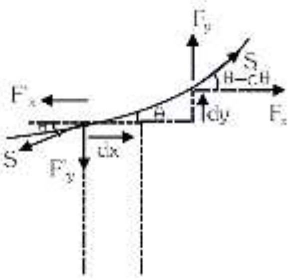
PHYSICS

1. (b)



For the given element, (consider length d in Z direction) Net force in upward direction = Weight $(S\sin(\theta + d\theta) - S\sin\theta)d = mg$

Angle is small $\therefore \sin\theta \approx \theta$

$\Rightarrow \frac{d\theta}{ydx} = \frac{\rho g}{S}$ ……..(i)

$\tan\theta = \frac{dy}{dx} \Rightarrow$ Differentiating wrt x

$\sec^2\theta \frac{d\theta}{dx} = \frac{d^2y}{dx^2}$ …….(ii)

Put $d\theta$ from (ii) in (i) d take $\cos\theta \approx 1$, we get $\frac{d^2y}{dx^2} = \frac{\rho gy}{S}$

2. (b)

$f_0 = 2$ cm $f_e = 4$ cm

$L = 40$ cm $D = 25$ cm

In the condition of normal adjustment.

$$m = \frac{L}{f_0} \cdot \frac{D}{f_e}$$
$$= \frac{40}{2} \times \frac{25}{4}$$
$$= 125$$

3. (b) For particle To Remain undeflected

$\vec{F}_e = -\vec{F}_m$

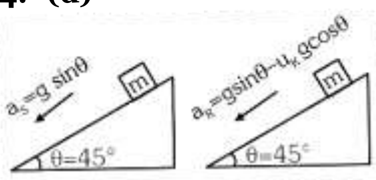
$\Rightarrow |\ \vec{E} = VB\sin\theta$

$E = \frac{c}{100} \times 9 \times 10^{-4} \sin 90$

$E = 27 \times 10^2$ V/m and

$\vec{E} = \vec{B} \times \vec{V}$

4. (d)



$$L = \frac{1}{2}a_S t_S^2 = \frac{1}{2}a_R t_R^2$$

$$\Rightarrow \left(\frac{t_S}{t_R}\right)^2 = \frac{a_R}{a_S}$$

$$\Rightarrow \left(\frac{1}{2}\right)^2 = \frac{g\sin\theta - \mu_k g\cos\theta}{g\sin\theta}$$

$$\Rightarrow \frac{1}{4} = \frac{\sin 45^\circ - \mu_k \cos 45^\circ}{\sin 45^\circ}$$

$$\Rightarrow \frac{1}{4} = \frac{\left(\frac{1}{\sqrt{2}}\right)}{\left(\frac{1}{\sqrt{2}}\right)}\left(\frac{1-\mu_k}{1}\right)$$

$$\Rightarrow \frac{1}{4} = 1 - \mu_k \Rightarrow \mu_k = 1 - \frac{1}{4} = \frac{3}{4} = 0.75$$

5. (b)

W.D. $= \Delta KE$

$\vec{F}\cdot\vec{S} = \Delta KE$

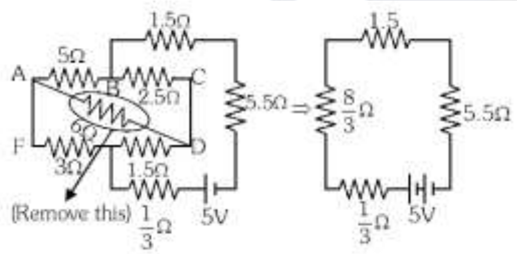
$$\frac{(\Delta KE)_A}{(\Delta KE)_B} = \frac{-F_A S_A}{-F_B S_B}$$

$$\frac{-100}{-225} = \frac{-F_A(1000)}{-F_B(1500)}$$

$$\frac{F_A}{F_B} = \frac{2}{3}$$

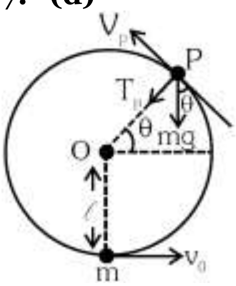
6. (b)

Simplified Diagram



$$i = \frac{V}{R_{eq}} = \frac{5}{\frac{1}{3}+\frac{8}{3}+1.5+5.5} = \frac{5}{10} = 0.5\ \text{A}$$

7. (d)



C.O.M.E. $\frac{1}{2}mv_0^2 = mg\ell(1+\sin\theta) + \frac{1}{2}mv_p^2$ ……(i)

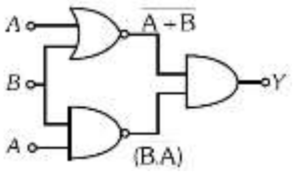
At pt P Tp + mgsin θ $= \frac{mv_p^2}{\ell}$ (as $T_p = 0$)

$mg\sin\theta = \frac{mv_p^2}{\ell} \Rightarrow mv_p^2 = mg\ell\sin\theta$ ……..(i)

From (i) & (ii)

$$\frac{1}{2}mv_0^2 = mg\ell(1+\sin\theta) + \frac{1}{2}mg\ell\sin\theta$$
$$v_0^2 = 2g\ell(1+\sin\theta) + g\ell\sin\theta$$
$$v_0 = \sqrt{2g\ell + 3g\ell\sin\theta} \quad \ldots\ldots(iii)$$
$$v_p = \sqrt{g\ell\sin\theta}$$
$$v_0 = \sqrt{2g\ell + 3g\ell\sin\theta}$$
$$\frac{v_p}{v_0} = \sqrt{\frac{\sin\theta}{2+3\sin\theta}}$$

8. (d)

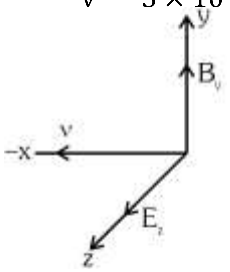


$$Y = \overline{(A+B)} \cdot \overline{(A\cdot B)}$$
$$\Rightarrow \overline{A}\cdot\overline{B}\cdot(\overline{A}+\overline{B})$$
$$\Rightarrow \overline{A}\cdot\overline{B}\cdot\overline{A} + \overline{A}\cdot\overline{B}\cdot\overline{B}$$
$$\Rightarrow \overline{A}\cdot\overline{B} + \overline{A}\cdot\overline{B}$$
$$\Rightarrow \overline{A}\cdot\overline{B} = \overline{(A+B)}$$

Behaves as NOR gate

9. (a)

$$v = \frac{\omega}{k} = \frac{1.5\times10^9}{5} = 3\times10^8 \text{ m/s}$$
$$B_0 = \frac{F_0}{v} = \frac{60}{3\times10^8} = 20\times10^{-8} = 2\times10^{-7}\text{ T}$$

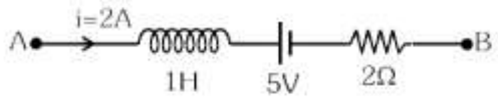


$$B_y = 2\times10^{-7}\cos(5x + 1.5\times10^9 t)\text{T}$$

10. (a)

$$v_i = -\sqrt{2gh_i} = -\sqrt{2\times9.8\times10} = -28 \text{ m/s}$$
$$v_f = \sqrt{2gh_i} = \sqrt{2\times9.8\times10} = 14 \text{ m/s}$$
$$\vec{I} = \Delta\vec{P} = m_v - m\vec{v}_i$$
$$= m[\vec{v}_f - \vec{v}_i] = 0.5[14-(-28)]$$
$$= 0.5\times42 = 21\text{NS}$$

11. (d)



Apply K.V.L.

$$V_A - \frac{LdI}{dt} - 5 - IR = V_B$$
$$V_A - V_B = \frac{LdI}{dt} + 5 + IR$$
$$= 1\times1 + 5 + 2\times2$$
$$= 1 + 5 + 4$$
$$= 10 \text{ V}$$

12. (a)

Magnetic moment $M = I(A)$

$M = I(\pi r^2)$

$$\frac{M_1}{M_2} = \frac{I\pi r_1^2}{I\pi r_2^2} = \left(\frac{r_1}{r_2}\right)^2 = \left(\frac{1}{2}\right)^2$$

$$\frac{M_1}{M_2} = \frac{1}{4}$$

13. (c)

When a combination of lens is used then total power

$P_{net} = P + P + P + P$

$= 4P$

Total magnification $m_{net} = m \times m \times m \times m = m^4$

14. (c)

$$n_f = \frac{P_f V}{RT} \; [P_{abs} = 12 \text{ atm}]$$

$$= \frac{12 \times 1.01 \times 10^5 \times 30 \times 10^{-3}}{\left(\frac{100}{12}\right) \times 300}$$

$= 14.544$

$\therefore$ moles removed $= 18.2 - 14.544 = 3.656$

$\therefore$ mass removed $= 3.656 \times \frac{32}{1000}$ kg $= 0.116$ kg

15. (b)

$t = x^2 + x$

$$\frac{dt}{dx} = \frac{d}{dx}[x^2 + x]$$

$$\frac{1}{v} = 2x + 1$$

$v = (2x+1)^{-1} \quad \ldots\ldots(i)$

$$a = \frac{vdv}{dx} = (2x+1)^{-1}[-1(2x+1)^{-2} \times 2]$$

$a = -1(2x+1)^{-3} \times 2$

$a = -2(2x+1)^{-3}$

$$= -\frac{2}{(2x+1)^3}$$

16. (b)

$X_C = 25\Omega \; X_L = 45\Omega$

$Z = \sqrt{R^2 + (X_L - X_c)^2}$

$Z = \sqrt{20^2 + (45-25)^2}$

$z = 20\sqrt{2}$

$$I_{m=} = \frac{V_{mx}}{Z} = \frac{220}{20\sqrt{2}} = \frac{11}{\sqrt{2}} = 7.8 \text{ A}$$

$$\tan\phi = \frac{X_L - X_C}{R} = \frac{45-25}{20} = \frac{20}{20} = 1$$

$\phi = 45°$

17. (d)

Angular Momentum conservation

$I_1\omega_1 = I_2\omega_2 \qquad M =$ same

$\omega_2 = \frac{\omega_1}{4} \qquad R_2 = 2r_1$

$T = \frac{2\pi}{\omega} \qquad I \propto r^2$

$I_2 = 4I_1$

$T_1 = 27$ day

$T_2 = 4\,T_1 = 4 \times 27$

$T_2 = 108$ days

18. (b)

Magnetic moment

$M = IA = I(\pi r^2)$

$M = \left(\frac{eu}{2\pi r}\right)(\pi r^2) \quad \ldots\ldots (i)$

Given $B(\pi r^2) = n\left(\frac{h}{e}\right)$

$\Rightarrow r^2 = \frac{h}{B\pi e} \quad \ldots\ldots (ii)$

$(\because n = 1)$

And when charge moving in external magnetic field then $r = \frac{mu}{qB}$

$\frac{v}{r} = \frac{e\,B}{m}$ ... (ii) $(\because q = e)$

Put value from equation (ii) and (iii) in equation (i)

$$M = \left(\frac{ev}{2\pi r}\right)(\pi r^2)$$

$$M = \frac{e}{2\pi}\left(\frac{eB}{m}\right)\pi\left(\frac{h}{B\pi e}\right)$$

$$M = \frac{eh}{2\pi\, m}$$

19. (c)

In steady state $\Rightarrow \left(\frac{dQ}{dt}\right)_1 = \left(\frac{dQ}{dt}\right)_2 = \left(\frac{dQ}{dt}\right)_3$

$$\frac{2KA(3\,T - T_1)}{L} = \frac{KA(T_1 - T_2)}{L} = \frac{2KA(T_2 - T)}{L}$$

$$6T - 2T_1 = T_1 - T_2 = 2T_2 - 2T$$

$6\,T - 2\,T_1 = T_1 - T_2$

$6\,T + T_2 = 3\,T_1 \quad \ldots\ldots (i)$

$T_1 - T_2 = 2\,T_2 - 2\,T$

$2\,T - 3\,T_2 = -T_1 \quad \ldots\ldots (ii)$

Multiply equation (ii) By '3'

$6\,T - 9\,T_2 = -3\,T_1 \quad \ldots\ldots (iii)$

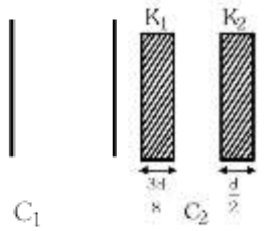
Equation (i) - (iii)

$10\,T_2 = 6\,T_1$

$\frac{T_1}{T_2} = \frac{5}{3}$

20. (a)

$C_1 = \varepsilon_0 A/d$



$$C_2=\frac{\varepsilon_0\,A}{\frac{3\,d}{8\,K_1}+\frac{d}{2\,K_2}+\left(d-\frac{3\,d}{8}-\frac{d}{2}\right)}$$

$$C_2=\frac{\varepsilon_0\,A/d}{\frac{3}{8\,K_1}+\frac{1}{2\,K_2}+\frac{1}{8}}$$

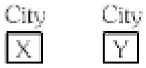
$$=\frac{\varepsilon_0\,A/d}{\frac{3}{8\,K_1}+\frac{1}{2\left(\frac{4}{5}\,K_1\right)}+\frac{1}{8}}$$

$$C_2=2C_1$$

$$\frac{\varepsilon_0\,A/d}{\frac{3}{8\,K_1}+\frac{5}{8\,K_1}+\frac{1}{8}}=2\varepsilon_0\,A/d$$

$$\Rightarrow\frac{1}{\frac{1}{K_1}+\frac{1}{8}}=2\Rightarrow\frac{1}{K_1}+\frac{1}{8}=\frac{1}{2}\Rightarrow\ K_1=\frac{8}{3}=2.66$$

21. (d)



$$t_1=30\text{ min}=\frac{1}{2}\text{hr}$$

$$t_2=10\text{ min}=\frac{1}{6}\text{hr}$$

$V_B=$ Speed of Bus

$V_S=$ Speed of scooty (girl)

$$d=\underset{\text{(Same direction)}}{(V_B-V_S)t_1}=\underset{\text{(Opposite direction)}}{(V_B+V_S)t_2}$$

$$\Rightarrow(V_B-60)\frac{1}{2}=(V_B+60)\frac{1}{6}$$

$$3V_B-180=V_B+60$$

$$2V_B=240$$

$$\Rightarrow V_B=120\text{ km/hr Ans.}$$

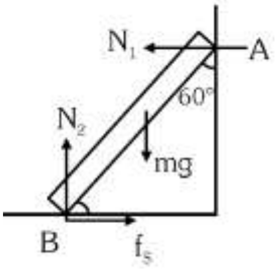
$$\text{Distance }=(V_B-V_S)t_1$$

$$D=(120-60)\frac{1}{2}=30\text{ km}$$

$$t=\frac{d}{V_B}=\frac{30}{120}=\frac{1}{4}\text{hr}=15\text{ min}$$

22.(b)

$$N_2=mg=200\text{ N}$$



Taking torque about A:

$$f_s\, L\cos 60^\circ + mg\frac{L}{2}\sin 60^\circ = N_2\, L\sin 60^\circ$$

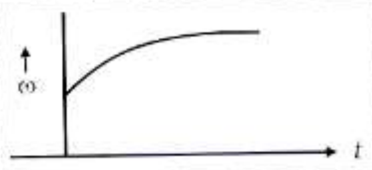
$$f_s\left(\frac{1}{2}\right) + 200\left(\frac{1}{2}\right)\frac{\sqrt{3}}{2} = 200\frac{\sqrt{3}}{2}$$

$$f_s = 100\sqrt{3}\text{ N}$$

23.(b)

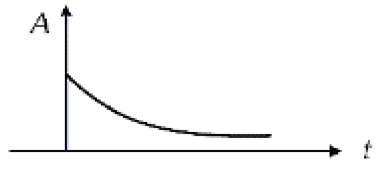
$$\omega = \sqrt{\frac{k}{m}}$$

$\because\ m \downarrow \Rightarrow \omega \uparrow$



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

The part of sand being removed takes away a part of energy.
$\therefore$ Total energy decreases.
$\therefore$ Energy of SHM decreases
As a result Amplitude also decreases.



24.(c)

$T \rightarrow$ Time $[T^1]$

$S \rightarrow$ Surface Tension $S = \frac{F}{\ell} = \frac{[M^1\, L^1\, T^{-2}]}{[L^1]} = [M^1\, T^{-2}]$

$A \rightarrow$ Area $[L^2]$

$\rho \rightarrow$ density $[M^1\, L^{-3}]$

$R \rightarrow$ Radius $[L^1\,]$

With Dimensional Analysis $\rightarrow$

$$T \propto S^\alpha A^\beta \rho^\gamma R^\delta$$

$$[M^0\, L^0\, T^1] = [MT^{-2}]^\alpha [L^2]^\beta [ML^{-3}]^\gamma [L]^5$$

$$[M^0\, L^0\, T^1] = \left[M^{\alpha+\gamma}, L^{2\beta+\delta-3\gamma},\ T^{-2\alpha}\right]$$

$$\Rightarrow -2\alpha = 1$$

$$\Rightarrow \alpha + \gamma = 0$$

$$\Rightarrow \alpha = -\frac{1}{2} \qquad \gamma = -\alpha = \frac{1}{2}$$

$$2\beta + \gamma - 3\gamma = 0$$

$$2\beta + \delta - 3\left(\frac{1}{2}\right) = 0$$

$$2\beta + \delta = \frac{3}{2}$$

25.(c)

$10 \text{ V.S.D.} = 9 \text{ M.S.D.}$
$1 \text{ M.S.D.} = 0.1 \text{ cm (Given)}$
$1 \text{ V.S.D.} = 0.9 \text{ M.S.D.}$
$1 \text{ V.S.D.} = 0.9 \times 0.1 \text{ cm}$
$\therefore \text{ V.S.D.} = 0.09 \text{ cm}$
$\text{L.C.} = 1 \text{ M.S.D.} - 1 \text{ V.S.D.}$
$= (0.1 - 0.09)\text{cm}$
$= 0.01 \text{ cm}$
$\text{Reading} = 5.08 \text{ cm}$
$\text{Positive zero error} = 0.1 \text{ cm (Given)}$
$\therefore \text{ Final Corrected reading} = (5.08 - 0.1)\text{cm}$
$= 4.98 \text{ cm}$

26.(c)

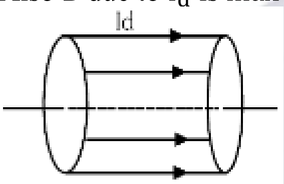
$$I_d = \epsilon_0 \frac{d\phi_e}{dt} = \epsilon_0 \frac{d}{dt}(EA\cos 0^\circ)$$

$$I_d = \epsilon_0 A \frac{dE}{dt}$$

$$\because E = \frac{\sigma}{\epsilon_0}; I_d = \epsilon_0 A \frac{d}{dt}\left(\frac{\sigma}{\epsilon_0}\right)$$

$$\Rightarrow I_d = A\left(\frac{d\sigma}{dt}\right) = \text{ constant}$$

Also B due to I_d is max at surface of imaginary cylinder



27.(a)

When unpolarized light is incident on a medium of refractive index 1.73 at Brewster's angle then reflected light is completely polarized.

Using Brewster's Law

$$\mu = \tan(i_p)$$

$$1.73 = \tan(i_p)$$

$$i_p = 60^\circ$$

By Law of reflection,

$i_p = r = 60^\circ$

28.(d)

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

on touching; $F' = \frac{k(Q/2)(3Q/4)}{r^2}$

$$F' = \frac{3F}{8}$$

After touching $\rightarrow$

(A) & (C) $\rightarrow$

Total charge $\rightarrow q + 0 = q$

$Q'_A = \frac{q}{2}, Q'_C = \frac{q}{2}$

(B) & (C)

$$\text{Total charge } = q + \frac{q}{2} = \frac{3}{2}q$$

$$Q'_B = \frac{3}{4}q \; Q'_C = \frac{3}{4}q$$

29.(b)

By energy conservation

$$E_1 + E_2 = E_{mix}$$

$$\frac{n_1 f_1 RT_1}{2} + \frac{n_2 f_2 RT_2}{2} = \frac{(n_1 \times n_2) fRT_{mix}}{2}$$

$$\Rightarrow \frac{3}{2}P_1V_1 + \frac{3}{2}P_2\,V_2 = \frac{3}{2}P_{mix}\,(V_1 + V_2)$$

$$\frac{3}{2} \times 1 \times 2 + \frac{3}{2} \times 2 \times 3 = \frac{3}{2} \times P_{mix}\,(5)$$

$$\therefore P_{mix} = \frac{8}{5}$$

$$P_{mix} = 1.6 \text{ atm}$$

30. (c)

$$\frac{mv^2}{r} = F \quad \ldots..(i)$$

$$mvr = \frac{nh}{2\pi} \Rightarrow v = \frac{nh}{2\pi mr} \quad \ldots\ldots(ii)$$

From equation (i)

$$\frac{m}{r}\left(\frac{nh}{2\pi mr}\right)^2 = F$$

$$\Rightarrow \frac{n^2h^2}{4\pi^2 mF} = r^3 \Rightarrow r^3 \propto n^2$$

$$\Rightarrow r \propto n^{2/3}$$

From (ii)

$$v \propto \frac{n}{r} \propto \frac{n}{n^{2/3}} \Rightarrow v \propto n^{1/3}$$

31. (a)

$$\frac{T_{Mercury}}{T_{Martian}} = \left(\frac{r_{Mercury}}{r_{Martian}}\right)^{\frac{3}{2}} = \left(\frac{1}{4}\right)^{\frac{3}{2}} = \frac{1}{8}$$

$$T_{Mercury} = \frac{T_{Martian}}{8} = \frac{687}{8} = 85.875 \text{ days } \approx 88 \text{ days}$$

32.(b)

$$W' = mg' = mg\left(\frac{R}{R+h}\right)^2$$

$$= 48\left(\frac{R}{R + \frac{R}{3}}\right)^2$$

$$= 48 \times \frac{9}{16} = 27 \text{ N}$$

33.(c)

Resistance of each part $= R/8$

$$R_{eq} = \frac{1}{4}(R/8) + \frac{1}{4}(R/8) = \frac{R}{16}$$

34.(b)

Given $n = 2, Z = 1$

$$2\pi r = n\lambda$$

$$2\pi \times \left(0.052\frac{n^2}{Z}\right) = n\lambda$$

On solving $\lambda = 0.67$ nm

35.(b)

Given,

$p = 5 \times 10^{-6}\,\text{Cm}$

$E = 4 \times 10^{5}\ \text{N/C}$

$\theta_i = 0°, \theta_f = 60°$

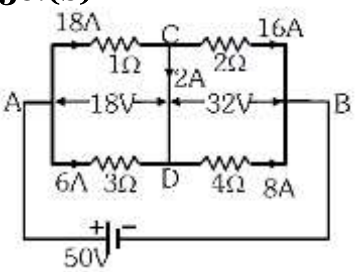
$\Delta U = U_f - U_i$

$= -pE\cos\theta_f - (-pE\cos\theta_i)$

$\Rightarrow pE(\cos\theta_i - \cos\theta_i)$

$\Rightarrow 5 \times 10^{-6} \times 4 \times 10^{5}\left(1 - \frac{1}{2}\right) = 1\ \text{J}$

36.(b)



by KCL; Current in branch CD = 18 − 16 = 2 *A*

37.(c)

Photon & electron have same energy E

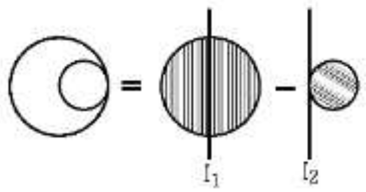
$$\frac{\lambda_{photon}}{\lambda_{electron}} = \frac{\frac{hc}{E}}{\frac{h}{\sqrt{2mE}}} = c\sqrt{\frac{2\ m}{E}}$$

38.(a)

i ∝ intensity so curve A is correct

Photo current does not depend linearly on frequency, so graph C & D are not correct.

39.(c)



$I_1 = \frac{2}{5}M(2R)^2$

$I_2 = \frac{2}{5}mr^2 + md^2$

$= \frac{2}{5}\left(\frac{M}{8}\right)R^2 + \frac{M}{8}(R)^2$

$= \frac{7MR^2}{40}$

$I = I_1 - I_2 = \frac{8MR^2}{5} - \frac{7MR^2}{40} = \frac{57}{40}MR^2$

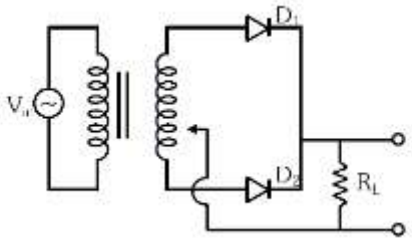
$\frac{I_2}{I_1} = \frac{7}{57}$

40. (b)

At t = 15msec

$V_{in} = 220\sin(100\pi \times 15 \times 10^{-3})$

$= 220\sin\left(\frac{3\pi}{2}\right) = -220\ \text{V}$



So diode D_1 is in reverse bias and D_2 is in forward bias

41. (b)

According to question

Pressure is constant $P_A = P_B$

$Q_A = Q_B$

$\Delta U_A = U_B$

So according to I law

$Q = \Delta U + w$

$w_1 = w_2$

$P_1 \Delta V_1 = P_2 \Delta V_2$

$(\pi r_A^2) x_B = (\pi r_B^2) x_A$

$$\frac{r_A}{r_B} = \sqrt{\frac{x_B}{x_A}} = \sqrt{\frac{9}{16}} = \frac{3}{4}$$

42.(c)

$P = a^3 b^2 c^{-1} d^{-1/2}$

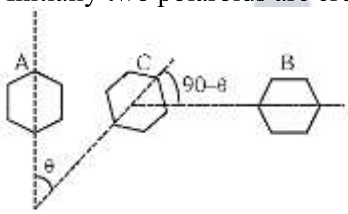
$$\left(\frac{\Delta P}{P} \times 100\right) = \left(\frac{3\Delta a}{a} + \frac{2\Delta b}{b} + \frac{1\Delta c}{c} + \frac{1}{2}\frac{3\Delta d}{d}\right) \times 100$$

$$= 3(1\%) + 2(3\%) + 1(2\%) + \frac{1}{2}(4\%)$$

$= 13\%$

43.(c)

Initially two polaroids are crossed i.e. 90°



After passing from first polaroid intensity is I_0

$$I_{unpolarised} \xrightarrow{A} I_0 \xrightarrow{C} I_0 \cos^2\theta \xrightarrow{B}$$

$I_0 \cos^2\theta \cos^2\theta(90-\theta)$

$$\Rightarrow \frac{I_0}{4}\sin^2(2\theta)$$

$$\Rightarrow \frac{I_0}{4}\sin^2(2\times 22.5)$$

$$\Rightarrow \frac{I_0}{8}$$

44.(d)

Given $m_P = m_Q$

Also $(V_{max})_P = (V_{max})_Q$

$\therefore A_P\omega_P = A_Q\omega_Q$

$$A_P\sqrt{\frac{k_1}{m_P}} = A_Q\sqrt{\frac{k_2}{m_Q}}\left[\because \omega = \sqrt{\frac{k}{m}}\right]$$

$$\therefore \frac{A_Q}{A_P} = \sqrt{\frac{k_1}{k_2}}$$

45. (b)

For open pipe

$$f = \frac{V}{2\ell}$$

When half of its length is dipped in water, Now it is COP.

$$f' = \frac{V}{4(\ell/2)}$$

$$f' = \frac{V}{2\ell}$$

$$f' = f$$

Chemistry

46.(d)

$$\frac{1}{\lambda} = RZ^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

For $2 \to 3 \Rightarrow \frac{1}{\lambda_1} = R \times (1)^2\left(\frac{1}{2^2} - \frac{1}{3^2}\right) \quad \ldots(i)$

For $4 \to 6 \Rightarrow \frac{1}{\lambda_2} = R \times (1)^2\left(\frac{1}{4^2} - \frac{1}{6^2}\right) \quad \ldots(ii)$

Divide (i) & (ii)

$$\frac{\lambda_2}{\lambda_1} = \frac{\frac{1}{2^2} - \frac{1}{3^2}}{\frac{1}{4^2} - \frac{1}{6^2}}$$

$$\frac{\lambda_2}{\lambda_1} = \frac{4}{1}$$

$$\therefore \frac{\lambda_1}{\lambda_2} = \frac{1}{4}$$

47.(b)

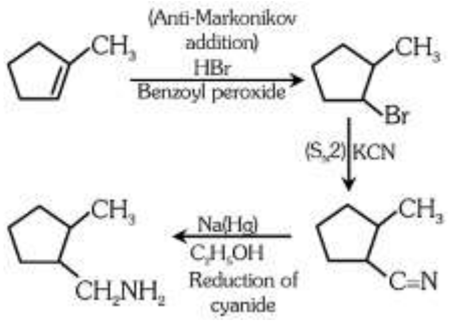
(C) $Ca^{2+}, K^+, Ar, Cl^-, S^{2-}$ all species have 18 electrons that's why these are isoelectronic species.

(E) Radius order $Cs > Rb > K > Na > Li$

48. (b)

A.	Co^{2+}	**III.**	Group-IV
B.	Mg^{2+}	**IV.**	Group-VI
C.	Pb^{2+}	**I.**	Group-I
D.	Al^{3+}	**II.**	Group-III

49.(a)



50.(a)

$E_n = -2.18 \times 10^{-18} \times \frac{Z^2}{n^2} J$

For $He^+ \Rightarrow E_1 = -2.18 \times 10^{-18} \times \frac{2^2}{1^2}$ J

$= -8.72 \times 10^{-18}$ J

For $Li^{2+} \Rightarrow E_1 = -2.18 \times 10^{-18} \times \frac{3^2}{1^2}$ J

$= -19.62 \times 10^{-18}$ J

$r_n = 52.9 \times \frac{n^2}{Z}$ pm

For $He^+ \Rightarrow r_1 = 52.9 \times \frac{1^2}{2}$ pm $= 26.4$pm

For $Li^{2+} \Rightarrow r_1 = 52.9 \times \frac{1^2}{3}$ pm $= 17.6$pm

51. (c)

(A) $[NiCl_4]^{2-} \Rightarrow$ Oxidation state $= +2$

Electronic configuration $= 3d^8 4s^0$

Cl = W.F.L. No Pairing

1⇂	1⇂	1⇂	1	1

2 unpaired electrons

(D) $[Ni(H_2O)_6]^{2+}$

Oxidation state $= +2$, configuration $= 3d^8$

H_2O is W.F.L. No pairing

1⇂	1⇂	1⇂	1	1

2 unpaired electrons

Hence both are paramagnetic

52.(c)

$N = NH_3$ $As \rightarrow AsH_3$ are possible correct statement.

All elements of N -family form two type of E_2O_3 & E_2O_5 oxide.

Statement is wrong.

Statement-I is correct & Statement-II is incorrect.

53.(b)

Main group elements are s & p-block elements.

A→ s-block

C→ p-block

54.(d)

Dalton's atomic theory could not explain law of gaseous volume.

55.(a)

KO_2	H_2O_2
Alkali metals always show +1 O.S. in its compounds	$2(+1) + 2x = 0$ $x = -1$

H_2SO_4

$2(+1) + x + 4(-2) = 0$

x = +6

56.(d)

For 1st order reactions:

$t_{99.9\%} = 10 \times t_{1/2}$

$t_{99.9\%} = 10 \times 1$

$= 10$ minute

57.(b)

Strength of ligand $\uparrow$ $\Delta_0 \uparrow$

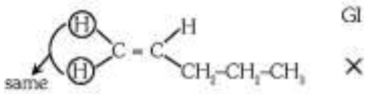
Absorbed Energy $\uparrow$ $\lambda_{\text{absorbed}} \downarrow$

58.(d)

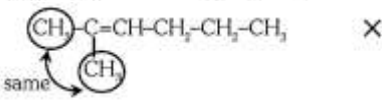
For GI in alkene, each terminal individually must have different atoms/groups attached to it.

For GI in cyclo-alkane, at least two sp^3C of ring individually must have different atoms/groups attached to it.

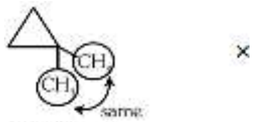
(a)



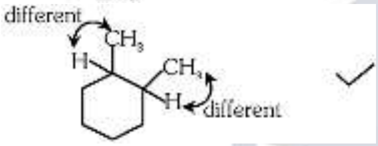
(b)



(c)



(d)



59.(d)

$H_3PO_4 \rightleftharpoons H^+ + H_2PO_4^-; Ka_1$

$H_2PO_4^- \rightleftharpoons H^+ + HPO_4^{2-}; Ka_2$

$HPO_4^{2-} \rightleftharpoons H^+ + PO_4^{3-}; Ka_3$

$H_3PO_4 \rightleftharpoons 3H^+ + PO_4^{3-}; K = Ka_1 \times Ka_2 \times Ka_3$

For polybasic acid, order of ionization constant is $Ka_1 > Ka_2 > Ka_3$ because as negative charge increases, tendency to loose H^+ions decreases.

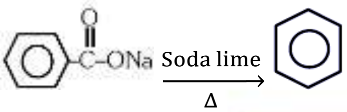
Overall $K = Ka_1 \times Ka_2 \times Ka_3$

Taking log on both sides

$\log K = \log Ka_1 + \log Ka_2 + \log Ka_3$

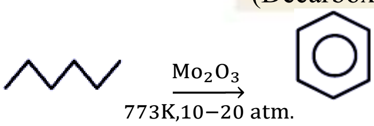
60. (d)

(a)



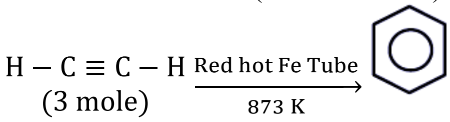
(Decarboxylation)

(b)



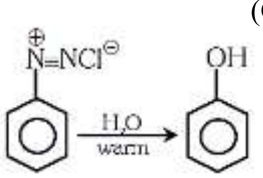
(Aromatization)

(c)



(Cyclic polymerization)

(d)



61.(c)

Degree of dissociation $(\alpha) = \frac{\Lambda_m}{\Lambda_m^o}$

$\Lambda_m^o = \Lambda_+^o + \Lambda_-^o$

$= 349.6 + 50.4 = 400 \text{Scm}^2 \text{ mol}^{-1}$

$\therefore \alpha = \frac{\Lambda_m}{\Lambda_m^o} = \frac{90}{400} = 0.225$

62.(b)

$\left.\begin{matrix} He_2 \\ Be_2 \\ Ne_2 \end{matrix}\right\}$ Bond order $= 0$ (does not exist)
Statement I is false

Bond order $\propto \frac{1}{\text{Bond length}}$

Statement II is false

63.(a, b)

Both (a) & (b) are non-electrolytes that's why they show minimum conductivity among following options.

64.(a)

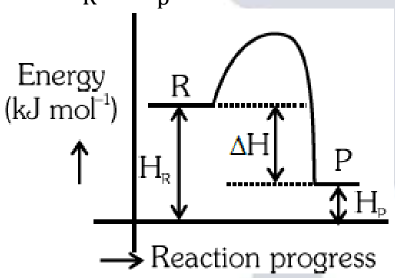
$XeO_3 \rightarrow sp^3$(1LP) – Pyramidal
$XeF_2 \rightarrow sp^3d$(3LP) - Linear
$XeOF_4 \rightarrow sp^3d^2$ (1LP) - Square pyramidal
$XeF_6 \rightarrow sp^3d^3$ (1LP) - Distorted octahedral

65.(a)

For Exothermic reaction

$\Rightarrow \Delta H = H_p - H_R = -ve$

$\therefore H_R > H_p$



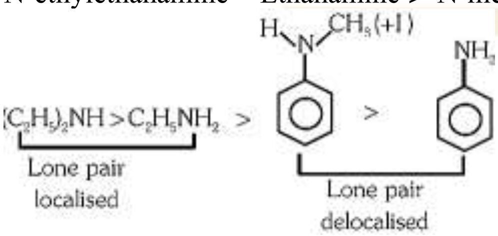
66.(b)

A → Humidity ⇒ Liquid in Gas
B → Alloy ⇒ Solid in solid
C → Amalgams ⇒ Liquid in solid
D → Smoke ⇒ Solid in Gas

67.(c)

Basic strength order

N-ethylethanamine > Ethanamine > N-methylaniline > Benzenamine



68. (b)

No. of atoms = Atomicity × mole × N_A

(A) No. of atoms $= 6 \times \frac{212}{106} \times N_A = 12\ N_A$

(B) No. of atoms $= 3 \times \frac{248}{62} \times N_n = 12\ N_A$

(C) No. of atoms $= 3 \times \frac{240}{40} \times N_A = 18 N_A$

(D) No. of atoms $= 2 \times \frac{12}{2} \times N_A = 12\ N_A$

(E) No. of atoms $= 3 \times \frac{220}{44} \times N_A = 15\ N_A$

69.(b)

Correct match

A. Vitamin B_{12} **IV.** Pemicious Anaemia

B. Vitamin D **III.** Rickets

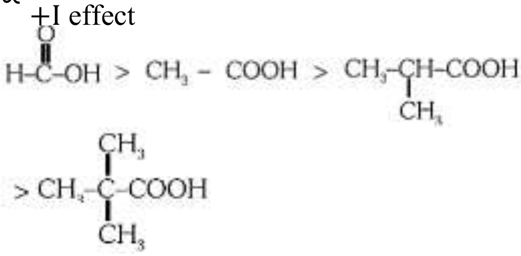
C. Vitamin B_2 **I.** Cheilosis

D. Vitamin B_6 **II.** Convulsions

70.(c)

Acidic strength $\propto -I$ effect

$\propto \frac{1}{+I \text{ effect}}$



71. (c)

Ferromagnetism > Paramagnetism

Statement-I is true

$Cr^{+2} = 3d^4$

1	1	1	1	

4 unpaired electrons

$Nd^{+3} = 4f^3$

1	1	1		

3 unpaired electrons

Statement-II is false.

72.(a)

Correct Match

A. $CHCl_3 + C_6H_5NH_2 \rightarrow$ Simple distillation (IV)

B. Crude oil in petroleum industry → Fractional distillation (III)

C. Glycerol from spent-lye → Distillation under reduced pressure (I)

D. Aniline-water → Steam distillation (II)

73.(c)

$K_C = \frac{K_f}{K_b}$

$= \frac{K_f}{2500\ K_f}$

$= \frac{1}{2500}$

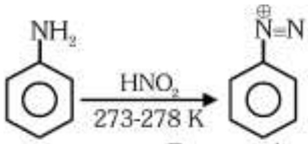
$K_p = K_c(RT)^{\Delta n_g}$

$= \frac{1}{2500}(0.0831 \times 1000)^1$

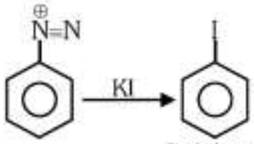
$K_p = 0.033$

74.(a)

Benzenediazonium chloride is a colourless crystalline solid. It is readily soluble in water and is stable in cold but reacts with water when warmed. It decomposes easily in the dry state.

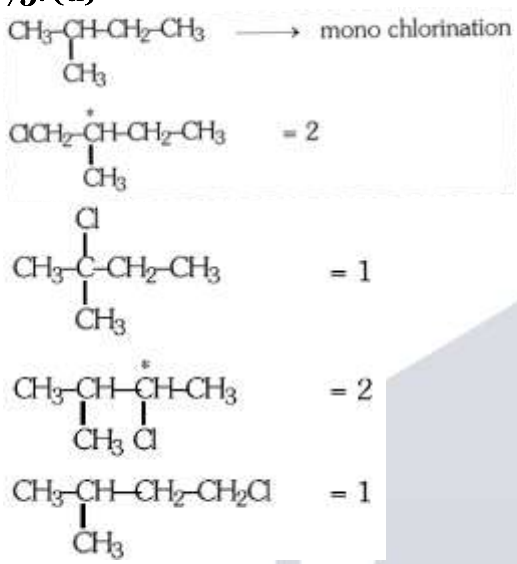


Benzene diazonium salt



Iodobenzene

75. (d)

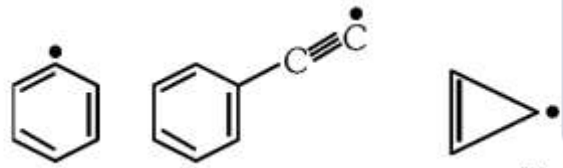


* → Chiral Carbon

Total = 6 (including stereo isomers

76. (a)

Bond dissociation energy $\propto \dfrac{1}{\text{Stability of free radical after formed C-H bond fission homolytically}}$

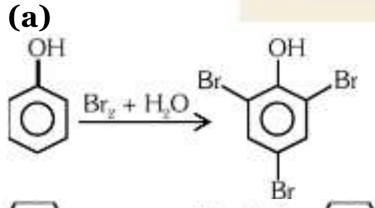


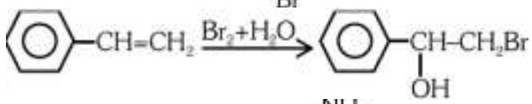
I I III

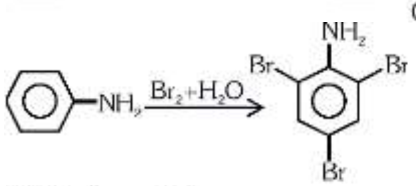
Stability order III > I > II

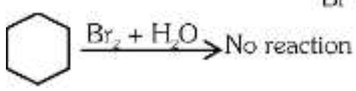
Bond dissociation energy order ⇒ II > I > III.

77. (a)

(a) 

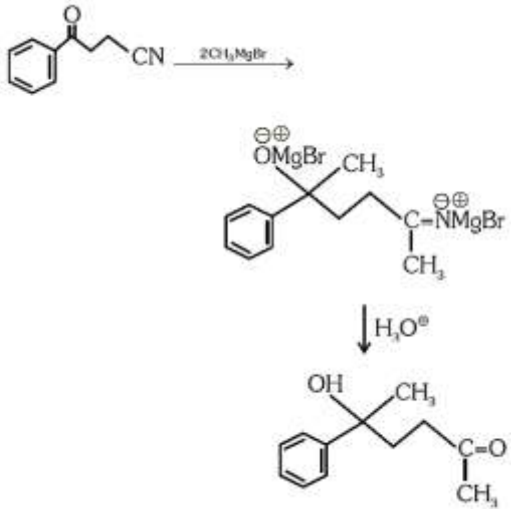
(b) 

(c) 

(d) 

∴ Bromine water solution is decolourised in reaction (a), (b), (c) but not in (d).

78. (b)



79. (c)

$\Delta T_b = iKm$

- Consider $m \approx M$
- K_b same for all

$i \times M$

(a) $1 \times 0.01 = 0.01$
(b) $2 \times 0.01 = 0.02$
(c) $3 \times 0.01 = 0.03$
(d) $1 \times 0.015 = 0.015$

$iM \uparrow \Rightarrow \Delta T_b \uparrow \Rightarrow T_b \uparrow$

80. (c)

Catalyst according to NCERT.

81. (b)

X Y

$n_x = 5$ $n_y = 10$

$P_x^0 = 63$ $P_y^0 = 78$

$P_{s(calc.)} = P_x^0 x_x + P_y^0 X_y$

$= \frac{63 \times 5}{15} + 78 \times \frac{10}{15}$

$= 21 + 52$

$= 73$

$P_{s\,(obs.)} = 70$

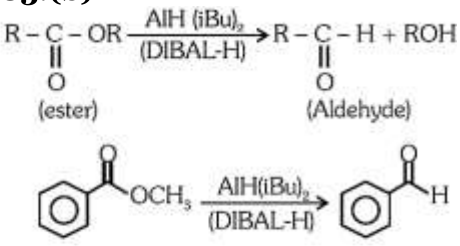
$P_{s\,(obs.)} < P_{s(calc.)}$

-ve deviation

82. (b)

D-fructose is a keto sugar exists in α and β anomeric forms. Its is laevorotatory, found in honey.

83. (b)



84. (a)

Rate of $S_n2 \propto$ Leaving tendency of leaving group. Iodine is better L.G. than chlorine due to its bigger size.

85.(a)

$Ba^{+2}_{(aq)} + SO^{-2}_{4(aq)} \rightarrow BaSO_4;\ \Delta H_r = \Delta H_{Crys.(BaSO_4)} = -4.5\ kCal\ mol^{-1}$

$\downarrow \quad \downarrow \quad \downarrow$

$\Delta H_f(Ba^{+2}) \quad \Delta H_f(SO_4^{-2}) \quad \Delta H_f(BaSO_4)$

$\downarrow \quad \downarrow \quad \downarrow$

$=? \quad = -216 \quad = -349$

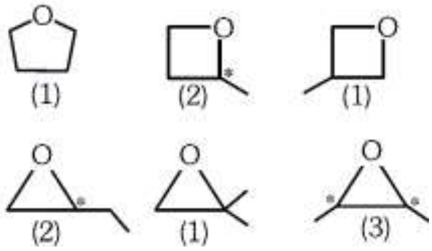
$\Delta H_{crys}(BaSO_4) = \Delta H_f(BaSO_4) - [\Delta H_f(Ba^{+2}) + \Delta H_f(SO_4^{-2})]$

$-4.5 = [-349] - [\Delta H_f(Ba^{+2}) + (-216)]$

$\Delta H_f(Ba^{+2}) = -128.5 kCal\ mol^{-1}$

86. (c)

* = Chiral Carbon

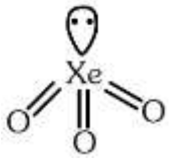


Total = 10

87.(a)

(A) $H_2O > NH_3 > CHCl_3$ – correct

(B)



1LP

XeF_4 XeO_3 XeF_2 - Incorrect

(2LP) (1LP) (3LP)

(C) O-H > C – H > N – O - Incorrect

According to size of element.

(D) $N_2 > O_2 > H_2$ – correct

$N \equiv N\ O = O\ H - H$

88. (d)

$N_2(g) + O_{2(g)} \rightleftharpoons 2NO_{(g)}; \Delta H = +180.7\ kJ\ mol^{-1}$

(A) as T $\uparrow \Rightarrow$ reaction shifts forward

(B) as T $\downarrow \Rightarrow$ reaction shifts backward

(C) as $[N_2] \uparrow \Rightarrow$ reaction shifts forward

(D) as $[O_2] \uparrow \Rightarrow$ reaction shifts forward

89. (a)

$K = 0.03\ s^{-1}$ (First order reaction)

$A_0 = 7.2\ mol\ L^{-1}$

$A_t = 0.9\ mol\ L^{-1}$

$7.2 \xrightarrow{t_{1/2}} 3.6 \xrightarrow{t_{1/2}} 1.8 \xrightarrow{t_{1/2}} 0.9$

$$t = 3t_{1/2} = \frac{3 \times 0.693}{0.03} = 69.3\ s$$

90. (d)

$2CuO + C \xrightarrow[\Delta]{} 2Cu + CO_2$

"Lassaigne's test" is used to detect Nitrogen, Halogen, Sulphur, Phosphorus.

4th option is detection of carbon, it is not "Lassaigne's test".

Biology

91.(b)

92.(b)

93.(a)
94.(d)
95. (a)
96. (a)
97. (a)
98. (a)
99. (c)
100. (c)
101. (d)
102. (b)
103. (c)
104. (d)
105. (d)
106. (c)
107. (d)
108. (d)
109. (b)
110. (a)
111. (a)
112. (a)
113. (b)
114. (d)
115. (c)
116. (a)
117. (c)
118. (a)
119. (c)
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124. (d)
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126. (d)
127. (c)
128. (a)
129. (b)
130. (b)
131. (d)
132. (b)
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135. (b)
136. (a)
137. (c)
138. (a)
139. (d)
140. (a)
141. (a)

142. (a)
143. (c)
144. (a)
145. (c)
146. (a)
147. (b)
148. (d)
149. (c)
150. (d)
151. (a)
152. (a)
153. (a)
154. (c)
155. (c)
156. (d)
157. (b)
158. (a)
159. (b)
160. (b)
161. (b)
162. (b)
163. (a)
164. (b)
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166. (b)
167. (b)
168. (b)
169. (d)
170. (c)
171. (d)
172. (a)
173. (a)
174. (c)
175. (c)
176. (b)
177. (b)
178. (a)
179. (d)
180. (b)