15. for t = 0

$x = A \sin \phi$ .... (1)

$v = A\omega \cos \phi$ ....(2)

$a = -A\omega^2 \sin\phi$ ....(3)

By (1) and (3)

$$\omega = \sqrt{-\frac{a}{x}} = \sqrt{-\frac{32 m/s^2}{-0.08 m}} = 20 \text{ rad/s}$$

By (1) and (2)

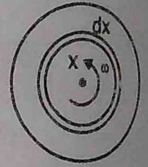
$$\frac{x}{v} = \frac{\tan\phi}{\omega} \Rightarrow \tan\phi = 1$$

$$\text{or } \phi = \frac{\pi}{4} \text{ or } \frac{5\pi}{4}$$

At t = 0 , x is negative hence $\phi = \frac{5\pi}{4}$

from (1), $A = \frac{x}{\sin\phi} = 0.08 \times \sqrt{2}\text{ m} = 11.3 \text{ cm}$

16. Consider a ring of radius x and thickness dx.



Equivalent current in this ring $= \frac{\omega}{2\pi} \times$ charge on ring $= \frac{\omega}{2\pi} \times (2\pi x\, dx)\frac{Q}{\pi R^2}$

dB (due to this ring) $= \frac{\mu_0}{2x}\left(\frac{\omega}{2\pi}\frac{2xQ}{R^2}dx\right)$ $\therefore B = \int_0^R \frac{\mu_0\omega}{2\pi}\frac{Q}{R^2}dx. = \frac{\mu_0\omega\theta}{2\pi R^2}. R = \frac{\mu_0\omega\theta}{2\pi R}.$

17. $\lambda' = \frac{V - V_s}{f} = \frac{332-32}{1000} = 0.3 \text{ m}$

$$f' = f\frac{(V+V_0)}{V-V_s} = 1000 \times \frac{332+64}{332-32} = 1320 \text{ Hz}$$

$$\lambda'' = \frac{V-V_0}{f'} = 0.2 \text{ m.}$$

18. $d \sin\theta = \lambda$

For first bright fringe. (There will be one bright fringe on both sides of central bright fringe and both are called first bright fringe.)

$$\sin\theta = \frac{\lambda}{d} \le 1 \quad \Rightarrow d \ge \lambda.$$

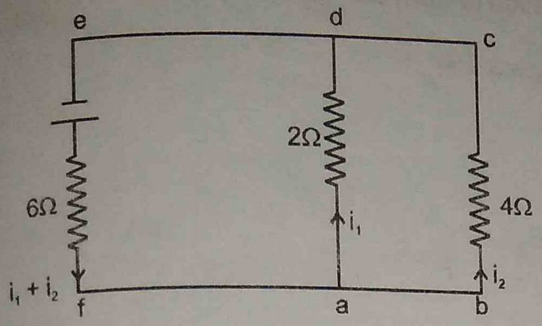
If $d = 2\lambda$, two maxima will be formed.

19. (A) When switch S_1 is closed and S_2 is opend 5×10^{-7} A current will flow, d to a.

(B) $I = \frac{\varepsilon}{R} = \frac{d\phi/dt}{R} = \frac{A(dB/dt)}{R} = \frac{10\times10^{-3}\times2\times1\times10^{-4}}{6} = 3.33 \times 10^{-7}$A, d to a

(C) When both S_1 and S_2 are either open or closed; current through ad is zero.

(D) When both S_1 and S_2 are closed then equivalent circuit will like shown below.



By applying KVL in both loops we gets $i_1 = 9.09 \times 10^{-8}$ A.

20. (A) $T = 2\pi\sqrt{\frac{m}{k}}$ $\quad m\uparrow \quad T\uparrow$

$E = \frac{1}{2}kA^2$

(B) $E = \frac{1}{2}kA^2$ $\quad A\uparrow \quad T\uparrow$

(C) $T = 2\pi\sqrt{\frac{m}{k}}$ $\quad k\uparrow \quad T\downarrow$

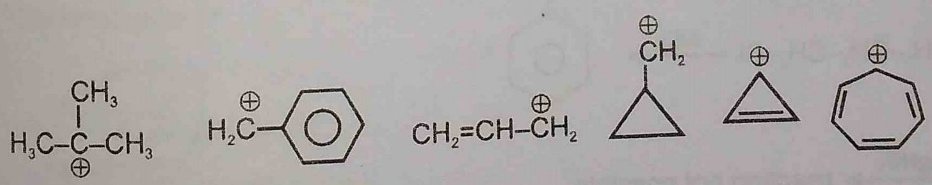
$E = \frac{1}{2}kA^2$ $\quad k\uparrow \quad E\uparrow$

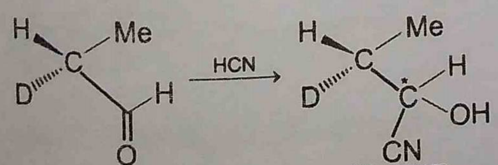
(D) $T = 2\pi\sqrt{\frac{m}{k_{eq}}}$ $\quad k_{eq}\uparrow \quad T\downarrow$

$k_{eq} = 2k$

$E = \frac{1}{2}k_{eq}A^2$ $\quad k_{eq}\uparrow \quad T\uparrow$

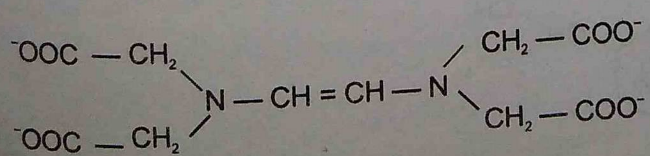
PART-II (CHEMISTRY)

21. 

22. 

2 isomers
(Diastereomess)

23. O=C=C=C=O (4σ and 4π bonds)
Sum = 4 + 4 = 8

24. 

25. 2 vacant orbitals per molecule participate in hybridisation (1 from each B atom).

$\therefore$ total number of vacant orbitals = $\dfrac{5600}{28 \times 100} \times 2 \times N_A = 4 \times N_A$.

So, X = 4.

26. $E = 13.6\left(\dfrac{2^2}{n_1^2}\right) + KE_1$ and $E = 13.6\left(\dfrac{3^2}{n_2^2}\right) + KE_2$

Given : $KE_1 - KE_2 = \pm\ 2.55 = \pm\ 13.6\left(\dfrac{1}{2^2} - \dfrac{1}{4^2}\right)$

on solving 2 equations,

$|n_2 - n_1| = 8$ or 2

27. **a, b, d, f**

28. $nC_6H_5OH \longrightarrow (C_6H_5OH)_n$

$i = 1 + \left(\dfrac{1}{n} - 1\right)\beta$

$\beta = 100\%, \quad \therefore \beta = 1$

$\Delta T_f = \dfrac{1000 \times K_f \times w_1}{m_1 \times w_2} \times i$

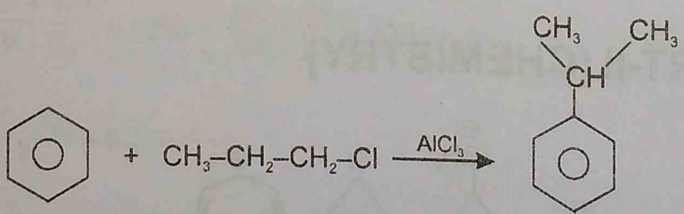
$0.93 = \dfrac{1000 \times 1.86 \times 9.4 \times i}{94 \times 100}$

$i = \dfrac{1}{2}$

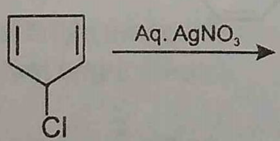
$n = 2$

29. $LiAlH_4$ is strong reducing agent than the $NaBH_4$. $NaBH_4$ cannot reduce ester functional group.

30. (A)

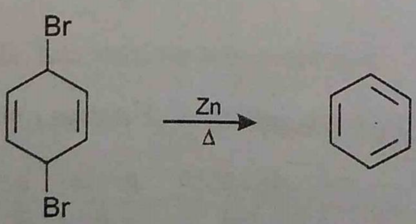


(B)

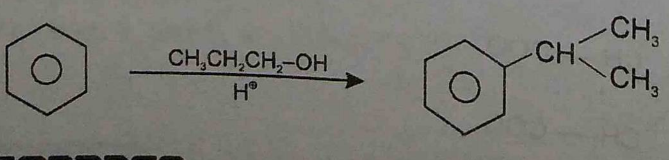


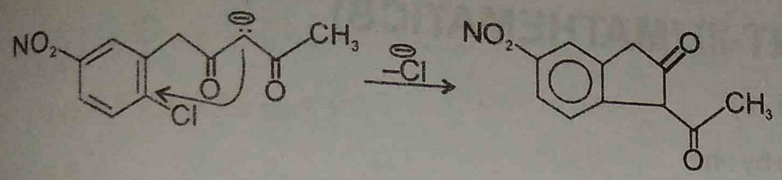
reaction not possible.

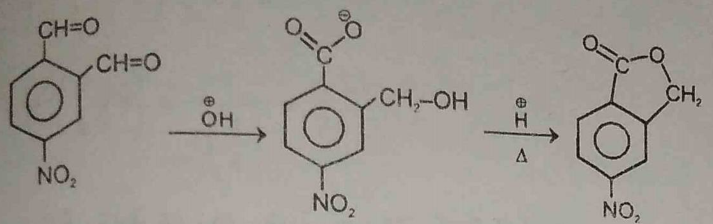
(C)

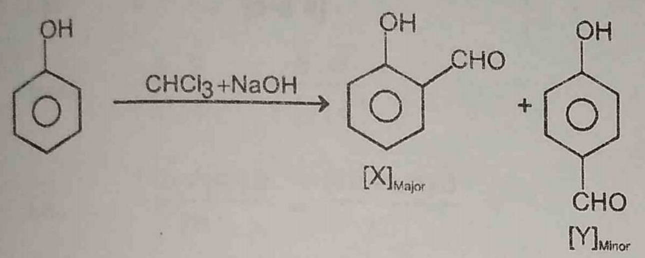


(D)



31. 

32. 

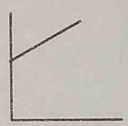
33. 

34. $_{24}Cr = [Ar]^{18}\ 3d^5 4s^1$; $_{25}Mn = [Ar]^{18}\ 3d^5 4s^2$

$^{25}Cu = [Ar]^{18}\ 3d^{10}\ 4s^1$; $_{30}Zn = [Ar]^{18} 3d^{10}\ 4s^2$.

37. $2A \longrightarrow$ Product

$$\frac{1}{[A]_t} - \frac{1}{[A]_0} = kt$$



Slope (ढाल) = k

Intercept (अंत:खण्ड) = $\frac{1}{[A]_0}$

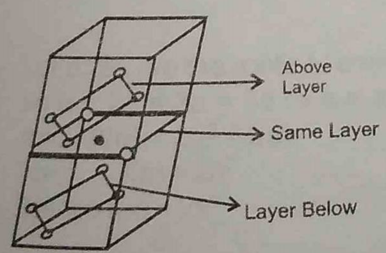
$$\frac{1}{[A]_t} = \frac{1}{[A]_0} + kt$$

38 Fcc can be viewed in two following ways -

(i) Planes along the faces (and parallel to it) of the unit cell.

$\Rightarrow$ Each atom touches 4 in same layer, 4 in layer above and 4 in layer bellow it.

(ii) Planes along closest packed spheres $\rightarrow$ each atom touches 6 atom in same layer, 3 in layer above and 3 in layer below it.



39. (A) $CuFeS_2$; $Cu_2S + 2\,Cu_2O \longrightarrow 6\,Cu + SO_2$; $Cu_2O + C \longrightarrow 2\,Cu + CO$

(B) PbS ; $PbS + 2PbO \longrightarrow 3Pb + SO_2$; $PbO + C \longrightarrow Pb + CO$; $PbO + CO \rightarrow Pb + CO_2$

(C) Ag_2S; Cyanide process, leaching with alkali metal cyanide followed by displacement with zinc dust.

(D) $CuCO_3.\ Cu(OH)_2$; Calcination $\longrightarrow CuO + C \longrightarrow Cu + CO$

PART-III (MATHEMATICS)

41. Let $\vec{d} = x(\vec{b}\times\vec{c}) + y(\vec{c}\times\vec{a}) + z(\vec{a}\times\vec{b})$

Take dot product with $\vec{a}$, $\vec{b}$, $\vec{c}$ one by one

$\vec{a}.\vec{d} = x[\vec{a}\,\vec{b}\,\vec{c}] + 0 + 0 \quad \therefore \; x = \dfrac{\vec{a}.\vec{d}}{[\vec{a}\,\vec{b}\,\vec{c}]}$

Similarly $y = \dfrac{\vec{b}.\vec{d}}{[\vec{a}\,\vec{b}\,\vec{c}]}$, $z = \dfrac{\vec{c}.\vec{d}}{[\vec{a}\,\vec{b}\,\vec{c}]}$

$\therefore \; \vec{d} = \dfrac{(\vec{a}.\vec{b})(\vec{b}\times\vec{c}) + (\vec{b}.\vec{d})(\vec{c}\times\vec{a}) + (\vec{c}.\vec{d})(\vec{a}\times\vec{b})}{[\vec{a}\,\vec{b}\,\vec{c}]} \qquad \therefore \; \left|\dfrac{(\vec{a}.\vec{d})(\vec{b}\times\vec{c}) + (\vec{b}.\vec{d})(\vec{c}\times\vec{a}) + (\vec{c}.\vec{d})(\vec{a}\times\vec{b})}{[\vec{a}\,\vec{b}\,\vec{c}]}\right| = 1$

42. $p = \sin(px - y) \Rightarrow px - y = \sin^{-1}p$ ....(i)

differentiate w.r.t. $x \Rightarrow x\dfrac{dp}{dx} = \dfrac{1}{\sqrt{1-p^2}}\dfrac{dp}{dx}$

$\Rightarrow \dfrac{dp}{dx} = 0$ or $\dfrac{1}{\sqrt{1-p^2}} = x \Rightarrow p = \dfrac{\sqrt{x^2-1}}{x}$ put in equation (i)

$y = \sqrt{x^2-1} - \sin^{-1}\dfrac{\sqrt{x^2-1}}{x}$

$a = 1, b = 1, c = 1$

43. Now $\left(\dfrac{\cos\alpha}{\sin\alpha} + \dfrac{\cos(\alpha+\beta)}{\sin(\alpha+\beta)}\right)\left(\dfrac{\cos\beta}{\sin\beta} - \dfrac{3\cos(2\alpha+\beta)}{\sin(2\alpha+\beta)}\right)$

$= \dfrac{\sin(2\alpha+\beta)}{\sin\alpha\sin(\alpha+\beta)}\left(\dfrac{\cos\beta}{\sin\beta} - \dfrac{3\cos(2\alpha+\beta)}{3\sin\beta}\right) = \dfrac{3\sin\beta}{\sin\alpha\sin(\alpha+\beta)}\,\dfrac{\cos\beta - \cos(2\alpha+\beta)}{\sin\beta} = \dfrac{3(2\sin(\alpha+\beta).\sin\alpha)}{\sin\alpha\sin(\alpha+\beta)} = 6$

44. $\tan^{-1}\left(\dfrac{p-q}{1+pq}\right) = \tan^{-1}p - \tan^{-1}q$ (since $p, q > 0$) ....(1)

now $pr < -1$ and $p > 0$ so $r < 0$

Let $r = -t$ $\tan^{-1}\left(\dfrac{r-p}{1+rp}\right) = -\tan^{-1}\left(\dfrac{t+p}{1+tp}\right)$ $\qquad rp < -1$

$tp > 1$

$-[-\pi + \tan^{-1}t + \tan^{-1}p]$

$\pi - \tan^{-1}p + \tan^{-1}r$ ....(2)

$\tan^{-1}\left(\dfrac{q-r}{1+qr}\right)$ (since $qr > -1$, $qt < 1$) $r < 0$, $r = -t$

$= \tan^{-1}\left(\dfrac{q+t}{1-qt}\right) = \tan^{-1}q + \tan^{-1}t$ $\qquad qt < 1$

$= \tan^{-1}q - \tan^{-1}r$ ....(3)

from (1), (2) and (3)

$n = 2$

45. $f\left(\frac{\pi}{4}\right) = \frac{\pi}{4} + 1$

$f'(x) = 1 + 3\tan^2 x \sec^2 x$

$f'\left(\frac{\pi}{4}\right) = 1 + 3 \times 2 = 7$

$$g'\left(\frac{\pi}{4}+1\right) = \frac{1}{f'\left(\frac{\pi}{4}\right)} = \frac{1}{7}$$

46. Let $\vec{a} = \lambda\vec{b} + \mu\vec{c}$

then $\frac{\vec{a}.\vec{b}}{|\vec{a}||\vec{b}|} = \frac{\vec{a}.\vec{d}}{|\vec{a}||\vec{d}|}$

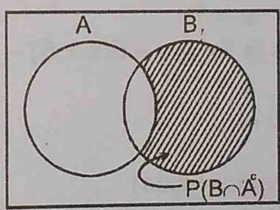
i.e. $\frac{(\lambda\vec{b}+\mu\vec{c}).\vec{b}}{|\vec{b}|} = \frac{(\lambda\vec{b}+\mu\vec{c}).\vec{d}}{|\vec{d}|}$

i.e. $\frac{[\lambda(2\hat{i}+\hat{j})+\mu(\hat{i}-\hat{j}+\hat{k})].(2\hat{i}+\hat{j})}{\sqrt{5}} = \frac{[\lambda(2\hat{i}+\hat{j})+\mu(\hat{i}-\hat{j}+\hat{k})].(\hat{j}+2\hat{k})}{\sqrt{5}}$

i.e. $\lambda(4+1) + \mu(2-1) = \lambda(1) + \mu(-1+2)$ i.e. $4l = 0$ i.e. $l = 0$

$\therefore$ $\hat{a} = \frac{\hat{i}-\hat{j}+\hat{k}}{\sqrt{3}}$

47. $P(A) = \frac{1}{4}$, $P(A \cup B) = \frac{1}{2}$



$P\left(\frac{B}{A^C}\right) = \frac{P(B \cap A^C)}{P(A^C)}$

$= \frac{P(A \cup B) - P(A)}{1 - P(A)} = \frac{\frac{1}{2}-\frac{1}{4}}{1-\frac{1}{4}} = \frac{1}{4} \cdot \frac{4}{3} = \frac{1}{3}$.

48. Let α, 2α are the roots of equation
so $\alpha + 2\alpha = 3\alpha = 3a \Rightarrow \alpha = a$
and $\alpha(2\alpha) = 2\alpha^2 = f(a)$
$\Rightarrow$ $f(a) = 2a^2$
Hence $f(x) = 2x^2$

49. $x + y + z - 1 = 0$
$4x + y - 2z + 2 = 0$
$\therefore$ direction ratios of the line are <–3, 6, –3>
i.e. <1, – 2, 1>
Let $z = k$, then $x = k - 1$, $y = 2 - 2k$
i.e. $(k - 1, 2 - 2k, k)$ is any point on the line
$\therefore$ $(-1, 2, 0)$, $(0, 0, 1)$ and $\left(-\frac{1}{2}, 1, \frac{1}{2}\right)$ are points on the line
$\therefore$ (A), (B) and (C) are correct options

50. $1 + |\cos x| + \cos^2 x$ ....

$= \frac{1}{1-|\cos x|}$ $\Rightarrow$ $8^{\frac{1}{1-|\cos x|}} = 4^3$

$\Rightarrow$ $2^{\frac{3}{1-|\cos x|}} = 2^6$ $\Rightarrow$ $\frac{3}{1-|\cos x|} = 6$ $\Rightarrow$ $1 - |\cos x| = \frac{1}{2}$

$|\cos x| = \frac{1}{2}$ $\Rightarrow$ $\cos x = \pm\frac{1}{2}$

$\cos x = \frac{1}{2}$ will give least positive value of x

$x = \frac{\pi}{3}$

51. All AAAAA BBB D EEF can be arranged in $\frac{12!}{5!\,3!\,2!}$

Between the gaps c can be arranged in ${}^{13}c_3$ ways

Total ways = ${}^{13}c_3 \times \frac{12!}{5! \times 3! \times 2!}$

Number of ways = without concidering separation of C – in which all C's are together – in which exactly two C's are together = $\frac{15!}{5!(3!)^2 2!} - \frac{13!}{5!\,3!\,2!} - \frac{12!}{5!\,3!}\,{}^{13}C_2$

52. Coordinates of O are (5, 3) and radius = 2
Equation of tangent at A(7, 3) is $7x + 3y - 5(x + 7) - 3(y + 3) + 30 = 0$
i.e. $2x - 14 = 0$ i.e. $x = 7$
Equation of tangent at B(5, 1) is $5x + y - 5(x + 5) - 3(y + 1) + 30 = 0$
i.e. $-2y + 2 = 0$ i.e. $y = 1$
$\therefore$ coordinate of C are (7, 1)
$\therefore$ area of OACB = 4
Equation of AB is $x - y = 4$ (radical axis)
Equation of the smallest circle is
$(x - 7)(x - 5) + (y - 3)(y - 1) = 0$
i.e. $x^2 + y^2 - 12x - 4y + 38 = 0$

53. $L.R. = \frac{2b^2}{a} = \frac{2\cos^2\alpha}{\cot\alpha} = \frac{1}{2}$

$\Rightarrow$ $\sin 2\alpha = \frac{1}{2}$ $\Rightarrow$ $2\alpha = \frac{\pi}{6}, \frac{5\pi}{6}$ $\Rightarrow$ $\alpha = \frac{\pi}{12}, \frac{5\pi}{12}$

54. $\cot\frac{A}{2} + \cot\frac{B}{2} + \cot\frac{C}{2} = \frac{s(s-a)}{\Delta} + \frac{s(s-b)}{\Delta} + \frac{s(s-c)}{\Delta}$

$= \frac{s}{\Delta}[3s - (a + b + c)] = \frac{s[3s-2s]}{\Delta} = \frac{s^2}{\Delta}$

$= \left(\frac{a+b+c}{2}\right)^2 \times \frac{4R}{abc} = \frac{(a+b+c)^2 R}{abc}$ $\left[\because \Delta = \frac{abc}{4R}\right]$ and $\frac{s^2}{\Delta} = \frac{\Delta^2}{r^2\Delta} = \frac{\Delta}{r^2}$

55. Since $\frac{e}{2}$ and $\frac{e'}{2}$ are eccentricities of a hyperbola and its conjugate

$\therefore \quad \frac{4}{e^2} + \frac{4}{e'^2} = 1 \qquad$ i.e. $\quad 4 = \frac{e^2 e'^2}{e^2 + e'^2}$

line passing through the points (e, 0) and (0, e′)

$e'x + ey - ee' = 0$

it is tangent to the circle $x^2 + y^2 = r^2$

$\therefore \quad \frac{ee'}{\sqrt{e^2 + e'^2}} = r \qquad \therefore \quad r^2 = \frac{e^2 e'^2}{e^2 + e'^2} = 4 \qquad \therefore \quad r = 2$

56. $(B^T AB)^T = B^T A^T (B^T)^T = B^T A^T B$

$= B^T AB$ iff A is symmetric

$\therefore$ $B^T AB$ is symmetric iff A is symmetric

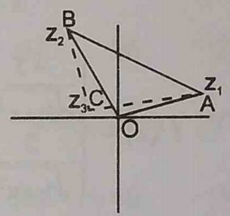
57. $\log_{\sin x} \frac{|x|}{x} \quad \Rightarrow \quad \sin x \in (0, 1)$ and $x \in (0, \infty)$

$\therefore \quad x \in \bigcup_{n \in W} \left(2n\pi, 2n\pi + \frac{\pi}{2}\right) \cup \left(2n\pi + \frac{\pi}{2}, (2n+1)\pi\right)$ and $y \in \{0\}$

exactly

58. $|z_2 + iz_1| = |z_1| + |z_2| \quad \Rightarrow \quad \text{Arg}(iz_1) = \text{Arg}(z_2)$

$\Rightarrow \quad \text{Arg}(z_2) - \text{Arg}(z_1) = \frac{\pi}{2}$



Let $\quad z_3 = \frac{z_2 - iz_1}{1 - i}$

$(1 - i)\, z_3 = z_2 - iz_1$

$\Rightarrow \quad (z_3 - z_2) = i\,(z_3 - z_1)$

$\Rightarrow \quad (z_2 - z_3) = i\,(z_1 - z_3)$

$\therefore \quad \angle ACB = \frac{\pi}{2}$ and $|z_2 - z_3| = |z_1 - z_3| \quad \Rightarrow \quad AC = BC$

$\because \quad AB^2 = AC^2 + BC^2 \quad \Rightarrow \quad AC = \frac{5}{\sqrt{2}}. \qquad (\because \quad AB = 5)$

$\therefore \quad \Delta ABC = \frac{1}{2} AC.BC = \frac{AC^2}{2} = \frac{25}{4}$ square unit

59. We have, $P(A \cap B) = P(A) . P(B) = \frac{1}{12}$

(A) $\quad P(A \cup B) = P(A) + P(B) - P(A \cap B) = \frac{1}{3} + \frac{1}{4} - \frac{1}{12} = \frac{1}{2}$

(B) $\quad P\left(\frac{A}{A \cup B}\right) = \frac{P(A)}{P(A \cup B)} = \frac{2}{3}$

(C) $\quad P\left(\frac{B}{A' \cap B'}\right) = \frac{P(B \cap (A' \cap B'))}{P(A' \cap B')} = \frac{P(\phi)}{P(A' \cap B')} = 0$

(D) $\quad P\left(\frac{A'}{B}\right) = P(A') = \frac{2}{3}$

60. P. Equation of the chord whose mid point is (0, 3) is

$$\frac{3y}{25}-1=\frac{9}{25}-1 \quad \text{i.e.} \quad y = 3$$

if intersects the ellipse $\frac{x^2}{16}+\frac{y^2}{25}=1$

at $\frac{x^2}{16}=1-\frac{9}{25}=\frac{16}{25} \Rightarrow x=\pm\frac{16}{5}$

$\therefore$ length of the chord $=\frac{32}{5}$

thus $\frac{4k}{5}=\frac{32}{5} \quad \therefore \quad k = 8$

Q. $f(x)=\cos^{-1}(4x^3-3x)=\cos^{-1}(\cos 3\theta)=\begin{cases} 3\theta &, 0<\theta<\frac{\pi}{3} \\ 2\pi-3\theta &, \frac{\pi}{3}<\theta<\frac{\pi}{2}\end{cases}$

$$=\begin{cases} 3\cos^{-1}x &, \frac{1}{2}<x<1 \\ 2\pi-3\cos^{-1}x &, 0<x<\frac{1}{2}\end{cases}$$

$\therefore \quad f'(x)=\begin{cases} \frac{-3}{\sqrt{1-x^2}} &, \frac{1}{2}<x<1 \\ \frac{3}{\sqrt{1-x^2}} &, 0<x<\frac{1}{2}\end{cases}$

$a=\lim\limits_{x\to\frac{1}{2}^+} f'(x)=-2\sqrt{3}$

$b=\lim\limits_{x\to\frac{1}{2}^-} f'(x)=2\sqrt{3} \quad \therefore \quad a+b+3=3$

R. $\log(-2x)=2\log(x+1)$

$-2x>0 \Rightarrow x<0$ .....(i)

$x+1>0 \Rightarrow x>-1$ .....(ii)

from (i) & (ii), we get $x\in(-1, 0)$

$\therefore \quad -2x=(x+1)^2 \Rightarrow x^2+4x+1=0 \Rightarrow x=\frac{-4\pm2\sqrt{3}}{2}$

so only one solution lies in (–1, 0)

S. Since (2, 3) lies on $ax+by-5=0 \quad \therefore \quad 2a+3b-5=0$

Slope of $ax+by-5=0 \Rightarrow \left(-\frac{a}{b}\right)=-1$ i.e. $a=b$

$\therefore \quad a=1, b=1$

$\therefore \quad |a+b|=2$

PRACTICE TEST - ONE

ANSWER KEY

PAPER - 2

PART-I (PHYSICS)

1.	(1)	2.	(1)	3.	(4)	4.	(8)	5.	(7)	6.	(2)	7.	4
8.	(3)	9.	(CD)	10.	(ABCD)	11.	(AC)	12.	(BC)	13.	(BC)	14.	(BCD)
15.	(BD)	16.	(CD)	17.	(A)	18.	(B)	19.	(ABCD)	20.	(AD)		

PART-II (CHEMISTRY)

21.	(6)	22.	(3)	23.	(4)	24.	(8)	25.	(5)	26.	(2)	27.	(4)
28.	(5)	29.	(AD)	30.	(BC)	31.	(ACD)	32.	(ABC)	33.	(ABCD)	34.	(ABC)
35.	(BD)	36.	(AC)	37.	(B)	38.	(D)	39.	(B)	40.	(A)		

PART-III (MATHEMATICS)

41.	(4)	42.	(3)	43.	(4)	44.	(8)	45.	(1)	46.	(3)	47.	(8)
48.	(8)	49.	(AB)	50.	(ABC)	51.	(AC)	52.	(AB)	53.	(AD)	54.	(AB)
55.	(BD)	56.	(AB)	57.	(B)	58.	(A)	59.	(D)	60.	(A)		

PRACTICE TEST - ONE
HINTS & SOLUTIONS
PAPER - 2

PART-I (PHYSICS)

1. For the first refraction image will be formed on object it self.
Now refraction at water air surface

$$\frac{\mu_2}{v} - \frac{\mu_1}{u} = 0 \quad \Rightarrow \quad v = 9 \text{ cm}$$

2. $$\omega = \sqrt{\frac{\mu g}{R}} = 1 \text{rad/sec}$$

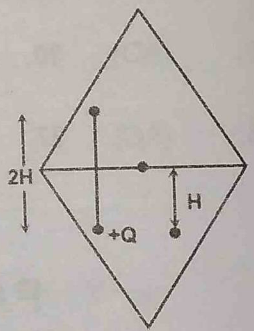
3. $$\frac{\Delta Q}{\Delta t} = K_A A \frac{dT}{dx}$$

$\frac{dT}{dx}$ in conductor A = slope of graph = $\frac{4}{3}$; $\frac{dT}{dx}$ in conductor B = slope of graph = 1

Since both conductors are connected in series, same heat current will flow in A and B.

$$120 \times \frac{4}{3} = 160$$

4. If we place another similar cone on this one, net flux = $\frac{Q}{\varepsilon_0}$



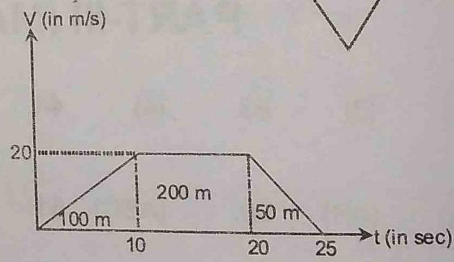
$$\Rightarrow \text{Flux with the upper cone} = \frac{Q}{\varepsilon_0} - \frac{3Q}{5\varepsilon_0} = \frac{2Q}{5\varepsilon_0} = \frac{8Q}{20\varepsilon_0}.$$

This must also be the flux associated with the lower cone when the charge is raised through a height 2H because of symmetry.

5. Accelerated of Lift

t = 0 to t = 10	2 m/s²
t = 10 to t = 20	zero
t = 20 to t = 25	–4 m/s²

V – t = curve



6. $$\tan\theta = \frac{a}{g} = \frac{h_2 - h_1}{h_2 \tan 45° + h_1 \tan 45°} = \frac{4\text{cm}}{20\text{cm}} \Rightarrow a = 2 \text{ m/s}^2$$

7. Let $\Delta\ell$ be the magnitude of contraction due to cooling by $T_1 - T_2 = 100°C$

$$\therefore \frac{\Delta\ell}{\ell} = \alpha (T_1 - T_2) \quad \text{.... (1)}$$

From condition of equilibrium

$$\frac{YA}{\ell}\Delta\ell = mg \quad \text{.... (2)}$$

From equation (1) and (2) we get

$YA\alpha(T_1 - T_2) = mg$

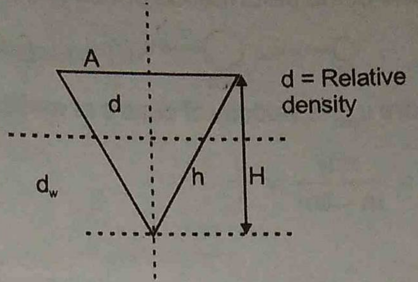
$$m = \frac{YA \ \alpha \ (T_1 - T_2)}{g}$$. Solving m = 4 kg Ans.

8. For floating condition buoyant force = weight

$$\frac{1}{3}A.\left(\frac{h}{H}\right)^2 h.d_w.g = \frac{1}{3}(AH)\,d_w.d.g$$

$$h = H(d)^{1/3} = 4\left(\frac{27}{64}\right)^{1/3} \qquad h = 3\text{ m}$$

Ans. 3



9.
$$\vec{E}_C = \frac{\rho\overrightarrow{OC}}{3\varepsilon_0} + \frac{-\rho\overrightarrow{BC}}{3\varepsilon_0} + \frac{Kq}{AC^3}\overrightarrow{AC}$$

$$\vec{E}_C = \frac{\rho\overrightarrow{OB}}{3\varepsilon_0} + \frac{Kq}{AC^3}\overrightarrow{AC}$$

Which is dependent on C hence field is non uniform inside cavity.

$$\vec{E}_A = 0 + \frac{\rho\overrightarrow{OA}}{3\varepsilon_0} + \frac{-\rho(R/2)^3}{3\varepsilon_0 R^2}.\hat{BA}$$

$$\vec{E}_A = \frac{\rho\overrightarrow{OA}}{3\varepsilon_0} - \frac{\rho R}{24\varepsilon_0 R}\overrightarrow{BA} = \frac{\rho}{3\varepsilon_0}\frac{R}{2}\hat{OA} - \frac{\rho}{24\varepsilon_0}R.\hat{OA}$$

$$\vec{E}_A = \left(\frac{\rho R}{6\varepsilon_0} - \frac{\rho R}{24\varepsilon_0 R}\right)\hat{OA} = \frac{\rho}{8\varepsilon_0}R.\hat{OA} = \frac{\rho 2\overrightarrow{OA}}{8\varepsilon_0} = \frac{\rho\overrightarrow{OA}}{4\varepsilon_0}$$

Similarly for $\vec{E}_B$ Hence C and D

10. Molecular wt. = 16 M_0 | Molecular wt. = M_0
mass = 2 m_0 | mass = m_0

$$n_A = \frac{n_0}{8} \qquad n_B = n_0$$

(A) K.E./atom = $\frac{f}{2}$k.T. = $\frac{f}{2}$k.T. for both the gases.

(B) $C_{rms_A} = \sqrt{\frac{3RT}{16M_0}}$, $C_{rms_B} = \sqrt{\frac{3RT}{M_0}}$, $(C_{rms})_B = 4\,(C_{rms})_A$

(C) $(P)_A = \frac{(n_0/8)RT}{V}$, $(P_B) = \frac{n_0 RT}{V}$, $(P_B) = 8\,(P_A)$

(D) $n_B = 8\,n_A$

11. The H-type atom is in the third excited state i.e. n = 4.

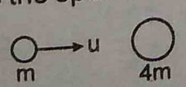
Energy corresponding to wave length $\frac{6200}{51}$ nm $= \frac{12400 \times 51}{62000} = 10.2$ eV

This is the $E_2 - E_1$ for H and $E_4 - E_2$ for He^+.

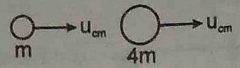
we get z = 2 for $4 \rightarrow 2$ radiation
Hence the atom is Helium ion.

Ans. He^+,

(b) Let u be the speed of neutron before collision



At end of the deformation phase (when the kinetic energy of (neutron + He^+) system is least)



Where u_{cm} is velocity of centre of mass. From conservation of momentum

$$u_{cm} = \frac{mu}{m+4m} = \frac{u}{5}$$

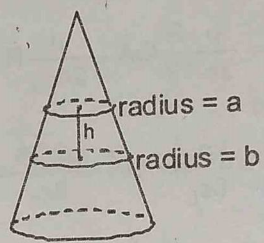
The loss of kinetic energy = $\frac{1}{2}mu^2 - \frac{1}{2}m\left(\frac{u}{5}\right)^2 - \frac{1}{2}4m\left(\frac{u}{5}\right)^2 = \frac{4}{5}\left(\frac{1}{2}mu^2\right)$

It K is the kinetic energy of electron then the maximum loss in K.E. of system is

$\frac{4}{5}K = 51$ eV or $K = \frac{51\times5}{4} = 63.75$ eV

$$K_{min} = \frac{255}{4} = \mathbf{63.75\ eV}$$

12. (A) initial acceleration of any point on circumference of ring is g cos θ
(B) initial acceleration of centre of ring is g sinθ cosθ



(C) $\tan\theta = \frac{b-a}{h}$

$h = (b-a)\cot\theta$

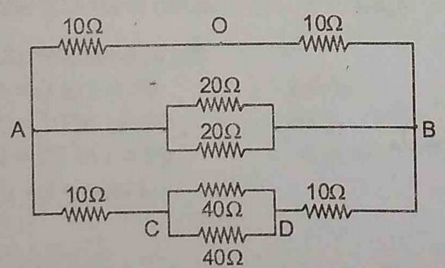
$$mg(b-a)\cot\theta = \frac{1}{2}k(2\pi b - 2\pi a)^2$$

$$mg(b-a)\cot\theta = \frac{1}{2}4\pi^2 k(b-a)^2$$

$$b - a = \frac{mg\cot\theta}{2\pi^2 k}$$

(D) at the moment maximum vertical displacement acceleration of centre of ring is upward.

13. Effective circuit



14. Initially potential and kinetic both energies zero and from conservation of mechanical energy total energy of the two object zero
Further, decrease in P.E. = increase in K.E.

$$\frac{G(m)(4m)}{r} = \frac{1}{2}\mu v_r^2$$

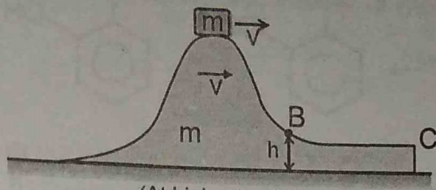
$$v_r = \sqrt{\frac{10Gm}{r}} \Rightarrow \text{Total K.E.} = \frac{G(m)(4m)}{r} = \frac{4Gm^2}{r}$$

15. Smaller the least count greater the precision.

Mean absolute error $|\Delta x| = \frac{\sum|x - x_i|}{N}$

16. The process is isothermal compression.

17. Let 'u' be the required minimum velocity. By momentum conservation :
$mu = (m + m)v \Rightarrow v = u/2.$



(At highest point)

Energy equation :

$$\frac{1}{2}mu^2 = \frac{1}{2}(2m)v^2 + mgH.$$

Substituting $v = u/2$:

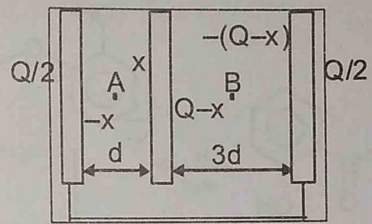
$$u = 2\sqrt{gH}$$

18. By work-energy theorem on the system :

$$-(\mu mg)(BE) - mgh = -\frac{1}{4}mu^2 = -\frac{1}{4}m(4\,gH) \Rightarrow BE = \frac{H-h}{\mu}$$

19. Field inside the conductor is zero

20. Since P.D between left and right plate is zero.



$$\frac{x}{A\epsilon_0}d = \frac{Q-x}{3A\epsilon_0} \times 3D$$

$$x = Q/2$$

PART-II (CHEMISTRY)

21.

CO_3^{2-}	: 1 or 2 donor oxygen atoms.
$NH_2-CH_2-COO^-$	: 1 nitrogen and 1 oxygen donor atoms.
EDTA	: 5 or 6 donor atoms (N and O).
$C_2O_4^{2-}$	: 2 donor oxygen atoms.
SO_4^{2-}	: 1 or 2 donor oxygen atoms.
$CH_3COCHCOCH_3^-$	: 2 donor oxygen atoms.
$CH_3C\equiv N$	: 1 donor nitrogen atom.
SCN^-	: Either 1 nitrogen atom or 1 sulphur atom.
DMG	: 2 donor nitrogen atoms.

22. Complex containing more number of 5 & 6 membered rings is more stable.

25. Given, $P_1 = P, V_1 = V, T_1 = T$

$$P_2 = P_2, V_2 = V - \frac{100/21}{100}V, T_2 = T \quad ; \quad P \times V = P_2 \times \left(V - \frac{100/21}{100}V\right)$$

$$P_2 = \frac{21}{20}P \quad ; \quad \Delta P = \frac{1}{20}P. \quad \% \text{ increase} = \frac{1}{20}\frac{P}{P} \times 100 = 5\% \text{ Ans.}$$

26. Since in acidic medium, A^{n+} is oxidesed to AO_3^-, the change in oxidation state from

$(+5)$ to $(+n) = 5 - n$

$\therefore$ Total number of electrons that have been given out uring oxidation of 2.68×10^{-3} moles of A^{n+}

$= 2.68 \times 10^{-3} \times (5 - n)$

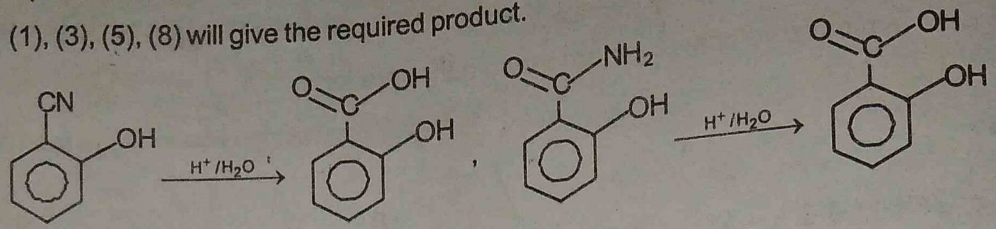
Thus the number of electrons added to reduce 1.61×10^{-3} moles of MnO_4^- to Mn^{2+}, i.e.,

$(+5)$ to $(+2)$ $= 1.61 \times 10^{-3} \times 5$

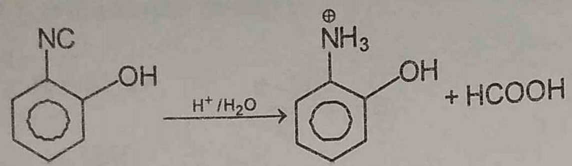
$\therefore$ $1.61 \times 10^{-3} \times 5 = 2.68 \times 10^{-3} \times (5 - n)$

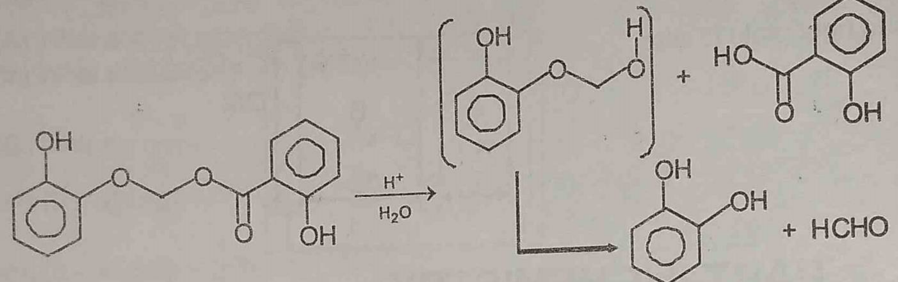
$$5 - n = \frac{1.61 \times 5}{2.68} \quad \text{or} \quad = 5\ \frac{8.05}{2.68} \approx 2$$

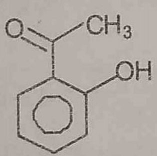
27. (1), (3), (5), (8) will give the required product.

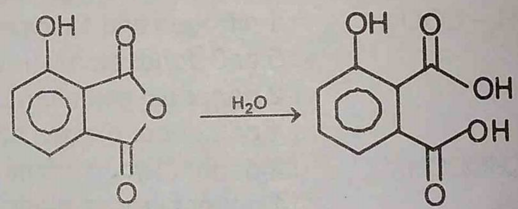


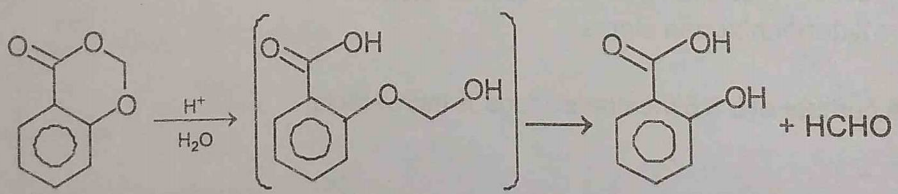
(—C≡N, $-\overset{O}{\overset{\|}{C}}-NH_2$, $-\overset{O}{\overset{\|}{C}}-\ddot{N}<$; all groups give $-\overset{O}{\overset{\|}{C}}-OH$ on acid hydrolysis)

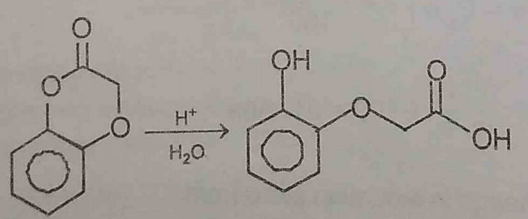






does not undergo any hydrolysis.






28. Compound (ii), (v), (vi), (vii), (viii), give CO_2 gas on heating.

30. (B) Aluminium hydroxide is a +ve sol, so – ve ions are effective in coagulation.
(C) Cellulose solution is an example of macromolecular colloid.

31. (A) Average velocity = 0, gas molecules are moving randomly
(B) All molecules do not have same speed there is maxwell distribution of molecular speeds.
(C) For an open container, $n_1T_1 = n_2T_2$; where n_1 and n_2 are number of mole of gas in the container at temperatures T_1 and T_2.

So, $n_2 = \frac{300}{400} \cdot n_1$

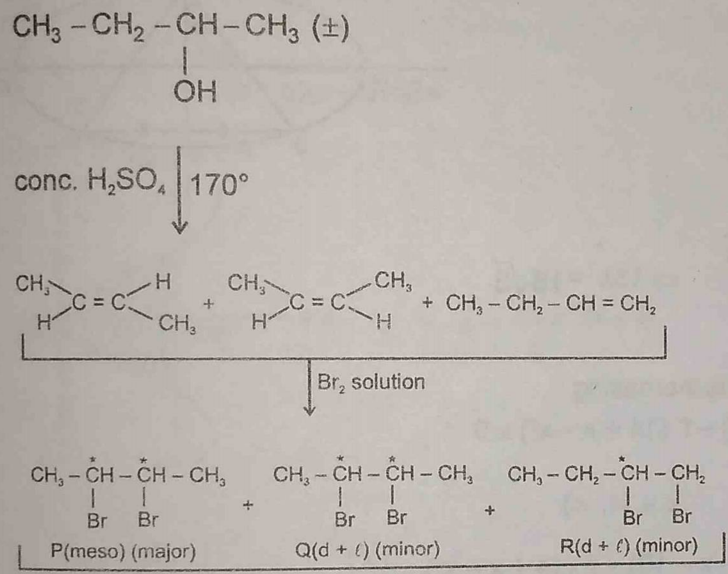
Hence fraction of gas that goes out = 1/4 of the original sample

(D) $Z = \frac{V_m,\text{real}}{V_m,\text{ideal}} = \frac{V_m,\text{real}}{(22.4L)}$ (at STP)

So, V_m. real < 22.4 L

32. (A) Tollen's reagent does not oxidise C = C
(B) Perkin reaction
(C) E-1cB Mechanism
(D) $KMnO_4$ oxidises both alkene and aldehyde.

33.



34. P & Q are tautomers similarly P & R are tautomers.
Q is more stable than R due to intramolecular hydrogen bonding.

36. (i) Bi ↓ (black) (ii) Ag_2CrO_4 ↓ (red) (iii) Bi_2S_3 ↓ (black)
(iv) $Fe_4[Fe(CN)_6]_3$ ↓ (Blue)

38. P must be $\boxed{\text{Ph–C(CH}_3\text{)=CH–Ph}}$

39. ΔH is positive as vaporisation is endothermic process.
ΔS is positive as liquid is changing to gas. ΔG is positive as process is non-spontaneous.

40. $\Delta G^\circ = -2.303\ RT \log K$.

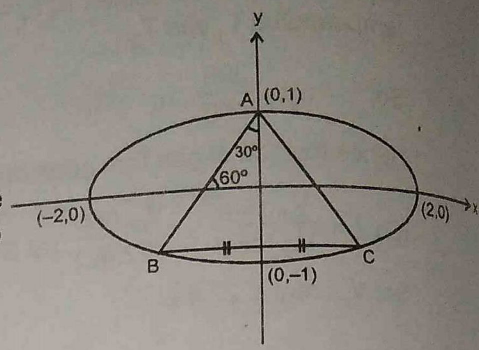
$-5.76 \times 1000 = -2.303 \times \frac{25}{3} \times 300 \log K$; $\log K = 1$

$K_p = 10$ atm. $K_p = P_{CO_2} = 10$ atm.

PART-III (MATHEMATICS)

41. Equation of ellipse is

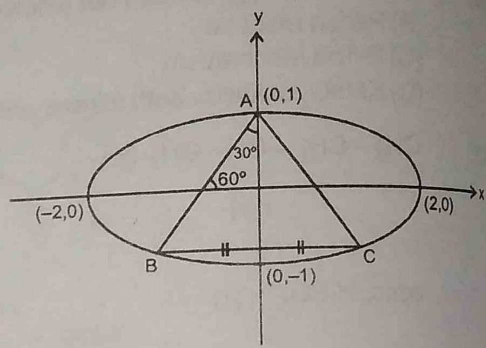
$\frac{x^2}{4} + \frac{y^2}{1} = 1$ ...(i)



Given that equation of altitude is x = 0 from A that means one side parallel to x-axis and given that length of the side is λ so triangle is equilateral.

Equation of AB will be $y = \sqrt{3}x + 1$ ...(ii)

Solving (i) and (ii)



$x = 0, -\frac{8\sqrt{3}}{13}$

$y = -\frac{24}{13} + 1 = -\frac{11}{13}, 1$

Coordinate of B = $\left(-\frac{8\sqrt{3}}{13}, -\frac{11}{13}\right)$

So, $\lambda = \sqrt{\frac{64 \times 3}{169} + \frac{24 \times 24}{169}} = \frac{16\sqrt{3}}{13}$ $\Rightarrow 13\lambda = 16\sqrt{3}$.

42. $\because$ $f''(x) > 0$ $\Rightarrow$ $f'(x)$ is increasing

Now $g'(x) = (2x - 1)\,[f'(x^2 - x - 10) - f'(14 + x - x^2) \geq 0$

Case-1 : $x \geq \frac{1}{2}$ and $x \geq 4$ $\Rightarrow$ $x \in [4, \infty)$

Case -2 $2x - 1 \leq 0$ and $f'(x^2 - x - 10) \leq f'(14 + x - x^2)$

$\Rightarrow$ $x \leq \frac{1}{2}$ and $-3 \leq x \leq 4$ $\Rightarrow$ $x \in \left[-3, \frac{1}{2}\right]$

43. If common ratio is 1 numbers are 111,222,...... , 999

If common ratio is 2(or $\frac{1}{2}$) numbers are 124, 248 (421, 842)

If common ratio is 3(or $\frac{1}{3}$) numbers are 139 (931)

If common ratio is $\frac{3}{2}$ (or $\frac{2}{3}$) numbers are 469 (964)

Hence total = 17

44. Total number of parts = number of point of intersection + 2

$= 2 \,.\, {}^nC_2 + 2$

$f(x) = n^2 - n + 2$

$f(3) = 8$

45. $|\overline{AB}|^2 + |\overline{CD}|^2 = 3^2 + 11^2 = 130 = 7^2 + 9^2 = |\overline{BC}|^2 + |\overline{DA}|^2$

$\overline{AB} + \overline{BC} + \overline{CD} + \overline{DA} = 0$ (As it will form a closed loop)

$|(\overline{DA})|^2 = |(\overline{AB} + \overline{BC} + (\overline{CD})|^2$

$|\overline{DA}|^2 = |\overline{AB}|^2 + |\overline{BC}|^2 + |\overline{CD}|^2 + 2(\overline{AB}.\overline{BC} + \overline{BC}.\overline{CD} + \overline{CD}.\overline{AB})$

$|\overline{DA}|^2 = |\overline{AB}|^2 - |\overline{BC}|^2 + |\overline{CD}|^2 + 2(\overline{BC}^2 + \overline{AB}.\overline{BC} + \overline{BC}.\overline{CD} + \overline{CD}.\overline{AB})$

$|\overline{DA}|^2 + |\overline{BC}|^2 = |\overline{AB}|^2 + |\overline{CD}|^2 + 2[(\overline{AB} + \overline{BC}).(\overline{BC} + \overline{CD})]$

$\overline{AC}.\overline{BD} = 0$

46. $I = (I - 3A)(I - \alpha A)$

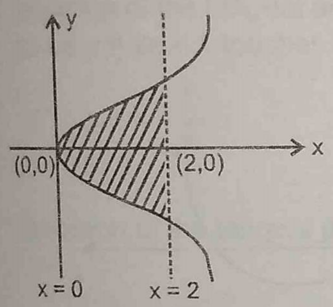
$\Rightarrow \quad I = I - \alpha A - 3A + 3\alpha A^2 \quad \Rightarrow \quad I = I + (2\alpha - 3)A \quad \Rightarrow \quad 2\alpha = 3$

47. $\log_2(a + b)(c + d) \geq 4 \Rightarrow (a + b)(c + d) \geq 16$

AM $\geq$ GM

$$\frac{a+b+c+d}{2} \geq \sqrt{(a+b)(c+d)} \geq 4$$

$\Rightarrow a + b + c + d \geq 8$

48. 

; $A = 2\int_0^2 x^3 dx = 8$

49. consider $\frac{2|x|}{|x-1|} - |x| = \frac{|x|^2}{|x-1|}$

i.e. $2 - |x - 1| = |x|$, $x = 0$

case-I $x < 0$, then

$2 + x - 1 = -x$ i.e. $x = -\frac{1}{2}$

case-II $0 \leq x < 1$

$2 + x - 1 = x$ (not possible)

case-III $x \geq 1$

$2 - x + 1 = x$ i.e. $x = \frac{3}{2}$

50. (A) ${}^{10+3-1}C_{3-1} = {}^{12}C_2$ = total number of terms

(B) coefficient of $a^8\, b\, c = \frac{10!}{8!\,1!\,1!} = 90$

(C) the term $a^4\, b^5\, c^3 \rightarrow$ does not exist

(D) coefficient of $a^4\, b^5\, c^1 = \frac{10!}{4!\,5!}$ etc.

Solutions (Practice Test - One)

51. $6a^2 + (7b - c)a - (3b^2 - 4bc + c^2) = 0$

$\Rightarrow$ $12a + 7b - c = \pm \sqrt{121b^2 + 25c^2 - 110bc}$

$\Rightarrow$ $12a + 7b - c = \pm (11b - 5c)$

$\Rightarrow$ $(3a - b + c) = 0$ or $(2a + 3b - c) = 0$

$\Rightarrow$ $(3, -1)$ or $(-2, -3)$ lies on the line $ax + by + c = 0$

52. Centre of circle is $\left(\frac{p}{2}, 0\right)$

Radius = p

Equation of circle is $\left(x - \frac{p}{2}\right)^2 + y^2 = p^2$ ... (1)

$y^2 = 2px$ ... (2)

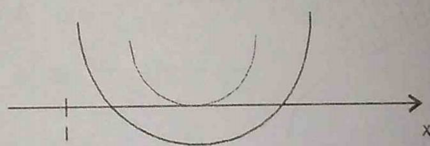
$\Rightarrow$ $x^2 + px = \frac{3p^2}{4}$ $\Rightarrow$ $4x^2 + 4px - 3p^2 = 0$

$\Rightarrow$ $x = \frac{p}{2}$ & $x = -\frac{3p}{2}$

$y^2 = p^2$ & $y^2 = -$ ve

$\Rightarrow$ $\left(\frac{p}{2}, p\right)$ and $\left(\frac{p}{2}, -p\right)$

53. $f(x) = 2x^2 + \lambda x - (\lambda + 1) = 0$

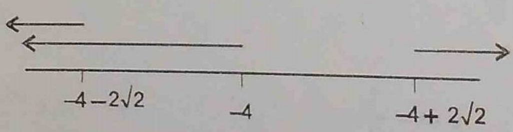


$D = \lambda^2 + 8(\lambda + 1) \geq 0$

$\lambda \in [-\infty, -4 - 2\sqrt{2}] \cup [-4 + 2\sqrt{2}, \infty]$ ....(1)

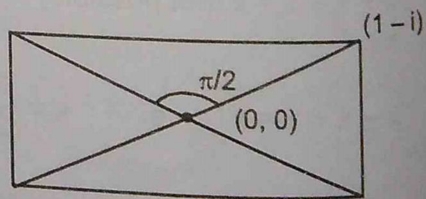
$\frac{-b}{2a} = \frac{-\lambda}{4} > 1$ $\Rightarrow$ $\lambda < -4$ ....(2)

$f(1) = 2 + \lambda - (\lambda + 1) > 0, \ \forall \ \lambda \in R$



So, $\lambda \in (-\infty, -4 - 2\sqrt{2}]$

54. Vertices are $(1 - i)e^{\pm i\pi/2}$



$(1 - i)(\pm i)$

So vertices ax $1 + i$ & $-1 - i$

55. we have $\cos^{-1}\frac{y}{\sqrt{1+y^2}} = \tan^{-1}\frac{1}{y}$

$\sin^{-1}\frac{3}{\sqrt{10}} = \tan^{-1}3$

$\therefore$ given equation $\equiv \tan^{-1}x + \tan^{-1}\frac{1}{y} = \tan^{-1}3$

$\Rightarrow \tan^{-1}\frac{1}{y} = \tan^{-1}\frac{3-x}{1+3x}$ $\Rightarrow \tan^{-1}\frac{1}{y} = \tan^{-1}\frac{3-x}{1+3x}$ $\Rightarrow y = \frac{1+3x}{3-x}$

$\because x, y \in N \;\; \therefore x = 1, 2$

$x = 1 \Rightarrow y = 2 \; ; \; x = 2 \Rightarrow y = 7$

56. $\because 1 + a.a > 0, \; \forall a \in R \quad \therefore R_1$ is reflexive

Let $(a, b) \in R_1$ s.t. $1 + ab > 0 \Rightarrow 1 + ba > 0 \;\; (\because ab = ba)$

$\Rightarrow (b, a) \in R_1 \Rightarrow R_1$ is symmetric

Now $\left(1, \frac{1}{2}\right) \in R_1$ & $\left(\frac{1}{2}, -1\right) \in R_1$ as $1 + (-1)\frac{1}{2} > 0$ & $1 - \frac{1}{2}1 > 0$

but $(1, -1) \notin R_1$ as $1 - 1.1 = 0$ not > 0

$\therefore R_1$ is not transitive

Sol. **57 to 58.**

Since no point of the parabola is below x-axis

$\therefore \quad a^2 - 4 \le 0$

$\therefore \quad$ maximum value of a is = 2

equation of the parabola, when a = 2 is $\quad y = x^2 + 2x + 1$

it intersects y-axis at (0, 1)

equation of the tangent at (0, 1) is $y = 2x + 1$

since $y = 2x + 1$ touches the circle $x^2 + y^2 = r^2$

$\therefore \quad r = \frac{1}{\sqrt{5}}$

Equation of the tangent at (0, 1) to the parabola $y = x^2 + ax + 1$ is $\frac{y+1}{2} = \frac{a}{2}(x+0) + 1$

i.e. $\quad ax - y + 1 = 0 \quad \therefore \quad r = \frac{1}{\sqrt{a^2+1}}$

radius is maximum when a = 0

$\therefore \quad$ equation of the tangent is y = 1 $\quad \therefore \quad$ slope of the tangent is 0

59. Let $0 < \alpha < \beta < 1$, and α, β are the roots of

$f(x) = x^3 - 3x + k = 0 \Rightarrow f(\alpha) = f(\beta) = 0$

$\Rightarrow \quad$ f(x) satisfies (Rolle's Theorem)

$\Rightarrow \quad f'(c) = 0$

$\Rightarrow \quad 3c^2 = 3$

$\Rightarrow \quad c = \pm 1$

but c must be lies between α & β.

Hence $k \in \phi$

60. Let $f(x) = \tan^{-1}x$

then for some $\alpha \in (x, y)$, $f'(\alpha) = \frac{\tan^{-1}y - \tan^{-1}x}{y - x}$ (LMVT)

$\Rightarrow \quad \left|\frac{1}{1+\alpha^2}\right| = \left|\frac{\tan^{-1}x - \tan^{-1}y}{x - y}\right| \quad \left(\left|\frac{1}{1+\alpha^2}\right| \le 1\right)$

$\Rightarrow \quad |\tan^{-1}x - \tan^{-1}y| \le |x - y|$

PRACTICE TEST - TWO

ANSWER KEY

PAPER - 1

PART-I (PHYSICS)

1.	(8)	2.	(4)	3.	(3)	4.	(3)	5.	(1)	6.	(4)	7.	(3)
8.	(9)	9.	(AC)	10.	(ACD)	11.	(BC)	12.	(BD)	13.	(CD)	14.	(AB)
15.	(ABC)	16.	(ACD)	17.	(AD)	18.	(ABD)						

19. (A) q,t (B) p,r,s (C) p,r,s (D) p,t
20. (A) p,q,t (B) p,q,s (C) p,q,t (D) p,q,s

PART-II (CHEMISTRY)

21.	(1)	22.	(5)	23.	(4)	24.	(6)	25.	(3)	26.	(9)	27.	(1)
28.	(5)	29.	(AD)	30.	(ABCD)	31.	(B)	32.	(CD)	33.	(D)	34.	(AD)
35.	(BD)	36.	(BD)	37.	(ABCD)	38.	(BC)						

39. (a) r (b) q (c) p (d) s
40. (A) p (B) p, q (C) q, r, s (D) r

PART-III (MATHEMATICS)

41.	(4)	42.	(4)	43.	(1)	44.	(8)	45.	(8)	46.	(5)	47.	(9)
48.	(2)	49.	(ABC)	50.	(AC)	51.	(ABCD)	52.	(BCD)	53.	(AB)		
54.	(BC)	55.	(ABD)	56.	(ABC)	57.	(AC)	58.	(BD)				

59. (A) r (B) p (C) t (D) q
60. (A) s (B) p (C) q (D) r

PRACTICE TEST - TWO
HINTS & SOLUTIONS
PAPER - 1

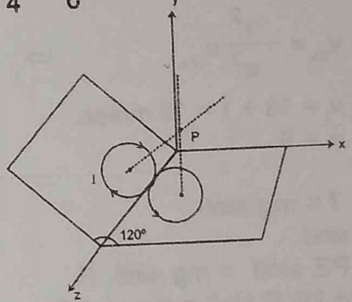
PART-I (PHYSICS)

1. $\Rightarrow \int_0^v v\,dv = \int_0^x (8-2x)dx \quad \Rightarrow \frac{v^2}{2} = 8x - x^2 \quad \Rightarrow v^2 = 16x - 2x^2$

At B, v = 0 so, x = 8 Hence, AB = 8

2. $\frac{\lambda_n}{2} = 6 \text{ cm} \quad \Rightarrow \quad \frac{2L}{2n} = 6 \quad \Rightarrow \quad n = \frac{L}{6}$

$\frac{\lambda_{n+1}}{2} = 4 \text{ cm} \quad \Rightarrow \quad \frac{2L}{2(n+1)} = 4 \quad \Rightarrow \quad n+1 = \frac{L}{4} \Rightarrow \frac{L}{4} - \frac{L}{6} = 1 \quad \Rightarrow \quad L = 12 \text{ cm}$



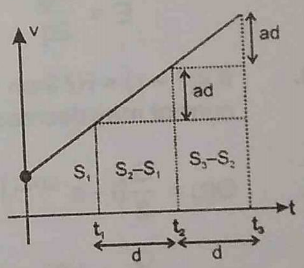
3. $B_1 = \frac{\mu_0 I}{2} \frac{R^2}{(R^2+3R^2)^{3/2}} = \frac{\mu_0 I}{16R}$

$B^2 = B_1^2 + B_1^2 + 2B_1 B_1 \cos 120$

$\Rightarrow B = B_1 = \frac{\mu_0 I}{16R} = \frac{3\mu_0 I}{48R}$

4. $(10 \times 11 - 10 \times 6) \times 10^{-4} \times 2T = \Delta w$

$50 \times 10^{-4} \times 2T = 3 \times 10^{-4} \quad \Rightarrow \quad T = \frac{3}{100} = 3 \times 10^{-2}$ N/m.



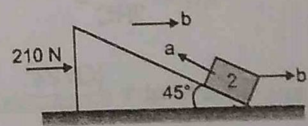
5. From figure

$(S_3 - S_2) - (S_2 - S_1) = ad.d$

$S_1 + S_3 - 2S_2 = ad^2$

$a = \frac{S_3 + S_1 - 2\sqrt{S_1 S_3}}{d^2} = \frac{\left(\sqrt{S_3} - \sqrt{S_1}\right)^2}{d^2}$

$\therefore$ **Ans.** n = 1



6. Let acceleration of wedge be 'b' and 2kg block with respect to wedge be 'a'.

Using newtons law for system ...(i)

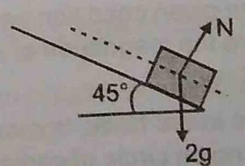
$210 = 9b + 2(b - a\cos 45°)$

F.B.D. of 2kg block : ...(ii)

$2g \sin 45° = 2(b\cos 45° - a)$ ...(iii)

$N - 2g\cos 45° = b \sin 45°$

After solving equation (i) and (ii) we have $b = 20$ m/s²



$a = \frac{10}{\sqrt{2}}$ m/s²

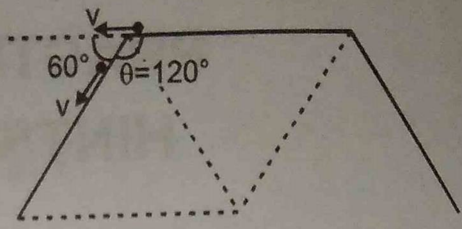
time taken by m to reach the top

$10\sqrt{2} = \frac{1}{2} \cdot \frac{10}{\sqrt{2}} t^2 \quad \Rightarrow \quad t = 2s$

distance moved by wedge. $\therefore \quad x = \frac{1}{2} b t^2 = \frac{1}{2} . 20 . (2)^2 = 40$ m

x = 40 m = 4 Dm **Ans.**

7. Impulse = | change in linear momentum |

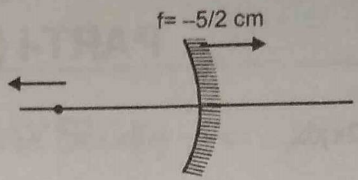


$= \left|\vec{P}_f - \vec{P}_i\right| = \sqrt{(mv)^2 + (mv)^2 + 2(mv)^2\cos(\pi - \theta)}$

Impulse = $2mv\cos\frac{\theta}{2}$ = $2mv\cos 60°$

I = mv = 3 kg m/s

8. $\frac{1}{f} = \frac{1}{f_m} - \frac{2}{f_\ell} = \frac{-1}{5} - \frac{2}{10} = \frac{-4}{10}$



$f = -\frac{5}{2}$ cm

$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

$v' = -\frac{2}{5} + \frac{3}{10} = -\frac{1}{10}$

v = –10 cm

$v_{Im} = -\frac{v^2}{u^2} v_{Om}$ $\Rightarrow$ $v_I - 1 = -\left(\frac{-10}{-10/3}\right)^2 (-1-1)$

v_I = 18 + 1 = 19 m/sec.

α = 9.

9. f = mg sinθ

and

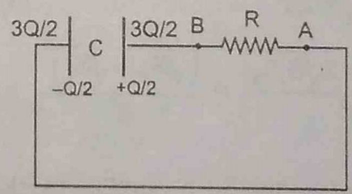
PE sinθ = mg sinθ. R

q 2R E sinθ = mg sinθ R

$E = \frac{mg}{2q}$ ∴ **Ans.** (A) & (C)

10. If $x(1-\ell) < R\ell$ then $v_A > v_B$ if x is increased then current may decrease, become zero or may increase.

11. $Q(t) = \frac{Q}{2}\left(1 - e^{-t/RC}\right)$



$i(t) = \frac{Q}{2RC}e^{-t/RC}$ (from B to A)

Δ heat = $\frac{(Q/2)^2}{2C}$

12. Under the given condition particle shall start from rest and final achieve a steady state terminal velocity. Therefore the magnitude of acceleration will decrease to zero and speed shall increase from zero to a constant value.

13. All points in the body, in plane perpendicular to the axis of rotation revolve in concentric circles. All points lying on circle of same radius have same speed (and also same magnitude of acceleration) but different directions of velocity (also different directions of acceleration)
Hence there cannot be two points in the given plane with same velocity or with same acceleration.
As mentioned above, points lying on circle of same radius have same speed.
Angular speed of body at any instant w.r.t. any point on body is same by definition.

14. When ball is immersed in liquid, weight will decrease due to buoyancy force. The loss in the weight will be increase in the weight of the tank. Hence $W_1 > W_3$ and $W_2 < W_4$. Also

$W_1 + W_2 = W_3 + W_4$

15. (A) The upper part of graph shows that acceleration is positive and becomes zero but just after this instant, the displacement cannot become negative suddenly. So, (A) is wrong.
(B) Displacement is not positive when velocity is negative. So, (B) is wrong.
(C) Velocity cannot increase if acceleration is negative. So, (C) is wrong.
(D) If velocity is negative then displacement will also be negative. So, (D) is correct.

17. $$i = -\frac{k_0 x^2}{L^2} A \frac{dT}{dx} \Rightarrow \int_{T_H}^{T} dT = -\frac{iL^2}{k_0 A}\int_1^x \frac{dx}{x^2} \Rightarrow T - T_H = \frac{iL^2}{k_0 A}\left[\frac{1}{x}\right]_1^x$$

18. $$\frac{W}{4\pi a^2} = \left(\frac{N}{\Delta t}\right)\frac{hc}{\lambda} \times \frac{1}{s} \quad \& \quad eV = \left(\frac{hc}{\lambda} - \phi\right)$$

19. (A) $$\frac{1}{f} = \underbrace{\left(\frac{n_\ell}{n_s} - 1\right)}_{-} \underbrace{\left(\frac{1}{R_1} - \frac{1}{R_2}\right)}_{+}$$

$f = -\text{ve}$

$P = \frac{1}{f} = -\text{ve}$ q,t

(B) $$\frac{1}{f} = \underbrace{\left(\frac{n_\ell}{n_s} - 1\right)}_{+} \underbrace{\left(\frac{1}{R_1} - \frac{1}{R_2}\right)}_{+}$$

$f = +\text{ve}$

$P = \frac{1}{f} = +\text{ve}$ p,r,s

(C) $$\frac{1}{f} = \underbrace{\left(\frac{n_\ell}{n_s} - 1\right)}_{-} \underbrace{\left(\frac{1}{R_1} - \frac{1}{R_2}\right)}_{-}$$

$f = +,\quad P = \frac{1}{f} = +\text{ve}$ p,r,s

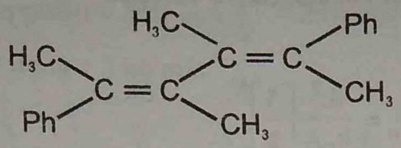
(D) $f = \frac{R}{2}$ $f = -$

$P = -\frac{1}{f} = +$ p,t

20. (A) Both charge will move towards each other so electric potential energy will decrease. Centre of mass will be at rest all the time.
(B) Charge 2C will move towards right and dipole move towards left. Centre of mass will be at rest all the time.
(C) Dipoles will attract each other. So, kinetic energy will increase and electric potential energy will decrease.
(D) Electric force on dipole will be in right direction. So, kinetic energy will increase and electric potential energy will decrease.

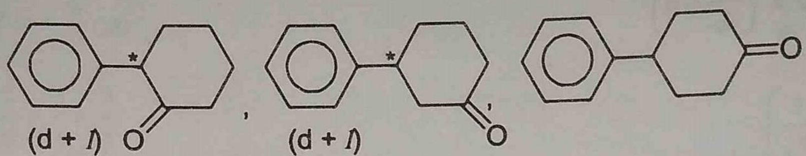
PART-II (CHEMISTRY)

21. Only one product (Single stereoisomers)



(Trans-Trans)

22.



(d + *l*) , (d + *l*)

23. Refer Notes.

25. IO_6^{5-}, XeO_6^{4-}, N_3^-.

26. $(E_{n_2\to 3})_{Li^{2+}} = (E_{3\to\infty})_{He^+} + KE_{electron}$ [Here $(E_{3\to\infty})_{He^+} = KE_{electron}$]

$$\therefore\ 13.6\,(3)^2\left(\frac{1}{3^2}-\frac{1}{n_2^2}\right) = 13.6\,(2)^2\left[\frac{1}{3^2}-\frac{1}{\infty^2}\right]\times 2$$

On solving, we get $n_2 = 9$

27. $$E_{cell} = E^\circ_{cell}\ \frac{-0.0591}{2}\log\frac{[H^+]^2}{[Ni^{2+}][H_2]}$$

$$\Rightarrow\quad E_{cell} - E^\circ_{cell} = \frac{-0.0591}{1}\log[H^+] = 0.0591\times pH$$

$\Rightarrow$ pH = 1

$H_2 \longrightarrow 2H^+ + 2e^-$

$Ni^{2+} + 2e^- \longrightarrow Ni(s)$

$H_2 + Ni^{2+} \longrightarrow 2H^+ + Ni(s)$.

28. $\Delta T_f = i\,K_f\,m$ $i = 1 + (n-1)\,\alpha$

$0.558 = i \times 1.86 \times 0.1$ $3 = 1 + (n-1).1$

$i = 3$ $n = 3$

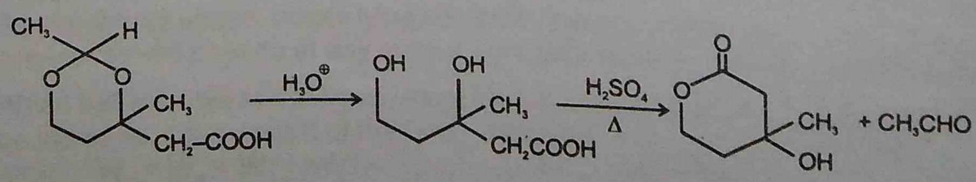
$[Co(NH_3)_5Cl].Cl_2 \Rightarrow x = 5$

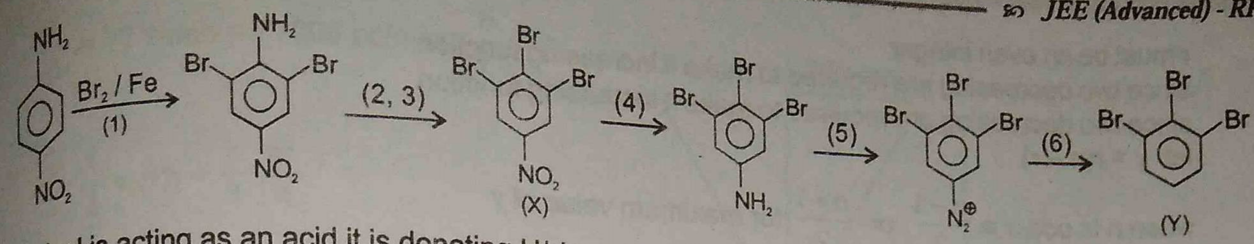
29. Major product is

```
              Br
              |
CH3–CH–CH–CH3
         |
        CH3
```

It has one chiral centre. So, Major product is mixture of two enantiomers.

31.



32. 

34. Quinol is acting as an acid it is donating H^+ ions and also as a reducing agent due to $Ag^+ \rightarrow Ag$.

37.

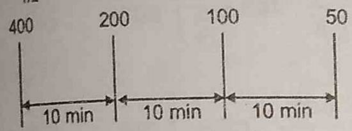
	A(g) $\longrightarrow$	2B(g) +	C(g)
t = 0	400	0	0
t = 20 min	400 – p	2p	p

Given $400 - p + 2p + p = 1000$

$400 + 2p = 1000$

$p = 300$ mm ; $k = \frac{1}{20} \ln \frac{400}{400 - 300} = \frac{1}{20} \ln 4$; $k = \frac{\ln 2}{10}$ min^{-1}

$T_{1/2} = 10$ min ; Value of $k = 0.0693$ min^{-1}



After 30 min Partial Pressure of A is 50 mm, After 30 min Partial Pressure of B is 700 mm
After 30 min Partial Pressure of C is 350 mm , After 30 min total pressure become 1100 mm

39. (A) Bauxite is leached with NaOH (concentrated) to form soluble $Na[Al(OH)_4]$ complex and insoluble impurities are filtered off.
(B) Carbonate and hydroxide ores are heated in absence of air below their melting point to convert in to their oxides in reverberatory furnace. This is called calcination. So magnesite, $MgCO_3$ is subjected to calcination.
(C) This method is commonly used for the concentration of the low grade sulphide ores like galena, PbS (ore of Pb) ; copper iron pyrites $Cu_2S.Fe_2S_3$ or $CuFeS_2$ (ore of copper) ; zinc blende, ZnS (ore of zinc) etc., and is based on the fact that gangue and ore particles have different degree of wettability with water and pine oil; the gangue particles are preferentially wetted by water while the ore particles are wetted by oil.
(D) Chromite ore $(FeO.Cr_2O_3)$ having magnetic properties is separated from non–magnetic silicious impurities by magnetic separator.

PART-III (MATHEMATICS)

41. x can be 2,3,4,5,6. The number of ways in which sum of 2,3,4,5,6 can occur is given by the coeffiicents of x^2, x^3, x^4, x^5, x^6 in $(3x + 2x^2 + x^3)((x + 2x^2 + 3x^3) = 3x^2 + 8x^3 + 14x^4 + 8x^5 + 3x^6$
This shows that sum that occurs most often is 4.

42. Equation of tangent is $y = 2x \pm \sqrt{4a^2 + b^2}$
this is normal to the circle $x^2 + y^2 + 4x + 1 = 0$
this tangent passes through (–2, 0)
$\Rightarrow 0 = -4 \pm \sqrt{4a^2 + b^2} \Rightarrow 4a^2 + b^2 = 16.$ Using AM ≥ GM, we

$$\frac{4a^2 + b^2}{2} \geq \sqrt{4a^2.b^2} \Rightarrow ab \leq 4$$

43. $$\tan\theta = \frac{2\tan^2\theta - \frac{1}{3}\tan\theta}{1 + \frac{2}{3}\tan^3\theta} \Rightarrow \tan\theta = 0 \text{ or } \frac{2\tan\theta - \frac{1}{3}}{1 + \frac{2}{3}\tan^3\theta} = 1$$

$\tan^3\theta - 3\tan\theta + 2 = 0 \Rightarrow \tan\theta = 1$ or -2

$\alpha = 0, \beta = 1, \gamma = -2$

44. r must be an even integer
since two decreasing are required to make it increasing function
since two decreasing are required to make it increasing function
let $y = r(n - r)$

when n is odd $r = \frac{n-1}{2}$ or $\frac{n+1}{2}$ for maximum value of y

when n is even $r = \frac{n}{2}$ for maximum value of y

$\therefore$ maximum (y) $= \frac{n^2-1}{4}$ when n is odd, $\frac{n^2}{4}$ when n is even

$\alpha = 4, \beta = 4$

45. Number of terms in each group 1, 3, 7, 15,.........
last term in each group 1, 4, 11, 26...........a_n
Now $S = 1 + 4 + 11 + 26 .... + a_n$
$S = \quad 1 + 4 .... a_n$
$-$

$\Rightarrow \quad a_n = 1 + 3 + 7 + 15 .... n$ term
$a_n = 1 + 3 + 7 + 15 .... n$ term
$a_n = \quad 1 + 3 + 7 .... n^{th}$ term
$-$

n^{th} term$= 1 + 2 + 4 + 8 + ... = (2^n - 1)$

So $\quad a_n = \sum_{n=1}^{n}(2^n - 1) = 2(2^n - 1) - n$

So last term of n^{th} group $= 2(2^n - 1) - n$
last term of $(n-1)^{th}$ group $= 2[2^{n-1} - 1] - (n - 1)$
Sum of the numbers in the n^{th} group

$$= \left\{1+2+3......\overline{2(2^n-1)-n}\right\} - \left\{1+2+3......\overline{2(2^{n-1}-1)-(n-1)}\right\}$$

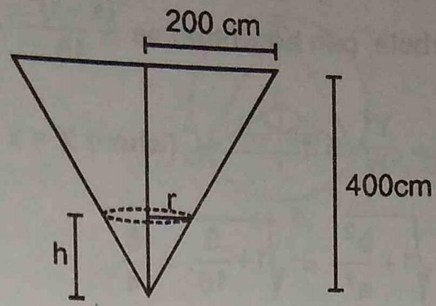
$$= \frac{(2^{n+1}-n-2)(2^{n+1}-n-1)-\{2^n-(n-1)\}(2^n-n)}{2}$$

$= 3.2^{2n-1} - (2n + 5)\, 2^{n-1} + (n + 1)$
$a + b = 08$

46. $(x - 1)(x - \alpha_1)(x - \alpha_2) ....(x - \alpha_8) \equiv x^9 - 1$
$\therefore \quad (2 - \alpha_1)(2 - \alpha_2)........ (2 - \alpha_8) = 2^9 - 1$
Now since $\quad 2 - \alpha_1$ and $2 - \alpha_8$ are conjugates of each other
$\therefore \quad |2 - \alpha_1| = |2 - \alpha_8|$
similarly
$|2 - \alpha_2| = |2 - \alpha_7|$, $\quad |2 - \alpha_3| = |2 - \alpha_6|$ and $|2 - \alpha_4| = |2 - \alpha_5|$
$\therefore \quad |(2 - \alpha_1)(2 - \alpha_3)(2 - \alpha_5)(2 - \alpha_7)| = \sqrt{2^9 - 1} = \sqrt{511}$

47. $n(S)$ = Total number of numbers $= 5 \times {}^5C_4 \times 4! = 5(5!)$
five digit numbers divisible by 6 are formed by using the numbers 0, 1, 2, 4 & 5 or 1, 2, 3, 4 & 5
$\therefore \quad$ number of such numbers $= n(E) = 2(4!) + 2 \times 3 \times 3! + 4 \times 3! = 108$
$\therefore \quad P(E) = 0.18$

48. $\frac{dv}{dt} = 77\ \ell/\text{min} = 77000\ \text{cc/min.}, \frac{h}{r} = 2$



$V = \frac{1}{3}\pi r^2 h = \frac{\pi}{3}\frac{h^3}{4}$

$\therefore \quad \frac{dv}{dt} = \frac{\pi h^2}{4}\frac{dh}{dt}$

$\therefore \quad \frac{dh}{dt} = \frac{77000 \times 4 \times 7}{22 \times 70 \times 70} = 20\text{cm/min}$

49. (A) $\sin\left(\tan^{-1}3 + \tan^{-1}\frac{1}{3}\right) = \sin\frac{\pi}{2} = 1$

(B) $\cos\left(\frac{\pi}{2} - \sin^{-1}\frac{3}{4}\right) = \cos\left(\cos^{-1}\frac{3}{4}\right) = \frac{3}{4}$

(C) $\sin\left(\frac{1}{4}\sin^{-1}\frac{\sqrt{63}}{8}\right)$

Let $\sin^{-1}\frac{\sqrt{63}}{8} = \theta$

so $\sin\theta = \frac{\sqrt{63}}{8}$ if $\cos\theta = \frac{1}{8}$

we have $\cos\frac{\theta}{2} = \sqrt{\frac{1+\cos\theta}{2}} = \frac{3}{4}$

$\sin\frac{\theta}{4} = \sqrt{\frac{1-\cos\frac{\theta}{2}}{2}} = \frac{1}{2\sqrt{2}}$

Now $\log_2 \sin\left(\frac{1}{4}\sin^{-1}\frac{\sqrt{63}}{8}\right) = \log_2\frac{1}{2\sqrt{2}} = -\frac{3}{2}$

(D) $\cos^{-1}\frac{\sqrt{5}}{3} = \theta$

$\cos\theta = \frac{\sqrt{5}}{3}$

$\therefore \quad \tan\frac{\theta}{2} = \frac{3-\sqrt{5}}{2}$ which is irrational

50. $(\vec{a} - \vec{b}) \times [(\vec{b} + \vec{a}) \times (2\vec{a} + \vec{b})] = \vec{b} + \vec{a}$

$\Rightarrow \quad \{(\vec{a} - \vec{b}).(2\vec{a} + \vec{b})\}(\vec{b} + \vec{a}) - \{(\vec{a} - \vec{b}).(\vec{b} + \vec{a})\}(2\vec{a} + \vec{b}) = \vec{b} + \vec{a}$

$\Rightarrow \quad (2 - \vec{a}.\vec{b} - 1)(\vec{b} + \vec{a}) = \vec{b} + \vec{a}$

$\Rightarrow \quad$ either $\vec{b} = -\vec{a}$ or $\vec{a}.\vec{b} = 0$

$\Rightarrow \quad$ either $\vec{b} + \vec{a} = \vec{0}$ or $1 - \vec{a}.\vec{b} = 1$

$\Rightarrow \quad$ either $\theta = \pi$ or $\theta = \frac{\pi}{2}$

51. Given hyperbola can be written as $\frac{(x-1)^2}{16} - \frac{(y-1)^2}{9} = 1$

$\Rightarrow \quad \frac{X^2}{16} - \frac{Y^2}{9} = 1 \qquad$ {where $X = x - 1$; $Y = y - 1$}

$$e = \sqrt{1+\frac{b^2}{a^2}} = \sqrt{1+\frac{9}{16}} = \frac{5}{4}$$

Directrices are $X = \pm \frac{a}{e}$

$\Rightarrow \quad x - 1 = \pm \frac{16}{5} \qquad \Rightarrow \qquad x = \frac{21}{5}$ and $x = -\frac{11}{5}$

Length of Latus rectum $= \frac{2b^2}{a} = \frac{9}{2}$ and focii are $\Rightarrow$ $X = \pm$ ae, $Y = 0$ $\Rightarrow$ (6, 1) and (–4, 1)

52.
$x + 3y + 2z = 6$ ....(i)
$x + \lambda y + 2z = 7$ ....(ii)
$x + 3y + 2z = \mu$ ....(iii)

(A) If $\lambda = 2$, then D = 0, therefore unique solution is not possible

(B) If $\lambda = 4$, $\mu = 6$

$x + 3y = 6 - 2z$
$x + 4y = 7 - 2z$
$\therefore$ $y = 1$ and $x = 3 - 2z$
substituting in equation (iii)
$3 - 2z + 3 + 2z = 6$ is satisfied
$\therefore$ infinite solutions

(C) $\lambda = 5$, $\mu = 7$
consider equation (ii) and (iii)
$x + 5y = 7 - 2z$
$x + 3y = 7 - 2z$
$\therefore$ $y = 0 \quad x = 7 - 2z$ are solution
sub. in (i)
$7 - 2z + 2z = 6$ does not satisfy
$\therefore$ no solution

(D) if $\lambda = 3$, $\mu = 5$
then equation (i) and (ii) have no solution
$\therefore$ no solution

53. Given $x^2 = ay$ & $y - 2x = 1$
$\therefore$ $x^2 = a(2x + 1)$
$\Rightarrow$ $x^2 - 2ax - a = 0$
$x_1 + x_2 = 2a$, $x_1 x_2 = -a$
$\therefore$ $\sqrt{40} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$\Rightarrow \quad 40 = (x_1 - x_2)^2 + \left(\frac{x_1^2}{a} - \frac{x_2^2}{a}\right)^2 \qquad \Rightarrow \qquad 40 = (x_1 - x_2)^2 \left[1 + \frac{(x_1+x_2)^2}{a^2}\right]$

$\Rightarrow \quad 40 = ((x_1 + x_2)^2 - 4x_1x_2)\left[\frac{4a^2}{a^2} + 1\right] \qquad \Rightarrow \qquad 40 = 5(4a^2 + 4a)$

$\Rightarrow \quad a^2 + a - 2 = 0 \qquad \Rightarrow \qquad a = -2, 1$

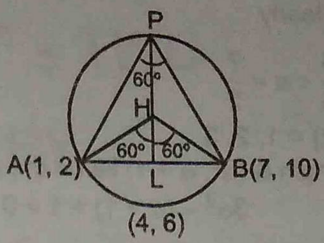
54. Equation of perpendicular of AB is

$y-6=-\frac{3}{4}(x-4)$

$\Rightarrow 3x+4y=36$

Also AB = 10, AL = 5

$\therefore$ AH = radius of circle $=\frac{10}{\sqrt{3}}$ = AL cosec 60°



55. $I=\int_0^{2\pi} x\sin^6 x\cos^4 x\,dx$

$I=\int_0^{2\pi}(2\pi-x)\sin^6 x\cos^4 x\,dx$

Add

$2I=2\pi\int_0^{2\pi}\sin^6 x\cos^4 x\,dx$

$2I=4\pi\int_0^{\pi}\sin^6 x\cos^4 x\,dx$

$I=4\pi\int_0^{\pi/2}\sin^6 x\cos^4 x\,dx=4\pi\left(\frac{(5\times3\times1)(3\times1)}{10\times8\times6\times4\times2}\right)\times\frac{\pi}{2}=\frac{3\pi^2}{128}$

56. Given $B^T = B$ and $A^T = A$ and $AB = BA$

$\Rightarrow ABA^{-1} = BAA^{-1}$

$\Rightarrow B = ABA^{-1}$

$\Rightarrow A^{-1}B = A^{-1}ABA^{-1}$

$\Rightarrow A^{-1}B = BA^{-1}$

Similarly $AB^{-1} = B^{-1}A$

Now

(A) $(A^{-1}B)^T = B^T(A^{-1})^T = B^T(A^T)^{-1} = BA^{-1} = A^{-1}B$

(B) $(AB^{-1})^T = (B^{-1})^TA^T = (B^T)^{-1}A^T = B^{-1}A = AB^{-1}$

(C) $(A^{-1}B^{-1})^T = (B^{-1})^T(A^{-1})^T = (B^T)^{-1}(A^T)^{-1} = B^{-1}A^{-1} = A^{-1}B^{-1}$

57. $f(1) = 0,\ f(1^-) = 0,\ f(1^+) = 1-1 = 0$

$f(-1) = 0,\ f(-1^-) = 4-1 = 3,\ f(-1^+) = 1$

Thus f(x) is continuous at x= 1 but not at x = – 1

58. $a=\underbrace{111.......1}_{55\text{ times}}=1+10+10^2+.......+10^{54}=\frac{10^{55}-1}{9}$

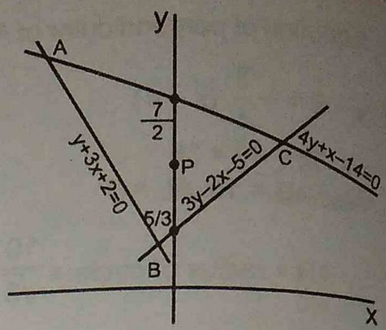
$b=1+10+10^2+10^3+10^4=\frac{10^5-1}{9}$

$c=1+10^5+10^{10}+.........+10^{50}$

$=\frac{(10^5)^{11}-1}{10^5-1}=\frac{10^{55}-1}{10^5-1}=\frac{\frac{10^{55}-1}{9}}{\frac{10^5-1}{9}}=\frac{a}{b}$

$a = bc$ $\quad\therefore\quad$ b, $\sqrt{a}$, c are in G.P.

59. (1) Clearly



$\frac{5}{3} < \alpha < \frac{7}{2}$

$\therefore$ $[\alpha] = 1, 2, 3$

(2) $\because$ origin & $(\alpha^2, \alpha + 1)$ lie on the same side of both lines

$\therefore$ $3\alpha^2 - (\alpha + 1) + 1 > 0$ & $\alpha^2 + 2(\alpha + 1) - 5 < 0$

$\Rightarrow$ $a \in (-\infty, 0) \cup \left(\frac{1}{3}, \infty\right)$ & $\alpha \in (-3, 0) \cup \left(\frac{1}{3}, 1\right)$

$\therefore$ $\alpha \in (-3, 0) \cup \left(\frac{1}{3}, 1\right)$

$\therefore$ $[\alpha] = -3, -2, -1, 0$

(3) Required circle is $(x-1)^2 + (y-1)^2 + \lambda(3x - y - 2) = 0$ it passes through $(1, -1)$

$\therefore$ $0 + 4 + \lambda(3 + 1 - 2) = 0$

$\lambda = -\frac{4}{2} = -2$

$\therefore$ $(x-1)^2 + (y-1)^2 - 2(3x - y - 2) = 0$

$\Rightarrow$ $x^2 + y^2 - 2x - 2y + 2 - 6x + 2y + 4 = 0$

$\Rightarrow$ $x^2 + y^2 - 8x + 6 = 0$

$\because$ Centre is $(4, 0) = (a, b)$

(4) Required locus is

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

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

$\Rightarrow$ $6x + 6y = 0$

$\Rightarrow$ $x + y = 0$

$\because$ $\boxed{a - 2b = -1}$

60. (1) obvious

(2) $\frac{z_3 - z_1}{z_3 - z_2}$ is purely Imaginary. Triangle is right angled with right angle at z_3.

(3) Obtuse angled triangle

(4) $|z_3 - z_1| = |z_3 - z_2|$

and $\frac{z_3 - z_1}{z_3 - z_2}$ is purely Imaginary, So triangle is right angled and isosceles.

PRACTICE TEST - TWO

ANSWER KEY

PAPER - 2

PART-I (PHYSICS)

1.	(5)	2.	(7)	3.	(9)	4.	(7)	5.	(1)	6.	(5)	7.	(4)
8.	(2)	9.	(AB)	10.	(ABC)	11.	(AC)	12.	(AC)	13.	(BC)	14.	(ABCD)
15.	(BC)	16.	(BD)	17.	(B)	18.	(C)	19.	(B)	20.	(C)		

PART-II (CHEMISTRY)

21.	(2)	22.	(0)	23.	(3)	24.	(6)	25.	(5)	26.	(2)	27.	(4)
28.	(8)	29.	(BCD)	30.	(AC)	31.	(ABC)	32.	(ABCD)	33.	(D)	34.	(ABC)
35.	(ABD)	36.	(ABC)	37.	(B)	38.	(B)	39.	(C)	40.	(C)		

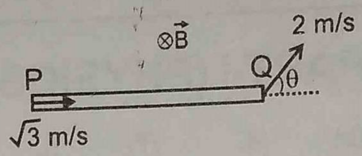
PART-III (MATHEMATICS)

41.	(0)	42.	(4)	43.	(2)	44.	(3)	45.	(5)	46.	(0)	47.	(8)
48.	(8)	49.	(AB)	50.	(ACD)	51.	(BC)	52.	(AB)	53.	(ABC)	54.	(AB)
55.	(AD)	56.	(ABD)	57.	(A)	58.	(B)	59.	(A)	60.	(B)		

PRACTICE TEST - TWO
HINTS & SOLUTIONS
PAPER - 2

PART-I (PHYSICS)

1. $2\cos\theta = \sqrt{3}$



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

$\theta = 30°$

$\omega_{QP} = \frac{2\sin\theta}{\ell} = 1$. Induced emf $= \frac{1}{2}B\omega^2\ell \quad = \frac{1}{2}B(1)(1) = 1/2$

2. In an adiabatic expansion,
$TV^{\gamma-1}$ = constant

$T_0V^{\gamma-1} = T\left(\frac{V}{5}\right)^{\gamma-1} \qquad \gamma = 1 + \frac{2}{5}$

$\therefore \quad T = (273).(5)^{2/5}$
$<(KE)_{rotational}> \quad = kT = 1.38 \times 10^{-23} \times 273 \times (5)^{2/5} = 7 \times 10^{-21}$ J (approx).

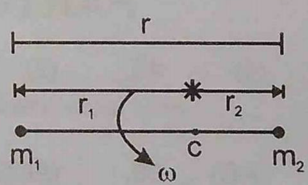
3. Side of cube = a

$Mg = \frac{3}{4}a^3\rho g$. If side of cavity is b.

New mass of cube $= (a^3 - b^3)\frac{3}{4}\rho + b^3\frac{6}{4}\rho = (a^3 + b^3)\frac{3}{4}\rho$

$a^3\rho g = (a^3 + b^3)\frac{3}{4}\rho g \quad \Rightarrow \quad b^3 = \frac{a^3}{3}, \quad b = \left[\frac{1}{3}\right]^{\frac{1}{3}} a \quad \Rightarrow \quad b = \left[\frac{4}{9}\frac{M}{\rho}\right]^{\frac{1}{3}}$

4. Given that $m_1 - m_2 = 6$ unit ...(1)
equation of motion



$\frac{Gm_1m_2}{r^2} = m_1\omega^2 r_1 = m_1\omega^2\frac{m_2 r}{m_1 + m_2}$

$\therefore \; m_1 + m_2 = \frac{\omega^2 r^3}{G} = 8$ unit ...(2)

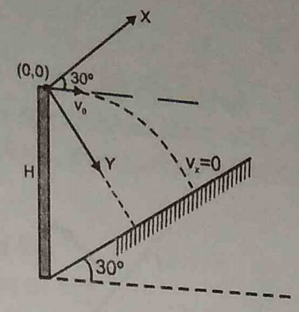
by (1) and $\frac{m_1}{m_2} = 7$

5. Consider the system gas+cylinder+piston.
From the conservation of energy,
heat given to the system +work done by the atmospheric pressure on the system = ΔU + ΔKE of the system

$Q - p_a A\Delta\ell = \frac{5}{2}nR\Delta T + \Delta KE$ of the sys

$20 \times 4.2 - 10^5 \times 10 \times 10^{-4} \times 4.2 \times 10^{-2} = \frac{5}{2} \times 2 \times 2 \times 1.8 \times 4.2 + \Delta KE$ of the system

6. $a_x = -g \sin 30^\circ$
$a_y = g \cos 30^\circ$
$u_x = V_0 \cos 30^\circ$
$u_y = V_0 \sin 30^\circ$
$V_x = u_x + a_x t$



$$0 = \frac{V_0\sqrt{3}}{2} - \frac{g}{2}t$$

$$t = \frac{V_0\sqrt{3}}{g} \quad \text{............(i)}$$

$$S_y = u_y t + \frac{1}{2} a_y t^2$$

$$(H \cos 30^\circ - 0) = V_0 \sin 30^\circ\, t + \frac{1}{2} g \cos 30^\circ\, t^2 \quad \text{............(ii)}$$

From (i) &

$$\Rightarrow \quad \frac{2gH}{V_0^2} = 5.$$

7. $Q = [M(Ra^{226}) - M(Rn^{222}) - M(He^4)] \times 931$
$= (226.025406 - 222.017574 - 4.002603)\, u \times 931$
$= 0.005229\, u \times 931 \frac{MeV}{u}$
$Q = 4.87$ MeV

8. $V_0 = V_C - R\omega$
$= 4 - (.2) \times 10 = 2$ m/s

10. The maximum compression in spring for shown situation is $\frac{m_2 F}{2(m_1 + m_2)K}$.

Since $(m_1 + m_2)K$ is same for all situations ; the compression is maximum for spring 3 and least for spring 2.

11. Use $\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$

13. (A) Current will be same for each section
(B) E a V_d, so $E_B > E_A > E_C$

$$J \propto E \Rightarrow \quad E \propto \frac{1}{A}$$

(C) $\phi = \vec{E}.\vec{A} = \frac{\vec{J}}{\sigma}.\vec{A}$. So, $\phi = i$

as 'i' is same for each section, so ϕ is also same
(D) current flows from high potential to low potential so $V_A > V_B > V_C$.

14. The potential gradient $= \frac{10}{(500+500)} \times \frac{500}{10} = 0.5\ Vm^{-1}$

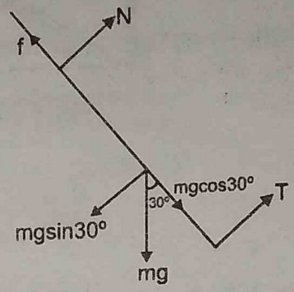
Since potential difference across
$R_1 = 0.5 \times 2 = 1V$
Since potential difference across
$R_2 = 0.5 \times 8 = 4V$
$E = 1 + 4 = 5V$
Also since in meter bridge the balancing length = 20 cm.

$\frac{R_1}{\ } \quad 20 \quad 1$

15. $F = \frac{YA}{L}x$

So, $k = \frac{YA}{L}$ and $W = \frac{1}{2}\frac{YAx^2}{L}$.

18. (17 to 18)
$N + T = mg\sin 30^\circ$



$\tau_{Net} = 0$, $mg\sin 30^\circ \frac{L}{4} = T\frac{3L}{4}$

$T = \frac{mg}{6}$

$f = mg\cos 30^\circ = \frac{\sqrt{3}mg}{2}$

19. $\lambda = 4m$ and तथा $f = 500$ Hz.
$\therefore V = f\lambda = 200$ m/s

$\because V = \sqrt{\frac{T}{\mu}}$ $\therefore T = \mu v^2 = (0.1) \times (200)^2 = 400$ N

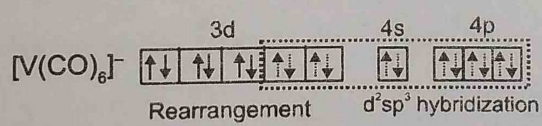
20. Since integral number of waves shall cross a point is 5 seconds, therefore power transmitted in 5 seconds is
$= \langle P \rangle \times 5 = 2\pi^2 f^2 A^2 \mu v \times 5$

PART-II (CHEMISTRY)

21. $\overset{III}{[Co(NH_3)_5Cl]}Cl_2.H_2O\,(aq) \rightleftharpoons \overset{III}{[Co(NH_3)_5Cl]}^{2+}(aq) + 2Cl^-(aq)$

$2Ag^+ + 2Cl^- \longrightarrow 2AgCl\downarrow$ (white) (श्वेत).

22. The Vandium is in –1 oxidation state and CO is a strong field ligand so compels for the pairing of electrons. Thus the complex has d^2sp^3 hybridisation and is diamagnetic.



$\mu_{BM} = \sqrt{n(n+2)} = 0$ as there is no unpaired electrons.

23. $P_4 + 3NaOH + 3H_2O \longrightarrow PH_3 + 3NaH_2PO_2$

24. $\lambda^\infty_{K^+} = 96.50$

$\therefore$ Ionic mobility $\mu^\infty_{K^+} = \frac{\lambda^\infty_{K^+}}{F} = \frac{96.50}{96500} = 10^{-3}$ cm^2 sec^{-1} volt^{-1}

Potential gradient applied $= \frac{6.0}{10} = 0.6$ volt cm^{-1}

Ionic mobility $(\mu) = \left(\frac{\text{speed of ion}}{\text{potential gradient}}\right)$

So speed of $(K^+) = (10^{-3} \times 0.6) = 6 \times 10^{-4}$ cm/sec.
$\therefore$ Distance travelled in 2 hours 46 minutes and 40 seconds
d = 6 cm.

25. Total pressure is = 80 cm of Hg

V. P. of H_2O is = 20 cm of Hg

$\therefore$ Pressure of H_2 gas = 80 – 20 = 60 cm of Hg

Now if the volume of the piston is doubled then V.P. of water won't change since there is water in the container to maintain the equilibrium. Pressure of H_2 will become half

$\Rightarrow$ P_{H_2} = 30 cm of Hg

V. P. of water = 20 cm of Hg

Total pressure = 20 + 30 = 50 cm of Hg.

Therefore answer = 50/10 = 5.

26. $\underset{(-1)}{NH_2OH} \longrightarrow \underset{(+1)}{N_2O}$ oxidation number of nitrogen.

$\therefore$ Vf = change in oxidation number of nitrogen = 2.

Organic

27. $CH_3-CH=CH-CH=O$, $CH_3-\underset{\underset{O}{\|}}{C}-CH=CH-CH_3$

$CH_3-\underset{\underset{O}{\|}}{C}-CH=\underset{\underset{CH_3}{|}}{C}-CH_3$, $CH_3-\underset{\underset{CH_3}{|}}{C}=CH-CH=O$

28. $\therefore$ Total number of stereoisomers = $2^{n-1} = 8$.

29. (A) Burns only in pure dioxygen gas.

(D) Avalability of electrons for metallic bonding $\downarrow$.

30. (A) $\Delta G = \Delta H - T\Delta S < O$ as $\Delta S < O$ so ΔH has to be negative

(B) micelles formation will take place above T_k and above CMC

(C) $Fe(OH)_3$ sol prepared by the hydrolysis of $FeCl_3$ solution adsorbs Fe^{3+} and this is positively charged.

$FeCl_3 + 3H_2O \rightleftharpoons Fe(OH_3) + 3HCl$; $Fe(OH)_3 + FeCl_3 \rightarrow \underbrace{Fe(OH)_3 \,\vdots\, Fe^{3+}}_{\text{Fixed part}} : \underbrace{3Cl^-}_{\text{Diffused part.}}$

Positive charge on colloidal sol is due to adsorption of Fe^{3+} ion (common ion between $Fe(OH)_3$ and $FeCl_3$).

(D) Fe^{3+} ions will have greater flocculatibility power so smaller flocculating value.

31. $\dfrac{r_{vapours}}{r_{O_2}} = \sqrt{\dfrac{M_{O_2}}{M_{vapours}}}$; ; $\dfrac{4}{3} = \sqrt{\dfrac{32}{M}}$

M = 18 Atomic weight $= \dfrac{18}{3} = 6$

V.D. = 9 Density $= \dfrac{18}{22.4} = 0.8035$ g/lt.

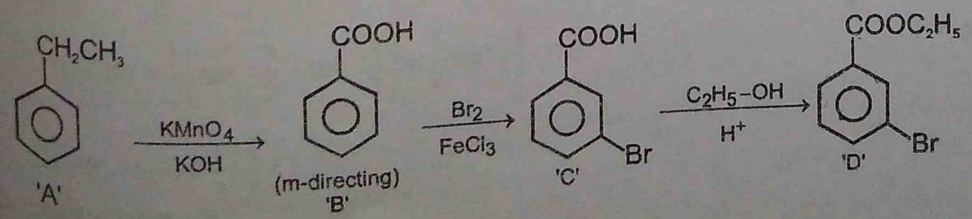
PV = 2RT

$PV = Z\dfrac{w}{V}RT$

PM = ZdRT

$Z = \dfrac{PM}{dRT} = \dfrac{18P}{dRT}$

33.



34. Picric acid, Aspirin and Squaric acid liberate CO_2 gas of reaction with Sodiumbicarbonate.

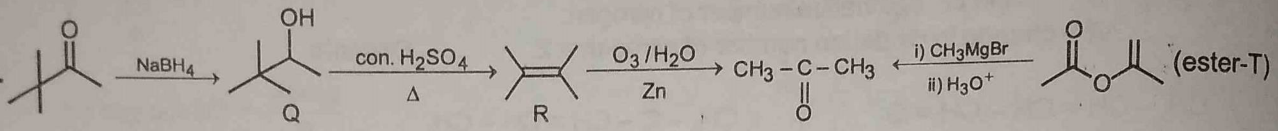
35. N_2O_5 Solid has NO_2 + and NO_3^- ions

PCl_5 solid has PCl_4^+ and PCl_5^+ ions

XeF_6 solid has XeF_5^+ and F^- ions

ICl_3 solid exist as dimer I_2Cl_6.

36. Gives prussian blue precipitate of $Fe_4[Fe(CN)_6]_3$ with Fe^{3+}.

38. 

39. At half neutralisation pH = pK_b

40. For complete neutralisation of WA and SB

$$pH = 7 + \frac{1}{2}\,pK_a + \frac{1}{2}\log C$$

where $C = \frac{0.1}{2}$ of CH_3COONa

PART-III (MATHEMATICS)

41. $AB = A + B$

$\Rightarrow B = AB - A = A(B - I)$

$\Rightarrow \det(B) = \det(A)\det(B - I) = 0$

$\Rightarrow \det(B) = 0$

42. $\sqrt{x+iy} = \frac{a+ib}{c+id} \Rightarrow (x + iy) = \left(\frac{a+ib}{c+id}\right)^2 \Rightarrow |x + iy| = \left|\frac{a+ib}{c+id}\right|^2$

$\Rightarrow \sqrt{x^2+y^2} = \frac{a^2+b^2}{c^2+d^2} = 2 \Rightarrow x^2 + y^2 = 4$

43. $p = \sin(px - y) \Rightarrow px - y = \sin^{-1}p$ ....(i)

differentiate w.r.t. x

$$\Rightarrow x\frac{dp}{dx} = \frac{1}{\sqrt{1-p^2}}\frac{dp}{dx}$$

$\Rightarrow \frac{dp}{dx} = 0$ or $\frac{1}{\sqrt{1-p^2}} = x \Rightarrow p = \frac{\sqrt{x^2-1}}{x}$ put in equation

$$y = \sqrt{x^2-1} - \sin^{-1}\frac{\sqrt{x^2-1}}{x}$$

a = 1, b = 1 , c = 1

44. Given $\bar{r} = x\hat{i} + y\hat{j}$ (in a plane)

$\Rightarrow \bar{r}.(10\hat{j} - 8\hat{i} - \bar{r}) = 40$

Gives $x^2 + y^2 + 8x - 10y + 40 = 0$

It is circle $(-4, 5)$ and radius $= 1$

$p_1 = \max \{(x+2)^2 + (y-3)^2\};\ p_2 = \min\{(x+2)^2 + (y-3)^2\}$

(x, y) is any point on the circle.

$p_2 = (2\sqrt{2} - 1);\ p_1 = (2\sqrt{2} + 1)$

$p_1^2 + p_2^2 = 18$ (even) $\Rightarrow$ tangents is drawn.

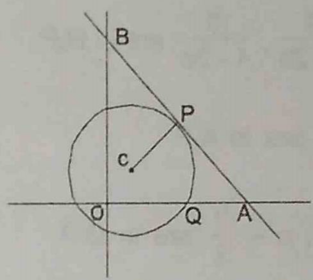
Slope of AB, $\left(\frac{dy}{dx}\right)_{(2,2)} = -2$

Equation of AB, $2x + y = 6$, $B = (3, 0)$

$\overline{OA} = 2\hat{i} + 2\hat{j}, \overline{OB} = 3\hat{i}, \overline{AB} = \overline{OB} - \overline{OA}$

$\overline{AB} = \hat{i} - 2\hat{j},\ \overline{AB}.\overline{OB} = (\hat{i} - 2\hat{j}).(3\hat{i}) = 3$ **Ans. 3**

45. Let centre be $C(h, k)$



$\because \quad CP \perp AB$

$\Rightarrow \quad \dfrac{2-k}{\frac{3}{2} - h} = \dfrac{3}{4}$

$\Rightarrow \quad 6h - 8k = -7 \quad$ .....(i)

$\because \quad CP = CQ$

$\Rightarrow \quad \left(h - \frac{3}{2}\right)^2 + (k-2)^2 = \left(h - \frac{3}{2}\right)^2 + k^2$

$\Rightarrow \quad k = 1$ put in (i), we get

$6h = 1 \quad \Rightarrow \quad h = \frac{1}{6}$

$\therefore \quad \text{radius}(r) = CQ = \sqrt{\left(\frac{1}{6} - \frac{3}{2}\right)^2 + 1} = \sqrt{\left(\frac{1-9}{6}\right)^2 + 1} = \frac{5}{3} \quad \therefore \quad 3r = 5$

46. $\displaystyle\int \frac{3x^2 + 2x}{x^6 + 2x^5 + x^4 + 2x^3 + 2x^2 + 5} dx$

$= \displaystyle\int \frac{3x^2 + 2x}{(x^3 + x^2 + 1)^2 + 4} dx = \frac{1}{2}\tan^{-1}\left(\frac{x^3 + x^2 + 1}{2}\right) + C$

$F(x) = \frac{1}{2}\tan^{-1}\left(\frac{x^3 + x^2 + 1}{2}\right) + C$

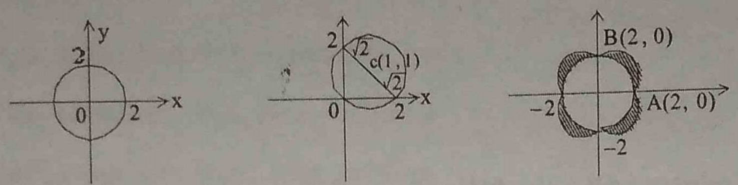
$\therefore F(1) - F(0) = \frac{1}{2}\left(\tan^{-1}\frac{3}{2} - \tan^{-1}\frac{1}{2}\right) = \frac{1}{2}\tan^{-1}\frac{4}{7}$

$\therefore 0 < F(1) - F(0) < \frac{1}{2} \cdot \frac{\pi}{2} < 1$

$[F(1) - F(0)] = 0$

47. The triangle has circumcentre at origin and its orthocentre lying on the cirumcircle.

48.



$x^2 + y^2 = 4$ $\qquad$ $x^2 + y^2 - 2x - 2y = 0$

required area = 4 (area in 1st quadrant) $= 4\left[\frac{\pi(\sqrt{2})^2}{2} - \left(\frac{\pi \times 2^2}{4} - \frac{1}{2}\times 2\times 2\right)\right] = 4(\pi - \pi + 2) = 8$

49. tan A + tan B + tan C = tan A tan B tan C = 3 tan B = 6 tan A

$\therefore$ 3 tan A + tan C = 6 tan A

tan C = 3 tan A

$\therefore$ tan A + 2 tan A + 3 tan A = tan A . 2 tan A . 3 tan A i.e. $\tan A = \tan^3 A$

i.e. $\tan^2 A = 1$ i.e. tan A = 1 $\therefore$ $A = \frac{\pi}{4}$

$\therefore$ $\tan A \tan B = 2\tan^2 A = 2$

50. (A) $\frac{a}{1-2a}, \frac{b}{1-2b}, \frac{c}{1-2c}$ are in H.P. $\Leftrightarrow$ $\frac{1-2a}{a}, \frac{1-2b}{b}, \frac{1-2c}{c}$ are in A.P.

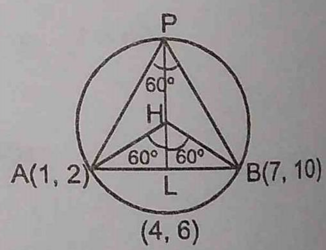
$\Leftrightarrow$ $\frac{1}{a}, \frac{1}{b}, \frac{1}{c}$ are in A.P. $\Leftrightarrow$ a, b, c are in H.P.

(B) $a - \frac{b}{2}, \frac{b}{2}, c - \frac{b}{2}$ are in G.P. $\Rightarrow$ $\ell n\left(a - \frac{b}{2}\right), \ell n \frac{b}{2}, \ell n\left(c - \frac{b}{2}\right)$ are in A.P.

(C) $c - \frac{b}{2}, \frac{b}{2}, a - \frac{b}{2}$ are in G.P.

(D) $\frac{1}{a}, \frac{1}{b}, \frac{1}{c}$ are in A.P. $\Rightarrow$ $e^{1/a}, e^{1/b}, e^{1/c}$ are in G.P.

51. Equation of perpendicular of AB is



$y - 6 = -\frac{3}{4}(x - 4)$

$\Rightarrow$ 3x + 4y = 36

Also AB = 10, AL = 5

$\therefore$ AH = radius of circle $= \frac{10}{\sqrt{3}}$ = AL cosec 60°

52. $P \equiv (2t^2, 4t)$

SP = 4 (given)

$\Rightarrow$ $2 + 2t^2 = 4$ $\Rightarrow$ $t = \pm 1$ $\Rightarrow$ $p \equiv (2, 4)$ or $(2, -4)$

Given f(1) = 2 and f(x + y) = f(x). f(y) $\Rightarrow$ $a_1 = f(1) = 2$ and $a_2 = f(2) = 4$

53. Given $r = |\cos\theta|$

$\Rightarrow$ $r^2 = |r\cos\theta|$ $\Rightarrow$ $x^2 + y^2 = |x|$ $\Rightarrow$ $x^2 + y^2 = \mp x$

$\Rightarrow$ $x^2 + y^2 \mp x = 0$ $\Rightarrow$ $x^2 + y^2 + x = 0$,

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

Centre $\left(-\frac{1}{2}, 0\right)$ $\qquad$ centre $\left(\frac{1}{2}, 0\right)$

Radius $= \frac{1}{2}$ $\qquad$ radius $\frac{1}{2}$ $\qquad$ $\therefore$ They are touching each other at origin.

54. Given $\log_x a$, $a^{x/2}$, $\log_b x$ are in GP. So, $a^x = \log_x a \cdot \log_b x$

$\Rightarrow \quad a^x = (\log_b a) \quad \Rightarrow \quad x = \log_a(\log_b a)$

$$\Rightarrow \quad x = \frac{\log\left(\frac{\log a}{\log b}\right)}{\log a} \quad \Rightarrow \quad x = \frac{\log(\log a) - \log(\log b)}{\log a}$$

55. $\because \sin B = \dfrac{b\sin A}{a}$ and $A < \dfrac{\pi}{2}$

when $b\sin A = a$, $\sin B = 1$, $B = \dfrac{\pi}{2}$ (possible)

when $\sin B < 1$

$\dfrac{b\sin A}{a} < 1$

$b \sin A < a$

If $b < a$, then one triangle possible

If $b > a$, then two triangle possible

56. Given function can be re-defined as

$y > 0 \Rightarrow y = \dfrac{1}{2}x \; ; x \geq 0$

$y < 0 \Rightarrow y = \dfrac{1}{10}x \; ; x < 0$

$$\therefore \; y = \begin{cases} \dfrac{x}{2}, & x \geq 0 \\ \dfrac{x}{10}, & x < 0 \end{cases} \qquad \text{Also. } f(0+h) = f(0-h) = f(0) = 0$$

$\Rightarrow$ f(x) is continuous at $x = 0$ but it is not diff. at $x = 0$ as $Rf'(0) = \dfrac{1}{2}$ & $Lf'(0) = \dfrac{1}{10}$

57. The diagonals are $\vec{d}_1 = 3\hat{a} - 2\hat{b} + 2\hat{c} + (-\hat{a} - 2\hat{c}) = 2\hat{a} - 2\hat{b}$

$\vec{d}_2 = 3\hat{a} - 2\hat{b} + 2\hat{c} - (-\hat{a} - 2\hat{c}) = 4\hat{a} - 2\hat{b} + 4\hat{c}$

Angle between them $= \cos^{-1}\dfrac{\vec{d}_1 . \vec{d}_2}{|\vec{d}_1| . |\vec{d}_2|} = \cos^{-1}\left(\dfrac{8+4}{2\sqrt{2}\,(6)}\right) = \cos^{-1}\dfrac{1}{\sqrt{2}} = \dfrac{\pi}{4}$

58. $\hat{a} \times \hat{b} = \hat{c} \quad \Rightarrow \quad \hat{c}.\hat{a} \times \hat{b} = \hat{c}.\hat{c} = 1$

$\Rightarrow \quad [\hat{a}\; \hat{b}\; \hat{c}] = 1$

$\Rightarrow \quad \hat{a} . (\hat{b} \times \hat{c}) + \hat{b} . (\hat{c} \times \hat{a}) + \hat{c} . (\hat{a} \times \hat{b}) = 3$

59. $\lim\limits_{x \to 0^+} f(x) = \lim\limits_{h \to 0} \sin^{-1}[\tan h] = \lim\limits_{h \to 0} \sin^{-1}(0) = 0$

60. $\lim\limits_{x \to 0^-} f(x) = \lim\limits_{h \to 0} \sin^{-1}[\tan(-h)] = \lim\limits_{h \to 0} \sin^{-1}(-1) = -\dfrac{\pi}{2}$