MATRIX

JEE MAIN 2026

Memory Based-Questions and Analysis of 5th April (Shift-2)

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. Find dimensions of $\sqrt{\frac{Gh}{C^5}}$

(1) $M\,L^2T^{-1}$ (2) $M^0L^0T^1$

(3) $M0LT^{-1}$ (4) $M^0L^0T^{-1}$

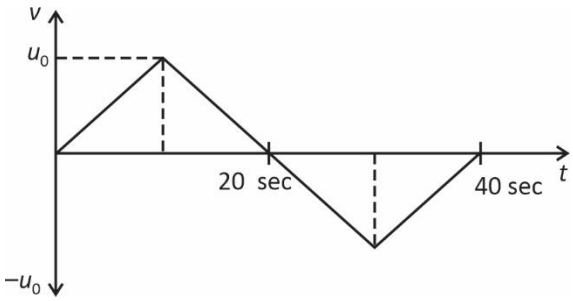
Answer (2)

Sol. $\sqrt{\frac{Gh}{C^5}}$

$\Rightarrow M^0L^{-1}L^1T^1$

$M^0L^0T^1$

2. Velocity v/s time graph of a particle is as shown in the figure below:



Find magnitude of acceleration of the particle at t = 105 sec.

(1) $\frac{u_0}{10}$ (2) $\frac{u_0}{20}$

(3) $\frac{u_0}{5}$ (4) $\frac{u_0}{4}$

Answer (1)

Sol. $|\bar{a}| = \left(\frac{u_0}{10}\right)$

3. 8 Hg drops coalesce to form a new drop. Ratio of final surface energy of single drop to total surface energy of 8 drops is

(1) $\frac{1}{4}$ (2) $\frac{1}{8}$

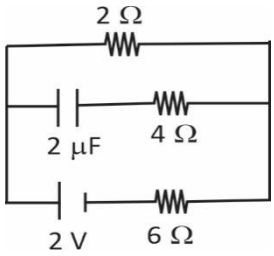
(3) $\frac{1}{2}$ (4) 1

Answer (3)

Sol. $8\frac{4}{3}\pi r^3 = \frac{4}{3}\pi R^3,\ R = 2r$

Ratio = $\frac{S\times 4\pi(R)^2}{8\times S\times 4\pi(r)^2} = \frac{1}{8}\times 4 = \frac{1}{2}$

4. In circuit below, find voltage across capacitor in steady state



(1) 1 V (2) 0.5 V

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

Answer (2)

Sol. $V_C = \frac{2\times 2}{8} = 0.5\text{ V}$

5. A particle of mass m moves from height 2R above earth surface to surface of earth. Find change in P.E. (R is radius of earth)

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

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

Answer (1)

Sol. $\Delta U = \frac{-GMm}{R} + \frac{GMm}{3R}$

$\Rightarrow \frac{-2GMm}{3R}$

6. Magnetic field $B = (2t^2 + 2t + 4)$ T is passing perpendicularly through a coil of radius r = 20 cm. Resistance of the coil is $R = 10\ \Omega$. Find current through the coil at $t = 3$ sec.

(1) $I = 8\pi \times 10^{-2}$ A (2) $I = 3.2\pi \times 10^{-2}$ A

(3) $I = 7.2\pi \times 10^{-2}$ A (4) $I = 5.6\pi \times 10^{-2}$ A

Answer (4)

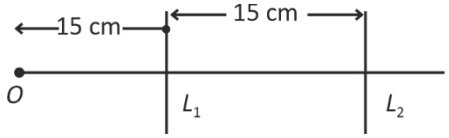
Sol. $\phi = \int B \cdot ds = (2t^2 + 2t + 4)\pi r^2$

$$\varepsilon = \left|\frac{d\phi}{dt}\right| = \pi r^2 (4t + 2)$$

So $\varepsilon = \pi(14)(4 \times 10^{-2})$

So $I = \left(\frac{\varepsilon}{R}\right) = \frac{14\pi \times 4 \times 10^{-2}}{10}$

$\Rightarrow$ $I = 5.6\pi \times 10^{-2}$ A

7. 

$f = -10$ cm $f = -15$ cm

Two concave lens are placed at separation of 15 cm, find final image of object *O*.

(1) $\frac{35}{2}$ cm from L_2 & virtual

(2) $\frac{17}{2}$ cm from L_1 & real

(3) $\frac{35}{4}$ cm from L_2 & virtual

(4) $\frac{17}{2}$ cm from L_2 & real

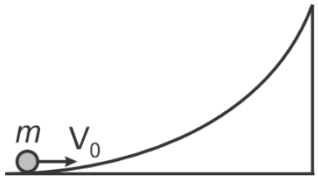
Answer (3)

Sol. $v = \frac{uf}{u+f} = \frac{-15 \times -10}{-15-10} = \frac{-150}{25} = -6$

$$v = \frac{-21 \times -15}{-21-15} = \frac{15 \times 21}{36} = \frac{35}{4}$$

8. Which of the following objects given in options can reach maximum height in situation shown in figure below :

(given that there is no slipping)



(1) Solid cylinder (2) Solid sphere

(3) Disc (4) Ring

Answer (4)

Sol. Ring because its KE is maximum for some mass & speed.

9. An ideal gas undergoes process whose equation is PT^3 = constant. What would be polytropic constant for this

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

(3) $\frac{2}{3}$ (4) 0.4

Answer (2)

Sol. PT^3 = constant

And PV = nRT

$\therefore$ $P(PV)^3$ = Constant

$\Rightarrow$ P^4V^3 = Constant

$\Rightarrow$ $PV^{3/4}$ = Constant

$\therefore$ $\frac{3}{4}$ will be answer

10. **Assertion (A):** EM wave exert pressure on surface on which it falls.

Reason (R): Rest mass of photons is zero.

(1) Both A & R are correct & R is correct explanation of A

(2) Both A & R are correct but R is not correct explanation of A

(3) A is correct but R is false

(4) A is false but R is correct

Answer (2)

Sol. Both are true but R is not correct explanation of A.

11. An electron is moving with sped 0.8*c* in a medium. de-Broglie wavelength of electron in medium is (*c* is speed of light)

(1) 1.54×10^{-15} m

(2) 3×10^{-12} m

(3) 2.34×10^{-27} m

(4) 3.5×10^{-15} m

Answer (2)

Sol. $\lambda = \frac{h}{mv}$

$$= \frac{20}{3} \times \frac{10^{-34}}{9.1 \times 10^{-31} \times 0.8 \times 3 \times 10^{8}}$$

$$= \frac{20}{7.2 \times 9.1} \times 10^{-11} = 0.3 \times 10^{-11}$$

12. If velocity of a particle is decreased by 20% then new de-Broglie wavelength is $\alpha\lambda_0$, where λ_0 is initial wavelength. Find the value of $\propto$.

(1) α = 1.50

(2) α = 0.5

(3) α = 1.25

(4) α = 0.75

Answer (3)

Sol. Initially $P_0 = mv_0$

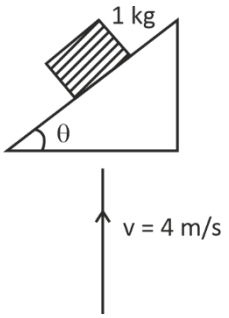
So $\lambda_0 = \frac{h}{mv_0}$

Now, $p = mv_0 \frac{8}{10}$

So, $\lambda = \frac{h \times 10}{mv_0 \times 8} = \frac{\lambda_0 \times 10}{8}$

$\Rightarrow \lambda = 1.25\,\lambda_0$

13. A block of mass 1 kg rests on an inclined plane. If whole system is moving with velocity 4 m/s (upward). Calculate the work done by friction in t = 2 sec.



(1) $\Delta w = 40 \sin 2\theta$ (2) $\Delta w = 80 \sin^2\theta$

(3) $\Delta w = 80 \sin^2\theta$ (4) $\Delta w = 40 \sin^2\theta$

Answer (2)

Sol. $f = mg\sin\theta$

And $Ar - V\in = 4 \times 2 = 8$ m

So $A = \vec{f} \cdot \overrightarrow{\Delta r}$

$\Rightarrow \Delta w = (mg \sin g) \times 8 \times \sin\theta$

$\Rightarrow \Delta w = 8\ mg \sin^2\theta = 80 \sin^2\theta$

14. A uniformly angular accelerated wheel rotates θ_1 in first 2 seconds and θ_2 in next 2 seconds. Initial angular speed is zero then $\frac{\theta_2}{\theta_1}$

(1) 4 (2) 3

(3) 5 (4) 6

Answer (2)

Sol. $\theta = \frac{1}{2}\alpha t^2$

$$\frac{\theta_2}{\theta_1} = \frac{4^2 - 2^2}{2^2 - 0^2} = \frac{16 - 4}{4} = 3$$

15. If a cell is connected to 20 Ω resistance then current is circuit is 0.25A. But if resistance of 2 Ω is connected across the cell then current is 2 A. Find internal resistance of the cell.

(1) $\frac{4}{7}\Omega$ (2) $\frac{2}{3}\Omega$

(3) $1\,\Omega$ (4) $2\,\Omega$

Answer (1)

Sol. $E = \frac{1}{4}r + \frac{1}{4}\times 20$

$E = \frac{r}{4} + 5$

And $E = 2r + 2 \times 2$

$\Rightarrow E = 2r + 4$

$\therefore \; E = \frac{r}{4} + 5 = 2r + 4$

$\Rightarrow \; 1 = \frac{7r}{4}$

$\therefore \; r = \frac{4}{7}\Omega$

16. Consider ${}_6C^{12}$ Nuclei

Given m_p = 1.007276 amu; m_n = 1.008664 amu. Find binding energy for nucleon.

(in MeV/nucleon)

(1) 7.42 (2) 10.4

(3) 2.20 (4) 12.3

Answer (1)

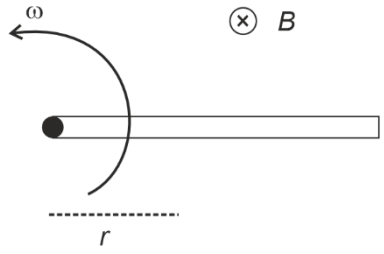
Sol. Δm = [(6 × 1.007276] + (6 × 1.008664) – 12] amu.

Δm = 0.09564 amu

BE = (0.09564 × 931.5) MeV = 89.08866 MeV

So $\frac{BE}{12}$ = 7.42 MeV/Nucleon

17. Spatial magnetic field is given as $B = B_0\, e^{-\lambda r}$ where r is distance from hinged end of the rod of length ℓ. Emf induced across ends of rod for angular velocity of ω is



(1) $B_0\omega\left(\frac{1}{\lambda^2} - \frac{e^{-\lambda\ell}}{\lambda^2}\right)$

(2) $B_0\omega\left(\frac{e^{-\lambda\ell}}{\lambda^2} + \frac{\ell}{\lambda}e^{-\lambda\ell}\right)$

(3) $\in = B_0\omega\left\{\frac{1}{\lambda^2} - \frac{c^{-\lambda\ell}}{\lambda^2} - \frac{\ell}{\lambda}e^{-\lambda\ell}\right)$

(4) $B_0\omega\left(\frac{e^{-\lambda\ell}}{\lambda}\right)$

Answer (3)

Sol. $\int d\in = \int Bdlv = \int_0^{\ell} B_0 e^{-\lambda r} dr\, r\omega$

$= B_0\omega\left\{\frac{re^{-\lambda r}}{-\lambda}\right\}_0^{\ell} - \left\{\frac{e^{-\lambda r}}{\lambda^2}\right\}_0^{\ell}$

$= \left[B_0\omega\left\{\frac{\ell e^{-\lambda r}}{-\lambda}\right\} - \frac{1}{\lambda^2}\left\{e^{-\lambda r} - 1\right)\right]$

$\in = B_0\omega\left\{\frac{1}{\lambda^2} - \frac{c^{-\lambda\ell}}{\lambda^2} - \frac{\ell}{\lambda}e^{-\lambda\ell}\right)$

18. Two thin lense are placed in contact in air. Than combination behaves as – (if)

(A) $|f_{concave}| > |f_{convex}|$ then combination acts as concave

(B) $|f_{convex}| > |f_{concave}|$ then combination acts as concave lens

(C) $|f_{convex}| = |f_{concave}|$ then combination acts as concave lens

(D) $|f_{convex}| = |f_{concave}|$ then combination acts as convex lens

(1) (A) (2) (B)

(3) (C) (4) (D)

Answer (2)

Sol. $P = P_1 + P_2$

If power of convex lens is larger then total power will be +ve and effectively the combination will be have like convex lens.

So for it $|f_{convax}| > |f_{concave}|$

Or $|f_{convax}| < |f_{concave}|$

And vise-versa

19. A particle is projected with velocity $\frac{v_0}{\sqrt{2}}(\hat{i}+\hat{j})$ from origin.

Electric field $\vec{E}$ and magnetic field $\vec{B}$ are present in space as $\vec{B} = B_0\hat{k}$ and $\vec{E} = E_0 e^{-\lambda x}\hat{i}$. Speed of particle at $x = L$ is (m and q are mass and charge of particle)

(1) v_0

(2) $\sqrt{2}v_0 + e^{-\lambda L}\frac{qE_0}{\lambda m}$

(3) $\sqrt{v_0^2 + \frac{2qE_0}{\lambda m}(1-e^{-\lambda L})}$

(4) $\sqrt{v_0^2 + \frac{qE_0}{\lambda m}e^{-\lambda L}}$

Answer (3)

Sol. $\int_0^L qE_0 e^{-\lambda x}dx = \frac{qE_0 e^{-\lambda x}}{(-\lambda)}\Big|_0^L$

$$\frac{1}{2}mv^2 = \frac{1}{2}mv_0^2 + \omega = \frac{qE_0}{\lambda}(1-e^{-\lambda L}) + \frac{1}{2}mv_0^2$$

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. Escape velocity on earth is $v_e = \sqrt{2gR}$. A planet of half the radius of earth with density equal to that of earth, the escape speed shall be $\frac{v_e}{N}$ then N is

Answer (2)

Sol. $V_e = \sqrt{\frac{2G\rho\frac{4}{3}\pi R^3}{R^2}R} \propto \sqrt{\rho R^2}$

$$V_e^1 = \sqrt{\rho\left(\frac{R}{2}\right)^2}\ \frac{Ve}{Ve'} = 2$$

22. A series RLC circuit is in resonance. It is given that L = 1.6 H and C = 40 μF. Then find value of inductive reactance (in SI unit)

Answer (200)

Sol. $\frac{1}{\sqrt{LC}}$

$$\Rightarrow \frac{1}{\sqrt{1.6\times 40\times 10^{-6}}} = \frac{10^3}{8}$$

$$\therefore \quad X_L = \omega L = \frac{10^3}{8}\times 1.6 = 200\,\Omega$$

23.

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 two statements:

Statement I: Glucose is found to exist in two different anomeric form α and β

Statement II: In open chain structure C_3, C_4 and C_5 carbon of glucose & fructose both have same orientation

In the light of above statements choose the correct option.

(1) Both statement I and statement II are correct

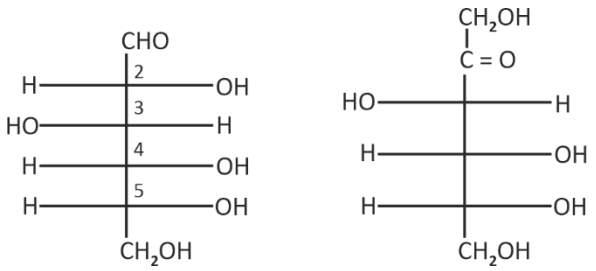
(2) Statement I is correct but statement II is incorrect

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

(4) Both statement I and statement II are incorrect

Answer (1)

Sol.



2. Given below are two statements:

Statement I: The shape of ICl_3 is square planar

Statement II: The shape of $ClBr_2^-$ is pyramidal

In the light of above statements choose the correct option.

(1) Both statement I and statement II are correct

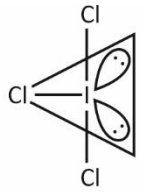
(2) Statement I is correct but statement II is incorrect

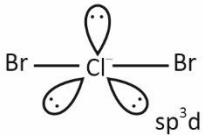
(3) Statement I is incorrect but statement II is correct

(4) Both statement I and statement II are incorrect

Answer (3)

Sol.

ICl_3  T-shaped sp^3d

$ClBr_2^-$  Linear sp^3d

3. Consider the following reversible reaction

$2AB(g) \rightleftharpoons A_2(g) + B_2(g)$,

If equilibrium pressure is P and degree of dissociation is α, then K_p is

(1) $\frac{\alpha^2}{4(1-\alpha)^2}$ (2) $\frac{P.\alpha^2}{4(1-\alpha)}$

(3) $\frac{P.\alpha}{(1-\alpha)}$ (4) $\frac{P.\alpha}{4(1-\alpha)}$

Answer (1)

Sol.

	$2AB$	$\rightleftharpoons$	$1A_2$	+	$1B_2$
Initial	1		0		0
	$-\alpha$		$+\frac{\alpha}{2}$		$+\frac{\alpha}{2}$
At Eq.	$(1-\alpha)$		$\frac{\alpha}{2}$		$\frac{\alpha}{2}$

$$p'_{A_2} = p'_{B_2} = \frac{P.\alpha}{2}$$

$$p'_{AB} = P(1-\alpha)$$

$$K_p = \frac{(P.\alpha/2)^2}{\{P(1-\alpha)\}^2} = \frac{\alpha^2}{4(1-\alpha)^2}$$

4. Which compound have total molecular mass of 72 with three primary carbons

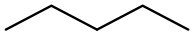
(1) n-pentane

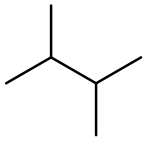
(2) 2, 2-Dimethylbutane

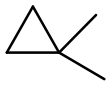
(3) 1, 1-Dimethylcyclopropane

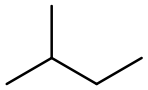
(4) 2-methylbutane

Answer (4)

Sol.  $(C_5H_{12}) \Rightarrow$ 72 g, 2-1°C

 (C_6H_{14})

 (C_5H_{10})

 $(C_5H_{12}) \Rightarrow$ 72 g, 3-1°C

5. The order of acidic strength in following compounds is

A. Phenol

B. p-nitrophenol

C. Ethanol

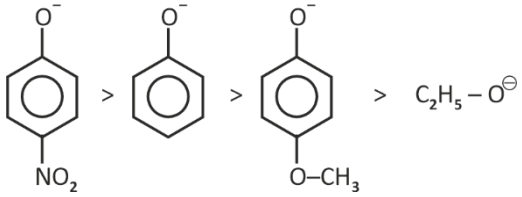
D. p-methoxyphenol

(1) B > A > D > C (2) C > B > A > D

(3) B > D > A > C (4) B > A > C > D

Answer (1)

Sol. Order of stability of conjugate base is



So, order of acidic strength is

B > A > D > C

6. Consider the following electrochemical cell

$$Zn \underset{(1\ M)}{\left|Zn^{2+}(aq)\right|} \left\|Ag^{+}(aq)\right| Ag$$

The E_{cell} was found to be 1.6 V.

The value of log[Ag⁺] is

Given $E^{o}_{Zn^{2+}/Zn} = -0.76$ V , $E^{o}_{Ag^{+}/Ag} = -0.8$ V

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

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

Answer (2)

Sol. $E^{o}_{cell} = 0.8 - (-0.76) = 1.56$ V

$$Zn(s) + 2Ag^{+}(aq) \rightleftharpoons Ag(s) + Zn^{2+}(aq)$$

$$E_{cell} = E^{o}_{cell} - \frac{0.06}{2}\log\frac{[Zn^{2+}]}{[Ag^{+}]^2}$$

$$1.6\ V = 1.56 - 0.03\log\frac{1}{[Ag^{+}]^2}$$

$$1.6 = 1.56 + 0.03\log[Ag^{+}]^2$$

$$0.03\log[Ag^{+}]^2 = 0.04$$

$$\log[Ag^{+}] = \frac{2}{3}$$

7. Aquous solution of a compound 'X' is acidified with H_2SO_4 and SO_2 is passed through it, turning the solution green. The compound 'X' is

(1) $KMnO_4$ (2) $Pb(CH_3COO)_2$

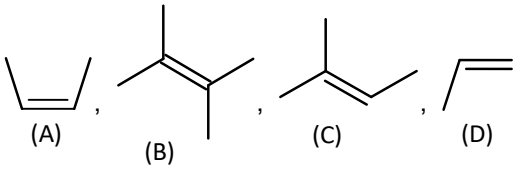
(3) $K_2Cr_2O_7$ (4) $Fe_2(SO_4)_3$

Answer (3)

Sol. $K_2Cr_2O_7 + 3SO_2 + H_2SO_4 \rightarrow$

$$K_2SO_4 + \underset{\text{green}}{Cr_2(SO_4)_3} + H_2O$$

8. Decreasing order of stability in the following compounds is



(1) A > B > C > D (2) B > C > A > D

(3) D > C > B > A (4) A > C > B > D

Answer (2)

Sol. More the number of alpha hydrogens more is the stability of alkene.

9. Consider the following sequence of reactions and determine the final major product (B) is ____.

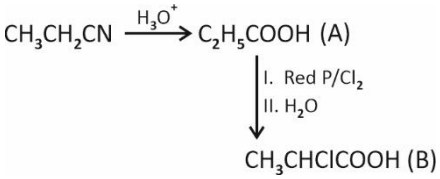
$$CH_3CH_2CN \xrightarrow{H_3O^+} A \xrightarrow[\text{II. } H_2O]{\text{I. Red } P/Cl_2} B$$

(1) $CH_3CH_2CONHCl$ (2) $CH_3CHClCOOH$

(3) CH_3CONH_2 (4) CH_3CH_2COCl

Answer (2)

Sol.



10. Choose the incorrect statement about tertiary structure of protein.

(1) Fibrous and globular are types of tertiary structures of protein

(2) It represents the overall folding of the polypeptide chain

(3) Disulphide linkage and hydrogen bonds stabilise the tertiary structure

(4) During denaturation, tertiary structure remains intact

Answer (4)

Sol. During denaturation, primary structure remain intact.

11. **Statement I :** When Aluminium reacts with NaOH, $[Al(OH)_6]^{3-}$ is formed.

Statement II : Shape of ClO_2^-, ClO_3^- and ClO_4^- are bent, pyramidal and tetrahedral respectively.

(1) Both statement I and statement II correct

(2) Statement I is correct and statement II is incorrect

(3) Statement I is incorrect and statement II is correct

(4) Both statement I and statement II are incorrect

Answer (3)

Sol. $Al + NaOH(aq) + \xrightarrow{H_2O(\ell)} Na\left[Al(OH)_4\right] + 3H_2$

ClO_2^- – bent shape (sp^3)

ClO_3^- – pyramidal (sp^3)

ClO_4^- – tetrahedral (sp^3)

12. If the bond length of molecule AB is R_{AB}, while radii of A and B are R_A and R_B respectively, then which of the following relation is correct? ($X_A > X_B$)

(1) $R_{AB} = (R_A + R_B) \times \frac{1}{2}$ (2) $R_{AB} > (R_A + R_B)$

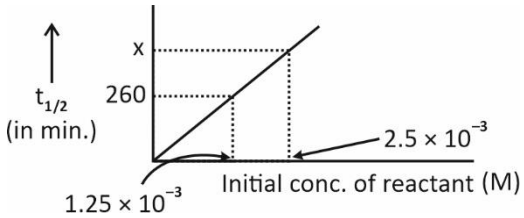
(3) $R_{AB} < (R_A + R_B)$ (4) $R_{AB} + R_A = R_B$

Answer (3)

Sol. If $(EN)_A > (EN)_B$, then bond AB is polar in nature and so $R_{AB} < (R_A + R_B)$

13. For a certain reaction a graph between half life ($t_{1/2}$) and initial concentration of reactant is given

The value of x is ____



(1) 150 min

(2) 125 min

(3) 520 min

(4) 260 min

Answer (3)

Sol. Since the graph of half-life and initial concentration in linear hence the reaction follows zero order kinetics :

$$\frac{(t_{1/2})_1}{(t_{1/2})_2} = \frac{Co_1}{Co_2}$$

$$\frac{260}{x} = \frac{1.25\times10^{-3}}{2.5\times10^{-3}}$$

x = 520 min.

14. 20 g of haemoglobin is present in 1 litre solution at 300 K. The osmotic pressure was found be 80 mm of Hg. The molar mass(g/mol) of haemoglobin is (approximately)

(1) 4424 g/mol (2) 4674 g/mol

(3) 4576 g/mol (4) 4722 g/mol

Answer (2)

Sol. $\frac{80}{760} = \frac{20}{M_0 \times 1} \times 0.082 \times 300$

M_0 = 4674 g/mol

15. Consider the following statements

Statement I : When value of azimuthal quantum number for subshells is same, then higher the value of principal quantum number, higher is the energy.

Statement II : Energy of 4s subshell is greater than 3d subshell.

Choose the correct option.

(1) Both statement I and statement II are correct

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

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

(4) Both statement I and statement II are incorrect

Answer (2)

Sol. Energy in multielectron species is decided by (n + ℓ) value.

If ℓ value same $\Rightarrow$ n$\uparrow$ $\Rightarrow$ Energy $\uparrow$

16. Which set among the following has the same character of oxides

(1) Al_2O_3 and V_2O_3 (2) Cr_2O_3 and NO

(3) CO and N_2O (4) SnO and N_2O_5

Answer (3)

Sol. Basic – V_2O_3

Amphoteric – Al_2O_3, Cr_2O_3, SnO

Acidic – N_2O_5

Neutral – NO, N_2O and CO

17. The correct order of specific heat capacity at 25°C is

(1) He(g) > Cu(s) > Ba(s)

(2) Cu(s) > Ba(s) > He(g)

(3) Ba(s) > Cu(s) > He(g)

(4) He(g) > Ba(s) > Cu(s)

Answer (1)

Sol. $He(g) \rightarrow 5.19\ Jg^{-1}\ K^{-1}$

$Cu(s) \rightarrow 0.39\ Jg^{-1}\ K^{-1}$

$Ba(s) \rightarrow 0.2\ Jg^{-1}\ K^{-1}$

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. Consider the following cases in octahedral complexes.

d^3 (low spin)

d^5 (low spin)

d^7 (high spin)

d^6 (high spin)

Sum of total number of unpaired e^- present is

Answer (11)

Sol. d^3 (low spin) $\rightarrow\ t_{2g}^3 e_g^0\ (n=3)$

d^5 (low spin) $\rightarrow\ t_{2y}^5 e_g^0\ (n=1)$

d^7 (high spin) $\rightarrow\ t_{2g}^5 e_g^2\ (n=3)$

d^6 (high spin) $\rightarrow\ t_{2g}^4 e_g^2\ (n=4)$

22. 20 gram of pure zinc reacts with 50 ml of H_2SO_4 solution whose purity is 50%. Density of H_2SO_4 solution is 1.3 g/ml. The volume of H_2 gas liberated at STP (in litres) is _____.

(Consider volume of 1 mol of gas at STP to be 22.4 litre)

(Atomic mass : Zn = 65, H = 1, S = 32, O = 16)

Answer (7)

Sol. Moles of Zn = $\frac{20}{65} = 0.31$

Mass of H_2SO_4 solution = 50 × 1.3 = 65 gram

Mass of H_2SO_4 = $65 \times \frac{50}{100} = 32.5$ g

Moles of H_2SO_4 = $\frac{32.5}{98} = 0.33$

Zn	+	H_2SO_4	$\rightarrow$	$ZnSO_4$	+	H_2
0.31		0.33		0		0

Limiting reactant = Zn

Moles of $H_{2(g)}$ formed = 0.31

Volume of $H_{2(g)}$ liberated at STP = 0.31 × 22.4

= 6.94 litres $\simeq$ 7 litres

23. Consider the reaction sequence :

$R - MgX + H_2O \rightarrow R - H$

1.4 dm^3/g at STP

$R - H + I_2 \rightarrow R - I$

(1eq.)

$$2R - I + Na \xrightarrow[\text{ether}]{} R - R$$

Find molar mass or R – R in g/mol

Answer (30)

Sol. 1.4 litre is equal to 1 g

22.4 litres is equal to $\frac{1}{1.4} \times 22.4$ g

16 g

R – H is CH_4

So, molar mass of R – R = 30 g/mol

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 coefficient of x^2 in the binomial expansion of $\left(2x^2+\frac{1}{x}\right)^{10}$ is

(1) 3260 (2) 3360

(3) 1760 (4) 1890

Answer (2)

Sol. $\left(2x^2+\frac{1}{x}\right)^{10}$

$T_{r+1}={}^{10}C_r(2x^2)^{10-r}\left(\frac{1}{x}\right)^r$

$20-2r-r=2$

$r=6$

coff of $x^2={}^{10}C_6(2)^4=3360$

2. If it is given that probability of A becoming captain of the team is 0.8 and B becomes captain is 0.4. If A becomes captain then chances of winning the match by the team is 0.6 and when B becomes captain then chances of team winning the match is 0.7. Then the probability that team wins the match is

(1) 0.76 (2) 0.78

(3) 0.74 (4) 0.84

Answer (1)

Sol. $P(w)=P(A)P\left(\frac{w}{A}\right)+P(B)P\left(\frac{w}{B}\right)$

$=0.8\times0.6+0.4\times0.7$

$=\frac{48+28}{100}=0.76$

3. Let $A=\{2,3\}$ and $B=\{5,6\}$. Then, the number of relations from $A\times B$ to $A\times B$ are

(1) 2^{12} (2) 2^{16}

(3) 2^{10} (4) 2^{15}

Answer (2)

Sol. $n(A\times B)=2\times2$

$=4$

Number of relations from $A\times B$ to $A\times B$

$=2^{4\times4}$

$=2^{16}$

4. Let $A_1, A_2, A_3, \ldots, A_{49}$ be 49 AM's between 49 and 149. Then the mean of A_1, A_{25}, A_{47} and A_{49} is

(1) 110 (2) 120

(3) 130 (4) 140

Answer (1)

Sol. $d=\frac{149-49}{49+1}$

$\boxed{d=2}$

$A_1=49+2$

$A_{25}=49+25.2$

$A_{47}=49+47.2$

$A_{49}=49+49.2$

Mean $=\frac{49.4+2[1+25+47+49]}{4}=110$

5. The value of $\sum_{r=1}^{10}\frac{r}{4+r^4}$ is equal to

(1) $\frac{4832}{123565}$ (2) $\frac{4565}{12322}$

(3) $\frac{4565}{12321}$ (4) $\frac{4564}{12321}$

Answer (2)

Sol. $\sum_{r=1}^{10}\frac{r}{4+r^4}=\sum_{r=1}^{10}\frac{r}{r^4+4-4r^2+4r^2}$

$=\sum_{r=1}^{10}\frac{r}{(r^2+2)^2-(2r)^2}$

$=\sum_{r=1}^{10}\frac{r}{(r^2+2r+2)-(r^2-2r+2)}$

$=\frac{1}{4}\sum_{r=1}^{10}\left(\frac{(r^2+2r+2)-(r^2-2r+2}{(r^2+2r+2)(r^2-2r+2)}\right)$

$=\frac{1}{4}\sum_{r=1}^{10}\left(\frac{1}{r^2-2r+2}-\frac{1}{r^2+2r+2}\right)$

$=\frac{1}{4}\left[1-\frac{1}{5}+\frac{1}{2}-\frac{1}{10}+\frac{1}{5}-\frac{1}{17}+\frac{1}{10}-\frac{1}{26}+\ldots+\frac{1}{65}-\frac{1}{101}+\frac{1}{82}-\frac{1}{122}\right]$

$=\frac{1}{4}\left[1+\frac{1}{2}-\frac{1}{101}-\frac{1}{122}\right]$

$=\frac{4565}{12322}$

6. If α, β are the roots of the equation $x^2 - 4x + p = 0$ and γ and δ are the roots of the equation $x^2 - x + q = 0$. If α, β, γ and δ form a GP with positive common ratio, then the value of $p + q$ is

(1) $\frac{22}{9}$ (2) $\frac{33}{9}$

(3) $\frac{21}{9}$ (4) $\frac{34}{9}$

Answer (4)

Sol. $\because\ \alpha, \beta, \gamma, \delta \to GP$

$\Rightarrow \alpha = a \quad \beta = ar, \gamma = ar^2, \delta = ar^3$

$\because\ x^2 - 4x + P = 0 <^{\alpha}_{\beta}$

$\Rightarrow a + ar = 4$ ...(1)

$a^2 r = P$

Also $x^2 - x + q = 0 <^{\gamma}_{\delta}$

$ar^2 + ar^3 = 1$ ...(2)

$a^2 r^5 = q$

from (1) and (2)

$\frac{a(1+r)}{ar^2(1+r)} = 4$

$\boxed{r = \pm\frac{1}{2}}$

If $r = \frac{1}{2}$ $a\left(\frac{3}{2}\right) = 4$

$\Rightarrow a = \frac{8}{3}$

Now $P = \left(\frac{8}{3}\right)^2 \times \frac{1}{2}$

$q = \left(\frac{8}{3}\right)^2\left(\frac{1}{2}\right)^5$

$p + q = \boxed{\frac{34}{9}}$

7. If Z_1 and Z_2 are the solutions of the equation $6Z^2 - 11Z + 59 - 3i = 0$ then $|Z_1|^2 + |Z_2|^2$ is equal to

(1) $\frac{709}{36}$ (2) $\frac{703}{18}$

(3) $\frac{705}{36}$ (4) $\frac{701}{36}$

Answer (1)

Sol. $6z^2 - 11z + 59 - 3i = 0$

$D = (-11)^2 - 4(6)(59 - 3i)$

$= -1295 + 72i$

$\sqrt{-1295 + 72i} = x + iy$

$\Rightarrow\ x^2 - y^2 = -1295$

$xy = 36$

$\Rightarrow\ x = \pm 1$ then $y = \pm 36$

$$z = \frac{11 \pm (1 \pm 36i)}{12}$$

= $1 + 3i, \frac{5}{6} - 3i$

$\Rightarrow$ $|z_1|^2 = 10$

$$|z_2|^2 = \left(\frac{25}{36} + 9\right)$$

$$|z_1|^2 + |z_2|^2 = \frac{709}{36}$$

8. If $f(x) = \lim\limits_{y \to 0} \frac{(1 - \cos xy)\tan(xy)}{y^3}$ then number of roots of the equation $f(x) = \sin x$ is

(1) 0

(2) 2

(3) 3

(4) 1

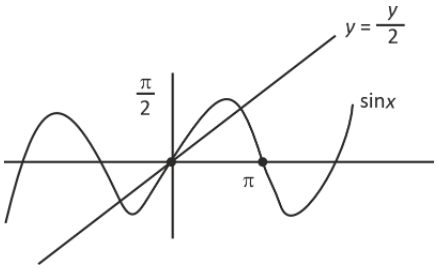
Answer (3)

Sol. $f(x) = \lim\limits_{y \to 0} \frac{(1 - \cos xy)\tan(xy)}{y^3}$

$$= \lim_{y \to 0} \frac{2\sin^2\left(\frac{xy}{2}\right)}{\left(\frac{xy}{2}\right)^2 \times \left(\frac{y}{x^2}\right)} \times \frac{\tan(xy)}{(xy) \times \frac{1}{x}}$$

$$= \lim_{y \to 0} \frac{x^2}{2} \times \frac{1}{x} = \frac{x}{2}$$

$$f(x) = \frac{x}{2}$$



9. Let $\overrightarrow{OP} = \vec{a}, \overrightarrow{OQ} = \vec{b}$. Let a point R be such that $\overrightarrow{OP} = 5\overrightarrow{OR}$. Let a point M be such that $\overrightarrow{OQ} = 5\overrightarrow{RM}$ then $\overrightarrow{PM}$ is equal to

(1) $\frac{1}{5}\left(\vec{b} - 4\vec{a}\right)$ (2) $\frac{1}{5}\left(4\vec{b} - \vec{a}\right)$

(3) $\frac{1}{5}\left(\vec{b} + 4\vec{a}\right)$ (4) $\frac{1}{5}\left(4\vec{b} + \vec{a}\right)$

Answer (1)

Sol. $\overrightarrow{OP} = \vec{a}, \overrightarrow{OQ} = \vec{b}$

$$\overrightarrow{OP} = 5\overrightarrow{OR} \Rightarrow \overrightarrow{OR} = \frac{1}{5}\vec{a}$$

$$\overrightarrow{OQ} = 5\overrightarrow{RM} \Rightarrow \overrightarrow{RM} = \frac{1}{5}\vec{b}$$

$$OM = \overrightarrow{OR} + \overrightarrow{RM} = \frac{1}{5}\left(\vec{a} + \vec{b}\right)$$

$$\overrightarrow{PM} = \overrightarrow{OM} - \overrightarrow{OP}$$

$$= \frac{1}{5}\vec{a} + \frac{1}{5}\vec{b} - \vec{a}$$

$$= \frac{1}{5}\vec{b} - \frac{4}{5}\vec{a}$$

$$= \frac{1}{5}\left(\vec{b} - 4\vec{a}\right)$$

10. If $f(x) = \int_1^x f(t)dt + (1 - x)(\ln x - 1) + e$. Then, the value of $f(f(1))$ is

(1) $e^e + 1$ (2) $e^e - 1$

(3) $e^e + 2$ (4) $e^e - 2$

Answer (1)

Sol. $f(n) = \left(\int_1^x f(t)dt\right) + (1 - x)(\ln x - 1) + e$

$$f'(x) = f(x) + \frac{(1 - x)}{x} + (\ln x - 1)(-1)$$

$$\frac{dy}{dx} = y + \frac{1}{x} - 1 - \ln x + 1$$

$$\frac{dy}{dx} + (-1)y = \frac{1}{x} - \ln x$$

$$\text{I.F} = e^{-x}$$

$$y(e^{-x}) = \int \left(\frac{e^{-x}}{x} - e^{-x} \ln x \right) dx$$

$$= \int \frac{e^{-x}}{x} dx - \left(-\ln x e^{-x} + \int \frac{e^{-x}}{x} dx \right) + c$$

$$y(e^{-x}) = e^{-x} \ln x + c$$

$$y = \ln x + ce^{x}$$

$$y(1) = e$$

$$\Rightarrow \boxed{c = 1}$$

$$y = e^{x} + \ln x$$

$$f(x) = e^{x} + \ln x$$

$$f(1) = e$$

$$f(f(1)) = e^{e} + \ln(e^{e})$$

$$= e^{e} + 1$$

11.

12.

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. A bag contains 4 red balls, 6 yellow balls and 5 blue balls. In how many ways we can select 8 balls such that we get at least two balls of each colour, is

Answer (4100)

Sol.

R	Y	B	ways
4	2	2	${}^4C_4 \cdot {}^6C_2 \cdot {}^5C_2 = 150$
2	4	2	${}^4C_2 \cdot {}^6C_4 \cdot {}^5C_2 = 900$
2	2	4	${}^4C_2 \cdot {}^6C_2 \cdot {}^5C_4 = 450$
3	3	2	${}^4C_3 \cdot {}^6C_3 \cdot {}^5C_2 = 800$
3	2	3	${}^4C_3 \cdot {}^6C_2 \cdot {}^5C_3 = 600$
2	3	3	${}^4C_2 \cdot {}^6C_3 \cdot {}^5C_3 = 1200$

Total ways = 4100

22. The number of solution of equation $\cos\theta \cos\frac{5\theta}{2} = \cos 7\theta \cos\frac{7\theta}{2}$, $\theta \in [-\pi, \pi]$ is equal to

Answer (19)

Sol. $\cos\theta \cos\frac{5\theta}{2} = \cos 7\theta \cos\frac{7\theta}{2}$

$$\cos\left(\theta + \frac{5\theta}{2}\right) + \cos\left(\theta - \frac{5\theta}{2}\right) = \cos\left(7\theta + \frac{7\theta}{2}\right) + \cos\left(7\theta - \frac{7\theta}{2}\right)$$

$$\cos\frac{7\theta}{2} + \cos\frac{3\theta}{2} = \cos\cos\frac{21\theta}{2} + \cos\frac{7\theta}{2}$$

$$\cos\frac{3\theta}{2} = \cos\frac{21\theta}{2}$$

$$\frac{21\theta}{2} = 2k\pi \pm \frac{3\theta}{2}$$

$$\frac{21\theta}{2} = 2k\pi + \frac{3\theta}{2} \Rightarrow \theta = \frac{2k\pi}{9},\ k \in I$$

$\frac{21\theta}{2} = 2k\pi - \frac{3\theta}{2} \Rightarrow \theta = \frac{k\pi}{6},\ k \in I$

when $\theta = \frac{2k\pi}{9}$

$-\pi \le \frac{2k\pi}{9} \le \pi \Rightarrow -\frac{9}{2} \le k \le \frac{9}{2}$

$k \in \{-4, -3, -2, -1, 0, 1, 2, 3, 4\} \rightarrow 9$ sol^n

for $\theta = \frac{k\pi}{6}$

$-\pi \le \frac{k\pi}{6} \le \pi \Rightarrow -6 \le k \le 6$

$k \in \{-6,-5,-4,-3,-2,-1,0,1,2,3,4,5,6\} \rightarrow 13$ sol^n

$\theta = \left\{-\frac{2\pi}{3}, 0, \frac{2\pi}{3}\right\}$ is common

$\therefore$ Total Sol^n = 19

23. If $y = y(x)$ be the solution of the differential equation $\left(\sqrt{\tan x}\right)dy = \left(\sec^3 x - (\tan x)^{\frac{3}{2}} y\right)dx$ and $y\left(\frac{\pi}{4}\right) = \frac{6\sqrt{2}}{5}$ and $y\left(\frac{\pi}{3}\right) = \frac{4\alpha}{5}$ then α^4 is equal to

Answer (48.00)

Sol. $\frac{dy}{dx} = \frac{\sec^3 x - (\sqrt{\tan x})^3}{\sqrt{\tan x}}$

$\frac{dy}{dx} + (\tan x)y = (\sec^2 x)\frac{\sec x}{\sqrt{\tan x}}$

I.F. $= e^{\int \frac{\sin x}{\cos x} dx} = e^{-\ln|\cos x|} = \sec x$

$\Rightarrow y \sec x = \int \frac{(\sec x)^2 (\sec x)^2}{\sqrt{\tan x}} dx$

Let $\tan x = t^2$

$(\sec^2 x)dx = 2t\,dt$

$y \sec x = \int \frac{(1 + t^4)(2t dt)}{t}$

$= 2t + \frac{2t^5}{5} + C$

$y \sec x = 2\sqrt{\tan x} + \frac{2}{5}(\sqrt{\tan x})^5 + C$

$y\left(\frac{\pi}{4}\right) \times \sqrt{2} = 2 + \frac{2}{5} + C \Rightarrow \frac{6\sqrt{2} \times \sqrt{2}}{5} = \frac{12}{5} + C$

$\Rightarrow \quad C = 0$

$y\left(\frac{\pi}{3}\right)(2) = 2 \times \sqrt{\left(\sqrt{3}\right)}\left[1 + \frac{1}{5}(\sqrt{3})^4\right]$

$= 2\sqrt{\sqrt{3}} \times \left(1 + \frac{3}{5}\right)$

$\Rightarrow y\left(\frac{\pi}{3}\right) = 3^{\frac{1}{4}} \times \frac{8}{5} = \frac{4\alpha}{5} \quad \Rightarrow \quad \alpha = 2 \cdot 3^{\frac{1}{4}}$

$\Rightarrow \quad \alpha^4 = 16 \times 3 = 48$

24. If the mean of the frequency distribution, table

x_i	0	2	6	12	. .	.	n(n+1)
f_i	${}^nC_0$	${}^nC_2$	${}^nC_3$	.	.	.	${}^nC_n$

is 45. Then, the mean will be

Answer (42)

Sol. Mean = 45

$\frac{\sum f_i x_i = 45}{\sum f_i}$

$\sum_{r=0}^{n} \frac{r(r+1)}{2^n} {}^nC_r = 45$

$\sum_{r=0}^{n} r^2 + {}^nC_r + \sum_{r=0}^{n} r\,{}^nC_r = 45 \times 2^n$

$\Rightarrow n(n+1)2^{n-2} + n(2^{n-1}) = 45 \times 2^n$

$\Rightarrow n^{n-2}(n^2 + n + 2n) = 45 \times 2^n$

$\Rightarrow n^2 + 3n = 180$

$\Rightarrow n^2 + 3n - 180 = 0$

$\Rightarrow \boxed{n = 12}$

Total frequency = 2^{12}

$$\sum_{i=0}^{5} {}^{12}C_i = \sum_{i=7}^{12} {}^{12}C_i$$

$\Rightarrow$ Median will be at $f_i = {}^{12}C_6$

$\Rightarrow$ Median = 6 × 7 = 42

25.

❑ ❑ ❑