VMC Vidyamandir Classes SINCE 1986

IIT JEE | MEDICAL | FOUNDATION

SOLUTIONS

Joint Entrance Exam | IITJEE-2025

22nd JANUARY 2025 | Evening Shift

MATHEMATICS

SECTION – 1

1.(1) $\left(\lambda\bar{a}+2\bar{b}\right)\cdot\left(3\bar{a}-\lambda\bar{b}\right)=0 \Rightarrow 3\lambda-\frac{\lambda^2}{2}+3-2\lambda=0 \Rightarrow \frac{-\lambda^2}{2}+\lambda+3=0 \Rightarrow \lambda^2-2\lambda-6=0$

2.(3) Case – I $f(A)=\{1\}$

Case – II $f(A)=\{1,4/9/16\}$

Select one out of $4/9/16$ in

${}^3C_1$ way and assign 4 inputs among 2 outputs s.t. no output empty in $2^4-{}^2C_1\cdot1^4=14$ ways

In $2^4-2C_1\cdot1^4=14$ ways So, Case – II Total $=14\times{}^3C_1=42$

Case – III $f(A)=\{1, 4/9/16, 4/9/16\}$

$\left(3^4-{}^3C_2\cdot2^4+{}^3C_2\cdot1^4\right)\times{}^3C_2=108$ Total $=108+42+1=151$

3.(3) $2\left[{}^5C_0x^5+{}^5C_2x^3\left(x^3-1\right)+{}^5C_4x\left(x^3-1\right)^2\right]$

$=2\left[x^5+10x^6-10x^3+5x^7-10x^4+5x\right]$

$\alpha=10$ $\beta=2$

$x=-20$ $s=10$

4.(3) $2ae=2\cdot A\cdot(3e)=2\sqrt{3}$

$\Rightarrow a=3A$

$a-A=2 \Rightarrow A=1,\ a=3$

$2ae=2\sqrt{3} \Rightarrow ae=\sqrt{3}$

$b^2=a^2-a^2e^2=6$

$L.R_1=2\times\frac{b^2}{a}=\frac{2\times6}{3}=4$

$A(3e)=\sqrt{3}$ $B^2=\left[A(3e)\right]^2-A^2=2$

$L\cdot R_2=\frac{2B^2}{A}=\frac{2\times2}{1}=4$

5.(1) Line PQ: $\frac{x+2}{3}=\frac{y+1}{2}=\frac{z-3}{2}=\lambda$

$Q\equiv\left(3\lambda-2, 2\lambda-1, 2\lambda+3\right)$, $R\equiv(1,3,3)$

$QR^2=25 \Rightarrow (3\lambda-3)^2+(2\lambda-4)^2+(2\lambda)^2=25 \Rightarrow 17\lambda^2-34\lambda=0 \Rightarrow \lambda=2$

For Q

$Q\equiv\left(4,3,7\right)$

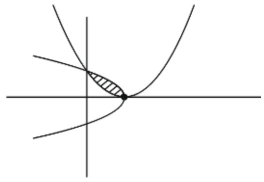
$\overline{QP}=6\hat{i}+4j+4k$

$\overline{QR}=3\hat{i}+0j+4k$

$\overline{QP}\times\overline{QR}=\begin{vmatrix}\hat{i} & j & k\\ 6 & 4 & 4\\ 3 & 0 & 4\end{vmatrix}=16\hat{i}-12j-12k$

$(Area)^2=\frac{1}{4}\left|\overline{QP}\times\overline{QR}\right|^2=\frac{1}{4}\times\left(256+144+144\right)=136$

6.(3) Solve $\left(x^2-4x+4\right)^2=-8\left(x-2\right)$



$\Rightarrow\ \left(x-2\right)\left(x-2\right)^3=-8\left(x-2\right)$

$\Rightarrow\ x=2\ \&\ (x-2)^3=-8\ \Rightarrow\ x=2\ \&\ x=0$

Point $(2,0)\quad(0,4)$

Area = $\int_0^2\left[\sqrt{16-8x}-\left(x-2\right)^2\right]dx$

7.(4) $f'(x)=\dfrac{x^4-8x^2+15}{(+ve)}\cdot 2x=\dfrac{\left(x^2-3\right)\left(x^2-5\right)\cdot 2\cdot x}{+ve}=\dfrac{\left(x-\sqrt{5}\right)\left(x-\sqrt{3}\right)\left(x\right)\left(x+\sqrt{3}\right)\left(x+\sqrt{5}\right)}{+ve}$

Minimum at $-\sqrt{5},0,\sqrt{5}$

Maximum at $-\sqrt{3},\sqrt{3}$

8.(1) $\dfrac{k}{2}\left[2a+\left(k-1\right)d\right]=40$ ... (i)

$\dfrac{k}{2}\left[2\left(a+d\right)+\left(k-1\right)d\right]=55$ ....(ii)

$\left(2k-1\right)d=27$ ... (iii)

From (i) and (ii) Find kd, use in (iii) to get d.

9.(4) $12x^2-7x+1=0$

Roots are $\dfrac{1}{4},\dfrac{1}{3}$

Let $P(A/B)=\dfrac{1}{4}$

$\Rightarrow\quad \dfrac{P(A\cap B)}{P(B)}=\dfrac{1}{4}\ \Rightarrow\ P(B)=\dfrac{4}{10}$

$P(B/A)=\dfrac{1}{3}\ \Rightarrow\ p(A)=\dfrac{3}{10}$

$\dfrac{P(\bar{A}\cup\bar{B})}{P(\bar{A}\cap\bar{B})}=\dfrac{P\left(\overline{A\cap B}\right)}{P(\overline{A\cup B})}=\dfrac{1-P(A\cap B)}{1-P(A\cup B)}=\dfrac{1-0.1}{1-\left[\dfrac{1}{3}+\dfrac{1}{4}-\dfrac{1}{10}\right]}$

10.(4) $\alpha+\beta=-\dfrac{\cos\theta}{2}$

$\alpha\beta=-\dfrac{1}{2}$

$\alpha^2+\beta^2=\dfrac{\cos^2\theta}{4}+1$

$\alpha^2+\beta^4=\left(\dfrac{\cos^2\theta}{4}+1\right)^2-2\times\dfrac{1}{4}$

$M=\left(\dfrac{1}{4}+1\right)^2-\dfrac{1}{2}$

$m=\left(0+1\right)^2-\dfrac{1}{2}$

11.(3) $Q = (2\lambda + 1, -\lambda - 2, 2\lambda - 3)$

$P \equiv (2, -10, 1)$

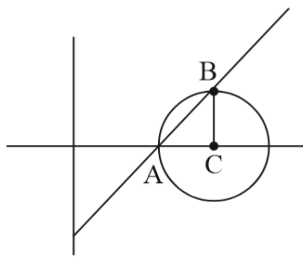
$\overline{PQ} = (2\lambda - 1)\hat{i} + (-\lambda + 8)j + (2\lambda - 4)k$

$\overline{PQ} \cdot (2\hat{i} - j + k) = 0$

$\Rightarrow \quad 2(2\lambda - 1) + (\lambda - 8) + 2(2\lambda - 4) = 0 \quad \Rightarrow \quad 9\lambda = 18 \quad \Rightarrow \quad \lambda = 2$

$\overline{PQ} = 3\hat{i} + 6j \; ; \; |\overline{PQ}| = \sqrt{45} = 3\sqrt{5}$

12.(3) $z(1+i) + z(1-i) = 4 \quad \Rightarrow \quad x - y = 2$



Circle $(x-3)^2 + y^2 \le 1$

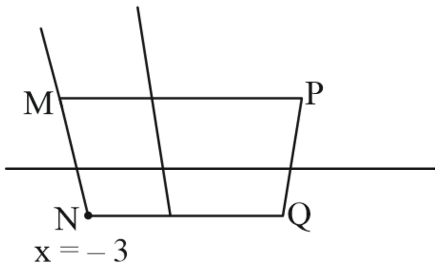
Point of intersection $x = 2, 3$

$\beta =$ area of sector $ACB -$ area of ΔACB

$= \frac{\pi \times 1}{4} - \frac{1}{2} = \frac{\pi}{4} - \frac{1}{2}$

$\alpha = \pi - \beta \; ; \; \alpha - \beta = -\lambda - 2\beta = \pi - 2\left(\frac{\pi}{4} - \frac{1}{2}\right) = \frac{\pi}{2} + 1$

13.(3) $48 = 4 \cdot a \cdot 4 \; \Rightarrow \; a = 3$



$S \equiv (3, 0)$

$P \equiv (4, 4, \sqrt{3}) \equiv (3t^2, 6t)$

$\Rightarrow \quad 6t = 4\sqrt{3} \quad \Rightarrow \quad t = \frac{2\sqrt{3}}{3}$

For $-\frac{1}{t} = -\frac{3}{2\sqrt{3}} = -\frac{\sqrt{3}}{2}$

$Q \equiv \left(3 \times \left(-\frac{\sqrt{3}}{2}\right)^2, 2 \times 3 \times \left(-\frac{\sqrt{3}}{2}\right)\right) \; ; \; Q \equiv \left(\frac{9}{4}, -3\sqrt{3}\right)$

$PM = 7$

$QN = 3 + \frac{9}{4} = \frac{21}{4}$

$MN = 7\sqrt{3}$

Area $= \frac{1}{2}\left(7 + \frac{21}{4}\right) \times 7\sqrt{3} = \frac{343\sqrt{3}}{8}$

14.(4) $\boxed{G_1G_2G_3}$ $\boxed{B_1B_2B_3B_4}$

Total $= 3! \times 4! \times 2!$

B_1B_2 together : $2! \times 3! \times 3! \times 2!$

$3! \times 4! \times 2! - 2! \times 3! \times 3! \times 2!$

$= 3! \times 2![4! - 3!2!] = 6 \times 2 \times [24 - 12] = 12 \times 12 = 144$

15.(1) $\Delta = \begin{vmatrix} 1 & 1 & 2 \\ 2 & 3 & a \\ -1 & -3 & b \end{vmatrix} = 0$

$\Delta_3 \begin{vmatrix} 1 & 1 & 6 \\ 2 & 3 & a+1 \\ -1 & -3 & 2b \end{vmatrix} = 0$

16.(3) $adj(adjA) = |A|^{n-2} A$

$B = adj(adj2A) = |2A|^1 (2A) = 2^3 |A| 2A$

$\Rightarrow B = 8A$

Trace(B) = 8 (trace A)

= 24

$|B| = 8^3 |A| = 256.$

17.(3) $2\sin^2\theta = 1 - 2\sin^2\theta$

$\Rightarrow \sin^2\theta = \frac{1}{4}$

$2 - 2\sin^2\theta = 3\sin\theta$

$\Rightarrow 2\sin^2\theta + 3\sin\theta - 2 = 0$

$\Rightarrow 2\sin^2\theta + 4\sin\theta - \sin\theta - 2 = 0$

$\Rightarrow \sin\theta = \frac{1}{2}$

$\theta = \frac{\pi}{6}, \frac{5\pi}{6}$

18.(4) $\int e^x \left[f(x) + f'(x)\right] dx$

$f(x) = \frac{x\sin^{-} x}{\sqrt{1-x^2}} \quad = e^x f(x) + C$

$g(x) = e^x . \frac{x.\sin^{-1} x}{\sqrt{1-x^2}}$ c

$g\left(\frac{1}{2}\right) = \sqrt{e}\,\frac{1\times 2}{2\sqrt{3}} \times \frac{\pi}{6}$

19.(3) $\lim_{x\to\infty} e^{[f(x)-1]}.g(x)$

$e^{\lim_{x\to\infty}\left[\left(\frac{e}{1-e}\right)\left[\frac{1}{e}-\frac{x}{1+x}\right]-1\right].x}$

$x = \frac{1}{h}$

$e^{\lim_{h\to 0}\left[\left(\frac{e}{1-e}\right)\left(\frac{1}{e}-\frac{1}{1+h}\right)-1\right]\frac{1}{h}}$

$e^{\lim_{h\to 0}\left[\left(\frac{e}{1-e}\right)\left[\frac{1+h-e}{e(e+h)}\right]-1\right]\frac{1}{h}}$

$e^{\lim_{h\to 0}\left[\frac{e+eh-e^2-e(1-e)(1+h)}{(1-e).e.(1+h)}\right]\frac{1}{h}}$

$\Rightarrow \alpha = e^{\frac{e}{1-e}}$

$\log\alpha = \frac{e}{1-e}$

20.(2) $\left(2e^{\tan^{-1}y}-x\right)\dfrac{dy}{dx}=1+y^2$

$\Rightarrow \dfrac{2e^{\tan^{-2}y}-x}{1+y^2}=\dfrac{dx}{dy}\Rightarrow\dfrac{dx}{dy}+\dfrac{1}{1+y^2}.x=\dfrac{2.e^{\tan^{-2}y}}{1+y^2}$

$I.F.=e^{\tan^{-1}y}$

equation $x.e^{\tan^{-1}y}=\int\dfrac{e^{\tan^{-1}y}.2.e^{\tan^{-1}y}}{1+y^2}dy$

Let $e^{\tan^{-1}}y=u\Rightarrow\dfrac{e^{\tan^{-1}y}}{1+y^2}dy=du$

$=2\int udu\Rightarrow x.e^{\tan^{-1}y}=e^{2\tan^{-1}y}+C$; $y=0,\ x=1\Rightarrow c=0$ Now put $y=\dfrac{1}{\sqrt{3}}$

SECTION – 2

21.(465) $r.r\dfrac{{}^{30}C_r.{}^{30}C_r}{{}^{30}C_{r-1}}=r.r\,{}^{30}C_r:\left(\dfrac{30-r+1}{r}\right)$

$=r.{}^{30}C_r.(31-r)=31.r.{}^{30}C_r-r^2.{}^{30}C_r$

$S=31.\sum_{r=1}^{30}r.{}^{30}C_r-\sum_{r=1}^{30}r^2.{}^{30}C_r$

$=31.30.2^{29}-30.31.2^{28}=2^{29}(31.30-15.31)=2^{29}(15\times31)=465\times2^{29}$

22.(145) $6+10\cos\alpha-10\sin\alpha=a$ ...(i)

$8+10\cos\alpha-10\sin\alpha=g$ ...(ii)

$\Rightarrow10\cos\alpha-10\sin\alpha=1$ ...(iii)

$\Rightarrow100\sin2\alpha=99$ ...(iv)

from (iii)

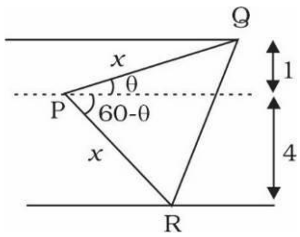
(i) $\Rightarrow a=7$

Now $\dfrac{8+10\cos\alpha-10\sin\alpha}{3}=k$

$\Rightarrow\dfrac{8+1}{3}=k\Rightarrow k=3$ and $\dfrac{6+10\cos\alpha-10\sin\alpha}{3}=h$

$\Rightarrow3h=7$ Ans. $5\times7-7+6\times3+99=145$

23.(28) $\sin\theta=\dfrac{1}{x}\Rightarrow\cos\theta=\sqrt{1-\dfrac{1}{x^2}}$



$\sin(60-\theta)=\dfrac{4}{x}$

$\Rightarrow\dfrac{\sqrt{3}}{2}.\sqrt{1-\dfrac{1}{x^2}}-\dfrac{1}{x}.\dfrac{1}{2}=\dfrac{4}{x}$

$\Rightarrow\dfrac{\sqrt{3}}{2}\sqrt{1-\dfrac{1}{x^2}}=\dfrac{9}{2x}$

$\Rightarrow3\left(1-\dfrac{1}{x^2}\right)=\dfrac{81}{x^2}$

$\Rightarrow1-\dfrac{1}{x^2}=\dfrac{27}{x^2}\Rightarrow\dfrac{28}{x^2}=1$

$\Rightarrow x^2=28$

24.(3) Some question in NCERT (1, 3) must be present
Need to decide for (2, 1), (3, 2), (3, 1)
One possible relation
{(1, 1), (2, 2), (3, 3), (1, 2), (2, 3), (1, 3)}
2nd possible add (2, 1) only
3rd possible add (3, 2) only
if we add (3, 1), for transitivity all other have to be added.

25.(27) I.F. $= e^{\frac{1}{2}\int \frac{2xdx}{x^2-1}} = e^{\frac{1}{2}\log|1-x^2|} = \sqrt{1-x^2}$

solution $y.\left(\sqrt{1-x^2}\right) = \int (x^6 + 4x)dx$

$$\Rightarrow y\sqrt{1-x^2} = \frac{x^7}{7} + 2x^2 + 0$$

$$f(x) = \frac{x^7}{7\sqrt{1-x^2}} + \frac{2x^2}{\sqrt{1-x^2}}$$

$$\int_{-1/2}^{1/2} \frac{x^7}{7\sqrt{1-x^2}} dx = 0$$

$$\int_{-1/2}^{1/2} \frac{2x^2}{\sqrt{1-x^2}} dx = 4\int_{0}^{1/2} \frac{x^2}{\sqrt{1-x^2}} dx$$

$$= 4\left[\int_{0}^{1/2} \frac{1-(1-x^2)}{\sqrt{1-x^2}} dx\right] = 4\left[\int_{0}^{1/2} \frac{dx}{\sqrt{1-x^2}} - \int_{0}^{1/2} \sqrt{1-x^2}dx\right]$$

$$4\left[\sin^{-1} x\Big|_0^{1/2} - \left\{\frac{x}{2}\sqrt{1-x^2} + \frac{1}{2}\sin^{-1} x\right\}_0^{1/2}\right] = \frac{\pi}{3} - \frac{\sqrt{3}}{2}$$

PHYSICS

SECTION – 1

26.(4) $\vec{F} = 2\hat{i} + \hat{j} + 2\hat{k}$

$\vec{r} = \hat{i} + \hat{j} + \hat{k}$

$\vec{\tau} = \vec{r} \times \vec{F} = \hat{i}(1) - \hat{j}(0) + \hat{k}(-1) = \hat{i} - \hat{k}$

27.(4) $\frac{hc}{\lambda} = 1 + 2 = 3$

$\frac{hc}{\frac{\lambda}{2}} = 6eV$

$6eV = \phi + KE_{\max}$

$KE_{\max} = 5eV$

28.(4) $\beta = \frac{\lambda D}{d}$

$\lambda_{Red} > \lambda_{violet} \quad \therefore \quad \beta_{Red} > \beta_{violet} \quad \therefore$ Assertion is false

29.(1) $evB = \frac{mv^2}{R}$

$mvR = \frac{2h}{2\pi}$

$eB = \frac{m}{R} \cdot \frac{2h}{2\pi mR}$

$R^2 = \frac{h}{\pi eB}$

$R = \left(\frac{h}{\pi eB}\right)^{1/2}$

30.(2) $V_B = 0$

$E_A = \frac{2kp}{r^3} = E_0$

$E_B = \frac{-kp}{(2r)^3} = \frac{-Kp}{8r^3}$

$E_B = \frac{E_0}{16}$

31.(3) Energy $= \frac{1}{2}CV^2$

Force $\times$ displacement $= C \cdot (\text{Electric field} \times d)^2$

Force $\times$ displacement $= C \cdot \left(\frac{Force \times d}{Charge}\right)^2$

$C = (charge)^2 \cdot \frac{displacement}{Force \times d^2}$

$C = \frac{(Charge)^2}{Force \times d}$

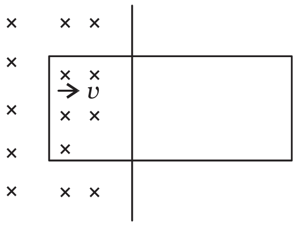
$[F] = [C^2 M^{-1} L^{-2} T^2]$

32.(1) Density $= \frac{mass}{volume}$

$$\frac{\Delta d}{d}\times 100 = \left(\frac{\Delta m}{m}+\frac{2\Delta r}{r}+\frac{\Delta l}{l}\right)\times 100 = \left(\frac{.003}{.6}+\frac{2\times .01}{.5}+\frac{.05}{10}\right)\times 100 = 0.5+4+0.5 = 5\%$$

33.(1) No option is matching

34.(2)



$\varepsilon_1 = Blv =$ Constant

35.(3) Work done = 0

$\vec{F}\cdot\vec{S} = 0$

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

$2-2b-1 = 0$

$1 = 2b$

$b = \frac{1}{2}$

36.(1) Theoretical

37.(2) $K_A + 0 = K_B + mg(2-2\cos 30°)$

$K_A + 0 = K_C + mg(2+2\cos 60°)$

$K_B = \frac{1}{2}m(100) - m(10)(2-13)$

$K_C = \frac{1}{2}m(100) - m(10)(3)$

$\frac{K_B}{k_C} = \frac{50-10(2-\sqrt{3})}{50-30} = \frac{3+\sqrt{3}}{2}$

38.(1) $\gamma_1 = \frac{7}{5} = 1.4,\ \gamma_2 = \frac{9}{7} = 1.28$

39.(2) $g_p = \frac{G\cdot 4M}{4R^2} = g_E$; $T = 2\pi\sqrt{\frac{l}{g}}$

Both are correct but not correct explanation

40.(4) $A_1V_1 = A_2V_2$

$4\times 2 = 1\times V_2$

$V_2 = 8$

41.(3) $2\mu t = \lambda$ {For maximum transmission}

$2\times 2\times t = 550\,nm$

$t = \frac{550}{4} = 137.5\,nm$

42.(4) $P = \frac{1}{f} = (\mu-1)\left(\frac{1}{R}+\frac{1}{R}\right) = (\mu-1)\left(\frac{2}{R}\right) = 4D$

$P' = \frac{1}{f'} = (\mu-1)\left(\frac{1}{R}-\frac{1}{\infty}\right) = \frac{\mu-1}{R} = 2D$

43.(2) $I_0 = \frac{V_0}{Z} = \frac{V_0}{R}$

$I' = \frac{V_0}{Z} = \frac{V_0}{2R} = \frac{I_0}{2}$

44.(4) $(KE)i = \frac{1}{2}(0.1)(20)^2 = 20J$

$(KE)f = \frac{1}{2}(0.1)(10)^2 = 5J$

$\Delta KE = 15J$

45.(3) $mg = B_F + F_V$

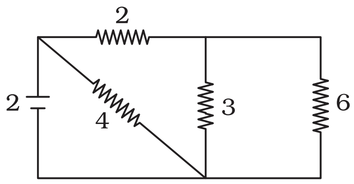
$F_V = mg - B_F = mg - \frac{mg}{2} = \frac{mg}{2}$

SECTION – 2

46.(1200) $i_{displacement\ for\ total\ area} = i_{conduction}$

But for small area is $= \varepsilon_0 \times \frac{d}{dt}(EA) = \varepsilon_0 (3.2)\frac{d}{dt}\left(\frac{Q}{A_{total}\varepsilon_0}\right) = 3.2 \times \frac{6}{16} = 2 \times \frac{6}{10} A = 1200\ mA$

47.(1) Right side circuit is short



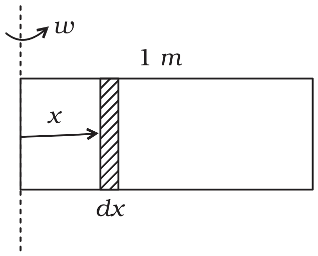
$\therefore i_0 = 1A$

48.(1) $B_{net} = \frac{\mu_0(4)}{2\pi(.04)} - \frac{\mu_0(5)}{2\pi(.1)} = 2\times10^{-7}\times100 - 2\times10^{-7}\times50 = 2\times10^{-7}(50) = 10^{-5}T$

49.(1) $1m \to 2M$

$dx \to 2Mdx$

$\int (dp)A = \int (2Mdx)w^2 x$



$PA = 2Mw^2 \left.\frac{x^2}{2}\right|_0^1$

$PA = Mw^2 1^2$

$w = \left(\frac{F}{M}\right)^{1/2}$

50.(2) $R = \frac{mv}{qB}$

$qB = \frac{mv}{R}$

$qvB = qE$

$\frac{mv^2}{R} = qE$

$\frac{1.6\times10^{-27}\times4\times10^{10}}{2\times10^{-2}} = 1.6\times10^{-19}\times E$

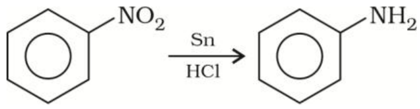
$E = 2\times10^{-8}\times10^{12} = 2\times10^4$

CHEMISTRY

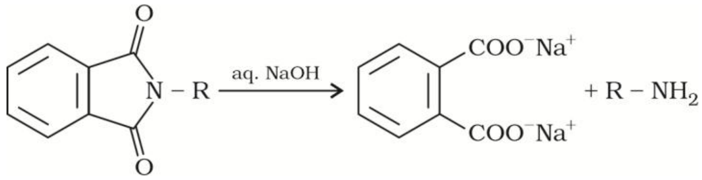
SECTION – 1

51.(3) **Extreme left :** Group-1 elements form basic oxides.
Extreme right : Group-17 elements form acids with their oxides on reaction with water.

52.(2) **(A)** $R-\overset{O}{\overset{||}{C}}-NH_2 \xrightarrow[H_2O]{LiAlH_4} R-CH_2-NH_2$

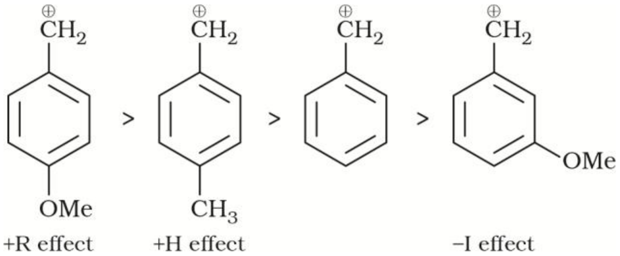
(B) 

(C) $R-C\equiv N \xrightarrow[Ni]{H_2} R-CH_2-NH_2$

(D) 

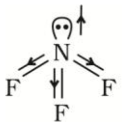
53.(1) Refer NCERT : Electrochemistry [Section-2.8, Corrosion]
During corrosion, pure metal acts as an anode and impure metal act as a cathode.
The rate of corrosion is more in acidic medium than in alkaline medium.

54.(4) Order of stability of carbocations:

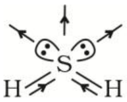


55.(4) $2p_x$ and $2p_y$ are degenerate orbitals and hence they have equal energy levels. There would be no spectral line observed for $2p_x \rightarrow 2p_y$ transition.

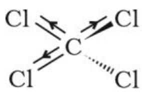
56.(3) $\overset{\delta+}{H} \rightleftharpoons \overset{\delta-}{Br}$ $\mu_{net} = 0.79D$



$\mu_{net} = 0.23D$



$\mu_{net} = 0.95D$



$\mu_{net} = 1.04D$

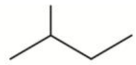
Refer to NCERT Table 4.5.

57.(1) $\left(\frac{\partial H}{\partial T}\right)_P = C_P$ and $\left(\frac{\partial U}{\partial T}\right)_V = C_V$ $\because$ $dG = VdP - SdT$

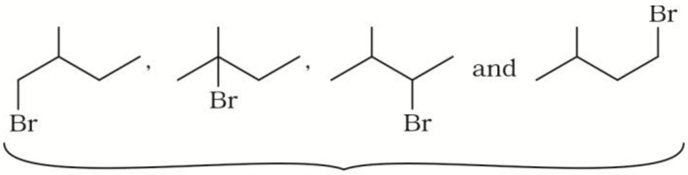
Hence, $\left(\frac{\partial G}{\partial T}\right)_P = -S$ and $\left(\frac{\partial G}{\partial P}\right)_T = V$

58.(2) $(Zr^{4+})_3(PO_4^{3-})_4(s) \rightleftharpoons \underset{3s}{3Zr^{4+}(aq)} + \underset{4s}{4PO_4^{3-}(aq)}$ [Let "s" be the solubility]

$K_{sp} = (3s)^3 \cdot (4s)^4 \Rightarrow K_{sp} = 6912\,s^7 \Rightarrow s = \left(\frac{K_{sp}}{6912}\right)^{1/7}$

59.(2) $R - Br \xrightarrow[\text{(ii) } H_2O]{\text{(i) Mg, dry ether}}$ 

2-methylbutane

Then, R – Br can be 

Total 4 types R – Br

60.(1) The single N – N bond is weaker than the single P – P bond because of high interelectronic repulsion of the non-bonding electrons, owing to the small bond length.
Hence, N has maximum covalency = 4.

61.(3) **Standard fisher projection :** Highest oxidised carbon is at the top. Here it is –CHO.
We compare position of –OH group at last chiral carbon in the standard fisher projection with D-glyceraldehyde for a D-Configuration.
Options A, B and D are correlated with D-glyceraldehyde.

62.(4) For Lassaigne's test, sodium is used and not magnesium to convert covalent into ionic form.

$$Na + C + N \xrightarrow{\Delta} NaCN$$

$$2Na + S \xrightarrow{\Delta} Na_2S$$

$$Na + X \xrightarrow{\Delta} NaX$$

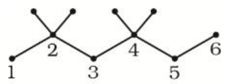
(X = Cl, Br or I)

C, N, S and X come from organic compound.
Cyanide, sulphide and halide of sodium so formed on sodium fusion are extracted from the fused mass by boiling it with distilled water. This extract is known as sodium fusion extract.

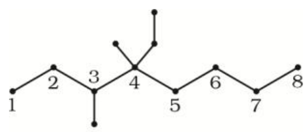
63.(1) Except $[Fe(CN)_5NO]^{2-}$, all are homoleptic as have only one type of ligand.

High spin complexes : $[CoF_6]^{3-}$, $[Cr(H_2O)_6]^{2+}$

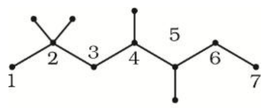
Low spin complexes : $[Fe(CN)_6]^{4-}$, $[Co(NH_3)_6]^{3+}$

64.(4) **(1)** 

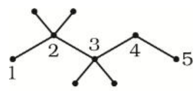
2°H = 4

(2) 

2°H = 10

(3) 

2°H = 4

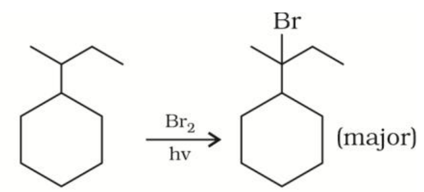
(4) 

2°H = 2

65.(4) $d_{NaCl} = 1.25 \text{ g / mL}$; $M_{NaCl} = 3M$

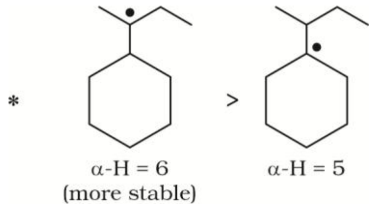
Molality, $m = \dfrac{M \times 1000}{1000\,d - MM_0}$

$$\Rightarrow \quad m = \frac{1000 \times 3}{(1000 \times 1.25) - (3 \times 58.5)} = \frac{3000}{1074.5} = 2.79 \text{ molal}$$

66.(1) 

sec-butyl cyclohexane

"radical stability via α-H"



67.(1) The species having Cl-atom in its maximum oxidation state (+7) or minimum oxidation state (–1) will not undergo disproportionation reaction.

ClO_4^- : Cl has +7 oxidation state; ClO^- : Cl has +1 oxidation state

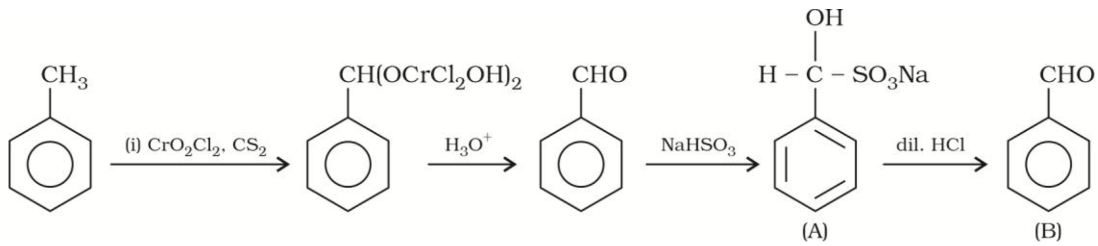
ClO_3^- : Cl has +5 oxidation state; ClO_2^- : Cl has +3 oxidation state

68.(1) Activation energy for forward reaction $= E_1 + E_2$

Activation energy for backward reaction $= E_1$

Product has more energy than reactant.

69.(1)



70.(1) CFSE $\propto$ Type of field $[\Delta_t < \Delta_0]$

CFSE $\propto$ Strength of ligand

CFSE $\propto$ Charge on central metal ion

* en is a chelating as well as more stronger ligand than NH_3.

$\therefore$ $[Co(NH_3)_6]^{3+} < [Co(en)_3]^{3+}$: CFSE order

* Due to higher charge on central metal ion.

$\therefore$ $[Co(NH_3)_6]^{2+} < [Co(NH_3)_6]^{3+}$: CFSE order

* Due to type of field $(\Delta_0 > \Delta_t)$

$\therefore$ $[Co(NH_3)_4]^{2+} < [Co(NH_3)_6]^{2+}$: CFSE order

SECTION – 2

71.(11) ${}_{41}Nb = [Kr]4d^4\,5s^1 \quad \Rightarrow \quad x = 4e^- \text{ in } 4d$

${}_{44}Ru = [Kr]4d^7\,5s^1 \quad \Rightarrow \quad y = 7e^- \text{ in } 4d$

$x + y = 11$

72.(95) $2C(\text{graphite}) + 3H_2(g) \rightarrow 1C_2H_6 \qquad \Delta_f H^\circ = x \text{ kJ mol}^{-1}$

$C_2H_6(g) + \frac{7}{2}O_2(g) \rightarrow 2CO_2(g) + 3H_2O(\ell) \qquad \Delta H_1^\circ = -1550 \qquad \ldots\ldots \text{(i)}$

$C(\text{graphite}) + O_2(g) \rightarrow CO_2(g) \qquad \Delta H_2^\circ = -393.5 \qquad \ldots\ldots \text{(ii)}$

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(\ell) \qquad \Delta H_3^\circ = -286 \qquad \ldots\ldots \text{(iii)}$

On solving, $2 \times \text{(ii)} + 3 \times \text{(iii)} - \text{(i)}$, we get,

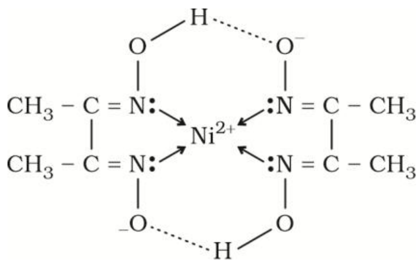
$\Delta_f H^\circ_{C_2H_6} = 2 \times (-393.5) + 3 \times (-286) - (-1550) = -787 - 858 + 1550 = -95 \text{ kJ mol}^{-1}$

73.(57) $(NaOH)_1 = 20\,\text{mL}, 2\,M \equiv 40\,\text{m.moles}$

$(NaOH)_2 = 400\,\text{mL}, 0.5\,M \equiv 200\,\text{m.moles}$

Final NaOH conc. $= \frac{(200+40)}{420\,\text{mL}}\text{m.moles} = \frac{240}{420}M = 0.571M = 57.1 \times 10^{-2} M$

74.(14) DMG : $CH_3 - C = N - OH$
$\quad\quad\quad\quad |$
$\quad\quad CH_3 - C = N - OH$

$Ni^{2+} + DMG + 2OH^- \rightarrow$ 

Number of H-atoms in the complex = 14

75.(8) 4 moles of H_2 per mole for complete hydrogenation $\Rightarrow$ 4π bonds

* C_6H_6 is a symmetrical dialkyne.

* $HC \equiv C - CH_2 - CH_2 - C \equiv CH \xrightarrow{\text{monobromination}} HC \equiv C - \underset{\underset{Br}{|}}{CH} - CH_2 - C \equiv CH$

* $CH \equiv C - CH_2 - CH_2 - C \equiv CH + 4H_2 \longrightarrow CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - CH_2$