SUBJECT - I	PHYSICS	SOLUTIONS

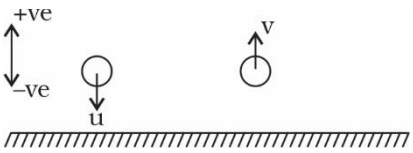
1.(1)

We are given that is constant

As displacement current is constant magnetic field will be maximum at surface.

2.(4) Potential energy of dipole in uniform electric field

3.(3) u = initial velocity

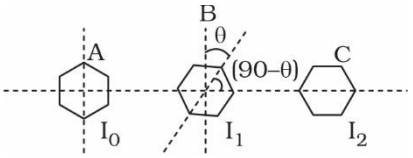


Final velocity

We know that impulse is equal to change in momentum.

Impulse

4.(1)



From law of malus

5.(4) From work energy theorem we can saw that net work done is equal to change in kinetic energy

$W = \Delta K$

$W = F S \cos 180°$

$\Delta K = K_f - K_i$

$$\frac{\Delta K_1}{\Delta K_2} = \frac{-F_1 S_1}{-F_2 S_2}$$

$S_1 = 1000\ m$

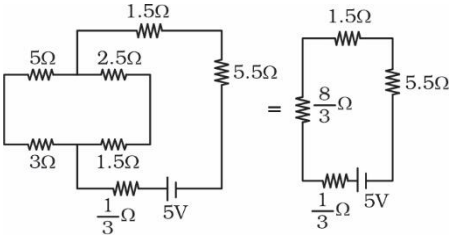
$S_2 = 1500\ m$

$\Delta K_1 = -100$ J

$\Delta K_2 = -225$ J

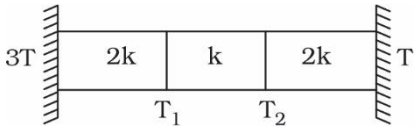
$$\boxed{\frac{F_1}{F_2} = \frac{2}{3}}$$

6.(4) As the wheat stone bridge is balanced we can remove the middle branch



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

7.(1)



Let us find net thermal resistance

$$R_{thermal} = \frac{\ell}{2kA} + \frac{\ell}{kA} + \frac{\ell}{2kA}$$

$$= \frac{\ell + 2\ell + \ell}{2kA} = \frac{4\ell}{2kA} = \frac{2\ell}{kA}$$

$$\text{Heat current} = i = \frac{\Delta T}{R_{thermal}}$$

$$i = \frac{3T - T}{\frac{2\ell}{kA}} = \frac{2T \times kA}{2\ell} = \frac{kAT}{\ell}$$

In rod 1

$$\Rightarrow \frac{3T - T_1}{\frac{\ell}{2kA}} = \frac{kAT}{\ell}$$

(in steady state current is same in every section of rod)

$2(3T - T_1) = T$

$6T - 2T_1 = T$

$2T_1 = 5T$ $\quad \boxed{T_1 = \frac{5}{2}T}$ ...(i)

In rod 3

$$\frac{T_2 - T}{\frac{\ell}{2kA}} = \frac{kAT}{\ell}$$

$$2(T_2 - T) = T$$

$$2T_2 - 2T = T$$

$$3T = 2T_2 \qquad \boxed{T_2 = \frac{3}{2}} \qquad \text{...(ii)}$$

From (i) and (ii)

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

8.(4) $\omega = \sqrt{\frac{k}{m}}$ as m is decreasing w will increase.

As sand leaks slowly $\frac{dm}{dt}$ is very small and relative velocity is zero, energy of the system is decreasing.

Hence amplitude will also decrease.

9.(2)

$$\frac{di}{dt} = 2A \qquad T = 2A$$

$$V_A - \frac{Ldi}{dt} - 5 - 2i = V_B$$

$$V_A - V_B = L\frac{di}{dt} + 5 + 2i = 1 + 5 + 2 \times 2 = 10V$$

10.(1) F = constant

$$F = \frac{mv^2}{r} \Rightarrow r \propto v^2 \qquad \text{...(i)}$$

$$mvr = \frac{nh}{2\pi} \qquad \text{...(ii)}$$

From (i) and (ii)

$v^3 \propto n$ & $\boxed{v \propto n^{1/3}}$

$r \propto v^2$ $\boxed{r \propto n^{2/3}}$

11.(4) $t = x^2 + x$

Differentiating both sides w.r.t time

$$l = 2x\frac{dx}{dt} + \frac{dx}{dt} = 2xv + v$$

$$V = \frac{1}{(2x+1)}$$

$$a = v\frac{dv}{dx} = \frac{1}{(2x+1)}\frac{-2}{(2x+1)^2}$$

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

12.(4) Flux $= BA\cos 0° = n\left(\frac{h}{e}\right)$

$A = \left(\frac{nh}{eB}\right)$ ...(i)

Magnetic moment$(M) = IA = \frac{ev}{2\pi r} \times \frac{nh}{eB}$ ...(ii)

$I = \frac{eB}{2\pi r}$

Also $evB = \frac{mv^2}{r}$ ...(iii)

$v = \frac{eBr}{m} = \frac{e}{2\pi r} \times \frac{eBr}{m} \times \frac{nh}{eB}$

From (i), (ii) and (iii) we get

For $\boxed{n = 1}$

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

13.(4) $f_0 = 2cm \quad f_e = 4 \text{ cm} \quad L = 40 \ cm$

$D = 25 \text{ cm}$

(magnification)$m = \frac{LD}{f_0 f_e}$

$m = \frac{40 \times 25}{2 \times 4} = 125$

14.(2) $t = \sqrt{\frac{2s}{a}}$ (time body take to slide down the inclined plane with constant acceleration)

$t_{friction(f)}$ = time body take to slide down the inclined plane with friction present.

$t_{frictionless(f\ell)}$ = time body take to slide down the inclined plane with friction absent.

From the question

$t_{friction(f)} = 2 \times t_{frictionless(f\ell)}$

$\sqrt{\frac{2s}{a_f}} = 2\sqrt{\frac{2s}{a_{f\ell}}}$

$\frac{1}{a_f} = \frac{4}{a_{f\ell}}$

$a_f = g\sin\theta - \mu_k g\cos\theta$ (acceleration when friction is present)

$a_{f\ell} = g\sin\theta$ (acceleration when friction is absent)

$\frac{1}{g\sin\theta - \mu_k g\cos\theta} = \frac{4}{g\sin\theta}$

$g\sin\theta = 4g\sin\theta - 4\mu_k g\cos\theta$

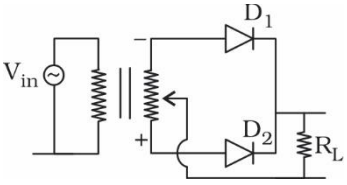
$3g\sin\theta = 4\mu_k \cos\theta$

$\mu_k = \frac{3}{4}\tan\theta = \frac{3}{4}\tan 45° = \frac{3}{4}$

15.(4) $V_{in} = 220\sin(100\pi t) \quad t = 15m\sec$

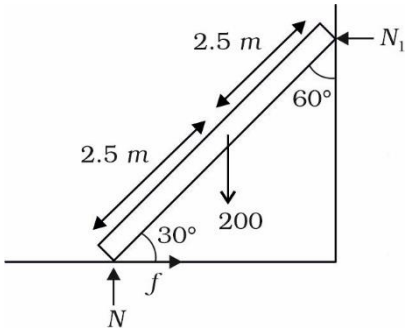
$$V_{in} = 220\sin\left(100\pi \times \frac{15}{1000}\right) = 220\sin\frac{3\pi}{2}$$

$\boxed{V = -220V}$



D_1 is reverse biased and D_2 is forward Biased.

16.(4)



$\Sigma F_x = 0$

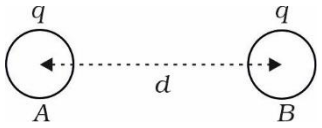
$\Rightarrow \; f = N_1 \qquad \ldots(i)$

$\tau_{net} = 0$ (about bottom)

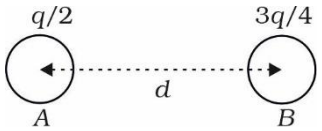
$$200 \times \frac{5}{2}\cos 30° - N_1 \times 5\cos 60° = 0$$

$N_1 = 100\sqrt{3}$ Newton $\quad \Rightarrow \; f = 100\sqrt{3}N$

17.(2)



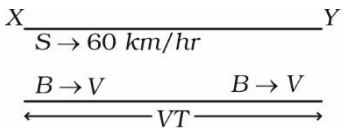
$$\frac{1}{4\pi\varepsilon_0}\frac{q^2}{d^2} = F$$

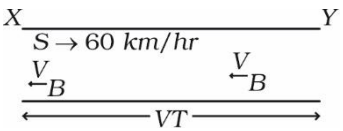


$$F' = \frac{1}{4\pi\varepsilon_0}\frac{(q/2)(3q/4)}{d^2}$$

$$F' = \frac{3}{8} \times \frac{1}{4\pi\varepsilon_0}\frac{q^2}{d^2} = \frac{3}{8}F$$

18.(2)





Separation between two buses $X = VT$

Relative velocity of bus w.r.t. girl in direction of motion of girl = $(V - 60)km/hr$

$$30\min = \frac{X}{V-60} = \frac{VT}{V-60} \qquad \ldots(i)$$

Relative velocity of bus w.r.t. girl in direction opposite to motion of girl = $(V + 60)km/hr$

$$10\,\text{min} = \frac{X}{V+60} = \frac{VT}{V+60} \qquad \ldots(ii)$$

Using (i) and (ii)

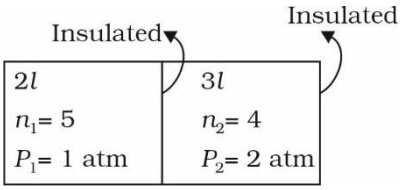
$$\frac{30}{10} = \frac{V+60}{V-60} \Rightarrow 3(V-60) = V+60$$

$$\Rightarrow \quad 2V = 240$$

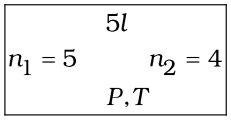
$$\Rightarrow \quad V = 120\,km/hr$$

So, $10 = \frac{120T}{120+60} = T = \frac{180}{12} = 15\,\text{min}$

19.(4)



$$\frac{(1\,atm)(2l)}{5R} = T_1, \quad \frac{(2\,atm)(3l)}{4R} = T_2$$



$$T = \frac{P\times 5l}{(n_1+n_2)R} = \frac{P\times 5l}{9R}$$

$\Delta Q = \Delta U + W$

$\Delta Q = 0, \; W = 0$ (for whole system)

$$\Rightarrow \quad \Delta U = 0$$

$$\Rightarrow \quad n_1 C_V (T - T_1) + n_2 C_V (T - T_2) = 0$$

$$\Rightarrow \quad n_1 (T - T_1) = n_2 (T_2 - T)$$

$$\Rightarrow \quad 5\times\left(\frac{P\times 5l}{9R} - \frac{1\,atm\times 2l}{5R}\right) = 4\times\left(\frac{2\,atm\times 3l}{4R} - \frac{P\times 5l}{9R}\right)$$

$$\Rightarrow \quad 9\times\frac{P\times 5l}{9R} = 8\,atm \quad \Rightarrow \quad P = \frac{8}{5} = 1.6\,atm$$

20.(4) $mvr = 2\times\frac{h}{2\pi}$

$$mv = \frac{h}{\pi r}$$

$$\lambda = \frac{h}{mv} = \frac{h}{h/\pi r} \Rightarrow \lambda = \pi r$$

$$\lambda = \pi\times 0.53\frac{n^2}{Z}\,\text{Å} = \pi\times 0.53\times\frac{(2)^2}{1}\,\text{Å}$$

$$\lambda \approx 0.67\,nm$$

21.(4) $i_{rms} = \frac{E_{rms}}{\sqrt{R^2+(X_L-X_C)^2}} = \frac{220}{\sqrt{(20)^2+(45-25)^2}} = \frac{220}{20\sqrt{2}} = 7.78A$

$$\tan\phi = \frac{X_L - X_C}{R} = \frac{45-25}{20} \Rightarrow \quad \phi = 45°$$

22.(3) Number of photons striking metal surface $(dN) = \dfrac{IA\lambda dt}{hC}$

$$\text{Photocurrent} = \frac{dN \times e}{dt}$$

$$\text{Photocurrent} = \frac{IA\lambda e}{hC}$$

Photocurrent $\propto$ Intensity

Photocurrent is independent of frequency.

23.(4) $f_{open} = \dfrac{V}{2l} = f$

$$f_{Closed} = \frac{V}{4(l/2)} = \frac{V}{2l}$$

$$f_{Closed} = f$$

24.(2) $V_{\max} = A\omega = A\sqrt{\dfrac{k}{m}}$

$V_P = V_Q$

$$\Rightarrow A_P\sqrt{\frac{k_1}{m}} = A_Q\sqrt{\frac{k_2}{m}} \Rightarrow \frac{A_Q}{A_P} = \sqrt{\frac{k_1}{k_2}}$$

25.(2) $Y = (\overline{A+B}).(\overline{A\cdot B})$

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

$= \overline{A}\cdot\overline{B}\cdot\overline{A} + \overline{A}\cdot\overline{B}\cdot\overline{B}$

$= \overline{A}\cdot\overline{B} + \overline{A}\cdot\overline{B} = \overline{A}\cdot\overline{B}$

$= \overline{A+B}$

26.(1) $P_f = 12\,atm, \qquad V_f = 30\,l, \qquad T_f = 27°C = 300K$

$$n_f = \frac{P_f V_f}{RT_f} = \frac{(12\times1.01\times10^5)\times(30\times10^{-3})}{\frac{100}{12}\times300}$$

$$n_f = \frac{12\times12\times1.01\times10^2\times30\times10^{-3}}{10^3\times30} \Rightarrow \eta_f = 14.544\,mol$$

$\Delta n = n_i - n_f = 18.20 - 14.544 = 3.656\,mol$

$$\text{Mass evacuated} = 3.656\times\frac{32}{1000} = 0.116\,kg$$

27.(1) $P_{eq} = P + P + P + P = 4P$

$M_{eq} = (m)^4$

28.(4) Given $\Delta Q_1 = \Delta Q_2$ and $\Delta U_1 = \Delta U_2$

$\Rightarrow W_1 = W_2$

$\Rightarrow P(\pi r_A^2)(16\,cm) = P(\pi r_B^2)(9\,cm)$

$$\frac{r_A}{r_B} = \frac{3}{4}$$

29.(1) $T \propto S^{\alpha} A^{\beta} P^{\gamma} R^{\delta}$

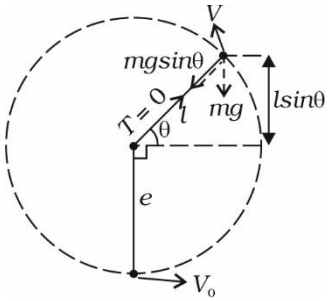
$$\left[M^0L^0T^1\right] = \left[MT^{-2}\right]^{\alpha}\left[L^2\right]^{\beta}\left[MT^{-3}\right]^{\gamma}\left[L\right]^{\delta}$$

Comparing exponent of T, $1 = -2\alpha \Rightarrow \alpha = \dfrac{-1}{2}$

Comparing exponent of M, $0 = \alpha + \gamma \Rightarrow \gamma = -\alpha = \dfrac{1}{2}$

$\alpha = \dfrac{-1}{2}$ and $\gamma = \dfrac{1}{2}$ is present in option (1) only.

30.(2)



$$mg\sin\theta = \frac{mV^2}{l} \Rightarrow V^2 = gl\sin\theta$$

$$\frac{1}{2}mV_0^2 = mg(l + l\sin\theta) + \frac{1}{2}mV^2$$

$$V_0^2 = 2gl(1 + \sin\theta) + V^2$$

$$V_0^2 = 2gl(1 + \sin\theta) + gl\sin\theta$$

$$V_0 = \sqrt{2gl + 3gl\sin\theta}$$

$$\frac{V}{V_0} = \sqrt{\frac{\sin\theta}{2 + 3\sin\theta}}$$

31.(1) $P = \dfrac{a^3b^2}{c\sqrt{d}}$

$$\frac{dP}{P} = 3\frac{da}{a} + 2\frac{db}{b} + \frac{dc}{c} + \frac{1}{2}\frac{d(d)}{d}$$

Multiply both sides by 100

$$\Rightarrow \frac{dP}{P}\times 100 = 3\frac{da}{a}\times 100 + 2\frac{db}{b}\times 100 + \frac{dc}{c}\times 100 + \frac{1}{2}\frac{d(d)}{d}\times 100$$

$$\Rightarrow \%\ \text{age error in}\ P = 3\times 1 + 2\times 3 + 2 + \frac{1}{2}\times 4$$

$$\Rightarrow \%\ \text{age error in}\ P = 13\%$$

32.(2) $I_iW_i = I_fW_f$

$$\Rightarrow \frac{2}{5}mR_i^2\frac{2\pi}{T_i} = \frac{2}{5}mR_f^2.\frac{2\pi}{T_f}$$

$$\Rightarrow T_f = \frac{R_f^2}{R_i^2}T_i$$

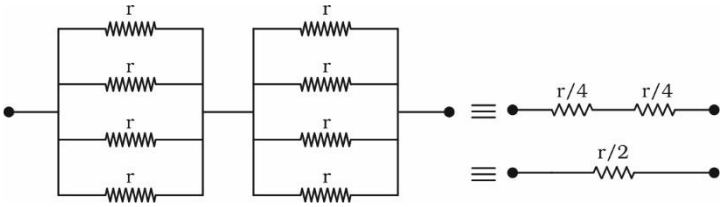
$$\Rightarrow T_f = 4T_i = 4\times 27 = 108\,\text{days}$$

33.(3) $R_{Mars} = 4R_{Mercury}$

We know $\frac{T_{Mars}^2}{T_{Mercury}^2} = \frac{R_{Mars}^3}{R_{Mercury}^3}$

$\Rightarrow \quad \frac{687^2}{T_{Mercury}^2} = 4^3 \Rightarrow T_{mercury} \approx 86\,days$

34.(1) Resistance of each pieces $= \frac{R}{8} = r(say)$



Thus $R_{eq} = \frac{r}{2} = \frac{R}{16}$

35.(1) $\lambda_{Photon} = \frac{hc}{E}$

$\lambda_{electron} = \frac{h}{\sqrt{2mE}}$

$\therefore \quad \frac{\lambda_{photon}}{\lambda_{electron}} = c\sqrt{\frac{2m}{E}}$

36.(1) Mass density $(\rho) = \frac{M}{\frac{4}{3}\times(2R)^3} = \frac{3M}{32\pi R^3}$

Removed mass (m) $= \rho \times \frac{4}{3}\pi R^3 = \frac{M}{8}$

Moment of inertia of removed part about y – axis $= \frac{2}{5}mR^2 + mR^2 = \frac{7}{40}MR^2$

Moment of inertia of remaining part $= \frac{2}{5}M(2R)^2 - \frac{7}{40}MR^2 = \frac{57}{40}MR^2$

Ratio $= \frac{\frac{7}{40}MR^2}{\frac{57}{40}MR^2} = \frac{7}{57}$

37.(4) $\vec{F}_B = q(\vec{V}\times\vec{B})$

$\vec{F}_E = q\vec{E}$

As electron passes undeflected $\vec{F}_{net} = 0$

$q(\vec{V}\times\vec{B}) = q\vec{E}$

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

$\Rightarrow \vec{B} \perp \vec{E}$ and $E = VB$

$= 3\times10^6 \times 9\times10^{-4} = 27\times10^2 V/m$

38.(3) $E_z = 60\cos(5x + 1.5\times10^8 R)V/m$

$\Rightarrow$ Propagation of wave is along (–) x, direction

$\hat{S} = \hat{E}\times\hat{B} \Rightarrow \vec{B}$ must oscillate in y.

$$s = \frac{w}{k} = \frac{1.5\times10^3}{5} = 3\times10^8 m/s$$

$$B = \frac{60}{3\times10^8} = 2\times10^{-7}T$$

Thus, $B_y = 2\times10^{-7}\cos(5x + 1.5\times10^{10})T$

39.(4) On the surface of earth

$$F_0 = \frac{Gm_1m_2}{R^2} = 48$$

At height $h = R/3$

$$F = \frac{Gm_1m_2}{\left(R+\frac{R}{3}\right)^2} \Rightarrow F = \frac{9}{16}F_0$$

$$\Rightarrow F = \frac{9}{16}\times48 \quad \Rightarrow F = 27N$$

40.(3) $\tan\theta_B = \mu$

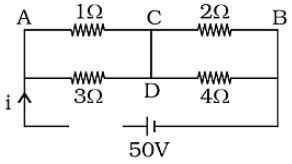
$\Rightarrow \tan\theta_B = 1.73 \quad \Rightarrow \theta_B = 60°$

If angle of incidence $= \theta_B$

Then reflected light in completely polarized and refracted light in partially polarised.

41.(4) $R_{eq} = \frac{25}{12}\Omega$

$$i = \frac{50}{25}\times12 = 24A$$



$V_{AC} = 18V$

$V_{CB} = 32V$

Current through 1Ω resistor $= \frac{18}{1} = 18A$

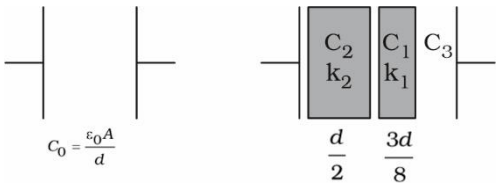
Current through 2Ω resistor $= \frac{32}{2} = 16A$

Thus, current through Cd branch = 18 – 16 = 2 A

42.(3) $C_1 = \frac{8\varepsilon_0 A}{3d}k_1$

$C_2 = \frac{2\varepsilon_0 A}{d}k_2$

$C_3 = \frac{8\varepsilon_0 A}{d}$



Here C_1, C_2 and C_3 can be considered in series

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

$$\Rightarrow \frac{1}{2C_0} = \frac{3d}{8k_1\varepsilon_0 A} + \frac{d}{2k_2\varepsilon_0 A} + \frac{d}{8\varepsilon_0 A}$$

$$\Rightarrow \frac{1}{2C_0} = \frac{d}{\varepsilon_0 A}\left(\frac{3}{8k_1} + \frac{1}{2k_2} + \frac{1}{8}\right)$$

$$\Rightarrow \frac{1}{2C_0} = \frac{1}{C_0}\left(\frac{3}{8k_1} + \frac{1}{2k_2} + \frac{1}{8}\right)$$

$$\Rightarrow k_1 = \frac{8}{3} = 2.66$$

43.(1) Measured value = Main scale reading + Vernier scale reading + correction

$= 5 + 8 \times 0.01 - 0.1 = 4.98cm$

44.(3) $M = NIA$

$$\frac{M_1}{M_2} = \frac{N.I.B}{N_2 I_2 A_2} \quad (\text{Here } N_1 = N_2 \,\&\, T_1 = T_2)$$

$$\Rightarrow \frac{M_1}{M_2} = \frac{\pi R_1^2}{\pi R_2^2} \Rightarrow \frac{M_1}{M_2} = \frac{1}{4}$$

45.(4) Let radius of curvature at point A is R

As we know that

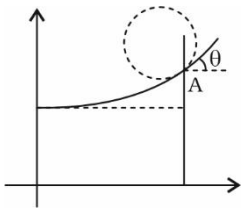
$$R = \frac{\left[1 + \left(\frac{dy}{dx}\right)^2\right]^{3/2}}{\frac{d^2y}{dx^2}}$$

For small value of $\frac{dy}{dx}$

$$R = \frac{1}{\left(\frac{d^2y}{dx^2}\right)} \qquad \ldots.(1)$$

Now decrease in pressure due to surface tension $= \frac{S}{R}$ and it should be equal to ρgy

$$\Rightarrow fgt = \frac{S}{R} \qquad \ldots.(ii)$$



Solve (i) and (ii)

$$\Rightarrow s.\frac{d^2y}{dx^2} = fgy$$

$$\Rightarrow \frac{d^2y}{dx^2} = \frac{fgy}{s}$$

SUBJECT - II	CHEMISTRY	SOLUTIONS

46.(4) DiBAL-H reduce ester into Aldehyde.

47.(1) Electron Donating group (+I effect) decrease the acidic character.

$$HCOOH > CH_3COOH > CH_3-\underset{\underset{CH_3}{|}}{CH}-COOH > CH_3 \rightarrow \overset{\overset{CH_3}{\downarrow}}{\underset{\underset{CH_3}{\uparrow}}{C}}-COOH$$

48.(2) $2CuO + C \xrightarrow{\Delta} 2Cu + CO_2$

49.(3) $k = \frac{2.303}{t}\log\frac{a}{a-x}$

$0.03 = \frac{2.303}{t}\log\frac{7.2}{0.9}$

$t = 69.3\,s$

50.(4)
- Bond order zero than molecule is not exist
- On increases in Bond order, Bond length decreases.

51.(3) & (4)

$\left[CO(NH_3)_3Cl_3\right]$ and $\left[Co(NH_3)_4Cl_2\right]$ does not produce ions so shows minimum conductance.

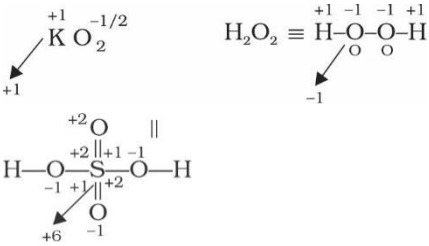
52.(1) Higher the ic, more the boiling point.

53.(3) Relative rate of S_N2 reaction

$R-F < R-Cl < R-Br < R-I$

Iodide is a better leaving group due to large size.

54.(3)



55.(1)

Haber process	Fe catalyst
Wacker oxidation	$PdCl_2$
Wilkinson catalyst	$Rh(PPh_3)_3Cl$
Zeigler catalyst	$TiCl_4 + Al(CH_3)_3$

56.(1) Arsenic can form arsine and all element of 15 gp can form pentoxide.

57.(1) Cr $3d^5\ 45^1$ Nd $4f^4\ 6s^2$

$Cr^{+2}\ 3d^4$ $4f^3$

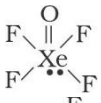
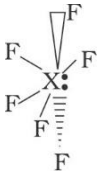
↑	↑	↑	↑	

58.(2)

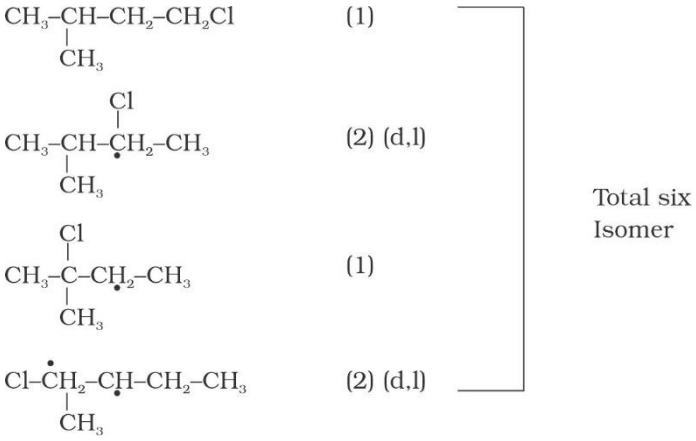
(NOT Benzene)

59.(3)

$$H = \frac{V + M - C + A}{2}$$

XeO_3	$H = \frac{8}{2} = 4\left(sp^3\right)$	 Pyamidal
X_eF_2	$H = \frac{8+2}{2} = 5\left(sp^3d\right)$	 Linear
$XeOF_4$	$H = \frac{8+4}{2} = 6\left(sp^3d^2\right)$	 Square Pyramidal
XeF_6	$H = \frac{8+6}{2} = 7\left(sp^3d^3\right)$	 distorted octahedral

60.(2)



61.(4) **A.** False, as gallium has an unusually low melting point, very much like cesium.

B. False

Atom (Period II)	Li	Be	B	C	**N**	O	F
Electronegativity	1.0	1.5	2.0	2.5	**3.0**	3.5	4.0
Atom (Period III)	Na	Mg	Al	Si	P	S	**Cl**
Electronegativity	0.9	1.2	1.5	1.8	2.1	2.5	**3.0**

C. True, as all the given species are $18e^-$ species.

D. False, as $IE_{Mg} > IE_{Al}$, because of effective shielding of 3p-electrons by 3s-electrons in aluminum.

E. True, as atomic radius increases down the group.

Atom (Group I)	**Atomic Radius (pm)**
Li	152
Na	186
K	231
Rb	244
Cs	262

[These tables can be traced back to NCERT in the chapter "Classification of Elements and Periodicity In Properties"].

$\therefore$ only statements C & E are true.

62.(3) $Ba(s) \rightarrow Ba^{2+}(aq);\ \Delta_f H^\circ = ?$ ...(A)

$\frac{1}{8}S_8(s) + 2O_2(g) \rightarrow SO_4^{2-}(aq);\ \Delta H_1^\circ = -216\,Kcal/mol$ ...(1)

$Ba(s) + \frac{1}{8}S_8(s) + 2O_2(g) \rightarrow BaSO_4(s);\ \Delta H_2^\circ = -349\ Kcal/mol$ ... (2)

$Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s);\ \Delta H_3^\circ = -4.5\,Kcal/mol$ ...(3)

(2) - (1) - (3), we get (A)

So, $\Delta_f H^\circ = \Delta H_2^\circ - \Delta H_1^\circ - \Delta H_3^\circ = (-349) - (-216) - (-4.5)$

$\Delta_f H^\circ = -128.5\,Kcal/mol$

63.(4) **A.** Humidity – Liquid in Gas (II)

B. Alloys – Solid in Solid (I)

C. Amalgams – Liquid in Solid (IV)

D. Smoke – Solid in Gas (III)

64.(3) $\Delta H = E_{products} - E_{Reactants}$

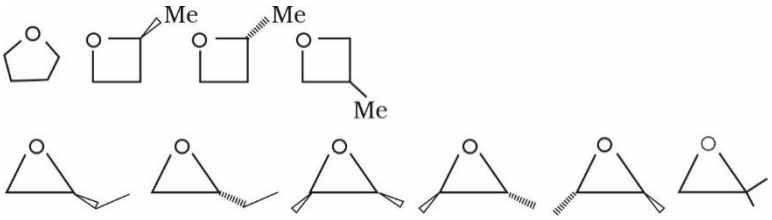
$\Delta H < 0$ for the given reaction

$\therefore \quad E_{Reactants} > E_{Products}$

65.(4) All the given statements are only true for D-fructose out of the given options.

$\therefore$ 'X' is D-fructose.

66.(1)



67.(1) $k_b = 2500\,k_f$ (given)

Now, $K_c = \frac{k_f}{k_b}$ $\quad\therefore\quad$ $K_c = \frac{1}{2500}$

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

$\Delta n_g = 2 - 1 = 1$

So, $K_p = \frac{1}{2500} \times 0.0831 \times 1000$

$K_p = 0.03324 \simeq 0.033$

68.(2) According to Rydberg's formula,

$\frac{1}{\lambda} = RZ^2\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$ [R: Rydberg's constant for wavelength]

So, $\frac{1}{\lambda_1} = R(1^2)\left[\frac{1}{2^2} - \frac{1}{3^2}\right] = \frac{5R}{36} \rightarrow \lambda_1 = \frac{36}{5R}$

$\frac{1}{\lambda_2} = R(1^2)\left[\frac{1}{4^2} - \frac{1}{6^2}\right] = \frac{5R}{144} \rightarrow \lambda_2 = \frac{144}{5R}$

So, $\lambda_1 : \lambda_2 = \frac{36}{5R} \times \frac{5R}{144} = \frac{1}{4}$

69.(1) Given acid: $HA \rightarrow H^+ + A^-$

Degree of dissociation, $\lambda = \dfrac{\Lambda_m}{\Lambda_m^\circ}$

According to Kohlrausch's law of independent migration of ions,

$\Lambda_m^\circ(HA) = \Lambda_{H^+}^\circ + \Lambda_{A^-}^\circ = 349.6 + 50.4 = 400\,Scm^2\,mol^{-1}$ So, $\alpha = \dfrac{90}{400} = 0.225$

70.(4) According to Raoult's law,

$P_{calculated} = P_x^0\chi_x + P_y^0\chi_y = 63 \times \dfrac{5}{15} + 78 \times \dfrac{10}{15} = 73\,torr$

$P_{observed} = 70\,torr\,(given)$

Now, $P_{observed} < P_{calculated}$ $\therefore$ Solution shows negative deviation.

71.(4) Number of molecules = Number of moles $\times N_A$ (N_A : Avogadro number)

Number of atoms = Number of molecules × atomicity

A. $n_{Na_2CO_3} = \dfrac{212}{106} = 2\,mol \rightarrow$ Number of atoms = $2 \times 6 \times N_A = 12N_A$

B. $n_{Na_2O} = \dfrac{248}{62} = 4\,mol \rightarrow$ Number of atoms = $4 \times 3 \times N_A = 12N_A$

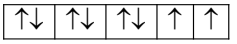
C. $n_{NaOH} = \dfrac{240}{40} = 6\,mol \rightarrow$ Number of atoms = $6 \times 3 \times N_A = 18N_A$

D. $n_{H_2} = \dfrac{12}{2} = 6\,mol \rightarrow$ Number of atoms = $6 \times 2 \times N_A = 12N_A$

E. $n_{NaOH} = \dfrac{220}{44} = 5\,mol \rightarrow$ Number of atoms = $5 \times 3 \times N_A = 15N_A$

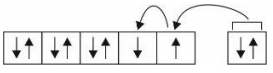
So, parts A, B and D have equal number of atoms, i.e., $12N_A$ atoms.

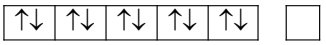
72.(1)A. $[NiCl_4]^{2-}$

$Ni^{2+} : 3d^8$  [Cl^- → Weak field ligand : No pairing occurs]

Complex has two unpaired electrons, $\therefore$, it is paramagnetic.

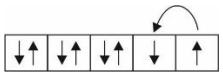
B. $[Ni(CO)_4]$

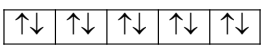
$Ni : 3d^8 4s^2$  [CO → strong field ligand : Pairing occurs]



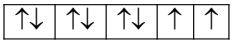
Complex has no unpaired electrons, $\therefore$, it is diamagnetic.

C. $[Ni(CN)_4]^{2-}$

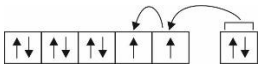
$Ni^{2+} : 3d^8$  [^-CN → strong field ligand : Pairing occurs]

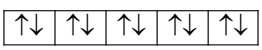


Complex has no unpaired electrons, $\therefore$, it is diamagnetic.

D. $[Ni(H_2O)_6]^{2+}$ $Ni^{2+} : 3d^8$  [H_2O → Weak field ligand : No pairing occurs]

Complex has two unpaired electrons, $\therefore$, it is paramagnetic.

E. $[Ni(PPh_3)_4]$ $Ni : 3d^8 4s^2$  [PPh_3 → Strong field ligand : pairing occurs]



Complex has no unpaired electrons, $\therefore$, it is diamagnetic.

$\therefore$ complexes in parts A and D are paramagnetic.

73.(2) $t_{99.9\%} \simeq 10 t_{1/2} = 10 \times 1 = 10\,\text{minutes}$

74.(3) $E_n(Li^{2+}) = -R_H \frac{Z^2}{n^2} = -2.18 \times 10^{-18} \times \frac{3^2}{1^2} = -19.62 \times 10^{-18} J$

$r_n(Li^{2+}) = a_0 \frac{n^2}{Z} = 52.9 \times \frac{1^2}{3} = 17.63\,\text{pm}$

$E_n(He^{+}) = -R_H \frac{Z^2}{n^2} = -2.18 \times 10^{-18} \times \frac{2^2}{1^2} = -8.72 \times 10^{-18} J$

$r_n(He^{+}) = a_0 \frac{n^2}{Z} = 52.9 \times \frac{1^2}{2} = 26.45\,\text{pm}$

75.(3) As % s-character increases in hybrid orbitals of an atom, its bond strength with other atoms also increases.
Order of bond strength:

$C_{sp} - H > C_{sp^2} - H > C_{sp^3} - H$

So, according to given options, II >I > III is the most appropriate answer.

76.(2) Dalton's atomic theory does not explain gas laws, like, law of gaseous volumes.

77.(3) **A.** Correct, because:

$\mu_{H_2O} = 1.85D, \mu_{NH_3} = 1.47D, \mu_{CHCl_3} = 1.04D$

B. Incorrect, because number of lone pairs on central atom in:

$XeF_4 \rightarrow 2, XeO_3 \rightarrow 1, XeF_2 \rightarrow 3$

C. Incorrect, because:

Bond Type	**Covalent Bond Length (pm)**
O–H	96
C–H	107
N–O	136

D. Correct, because:

$H_2(g) \rightarrow H(g) + H(g); \Delta_a H^{\ominus} = 435.8\,kJ\,mol^{-1}$

$O_2(O = O)(g) \rightarrow O(g) + O(g); \Delta_a H^{\ominus} = 498\,kJ\,mol^{-1}$

$N_2(N \equiv N)(g) \rightarrow N(g) + N(g); \Delta_a H^{\ominus} = 946.0\,kJ\,mol^{-1}$

[All this data can be traced back to NCERT in the chapter "Chemical Bonding and Molecular Structure"]

78.(4)

	Name of Vitamins	**Deficiency diseases**
1.	Vitamin A	Xerophthalmia (hardening of cornea of eye); Night blindness
2.	Vitamin B_1 (Thiamine)	Beri beri (loss of appetite, retarded growth)
3.	Vitamin B_2 (Riboflavin)	Cheilosis (fissuring at corners of mouth and lips), digestive disorders and burning sensation of the skin.
4.	Vitamin B_6 (Pyridoxine)	Convulsions
5.	Vitamin B_{12}	Pernicious anaemia (RBC deficient in haemoglobin)
6.	Vitamin C (Ascorbic acid)	Scurvy (bleeding gums)
7.	Vitamin D	Rickets (bone deformities in children) and osteomalacia (soft bones and joint pain in adults)
8.	Vitamin E	Increased fragility of RBCs and muscular weakness
9.	Vitamin K	Increased blood clotting time

[This table can be traced back to NCERT in the chapter "Biomolecules"].

79.(1) Aliphatic amines are more basic than aromatic amines and 2° amines are more basic than 1° amines.

	Name of amine	pK_b
A.	Ethanamine	3.29
B.	N-Ethylethanamine	3.00
C.	Benzenamine	9.38
D.	N-Methylaniline	9.30

[This table can be traced back to NCERT in the chapter "Amines"].

80.(4)

Coordination entity	Wavelength of light absorbed (nm)	Colour of light absorbed	
$[Co(NH_3)_6]^{3+}$	475	Blue	
$[Co(CN)_6]^{3-}$	310	Ultraviolet	Not in visible region
$[Cu(H_2O)4]^{2+}$	600	Red	
$Ti(H_2O)_6]^{3+}$	498	Blue Green	

[This table can be traced back to NCERT in the chapter "Coordination Compounds"].

[Δ : Crystal field splitting energy]

$\Delta \propto Z_{eff}$ of central metal ion

$\Delta \propto$ Ligand field strength

$\Delta_o > \Delta_t$ and $\lambda_{absorbed} \propto \frac{1}{\Delta}$

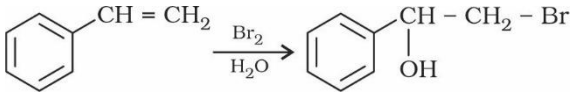
So, $[Cu(H_2O_4]^{2+}$ has the maximum value of $\lambda_{absorbed}$ because of lower oxidation state of copper and lesser number of ligands.

$[Co(CN)_6]^{3-}$ has the minimum value of $\lambda_{absorbed}$ because of higher Z_{eff} on cobalt {as compared to titanium (in D) } and highest ligand field strength of ^-CN (out of all three given ligands)

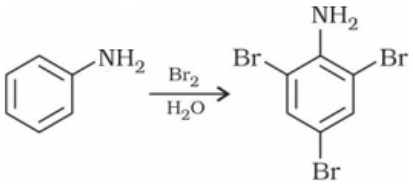
$[Co(NH_3)_6]^{3+}$ has the second lowest value of $\lambda_{absorbed}$ whereas $[Ti(H_2O)_6]^{3+}$ has the second highest value of $\lambda_{absorbed}$ because of higher Z_{eff} on cobalt as compared to titanium and higher ligand field strength of NH_3 over H_2O.

81.(3) Unsaturated compounds decolorise bromine water.

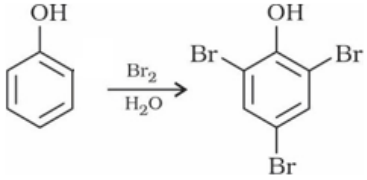
A.



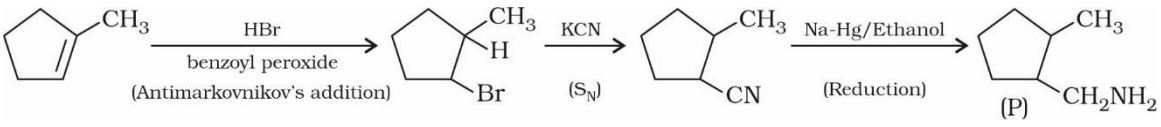
B.



D.



82.(3)



83.(3) **A.** Chloroform (boiling point - 334 K) and aniline (boiling point - 457 K) can be easily separated by simple distillation.

B. Crude oil in petroleum industry is separated using fractional distillation.

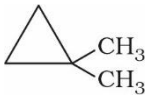
C. Glycerol from spent-lye in soap industry is separated using distillation under reduced pressure.

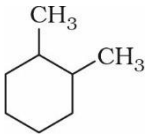
D. Aniline and water are separated using steam distillation.

84.(4) s and p-Block elements are collectively referred as main group elements.

A. $[Ne]3s^1$ **B.** $[Kr]4d^{10}\,5s^2\,5p^5$

85.(2) For geometrical isomerism in alkenes, both carbons must be differently substituted.
In cycloalkanes, at least 2 carbon atoms must be differently substituted.

1.  No G.I.

2.  G.I. exist

3. $CH_2 = CH - CH_2 - CH_2 - CH_3$ No G.I.

4. $CH_3 - \underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}} = CH - CH_2 - CH_2 - CH_3$ No G.I.

86.(2) $H_3PO_4 \rightleftharpoons H_2PO_4^- + H^+$ K_{a_1}

$H_2PO_4^- \rightleftharpoons HPO_4^{2-} + H^+$ K_{a_2}

$HPO_4^{2-} \rightleftharpoons PO_4^{3-} + H^+$ K_{a_3}

$H_3PO_4 \rightleftharpoons PO_4^{3-} + 3H^+$ $K_{net} = K_{a_1} \cdot K_{a_2} \cdot K_{a_3}$

$\log K = \log K_{a_1} + \log K_{a_2} + \log K_{a_3}$

The value of $K_{a_1} >> K_{a_2} > K_{a_3}$, thus, H_3PO_4 is a stronger acid than $H_2PO_4^-$.

Acidity $\propto K_a$

87.(4) Co^{2+} – Group IV

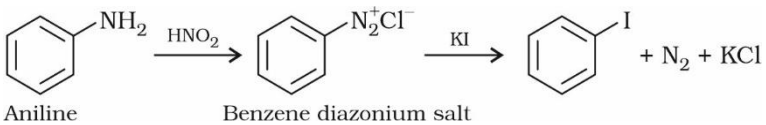
Mg^{2+} – Group VI

Pb^{2+} – Group I

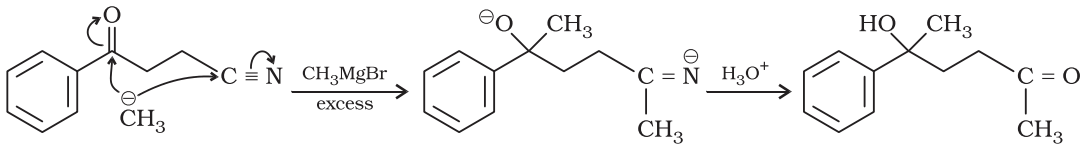
Al^{3+} – Group III

88.(2) For equilibrium, $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$

- Increasing the concentration of reactant i.e., N_2 and O_2 at the state of equilibrium, shifts the reaction in forward direction (Le-Chatelier's Principle).
- Since the reaction is endothermic, high temperature will shift the equilibrium to right direction.

89.(3) 

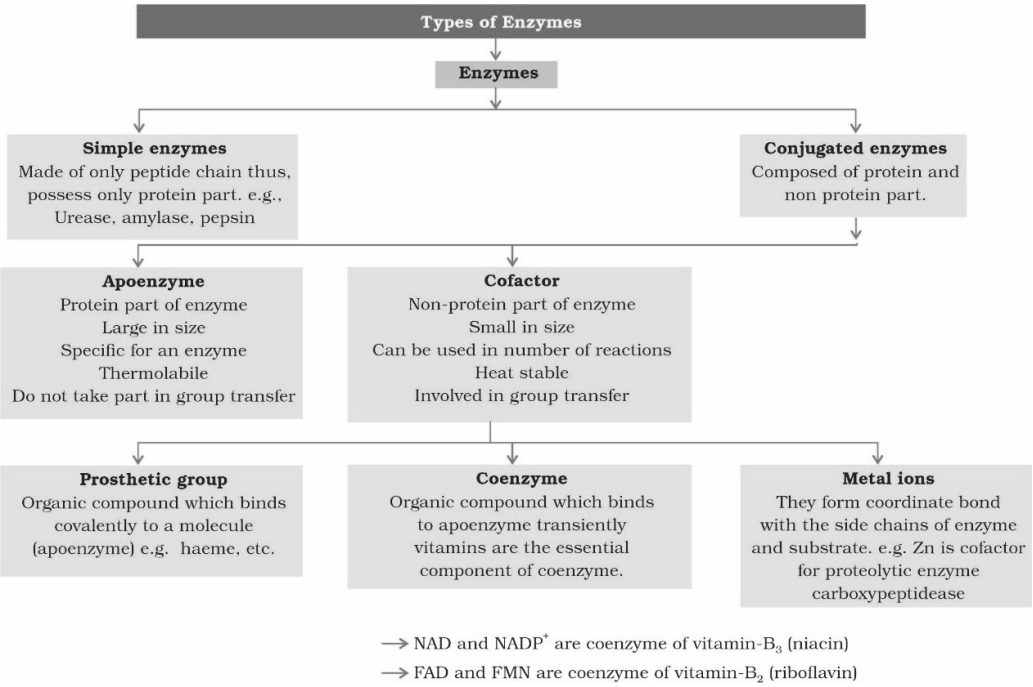
Aniline Benzene diazonium salt

90.(4) 

SUBJECT - III	BIOLOGY	SOLUTIONS

91.(1) In this, a recombinant DNA is inserted within the coding sequence of an enzyme, β-galactosidase. This results into inactivation of the gene for synthesis of this enzyme, which is referred to as insertional inactivation. The presence of a chromogenic substrate gives blue coloured colonies if the plasmid in the bacteria does not have an insert. Presence of insert results into insertional inactivation of the β-galactosidase gene and the colonies do not produce any colour these are identified as recombinant colonies.

92.(1) Enzymes are composed of one or several polypeptide chains. However, there are a number of cases in which non-protein constituents called cofactors are bound to the enzyme to make the enzyme catalytically active. In these instances, the protein portion of the enzymes is called the apoenzyme. Three kinds of cofactors may be identified: prosthetic groups, co-enzymes and metal ion.



93.(1) The rate of production of organic matter during photosynthesis in an ecosystem is gross primary productivity

94.(1) Egg apparatus consist of two synergids and one egg cell.

95.(4) The malignant tumors are a mass of proliferating cells called neoplastic or tumor cells. These cells grow very rapidly, invading and damaging the surrounding normal tissues. As these cells actively divide and grow they also starve the normal cells by competing for vital nutrients. Cells sloughed from such tumors reach distant sites through blood, and wherever they get lodged in the body, they start a new tumor there. This property called metastasis is the most feared property of malignant tumors. So, Neoplastic tumors are not confined to one place.

96.(4) Gymmosperms bears naked seed i.e. no fruit formation.

97.(3) Pars intermedia secretes only one hormone called melanocyte stimulating hormone (MSH). However, in humans, the pars intermedia is almost merged with pars distalis.

After ovulation, the ruptured follicle is converted to a structure called corpus luteum, which secretes mainly progesterone.

Adrenal medulla secretes two hormones called adrenaline or epinephrine and noradrenaline or norepinephrine. These are commonly called as catecholamines.

98.(1) Chromosome 1 carries highest number of genes i.e., 2968 whereas chromosome Y bears least number of genes i.e., 231.

99.(2) Rubisco is most abundant enzyme on earth. It catalyzes carboxylation of RuBP in Calvin cycle.

100.(4) (1) Diapause: A period of suspended development, usually in insects and some animals not related to human menstruation.

(2) Ovulation: Release of an secondary oocyte from the ovary—occurs during each menstrual cycle, not the beginning.

(3) Menopause: Permanent cessation of menstruation—marks the end, not the beginning.

(4) Menarche: Correct answer – The reproductive cycle in the female primates (e.g. monkeys, apes and human beings) is called menstrual cycle. The first menstruation begins at puberty and is called menarch

101.(3) (1) Virus: While viruses are used in gene therapy, insulin production is done using bacteria for large-scale expression.

(2) Phage: Bacteriophages are viruses that infect bacteria, not used directly in insulin production.

(3) Bacterium: E. coli was used by Eli Lilly. 1983, Eli Lilly an American company prepared two DNA sequences corresponding to A and B, chains of human insulin and introduced them in plasmids of E. coli to produce insulin chains. Chains A and B were produced separately, extracted and combined by creating disulfide bonds to form human insulin.

(4) Yeast: Used for production of vaccines (e.g., hepatitis B).

102.(3) The members of subphylum Vertebrata possess notochord during the embryonic period. The notochord is replaced by a cartilaginous or bony vertebral column in the adult. Thus all vertebrates are chordates but all chordates are not vertebrates. Besides the basic chordate characters, vertebrates have a ventral muscular heart with two, three or four chambers, kidneys for excretion and osmoregulation and paired appendages which may be fins or limbs.

103.(3) Spindle fibres arises from centrosome which helps in separation of chromosome.

104.(1) Unequivocal proof of DNA as a genetic material was given by Alfred Hershey and Martha chase.

105.(1) Adenosine $\rightarrow$ Nucleoside: Correct – base + sugar

Adenylic acid $\rightarrow$ Nucleotide: Correct – base + sugar + phosphate

Adenine $\rightarrow$ Nitrogen base: Correct – purine base

Alanine $\rightarrow$ Amino acid: Correct – protein monomer

106.(2) Special venous connection between liver and intestine as well as the kidney and lower parts of the body are present in frogs. The former is called hepatic portal system and the latter is called renal portal system.

107.(4) In eukaryotes, pre-mRNA undergoes all the post-transcriptional modification in Nucleus.

108.(4) n = no. of PCR cycle

After 30 PCR cycles, no. of DNA amplifies to 1 billion copies.

109.(4) In abiotic means of pollination, there is production of large number of pollen grains, flowers are colorless and nectar less.

110.(3) Commensalism is a positive interaction. Epiphytes growing on mango branch is an example of commensalism.

111.(2)

Months	Development
1	Heart, heart beat
2	Limbs and digits
3	Organ and organ system
4	
5	Hair on head, first movement of foetus
6	Hair on body, eyelashes are formed and separated
7	
8	
9	

112.(2)

113.(1) Frogs respire on land and in the water by two different methods. In water, skin acts as aquatic respiratory organ (cutaneous respiration). Dissolved oxygen in the water is exchanged through the skin by diffusion. On land, the buccal cavity, skin and lungs act as the respiratory organs. The respiration by lungs is called pulmonary respiration. The lungs are a pair of elongated, pink coloured sac-like structures present in the upper part of the trunk region (thorax). Air enters through the nostrils into the buccal cavity and then to lungs. During aestivation and hibernation gaseous exchange takes place through skin.

114.(4) Adrenaline and noradrenaline are rapidly secreted in response to stress of any kind and during emergency situations and are called emergency hormones or hormones of Fight or Flight. These hormones increase alertness, pupilary dilation, piloerection (raising of hairs), sweating etc. Both the hormones increase the heart beat, the strength of heart contraction and the rate of respiration. Catecholamines also stimulate the breakdown of glycogen resulting in an increased concentration of glucose in blood. In addition, they also stimulate the breakdown of lipids and proteins

115.(3) Abscisic acid is a plant growth inhibitor. Apical dominance promotes growth of apical buds.

116.(4) Neurohypophysis (pars nervosa) also known as posterior pituitary, stores and releases two hormones alled oxytocin and vasopressin, which are actually synthesised by the hypothalamus and are transported axonally to neurohypophysis. Vasopressin also called as ADH

117.(1) Beer and wine are non-distilled alcohol.

118.(4) Polygenic inheritance shows non-Mendelian inheritance pattern.

119.(3) Sperm a microscopic structure composed of a head, neck, a middle piece and a tail. Plasma membrane envelops the whole body of sperm. The sperm head contains an elongated haploid nucleus, the anterior portion of which is covered by a cap-like structure, acrosome. The acrosome is filled with enzymes that help fertilisation of the ovum. The middle piece possesses numerous mitochondria, which produce energy for the movement of tail that facilitate sperm motility essential for fertilisation.

120.(1) Pea, Bean, Gulmohur, *Cassia* are example of zygomorphic flowers.

121.(4) *Volvox* is an example of Green algae, which does not fixes nitrogen.

122.(1) Zoological parts and Botanical garden are examples of ex-situ conservation.

123.(4) Ramdeo Misra is father of Ecology in India.

124.(3) Therefore, DNA has evolved from RNA with chemical modifications that make it more stable. DNA being double stranded and having complementary strand further resists changes by evolving a process of repair.

125.(2) Transfer RNAs and Ribosomal RNA participates in translation process therefore, they interact with m-RNA.

126.(2) Atrial wall of our heart secretes a very important peptide hormone called atrial natriuretic factor (ANF), which decreases blood pressure. When blood pressure is increased, ANF is secreted which causes dilation of the blood vessels. This reduces the blood pressure. The juxtaglomerular cells of kidney produce a peptide hormone called erythropoietin which stimulates erythropoiesis (formation of RBC). Endocrine cells present in different parts of the gastro-intestinal tract secrete four major peptide hormones, namely Gastrin, secretin, cholecystokinin (CCK) and gastric inhibitory peptide (GIP).

* Gastrin acts on the gastric glands and stimulates the secretion of hydrochloric acid and pepsinogen.
* Secretin acts on the exocrine pancreas and stimulates secretion of water and bicarbonate ions.

127.(2) All living members of the class Cyclostomata are ectoparasites on some fishes. They have an elongated body bearing 6-15 pairs of gill slits for respiration. Cyclostomes have a sucking and circular mouth without jaws. Their body is devoid of scales and paired fins.

128.(2) Streptokinase produced by the bacterium Streptococcus and modified by genetic engineering is used as a 'clot buster for removing clots from the blood vessels of patients who have undergone myocardial infarction leading to heart attack.

129.(4) The most distinctive feature of echinoderms is the presence of water vascular system which helps in locomotion, capture and transport of food and respiration. An excretory system is absent

130.(4) *Salvinia* is a pteridophyte.

Polytrichum is a Bryophyte

131.(2) Statement A: Computed tomography and magnetic resonance imaging detect cancers and internal organs.

Correct. CT and MRI are imaging techniques widely used for detecting tumors and internal organ details.

Statement B: Chemotherapeutic drugs are used to kill non-cancerous cells.

Incorrect. Chemotherapy primarily targets rapidly dividing cancer cells, though it may unintentionally affect some

normal cells.

Statement C: α -interferon activate the cancer patients' immune system and helps in destroying the tumour.

Correct. α -interferon is a biological response modifier that stimulates the immune system against cancer.

Statement D: Chemotherapeutic drugs are biological response modifiers.

Incorrect. Chemotherapeutics are chemical agents, whereas biological response modifiers (like nterferons,

interleukins) are different.

Statement E: In the case of leukaemia blood cell counts are decreased. Incorrect: In Leukaemia white blood cell counts increases.

132.(3) High fatality risk to mother - Not usually a significant drawback in IVF, the risk is low.

A. Expensive instruments and reagents- True, IVF is costly due to high tech equipments.

B. Husband / wife necessary for being donors- No, donor sperm of eggs can be used.

C. Less adoption of orphans- True, IVF might reduce the rate of adoption.

D. Not available in India- False, IVF is widely available in India.

E. Possibility that early embryo does not survive - True, there is a real risk of implantation failure.

133.(3) In females, meiosis begins during fetal development. Primary oocytes start meiosis I but arrest in prophase I until puberty. In males, meiosis begins at puberty and continues throughout life.

Hence statement A is true. In males, meiosis I and meiosis II happen in quick succession without significant delay. In females, there is a long gap, meiosis I complete at ovulation but meiosis II is arrested at metaphase II and only completes after fertilisation.

Hence statement B is true.

134.(4) Asexual reproduction in Bryophytes occurs by fragmentation and Gemmae.

135.(3) The Golgi apparatus principally performs the function of packaging materials, to be delivered either to the intra-cellular targets or secreted outside the cell. Materials to be packaged in the form of vesicles from the ER fuse with the cis face of the Golgi apparatus and move towards the maturing face. This explains, why the Golgi apparatus remains in close association with the endoplasmic reticulum.

136.(3) Reductionists analyse a larger system (like neurons, brain structure, hormones etc.) by breaking it down into pieces and determining the connections between the parts.

137.(2) After maturation the lymphocytes migrate to secondary lymphoid organs like spleen, lymph nodes, tonsils, peyer's patches of small intestine and appendix. The secondary lymphoid organs provide the sites for interaction of lymphocytes with the antigen.

138.(4) (A) There are four major causes of biodiversity losses

– 'The Evil quartet' is the sobriquet used to describe them.

(B) Cryopreservation is an Ex-situ conservation method.

(C) *Lantana camara* is an alien weed came into India and caused environmental damage and posed threat to our native species.

(D) 'Dodo' is a recent extinction from Mauritius.

139.(1) Megaspore mother cell undergo 1 Meiosis to form 4 Megaspores. 3 Megaspores degenerated out of four. This single megaspore undergo 3 Mitosis to form an embryo sac/mature female gametophyte.

140.(4) Innate immunity is non- specific type of defence, that is present at the time of birth. It provides different types of barriers.

141.(3)* (I) Fig fruit is a vegetarian fruit but some believed it as a non-vegetarian fruit as it can enclosed fig wasps in it.

(II) In many species of fig trees, there is tight one-to-one relationship with the pollinator species of wasp i.e., exhibit mutual relationship.

142.(1) Tapetum nourishes the developing pollen grain not the developing microspore mother cell.

143.(3) Prokaryotic ribosome 70S has two sub-units–larger is 50S and smaller in 30S

Eukaryotic ribosome 80S has two sub-units larger is 60S and smaller sub-unit is 40S.

144.(2) Prosthetic groups are organic compounds and are tightly bound to the apoenzyme. In per oxidase and catalase haem is the prosthetic group and is the part of active site of the enzyme.

145.(2) Right atrium receives the deoxygenated blood through the major veins called as vena cava.

146.(3) In pteridophytes, sporophyte & gametophyte are independent plant body. Spore mother cell in sporophytes undergo meiosis to form spores. These haploid spores germinate and produce gametophyte i.e. prothallus stage.

Prothallus contain sex organs i.e. antheridia and archegonia.

Antheridia produce male gamete i.e. antherozoids which transferred to archegonia through water to cause fertilization inside archegonia.

147.(2) Statement I is incorrect- Blue colonies indicate that the lac z gene is functional, meaning no foreign DNA was inserted into the plasmid.

Statement II is correct- when foreign DNA is inserted into the cloning sites within lac z gene, it disrupts it's function (insertional inactivation). As a result, the enzyme beta galactosidase is not produced and the colony appears white on the media with chromogenic substrate(X-gal).

148.(4) *Aspergillus niger* (a fungus) produce citric acid and *Trichoderma polysporum* (a fungus) produces bioactive molecule cyclosporin-A. Both are not involved in the preparation of household products.

149.(3) RNAi takes place in all eukaryotic organisms as a method of cellular defense. It involves silencing of specific mRNA due to complementary dsRNA molecule that binds to and prevents translation of the mRNA.

150.(4) The complex-II of mitochondrial electron transport chain is also known as succinate dehydrogenase or $FADH_2$ dehydrogenase complex.

151.(4) In pseudocoelomates, the body is only partially lined by mesoderm- mesoderm is present on the outer side but not around the gut.

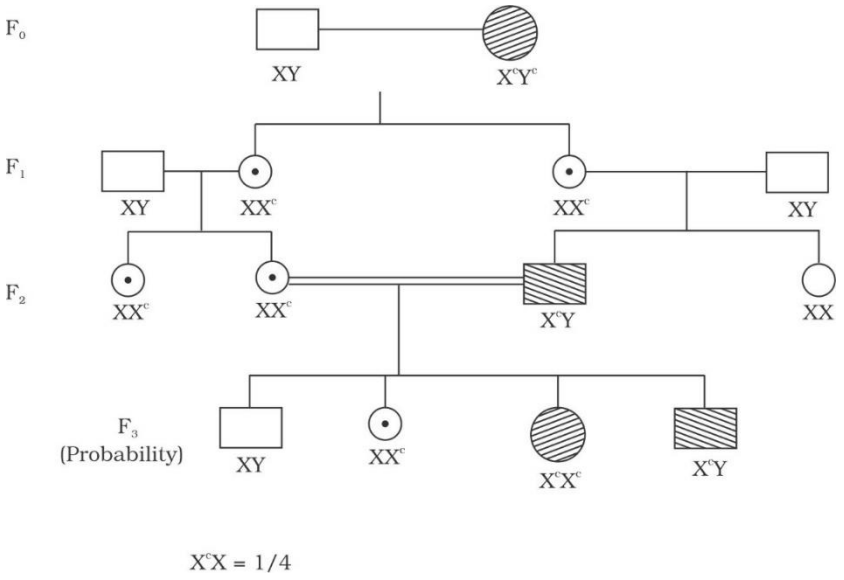
152.(2) Symbol $\oplus$ represent actinomorphic symmetry and symbol $\underline{G}$ represent superior ovary.

153.(1) Ecosystems are not exempt from the 2^{nd} law of thermodynamics. They need a constant supply of energy to synthesise the molecules they require, to counteract the universal tendency towards increasing disorderliness.

154.(2) The unit of productivity of an Ecosystem is:

$\left(K\,cal\,m^{-2}\right)yr^{-1}$ or $gm^{-2}\,yr^{-1}$

155.(3)



$X^cX = 1/4$

156.(2) Endosperm contain a protein rich layer called Aleurone layer.

157.(4) Chlorophyll-a : Blue-green colour

Chlorophyll-b : Yellow-green colour

Xanthophylls : Yellow colour

Carotenoids : Yellow to yellow orange colour

158.(3) George Gamow proposed that the genetic codons are triplet in nature.

159.(3) Histone proteins are rich in basic amino acids like lysine and Arginine.

160.(3) DNA mutase and DNA recombinase are not essential for gene cloning.

DNA mutase involved in DNA mutation or repair, not required in gene cloning.

DNA recombinase helps in crossing over not essential in gene cloning.

161.(3) Mesosome in prokaryotic cell is a specialised membranous structure.

162.(1) RNA polymerase enzyme terminated by rho(ρ) factor during transcription.

163.(2) Male frogs can be distinguished by the presence of sound producing vocal sacs and also a copulatory pad present on the first digit of the fore limbs which are absent in female frogs.

164.(4) Option correctly represents the reabsorption of HCO^{3-} , NaCl and water and secretion of H+, NH_3 from proximal tubule, and reabsorption of NaCl, water and HCO^{3-} , secretion of K+ and H+ from distal tubule of nephron.

165.(1) Antigen binding site is located at the C- terminal region of antibody molecules.

Antigen binding site is located at the N- terminal region of antibody.

166.(3)

- Scutellum – Single cotyledon of monocot seed.
- Non-albuminous seed – Groundnut.
- Epiblast – 2^{nd} cotyledon is rudimentary in monocot seed.
- Perisperm – Persistent nucellus in seed.

167.(3) In monocot stem hypodermis is sclerenchymatous.

168.(4) Identical twins come from one fertilised egg that splits into two embryos. They have the same genetic material and are always same sex called as monozygotic twins.

Fraternal twins come from two separate eggs fertilised by two different sperm, so they can have different sexes, called as dizygotic twins.

169.(3) Sweet potato is root modification and potato is stem modification but both shows the function of food storage.

170.(2) Cytokinin promotes nutrient mobilization to delay leaf senescence in plants.

171.(4) Insulin is a protein hormone, like any other protein it would be digested by enzymes of stomach and intestine and breaking it down into amino acids before it can enter the bloodstream.

172.(1) Transferases are enzymes catalysing a transfer of a group, G (other than hydrogen) between a pair of substrate S and S#.

173.(3) Statement I is correct - After separating DNA fragments using agarose gel electrophoresis, desired fragments can be cut out, purified and used in cloning or recombinant DNA construction.

Statement II is correct- In gel electrophoresis, DNA moves toward the positive anode due to it's negative charge. Smaller DNA fragments migrate faster and farther, so they found closer to anode while larger fragments stay closer to the wells.

174.(1) In bryophytes, gametophyte is dominant over sporophyte. Gametophyte attached to substratum. It contain sex organs, antherozoids released by antheridium which transport through water & fuses with egg cell in archegonium. Fertilization results into zygote formation and then sporophyte formed. Spore mother cells in capsule of sporophyte undergo meiosis to produce haploid spores.

175.(1) Mendel's dihybrid phenotypic ratio is 9 : 3 : 3 : 1.

176.(4) Phylogenetic sequence of five kingdom classification is:

Monera $\rightarrow$ Protista $\rightarrow$ Fungi $\rightarrow$ Plantae $\rightarrow$ Animalia.

177.(2)

Centromere	–	Cell division
Cilium	–	Cell movement
Cristae	–	Mitochondrion
Cell	–	Phospholipid bilayer

178.(4) Equation of Logistic growth curve:

$$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$$

179.(2) A-Emphysema -(II) Damaged alveolar walls and decreased respiratory surface.

B- Angina Pectoris- (III) Acute chest pain when not enough oxygen is reaching to heart muscle.

C- Glomerulonephritis-(IV) inflammation of glomeruli of kidney)

D- Tetany- (I) Rapid spasm in muscle due to low ca ++ in body fluid.

180.(4) Regular activities of heart are regulated intrinsically by specialised muscle - nodal tissue, a special centre in medulla oblongata can moderate the cardiac function through ANS. Adrenal medullary hormones can also increase the cardiac output. Cortisol (adrenal cortical hormone) maintains the cardio- vascular activity.