1. (c)

Let $A = x \in R: \frac{2x-1}{x^3+4x^2+3x}$
Now, $x^3 + 4x^2 + 3x = x(x^2 + 4x + 3)$
$= x(x+3)(x+1)$
$A = R - \{0, -1, -3\}$

2. (c) The total number of subsets of given set is $2^9 = 512$ Even numbers are $\{2,4,6,8\}$.

Case I When selecting only one even number.

$= {}^4C_1 = 4$

Case II When selecting only two even numbers

$= {}^4C_2 = 6$

Case III When selecting only' three even numbers.

$= {}^4C_3 = 4$

Case IV When selecting only four even numbers $= {}^4C_4 = 1$
$\therefore$ - Required number of ways

$$= 512 - (4 + 6 + 4 + 1) - 1$$
$$= 496$$

[Here, we subtract 1 for due to the null set]

3. (b)

Now, $(1 + x^2)^{12}(1 + x^{12} + x^{24} + x^{36})$

$$= [1 + {}^{12}C_1(x^2) + {}^{12}C_2(x^2)^3 + {}^{12}C_3(x^2)^3 + {}^{12}C_4(x^2)^4 + {}^{12}(x^2)_5 + {}^{12}C_6(x^2)^6$$

$$+ \cdots \ldots . + {}^{12}C_{12}(x^2)^{12}] \times (1 + x^{12} + x^{24} + x^{36})$$
Coefficient of $x^{24} = {}^{12}C_6 + {}^{12}C_{12} + 1$
$= {}^{12}C_6 + 2$

4. (d)

$$\frac{1}{x - 1^2 x - 2} = \frac{1}{-21 - x^2 1 - \frac{x}{2}}$$
$$= -\frac{1}{2}\ 1 - x^{-2} 1 - \frac{x^{-1}}{2}$$
$$= -\frac{1}{2}\ 1 + 2x + \cdots .\ 1 + \frac{x}{2} + \cdots \ldots$$

$\therefore$ Coefficient of constant term is $-\frac{1}{2}$.

5. (c) Given,

$(x - a)(x - a - 1) + (x - á - 1)(x - a - 2) + (x - a)(x - a - 2) = 0$

Let $x - a = t$, then

$$t(t-1) + (t-1)(t-2) + t(t-2) = 0$$
$$\Rightarrow \quad t^2 - t + t^2 - 3t + 2 + t^2 - 2t = 0$$
$$\Rightarrow \quad 3t^2 - 6t + 2 = 0$$
$$\Rightarrow \quad t = \frac{6 \pm \sqrt{36 - 24}}{23} = \frac{6 \pm 2\sqrt{3}}{23}$$
$$\Rightarrow \quad x - a = \frac{3 \pm \sqrt{3}}{3}$$
$$\Rightarrow \quad x = a + \frac{3 \pm \sqrt{3}}{3}$$

Hence, x is real and distinct.

6. (b) Given, $f(x) = x^2 + ax + b$ has imaginary roots.

$\therefore$ Discriminant, $D < 0 \Rightarrow a^2 - 4b < 0$
Now, $f'(x) = 2x + a$

$f'(x) = 2$

Also, $f(x) + f'(x) + f''(x) = 0$

$$\Rightarrow x^2 + ax + b + 2x + a + 2 = 0$$
$$\Rightarrow x^2 + (a+2)x + b + a + 2 = 0$$
$$\therefore x = \frac{-a + 2 \pm \sqrt{a + 2^2 - 4a + b + 2}}{2}$$
$$= \frac{-a + 2 \pm \frac{a^2 - 4b - 4}{2}}{2}$$

Since, $a^2 - 4b < 0$
$a^2 - 4b - 4 < 0$

Hence, Eq. (i) has imaginary roots.

7. (a)

Given, $\begin{vmatrix} 3 & 5 & x \\ 7 & x & 7 \\ x & 5 & 3 \end{vmatrix} = 0$

$$\Rightarrow 3(3x - 35) > 5(21 - 7x) + x(35 - x^2) = 0$$
$$\Rightarrow 9x - 105 - 105 + 35x + 35x - x^3 = 0$$
$$\Rightarrow x^3 - 79x + 210 = 0$$
$$\Rightarrow (x + 10)(x - 3)(x - 7) = 0$$
$$\Rightarrow x = -10, 3, 7$$

8. (d) Let a and R be the first term and common ratio of a GP.

$\therefore T_p = aR^{p-1} = x$
$T_q = aR^{q-1} = y$

And $\quad T_r = aR^{r-1} = z$

$\Rightarrow \quad \log x = \log a + (p-1)\log R$

$\quad \log y = \log a + (q-1)\log R$

and $\quad \log z = \log a + (r-1)\log R$

$\log x \; x \; 1 \; \log a + p - 1\log R \; p \; 1$

$\log y \; y \; 1 = \log a + q - 1\log R \; q \; 1$

$\log z \quad z \quad 1 \quad \log a + r - 1\log R \quad r \quad 1$

$$= \begin{matrix} \log a & p & 1 \\ \log a & q & 1 \\ \log a & r & 1 \end{matrix} + \begin{matrix} p-1 & \log R & p & 1 \\ q-1 & \log R & q & 1 \\ r-1 & \log R & r & 1 \end{matrix}$$

$$\log a \begin{matrix} 1 & p & 1 \\ 1 & q & 1 \\ 1 & r & 1 \end{matrix} + \log R \begin{matrix} p-1 & p-1 & 1 \\ q-1 & q-1 & 1 \\ r-1 & r-1 & 1 \end{matrix}$$

$C_2 \to C_2 - C_3 -$

$= \; 0 + 0 = 0 <$ (two columns are identical)

9. **(d)** If matrix has no inverse it means the value of determinant should be zero.

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

If we put x = 1, then column Ist and IIIrd are identical.

10. **(c)** Let $z = x + iy$

Given, $\dfrac{z+2i}{2z+i} < 1$

$\Rightarrow \dfrac{\overline{x^2 + y + 2^2}}{2x^2 + 2y + 1^2} < 1$

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

$\Rightarrow 3x^2 + 3y^2 > 3$

$\Rightarrow x^2 + y^2 > 1$

11. **(d)**

Let $f(x) = \sin^4 x + \cos^4 x$

$= (\sin^2 x + \cos^2 x)^2 - 2\sin^2 x\cos^2 x$

$= 1 - \dfrac{1}{4} \cdot 2\sin 2x^2$

$= 1 - \dfrac{1}{4} 1 - \cos 4x$

$= \dfrac{3}{4} + \dfrac{\cos 4x}{4}$

$\therefore$ Period of $f(x) = \dfrac{2\pi}{4} = \dfrac{\pi}{2}$

12. (b)

Now, $\tan(x-y)\tan y$

$$= \frac{\sin x - y\sin y}{\cos x - y\cos y} \times \frac{2}{2}$$
$$= \frac{\cos x - 2y - \cos x}{\cos x - 2y + \cos x}$$
$$= \frac{1\frac{\cos x}{\cos x - 2y}}{1 + \frac{\cos x}{\cos x - 2y}}$$
$$= \frac{1-\lambda}{1+\lambda} \text{ Given, } \lambda = \frac{\cos x}{\cos x - 2y}$$

13. (a) It is a standard result.

$$\cos A \cos 2A \cos 2^2 A \ldots \ldots \cos 2^{n-1} A$$
$$= \frac{\sin 2^n A}{2^n \sin A}$$

14. (c)

$$\sin^2 x - \cos 2x = 2 - \sin 2x$$
$$\Rightarrow\ 1 - \cos^2 x - (2\cos^2 x - 1) = 2 - 2\sin x\cos x$$
$$\Rightarrow\ -3\cos^2 x + 2\sin x\cos x = 0$$
$$\Rightarrow\ \cos x(2\sin x - 3\cos x) = 0$$
$$\Rightarrow\ \cos x = 0, (\because 2\sin x - 3\cos x \neq 0)$$
$$\Rightarrow\ x = 2n\pi \pm \frac{\pi}{2}$$
$$\Rightarrow\ x = (4n \pm 1)\frac{\pi}{2}$$

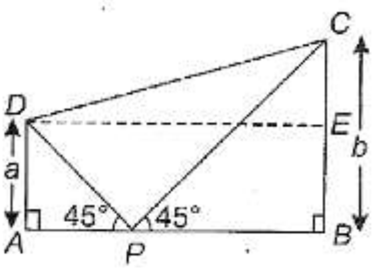
15. (c)

We know that, $2\text{ s} = \text{a} + \text{b} + \text{c}$

$$\therefore \frac{\text{a}+\text{b}+\text{c}\, b+\text{c}-\text{a}\, \text{c}+\text{a}-\text{b}\, a+\text{b}-\text{c}}{4\,\text{b}^2\text{c}^2}$$
$$= \frac{2s\ 2s-2a\ 2s-2b\ 2s-2c}{4b^2c^2}$$
$$= 4\frac{ss-a}{bc} \times \frac{s-bs-c}{bc}$$
$$= 4\cos^2\frac{\text{A}}{2} \times \sin^2\frac{\text{A}}{2}$$
$$= \sin^2\ \text{A}$$

16. (c) In $\triangle$ APD

$$\tan 45^\circ = \frac{\text{a}}{\text{AP}} \Rightarrow \text{AP} = \text{a}$$

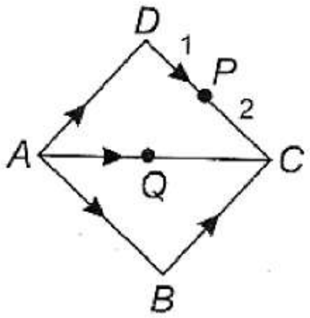


And in $\triangle BPC$, $\tan 45° = \frac{b}{PB} \Rightarrow PB = b$

$\therefore\ DE = a + b$ and $CE = b - a$
In $\triangle DEC,\ DC^2 = DE^2 + EC^2$
$= (a+b)^2 + (b-a)^2$
$= 2(a^2 + b^2)$

17. (a)

Now, AB + 2AD + **BC** − 2DC
$= AC + 2AD - 2DC$
$= AC + 2(AC + CD) - 2DC$



$= 3AC - 4DC$
$= 3(2QC) - 4\left(\frac{3}{2}PC\right)$
$= 6\boldsymbol{QC} - 6\boldsymbol{PC} = 6(QC + CP)$
$= k\boldsymbol{PQ} = 6\boldsymbol{QP} = -6PQ$ (given)
$\Rightarrow\ k = -6$

18. (a)

Given, $m_1 = |a_1| = \overline{2^2 + -1^2 + 1^2} = \overline{6}$
$m_2 = |a_2| = \overline{3^2 + -4^2 + -4^2} = \overline{6}$
$m_3 = |a_3| = \overline{1^2 + 1^2 + -1^2} = \overline{3}$
and $m_4 = |a_4| = \overline{-1^2 + 3^2 + 1^2} = \overline{11}$
$\therefore\ m_3 < m_1 < m_4 < m_2$

19. (a) Let $\mathbf{a} = 1 + 2j - \mathbf{k}, \mathbf{b} = \mathbf{1} + \jmath + \mathbf{k}$ and $c = \imath - \jmath + \lambda k$

Since, volume of tetrahedron $= \frac{1}{6}[abc]$

$$\Rightarrow \frac{2}{3} = \frac{1}{6}\begin{vmatrix} 1 & 2 & -1 \\ 1 & 1 & 1 \\ 1 & -1 & \lambda \end{vmatrix}$$

$\Rightarrow 4 = -\lambda + 5$

$\Rightarrow \lambda = 1$

20. (c) Given, $P(\bar{A} \cup \bar{B}) = P(\overline{A \cap B}) = \frac{7}{10}$

Since, $P(A \cap B) + P(\overline{A \cap B}) = \frac{1}{3}$

$\Rightarrow \quad PA \cap B = 1 - \frac{7}{10} = \frac{3}{10}$

Also, $\quad P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$\Rightarrow \quad \frac{4}{5} = PA + \frac{2}{5} - \frac{3}{10}$

$\Rightarrow \quad PA = \frac{4}{5} - \frac{2}{5} + \frac{3}{10}$

$= \frac{2}{5} + \frac{3}{10} = \frac{7}{10}$

21. (a) Here, $n = 6$

According to the question

$^6C_2 p^2 q^4 = 4 \cdot {}^6C_4 p^4 q^2$

$\Rightarrow \quad q^2 = 4p^2$

$\Rightarrow \quad (1-p)^2 = 4p^2$

$\Rightarrow \quad 3p^2 + 2p - 1 = 0$

$\Rightarrow \quad (p+1)(3p-1) = 0$

$\Rightarrow \quad p = \frac{1}{3}$

($\because$ p cannot be negative)

22. (d)

23. (b) Let point (x_1, y_1) be on the line $3x + 4y = 5$.

$3x_1 + 4y_1 = 5$

Also, $(x_1 - 1)^2 + (y_1 - 2)^2 = (x_1 - 3)^2 + (y_1 - 4)^2$

$\Rightarrow \quad x_1 + y^2{}_1 - 2x_1 - 4y_1 + 5$

$= x^2{}_1 + y^2{}_1 - 6x_1 - 8y_1 + 25$

$\Rightarrow \quad 4x_1 + 4y_1 = 20$

On solving Eqs. (i) and (ii), we get, $x_1 = 15, y_1 = -10$

24. (d) The point of intersection of lines

$x + 3y - 1 = 0$ and $x - 2y + 4 = 0$ is $(-2,1)$.

Let equation of line perpendicular to the given line is

$2x - 3y + \lambda = 0.$

Since, it passes through $(-2, \mathbf{1})$.

$\therefore \quad 2(-2) - 3(1) + \lambda = 0$

$\Rightarrow \quad \lambda = 7$

$\therefore$ Required line is $2x - 3y + 7 = 0$

25. (b) Given equation is

$$2x^2 - 10xy + 12y^2 + 5x + \lambda y - 3 = 0$$

Here, $a = 2, h = -5, b = 12, g = \frac{5}{2'}, f = \frac{\lambda}{2'}, c = -3$

For pair of lines $\begin{matrix} a & h & g \\ g & b & f \\ g & f & c \end{matrix} = 0$

$$\Rightarrow \begin{matrix} 2 & -5 & 5/2 \\ -5 & 12 & \lambda/2 \\ 5/3 & \lambda/2 & -3 \end{matrix} = 0$$

$$\Rightarrow \quad 2 - 36 - \frac{\lambda^2}{4} + 5 \quad 15 - \frac{5\lambda}{4}$$

$$+ \frac{5}{2}\frac{-5\lambda}{2} - 30 = 0$$

$$\Rightarrow \quad -72 - \frac{\lambda^2}{2} + 75 - \frac{25\lambda}{4} - \frac{25\lambda}{4} - 75 = 0$$

$$\Rightarrow \quad \lambda^2 + 25\lambda + 144 = 0$$

$$\Rightarrow \quad \lambda + 9\lambda + 16 = 0$$

$$\Rightarrow \quad \lambda = -9 \quad \because \lambda < 16$$

26. (c) Given,

$x^2 - 2xy - xy + 2y^2 = 0$

$\Rightarrow \quad (x - 2y)(x - y) = 0$

$\Rightarrow \quad x = 2y, x = y$

Also, $x + y + 1 = 0$

On solving Eqs. (i) and (ii), we get

$A -\frac{2}{3}, -\frac{1}{3} B -\frac{1}{2}, -\frac{1}{2}, C0,0$

$$\text{Area of } \Delta ABC = \frac{1}{2} \begin{matrix} -\frac{2}{3} & -\frac{1}{3} & 1 \\ -\frac{1}{2} & -\frac{1}{2} & 1 \\ 0 & 0 & 1 \end{matrix}$$

$$= \frac{1}{2} - \frac{1}{3} - \frac{1}{6} = \frac{1}{2}\frac{1}{6} = \frac{1}{12}$$

27. (c) Given pair of lines are $x^2 - 3xy + 2y^2 = 0$

and $x^2 - 3xy + 2y^2 + x - 2 = 0$

$\therefore \; (x - 2y)(x - y) = 0$

And $(x - 2y + 2)(x - y - 1) = 0$

$\Rightarrow\ x-2y=0, x-y=0$ and $x-2y+2=0$

$x-y-1=0$

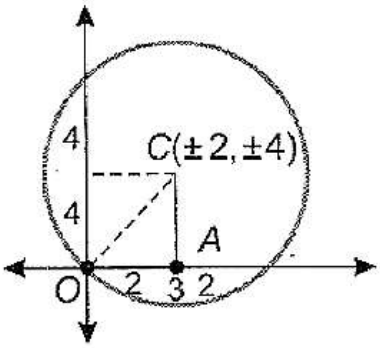
Since, the lines $x-2y=0, x-2y+2=0$ and $x-y=0, x-y-1=0$ are parallel.

Also, angle between $x-2y=0$ and $x-y=0$ is not 90°.
$\therefore$ It is a parallelogram.

28. (a) In $\triangle$ OAC

$\mathrm{OC}^2=2^2+4^2=20$

$\therefore$ Required equation of circle is

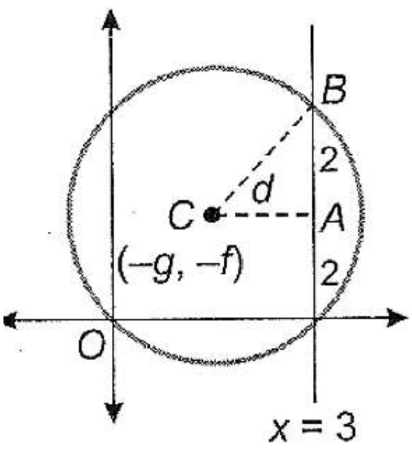


$$(x\pm 2)^2+(y\pm 4)^2=20$$
$$\Rightarrow\quad -x^2+y^2\pm 4x\pm 8y=0$$

29. (b) Let centre of circle be $C(-g,-f)$, then equation of circle passing through origin be

$x^2+y^2+2, gx+2fy=0$

Distance, $d=|-g-3|=g+3$



In $\triangle$ ABC, $(\mathrm{BC})=\mathrm{AC}^2+\mathrm{BA}^2$
$\Rightarrow g^2+f^2=(g+3)^2+2^2$
$\Rightarrow g^2+f^2=g^2+6g+9+4$
$\Rightarrow f^2=6g+13$

Hence, required locus is $y^2+6x=13$

30. (d) Given circles are $x^2+y^2-2x+8y+13=0$ and $x^2+y^2-4x+6y+11=0$.

Here,

$C_1=(1,-4), C_2=(2,-3)$,

$\Rightarrow \quad r_1=\sqrt{1+16-13}=2$

$r_2=\sqrt{4+9-11}=\sqrt{2}$

and

Now, $d=C_1C_2=\sqrt{(2-1)^2+(-3+4)^2}=\sqrt{2}$

$\therefore \cos\theta=\dfrac{d^2-r_1^2-r_2^2}{2r_1r_2}=\dfrac{2-4-2}{2\times 2\times\sqrt{2}}=-\dfrac{1}{\sqrt{2}}$

$\Rightarrow \theta=135^\circ$

31. (b) Let the required equation of circle be $x^2+y^2+2gx+2fy=0$.
Since, the above circle cuts the given circles orthogonally.

$\therefore 2(-3g)+2f(0)=8 \Rightarrow 2g=-\dfrac{8}{3}$

And $-2g-2f=-7$

$\Rightarrow 2f=+7+\dfrac{8}{3}=\dfrac{29}{3}$

$\therefore$ Required equation of circle is

$x^2+y^2-\dfrac{8}{3}x+\dfrac{29}{3}y=0$

Or $3x^2+3y^2-8x+29y=0$

32. (b)

33. (a) Given,

$x^2y^2=c^4$

$\Rightarrow \quad y^2(a^2-y^2)=c^4$

$\Rightarrow \quad y^4-a^2y^2+c^4=0$

Let $y_1+y_2+y_3$ and y_4 are the roots.

$\therefore y_1+y_2+y_3+y_4=0$

34. (b)

Given, $4x-3y=5$ and $2x^2-3y^2=12$

$\therefore 2\left(\dfrac{5+3y}{4}\right)^2-3y^2=12$

$\Rightarrow \dfrac{25+9y^2+30y}{8}-3y^2=12$

$\Rightarrow 15y^2-30y+71=0$

$\Rightarrow y=\dfrac{30\pm\sqrt{900-4260}}{30}$

$=1\pm\dfrac{\sqrt{-3360}}{30}$

Also, $2x^2 - 3\frac{4x-5^2}{3} = 12$

$\Rightarrow \quad 10x^2 - 40x + 61 = 0$

$\Rightarrow \quad x = \frac{40 \pm \overline{1600 - 4 \times 10 \times 61}}{2 \times 10}$

$= \frac{40 \pm \overline{-840}}{20}$

$= 2 \pm \frac{\overline{-840}}{20}$

$\therefore$ Point are $A2 + \frac{\overline{-840}}{20}, 1 + \frac{\overline{-3360}}{30}$ and

$B\ 2 - \frac{\overline{-840}}{20}, 1 - \frac{\overline{-3360}}{30}$.

$\therefore$ Mid point of AB is (2,1).

35. (c)

$\cos 2a \quad + \cos 2\beta + \cos 2y + \sin^2 a + \sin^2 \beta + \sin^2 y$

$= \quad (\cos^2 a - \sin^2 a) + (\cos^2 \beta - \sin^2 \beta)$

$\quad + (\cos^2 y - \sin^2 y) + \sin^2 a + \sin^2 \beta + \sin^2 y$

$= \quad \cos^2 a + \cos^2 \beta + \cos^2 y = 1$

36. (c) We know that image (x, y, z) of a point (x_1, y_1, z_1) in a plane ax + by $+cz + d = 0$ is

$\frac{x - x_1}{a} = \frac{y - y_1}{b} = \frac{z - z_1}{c}$

$= \frac{-2ax_1 + by_1 + cz_1 + d}{a^2 + b^2 + c^2}$

Here, point is (3,2,1) and plane is $2x - y + 3z = 7$.

$\therefore \quad \frac{x-3}{2} = \frac{y-2}{-1} = \frac{z-1}{3}$

$= \frac{-2\ \ 2\ \ 3 - 2 + 3\ \ 1 - 7}{2^2 + 1^2 + 3^2}$

$\Rightarrow \quad \frac{x-3}{2} = \frac{y-2}{-1} = \frac{z-1}{3} = -2\ \ 0$

$\Rightarrow \quad x = 3, y = 2, z = 1$

37. (c)

$\lim_{x\to\infty} \frac{x+5}{x+2}^{x+3} = \lim_{x\to\infty} 1 + \frac{3}{x+2}^{x+3}$

$= \lim_{x\to\infty} 1 + \frac{3}{x+2}^{\frac{x+2}{3}\frac{3x+3}{x+2}}$

$= e^{\lim_{x\to\infty} 3\frac{1+\frac{3}{x}}{1+\frac{2}{x}}} = e^3$

38. (d)

Given, $f(x) = \frac{2\sin x - \sin 2x}{2x\cos x}, \quad \begin{matrix} \text{if } x \neq 0 \\ a, \end{matrix}$

Now, $\lim_{x\to0} fx = \lim_{x\to0} \frac{2\sin x - \sin 2x}{2x\cos x}$ $\frac{0}{0}$ form

$$= \lim_{x\to0} \frac{2\cos x - 2\cos 2x}{2\cos x - x\sin x}$$
$$= \lim_{x\to0} \frac{2-2}{21-0} = 0$$

Since, $f(x)$ is continuous at $x = 0$

$\therefore \quad f\,0 = \lim_{x\to0} fx$

$\Rightarrow \quad a = 0$

39. (b)

Given, $\frac{x}{1} = \frac{1-\bar{y}}{1+\bar{y}}$

Applying componendo and dividendo, we get

$$\frac{1+x}{1-x} = \frac{1+\bar{y}+1-\bar{y}}{1+\bar{y}-1-\bar{y}}$$

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

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

$$\frac{dy}{dx} = \frac{-2 \quad 1+x^2 \quad 1-x-1-x^2 \cdot 2 \quad 1+x}{1+x^4}$$
$$= \frac{1-x \quad 1+x \quad -2-2x-2+2x}{1+x^2}$$
$$= \frac{4x-1}{x-1^3}$$

40. (b)

Given, $\frac{d}{dx} \operatorname{atan}^{-1} x + b\log\frac{x+1}{x+1} = \frac{1}{x^4-1}$

On integrating both sides, we get

$$a\tan^{-1}x + b\log\frac{x-1}{x+1}$$
$$=\frac{1}{2}\ \frac{1}{x^2-1} - \frac{1}{x^2+1}dx$$
$$\Rightarrow\ a_{tan}\tan^{-1}x + b\log\frac{x-1}{x+1}$$
$$=\frac{1}{4}\log\frac{x-1}{x+1} - \frac{1}{2}\tan^{-1}x$$
$$\Rightarrow\ a = -\frac{1}{2}, \mathrm{b} = \frac{1}{4}$$
$$\therefore\ a - 2b = -\frac{1}{2} - 2\frac{1}{4} = -1$$

41. (c)

Given, $Y = e^{a\sin^{-1}x}$
Qn differentiating w.r.t. x, we get

$$\Rightarrow \qquad y_1 = e^{a\sin^{-1}x}a\cdot\frac{1}{\overline{1-x^2}}$$
$$y_1\overline{1-x^2} = ay$$

$$\Rightarrow\ 1 - x^2 y_1^2 = a^2 y^2$$

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

$$(1-x^2)2y_1y_2 - 2xy_1^2 \quad = a^2 2yy_1$$
$$\Rightarrow\ (1-x^2)y_2 - xy_1 - a^2y \quad = 0$$

Using Leibnitz's rule,

$$(1-x^2)y_{n+2} + {}^nC_1 y_{n+1}(-2x) + {}^nC_2 y_n(-2)$$
$$-xy_{n+1} - {}^nC_1 yn - a^2yn = 0$$
$$\Rightarrow\ (1-x^2)y_{n+2} + xy_{n+1}(-2n-1)$$
$$+y_n[-n(n-1) - n - a^2] = 0$$
$$\Rightarrow\ (1-x^2)y_{n+2} - (2n+1)xy_{n+1} = (n^2+a^2)y_n$$

42. (c)

Given, $f(x) = x^3 + ax^2 + bx + c, a^2 \leq 3b$
On differentiating w.r.t. x, we get

$f'(x) = 3x^2 + 2ax + b$

Put $f'(x) = 0$

$$\Rightarrow\ 3x^2 + 2ax + b = 0$$
$$\Rightarrow\ x = \frac{-2a \pm \overline{4a^2 - 12b}}{2\times 3} = \frac{-2a \pm 2\overline{a^2 - 3b}}{3}$$

Since, $a^2 = 3b$,
x has an imaginary value.

Hence; no extreme value of x exist.

43. (a)

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

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

$= \operatorname{cosec}^2 x e^x dx - \cot x e^x dx$

$= -\cot x e^x - -\cot x e^x dx$

$- \cot x e^x dx + c$

$= -\cot x e^x + c$

44. (b)

45. (b) Given, $\frac{dy}{dx} = \sin x + y \tan x + y - 1$

$$\text{Put } x + y = z \Rightarrow 1 + \frac{dy}{dx} = \frac{dz}{dx}$$

$$\therefore \frac{dz}{dx} - 1 = \sin z \tan z - 1$$

$$\Rightarrow \frac{\cos z}{\sin^2 z} dz = \frac{dx}{l}$$

Put $\sin z = t \Rightarrow \cos z dz = dt$

$$\therefore \frac{1}{t^2} dt = x - c \Rightarrow -\frac{1}{t} = x - c$$

$$\Rightarrow \ -\operatorname{cosec} z = x - c$$

$$\Rightarrow \ x + \operatorname{cosec} x + y = c$$

46. (d) Given, $y = a\sin(bt - cx)$

Comparing the given equation with general wave equation

$$y = a\sin \frac{2\pi t}{T} - \frac{2\pi x}{\lambda}$$

we get $b = \frac{2\pi}{T}, c = \frac{2\pi}{\lambda}$

(a) Dimensions of $\frac{y}{a} = \frac{\text{metre}}{\text{metre}} = \frac{L}{L}$

(b) Dimensions of $bt = \frac{2\pi}{T} \cdot t = \frac{T}{T}$

(c) Dimensions of $cx = \frac{2\pi}{\lambda} \cdot x = \frac{L}{L}$

(d) Dimensions of $\frac{b}{c} = \frac{2\pi}{T} / \frac{2\pi}{\lambda} = \lambda/T = LT^{-1}$

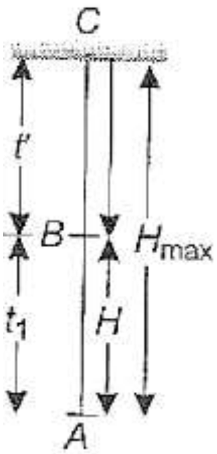
Thus, option (d) has dimensions.

47. (c) Let time taken by the body to fall from point C to B is t'.

Then $t_1 + 2t' = t_2$

$$t' = \frac{t_2 - t_1}{2}$$

Total time taken to reach point C

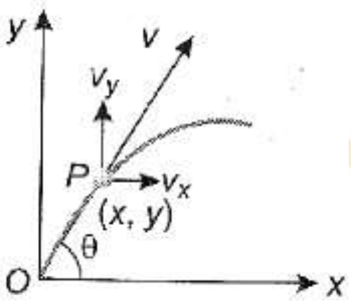


$$T = t_1 + t'$$
$$= t_1 + \frac{t_2 - t_1}{2}$$
$$= \frac{2t_1 + t_2 - t_1}{2}$$
$$= \frac{t_1 + t_2}{2}$$

Maximum height attained

$$H_{max} = \frac{1}{2} g\, T^2$$
$$= \frac{1}{2} g \frac{t_1 + t_2}{2}^2$$
$$= \frac{1}{2} g \cdot \frac{t_2 + t_2^2}{4}$$
$$\Rightarrow \quad H_{max} = \frac{1}{8} g \cdot t_1 + t_2^2 m$$

48. (a) Momentum, $p = m.v$

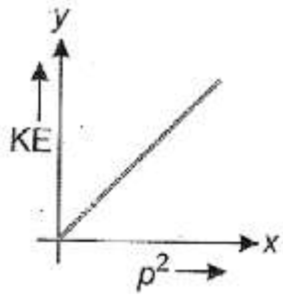


$$\Rightarrow v = \frac{p}{m}$$

Kinetic energy, $KE = \frac{1}{2} mv^2$

$$= \frac{1}{2} m \frac{p^2}{m^2} = \frac{1}{2n} p^2$$
$$\Rightarrow KE \propto p^2 \because \frac{1}{2\,m} = \text{ constant}$$

Hence, the graph between KE and p^2 will be linear as shown below



Now, Kinetic energy KE $= \frac{1}{2}\mathrm{mv}^2$
The velocity component at point P,

and $v_y = (\mathrm{usin\,a} - \mathrm{gt})$
$\mathrm{v_x} = \mathrm{ucos}\,\theta$

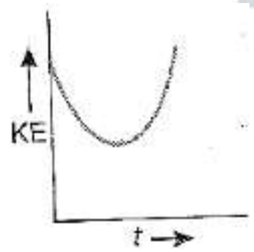
Resultant velocity at point P,

$$v = v_y\mathbf{y} + v_{x^1}$$
$$= u\sin\theta - gt\mathrm{j} + u\cos\theta_1$$

$$\mathrm{v} = \overline{\mathrm{ucos}\,\theta^2 + \mathrm{usin}\,\theta - \mathrm{gt}^2}$$
$$= \overline{u^2\cos^2\theta + u^2\sin^2\theta + g^2t^2 - 2ugt\sin\theta}$$
$$= \sqrt{u^2\cos^2\theta + \sin^2\theta + g^2t^2 - 2ugt\sin\theta}$$

$$\mathrm{KE} = \frac{1}{2}\,\mathrm{m}\quad \mathrm{u}^2 + \mathrm{g}^2\mathrm{t}^2 - 2\mathrm{ugt}\sin\theta$$
$$\rightarrow \quad \mathrm{KE} \propto \mathrm{t}^2$$

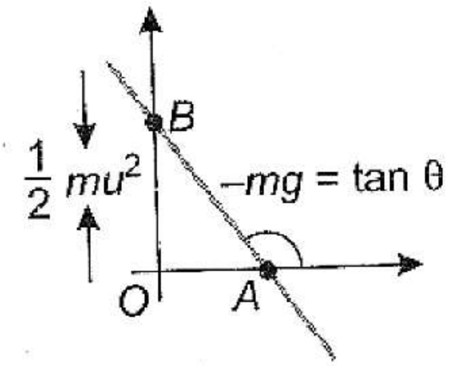
Hence, graph will be parabolic with intercept on y-axis. Hence, the graph between KE and t



Now, in case of height

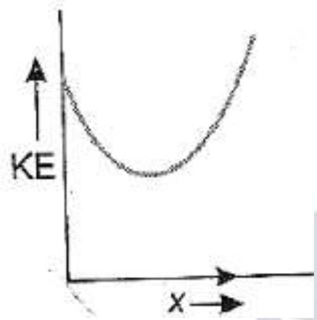
$$\mathrm{KE} = -\frac{1}{2}\,\mathrm{m}(\mathrm{v}^2)$$
and $v^2 = (u^2 - 2gy)$
$$\therefore\ \mathrm{KE} = \frac{1}{2}\,\mathrm{m}(\mathrm{u}^2 - 2\mathrm{gy})$$
$$KE = -mgy + \frac{1}{2}mu^2$$

Intercept on y-axis $= \frac{1}{2}\mathrm{mu}^2$



Now, $KE = \frac{1}{2}mv^2$

$KE = \frac{1}{2}\ m\frac{x^2}{t}$



$KE \propto x^2$. Thus graph between KE and x will be parabolic.'

49. **(a)** Power of motor initially $= P_0$

Let, rate of flow of motor $= (x)$

Since, power, $P_0 = \frac{\text{work}}{\text{time}} = \frac{\text{mgy}}{t}$

$$= mg \quad y/t$$
$$= \frac{y}{t} = x = \text{ rate of flow of water}$$
$$= mgx$$

If rate of flow of water is increased by n times, ie, (nx).

Increased power $P_1 \ = \frac{mgy'}{t}$

$$= mg\frac{y'}{t}$$
$$= mgn \cdot x$$
$$= nmgx$$

The ratio of power

$$\frac{P_1}{P_0} = \frac{nmgx}{mgx}$$
$$\frac{p_1}{P_0} = \frac{n}{1} \Rightarrow P_1 : P_0 = n : 1$$

50. **(a)** Mass of the first body $m_1 = 5$ kg, for elastic collision $e = 1$.

Suppose initially body m_1 moves with velocity v after collision velocity becomes $\frac{u}{10}$.

Let after collision velocity of M block becomes (v_2).
By conservation of momentum

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$

or

$$5u + M \times 0 = 5 \times \frac{u}{10} + Mv_2$$

or

$$5u = \frac{u}{2} + Mv_2$$

Since, $v_1 - v_2 = -e(u_1 - u_2)$

$$\frac{u}{10} - v_2 = -u$$

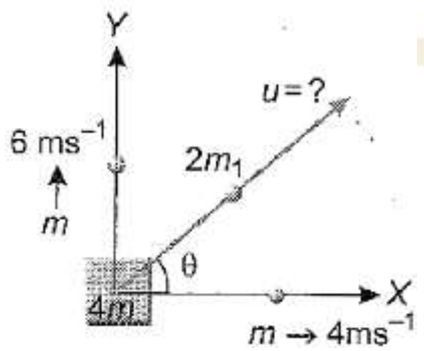
Or $\frac{u}{10} + u = v_2$

$$\frac{11u}{10} = v_2$$

Substitutifg value of v_2 in Eq. (i) from Eq. (ii). we get

$$5u = \frac{u}{2} + M\,\frac{11u}{10}$$
$$\text{Or}\ \ 5 - \frac{1}{2} = M\,\frac{11}{10}$$
$$\text{Or}\ \ M = \frac{9 \times 10}{2 \times 11}$$
$$\text{Or}\ \ M = \frac{45}{11} = 4{,}09\ \text{kg}$$

51. (c)



Let third mass particle (2 m) moves making angle 8 with X-axis.
The horizontal component of velocity of 2 m mass particle = u cos θ and vertical component = usin θ
From conservation of linear momentum in X-direction

$$m_1u_1 + m_2u_2 = m_1y_1 + m_2v_2$$

or $\quad 0 = m \times 4 + 2m(u\cos\theta)$

or $\quad -4 = 2u\cos\theta$

or $\quad -2 = u\cos\theta$

Again, applying law of conservation of linear momentum in $y -$ direction.

$$0 = \mathrm{m} \times 6 + 2\ \mathrm{m}(\mathrm{u}\sin\theta)$$

$$\Rightarrow \quad -\frac{6}{2} = u\sin\theta$$

or $\quad -3 = \mathrm{u}\sin\theta$

Squaring Eqs. (i) and (ii) and adding, we get

$$(4) + (9) \quad = u^2\cos^2\theta + u^2\sin^2\theta$$
$$= u^2(\cos^2\theta + \sin^2\theta)$$

or $\ 13 = u^2$

or $\ u = \overline{13}\ \mathrm{ms}^{-1}$

52. (b) Maximum height attained by a projectile

$$\mathrm{h} = \frac{\mathrm{v}^2\mathrm{R}}{2\mathrm{gR} - \mathrm{v}^2}$$

Velocity of body = half the escape velocity

$$v = \frac{v_e}{2}$$

Or $v = \frac{\overline{2gR}}{2} \Rightarrow v^2 = \frac{2gR}{4}$

Or $\ v^2 = \frac{gR}{2}$

Now, putting value of v^2 in Eq. (i), we get

$$h = \frac{\frac{gR}{2} \cdot R}{2gR - \frac{gR}{2}}$$

$$= \frac{gR^2/R}{3gR/2}$$

Or $\ h = \frac{R}{3}$

53. (d) The displacement of particle, executing SHM is

$$y = 5\sin 4t + \frac{\pi}{3}$$

Velocity of particle

$$\frac{\mathrm{dy}}{dt} = \frac{5\ \mathrm{d}}{dt}\sin 4t + \frac{\pi}{3}$$

$$= 5\cos 4t + \frac{\pi}{3}$$

$$= 20\cos 4t + \frac{\pi}{3}$$

Velocity at t $= \frac{T}{4}$

$$\frac{dy}{dt}_{t=\frac{T}{4}} = 20\cos 4 \times \frac{T}{4} + \frac{\pi}{3}$$

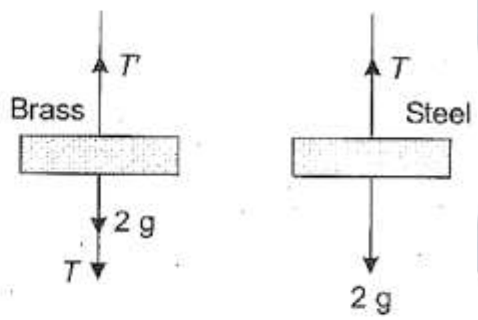
Or $u = 20\cos T + \frac{\pi}{3}$
Now, putting value of T in Eq. (ii), we get

$$u = 20\cos\frac{\pi}{2} + \frac{\pi}{3}$$
$$= -20\sin\frac{\pi}{3}$$
$$= -20 \times \frac{\overline{3}}{2}$$
$$= -10 \times \overline{3}$$

The kinetic energy of particle,

$$\text{KE} = \frac{1}{2}\text{mu}^2$$
$$\because \quad \text{m} = 2\text{ g} = 2 \times 10^{-3}\text{ kg}$$
$$= \frac{1}{2} \times 2 \times 10^{-3} \times -10\overline{3}^2$$
$$= 10^{-3} \times 100 \times 3$$
$$= 3 \times 10^{-1}$$
$$\text{KE} = 0.3$$

54. (d) Free body diagram of the two blocks are



Given, $\frac{l_1}{l_2} = a, \frac{r_1}{r_2} = b, \frac{Y_1}{Y_2}$
Let Young's modulus of steel is Y_1 and of brass is Y_2.

$$\therefore \; Y_1 = \frac{F_1 \cdot l_1}{A_1 \cdot \Delta l_1}$$

And $Y_2 = \frac{F_2 \cdot l_2}{A_2 \Delta l_2}$
Diving Eq. (i) by Eq.) (ii), we get

$$\frac{Y_1}{Y_2} = \frac{\frac{F_1 \bar{l}_1}{A_2 l_1}}{\frac{F_2 \cdot l_2}{A_2 \Delta_2}}$$

Or $\frac{Y_1}{Y_2}=\frac{F_1 \cdot A_2 \cdot l_1 \cdot \Delta l_2}{F_2 \cdot A_1 \cdot l_2 \cdot \Delta l_1}$
Force on sfeel wire from free body diagram

$T=F_1=(2g)$ newton

Force on brass wire from free body diagram

$\mathrm{F}_2=\mathrm{T}'=\mathrm{T}+2\ \mathrm{g}=(4\ \mathrm{g})$ newton

Now, putting the value of F_1, F_2, in Eq. (iii), we get

$$\frac{Y_1}{Y_2}=\frac{2g}{4g} \cdot \frac{\pi r_2^2}{\pi r_1^2} \cdot \frac{l_2}{l_2} \cdot \frac{\Delta l_2}{\Delta l_1}$$

Or $c=\frac{1}{2} \frac{1}{b^2} \cdot a \frac{\Delta l_2}{\Delta l_1}$
Or $\frac{\Delta l_1}{\Delta l_2}=\frac{a}{2b^2 c}$

55. **(d)** Initially area of soap bubble $A_1=4\pi r^2$
Under isothermal condition radius becomes 2r, Then,

$$\begin{aligned} \text{area } A_2 &= 4n(2r)^2 \\ &= 4n \cdot 4r^2 \\ &= 16\pi r^2 \end{aligned}$$

Increase in surface area

$$\begin{aligned} \Delta A &= 2(A_2-A_1) \\ &= 2(16\pi r^2-4 \cdot \pi r^2) \end{aligned}$$

$=24\pi r^2$

Energy spent

$$\begin{aligned} W=T &\times \Delta A \\ &= T.24\pi r^2 \end{aligned}$$

or

$W=24\pi \mathrm{Tr}^2 J$

56. **(c)** Let now radius of big drop is R.
Then

$$\frac{4}{3}\pi \mathrm{R}^3=\frac{4}{3} \times \pi \mathrm{r}^3 .8$$
$$\mathrm{R}=2\mathrm{r}$$

where r is radius of small drops. Now, terminal velocity of drop in liquid.

$$\mathrm{v}_{\mathrm{e}}=\frac{2}{9} \times \frac{\mathrm{r}^2}{\eta} \rho-\sigma \mathrm{g}$$

where η is coefficient of viscosity and ρ is density of drop σ is density of liquid.

Terminal speed drop is 6 cm s^{-1}

$$\therefore\ 6=\frac{2}{9}\times\frac{r^2}{\eta}\rho-\sigma g$$

Let terminal velocity becomes v′ after coalesce, then

$$v'=\frac{2}{9}\frac{R^2}{\eta}\rho-\sigma g$$

Dividing Eq. (i) by Eq. (ii), we get

$$\frac{6}{v'}=\frac{\frac{2}{9}\frac{r^2}{\eta}\rho-\sigma g}{\frac{2R^2}{9}\rho-\sigma g}$$

Or $\frac{6}{v'}=\frac{r^2}{2r^2}$
Or $v'=24\text{ cm s}^{-1}$

57. (a)

Time period of oscillation,

$$T=2\pi\sqrt{\frac{l}{g}}$$
$$\Rightarrow\ \frac{dT}{T}=\frac{1}{2}\frac{dt}{l}$$
$$\text{As, }-\frac{dl}{l}=adt$$
$$\Rightarrow\ \frac{dT}{T}=\frac{1}{2}adt$$
$$=\frac{1}{2}\times 9\times 10^{-7}\times 30-20$$
$$=4.5\times 10^{-6}$$
$$\therefore\ \text{Loss in time }=4.5\times 10^{-6}\times 0.5$$
$$=2.25\times 10^{-6}\text{ s}$$

58. (c) The volume of the metal at 30°C is

$$V_{30}=\frac{\text{loss of weight}}{\text{specific gravity }\times g}$$
$$=\frac{45-25\text{ g}}{1.5\times g}=13.33\text{ cm}^3$$

Similarly, volume of metal at 40°C is

$$V_{40}=\frac{40-27\text{ g}}{1.25\times g}$$
$$=14.40\text{ cm}^3$$

Now, $V_{40}=V_{30}1+\gamma t_2-t_1$

Or

$$\gamma = \frac{V_{40} - V_{30}}{V_{30} t_2 - t_1}$$
$$= \frac{14.40 - 13.33}{13.33 \quad 40 - 30}$$
$$= 8.03 \times 10^{-3} / ^\circ C$$

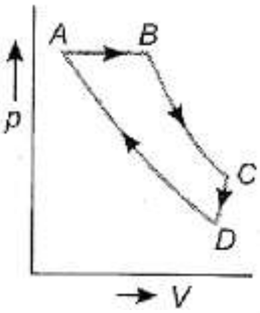
∴ Coefficient of linear expansion of the metal is

$$a = \frac{\gamma}{3} = \frac{8.03 \times 10^{-3}}{3}$$
$$\approx 2.6 \times 10^{-3} / ^\circ \bar{C}$$

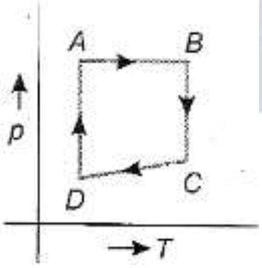
59. **(a)** A → B → C → D → A is clockwise process.

During A → B, pressure is constant and B → C, process follows $p \propto \frac{1}{V'}$, it means T is constant.

Dúring process C → D, both p and V changes and process D → A follows $p < \frac{1}{v}$ which means T is constant:



Hence, from above data it is dear that equivalent cyclic process is



60. **(b)** From first law of thermodynamics

$$\therefore \ Q = \Delta U + W$$
or $\Delta U = Q - W$

$$\therefore \ \Delta U_1 = Q_1 - W_1 = 6000 - 2500 = 3500 \text{ J}$$

$$\Delta U_2 = Q_1 - W_2 = -5500 + 1000 = -4500 \text{ J}$$
$$\Delta U_3 = Q_3 - W_3 = -3000 + 1200 = -1800 \text{ J}$$
$$\Delta U_4 = Q_4 - W_4 = 3500 - x = 0$$

For cyclic process $\Delta U = 0$

$\therefore \ 3500 - 4500 - 1800 + 3500 - x = 0$

or $x = 700$ J

$$\text{Efficiency, } \eta = \frac{\text{output}}{\text{input}} \times 100$$
$$= \frac{W_1 + W_2 + W_3 + W_4}{Q_1 + Q_4} \times 100$$
$$= \frac{2500 - 1000 - 1200 + 700}{6000 + 3500} \times 100$$
$$= \frac{1000}{9500} \times 100$$
$$\eta = 10.5\%$$

61. (c) From first law of thermodynamics

$Q = \Delta U + W$

For cylinder A préssure remains constant
$\therefore$ Work done by a system

$$W = \frac{\mu R}{\gamma - 1} T_1 - T_2$$

For monatomic gases

$$\mu = 1$$
$$\gamma = \frac{5}{3}$$
$$\therefore\ W = \frac{1 \times R}{5} 442 - 400 = \frac{3}{2} R \times 42$$

or $W = 63R$

But $\Delta U = 0$, for cylinder A

$$Q = 0 + 63R$$
$$Q = 63R$$

For cylinder B volume is constant,

$\therefore \quad W = 0$
and $\quad Q = \mu C_v \Delta T$

For mono atomic gas

$$C_V = \frac{3}{2} R$$
$$Q = 1 \times \frac{3}{2} R \Delta T$$

As heat given to both cylinder is same

$$\therefore\ 63R = \frac{3}{2} R \Delta T$$
$$\Delta T = 42\text{ K}$$

62. (a) According to the figure

$$H = H_1 + H_2$$

$$\Rightarrow \quad \frac{3KA100 - T}{l} = \frac{2KAT - 50}{l} + \frac{KAT - 0}{l}$$

$$300 - 3\,T = 2\,T - 100 + T$$

$$\Rightarrow \quad 6T = 400$$

Or $\quad T = \frac{200}{3}\ ^\circ C$

63. (b) Listener go from A → B with velocity (u) let the apparent frequency of sound from source A by listener

$$n' = n\,\frac{v - v_0}{v + v_s}$$

or $n' = 680\,\frac{340-u}{340+0}$

The apparent frequency of sound from source B by listener

$$n'' = n\,\frac{v + v_0}{v - v_s} = 680\,\frac{340 + u}{340 - 0}$$

But listener hear 10 beats per second.

Or $680\frac{340+u}{340} - 680\,\frac{340-u}{340} = 10$

Or $2340 + u - 340 + u = 10$

$u' = 2.5\ \mathrm{m\,s^{-1}}$

64. (b) Beats per second when both the wires vibrate simultaneously.

$n_1 \pm n_2 = 6$

or $\ -\frac{1}{2l}\frac{\overline{T'}}{m} \pm \frac{1}{2l}\frac{\overline{T'}}{m} = 6$

or $\ \frac{1}{2l}\frac{\overline{T'}}{m} - \frac{1}{2l}\frac{\overline{T}}{m} = 6$

or $\ \frac{1}{2l}\frac{\overline{T'}}{m} - 600 = 6$

$\Gamma\frac{\frac{1}{\overline{T'}}}{\frac{1}{2l}} = 606$

Given that fundamental frequency

$\frac{1}{2l}\ \frac{\overline{T}}{m} = 600$

Dividing Eq.(i) by Eq. (ii), we get

$$\frac{\frac{1}{2l}\frac{\overline{T'}}{m}}{\frac{1}{2l}\frac{\overline{T}}{m}} = \frac{606}{600}$$

Or $\ \frac{\overline{T'}}{T} = 1.01$

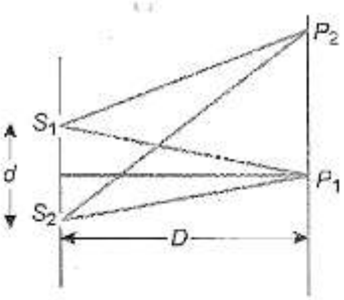
Or $\ \frac{\overline{T'}}{T} = 1.02\%$

Or $T' = T1.02$
Increase in tension

$$\Delta T' = T \times 1.02 - T$$
$$= 0.02\ T$$

Hence, $\Delta T' = 0.02$

65. (d)



Fringe width $\beta = \frac{\lambda D}{d}$
Let the amplitude of that place where constructive inference takes place is a.

The position of fringe at p_2 is

$$x = \frac{n\lambda D}{d}$$

Given,

$$\beta = \frac{\beta}{4}$$

$$\therefore \frac{\lambda D}{4d} = \frac{n\lambda D}{d}$$
or $n = \frac{1}{4}$
$$\therefore \frac{l_1}{l_2} = \frac{a^2}{\frac{a^2}{4}\,{}^2}$$
Or $I_1 : I_2 = 16 : 1$

66. (a) Position fringe from centfal maxima

$$y_1 = \frac{n\lambda_1 D}{d}$$

Given, $n = 10$
$$\therefore\ y_1 = \frac{10\lambda_1 D}{d}$$
For second source

$$y_2 = \frac{5\lambda_2 D}{d}$$
$$\frac{y_1}{y_2} = \frac{\frac{10\lambda_1 D}{d}}{\frac{5\lambda_2 D}{d}}$$
$$\frac{y_1}{y_2} = \frac{2\lambda_1}{\lambda_2}$$

67. (c) Interference phenomenon takes place between two waves which

have equal frequency and propagate in same direction.

Hence, $\quad y_1 = a\sin(\omega t + \phi)_1$
$\quad y_3 = a' \sin(\omega t + \phi_2)$

will give rise to interference as the two waves have same frequency ω.

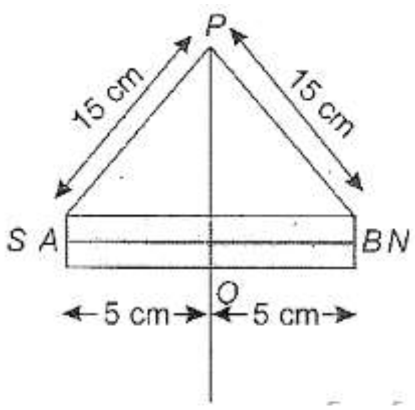
68. (d) The two lenses of an achromatic doublet should have, sum of the product of their powers and dispersive power equal to zero.

69. (b) Ratio of magnetic moments of two magnets of equal size when in sum and difference position is

$$\frac{\mathrm{M_A}}{\mathrm{M_B}} = \frac{T_d^2 + T_s^2}{T_d^2 - T_s^2} = \frac{v_s^2 + v_d^2}{v_s^2 - v_d^2}$$
$$= \frac{{\frac{1}{20}}^2 + {\frac{1}{15}}^2}{{\frac{1}{15}}^2 - {\frac{1}{20}}^2}$$
$$= \frac{400 + 225}{400 - 225}$$
$$\Rightarrow \mathrm{M_A} : \mathrm{M_B} = 25 : 7$$

70. (d)

Length of magnet $= 10\text{ cm} = 10 \times 10^{-2}$ m,
$r = 15 \times 10^{-2}$ m



$\mathrm{OP} = \overline{225 - 25} = \overline{200}$ cm

Since, at the neutral point, magnetic field/due to the magnet is equal to B_H

$$B_H = \frac{\mu_0}{4\pi} \cdot \frac{M}{OP^2 + Ao^{2/3/2}}$$

$$0.4 \times 10^{-4} = 10^{-7} \times \frac{M}{200 \times 10^{-4} + 25 \times 10^{-43/2}}$$

$$\frac{0.4 \times 10^{-4}}{10^{-7}} \times 225 \times 10^{-4} 3/2 = M$$

$$-0.4 \times 10^3 \times 10^{-6} 225^{3/2} = M$$

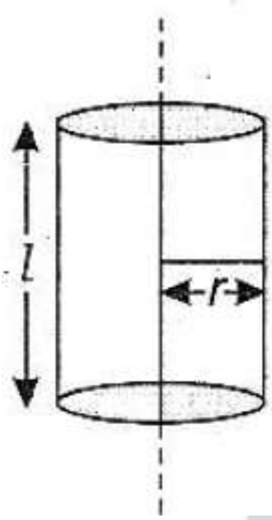
$$M = 1.35 \text{ A} - \text{m}$$

71. (a)

Charge density of long wire

$\lambda = \frac{1}{3} \text{C} - \text{m}$

And $\text{r} = 18 \times 10^{-2}$ m



From Gauss theorem

$$\text{E. dS} = \frac{\text{q}}{\varepsilon_0}$$

$$\text{EdS} = \frac{\text{q}}{\varepsilon_0}$$

or $\text{E} \times 2\pi\text{rl} = \frac{\text{q}}{\varepsilon_0}$

or $\text{E} = \frac{\text{q}}{2\pi\varepsilon_0 \text{rl}} = \frac{\text{q/l}}{2\pi\varepsilon_0 \text{r}}$

$= \frac{\lambda \times 2}{2\pi\varepsilon_0 \text{r} \times 2} = \frac{\lambda \times 2}{4\pi\varepsilon_0 \text{r}}$

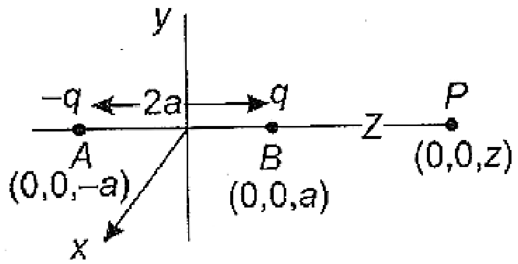
$= 9 \times 10^9 \times \left(\frac{1}{3} \times 2 \times \frac{1}{18 \times 10^{-2}}\right.$

$= \frac{1}{3} \times 10^{11} = 0.33 \times 10^{11}$

$= 0.33 \times 10^{11} \text{NC}^{-1}$

72. (c) Potential at P due to $(+q)$ charge

$$V_1 = \frac{1}{4\pi\varepsilon_0} \cdot \frac{q}{z - a}$$



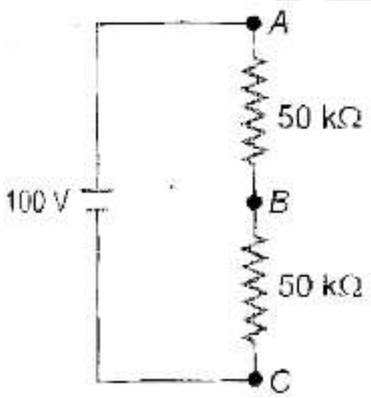
Potential at P due to $(-q)$ charge

$$V_2 = \frac{1}{4\pi\varepsilon_0} \cdot \frac{-q}{z+a}$$

Total potential at P due to (AB) electric dipole

$$\begin{aligned} V &= \mathrm{V}_1 + \mathrm{V}_2 \\ &= \frac{1}{4\pi\varepsilon_0} \cdot \frac{q}{z-a} - \frac{1}{4\pi\varepsilon_0} \frac{q}{z-a} \\ &= \frac{q}{4\pi\varepsilon_0} \frac{z-a-z+a}{z-az+a} \\ \Rightarrow V &= \frac{2qa}{4\pi\varepsilon_0 z^2 - a^2} \end{aligned}$$

73. (c)



Internal resistance of voltmeter is R.
Therefore effective resistance across B and C, R' is given by

$$\frac{1}{R'} = \frac{1}{R} + \frac{1}{50} = \frac{50+R}{50R}$$

$$\text{Or } R' = \frac{50R}{50+R}$$

According to Ohm's law

$\mathrm{V}' = \mathrm{IR}^-$

or $\frac{100}{3} = I \cdot \frac{50R}{50+R}$

or $\frac{100}{3} \frac{50+R}{50R} = I$

Now, total resistance of circuit

$$R'' = 50 + \frac{50R}{50 + R}$$

$$\text{Or } R'' = \frac{2500 + 100R}{50 + R}$$

Now, $V'' = IR''$

$$\Rightarrow 100 = \frac{100}{3} \frac{50 + R}{50R} \frac{2500 + 100R}{50 + R}$$

or $150R = 2500 + 100R$
or $50R = 2500$
or $R = 50k\Omega$

74. (c) Resistance of potentiometer wire

$$R = \rho \times \frac{1}{A}$$

Or $R' = \frac{2.5\rho}{A \times 10}$
Potential $V'I \times R'$

$$= I \frac{2.5\rho}{A \times 10}$$

Now, again the length of potentiometer wire is increased by 1 m, then resistance of null position wire.

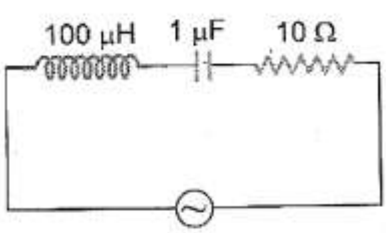
$$R'' = \frac{\rho \times l}{11 \times A}$$
$$V'' = IR''$$

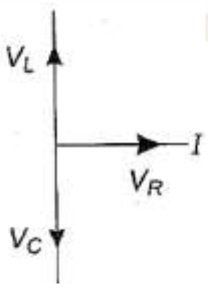
And $V = V'$

$$\frac{I \times 2.5\rho}{A \times 10} = \frac{\rho \times l}{11 \times A} \times I$$

Or $\frac{2.5 \times 11}{10} = l = 2.75$ m

75. (c)





Impedance, $Z = \sqrt{X_L \sim X_c{}^2 + R^2}$

Or

$$Z = \sqrt{\omega L \sim \frac{1}{\omega C}^2 + R^2}$$

Inductive reactance

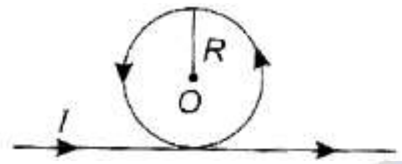
$X_L = \omega L = 70 \times 10^3 \times 100 \times 10^{-6} = 7\Omega$

Capacitance reactance

$$X_C = \frac{1}{\omega C} = \frac{1}{70 \times 10^3 \times 1 \times 10^{-6}}$$
$$= \frac{1}{7 \times 10^{-2}} = \frac{10^2}{7} = \frac{100}{7}$$

As $X_C > X_L$
Hence, cirquit behave like as $R - C$ circuit.

76. (c)
77. (c)



Magnetic field due to long wire at O point $B_1 = \frac{\mu_0}{2\pi}\frac{I}{R}$ upward direciton Magnetic field due to loop at O point

$$B_2 = \frac{\mu_0}{4\pi} \cdot \frac{1.2\pi R}{R^2}$$
$$B_2 = \frac{\mu_0}{2} \cdot \frac{I}{R} \text{ in upward direction}$$

Hence, resultant magnetic field at centre O

$$B = B_1 + B_2$$
$$B = \frac{\mu_0 I}{2\pi \cdot R}\pi + 1$$

78. (b) Work function $W_0 = 3.31 \times 10^{-19}$ J
Wavelength of incident radiation

$$\lambda = 5000 \times 10^{-10} \text{ m}$$
$$E = W_0 + KE$$

(According to Einstein equation)

$$\frac{hc}{\lambda} = 3.31 \quad \times 10^{-19} + \text{KE}$$

$$\text{KE} \quad = -3.31 \times 10^{-19} + \frac{6.62 \times 10^{-34} \times 3 \times 10^8}{5000 \times 10^{-10}}$$
$$= \quad -3.31 \times 10^{-19} + \frac{6.62 \times 3}{5} \times 10^{-19}$$
$$= \quad (-3.31 \times 1.324 \times 3) \times 10^{-19}$$

$$= (3.972 - 3.31) \times 10^{-19} = 0.662 \times 10^{-19} \text{ J}$$

$$\Rightarrow \quad E = \frac{0.662 \times 10^{-19}}{1.6 \times 10^{-19}} = 0.41\text{eV}$$

79. (d) From Einstein's equation

$$E = W_0 + \frac{1}{2}mv^2$$

$$\sqrt{\frac{2E - W_0}{m}} = v$$

or A charged particle placed in uniform maghetic field experience a force

$$F = \frac{mv^2}{r}$$

$$\text{or } evB = \frac{mv^2}{r}$$

$$\text{or } r = \frac{mv}{eB}$$

$$\text{or } r = \frac{m\sqrt{\frac{2E - W_0}{m}}}{eB}$$

$$\Rightarrow r = \frac{\sqrt{2mE - W_0}}{eB}$$

80. (d)

$$N_1 = NO^{-10\lambda t}$$

$$\text{and } N_2 = N_0 e^{-\lambda t}$$

$$\Rightarrow \frac{N_1}{N_2} = \frac{1}{e} = e^{-1} = e^{-10\lambda + \lambda t}$$

$$= e^{-9\lambda t}$$

$$\Rightarrow t = \frac{1}{9\lambda}$$

81. (c) In circuit A, both (p-n) junction diode act as Forword

Hence, current flows in circuit A.
Total resistance R is given by

$$\frac{1}{R} = \frac{1}{4} + \frac{1}{4}$$

Or $\frac{1}{R} = \frac{2}{4}$
Or $R = 2\Omega$
According to Ohm's law

$$V = I_A R$$

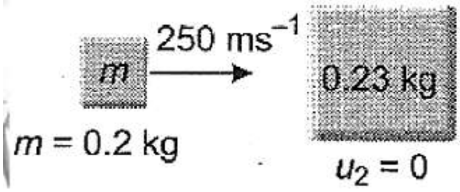
or $8 = I_A \times 2$
or $I_A = 4A$
In circuit B, lower $p-n$-junction diode is reverse biased. Hence, no current will flow but upper diode is forward biased so current, can flow through it

$$V = I_B R$$

$$\text{or } 8 = I_B \times 4$$

$$\text{or } I_B = 2\text{ A}$$

82. (c) After impact the bullet and block move together and come's to rest after covering a distance of 40 m.



By conservation of momentum,

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

or

$$0.02 \times 250 + 0.23 \times 0 = 0.02v + 0.23v$$
$$5 + 0 = v(0.25)$$
$$\frac{500}{25} v = 20\ ms^{-1}$$

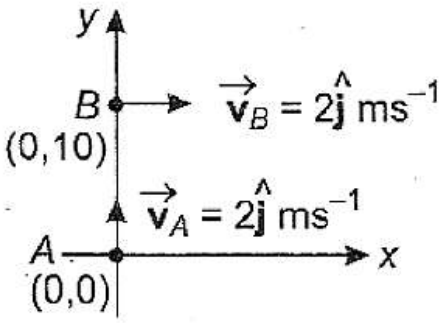
Now, by conservation of energy

$$\frac{1}{2}Mv^2 = \mu R.d$$

or $\frac{1}{2} \times 0.25 \times 400 = \mu \times 0.25 \times 9.8 \times 40$

$\Rightarrow \quad \mu = \frac{200}{9.8 \times 40} = 0.51$

83. (a) Let after the time (t) the position of A is $(0, v_At)$ and position of B $= (v_Bt, 10)$. Distance between them

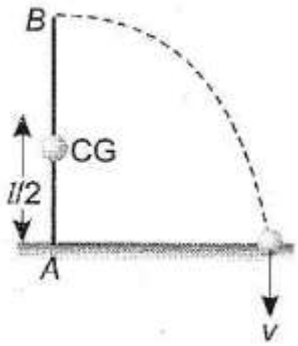


$$y = \sqrt{0 - v_Bt^2 + v_At - 10^2}$$
$$\text{or } y^2 = (2t)^2 + (2t - 10)^2$$
$$\text{or } y^2 = 1 = 4t^2 + 4t^2 + 100 - 40t$$
$$\Rightarrow l = 8t^2 + 100 - 40t$$
$$\text{Now, } \frac{dl}{dt}(16t - 40) = 0$$
$$t = \frac{40}{16} = 2.5\ s$$

As $\frac{d^2l}{dt^2} = -16 = (-ve)$
Hence, l will be minimum.

84. (b) In this process potential energy of the metre stick will be converted into rotational kinetic energy.

PE of metre stick $= \frac{mgl}{2}$
Because its centre of gravity lies at the middle of the rod.
Rotational kinetic energy $E = \frac{1}{2}I\omega^2$



I = moment of inertia of metre stick about point A $= \frac{3l^2}{3}$.
By the law of conservation of energy

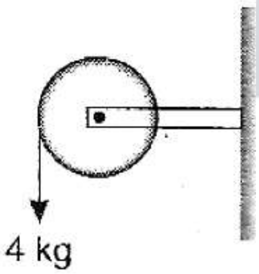
$$mg\frac{l}{2} = \frac{1}{2}I\omega^2 = \frac{1}{2}\frac{ml^2}{3}\frac{v_B}{l}^2$$

By solving, we get $v_B = \overline{3gl}$

85. (a) Given, $r = 0.4$ m, $a = 8\text{rads}^{-1}$,

$m = 4$ kg, $1 = ?$

Torque, $\tau = Ia$



$$mgr + I.a$$
or $4 \times 10 \times 0.4 = I \times 8$
$\Rightarrow I = \frac{16}{8} = 2 \text{ kg} - \text{m}^2$
or $I = 2 \text{ kg} - \text{m}^2$

86. (c) Given: $\Delta H_f(\text{H}) = 218$ kJ/mol;

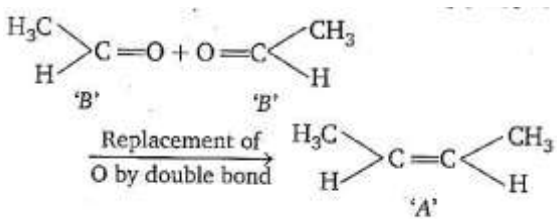
ie; $\frac{1}{2}H_2 \rightarrow H$; $\Delta H = 218$ kJ/mol
or $H_2 \rightarrow 2H$; $\Delta H = 436$ kJ/mol
$$= \frac{436}{4.18} = 104.3\text{kcal/mol}$$

Thus, 104.3kcal/mol energy is absorbed for breaking one mole of H − H. bonds. Hence, H − H bond energy is 104.3kcal/mol.

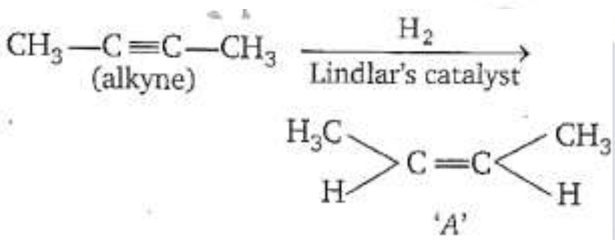
87. (a) In Wacker process, alkene is oxidised into aldehyde.

$$CH_2 = CH_2 + \frac{1}{2} \xrightarrow[H_2O]{PdCl_2\ CuCl} \underset{B}{CH_3CHO}$$

Since on ozonolysis, only alkenes produce aldehydes, 'A' must be an alkene. To decide the structure of alkene that undergoes ozonolysis, bring the products together in such a way that 0 atoms are face to face and, replace O by double (=) bond. Thus,



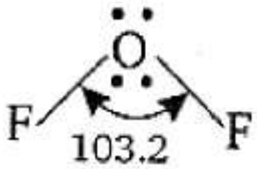
Therefore, alkyne must be



88. (b)

$2\ F_2 + \underset{\text{dilute}}{2NaOH} \rightarrow 2NaF + \underset{A}{OF_2} \uparrow + H_2O$

The structure of ' A ' (OF_2) is as



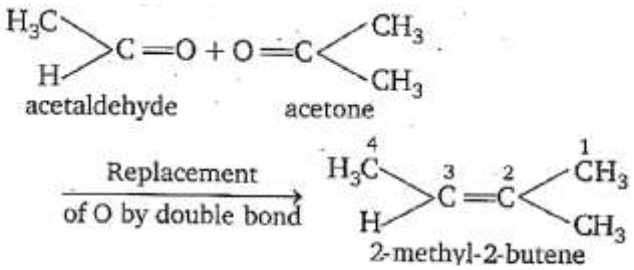
σ bonds made by $O = 2$
Lone pairs of electrons on $O = 2$
$\therefore$ No. of orbitals used by O for hybridisation

$= 2 + 2 = 4$

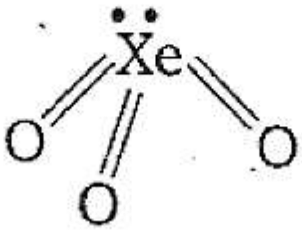
$\therefore$ Hybridisation of O in $OF_2 = sp^3$

Due to repulsion between" two /one pairs of electrons, its shape gets distorted. Therefore, the bond angle in the molecule is 103°.

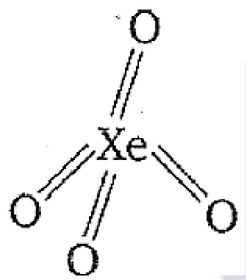
89. (a) To decide the structure of alkene that undergoes " ozonolysis, bring the products together in such a way that O atoms are face to face, and replace 0 by double (=) bond. Thus,



90. **(a)** Structure of XeO_3



$\Rightarrow$ $3p\mu - d\pi$ pi bonds.
Structure of XeO_4



$\Rightarrow$ $4p\pi - d\pi$ bonds.

91. **(a)** From de-Broglie's equation

$$\lambda = \frac{h}{mv}$$
$$\Rightarrow \lambda^2 = \frac{h^2}{m^2v^2}$$
$$\Rightarrow mv^2 \neq \frac{h^2}{m\lambda^2}$$
$$\because KEK = \frac{1}{2}mv^2$$
$$\therefore KEK = \frac{1}{2}\frac{h^2}{m\lambda^2}$$
$$\Rightarrow \frac{K_1}{K_2} = \frac{{\lambda_2}^2}{\lambda_1} = \frac{5^2}{3}$$
$$\therefore K_1 : K_2 = 25:9$$

92. **(c)** Paramagnetic property depends upon the number of unpaired electrons. Higher the number of unpaired electrons, higher the paramagnetic property will be.
$Cu^{2+} = [Ar]3\ d^9$, no. of unpaired electrons = 1
$v^{2+} = [Ar]3d^3$, no. of unpaired electrons = 3
$Cr^{2+} = [Ar]3\ d^4$, no. of unpaired electrons = 4

$Mn^{2+} = [Ar]3\ d^5$, no. of unpaired electrons = 5
Hence, correct order is -
$Cu^{2+} < V^{2+} < Cr^{2+} < Mn^{2+}$

93. (a)

1 mol $= 6.023 \times 10^{23}$ atoms
KE of 1 mol $= 6.023 \times 10^4$ J
or KE of 6.023×10^{23} atoms

$= 6.023 \times 10^4$ J

$$\therefore \text{ KE of 1 atom } = \frac{6.023 \times 10^4}{6.023 \times 10^{23}}$$
$$1 = 1.0 \times 10^{-19}\ \text{J}$$

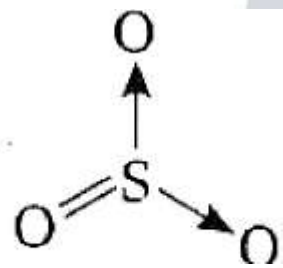
$$h\nu_{\text{energy}} = \frac{h\nu}{\lambda} = \frac{6.626 \times 10^{-34} \times 3 \times 10^8}{600 \times 10^{-9}}$$
$$= 3.313 \times 10^{-19}\ \text{J}$$

Minimum amount of energy required to remove an electron from the metal ion (ie, Threshold energy)

$$= hy - KE$$
$$= 3.313 \times 10^{-19} - 1.0 \times 10^{-19}$$
$$= 2.313 \times 10^{-19}\ \text{J}$$

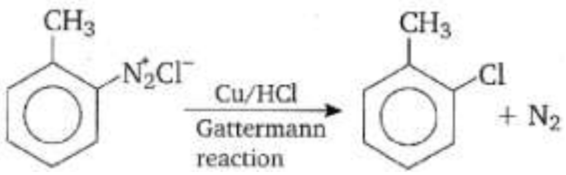
94. (a) The thermosphere is the fourth layer of the earth's atmopshere and is located above the mesosphere. The air is thin in the thermosphere. The earth's thermosphere also includes the region of the atmosphere, called the ionosphere. The ionosphere is the region of the atmosphere that is filled with charged particles such as O^+, NO^+. The high temperature in the thermosphere can cause molecules to ionize.

95. (b) Sulphuric anhydride is SO_3 and its structure is as follows:

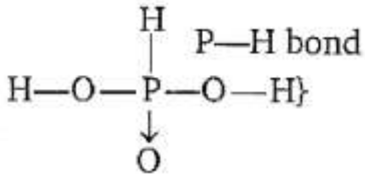


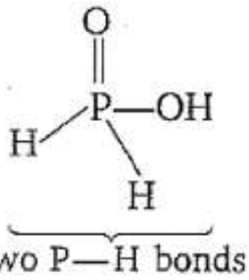
$\Rightarrow$ $3\sigma, 1p\pi, 2p\pi - d\pi$ bonds are present.

96. (a)



97. (c)

$H_3PO_3 \Rightarrow$ 

$H_3PO_2 \Rightarrow$ 

98. (c) From the definition of dipole moment,

$\mu = 8 \times d$

where, δ = magnitude of electric charge
d = distance between particles (here bond length)
$\therefore \ \delta = \frac{\mu}{d}$
or,

$$\frac{\delta_{HCI}}{\delta_{HI}} = \frac{\mu_{HCI}}{d_{HCI}} \times \frac{d_{HI}}{\mu_{HI}}$$
$$= \frac{1.03 \times 1.6}{1.3 \times 0.38} = 3.3:1$$

99. (d)

$$SiCl_4 + 4H_2O \rightarrow H_4SiO_4 + 4HCI$$
$$H_4SiO_4 \xrightarrow[1000^\circ c]{\Delta} SiO_2 + 2H_2O$$

100. (c)

$$\% \text{ of Cd in } CdCl_2 = \frac{0.9}{1.5} \times 100$$
$= 60\%$
Therefore, % of Cl_2 in $CdCl_2 = 100 - 60 = 40\%$
$\because$ 40% part (Cl_2) has atomic weight
$= 2 \times 35.5 = 71.0$
$\therefore$ 60% part (Cd) has atomic weight
$$= \frac{71.0 \times 60}{40}$$
$= 106.5$

101. (c)

$2Al + 2NaOH + 2H_2O \rightarrow 2NaAlO_2 + 3H_2$

sodium metal aluminate
Sodium metaaluminate, thus formed, is soluble in water and changes into the complex $[Al(H_2O)_2(OH)_4]^-$, in which coordination number of Al is 6.

102. **(b)** Average kinetic energy per molecule

$$= \frac{3}{2}kT$$

Or $$= \frac{3}{2}\frac{R}{N_0}T$$

$$= \frac{3}{2} \times \frac{8.314}{6.023 \times 10^{23}} \times 300$$

$$= 6.21 \times 10^{-21} JK^{-1} \text{ molecule }^{-1}$$

103. **(c)** Superoxides are the species having an $O-O$ bond and O in ana oxidation state of $-\frac{1}{2}$ (Superoxide ion is O_2^-). Usually these are formed by active metals such as $KO_2, RbO_,$, and CsO_2. For the salts of larger anions (like O_2^-), lattice energy increases in a group. Since, lattice energy is the driving force for the formation of an ionic compound and its stability, the stability of the superoxides from ' K ' to 'Cs' also increases.

104. **(a)** Perhydrol means 30% solution of H_2O_2.

H_2O_2 decomposes as

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

Volume strength of $30\% H_2O_2$ solution is 100 chat means 1 mL of this solution on decomposition gives 100 mL oxygen.

$SO_2 +$	$\frac{1}{2}2$	$\rightarrow$	SO_3
1L	$\frac{1}{2}L$		1L
2L	1L		2L

Since, 100 mL of oxygen is obtained by

$= 1$ mL of H_2O_2

$\therefore$ 1000 mL of oxygen will be obtained by

$$= \frac{1}{100} \times 1000 \text{ mL of } H_2O_2$$

$$= 10 \text{ mL of } H_2O_2$$

105. **(d)**

Buffer capacity, $\beta = \frac{dc_{HA}}{d_{pH}}$

where, $dC_{HA} =$ no. of moles of acid added per litre

$d_{PH} =$ change in pH.

$$dC_{HA} = \frac{\text{moles of acetic acid}}{\text{volume}}$$

$$= \frac{0.12/60}{250/1000} = \frac{1}{125}$$

$$\therefore \beta = \frac{1/125}{0.02} = \frac{1}{2.5} = 0.4$$

106. (b)

(A) Felspar (orthoclase) ($KAlSi_3O_8$)
It is used in the manufacture of porcelain.
(B) Asbestos $\{CaMg_3(SiO_3)_4\}$
It is used for fireproof sheets, cloths etc.
(C) Pyrargyrite (Ruby silver) (Ag_3SbS_3) It is an ore of silver.
(D) Diaspore ($Al_2O_3 \cdot H_2O$) It is an ore of aluminium.

107. (c) First ionisation energy increases in. a period. Thus, the first IE of the elements of the second period should be as follows

$Be < B < N < O$

But in practice, the elements do not follow the above order. The first IE of these elements is

$B < Be < O < N$

The lower IE of B than that of Be is because in $B(1s^2, 2s^2 2p^1)$, electron is to be removed from $2p$ which is easy while in $Be(1s^2, 2s^2)$, electron is to be removed from 25 which is difficult. The low IE of O than that of N is because of the half-filled 2p orbitals in $N(1s^2, 2s^2 2p^3)$.

108. (c)

$$CH_3\,CH_2\,OH + Cl_2 \xrightarrow{-2HCl} \underset{X}{CH_3\,CHO}$$

$$\text{Acetaldehyde} \xrightarrow[-3HCl]{3Cl_2} \underset{\text{chloral}}{\underset{Y}{CCl_3\,CHO}}$$

109. (c)

$$\text{I.}\quad \begin{matrix} CH_3COO \\ CH_3COO \end{matrix}\!\!>Ca \xrightarrow[-CaCO_3]{\Delta} CH_3COCH_3$$

$$\text{II.}\quad CH_3COOH \longrightarrow 6HI \xrightarrow{\text{Red P}} CH_3CH_3 + 3I_2 + 2H_2O$$

$$\text{III.}\quad \begin{matrix} CH_3CO|OH \\ CH_3COO|H \end{matrix} \xrightarrow{\Delta,\, P_4O_{10}} \begin{matrix} CH_3CO \\ CH_3CO \end{matrix}\!\!>O + H_2O$$

110. (b)

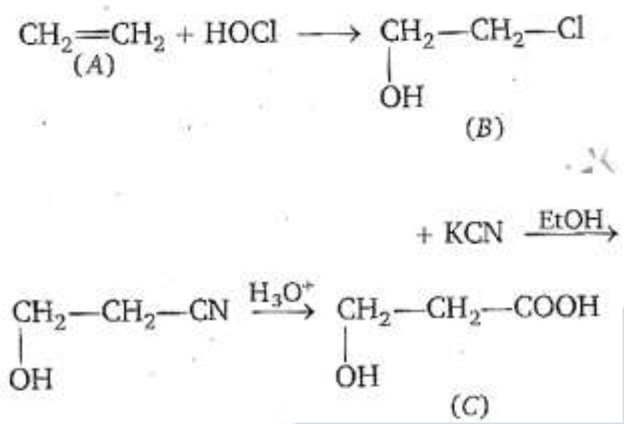
$$C = 85.71\% \quad = \frac{85.71}{12} = 7.14; \quad \frac{7.14}{7.14} = 1$$

$$H = 14.29\% \quad = \frac{14.29}{1} = 14.29; \quad \frac{14.29}{7.14} = 2$$

$\therefore$ Empirical formula $= CH_2$
And, empirical formula weight $= 12 + 2 = 14$
Again, molecular formula weight

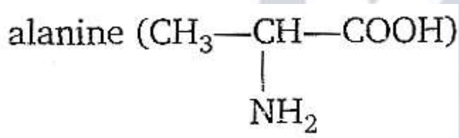
$$= 2 \times \text{ vapour density}$$
$$= 2 \times 14 = 28$$
$$\therefore n \quad = \frac{28}{14} = 2$$

Molecular formula $= CH_{22} = C_2H_4$

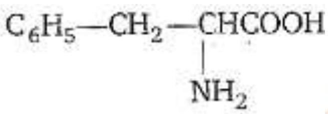


111. **(c)** Tripeptides are amino acids polymers in which three individual amino acid units, called residues, are linked together by amide bonds.

In these, an amine group "from one residue forms an amide bond with the carboxyl group of a second residue, the amino group of the second forms an amide bond with the carboxyl group of the third.
Therefore, glycine $(NH_2 - CH_2 - COOH)$,



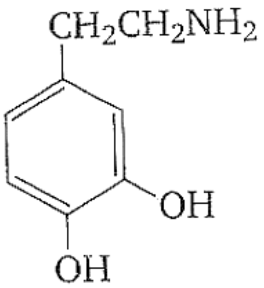
and phenyil alanine



can be linked in six different ways.

112. **(d)** A codon is a specific sequence of three adjacent bases on a strand of DNA or RNA that provides genetic code information for a particular amino acid.

113. **(c)** Dopamine is produced in several areas of the brain. If the amount of dopamine increases in the brain, the patient may be affected with Parkinson's/ disease. The IUPAC name of dopamine is 2-(3, 4-dihydroxyphenyl) ethylamine and its structure is as follows:



114. **(a)** Freezing point of a substance is the temperature at which the solid and the liquid forms" of the substance are in equilibrium."

If a non-volatile solute is added to the solvent, there is" decrease

in vapour pressure of the solution and thus the freezing point of the solution is less than that of pure solvent. It is called depression in freezing point.

115. **(b)**

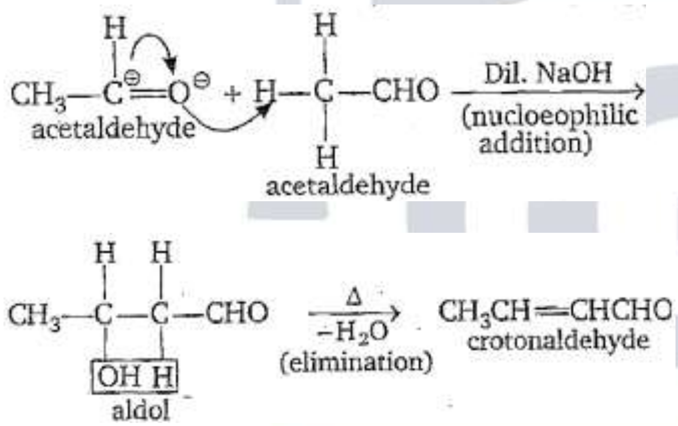
$$C_2H_5{-}Cl + AgCN \xrightarrow[H_2O]{EtOH/} C_2H_5{-}NC + AgCl$$

$\Downarrow$

N-linked to ethyl carbon

116. **(a)**

117. **(d)** Crotonaldehyde is produced by the aldol condensation of acetaldehyde-



118. **(b)**

$$BaCl_2 + 2NaOH \rightarrow Ba(OH)_2 + 2NaCl$$
$$\lambda^0 mBaOH_2 = \lambda_{mBaCl_2} + 2\lambda^{\infty}_{mNaCl}$$
$$= 280 \times 10^{-4} + 2 \times 248 \times 10^{-4}$$
$$-2 \times 126 \times 10^{-4}$$
$$= (280 + 496 - 252) \times 10^{-4}$$
$$= 524 \times 10^{-4} Sm^2\ mol^{-1}$$

119. **(b)** Density, $d = \frac{Mz}{N_0 a^3}$

where, Z = number of atoms in unit cell

$$\therefore\ Z=\frac{dN_0a^3}{M}$$
$$=\frac{8.92\times6.023\times10^{23}\times362\times10^{-10^3}}{63.55}$$
$$=4.0$$

Thus, metal has face centred unit cell.

120. (c)

$$N_2+2O_2\rightleftharpoons2NO_2$$
$$K_1=\frac{{NO_2}^2}{N_2{O_2}^2}$$

or $100=\frac{{NO_2}^2}{N_2{O_2}^2}$

Again, $NO_2\rightleftharpoons\frac{1}{2}N_2+O_2$

$$K_2=\frac{{N_2}^{1/2}O_2}{NO_2}$$

or $K_2^2=\frac{N_2{O_2}^2}{{NO_2}^2}$

eqs. (i) x (ii), we get

$100\times K_2^2=1$

or $K_2^2=\frac{1}{100}$ or $K_2=\frac{1}{10}=0.1$

121. (c)

For a first order reaction,

$$t=\frac{2.303}{\lambda}\log_{10}\frac{a}{a-x}$$

Let initial amount of reactant is 100 .

$$\frac{t_1}{t_2}=\frac{\log100/\underline{100-75}}{\log\frac{100}{\underline{100-25}}}$$

$\because\ \lambda$ remains constant

$$=\frac{\log\frac{100}{25}}{\log\frac{100}{75}}=\frac{\log4}{\log4/3}$$
$$=\frac{\log4}{\log4-\log3}$$
$$=\frac{2\times0.3010}{2\times0.3010-0.4771}$$

122. (c)

$$a = \frac{a_{\text{observed}}}{l \times C} = \frac{-1.2}{5 \times \frac{6.15}{1000}} = -39°$$

123. **(b)** Let me concentration or potassium acetate is x.
From Henderson's equation,

$$\mathrm{pH} = \mathrm{pK_a} + \log\frac{\text{salt}}{\text{acid}}$$
$$4.8 = -\log 1.\bar{8} \times 10^{-5} + \log\frac{x \times 50}{20 \times 0.1\mathrm{M}}$$
$$4.8 = 4.74 + \log 25x$$

or $\log 25x = 0.06$
$25x = 1.148$
$x = 0.045\mathrm{M}$

124. **(b)**

By ' $2A + \frac{c}{2} - B'$, we get

$$\mathrm{Na_2O + SO_3 \rightarrow Na_2SO_4};$$
$$\Delta\mathrm{H} = -2 \times 146 + \frac{259}{2} - 418$$
$$\text{or } \Delta\mathrm{H} = -580.5 \approx 581 \text{ kJ}$$

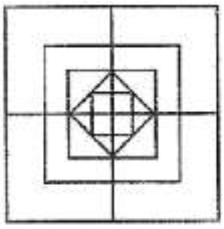
125. **(b)** $As_2\ S_3$ is a negative sol. It is obvious that cations are effective in coagulating negative sols. According to Hardy Schulze rule, greater the valency of the coagulating ion, greater is its coagulating power. Thus, out of the given, $AlCl_3(Al^{3+})$ is most effective for causing coagulation of $As_2\ S_3$ sol.
126. **(a)**
127. **(d)**
128. **(c)**
129. **(d)**
130. **(b)**
131. **(b)**
132. **(a)**
133. **(d)**
134. **(b)**
135. **(b)**
136. **(a)**
137. **(c)**
138. **(b)**
139. **(c)**
140. **(a)**
141. **(d)** From problem figure (1) to (2), double figure is converted into single figure and vice-versa. Also, figures change place in a set order. Hence, answer figure (d) will replace the sign?
142. **(d)** 'Nurse' receives instructions from 'Doftor' and 'Follower' receives instructions from 'Leader'.
143. **(b)**

$24 \times 2 + 4 = 52$
$52 \times 2 + 4 = 108$
$108 \times 2 + 4 = 220$
$220 \times 2 + 4 = 444$

and so on. Hence, number 112 is wrong and should be replaced by 108

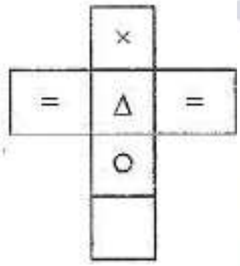
144. **(b)** Only I and III are implicit because in the relief camp the facilities of food, water and shelter are available.

145. **(b)** It is clear that answer figure (b) completes the original figure, which looks like as shown in the adjacent figure hence alternative (b) is the correct answer.



146. **(b)** Clearly figure (x) is embedded in alternative figure (b). The portion which figure (x) occupies in the alternative figure has been shown in the adjacent figure. Hence, the correct answer figure is - (b),

147. **(d)** Symbol appearing on the faces of dice can be shown as given in the figure.'We see from the figure that symbol o will appear on the opposite face symbol x.



148. **(b)** Figure X is the first step in which a circular piece of paper is folded from upper to the lower half along the diameter. In figure Y both the extreme ends of the figure X have been folded to form a triangle and then as given in figure Z, a cut has been marked from the right side. It is clear that this cut will result into two marks, one in the lower half and one in the upper half of the paper, when it will be unfolded. Answer figure (b) represents the correct design of the unfolded paper and hence, is the correct answer.

149. **(a)**

150. **(c)** Converting alphabets into mathematical symbols as- given above, we get

$$18 \times 1274 + 5 - 6$$
$$= 18 \times \frac{12}{4} + 5 - 6$$
$$= 18 \times 3 + 5 - 6$$
$$= 54 + 5 - 6$$
$$= 59 - 6 = 53$$