

SOLUTIONS OF JEE ADVANCED 2025 | PAPER - 1

PHYSICS

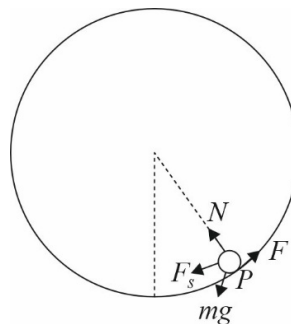
- 1.(A) Torque equation about point of contact $\tau_P = I_P \alpha$

$$F_s r + mg \sin \theta r = \left(\frac{3}{2} m r^2 \right) \frac{a}{r}$$

$$kx r + mg \frac{x}{R-r} r = \frac{3}{2} m r a$$

$$a = \frac{2}{3} \left(\frac{k}{m} + \frac{g}{R-r} \right) x$$

$$\therefore \omega^2 = \frac{2}{3} \left(\frac{k}{m} + \frac{g}{R-r} \right)$$



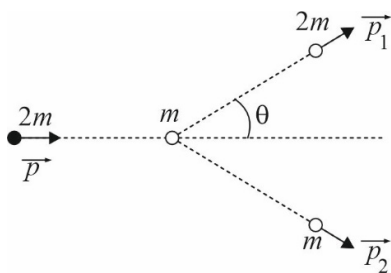
- 2.(D) Momentum conservation

$$\vec{p}_1 + \vec{p}_2 = \vec{p} \Rightarrow \vec{p}_2 = \vec{p} - \vec{p}_1 \quad \therefore p_2 = \sqrt{p^2 + p_1^2 - 2pp_1 \cos \theta}$$

Energy conservation

$$\frac{p_1^2}{4m} + \frac{p_2^2}{2m} = \frac{p^2}{4m}$$

$$p_1^2 + 2(p^2 + p_1^2 - 2pp_1 \cos \theta) = p^2$$



$$3p_1^2 - (4p \cos \theta) p_1 + p^2 = 0$$

For real root of p_1 , $D \geq 0$

$$\Rightarrow 16p^2 \cos^2 \theta - 12p^2 \geq 0 \Rightarrow \cos^2 \theta \geq \frac{3}{4}$$

$$\Rightarrow \cos \theta \geq \frac{\sqrt{3}}{2} \Rightarrow \theta \leq \frac{\pi}{6}$$

3.(A) After time t , $\vec{A} = a^2 (-\cos \omega t \hat{j} + \sin \omega t \hat{k})$

$$\therefore \Phi = \vec{B} \cdot \vec{A} = B_0 a^2 \sin \omega t \cos \omega t = \frac{B_0 a^2}{2} \sin 2\omega t$$

$$V = -\frac{d\Phi}{dt} = \frac{-B_0 a^2}{2} 2\omega \cos 2\omega t = -B_0 a^2 \omega \cos 2\omega t \quad \text{For } 0 < t < \frac{\pi}{\omega}$$

$$V = 0 \quad \text{For } \frac{\pi}{\omega} < t < \frac{2\pi}{\omega}$$

4.(C) 1 MSD = 0.1 cm $V = 0$

$$10 \text{ VSD} = 7 \text{ MSD} \rightarrow 1 \text{ USD} = 0.7 \text{ cm}$$

$$LC = 1 \text{ MSD} - 1 \text{ VSD} = 0.03 \text{ cm}$$

$$D = 0.1 \text{ cm} + 0.03 = 0.13 \text{ cm}$$

5.(BD) Let velocity of loop be v after it moves a distance y .

$$\varepsilon_{\text{induced}} = B_0 L v$$

$$I = \frac{B_0 L v}{R}$$

$$F_m = B_0 I L = \frac{B_0^2 L^2}{R} v$$

$$a = \frac{-B_0^2 L^2 V}{MR} = \frac{dv}{dt} \Rightarrow dv = -K v dt$$

$$\int_{v_0}^v \frac{dv}{v} = -K \int_0^t dt \Rightarrow v = v_0 e^{-Kt}$$

$$\frac{dy}{dt} = v_0 e^{-Kt} \Rightarrow \int_0^y dy = v_0 \int_0^t e^{-Kt} dt \quad \therefore y = \frac{v_0}{K} (1 - e^{-Kt})$$

(A) If $v_0 = 1.5KL$

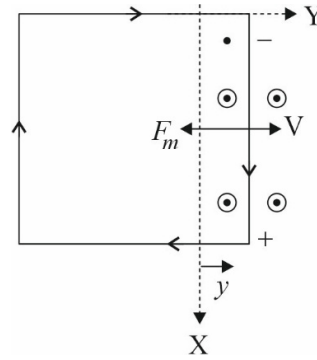
$$y_{\max} = \frac{v_0}{K} = 1.5L > L \quad \therefore \text{Loop will enter field completely}$$

(B) When complete loop is inside, $I = 0 \Rightarrow F = 0$

(C) If $v_0 = \frac{KL}{10}$

$$y_{\max} = \frac{v_0}{K} = \frac{L}{10}$$

So, loop stops after travelling $\frac{L}{10}$ but it will take infinite time.



(D) If $v_0 = 3KL$

$$y_{\max} = \frac{v_0}{K} = 3L$$

For $y = L$,

$$L = 3L(1 - e^{-Kt}) \Rightarrow e^{-Kt} = 1 - \frac{1}{3} = \frac{2}{3} \Rightarrow -Kt = \ln \frac{2}{3} \Rightarrow t = \frac{1}{K} \ln \frac{3}{2}$$

6.(D) $l = 10.5 \text{ cm}$ (3 significant figures)

$$b = 0.05 \text{ mm} = 0.05 \times 10^{-1} \text{ cm} \text{ (1 significant figure)}$$

$$t = 6.0 \mu\text{m} = 6.0 \times 10^{-4} \text{ cm} \text{ (2 significant figure)}$$

$$= 3 \times 10^{-5} \text{ cm}^3$$

Rounding off to one significant figure

7.(AD) $v_1 = \sqrt{\frac{T}{\mu}}, v_2 = \sqrt{\frac{T}{4\mu}} = \frac{v_1}{2}, v_3 = \sqrt{\frac{T}{16\mu}} = \frac{v_1}{4}$

$$K_1 = \frac{\omega}{V_1} = K, K_2 = \frac{\omega}{V_2} = 2K, K_3 = \frac{\omega}{V_3} = 4K$$

8.(2) $V = \frac{dy}{dt} = 8 \left(\frac{2\pi}{T} \right) \cos \frac{2\pi t}{T}$

$$a = \frac{dV}{dt} = -8 \left(\frac{2\pi}{T} \right)^2 \sin \frac{2\pi t}{T}$$

$$\text{Acceleration amplitude, } a_0 = 8 \left(\frac{2\pi}{T} \right)^2 = 8 \left(\frac{2\pi}{40\pi} \right)^2 = \frac{1}{50}$$

$$\text{Maximum weight observed} = m(g + a_0)$$

$$\text{Minimum weight observed} = m(g - a_0)$$

$$\text{So, maximum variation} = 2ma_0 = 2(50) \left(\frac{1}{50} \right) = 2N$$

9.(22.95 – 23.00)

$$\frac{nh\nu}{1} = \frac{1}{2} \frac{B_0^2}{\mu_0}$$

$$35 \times 10^7 \times 6 \times 10^{-34} \times 10^{15} = \frac{B_0^2}{2 \times 4 \times \frac{22}{7} \times 10^{-7}}$$

$$B_0^2 = 35 \times 6 \times 8 \times \frac{22}{7} \times 10^{-19} = 528 \times 10^{-18}$$

$$B_0 = \sqrt{528} \times 10^{-9} = 22.98 \times 10^{-9} T$$

If $\sqrt{528}$ is taken as $\sqrt{529}$, then α ranges 22.95 to 23.00.

For $\lambda_n = \lambda_e$

$$\frac{h}{\sqrt{2m_N K_B T}} = \frac{6\pi a_0}{Z} \Rightarrow T = \frac{h^2 Z^2}{72\pi^2 a_0^2 m_N k_B} \quad \therefore \alpha = 72$$

14.(C) (P) $\vec{E} = \frac{1}{4\pi\epsilon_0} \frac{p}{r^3} (-\hat{j}) + \frac{1}{4\pi\epsilon_0} \frac{p}{r^3} (-\hat{j}) \Rightarrow P \rightarrow 2$

(Q) $\vec{E} = \frac{1}{4\pi\epsilon_0} \frac{p}{r^3} (-\hat{j}) + \frac{1}{4\pi\epsilon_0} \frac{p}{r^3} \hat{j} = 0 \Rightarrow Q \rightarrow 1$

(R) $\vec{E} = \frac{1}{4\pi\epsilon_0} \frac{p}{r^3} (-\hat{j}) + \frac{1}{2\pi\epsilon_0} \frac{p}{r^3} \hat{i} \Rightarrow R \rightarrow 4$

(S) $\vec{E} = \frac{1}{2\pi\epsilon_0} \frac{p}{r^3} \hat{i} + \frac{1}{2\pi\epsilon_0} \frac{p}{r^3} \hat{i} \Rightarrow S \rightarrow 5$

15.(A) (P) I and V are in same phase

$$I_0 = \frac{300}{30} = 10A \quad \therefore P \rightarrow 3$$

(Q) $X_L = \omega L = 400 \times 100 \times 10^{-3} = 40\Omega$

$$Z = \sqrt{R^2 + X_L^2} = 50\Omega$$

$$I_0 = \frac{300}{50} = 6A$$

$$\text{So } i = (6A) \sin(400t - 53^\circ)$$

$$I \text{ lags } V \quad \therefore Q \rightarrow 5$$

(R) $X_L = \omega L = 400 \times 25 \times 10^{-3} = 10\Omega$

$$X_C = \frac{1}{\omega_C} = \frac{1}{400 \times 50 \times 10^{-6}} = 50\Omega$$

$$\therefore Z = \sqrt{30^2 + (50 - 10)^2} = 50\Omega$$

$$I_0 = \frac{300}{50} = 6A \Rightarrow i = (6A) \sin(400t + 53^\circ)$$

I leads V

$$\therefore R \rightarrow 2$$

(S) $X_L = 400 \times 125 \times 10^{-3} = 50\Omega$

$$X_C = \frac{1}{400 \times 50 \times 10^{-6}} = 50\Omega \quad \therefore Z = R = 60\Omega$$

$$I_0 = \frac{300}{60} = 5A \Rightarrow i = (5A) \sin 400t$$

$$\text{I and V are in same phase} \quad \therefore S \rightarrow 1$$

16.(C) (P)
$$E = \frac{-13.6Z^2}{n_1^2} - \left(\frac{-13.6Z^2}{n_2^2} \right)$$

For $E \propto Z^2$ for transition of electron in hydrogen like atoms.

(Q) In case wavelength of K_α line

$$\frac{1}{\lambda} = R(Z-1)^2 \left(\frac{1}{1^2} - \frac{1}{2^2} \right)$$

$$\Rightarrow \frac{hc}{\lambda} = hcR(Z-1)^2 \left(\frac{3}{4} \right)$$

$$E \propto (Z-1)^2$$

So, energy of characteristic X rays $\propto (Z-1)^2$

(R) If E be energy electrostatic intraction of Z protons in a nucleus then $E \propto Z(Z-1)$

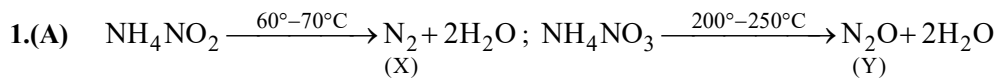
(S) If E is independent of Z , then

It is binding energy per nucleon for stable nuclear having Z between 30 to 170

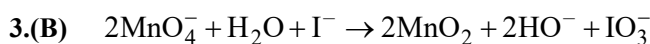
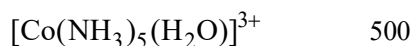
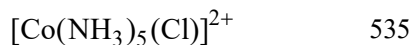
So, answer C

$$P \rightarrow 5 \quad Q \rightarrow 1 \quad R \rightarrow 2 \quad +57.4$$

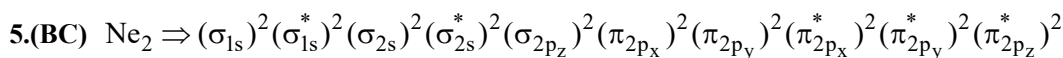
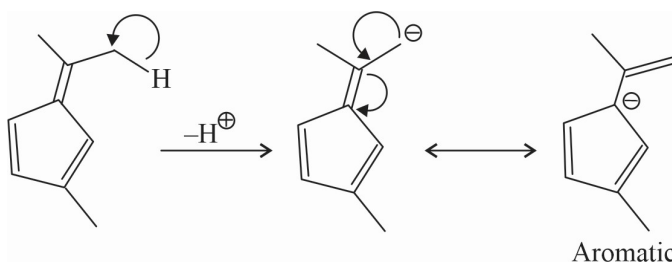
CHEMISTRY



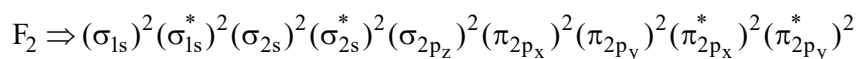
2.(A) Coordination entity Wavelength of light absorbed (nm)



4.(B)



$$\text{Bond order} = \frac{N_{\text{BMO}} - N_{\text{ABMO}}}{2} = \frac{10 - 10}{2} = 0$$



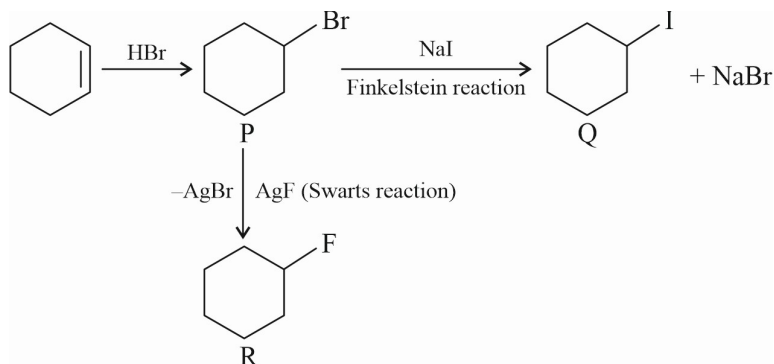
Bond order of O_2^+ (2.5) > Bond order of O_2 (2)

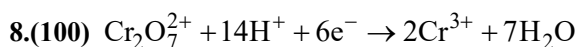
Bond energy of O_2^+ > Bond energy of O_2

Bond length of Li_2 (267 pm) > Bond length of B_2 (159 pm)

6.(AB) La^{3+}	$4f^0$	Diamagnetic
Ce^{4+}	$4f^0$	Diamagnetic
Yb^{2+}	$4f^{14}$	Diamagnetic
Lu^{3+}	$4f^{14}$	Diamagnetic
La^{2+}	$5d^1$	Paramagnetic
Ce^{3+}	$4f^1$	Paramagnetic
Yb^{3+}	$4f^{13}$	Paramagnetic
Lu^{2+}	$4f^{14}5d^1$	Paramagnetic

7.(B)


C – X bond length order $Q > P > R$

C – X bond enthalpy order $R > P > Q$
 S_N2 reactivity order $Q > P > R$
 pK_a order of HX $R > P > Q$

Number of faradays = 3 $\times$ Mole of Cr^{3+} produced

$$\frac{I \times 48.25 \times 60}{96500} = 3 \times 1$$

$$I = \frac{3 \times 1 \times 96500}{48.25 \times 60} = 100 \text{ amperes}$$

9.(2.24) $[\text{H}^+]_{\text{Total}} = [\text{H}^+]_{\text{acid}} + [\text{H}^+]_{\text{H}_2\text{O}}$

$$= \sqrt{K_a \times C + K_w}$$

$$= \sqrt{4.00 \times 10^{-11} \times 1.00 \times 10^{-3} + 10^{-14}} = \sqrt{5 \times 10^{-14}}$$

$$X \times 10^{-7} = 2.24 \times 10^{-7} \Rightarrow X = 2.24$$

10.(-7.1)

$$\left(p + \frac{a}{V_m^2}\right)(V_m - b) = RT$$

$$pV_m + \frac{a}{V_m} - pb - \frac{ab}{V_m^2} = RT$$

$$pV_m^2 + a - \frac{ab}{V_m} = (RT + pb)V_m$$

$$pV_m^3 + aV_m - ab = (RT + pb)V_m^2$$

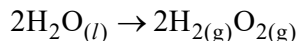
$$pV_m^3 - (RT + pb)V_m^2 + aV_m - ab = 0$$

$$\text{Coefficient of } V_m^2 = -(RT + pb) = -[(0.082 \times 300) + (300 \times 0.060)] = -[24.6 + 18] = -42.6$$

$$\text{Coefficient of } V_m = a = 6$$

$$-\frac{(RT + pb)}{a} = \frac{-42.6}{6} = -7.1$$

11.(-29.88)



$$w = -P_{\text{ext}}\Delta V = -P_{\text{ext}}[V_P - V_R] = -P_{\text{ext}}\left[\frac{n_T RT}{P_{\text{ext}}}\right] = -n_T RT$$

$$\text{Mole of H}_2 \text{ formed} = \text{mole of H}_2\text{O electrolysed} = \frac{144}{18} = 8$$

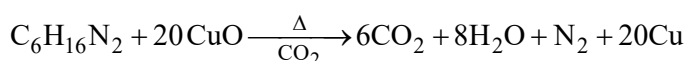
$$\text{Mole of O}_2 \text{ formed} = \frac{1}{2} \times \text{mole of H}_2\text{O electrolysed} = 4$$

$$w = -12 \times 8.3 \times 300 = -29880 = -29.88 \text{ kJ}$$

12.(280)

$\text{H}_2\text{N}-(\text{CH}_2)_6-\text{NH}_2$ and $\text{HOOC}-(\text{CH}_2)_4-\text{COOH}$ are monomers of Nylon 6, 6.

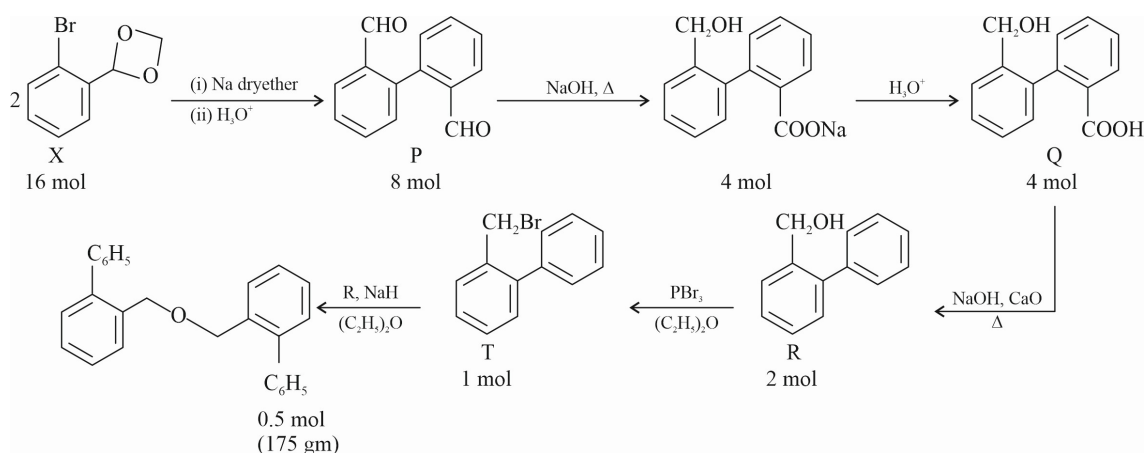
$\text{H}_2\text{N}-(\text{CH}_2)_6-\text{NH}_2$ gives positive carbylamine test.



Mole of N_2 formed = mole of monomer $\text{H}_2\text{N}-(\text{CH}_2)_6-\text{NH}_2$ taken = 10

Amount of nitrogen gas formed = $10 \times 2 \times 14 = 280 \text{ g}$

13.(175)



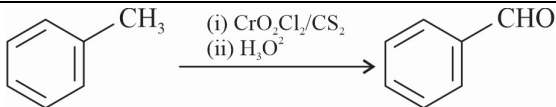
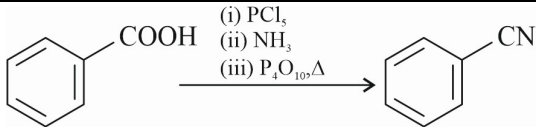
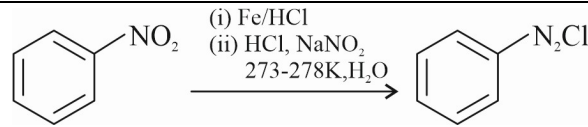
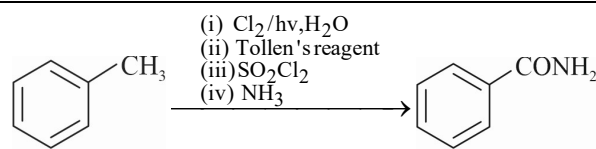
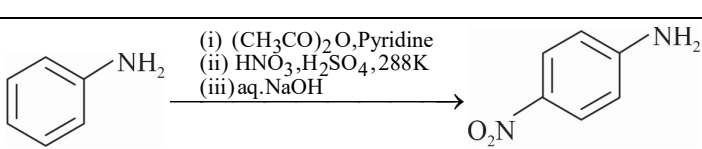
14.(A) $\text{P} \rightarrow 3$: Passing H_2S in the presence of NH_4OH precipitates Mn^{2+}

$\text{Q} \rightarrow 4$: Passing $(\text{NH}_4)_2\text{CO}_3$ in the presence of NH_4OH precipitates Ba^{2+}

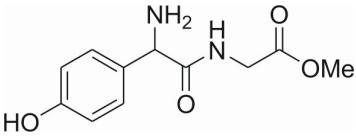
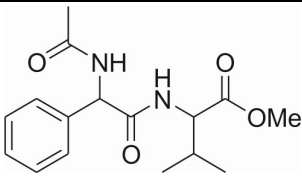
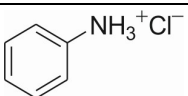
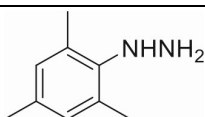
$\text{R} \rightarrow 2$: Passing NH_4OH in the presence of NH_4Cl precipitate Al^{3+}

$\text{S} \rightarrow 1$: Passing H_2S in the presence of dilute HCl precipitates Cu^{2+}

15.(B)

	Product is reactant of Cannizzaro reaction (S)-1
	Product is reactant of Stephen reaction (P)-2
	Product is reactant of Sandmeyer reaction (Q)-3
	Product is reactant of Hoffmann bromamide degradation reaction (R)-4
	Product is reaction of carbylamine reaction

16.(B)

P → 2		- Ninhydrin Test (amide) - Violet colour with FeCl_3 (Phenolic compound)
Q → 5		- Ninhydrin Test - After complete hydrolysis, gives ninhydrin test (amino acid) and does not give positive phthalein dye test (absence of phenolic OH group)
R → 1		Reaction with phenyl diazonium salt gives yellow dye (Aniline yellow)
S → 3		Reaction with glucose will give corresponding hydrazone.

MATHEMATICS

1.(C) $f(x) - g(x) \neq 0$

$$(a_3 - b_3)x^3 + (a_2 - b_2)x^2 + 7x + (a_1 - b_1) \neq 0$$

$$a_3 = b_3 \quad \dots(1)$$

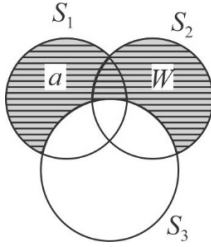
$$\frac{(a_2 - b_2)x^2 + 7x + (a_1 - b_1) \neq 0}{\text{no. roots}}$$

Focus only on the coefficient of x^3

$$h(x) = \underbrace{a_3(x+1)^3 + (x+1)^4 - b_3(x+2)^3 - (x+2)^4}_{(a_3=b_3)[x^3-x^3] + 4c_3 - 4c_3 \cdot 2}$$

$$\Rightarrow 4 - 8 = -4$$

2.(A)



$$p(V) = P\left(\frac{S_1}{(S_2 \cup S_3)'}\right) = \frac{1}{10}$$

$$P(S_1 \cup S_2 \cup S_3) = \frac{1}{2}$$

Let, $P(S_1) = a$

$$\frac{a}{a + \frac{1}{2}} = \frac{1}{10}$$

$$20a = 2a + 1$$

$$18a = 1$$

$$a = \frac{1}{18} \quad P(W) = \frac{1}{12}$$

$$\frac{1}{2} - \left[\frac{1}{18} + \frac{1}{12} \right] = \frac{1}{2} - \frac{5}{36} = \frac{13}{36}$$

3.(C) The function

$$f(x) = \begin{cases} 2 - x^2(2 + \sin \frac{1}{x}), & \text{if } x \neq 0 \\ 2, & \text{if } x = 0 \end{cases}$$

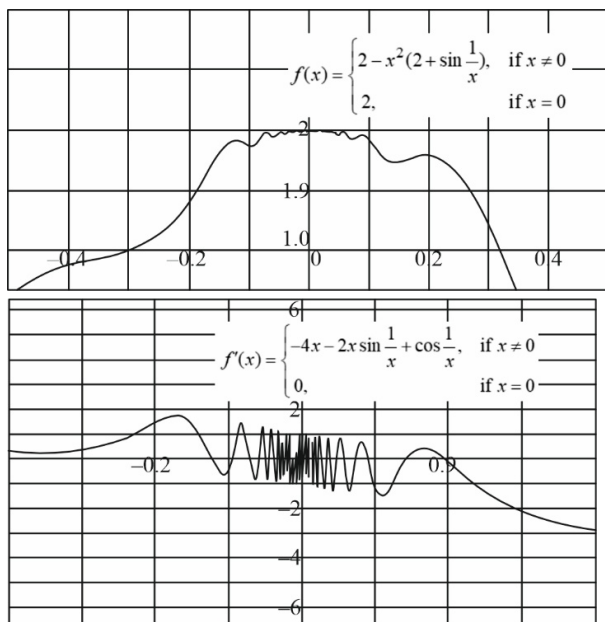
is continuous on $\mathbb{R}$. Since $x^2(2 + \sin \frac{1}{x})$ is positive for all $x \neq 0$, then

$2 > 2 - x^2(2 + \sin \frac{1}{x})$. Therefore the function $y = f(x)$ has a local maximum at the point $x = 0$. But

it is neither increasing for all $x < 0$ nor decreasing for all $x > 0$ in any neighborhood of the point $x = 0$. To show this we can find the derivative

$$f'(x) = -4x - 2x \sin \frac{1}{x} + \cos \frac{1}{x}; \quad x \neq 0.$$

The derivative takes both positive and negative values in any interval $(-\delta, 0) \cup (0, \delta)$ and therefore the function is not monotone in any interval $(-\delta, 0) \cup (0, \delta)$, where $\delta > 0$.



4.(C) Let $Q = \begin{bmatrix} a_1 & a_2 & a_3 \\ a_4 & a_5 & a_6 \\ a_7 & a_8 & a_9 \end{bmatrix}$

$$QP = PQ$$

$$P = \begin{bmatrix} 2a_1 & 2a_2 & 3a_3 \\ 2a_4 & 2a_5 & 3a_6 \\ 2a_7 & 2a_8 & 3a_9 \end{bmatrix} = \begin{bmatrix} 2a_1 & 2a_2 & 2a_3 \\ 2a_4 & 2a_5 & 2a_6 \\ 3a_7 & 3a_8 & 3a_9 \end{bmatrix}$$

So, from Equality

$$a_3 = a_6 = a_8 = a_7 = 0$$

$$Q^{-1} = Q^T$$

So, $Q \cdot Q^T = I$

$$\begin{bmatrix} a_1 & a_2 & 0 \\ a_4 & a_5 & 0 \\ 0 & 0 & a_9 \end{bmatrix} \begin{bmatrix} a_1 & a_4 & 0 \\ a_2 & a_5 & 0 \\ 0 & 0 & a_9 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$-a_1^2 + a_2^2 = 1 \quad \dots(1)$$

$$a_1 a_4 + a_2 a_5 = 0 \quad \dots(2)$$

$$a_4 a_1 + a_2 a_5 = 0$$

$$a_4^2 + a_5^2 = 1 \quad \dots(3)$$

$$a_9^2 = 1 \quad \dots(4)$$

Determinant

$$a_9(a_1 a_5 - a_4 a_2)$$

$$a_1 a_5 \neq a_4 a_2$$

$$a_9 = \pm 1 \quad \text{from(1)}$$

$$a_1^2 = 1, \quad a_2^2 = 0$$

$$a_2^2 = 0, \quad a_5^2 = 1$$

$$a_4^2 = 0, \quad a_5^2 = 1$$

$$a_4^2 = 1, \quad a_5^2 = 0$$

Total ways: $2 \times [8] = 16$
for a_9

5.(AC) Equation of L_2 : Direction $\begin{vmatrix} i & j & k \\ 2 & 3 & 1 \\ 1 & 2 & 1 \end{vmatrix} = \hat{i}(1) - \hat{j}(1) + k(1)$

$$L_2 : \frac{x-2}{1} = \frac{y+1}{-1} = \frac{z-3}{1} = \lambda$$

$$P_1(\lambda+2, -\lambda-1, \lambda+3)$$

For Q: $2(\lambda+2) + (-\lambda-1) - 2(\lambda+3) = 6$

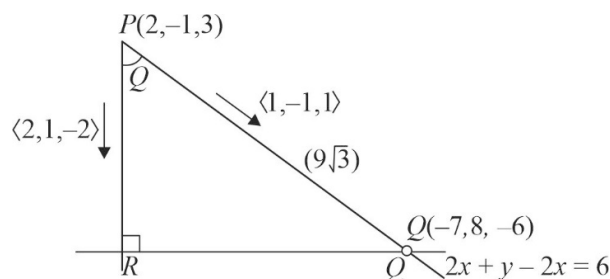
$$2\lambda + 4 - \lambda - 1 - 2\lambda - 6 = 6$$

$$\lambda = -9$$

$$Q(-7, 8, -6) \quad P(2, -1, 3)$$

(A) $PQ = \sqrt{9^2 + 9^2 + 9^2} = 9\sqrt{3}$

(B)



$$\cos \phi = \frac{|2 - 1 - 2|}{\sqrt{9} \sqrt{3}}$$

$$\cos \phi = \frac{1}{3\sqrt{3}} \quad \dots(1)$$

$$\frac{1}{3\sqrt{3}} = \frac{PR}{9\sqrt{3}}$$

$$PR = 3$$

$$QR = \sqrt{81 \times 3 - 9} = \sqrt{234}$$

(C) Area of ΔPQR

$$\frac{1}{2} \times \sqrt{234} \times 3 = \frac{3}{2} \sqrt{234}$$

(D) Wrong, refer equation (1)

$$6.(AD) \quad f(x) = \begin{cases} \frac{2k+2}{2} = k+1, & n = 2k+1 \rightarrow n = \text{odd} \\ \frac{4-2k}{2} = 2-k & n = 2k \rightarrow n = \text{Even} \end{cases}$$

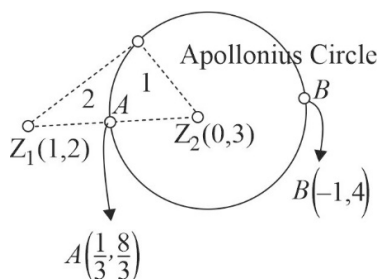
$$\text{At } x = 2 \quad \left. \begin{array}{l} g(f(1)) = g(1) \\ f(f(1)) = g(1) \end{array} \right\} \text{gof is not one-one}$$

$g(f(x)) = g(\text{integer}) \rightarrow \text{not into}$ (as per option C we have done above)

Option (B) $f(9(x)) = f(\text{Natural except } 1)$ Hence it is one-one

B is wrong

7.(AD)



$$\text{Centre} = \left(\frac{\frac{1}{3} - 1}{2}, \frac{\frac{8}{3} + 4}{2} \right)$$

$$\left(-\frac{1}{3}, \frac{10}{3} \right)$$

$$r = \sqrt{\frac{4}{9} + \frac{4}{9}}$$

$$r = \frac{2}{3}\sqrt{2}$$

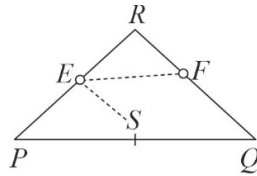
8.(105) Total = 36

Diagonal = 6 = 30

$$\left[\begin{array}{c} \text{---} \\ \text{---} \\ \text{---} \\ \text{---} \\ \text{---} \\ \text{---} \end{array} \right] \rightarrow 15 \text{ Elements}$$

$$= {}^{15}C_2 = \frac{15 \times 14}{2} = 15 \times 7 = 105$$

9.(1.2)



p.v of $S \rightarrow s$

$P \rightarrow p$

$Q \rightarrow q$

$R \rightarrow r$

$$\text{Length of } EF = \left| \frac{p+r}{2} - \frac{q+r}{2} \right| = \left| \frac{p-q}{2} \right| \quad \dots(1)$$

$$\text{Length of } ES = \left| \frac{p+r}{2} - s \right|$$

For S , we have $\overrightarrow{SP} + 5\overrightarrow{SQ} + 6\overrightarrow{SR} = \vec{0}$

$$p - s + 5(q - s) + 6(r - s) = 0$$

$$\frac{p + 5q + 6r}{12} = s$$

$$= \left| \frac{p+r}{2} - \frac{p}{12} - \frac{5q}{12} - \frac{r}{2} \right|$$

$$= \left| \frac{p}{2} - \frac{p}{12} - \frac{5q}{12} \right|$$

$$= \left| \frac{5p}{12} - \frac{5q}{12} \right| = \frac{5}{12} |p - q| \quad \dots(2)$$

$$(1) \div (2)$$

$$\frac{12}{10} = 1.2$$

10.(762) **Case-I:** O appears 2 times select 2 out of last 6 places in 6C_2 ways and place $\frac{1}{2}$ in any of

remaining 5 places in $6C_1 \times 2^5 = 480$ ways

Case-II: 1 appears 2 times with 1st digit as 1 select 1 out of 6 places for 1 and place $\frac{0}{2}$ in rest 5 in

$$6C_1 \times 2^5 = 192 \text{ ways}$$

Case-III: 1 appears 2 times with 1st digit as 2 select 2 out of 6 places for 1 and place $\frac{0}{2}$ in rest 4

places ${}^6C_2 \times 2^4 = 240$ ways

Case-IV: '0' & '1' both 2 times.

1st digit is 1

$${}^6C_2 \times {}^4C_1 \times 1 = 60$$

Case-V: '0' & both 2 times.

1st digit is 2

$${}^6C_4 \times {}^4C_2 \times 1 = 90$$

By inclusion and exclusion

Case 1 + Case 2 + Case 3 – Case 4 – Case 5

$$480 + 192 + 240 - 60 - 90 = 762$$

11.(2.40)

$$\text{L.H} \frac{\frac{\alpha}{2} \left(\frac{1}{1-x^2} \right) - \beta x \sin x + \beta \cos x}{3 \times 2} = 2$$

Using expansion

$$\frac{\frac{\alpha}{3} (1+x^2) - \beta \times x^2 + \beta \left(1 - \frac{x^2}{2} \right)}{3 \times 2} = 2$$

$$\frac{\alpha}{2} + \beta = 0$$

$$\frac{\alpha}{2} - \beta - \frac{\beta}{2} = 6$$

$$-\beta - \beta - \frac{\beta}{2} = 6$$

$$-\frac{5\beta}{2} = 6$$

$$\beta = \frac{-12}{5}$$

$$\alpha = \frac{24}{5}$$

$$\alpha + \beta = \frac{12}{5} = 2.4$$

12.(96) $f(a_1 + 30d) = 64 f[a_1 + 24d]$

$$f(a_1) f(30d) = 64 f(a_1) f(24d)$$

$$K^{30d} = 64 K^{24d} \text{ set } f(x) = k^x$$

$$k^{6d} = 64 \quad \dots(1)$$

$$k^{a_1} + k^{a_1+d} + k^{a_1+2d} + \dots + k^{a_1+49d} = 3(2^{25} + 1)$$

$$\frac{k^{a_1} [k^{50d} - 1]}{k^d - 1} = 3(2^{25} + 1) \quad \dots(2)$$

Using (1) in (2)

$$k^{a_1} [2^{50} - 1] = 3(2^{25} + 1)$$

$$k^{a_1} [2^{25} - 1] [2^{25} + 1] = 3 [2^{25} + 1]$$

$$k^{a_1} = \frac{3}{2^{25} - 1}$$

Now $\sum_{i=6}^{30} f(a_i) = K^{a_1+5d} + K^{a_1+6d} + \dots + K^{a_1+29d}$

$$= K^{a_1} \cdot K^{5d} \frac{[K^{25d} - 1]}{(K^d - 1)}$$

$$= \frac{3}{(2^{25} - 1)} \times 2^5 \frac{[2^{25} - 1]}{(2 - 1)} = 32 \times 3 = 96$$

13.(2) 3-L.D.E with $q = 0$

$$y_1 \cdot e^{-\int \frac{1-\cos 2x}{2} dx} = C_1$$

$$y_1 \cdot e^{-\left[\frac{x}{2} - \frac{\sin 2x}{4}\right]} = C_1$$

$$(5) e^{-\left[\frac{1}{2} - \frac{\sin 2}{4}\right]} = C_1$$

$$y_2 \cdot e^{-\int \frac{1+\cos 2x}{2} dx} = C_2$$

$$y_2 \cdot e^{-\left[\frac{x}{2} + \frac{\sin 2x}{4}\right]} = C_2$$

$$\frac{1}{3} e^{-\left[\frac{1}{2} + \frac{\sin 2}{4}\right]} = C_2$$

$$Y_3 \cdot e^{\int \left(\frac{2}{x^3} - 1\right) dx} = C_3$$

$$Y_3 \cdot e^{-\left[\frac{-1}{x^2} - x\right]} = C_3$$

$$\frac{3}{5e} e^2 = C_3$$

$$C_1 C_2 C_3 = 1$$

$$\lim_{x \rightarrow 0} \frac{e^{\frac{-1}{x^2}} + 2x}{(e^{3x})x} = \lim_{x \rightarrow 0^+} \frac{e^{\frac{-1}{x^2}} + 2x}{x} = 2$$

14.(C) Given median = 6

$$\text{So, } f_1 + 5 = 9 = f_2 + 2 + 3 + 1$$

$$f_1 = 4, f_2 = 3$$

$$(P) \quad 7.4 + 9.3 = 28 + 27 = 55$$

So, D is Rejected

$$\text{Mean: } \frac{20+20+6+24+18+33+12}{19}$$

$$\Rightarrow \frac{133}{19} = 7$$

4 — 5
5 — f_1
6 — 1
8 — f_2
9 — 2
11 — 3
12 — 1
$f_1 + f_2 = 7$

Deviation by mean

3, 2, 1, 1, 2, 4, 5

$$\alpha = \frac{\overbrace{15+8+1}^{23} + \overbrace{3+4+12+5}^{25}}{19}$$

$$19\alpha = 48$$

$$19\alpha = 18 \quad \text{Q.3 (B-Rejected)}$$

Deviation by Median $\rightarrow$ 2, 1, 0, 2, 3, 5, 6

4 — 5
5 — f_1
6 — 1
8 — f_2
9 — 2
11 — 3
12 — 1
$f_1 + f_2 = 7$

$$\beta = \frac{\overbrace{10+4+0+6+6}^{20} + \overbrace{15+6}^{27}}{19}$$

$$19\beta = 47$$

$$R \rightarrow 2$$

Variance,

Deviation by Mean 3, 2, 1, 1, 2, 4, 5

Square of Deviation by Mean 9, 4, 1, 1, 4, 16, 25

4 — 5
5 — f_1
6 — 1
8 — f_2
9 — 2
11 — 3
12 — 1
$f_1 + f_2 = 7$

$$\sigma^2 = \frac{45+16+1+3+8+48+25}{19}$$

$$19\sigma^2 = 146$$

$$15.(B) \quad f(1) = \left[\frac{10 - \overbrace{45+60+35}}{n} \right] = \left[\frac{60}{n} \right]$$

$$f(2) = \left[\frac{\overbrace{80-180+120+35}}{n} \right]$$

$$f(2) = \left[\frac{55}{n} \right]$$

From the option $n = 9$

$$P \rightarrow 2$$

$$g(x) = (2n^2 - 13n - 15)(3x^2 + 3) > 0$$

$$2n^2 - 15n + 2n - 15 > 0$$

$$(n+1)(2n-15) < 0$$

$$n < -1, n > \frac{15}{2}$$

$$n = 8$$

$$16.(A) \quad \vec{v} = (\vec{v} \times \vec{w})$$

$$\vec{u} \times \vec{v} = (\vec{v} \times \vec{w}) \times \vec{v}$$

$$\vec{w} = (\vec{v} \cdot \vec{v})\vec{w} - (\vec{w} \cdot \vec{v})\vec{v}(0)$$

$$\vec{w} = |\vec{v}|^2 \cdot \vec{w} \quad \dots(1)$$

D-Rejected

From, Q, R, 5 α is non-zero

So, α, β, γ cannot be All zero.

$$D = 0$$

$$\begin{vmatrix} -t & 1 & 1 \\ 1 & -t & 1 \\ 1 & 1 & -t \end{vmatrix} = 0$$

$$-t(t^2 - 1) - 1(-t - 1) + 1(1 + t) = 0$$

$$-t^3 + t + t + 1 + t + 1 = 0$$

$$-t^3 + 3t + 2 = 0$$

$$t^3 - 3t - 2 = 0$$

$$t^3 + t^2 - t^2 - t - 2t - 2 = 0$$

$$(t + 1)[t^2 - t - 2] = 0$$

$$(t + 1)[t^2 - 2t + t - 2] = 0$$

$$(t + 1)^2(t - 2) = 0$$

$$t = -1, t = 2$$

$$-t\alpha + \beta + \gamma = 0, \alpha - t\beta + \gamma = 0 \text{ and}$$

$$t = -1 \rightarrow \alpha + \beta + \gamma = 0$$

$$t = 2 \rightarrow \beta + \gamma = 2\alpha$$

$$2\beta = 2\alpha$$

$$\alpha = \beta$$

$$\alpha + \gamma = 2\beta$$

$$\alpha + \beta = 2\gamma$$

$$-$$

$$\gamma - \beta = 2\beta - 2\gamma$$

$$\beta - \gamma$$

$$\alpha = \beta = \gamma$$

$$\vec{u} \times \vec{v} = \vec{w}$$

$$|u||v| = |w|$$

$$(\alpha^2 + \beta^2 + \gamma^2)1 = 6$$

$$\alpha^2 + \beta^2 + \gamma^2 = 6$$

Option B : $\alpha = \sqrt{3}$ possible when $t = -1$

$$\vec{u} \cdot \vec{w} = 0 \rightarrow \alpha + \beta = 2\gamma$$

$$\alpha + \beta - t\gamma = 0$$

$$2\gamma - t\gamma = 0$$

$$\gamma(2 - t) = 0$$

$$y = 0$$

$$t \neq 2$$

Option C:

$$\begin{cases} \alpha = \sqrt{3} \\ \alpha + \beta + \gamma = 0 \end{cases}$$

$$\sqrt{3} + \beta + 0 = 0$$

$$\beta = -\sqrt{3}$$

$$(\beta + \gamma)^2$$

$$(-\sqrt{3} + 0) \quad \dots(3)$$

Option D: $\alpha = \sqrt{2}$

$$\alpha^2 + \beta^2 + \gamma^2 = 6$$

$$(\sqrt{2})^2 + (\sqrt{2})^2 + (\sqrt{2})^2 = 6$$

Means, $t = 2$

$$(t + 3) = 5$$