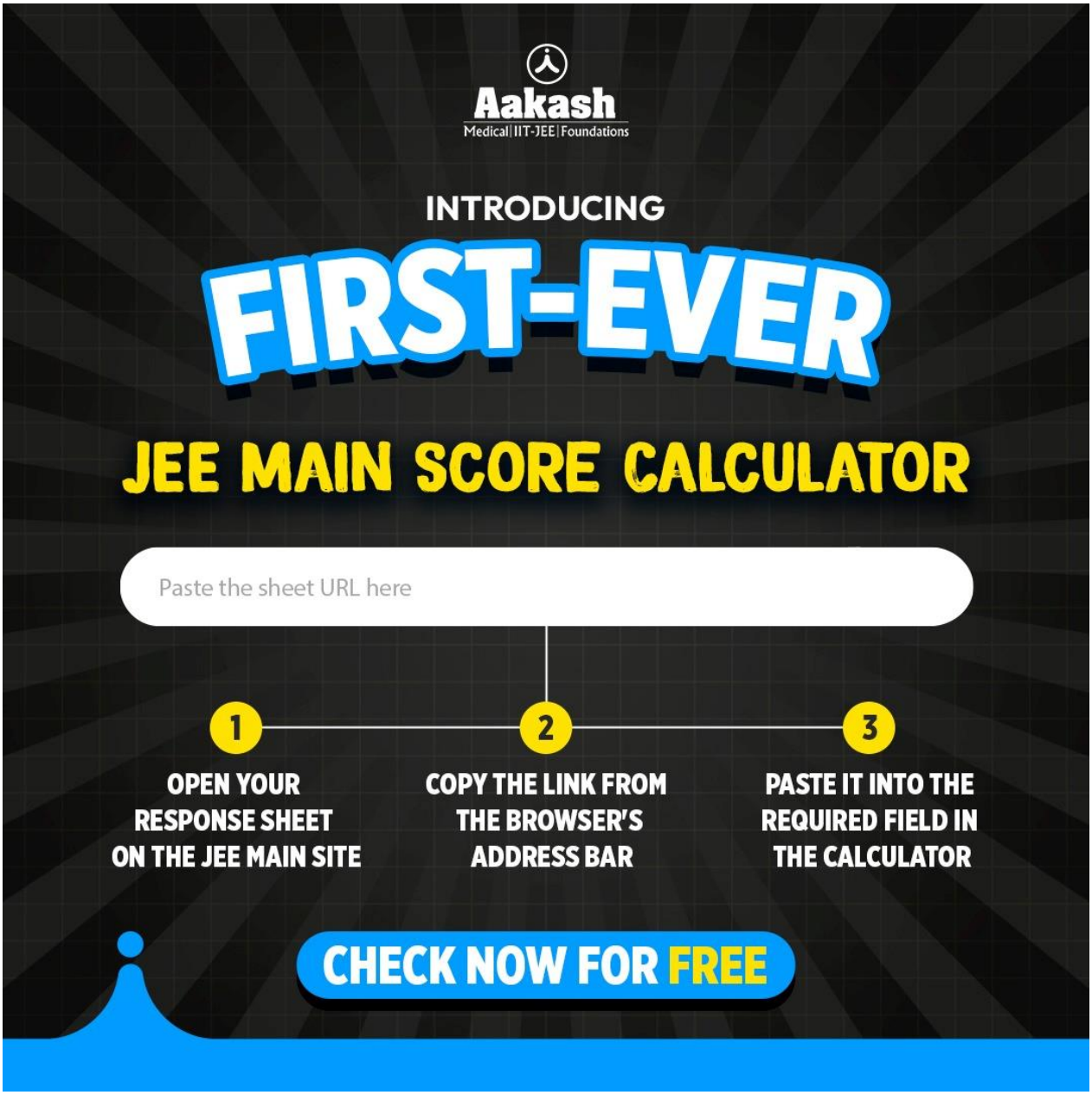
$\Rightarrow\ PF = \sqrt{3^2 + 4^2},\ FQ = \sqrt{12^2 + 16^2}$

$\Rightarrow\ \dfrac{PF}{QF} = \dfrac{5}{20} = \dfrac{1}{4} = \dfrac{m}{n}$

$\Rightarrow\ m^2 + n^2 = 17$

25.

❑ ❑ ❑



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