1. (c)

Given that, $f(x) = |x|$ and $g(x) = [x - 3]$
For $-\frac{8}{5} < x < \frac{8}{5}, 0 \leq fx < \frac{8}{5}$
Now, for $0 < f(x) < 1$,

$$g(f(x)) = [f(x) - 3]$$
$$= -3 \because -3 \leq fx - 3 < -2$$

Again, for $1 < f(x) < 1.6$

$$g(f(x)) = -2$$
$$\because -2 \leq fx - 3 < -1.4$$

hence, required set is $\{-3, -2\}$.

2. (c)

3. (c) Required number of arrangements

$$= {}^6P_5 \times 4!$$
$$= 17280$$

4. (b)

Given that, ${}^nP_r = 30240$ and ${}^nC_r = 252$

$$\Rightarrow \frac{n!}{n-r!} = 30240 \text{ and } \frac{n!}{n-r!\,r!} = 252$$
$$\Rightarrow r! = \frac{30240}{252} = 120$$
$$\Rightarrow r = 5$$
$$\therefore \frac{n!}{n-5!} = 30240$$
$$\Rightarrow n(n-1)(n-2)(n-3)(n-4) = 30240$$
$$\Rightarrow n(n-1)(n-2)(n-3)(n-4)$$
$$= 10(10-1)(10-2)(10-3)(10-4)$$
$$\Rightarrow n = 10$$

5. (c)

Given, $(1 + x + x^2 + x^3)^5 = {}_{k=0}^{15} a_k x^k$
$$\Rightarrow [(1+x) + x(1+x)]^5 = {}_{k=0}^{15} a_k x^k$$
$$\Rightarrow (1+x)^{10} = a_0x^0 + a_1x + a_2x^2 + \cdots + a_{15}x^{15}$$
$$\Rightarrow {}^{10}C_0 + {}^{10}C_1x + {}^{10}C_2x^2 + \cdots + {}^{10}C_{10}x^{10}$$
$$= a_0 + a_kx + a_2x^2 + a_3x^3 + \cdots + a_{15}x^{15}$$

On equating the coefficient of constant and even powers of x, we get

$$a_0 = {}^{10}C_0, a_2 = {}^{10}C_2$$
$$a_4 = {}^{10}C_4, \ldots, a_{10} = {}^{10}C_{10},$$
$$a_{12} = a_{14} = 0$$

$$= 2^{10-1} = 29$$
$$= 512$$

6. **(d)** Given that, $\alpha + \beta = -2$ and $\alpha^3 + \beta^3 = -56$

$\Rightarrow \quad (\alpha + \beta)(\alpha^2 + \beta^2 - \alpha\beta) = -56$
$\Rightarrow \quad \alpha^2 + \beta^2 - \alpha\beta = 28$

Now,

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

$\Rightarrow \quad \alpha^2 + \beta^2 + 2\alpha\beta = 4$
$\Rightarrow \quad 28 + 3\alpha\beta = 4$
$\Rightarrow \quad \alpha\beta = -8$

$\therefore$ Required equation is

$x^2 - (-2)x + (-8) = 0$
$\Rightarrow \quad x^2 + -(2x - 8 = 0$

7. **(d)**

Given equation is

$x^3 + 2x^2 - 4x + 1 = 0$

Let α, β and γ be the roots of the given equation

$\therefore \quad \alpha + \beta + \gamma = -2, \alpha\beta + \beta\gamma + \gamma\alpha = -4$
and $\quad \alpha\beta\gamma = -1$

Let the required cubic equation has the roots $3\alpha, 3\beta$ and 3γ.

$\Rightarrow \; 3\alpha + 3\beta + 3\gamma = -6,$
$3\alpha \cdot 3\beta + 3\beta + 3\gamma + 3\gamma \cdot 3\alpha = 36$
and
$3\alpha \cdot 3\beta \cdot 3\gamma = -27$

$x^3 - (-6)x^2 + (-36)x - (-27) \quad = 0$

$x^3 + 6x^2 - 36x + 27 = 0$

8. **(b)** Given that,

$A = \begin{matrix} 1 & -2 \\ 4 & 5 \end{matrix}$ and $f(t) = t^2 - 3t + 7$

Now, $A^2 = \begin{matrix} 1 & -2 \\ 4 & 5 \end{matrix} \; \begin{matrix} 1 & -2 \\ 4 & 5 \end{matrix}$

$= \begin{matrix} -7 & -12 \\ 24 & 17 \end{matrix}$

Now, $f(A) = A^2 - 3A + 7$

$= \begin{matrix} -7 & -12 \\ 24 & 17 \end{matrix} - 3\begin{matrix} 1 & -2 \\ 4 & 5 \end{matrix} + 7/\begin{matrix} 1 & 0 \\ 0 & 1 \end{matrix}$

$= \begin{matrix} -3 & -6 \\ 12 & 9 \end{matrix}$

$\therefore$ f(A) + $\begin{matrix} 3 & 6 \\ -12 & -9 \end{matrix} = \begin{matrix} -3 & -6 \\ 12 & 9 \end{matrix} + \begin{matrix} 3 & 6 \\ -12 & -9 \end{matrix}$

$\therefore 1 >= \begin{matrix} 0 & 0 \\ 0 & 0 \end{matrix}$

9. (d)

Let $\Delta = \begin{matrix} a-b-c & 2a & 2a \\ 2b & b-c-a & 2b \\ 2c & 2c & c-a-b \end{matrix}$

Applying $R_1 \to R_1 + R_2 + R_3$ and taking common $(a+b+c)$ from R_1

$= (a+b+c)\begin{matrix} 1 & 1 & 1 \\ 2b & b-c-a & 2b \\ 2c & 2c & c-a-b \end{matrix}$

Applying $C_2 \to C_2 \to C_1$ and $C_3 \to C_3 \to C_1$,

$= (a+b+c)\begin{matrix} 2b & -b-c-a & 0 \\ 2c & 0 & -a-b-c \end{matrix}$

$= (a+b+c)[(-b-c-a)(-a-b-c)]$

$= (a+b+c)$

10. (a) Since, ω is a cube root of unity,

$\therefore \sin \omega^{10} + \omega^{23}\pi - \frac{\pi}{4}$

$= \sin \omega + \omega^2\pi - \frac{\pi}{4}$

$= \sin -\pi - \frac{\pi}{4}$ $(\because 1 + \omega + \omega^2 = 0)$

$= \sin -\pi - \frac{\pi}{4} = \sin\frac{\pi}{4}$

$= \frac{1}{2}$

11. (c)

$\overline{3}\text{cosec}\, 20^\circ - \sec 20^\circ$

$= \frac{\tan 60^\circ}{\sin 20^\circ} - \frac{1}{\cos 20^\circ}$

$= \frac{\sin 60^\circ \cos 20^\circ - \sin 20^\circ \cos 60^\circ}{\cos 60^\circ \sin 20^\circ \cos 20^\circ}$

$= \frac{\sin 40^\circ}{\cos 60^\circ \sin 20^\circ \cos 20^\circ}$

$= \frac{2\sin 20^\circ \cos 20^\circ}{\frac{1}{2}\sin 20^\circ \cos 20^\circ} = 4$

12. (b)

13. (b) Given equation is

$$
\begin{aligned}
& \cos 2x + 2\cos^2 x = 2 \\
\Rightarrow\ & 2\cos^2 x - 1 + 2\cos^2 x = 2 \\
\Rightarrow\ & 4\cos^2 x = 3 \\
\Rightarrow\ & \cos^2 x = \frac{3}{4} \\
\Rightarrow\ & \cos x = \pm\frac{3}{2} \\
\therefore\ & x = n\pi \pm \frac{\pi}{6} : n \in Z
\end{aligned}
$$

14. (b)

Given that,

$$
\begin{aligned}
& \sin^{-1}\frac{3}{x} \sin^{-1}\frac{4}{x} = \frac{\pi}{2} \\
\therefore\ & \sin^{-1}\frac{3}{x} = \frac{\pi}{2} - \sin^{-1}\frac{4}{x} \\
\Rightarrow\ & \sin^{-1}\frac{3}{x} = \cos^{-1}\frac{4}{x} \\
\Rightarrow\ & \sin^{-1}\frac{3}{x} = \sin^{-1}\frac{\overline{x^2-16}}{x} \\
\Rightarrow\ & \frac{3}{x} = \frac{\overline{x^2-16}}{x}
\end{aligned}
$$

$\Rightarrow\ x = \pm 5$
$\Rightarrow\ x = 5$

$(\because -5$ is not satisfied the given equation)

15. (b)

Given that,

$$
\begin{aligned}
& \frac{1}{b+c} + \frac{1}{c+a} = \frac{3}{a+b+c} \\
\Rightarrow\ & 1 + \frac{b}{a+c} + 1 + \frac{a}{b+c} = 3 \\
\Rightarrow\ & \mathrm{b(b+c) + a(a+c) = (a+c)(b+c)} \\
\Rightarrow\ & \mathrm{b^2 + bc + a^2 + ac = ab + ac + bc + c^2} \\
\Rightarrow\ & \mathrm{a^2 + b^2 - c^2 = ab}
\end{aligned}
$$

We know that, $\cos \mathrm{C} = \frac{a^2+b^2-c^2}{2ab} = \frac{ab}{2ab} = \frac{1}{2}$

$\Rightarrow\ C = 60^\circ$

16. (d)

Given that, $r_1 = 2r_2 = 3r_3$

$\therefore\ \frac{\Delta}{s-a} = \frac{2\Delta}{s-b} = \frac{3\Delta}{s-c} = \frac{\Delta}{k}$

Then, $s - a = k, s - b = 2k, s - c = 3k$

$$\Rightarrow 3x-(a+b+c)=6k \Rightarrow s=6k$$

$$\therefore \frac{a}{5}=\frac{b}{4}=\frac{c}{3}=k$$

Now, $\frac{a}{b}+\frac{b}{c}+\frac{c}{a}=\frac{5}{4}+\frac{4}{3}+\frac{3}{5}$

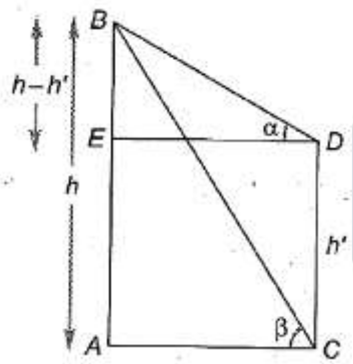
$$=\frac{75+80+36}{60}=\frac{191}{60}$$

17. (a) Let AB be a hill whose height is h metres and CD be a pillar of height h′ metres.

In $\triangle$ EDB,

$$\tan\alpha=\frac{h-h'}{ED}$$

and in $\triangle$ ACB,



$$\tan\beta=\frac{h}{AC}=\frac{h}{ED}$$

Eliminate ED from Eqs. (i) and (ii), we get

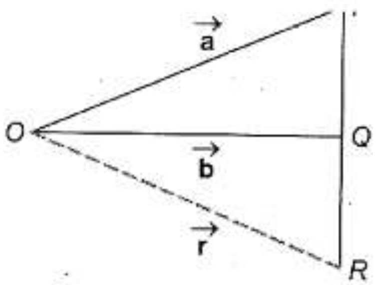
$$\tan\alpha=\frac{h-h'}{\frac{h}{\tan\beta}}$$

$$\Rightarrow h\frac{\tan\alpha}{\tan\beta}=h-h'$$

$$\Rightarrow h'=\frac{h\tan\beta-\tan\alpha}{\tan\beta}$$

18. (a) Given that,

$PR=5PQ$



It mean R divides PQ externally in the ratio 5: 4.

$$\therefore \text{ Position vector of R } = \frac{5b-4a}{5-4}$$
$$= 5b-4a$$

19. (c)

Let $OA = 2\imath - \jmath + k, OB = \imath - 3\jmath - 5k$ and $OC = 3\imath - 4\jmath - 4k$

$\therefore\ a = OA = \sqrt{6}, b = OB = \sqrt{35}$

and $C = OC = \sqrt{41}$

$$\therefore\ \cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

$$= \frac{\sqrt{35}^2 + \sqrt{41}^2 - \sqrt{6}^2}{2\sqrt{35}\sqrt{41}}$$

$$\Rightarrow\ \cos A = \frac{70}{2\sqrt{35}\sqrt{41}} = \frac{\sqrt{35}}{\sqrt{41}}$$

$$\Rightarrow\ \cos^2 A = \frac{35}{41}$$

20. (d)

21. (b)

Given that, $P(A \cap B) = \frac{1}{6}$ and $P\bar{A} \cap \bar{B} = \frac{1}{3}$

Since, A and B are independent.

$$\therefore P(A)P(B) = \frac{1}{6} \text{ and } P(\bar{A})P(\bar{B}) = \frac{1}{3}$$

$$\Rightarrow\ [1 - P(A)][1 - P(B)] = \frac{1}{3}$$

$$\Rightarrow\ 1 - [P(A) + P(B)] + P(A)P(B) = \frac{1}{3}$$

$$\Rightarrow\ 1 + \frac{1}{6} - \frac{1}{3} = P(A) + P(B)$$

$$\Rightarrow\ P(A) + P(B) = \frac{5}{6}$$

$$\Rightarrow\ P(A) = \frac{1}{2'}, P(B) = \frac{1}{3}$$

$$\text{and } P(A) = \frac{1}{3}, P(B) = \frac{1}{2}$$

22. (b) In a box,

$$\begin{aligned} B_1 &= 1R, 2W \\ B_2 &= 2R, 3W \\ \text{and } B_3 &= 3R, 4W \end{aligned}$$

Also, given that,

$$\mathrm{P}(\mathrm{B}_1) = \frac{1}{2'}\mathrm{P}(\mathrm{B}_2) = \frac{1}{3} \text{ and } \mathrm{P}(\mathrm{B}_3) = \frac{1}{6}$$

$$\therefore \mathrm{P}\frac{B_2}{R}$$

$$= \frac{PB_2P\frac{R}{B_2}}{PB_1P\frac{R}{B_1} + PB_2P\frac{R}{B_2} + PB_3P\frac{R}{B_3}}$$

$$= \frac{\frac{1}{3}\times\frac{2}{5}}{\frac{1}{2}\times\frac{1}{3}\times\frac{1}{3}\times\frac{2}{5}+\frac{1}{6}\times\frac{3}{7}} = \frac{\frac{2}{15}}{\frac{1}{6}+\frac{2}{15}+\frac{1}{14}}$$

$$= \frac{\frac{2}{15}}{\frac{35+28+15}{210}} = \frac{2}{15}\times\frac{210}{78} = \frac{14}{39}$$

23. **(a)** The sum of the distance of a point P from two perpendicular lines in a plane is 1 , then the locus of P is a rhombus.

24. **(b)** Since, the axes are rotated through an angle 45°, then we replace (x, y) by

$(x\cos 45^\circ - y\sin 45^\circ, x\sin 45^\circ + y\cos 45^\circ)$

in the given equation $3x^2 + 3y^2 + 2xy = 2$

$$\therefore\ 3\frac{x}{2} - \frac{y^2}{2} + 3\frac{x+y}{2} + 2\frac{x-y}{2}\ \frac{x+y}{2} = 2$$

$$\Rightarrow\ 4x^2 = 2y^2 = 2$$
$$\Rightarrow\ 2x^2 + y^2 = 1$$

25. **(b)** Since, l, m, n are in AP.

$\therefore\ 2m = 1 + n$

Given equation of line is

$\mathrm{Ix} + \mathrm{my} + \mathrm{n} = 0$

Now, assume that the point $(1, -2)$ satisfy the given equation.

$\therefore\quad 1 - 2m + n = 0$

$\Rightarrow\quad 2m = 1 + n$

$\Rightarrow\quad 1, m, n$ are in AP.

$\Rightarrow$ I, m, n are in AP.

26. **(a)** To make the given curves $x^2 + y^2 = 4$ and $x + y = a$ homogenous.

$\therefore \quad x^2 + y^2 - 4\dfrac{x + y^2}{a} = 0$

$\Rightarrow \; a^2(x^2 + y^2) - 4(x^2 + y^2 + 2xy) = 0$

$\Rightarrow \; x^2(a^2 - 4) + y^2(a^2 - 4) - 8xy = 0$

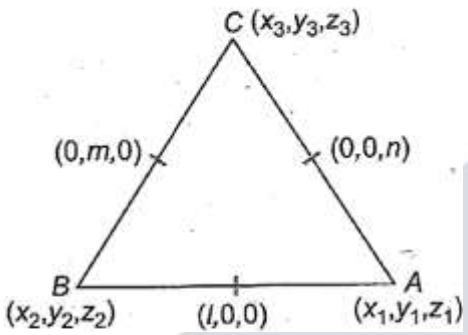
Since, this is a perpendicular pair of straight lines.

$\therefore \quad a^2 - 4 + a^2 - 4 = 0$

$\Rightarrow \quad a^2 = 4 \Rightarrow a = \pm 2$

Hence, required set of a is $\{-2,2\}$.

27. (c) Form the figure



$x_1 + x_2 = 21, y_1 + y_2 = 0, z_1 + z_2 = 0$

$x_2 + x_3 = 0, y_2 + y_3 = 2m, z_2 + z_3 = 0$

and $x_1 + x_3 = 0, y_1 + y_3 = 0, z_1 + z_3 = 2n$

On solving, we get

$$\begin{aligned} &x_1 = 1, x_2 = 1, x_3 = -1, \\ y_1 &= -m, y_2 = m, y_3 = m \\ \text{and } z_1 &= n, z_2 = -n, z_3 = n \end{aligned}$$

$\therefore$ Coordinates are $\mathrm{A(I, -m, n), B(I, m, -n)}$ and $\mathrm{C(-1, m, n)}$

$$\therefore \frac{AB^2 + BC^2 + CA^2}{l^2 + m^2 + n^2}$$

$$= \frac{4m^2 + 4n^2 + 4l^2 + 4n^2 + (4l^2 + 4m^2)}{l^2 + m^2 + n^2}$$

$= 8$

28. (c) Since, the lines $2x - 3y = 5$ and $3x - 4y = 7$ are the diameters of a circle. Therefore, the point of intersection is the centre of

-1 i.e., the centre of the circle.
Required equation of circle is

$$(x - 1)^2 + (y + 1)^2 = 72$$

$\Rightarrow \quad x^2 + y^2 - 2x + 2y + 2 = 49$

$\Rightarrow \quad x^2 + y^2 - 2x + 2y - 47 = 0$

29. (c) The equation of pole w.r.t. the point $(1,2)$ to the circle $x^2 + y^2 - 4x - 6y + 9 = 0$ is

$$x + 2y - 2(x+1) - 3(y+2) + 9 = 0$$
$$\Rightarrow\ x + y - 1 = 0$$

Since, the inverse of the point $(1,2)$ is the foot (α, β) of the perpendicular from the point $(1,2)$ to the line $x + y - 1$.

$$\therefore\quad \frac{\alpha - 1}{1} = \frac{\beta - 2}{1} = -\frac{1.1 + 1.2 - 1}{1^2 + 1^2}$$
$$\Rightarrow\quad \alpha - 1 = \beta - 2 = -1$$
$$\Rightarrow\quad \alpha = 0, \beta = 1$$

Hence, required point is $(0,1)$.

30. (d) Using the condition that if two lines $I_1x + m_1y + n_1 = 0$ and $I_2x + m_2y + n_2 = 0$ are conjugate w.r.t. parabola $y^2 = 4ax$, then

$$I_1n_2 + I_2n_1 = 2am_1m_2$$

Given conjugate lines are $2x + 3y + 12 = 0$ and $x - y + 4\lambda = 0$ and equation of parabola is $y^2 = 8x$.

Here, $l_1 = 2,\ m_1 = 3, n_1 = 12; l_2 = 1,\ m_2 = -1,$
$n_2 = 4\lambda$ and $a = 2$

$$2 \times 4\lambda + 1 \times 12 = 2 \times 2 \times 3 \times (-1)$$
$$8\lambda = -12 - 12\ \Rightarrow\ \lambda = -3$$

31. (c) Given, equation of hyperbola is

$$x^2 - 3y^2 - 4x - 6y - 11 = 0$$
$$\Rightarrow\quad (x^2 - 4x + 4) - 3(y^2 + 2y + 1) - 11 = 4 - 3$$
$$\Rightarrow\quad (x-2)^2 - 3(y+1)^2 = 12$$
$$\Rightarrow\quad \frac{x-2^2}{12} - \frac{y+1^2}{4} = 1$$

Now, $e = \overline{1 + \frac{4}{12}} = \frac{2}{3}$
$\therefore$ Distance between foci

$$= 2ae = 2 \times \overline{12} \times \frac{2}{\overline{3}} = 8$$

32. (b) Given polar equation of circle is

$$r^2 - 8(\overline{3}\cos\theta + \sin\theta) + 15 = 0$$

or $r^2 8(\overline{3} r\cos\theta + r\sin\theta) + 15 = 0$

where $r\cos\theta = x$ and $y = r\sin\theta$.
It can be rewritten in cartesian form

$$\Rightarrow\quad x^2 + y^2 - 8\ \overline{\ 3x + y} + 15 = 0$$
$$x^2 + y^2 - 8\ \overline{3}x - 8y + 15 = 0$$

Now, radius $= 4 \quad 3 + 4^2 - 15$
$= \overline{48 + 16 - 15} = 7$

33. **(c)** Given that,

$$f(x) = [x-3] + |x-4|$$
$$\therefore \lim_{x\to 3^-} fx = \lim_{x\to 3^-} x - 3 + x - 4$$
$$= \lim_{h\to 0} 3 - h - 3 + 3 - h - 4$$
$$= \lim_{h\to 0} -h + 1 + h$$
$$= -1 + 1 + 0 = 0$$

34. **(b)** Given that,

$$f(x) = \begin{matrix} \dfrac{\cos 3x - \cos x}{x^2} & \text{for } x \neq 0 \\ \lambda & \text{for } x = 0 \end{matrix}$$

Now, LHL $= \lim_{x\to 0^-} f^x$

$$= \lim_{x\to 0^-} \frac{\cos 3x - \cos x}{x^2}$$
$$= \lim_{h\to 0} \frac{\cos 30 - h - \cos 0 - h}{0 - h^2}$$
$$= \lim_{h\to 0} \frac{\cos 3h - \cos h}{h^2}$$
$$= \lim_{h\to 0} \frac{-3\sin 3h + \sin h}{2h}$$

(using L Lospitals rule)

$$= \frac{-9+1}{2} = -4$$

Since, $f(x)$ is continuous at $x = 0$
$\therefore \lim_{x\to 0^-} fx = f0$

35. **(c)** Given that, $f(2) = 4$ and $f'(2) = 1$

$$\therefore \lim_{x\to 2} \frac{xf2 - 2f(x)}{x-2}$$
$$= \lim_{x\to 2} \frac{xf2 - 2f2 + 2f2 - 2fx}{x-2}$$
$$= \lim_{x\to 2} f2 - 2\lim_{x\to 2} \frac{fx - f2}{x-2}$$
$$= f(2) - 2f'(2)$$
$$= 4 - 2(1)$$
$$= 2$$

36. **(b)**

Given that,
$x = a\cos\theta + \log\tan\frac{\theta}{2}$ and $y = a\sin\theta$
On differentiating w.r.t. θ respectively, we get

$$\frac{dx}{d\theta} = a - \sin\theta + \frac{1}{\tan\frac{\theta}{2}} \cdot \sec^2\frac{\theta}{2} \cdot \frac{1}{2}$$

$$= a - \sin\theta + \frac{1}{\sin\theta} = \frac{a\cos^2\theta}{\sin\theta}$$

and $\frac{dy}{d\theta} = a\cos\theta$

$$\therefore \frac{dy}{dx} = \frac{dy/d\theta}{dx/d\theta} = \frac{a\cos\theta}{a\cos^2\theta/\sin\theta}$$

$$= \tan\theta$$

37. (c)

Given curve is $y^4 = ax^3$

$$4y^3\frac{dy}{dx} = 3ax^2$$

$$\Rightarrow \quad dx/dy_{a,a} = \frac{3a^3}{4a^3} = \frac{3}{4}$$

$\therefore$ Equation of normal at point (a, a) is

$$y - a = -\frac{4}{3}(x - a)$$

$$\Rightarrow \quad 4x + 3y = 7a$$

38. (b)

Given that,

$2y^4 = x^5$

On differentiating w.r.t. x, we get

$$8y^3\frac{dy}{dx} = 5x^4$$

$$\Rightarrow \quad \frac{dy}{dx} = \frac{52^4}{82^3} = \frac{5}{4}$$

$\therefore$ Length of subtangent $= \frac{y}{dy/dx}$

$$= \frac{2}{5/4} = \frac{8}{5}$$

39. (c)

$$e^x\frac{1 - \sin x}{1 - \cos x}dx$$

$$= e^x\frac{1 - 2\sin\frac{x}{2}\cos\frac{x}{2}}{2\sin^2\frac{x}{2}}\,dx$$

$$= \frac{1}{2}e^x\mathrm{cosec}^2\frac{x}{2}dx - e^x\cot\frac{x}{2}dx$$

$$= \frac{1}{2} - e^x\cot\frac{x}{2} \cdot 2 + e^x\cot\frac{x}{2}2dx$$

$= -e^x \cot\frac{x}{2} + c$

40. (d) Given that,

$$e^x \quad 1 + x \cdot \sec^2 xe^x dx = fx + \text{ constant}$$

Put $\quad xe^x = t$ in LHS

$\Rightarrow \quad (e^x + xe^x)dx = dt$

$\therefore \quad \text{LHS } = \sec^2 tdt$

$= \tan t + \text{ constant}$

$\Rightarrow \quad \tan(xe^x) + \text{ constant } = f(x) + \text{ constant}$

$\Rightarrow \quad f(x) = \tan(xe^x)$

41. (c)

$$I \quad = {}_{-\pi/2}^{\pi/2} \sin x \mid dx$$

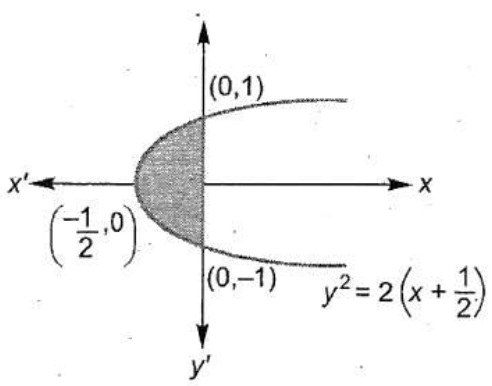
Let $\quad = 2_{-\pi/2}^{\pi/2} \sin x dx$

$= 2 - \cos x \quad 0^{\pi/2}$

$= 2$

42. (b) Given curve can be rewritten as

$$y^2 = 2x + \frac{1}{2}$$



Required area $\quad = {}_{-1}^{1} xdy$

$$= 2 {}_0^1 \frac{y^2 - 1}{2} dy$$

$$= \frac{y^3}{3} - y {}_0^1$$

$$= \frac{1}{3} - 1 = \frac{2}{3} \text{ sq unit}$$

43. (d) Given differential equation is

$$\frac{dy}{dx}=\frac{xy+y}{xy+x}$$
$$\Rightarrow \frac{dy}{dx}=\frac{y1+x}{x1+y}$$
$$\Rightarrow \frac{1+y}{y}dy=\frac{1+x}{x}dx$$
$$\Rightarrow \frac{1}{y}+1dy=\frac{1}{x}+1dx$$
$$\Rightarrow \log ydydx+y=\log x+x+\log c$$
$$\Rightarrow y-x=\log\frac{cx}{y}$$

$$\frac{dy}{dx}-y\tan x=e^x\sec x$$
$$\therefore \text{ IF }=e^{-\tan xdx}=e^{-\log\sec x}$$
$$=\frac{1}{\sec x}$$

$\therefore$ Complete solution is

$$y\cdot\frac{1}{\sec x}=e^x\sec x\cdot\frac{1}{\sec x}dx$$
$$\Rightarrow \frac{y}{\sec x}=e^x+c$$
$$\Rightarrow y\cos x=e^x+c$$

44. (b)

45. (b) Given differential equation can be rewritten as

$$\frac{dy}{dx}=\frac{x^3+y^3}{xy^2}$$

It is a homogeneous differential equation.

$$\text{Put } y=vx\Rightarrow\frac{dy}{dx}=v+x\frac{dv}{dx}$$
$$\therefore x\frac{dv}{dx}+v=\frac{x^3+v^3x^3}{x^3v^2}$$
$$\Rightarrow x\frac{dv}{dx}+v=\frac{1+v^3}{v^2}$$
$$\Rightarrow x\frac{dv}{dx}=\frac{1}{v^2}\Rightarrow v^2dv=\frac{dx}{x}$$

On integrating both sides, we get

$$\frac{v^3}{3}=\log x+\log c$$
$$\Rightarrow \frac{1}{3}\frac{y^3}{x}=\log x+\log c$$
$$\Rightarrow y^3=3x^3\log cx$$

46. (a) $hG^xL^yE^z$

$$[M^1L^2T^{-1}][M^{-1}L^3T^2]^x[M^1L^2T^1]^y[M^1L^2T^2]^z$$
$$[M^1L^2T^{-1}][M^{-1}L^3T^2]^x[M^1L^2T^1]^y[M^1L^2T^2]^z$$

Comparing the power, we get

$$1 = -x + y + z$$
$$2 = 3x + 2y + 2z$$
$$-1 = -2x - y - 2z$$

On solving Eq. (i), (ii) and (iii), we get

$x = 0$

47. (c)
48. (b)

The ball is thrown vertically upwards then according to equation of motion
$(0)^2 - u^2 = -2gh$

From Eqs. (i) and (ii),

$$h = \frac{gt^2}{2}$$

When the ball is falling downwards after reaching the maximum height

$$s = ut' + \frac{1}{2} g(t')^2$$
$$\frac{h}{2} = (0)t' + \frac{1}{2} g(t')^2$$
$$\Rightarrow t' = \frac{\bar{h}}{g}$$
$$t' = \frac{t}{\bar{2}}$$

Hence, the total time from the time of projection to reach a point at half of its maximum height while returning $= t + t'$

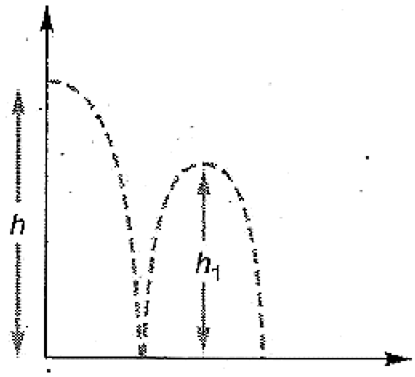
$$= t + \frac{t}{\bar{2}}$$

49. (c)
50. (c)

Given, velocity of river, $(v) = 2$ m/s
Density of water $\rho = 1.2$ g/cc
Mass of each cubic metre

$$m = \frac{1.2 \times 10^{-3}}{10^{-23'}} = 1.2 \times 10^3 \text{ kg}$$
$$\therefore \text{ Kinetic energy } = \frac{1}{2} mv^2$$
$$= \frac{1}{2} \times 1.2 \times 10^3 \times (2)^2$$

51. (b)



Total distance travelled by the ball before its second hit is

$$H = h + 2h_1$$
$$= h[1 + 2e^2]$$

$[\because h_1 = he^2]$

52. (a) As initially both the particles were at rest therefore velocity of centre of mass was zero and there is no external force on the system so speed of centre of mass remains constant i.e., it should be equal to zero

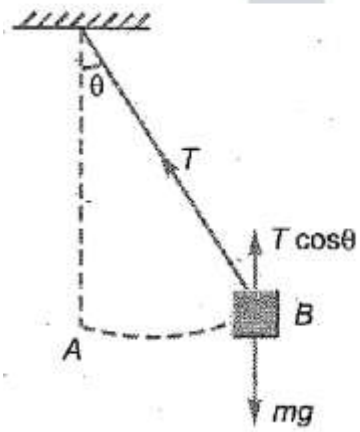
53. (d)

$$\mu = \tan\theta\, 1 - \frac{1}{n^2}$$

Here, $\theta = 45^\circ$ and $n = 2$

$$\therefore\ \mu = \tan 45^\circ 1 - \frac{1}{2^2}$$
$$= 1 - \frac{1}{4} = \frac{3}{4} = 0.75$$

54. (b)



In equilibrium,

$$T\cos\theta = mg$$
$$\Rightarrow\quad \cos\theta = \frac{150 \times 9.8}{2940}$$
$$\Rightarrow\quad \cos\theta = 0.5$$
$$\Rightarrow\quad \theta = 60^\circ$$

55. (d) Moment of inertia of a circular disc about an axis passing through centre of gravity and perpendicular to its plane

$I = \frac{1}{2} MR^2$

From Eq. (i) $MR^2 = 2I$
Then, moment of inertia of disc about tangent in a plane

$$= \frac{5}{4} MR^2$$
$$= \frac{5}{4}(2I)$$
$$= \frac{5}{2} I$$

56. (d) Time period of satellite

$T \frac{1}{M^{1/2}}$, where M is mass of earth.

$\propto (R+h)^{3/2}$ where R is radius of the orbit, h is the height of satellite from the earth's surface.

57. (d) It is the least interval of time after which the periodic motion of a body repeats itself. Therefore, displacement will be zero.

58. (a)

$$Y = \frac{mgl}{A\Delta l}$$
$$\Rightarrow \frac{\Delta l}{l} = \frac{mg}{AY}$$
$$\therefore \frac{\Delta l}{l} = \frac{1 \times 10}{3 \times 10^{-6} \times 10^{11}}$$
$$= 0.3 \times 10^{-4}$$

59. (b)

60. (d)

Terminal velocity, $v_T \propto r^2$
Or

$$\frac{v_{T_1}}{v_{T_2}} = \frac{r_1^2}{r_2^2}$$
$$\overline{9/4} = \frac{r_1}{r_2}$$

$r_2 \quad 2$

$$\therefore v = \frac{4}{3}\pi r^3$$

$$\text{Or } \frac{v_1}{v_2} = \frac{r_1^3}{r_2^3} = \frac{27}{8}$$

61. (c) Ideal gas equation is given by

$pV = nRT$

For oxygen, $p = 1$ atm, $V = 1$ L, $n = n_o$ Therefore Eq. (i) becomes

$\therefore \quad 1 \times 1 = n_{O_2}RT$

$\Rightarrow \quad n_{O_2} = \dfrac{1}{RT}$

For nitrogen $p = 0.5$ atm, $V = 2L, n = nN$

$\therefore\ 0.5 \times 2 = n_{N_2}\ RT$

$\Rightarrow\ n_{N_2} = \dfrac{1}{RT}$

For mixture of gas

$p_{mixix}\ V_{mix}\ = h_{mix}\ RT$

Here,

$n_{mix}\ = n0 + n_{N_2}$

$\therefore\ \dfrac{p_{mix}\ V_{mix}}{RT} = \dfrac{1}{RT} + \dfrac{1}{RT}$

$\Rightarrow\ p_{mix}\ V_{mix}\ = 2$

62. (c)

Modulus of elasticity $= \dfrac{\text{Force}}{\text{Area}} \times \dfrac{l}{\Delta l}$

$3 \times 10^{11} = \dfrac{33000}{10^{-3}} \times \dfrac{l}{\Delta l}$

$10^{-3}\ 3 \times 10^{11}$

$= 11 \times 10^{-5}$

Change in length, $\frac{\Delta l}{l} = \alpha \Delta T$

$11 \times 10^{-5} = 1.1 \times 10^{-5} \times \Delta T$

$\Rightarrow \quad \Delta T = 10$ K or 10°C

63. (d)

64. (a) For adiabatic change equation of state is

$pV^{\gamma} =$ constant

It can also be re-written as

$TV^{\gamma - 1} =$ constant as $p = \dfrac{nRT}{V}$

and $p^{1-\gamma}T^{\gamma} =$ constant as $V = \frac{nRT}{p}$

65. (a) The temperature at the contact of the surface

$$= \frac{K_1 d_2 \theta_1 + K_2 d_1 \theta_2}{K_1 d_2 + K_2 d_1}$$
$$= \frac{2K_2 d_2 \times 100 + 2d_2 \times K_2 \times 25}{2K_2 d_2 + K_2 2d_2}$$
$$= \frac{200 + 50}{4} = 62.5^\circ\text{C}$$

66. (c)

$$v_{max} = v$$
$$\Rightarrow A\omega = v$$
Or $A = \frac{\lambda}{2\pi}$

67. (c) The speed of the car is 72 km/h

$$= 72 \times \frac{5}{18} = 20 \text{ m/s}$$

The distance travelled by car in 10 s

$= 10 \times 20 = 200$ m

Hence, the distance travelled by sound in reachihg the hill and coming back to the moving driver

$$= 1800 + (1800 - 200)$$
$$= 3400 \text{ m}$$

So, the speed of sound $= \frac{3400}{10} = 340$ m/s

68. (a) Lens maker's formula

$$= \frac{1}{f} = \mu - 1 \frac{1}{R_1} - \frac{1}{R_2}$$

where, $R_2 = \infty, R_1 = 0.3$ m

$$\therefore \quad \frac{1}{f} = \frac{5}{3} - 1 \; \frac{1}{0.3} - \frac{1}{\infty}$$
$$\Rightarrow \quad \frac{1}{f} = \frac{2}{3} \times \frac{1}{0.3}$$

Or $f = 0.45$ m

69. (a) Using Huygen's eye-piece, measurements can be taken but not accurately due to the reason given.

70. (c) The image of an object in white light formed by a lens is usually coloured and blurred. This defect of image is called chromatic aberration and arises due to the fact that focal length of a lens is different for different colours. In case of two thin lenses in contact, the combination will be free from chromatic aberration. The lens combination which satisfies this condition are called achromatic lenses.

71. (c) The general condition for Froun hofer diffraction is $\frac{b^2}{L\lambda} << 1$.

72. (c) Time period of magnet, $T = 2\pi\sqrt{\frac{I}{MB}}$

When magnet is cut parallel to its length into four equal pieces. Then new magnetic moment, $M' = \frac{M}{4}$

New moment of inertia, $I' = \frac{I}{4}$

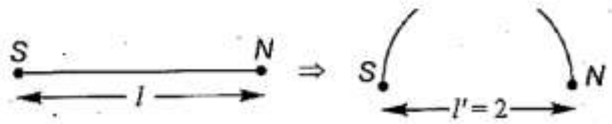
New time period, $T' = 2\pi\sqrt{\frac{I'}{M'B'}}$

$T = T' = 4\text{ s}$

73. (a) On bending a wire its pole strength remains unchanged whereas its magnetic moment changes.

New magnetic moment,

$$M' = m(2r) = m\frac{2l}{\pi} = \frac{3M}{\pi}$$



74. (b)

Ratio of charges $= 2:3$

$$\therefore\ q_1 = \frac{2}{5} \times 1\mu C \text{ and } q_2 = \frac{3}{5} \times 1\mu C$$

Electrostatic force between the two charges

$$F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$$
$$= \frac{9 \times 10^9 \times 2 \times 10^{-6} \times 3 \times 10^{-6}}{5 \times 5 \times 1^2}$$
$$= 2.16 \times 10^{-3}\text{ N}$$

75. (b) At equatorial point

$$E_e = \frac{1}{4\pi\varepsilon_0}\frac{p}{r^3}$$

(directed from $+q$ to $-q$) and $V_e = 0$,

76. (c) Current through each arm
PRQ and PSQ = 1 A

$$V_P - V_R = 3V$$
$$V_P - V_S = 7V$$

From Eqs. (i) and (ii), we get

$V_R - V_S = +4V$

77. (b)

Here, $V < E$

$\therefore$ $E = V + Ir$

For first case

$$E = 12 + \frac{12}{16}r$$

For second case

$$E = 11 + \frac{11}{10}r$$

From Eqs. (i) and (ii),

$$12 + \frac{12}{16}r = 11 + \frac{11}{10}r$$
$$\Rightarrow \quad r = \frac{20}{7}\Omega$$

78. (a) We know that thermoelectric power

$$S = \frac{dE}{dT}$$

Given, $E = K(T - T_r)T_0 - \frac{1}{2}T + T_r$

By differentiating the above equation w.r.t. T and putting $T = \frac{1}{2}T_0$, we get $S = \frac{1}{2}kT_0$

79. (b) Shunt of an ammeter,

$$S = \frac{I_g \times G}{I - I_g}$$
$$= \frac{5 \times G}{100 - 5}$$
$$= \frac{G}{19}$$

80. (b) Two coils carry currents in opposite directions, hence net magnetic field at centre will be difference of the two fields.

$$B_{net} = \frac{\mu_0}{4\pi} \cdot 2\pi N \frac{i_1}{r_1} - \frac{i_2}{r_2}$$

ie, $$= \frac{10\mu_0}{2}\frac{0.2}{0.2} - \frac{0.3}{0.4}$$
$$= \frac{5}{4}\mu_0$$

81. (a) In a transformer

$$\frac{N_P}{N_S} = \frac{I_S}{I_P}$$
$$\frac{50}{200} = \frac{I_S}{4}$$
$$\Rightarrow I_S = 1\text{ A}$$

82. (b)

$$\text{For } \phi = 90°, \cos\phi = 0$$

$$\text{So, } \lambda' = \lambda + \frac{h}{m_e c}$$

$$= 0.140 \times 10^{-9} + \frac{6.63 \times 10^{-34}}{9.1 \times 10^{-31} 3 \times 10^{8}}$$

$$= (0.140 \times 10^{-9} + 2.4 \times 10^{-12})\text{m}$$

$$= 0.142 \text{ nm}$$

83. (a)

$$E = \frac{hc}{\lambda}$$

$$= \frac{6.62 \times 10^{-34} \times 3 \times 10^{8}}{45 \times 10^{-12}}$$

$$= \frac{0.44 \times 10^{-14}}{1.6 \times 10^{-19}}$$

$$= 0.275 \times 10^{5}\text{eV}$$

84. (c) Nuclear force between two particles is independent of charges of particles.

$$\Rightarrow F_{pp} = F_{nn} = F_{np}$$

85. (d) In forward biasing both electrons and protons move towards the junction and hence the width of depletion region decreases.

86. (b) Energy of an electron in $/n^{\text{th}}$ orbit,

$$E_n = -\frac{2\pi^2 k^2 m Z^2 e^4}{n^2 h^2}$$

On substituting the values of k, m, e and h, we get

$$E_n = -\frac{2.172 \times 10^{-18} Z^2}{m^2} \text{Jatom}^{-1}$$

$$\text{or} \quad -\frac{1311.8 Z^2}{n^2} \text{ kJ mol}^{-1}$$

$$\text{or} \quad = -\frac{313.52 Z^2}{n^2} \text{kcalmol}^{-1}$$

$[\because 1\text{kcal} = 4.184 \text{ kJ}]$

For H-atom, $Z = 1$

For Lyman series, $n_1 = 1, n_2 = 2$

Energy of electron in n_1 orbit

1^2

$$= -313.52 \text{kcalmol}^{-1}$$

$$= -313.6 \text{kcalmol}^{-1}$$

Energy of electron in n_2 orbit

$$=-\frac{313.52\times1^2}{2^2}\text{kcalmol}^{-1}$$
$$=-\frac{313.52}{4}\text{kcalmol}^{-1}$$
$$=-78.38\text{kcalmol}^{-1}$$

87. (a) Given, velocity of particle $A=0.05\ \mathrm{ms}^{-1}$
Velocity of particle $B=0.02\ \mathrm{ms}^{-1}$
Let the mass of particle $A=x$
$\therefore$ The mass of particle $B=5x$
de-Broglie's equation is

$$\lambda=\frac{n}{mv}$$

For particle A

$$\lambda_A=\frac{h}{x\times0.05}$$

For partítle B

$$\lambda=\frac{h}{5x\times0.02}$$

Eq(i)/(i)

$$\frac{\lambda_A}{\lambda_B}=\frac{5x\times0.02}{x\times0.05}$$
$$\frac{\lambda_A}{\lambda_B}=\frac{2}{1}$$

88. (b)

Given, $\Delta\mathrm{m}$ for ${}_5\mathrm{B}^{11}=0.0821\mathrm{u}$
Number of nucleons $=11$
Binding energy $=931\times\Delta\mathrm{mMeV}$
$=931\times0.081$
$=75.411\mathrm{MeV}$
Average binding energy
$$=\frac{\text{binding energy}}{\text{number of nucleons}}$$
$$=\frac{75.411}{11}$$
$=6.85\mathrm{MeV}$

89. (c) Given,
Atomic number of element $\mathrm{B}=\mathrm{Z}$
($\because$ noble gas $\therefore$ belong to zero group)

Atomic humber of element $\mathrm{A}=\mathrm{Z}-1$
(ie, halogens)

Atomic number of element C = Z + 1
(ie, group IA)

Atomic number of element D = Z + 2
(ie, group IIA)
F. Element B is a noble gas

affinity. and element C must be an alkali metal and exist in +1 oxidation

state. and element D must be an alkaline earth metal with +2 oxidation state.

90. (d) Given,

observed dipole moment $= 1.03\text{D}$

Bodn length of HCl molecule, $d = 1.275\text{Å}$

$= 1.275 \times 10^{-8}$ cm

Charge of electrons, $e^{-} = 4.8 \times 10^{-10}$ esu
Percentage ionic character = ?
Theoretical value of dipole moment = e × d

$$\begin{aligned} &= 4.8 \times 10^{-10} \times 1.275 \times 10^{-8} \text{esu} - \text{cm} \\ &= 6.12 \times 10^{-18} \text{esu} - \text{cm} \\ &= 6.12\text{D} \end{aligned}$$

Percentage ionic character

$$\begin{aligned} &= \frac{\text{observed dipole moment}}{\text{theoretiegl value of dipole moment}} \times 100 \\ &= \frac{1.03}{6.12} \times 100 \\ &= 16.83\% \end{aligned}$$

91. (a)

Molecule	bp + Ip	Hybridisation	Shape
H_2O	2 + 2	sp^3	angular
BCl_3	3 + 0	sp^2	trigonal planar
NH_4^+	4 + 0	sp^3	tetrahedral
CH_4	4 + 0	sp^3	tetrahedral

92. (a)
93. (c)

Number of moles of helium $= 0.3$
Number of moles of argon $= 0.4$
We know that $KE = nRT$
KE of helium $= 0.3 \times R \times T$
KE of argon $= 0.4 \times R \times 400$

According to question
KE of helium = KE of argon

$$0.3 \times R \times T = 0.4 \times R \times 400$$
$$T = 533 \text{ K}$$

94. (c)

Given,
Weight of non-volatile solute,

$w = 25$ g

Weight of solvent, $W = 100$ g

$p^0 - p_s = 0.225$ mm

Vapour pressure of pure solvent,

$p^\circ = 17.5$ mm

Molecular weight of solvent (H_2O), $M = 18$ g
Molecular weight of solute, $m = ?$
According to Raoult's law

$$\frac{p^0 - p_s}{p^0} = \frac{w \times M}{m \times W}$$
$$\frac{0.225}{17{,}5} = \frac{25 \times 18}{m \times 100}$$
$$m = \frac{25 \times 18 \times 17{,}5}{22{,}5}$$
$$= 350 \text{ g}$$

95. (c) In water, barium hydroxide is hydrolysed as follows,

$$\begin{aligned}
Ba(OH)_2 &\rightleftharpoons Ba^{2+} + 2OH^- \\
\text{conc. of } Ba^{2+} &= 1 \times 10^{-3} M \\
\text{conc. Of } [OH^-] &= 2 \times 1 \times 10^{-3} M \\
&= 2 \times 10^{-3} M \\
pOH &= -\log[OH^-] \\
&= -\log(2 \times 10^{-3}) \\
&= 2.69 \\
pH + pOH &= 14 \\
pH &= 14 - pOH
\end{aligned}$$

$= 11.3$
≈ 11.0

96. (a) $CH_3COONa + H_2O \rightarrow CH_3COOH + NaOH$

The above process takes place in following steps

$$CH_3COONa \xrightarrow[\text{in aqueous solution}]{\text{Ionisation}} \underset{\text{strong base}}{CH_3COO^-} + Na^+$$

$$CH_3COO^- + H_2O \rightarrow CH_3COOH + OH^-$$

Acetate ion undergoes hydrolysis and the resulting solution is slightly basic due to excess of OH^- ions. Hence, both (A) and (R) are true and (R) is the correct explanation of (A).

97. (c)
98. (c)
99. (a) Given, angle of diffraction (2θ)

$$= 90^\circ \theta$$
$$= 45^\circ$$

n = 2 [$\because$ second order diffraction]
Bragg's equation is

$$n\lambda = 2\,d\sin\theta$$
$$2 \times \lambda = 2 \times 2.28 \times \sin 45^\circ$$
$$\lambda = 1.612$$

100. (b)

$$PCl_5 \rightleftharpoons PCl_3 + Cl_2$$

5	0	0	initial moles
$5(1-\alpha)$	5α	5α	moles at equilibrium
$\frac{5(1-\alpha)}{0.5}$	$\frac{5\alpha}{0.5}$	$\frac{5\alpha}{0.5}$	conc at equilibrium

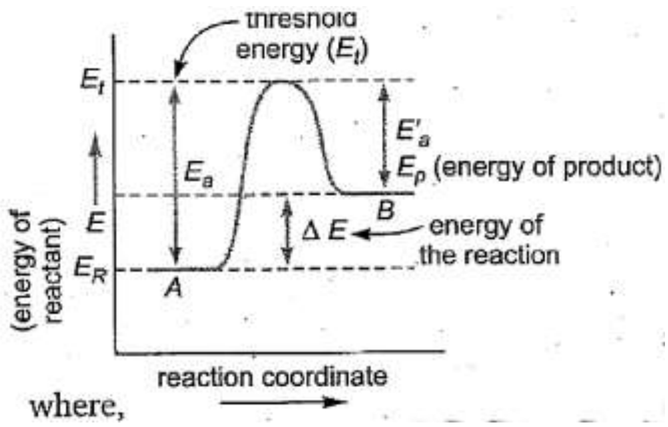
$$\alpha = 40\% = 0.4$$

$$K_c = \frac{PCl_3\,Cl_2}{PCl_5}$$

$$= \frac{\frac{5\times0.4}{0.5}\frac{5\times0.4}{0.5}}{\frac{5\times0.6}{0.5}} = \frac{16}{6}$$

$$= 2.66\ \text{mol/L}$$

101. (c)



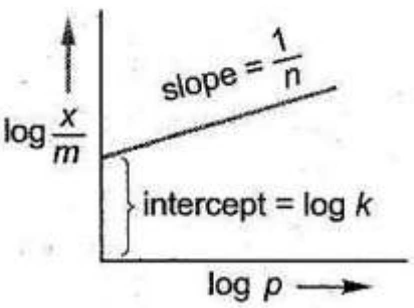
where,
E_a = activation energy of forward reaction
E_a = activation energy of backward reaction
The above energy profile diagram shows that

$E_a > E'_a$

The potential energy of the product is greater than that of the reactant, so the reaction is endothermic.

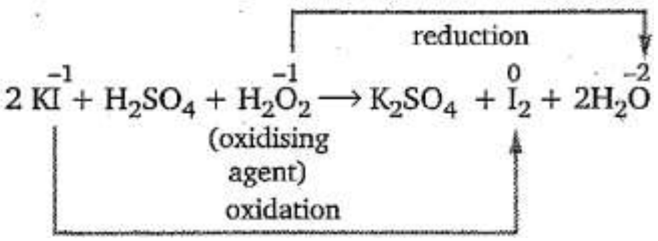
$E_a = E_a{}' + \Delta E$
$E_t = E_a$ or $E_t > E_a{}'$

102. **(a)**
103. **(c)** When we plot a graph between $\log(x/m)$ and $\log p$, a straight line with positive slope will be obtained. This graph represents the Freundlich adsorption isotherm.



Graph of Freundlich adsorption isotherm.

104. **(d)** The reaction in which H_2O_2 is reduced while the other reactant is oxidised, represents the oxidising property of H_2O_2.



105. **(b)** (i) The alkali metal superoxides contain O_2 ion, which has an unpaired electron, hence they are paramagnetic in nature.
(ii) The basic character of alkali metal hydroxides increases on moving down the group.
(iii) The conductivity of alkali metal chlorides in their aqueous solution increases on moving down the group

because in aqueous solution alkali metal chlorides ionise to give alkali metal ions. On moving down the group the size of alkali metal ion increases, thus degree of hydration decreases, due to this reason their conductivity in aqueous solution increases on moving down the group.

(iv) $M_2CO_3 \underset{\text{aq solution}}{\rightleftharpoons} 2M^+ + CO_3^{2-}$

$CO_3^{2-} + 2H_2O \longrightarrow H_2CO_3 + 2OH^-$

Thus, basic nature of carbonates in aqueous solution is due to anionic hydrolysis.

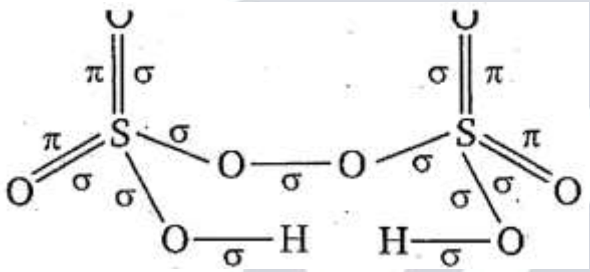
106. **(c)** According to Lewis, the compound which can accept a lone pair of electron, are called acids. Boron halides, being electron deficient compound$, can accept a lone pair of electrons, so termed as Lewis acid.

107. **(d)** Orthosilicic acid (H_4SiO_4), on heating at high temperature, loses two water molecules and gives silica (SiO_2) which on reduction with carbon gives carborundum (SiC) and CO.

108. **(a)** The reducing character of the hydrides of group V elements depends upon the stability of hydrides. With progressive decrease in stability, the reducing character of hydrides increases as we move down the group. Thus, ammonia, being stable, has least reducing ability. The order of reducing abilities of V group hydrides is

$NH_3 < PH_3 < AsH_3 < SbH_3 < BiH_3$

109. **(b)** The structure of peroxodisulphuric acid ($H_2\ S_2O_8R$) is



Hence, it contains 11σ and 4π bonds.

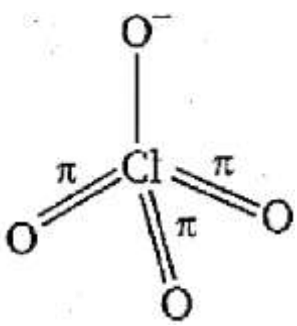
110. **(b)** With progressive increase in atomic number, (the reduction potential of halogens decreases, thu's oxidising power also decreases, Hence, a halogen with lower atomic number will oxidise the halide ion of higher atomic number and therefore, will liberate them from their salt solution.

Hence, the reaction

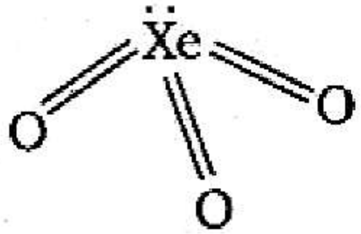
$Cl_2 + 2\ F^- \rightarrow 2CI^- + F_2$

is not possible.

111. **(b)** The structure of CIO_4^- is



Thus, it contains 3 $d\pi - p\pi$ bonds,
XeO_3 also contains 3 $d\pi - p\pi$ bonds as



112. **(a)** $[Co(NH_3)_5SO_4]Br \rightleftharpoons [Co(NH_3)_5SO_4]^+ + Br^-$

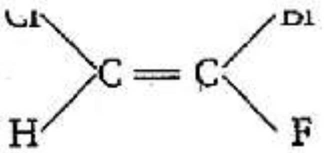
$[Co(NH_3)_5 \quad BrSO_4 \rightleftharpoons [CO(NH_3)_5Br]^{2+} + SO_4^{2-}$ the molecular formula of both of the above compounds is same but on ionisation they give different ions in solution, so they are called ionisation isomers.

113. **(a)** In stratosphere the following reactions takes place which are responsible for depletion of ozone layer.

$NO + O_3 \quad \rightarrow \quad NO_2 + O_2$
$CF_2Cl_2 \quad hv \quad C^{\cdot}F_2CI + C^{\cdot}I$
$CFCl_3 \quad hv \quad C^{\cdot}FCl_2 + C^{\cdot}I$
$Cl^{\cdot} + O_3 \quad \rightarrow \quad ClO^{\cdot} + O_2$
$Cl^{\cdot}O + O \quad \rightarrow \quad C^{\cdot}I + O_2$

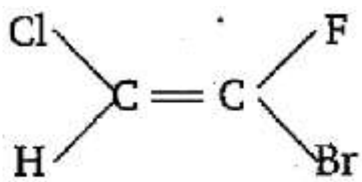
Hence, methane (CH_4) is not responsible for ozone layer depletion.

114. **(d)** When the groups with higher priority (ie, with high atomic number) are present on same side of double bond, then the configuration is Z but when present on opposite side of double bond, the configuration is E.



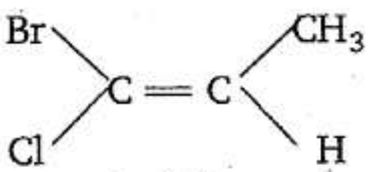
(i) (Z)

(Priority: Cl > H and Br > F)



(ii) (E)

(Priority: Cl > H and Br > F)



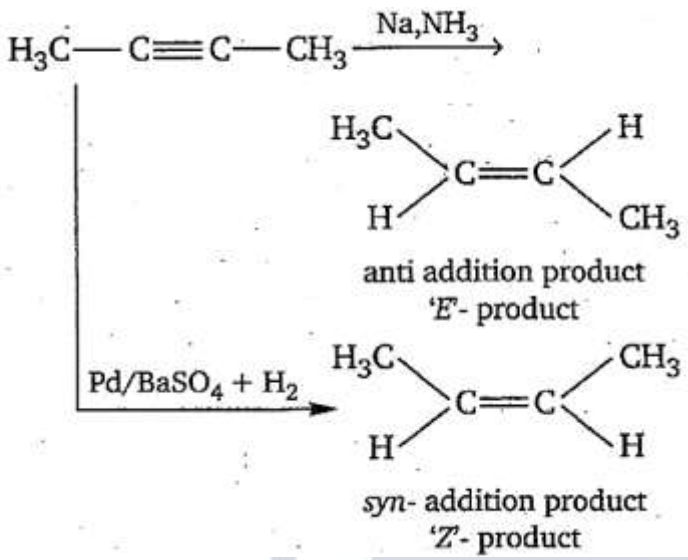
(iii) (Z)

(Priority: Br > CI and CH_3 > H)
Hence, compound (i) and (iii) have (Z) configuration.

115. **(d)** According to Cahn-Ingold-Prelog sequence rules, the priority of groups is decided by the atomic number of their atoms. When the atom - (which is directly attached to the asymmetric carbon atom) of a group has higher atomic number, then the group gets higher priority. Groups with atoms of comparable atomic number having double or triple bond, have high priority than those have single bond

Hence, the order of priority of groups is
$-OH > -COOH > -CHO > -CH_2OH$

116. **(a)**



Hence, reagent X and Yare respectively
Na, NH_3 and $Pd/BaSO_4 + H_2$.

117. **(d)** In a reaction, the reagent, which is reduced or remove hydrogen from the other reactant

(reagent), is termed as oxidising agent.

reduction

(i) $CH_3CH_2OH + \overset{0}{Cl_2} \longrightarrow CH_3CHO + H\overset{-1}{Cl}$

oxidising agent

removal of hydrogen
ie, oxidation

reduction

(ii) $CH_3CHO + \overset{0}{Cl_2} \longrightarrow CCl_3{\cdot}CHO + H\overset{-1}{Cl}$

oxidising agent

oxidation (removal of H)

reduction

(iii) $CH_4 + \overset{0}{Cl_2} \xrightarrow{h\nu} CH_3Cl + H\overset{-1}{Cl}$

oxidising agent

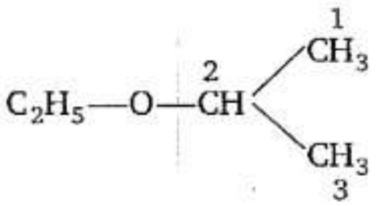
oxidation

Hence, in all of the above reactions, chlorine /acts as an oxidising agent.

118. **(d)** Among hydrogen halides, as the size of halide ion increases, its reactivity towards ethyl alcohol also increases. Thus, the order of reactivity of hydrogen halides is

HI > HBr > HCI > HF

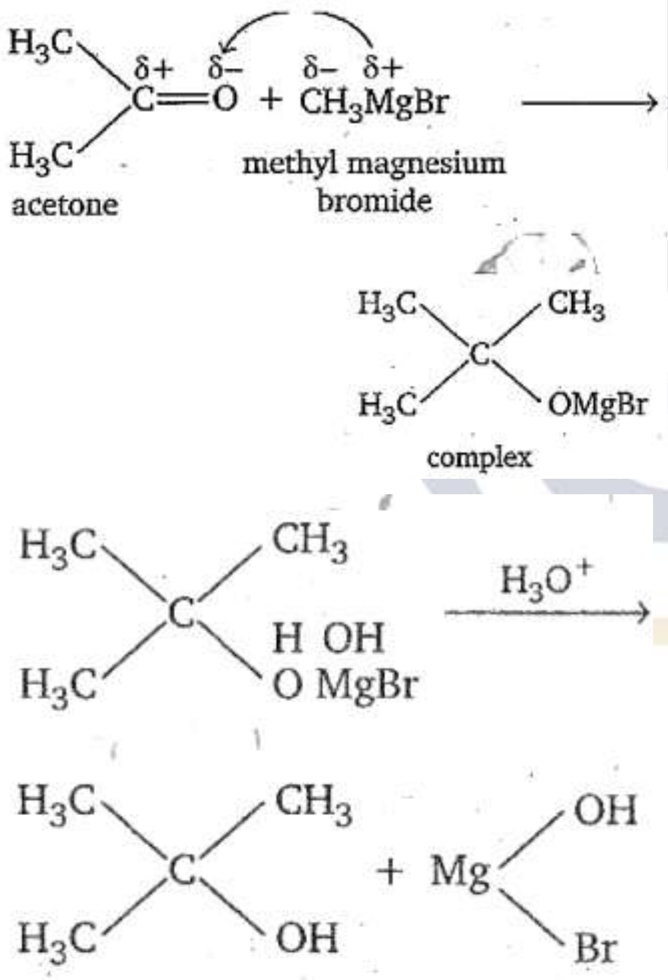
119. **(d)**



2-ethoxy propan

alkoxy alkane. Oxy is attached with the lower group. Hence, the IUPAC name of above compound is 2 -ethoxy propane.

120. **(b)**



'X' or $(CH_3)_3COH$
2- methyl propanol-2

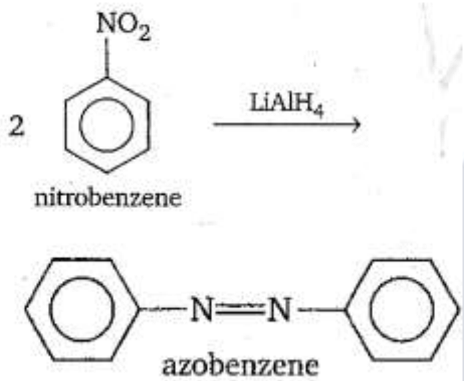
121. **(c)** Acetic acid on reduction with lithium aluminiumhydride gives ethyl alcohol while on reduction with HI and red P gives

$$CH_3COOH \xrightarrow{LiAlH_4} \underset{\text{ethyl alcohol}}{CH_3CH_2OH}$$

$$CH_3COOH \xrightarrow{\text{Red P + HI}} \underset{\text{ethane}}{CH_3{-}CH_3}$$

Hence, reagent A and B are respectively $LiAlH_4$ and Hi/ red P.

122. **(c)** Nitrobenzene on reduction with lithium aluminium hydride ($LiAlH_4$) gives azobenzene.



123. **(a)** Aspirin is used as analgesics as well as antipyretics, ie, it serve a dual purpose.

Chlorophyll is used in photosynthesis. Oxyhaemoglobin contains Fe^{2+} ion, so it is paramagnetic and haemoglobin works as oxygen carrier.

Hence, A-(v), B-(i), C − (ii), D-(iii).

124. **(b)** The ratio of weight average molecular weight and the number average molecular weight is called poly dispersity index (PDI).

$$PDI = \frac{\overline{M}_w}{M_n}$$

where,
$\overline{M}_w$ = weight average molecular weight
$\overline{M}_n$ = number average molecular weight
PDI is unity for natural monodispersed polymer but for synthetic polymers it is always greater than unity.

125. **(a)** On hydrolysis with dilute aqueous sulphuric acid, sucrose gives a equimolar mixture of D − (+) glucose and D − (−)-fructose.

$$\underset{\text{sucrose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{H_2SO_4}$$

$$\underset{\substack{\text{D-(+) glucose} \\ 1}}{C_6H_{12}O_6} + \underset{\substack{\text{D-(–) fructose} \\ 1}}{C_6H_{12}O_6}$$

$1 : 1$

Sucrose is dextrorotatory but after hydrolysis gives dextrorotatory glucose and laevorotatory fructose, laevorotatory fructose is more, so the mixture is laevorotatory.

126. (c)
127. (d)
128. (c)
129. (a)
130. (c)
131. (a)
132. (c)
133. (b)
134. (c)
135. (a)
136. (c)
137. (a)
138. (c)
139. (c)
140. (c)
141. (a)
142. (b)
143. (b)
144. (c)
145. (b)
146. (b)
147. (a)
148. (c)
149. (d)
150. (c)