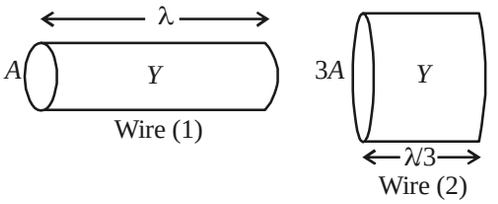
NEET TEST SERIES

SOLUTIONS PART TEST-2

PART A – PHYSICS

1. (3)



As shown in the figure, the wires will have the same Young's modulus (same material) and the length of the wire of area of cross-section $3A$ will be $\ell/3$ (same volume as wire 1).

For wire 1,

$$Y = \frac{F/A}{\Delta x/\ell} \qquad ...(i)$$

For wire 2 ,

$$Y = \frac{F'/3A}{\Delta x/(\ell/3)} \qquad ...(ii)$$

From (i) and (ii) , $\frac{F}{A}\times\frac{\ell}{\Delta x} = \frac{F'}{3A}\times\frac{\ell}{3\Delta x} \Rightarrow F' = 9F$

2. (4) At t = 0, $x = 5 = \frac{A}{2}$

$\Rightarrow$ Initial phase, $\phi = 30° = \frac{\pi}{6}$

$\Rightarrow x = A\sin(\omega t + \phi)$

$= 10\sin\left(\frac{2\pi}{T}t + \frac{\pi}{6}\right) = 10\sin\left(\pi t + \frac{\pi}{6}\right)$

3. (4) Molar mass of the gas = 4g/mol

Speed of sound

$$V = \sqrt{\frac{\gamma RT}{m}} \Rightarrow 952 = \sqrt{\frac{\gamma\times 8.3\times 273}{4\times 10^{-3}}}$$

$$\Rightarrow \gamma = 1.6 = \frac{16}{10} = \frac{8}{5}$$

Also, $\gamma = \frac{C_P}{C_V} = \frac{8}{5}$

So, $C_P = \frac{8\times 5}{5} = 8JK^{-1}mol^{-1}$ $\quad [C_V = 5.0\,JK^{-1}$ given]

4. (3) Power radiated by the sun at t°C

$= \sigma(t+273)^4 4\pi r^2$

Power received by a unit surface

$$= \frac{\sigma(t+273)^4 4\pi r^2}{4\pi R^2} = \frac{r^2\sigma(t+273)^4}{R^2}$$

5. (3) $h = \frac{2T\cos\theta}{r\rho g} \Rightarrow h \propto \frac{1}{r} \Rightarrow \frac{h_2}{h_1} = \frac{r_1}{r_2} = \frac{2}{3}$

$\left(\because r_1 = r,\ \ r_2 = r + 50\%\text{ of } r = \frac{3}{2}r\right)$

New mass $m_2 = \pi r_2^2 h_2\rho = \pi\left(\frac{3}{2}r_1\right)^2\left(\frac{2}{3}h_1\right)\rho$

$$= \frac{3}{2}\left(\pi r_1^2 h_1\right)\rho = \frac{3}{2}m$$

6. (2) $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ $\qquad$ Here, $P_1 = 200kPa$

$T_1 = 22°C = 295\,K$ $\qquad T_2 = 42°C = 315K$

$V_2 = V_1 + \frac{2}{100}V_1 = 1.02V_1$

$\therefore \quad P_2 = \frac{200\times 315V_1}{295\times 1.02V_1} = 209.37kPa$

7. (3)

$W_{AB} = P\Delta V$

$= 1\times R(\Delta T) = RT.$

$W_{BC} = nR(2T)\ell n\frac{P_i}{P_f}$

$= 1\times 2RT\ell n2 = 2RT\ell n2$

$W_{CD} = P\Delta V$

$= nR\Delta T = 1\times R\times(T - 2T)$

$= -RT$

$W_{DA} = nRT\ell n\frac{P_i}{P_f} = 1\times R\times T\ell n\left(\frac{1}{2}\right)$

$= -RT\ell n2$

$W = W_{AB} + W_{BC} + W_{CA} + W_{DA}$

$= RT\ell n2$

8. (2) Fundamental frequency,

$$f = \frac{v}{2\ell} = \frac{1}{2\ell}\sqrt{\frac{T}{\mu}} = \frac{1}{2\ell}\sqrt{\frac{T}{A\rho}}$$

$\left[\because\ v = \sqrt{\frac{T}{\mu}}\text{ and }\mu = \frac{m}{\ell}\right]$

Also, $Y = \frac{T\ell}{A\Delta\ell} \Rightarrow \frac{T}{A} = \frac{Y\Delta\ell}{\ell}$

$$\Rightarrow f = \frac{1}{2\ell}\sqrt{\frac{\gamma\Delta\ell}{\ell\rho}} \qquad ....(i)$$

$\ell = 1.5$ m, $\frac{\Delta\ell}{\ell} = 0.01$,

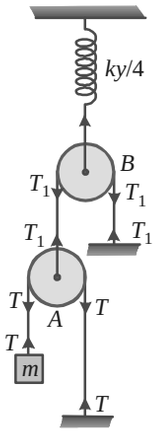
$\rho = 7.7 \times 10^3$ kg/m^3 (given)

$\gamma = 2.2 \times 10^{11}$ N/m^2 (given)

Putting the value of ℓ, $\frac{\Delta\ell}{\ell}$, ρ and γ in eq^n. (i) we get,

$$f = \sqrt{\frac{2}{7}} \times \frac{10^3}{3} \quad \text{or} \quad f \approx 178.2 \text{ Hz}$$

9. (4) When one displaces the block by y, the pulley A will go down by $y/2$. Accordingly the pulley B goes down by $y/4$. So spring will stretch by $y/4$.



Thus $\frac{ky}{4} = 2T_1$

and $2T = T_1$

$\therefore \quad T = \frac{ky}{16}$

The restoring force, $F = -T = -\frac{k}{16}y$

and acceleration, $a = \frac{F}{m} = \frac{k}{16m}(-y)$

$\therefore \quad T = 2\pi\sqrt{\frac{16m}{k}} = 8\pi\sqrt{\frac{m}{k}}$.

10. (2) $[v_P]_{max} = 4v$

or $\omega A = 4v$

or $2\pi f y_0 = 4 \times (f\lambda)$

$\therefore \quad \lambda = \frac{\pi y_0}{2}$

11. (3) The upthrust is given by $\frac{4}{3}\pi R_t^{\,3} \rho\, g$

Here $R_t^{\,3} = R_0^{\,3}(1+\gamma_m t)$ and $\rho_t = \rho_0/(1+\gamma_a t)$

So, the upthrust at t°C is given by

$$= \frac{4}{3}\pi R_0^{\,3}(1+\gamma_m t) \times \{\rho_0/(1+\gamma_a t)\}\, g$$

As $\gamma_m < \gamma_a$, hence upthrust at t°C < upthrust at 0°C

So, the upthrust is decreased. Hence weight in liquid gets increased.

12. (4) In simple harmonic motion, starting from rest,

At $t = 0$, $x = A$

$x = A\cos\omega t$ ..... (i)

When $t = \tau$, $x = A - a$

When $t = 2\tau$, $x = A - 3a$

From equation (i)

$A - a = A\cos\omega\tau$ .....(ii)

$A - 3a = A\cos 2\omega\tau$ ....(iii)

As $\cos 2\omega\tau = 2\cos^2\omega\tau - 1$ ...(iv)

From equation (ii), (iii) and (iv)

$$\frac{A-3a}{A} = 2\left(\frac{A-a}{A}\right)^2 - 1$$

$$\Rightarrow \quad \frac{A-3a}{A} = \frac{2A^2 + 2a^2 - 4Aa - A^2}{A^2}$$

$$\Rightarrow \quad A^2 - 3aA = A^2 + 2a^2 - 4Aa$$

$$\Rightarrow \quad 2a^2 = aA$$

$$\Rightarrow \quad A = 2a$$

$$\Rightarrow \quad \frac{a}{A} = \frac{1}{2}$$

Now, $A - a = A\cos\omega\tau$

$$\Rightarrow \quad \cos\omega\tau = \frac{A-a}{A}$$

$$\Rightarrow \quad \cos\omega\tau = \frac{1}{2} \quad \text{or} \quad \frac{2\pi}{T}\tau = \frac{\pi}{3}$$

$$\Rightarrow \quad T = 6\tau$$

13. (2) Compressibility of water,

$K = 45.4 \times 10^{-11}$ Pa^{-1}

Density of water $P = 10^3$ kg/m^3

Depth of ocean, $h = 2700$ m

We have to find $\frac{\Delta V}{V} = ?$

As we know, compressibility,

$$K = \frac{1}{B} = \frac{(\Delta V/V)}{P}$$

So, $(\Delta V/V) = K\rho gh$ $(P = \rho gh)$

$= 45.4 \times 10^{-11} \times 10^3 \times 10 \times 2700$

$= 1.2258 \times 10^{-2}$

14. (1) $\frac{3}{2}k_B T = K_{av}$

where K_{av} is the average kinetic energy of the proton.

$$\therefore \quad T = \frac{2K_{av}}{3k_B}$$

$$T = \frac{2 \times 4.14 \times 10^{-14} \text{ J}}{3 \times 1.38 \times 10^{-23} \text{JK}^{-1}} = 2 \times 10^9 \text{ K}.$$

15. (4) According to principle of continuity, for a streamline flow of fluid through a tube of non-uniform cross-section the rate of flow of fluid (Q) is same at every point in the tube.

i.e., Av = constant $\Rightarrow A_1v_1 = A_2v_2$

Therefore, the rate of flow of fluid is same at M and N.

16. (3) $T_1 = 273 + 27 = 300$K

$T_2 = 273 + 927 = 1200$K

For adiabatic process,

$P^{1-\gamma}\, T^{\gamma}$ = constant

$\Rightarrow P_1^{\,1-\gamma} T_1^{\,\gamma} = P_2^{\,1-\gamma} T_2^{\,\gamma}$

$$\Rightarrow \left(\frac{P_2}{P_1}\right)^{1-\gamma} = \left(\frac{T_1}{T_2}\right)^{\gamma}$$

$$\Rightarrow \left(\frac{P_1}{T_2}\right)^{1-\gamma} = \left(\frac{T_2}{T_1}\right)^{\gamma}$$

$$\left(\frac{P_1}{P_2}\right)^{1-1.4} = \left(\frac{1200}{300}\right)^{1.4}$$

$$\left(\frac{P_1}{P_2}\right)^{-0.4} = (4)^{1.4}$$

$$\left(\frac{P_2}{P_1}\right)^{0.4} = 4^{1.4}$$

$$P_2 = P_1\, 4^{\left(\frac{1.4}{0.4}\right)} = P_1\, 4^{\left(\frac{7}{2}\right)}$$

$$= P_1 (2^7) = 2 \times 128 = 256 \text{ atm}$$

17. (3) According to Stefan's Law, the rate of loss of heat is

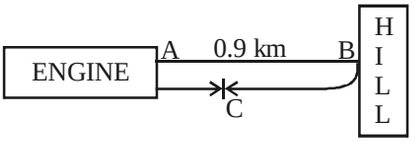
$$\frac{Q}{t} = \sigma A(T_1^4 - T_2^4) \times e$$

here $\sigma = 5.67 \times 10^{-8} \text{J/m}^2 \times \text{sec.K}^2$,
$T_1 = 527+273 = 800\text{K}$,
$T_2 = 27 + 273 = 300\text{K}$ & $A = 200\times10^{-4}\text{m}^2$

So. $\frac{Q}{t} = 5.67 \times 10^{-8} \times 2 \times 10^{-2}$
$[(800)^4 - (300)^4] \times 0.4$

$\cong$ 182 joule S^{-1}

18. (4)



Let after 5 sec engine at point C

$$t = \frac{AB}{330} + \frac{BC}{330}$$

$$5 = \frac{0.9 \times 1000}{330} + \frac{BC}{330}$$

$\therefore$ BC = 750 m
Distance travelled by engine in 5 sec
= 900 m – 750 m = 150 m
Therefore velocity of engine

$$= \frac{150\,\text{m}}{5\,\text{sec}} = 30 \text{ m/s}$$

19. (4) As the block moves up with the fall of coil, *l* decreases, similarly *h* will also decrease because when the coin is in water, it displaces water equal to its own volume only.

20. (3) Heat required to change the temperature of vessel by a small amount *dT*

$$-dQ = mC_p dT$$

Total heat required

$$-Q = m\int_{20}^{4} 32\left(\frac{T}{400}\right)^3 dT = \frac{100\times10^{-3}\times32}{(400)^3}\left[\frac{T^4}{4}\right]_{20}^{4}$$

$$\Rightarrow \quad Q = 0.001996 \text{ kJ}$$

Work done required to maintain the temperature of sink to T_2

$$W = Q_1 - Q_2 = \frac{Q_1 - Q_2}{Q_2} Q_2 = \left(\frac{T_1}{T_2} - 1\right) Q_2$$

$$\Rightarrow \quad W = \left(\frac{T_1 - T_2}{T_2}\right) Q_2$$

For $T_2 = 20\,\text{K}$

$$W_1 = \frac{300 - 20}{20} \times 0.001996 = 0.028\,\text{kJ}$$

For $T_2 = 4\,\text{K}$

$$W_2 = \frac{300 - 4}{4} \times 0.001996 = 0.148\,\text{kJ}$$

As temperature is changing from 20k to 4 k, work done required will be more than W_1 but less than W_2.

21. (4) At mean position velocity is maximum

i.e., $v_{\max} = \omega a \Rightarrow \omega = \frac{v_{\max}}{a} = \frac{16}{4} = 4$

$$\therefore v = \omega\sqrt{a^2 - y^2} \Rightarrow 8\sqrt{3} = 4\sqrt{4^2 - y^2}$$

$$\Rightarrow 192 = 16(16 - y^2) \Rightarrow 12 = 16 - y^2 \Rightarrow y = 2cm.$$

22. (1) $y = \frac{F/A}{\Delta l/l} = \frac{F}{A}.\frac{l}{\Delta l}$

$$= \frac{20 \times 1}{10^{-6} \times 10^{-4}} = 2 \times 10^{11}\,\text{Nm}^{-2}$$

23. (2) The rate of heat flow is given by

$$\frac{Q}{t} = \text{K. A. } \frac{\Delta T}{\ell}$$

Area of Original rod A = πR^2;

Areal of new rod A′ = $\frac{\pi R^2}{4}$.

Volume of original rod will be equal to the volume of new rod.

$$\therefore \quad \pi R^2 \ell = \pi\left(\frac{R}{2}\right)^2 \ell'$$

$$\Rightarrow \frac{\ell'}{\ell} = \frac{R^2}{\left(\frac{R^2}{4}\right)} = 4$$

$$\therefore \quad \frac{Q'}{Q} = \frac{A'}{A}\,\frac{\ell}{\ell'} = \frac{1}{4}\cdot\frac{1}{4} = \frac{1}{16}$$

$$\therefore \quad Q' = \frac{Q}{16}$$

24. (1) As $A_1v_1 = A_2v_2$ (Principle of continuity)

or, $\ell^2\sqrt{2gh} = \pi r^2\sqrt{2g\times 4h}$

(Efflux velocity = $\sqrt{2gh}$)

$\therefore \quad r^2 = \dfrac{\ell^2}{2\pi}$ or $r = \sqrt{\dfrac{\ell^2}{2\pi}} = \dfrac{\ell}{\sqrt{2\pi}}$

25. (1) Let T be the temperature of the mixture, then

$U = U_1 + U_2$

$\Rightarrow \quad \dfrac{f}{2}(n_1+n_2)\,RT$

$= \dfrac{f}{2}(n_1)\,(R)\,(T_0) + \dfrac{f}{2}(n_2)\,(R)\,(2T_0)$

$\Rightarrow (2+4)T = 2T_0 + 8T_0 \ (\because\ n_1 = 2, n_2 = 4)$

$\therefore\ T = \dfrac{5}{3}T_0$

26. (3) Length of pipe = 85 cm = 0.85m

Frequency of oscillations of air column in closed organ pipe is given by,

$f = \dfrac{(2n-1)\upsilon}{4L}$

$f = \dfrac{(2n-1)\upsilon}{4L} \le 1250$

$\Rightarrow \quad \dfrac{(2n-1)\times 340}{0.85\times 4} \le 1250$

$\Rightarrow \quad 2n-1 \le 12.5 \approx 6$

27. (1) $\dfrac{T_2}{T_1 - T_2} = \dfrac{Q_2}{W}$

$\dfrac{273}{300-273} = \dfrac{50{,}000}{W}$

$W = \dfrac{27\times 50{,}000}{273}$ cal/min

$P = \dfrac{W}{t} = \dfrac{4.2\times 27\times 50{,}000}{60\times 273}$ Joule/sec

$= 346$ watt $= 0.346$ kW

28. (3) $\dfrac{PV}{T} = nR = \left(\dfrac{m}{M}\right)R$ or $\dfrac{PV}{T} = \left(\dfrac{R}{M}\right)m$

i.e. $\dfrac{PV}{T}$ versus m graph is straight line passing through origin with slope R/M, i.e. the slope depends on molecular mass of the gas M and is different for different gases.

29. (2) Here, T = 0.05 sec, v = 300 ms^{-1}.

Now $\lambda = \dfrac{v}{\nu} = vT = (300\times 0.05)$m

or, $\lambda = 15$ m

Phase of the point at 10 m from the source

$= \dfrac{2\pi}{\lambda}\times x = \dfrac{2\pi}{15}\times 10 = \dfrac{4\pi}{3}$ rad

Phase of the point at 15 m from the source

$\dfrac{2\pi}{\lambda}\times x = \dfrac{2\pi}{15}\times 15 = 2\pi$ rad

$\therefore$ The phase difference between the points

$= 2\pi - \dfrac{4\pi}{3} = \dfrac{2\pi}{3}$ rad

30. (1) Under the action of first force, $F_1 = m\omega_1^2 y$

Under the action of second force,

$F_2 = m\omega_2^2 y$

Under the action of resultant force,

$F_1 + F_2 = m\omega^2 y$

$\Rightarrow m\omega^2 y = m\omega_1^2 y + m\omega_2^2 y$

$\Rightarrow \omega^2 = \omega_1^2 + \omega_2^2$

$\Rightarrow \left(\dfrac{2\pi}{T}\right)^2 = \left(\dfrac{2\pi}{T_1}\right)^2 + \left(\dfrac{2\pi}{T_2}\right)^2$

$\Rightarrow T = \sqrt{\dfrac{T_1^2T_2^2}{T_1^2+T_2^2}} = \sqrt{\dfrac{\left(\frac{4}{5}\right)^2\cdot\left(\frac{3}{5}\right)^2}{\left(\frac{4}{5}\right)^2+\left(\frac{3}{5}\right)^2}} = \dfrac{12}{25}.$

31. (2) Bulk modulus, $B = -V_0\dfrac{\Delta p}{\Delta V} \Rightarrow \Delta V = -V_0\dfrac{\Delta p}{B}$

$\Rightarrow V = V_0\left[1-\dfrac{\Delta p}{B}\right]$

$\therefore$ Density, $\rho = \rho_0\left[1-\dfrac{\Delta p}{B}\right]^{-1} = \rho_0\left[1+\dfrac{\Delta p}{B}\right]$

where, $\Delta p = p - p_0 = h\rho_0 g$

= pressure difference between depth and surface of ocean

$\therefore\ \rho = \rho_0\left[1+\dfrac{\rho_0 gy}{B}\right]$ (As h = y)

32. (4) Frequency is independent of medium.

33. (4) $R = R_1 + R_2$

or $\dfrac{(x+4x)}{K'A} = \dfrac{x}{KA} + \dfrac{4x}{2KA}$

$\therefore \quad K' = \dfrac{5K}{3}$

The rate of heat flow,

$H = K'A\left(\dfrac{T_2-T_1}{5x}\right)$

$= \dfrac{5K}{3}A\left(\dfrac{T_2-T_1}{5x}\right)$

$= \dfrac{K}{3}A\left(\dfrac{T_2-T_1}{x}\right).$

Thus $f = \dfrac{1}{3}.$

34. (1) Given: $F = 100\,\text{kN} = 10^5\,\text{N}$
$Y = 2 \times 10^{11}\,\text{Nm}^{-2}$
$\ell_0 = 1.0\,\text{m}$
radius $r = 10\,\text{mm} = 10^{-2}\,\text{m}$

From formula, $Y = \dfrac{\text{Stress}}{\text{Strain}}$

$$\Rightarrow \quad \text{Strain} = \frac{\text{Stress}}{Y} = \frac{F}{AY}$$

$$= \frac{10^5}{\pi r^2 Y} = \frac{10^5}{3.14 \times 10^{-4} \times 2 \times 10^{11}}$$

$$= \frac{1}{628}$$

Therefore % strain $= \dfrac{1}{628} \times 100 = 0.16\%$

35. (1) The change in internal energy depends only on initial and final state, so $\Delta U_I = \Delta U_{II}$.

36. (2) $y = 60 \cos(180t - 6x)$ ....(1)

$$\omega = 180,\ k = 6 \Rightarrow \frac{2\pi}{\lambda} = 6$$

$$v = \frac{\omega}{k} = \frac{2\pi}{T} \times \frac{\lambda}{2\pi} = \frac{180}{6} = 30\ \text{m/s}$$

Differentiating (1) w.r.t. *t*,

$$v = \frac{dy}{dt} = -60 \times 180 \sin(180t - 6x)$$

$$v_{max} = 60 \times 180\ \mu\text{m/s}$$

$$= 10800\ \mu\text{m/s} = 0.0108\ \text{m/s}$$

$$\frac{v_{max}}{v} = \frac{0.0108}{30} = 3.6 \times 10^{-4}$$

37. (1) Weight of the liquid column = $T\cos\theta \times 2\pi r$.
For water $\theta = 0°$. Here weight of liquid column $W = 7.5 \times 10^{-4}$N and $T = 6 \times 10^{-2}$N/m. Then circumference, $2\pi r = W/T = 1.25 \times 10^{-2}$m

38. (1) As, $P = \dfrac{1}{3}\left(\dfrac{U}{V}\right)$

But $\dfrac{U}{V} = KT^4$

So, $P = \dfrac{1}{3}KT^4$

or $\dfrac{uRT}{V} = \dfrac{1}{3}KT^4$ [As PV = u RT]

$$\frac{4}{3}\pi R^3 T^3 = \text{constant}$$

Therefore, $T \propto \dfrac{1}{R}$

39. (3) Given : Wavelength (λ) = 5000 Å
velocity of star (v) = 1.5×10^6 m/s.
We know that wavelength of the approaching star (λ') =

$$\lambda \frac{c - v}{c}$$

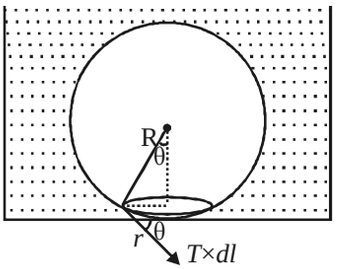
or, $\dfrac{\lambda'}{\lambda} = \dfrac{c - v}{c} = 1 - \dfrac{v}{c}$

or, $\dfrac{v}{c} = 1 - \dfrac{\lambda'}{\lambda} = \dfrac{\lambda - \lambda'}{\lambda} = \dfrac{\Delta\lambda}{\lambda}$. Therefore,

$$\Delta\lambda = \lambda \times \frac{v}{c} = 5000 \times \frac{1.5 \times 10^6}{3 \times 10^8} = 25\ \text{Å}.$$

[where $\Delta\lambda$ = Change in the wavelength]

40. (1) When the bubble gets detached,
Buoyant force = force due to surface tension



Force due to excess pressure = upthrust

Excess pressure in air bubble = $\dfrac{2T}{R}$

$$\frac{2T}{R}(\pi r^2) = \frac{4\pi R^3}{3}\rho_w g$$

$$\Rightarrow \quad r^2 = \frac{2R^4 \rho_w g}{3T} \Rightarrow r = R^2\sqrt{\frac{2\rho_w g}{3T}}$$

41. (3) If *m* is the mass of steam condenses, then according to law of calorimetry,

heat lost = heat gain

$m \times 540 = (250) \times 1 \times (100 - 0) + 20 \times 80$
$+ 20 \times 1 \times (100)$

$\therefore \quad m = 53\,\text{g}$

The entire contents will reach the temperature 100°C.

42. (2) Stress = 1 kg wt/mm^2 = 9.8 N/mm^2
= 9.8×10^6 N/m^2.

$Y = 1 \times 10^{11}\,\text{N/m}^2$, $\quad \dfrac{\Delta\ell}{\ell} \times 100 = ?$

$$Y = \frac{\text{Stress}}{\text{Strain}} = \frac{\text{Stress}}{\Delta\ell/\ell}$$

$$\therefore \quad \frac{\Delta\ell}{\ell} = \frac{\text{Stress}}{Y} = \frac{9.8 \times 10^6}{1 \times 10^{11}}$$

$$\frac{\Delta\ell}{\ell} \times 100 = 9.8 \times 10^{-11} \times 100 \times 10^6$$

$$= 9.8 \times 10^{-3} = 0.0098\ \%$$

43. (2) Over a small temperature ranges, S.T. of water decreases linearly with rise of temperature.

44. (1) $K.E. = \frac{1}{2}m\omega^2(a^2 - y^2)$

At mean position, $y = 0$

$\therefore K.E. = \frac{1}{2}m\omega^2 a^2$

$P.E. = \frac{1}{2}m\omega^2 y^2$

At, $y = \frac{a}{2}$; $P.E. = \frac{1}{2}m\omega^2\frac{a^2}{4} = \frac{1}{8}m\omega^2a^2$

$\therefore$ Ratio $= \frac{(1/2)m\omega^2a^2}{(1/8)m\omega^2a^2}$

$= \frac{K.E.\ at\ mean\ position}{PE\ at\ a/2} = \frac{4}{1}$

45. (2) Vapour pressure does not depend on the amount of substance. It depends on the temperature alone.

PART B – CHEMISTRY

46. (2) $\overset{2}{C}H=\overset{1}{C}H_2$

$\overset{6}{C}H_3\overset{5}{C}H_2\overset{4}{C}H_2\overset{3}{C}HCH_2CH_2CH_3$

47. (3) The redox reaction involves loss or gain of electron(s) i.e. change in oxidation state. Given reaction is not a redox reaction as this reaction involves no change in oxidation state of reactant or product.

48. (2) $Na(zeolite) + CaCl_2 \rightarrow Ca(zeolite) + 2NaCl$

49. (4) Br_2 in CCl_4 (a), Br_2 in CH_3COOH (b) and alk. $KMnO_4$ (c) will react with all unsaturated compounds, i.e., 1, 3 and 4 while ammonical $AgNO_3$ (d) reacts only with terminal alkynes, i.e., 3 and hence compund 3 can be distinguished from 1, 2 and 4 by ammonical $AgNO_3$ (d).

50. (3) Grignard reagent on reaction with heavy water gives deuteroalkane.

$R—MgX + D_2O \longrightarrow R—D + Mg(OD)X$

i.e., $(CH_3)_3CMgCl + D_2O \longrightarrow (CH_3)_3C—D$

51. (2) Boiling point among isomeric alkanes decreases with branching. Branching decreases surface area of molecule on which van der Waal's forces of attraction depends thereby decreasing intermolecular attraction.

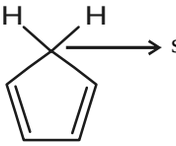
52. (2) $\overset{1}{C}H_3-\overset{2}{C}H(\overset{CH_3}{|})-\overset{3}{C}H_2-\overset{4}{C}H_3 \xrightarrow[\text{chlorination}]{\text{mono}-}$

$CH_3CH(Cl)\overset{*}{C}HCH_3$ (d and l) $+ ClCH_2\overset{*}{C}H(CH_3)CH_2CH_3$ (d and l)

(i) Chlorination at C-2 and C-4 produces no chiral compounds

(ii) Chlorination at C-3 produces a chiral carbon marked with star (*d* and *l* form).

(iii) Chlorination at C-1 also produces a chiral carbon marked with star (*d* and *l* form).

53. (4)  $\rightarrow sp^3$ Carbon

Cyclopentadiene is non aromatic, as it has sp^3 carbon in the ring.

54. (3) The atom becomes larger on descending the group, so the bonds becomes weaker (metallic bond), the cohesive force/energy decreases and accordingly melting point also decreases.

55. (3) $CH_3-\overset{H}{\underset{CH_2CH_3}{\overset{|}{\underset{|}{C}}}}-\triangleleft$ contains asymmetric carbon thus optically active.

56. (3) Because KO_2 not only provides O_2 but also removes CO_2 as follows

$4KO_2 + 2CO_2 \rightarrow 2K_2CO_3 + 3O_2$

$4KO_2 + 4CO_2 + 2H_2O \rightarrow 4KHCO_3 + 3O_2$

57. (4) Very pure hydrogen can be prepared by the action of water on sodium hydride.

$NaH + H_2O \longrightarrow NaOH + H_2$

(very pure Hydrogen)

58. (4) $CH_3-CH=CH-CH=CH-CH_3$

2, 4-hexadiene

$\xrightarrow{\text{ozonolysis}}$ $2\underset{\text{ethanal}}{CH_3CHO} + \underset{\text{ethanedial}}{OHC-CHO}$

59. (1) The intermediate 2° carbocation shows resonance

$CH_2=CH-CH=CH_2 \xrightarrow{Br^+} \left[CH_2Br-\overset{+}{C}H-CH=CH_2 \longleftrightarrow CH_2Br-CH=CH-\overset{+}{C}H_2\right] \xrightarrow{Br^-} \underset{\text{1,4–dibromo–2–butene}}{CH_2Br-CH=CH-CH_2Br}$

60. (2) Down the group basic character of oxides increases.

B_2O_3 - Acidic

Al_2O_3 - Amphoteric

Ga_2O_3 - Amphoteric

In_2O_3 - Basic

Tl_2O_3 - Basic

61. (2) $CH_3 - CH = CH - \overset{*}{C}HCH_3$ (OH)

exhibits both geometrical as well as optical isomerism.

cis - R *cis* - S

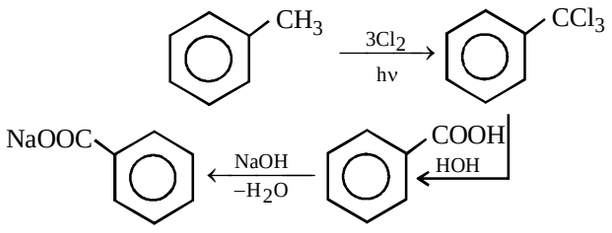
trans - R *trans* - S

62. (3) $HC \equiv CNa + XR \rightarrow HC \equiv CR + NaX$

Since the atom or group attached to two acetylenic carbon atoms are different, the alkyne formed (higher alkyne) is unsymmetrical.

63. (2) Electrostatic forces of attraction are reduced to 1/80th in water.

64. (2)



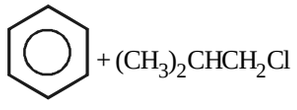
65. (2) cis 2-butene + $Br_2 \rightarrow$ Racemic 2, 3-dibromobutane

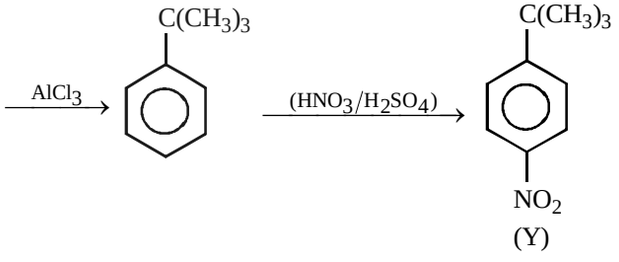
Trans 2-butene + $Br_2 \rightarrow$ Meso 2, 3-dibromobutane.

66. (3) Due to structural changes, melting point increases from Ga to Tl and Ga has the lowest melting point.

67. (1) The stability of dihalides (MX_2) increases down the group. Except C and Si, the other members form dihalides.

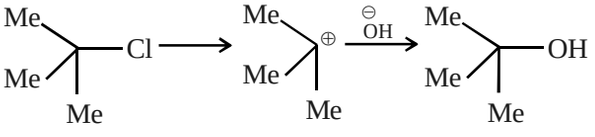
68. (3)





(Y)

69. (2) Hydrolysis of 3° RX is independent of nucleophilic concentration (S_N1 reaction).



70. (4) $R - CH_2 - CCl_2 - R \xrightarrow{alc.KOH} R - CH = CCl - R$

$\xrightarrow{NaNH_2} R - C \equiv C - R$

71. (4) B_4C is the hardest substance after diamond and BN.

72. (4) $C_6H_5CH_2Br + Mg \xrightarrow{ether} C_6H_5CH_2MgBr$

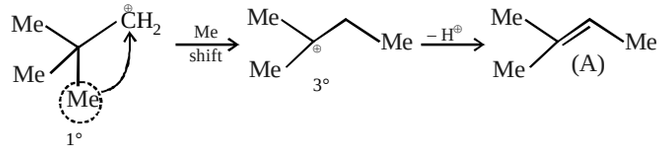
$C_6H_5CH_2 - \underset{H}{\overset{MgBr}{\overset{|}{\underset{|}{C}}}} - OH \xrightarrow{H^+/H_2O} C_6H_5CH_3 + MgBr(OH)$

73. (4) BF_3 and $R_3C - X$ are electrophile while $(CH_3)_3N$ and $C_2H_5O^-$ are nucleophile

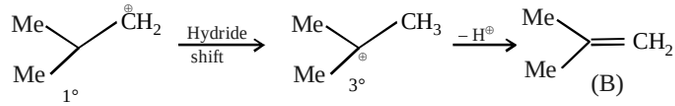
74. (3)

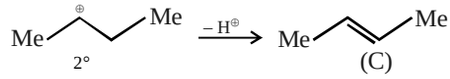
75. (2)

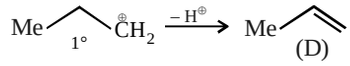
(IV)



(III)



(I) 

(II) 

Stability of alkene: (A) > (B) > (C) > (D) (More-substituted alkenes are more stable).

76. (1) In (b), (c) and (d), carbanion is stablised by resonance, but in (a) it is not resonance stabilised. Moreover, (+I) effect of (Me) group destabilises the carbanion in (a).

77. (3) $MgSO_4$ is the only alkaline earth metal sulphate which is soluble in water and for solubility hydration energy should be greater than lattice energy i.e hydration energy > lattice energy

78. (1)

79. (3) The excess of fluorine in water causes fluorosis. The symptoms of fluorosis are mottling of teeth (yellowish streaks) and abnormal bones liable to fracture, etc. It is an example of endemic disease.

80. (2) $BaO_2 + H_2SO_4 \rightarrow BaSO_4 + H_2O_2$

Oxygen is the most electronegative element in the reaction and has the oxidation states of –1 (in H_2O_2) and –2 (in $BaSO_4$). In H_2O_2, peroxo ion is present.

81. (2) $Zn^{2+} + 2NaOH \rightarrow 2Na^+ + Zn(OH)_2$

$Zn(OH)_2 + 2NaOH \rightarrow Na_2ZnO_2 + 2H_2O$

Thus Na_2ZnO_2 forms $2Na^+$ and $[ZnO_2]^{2-}$ ions.

82. (2) Carboxylic acids are stronger acids than $-\overset{\oplus}{N}H_3$ because the corresponding conjugate base ($-COO^-$) is more stable than $-NH_2$. Hence Y is the strongest acid. Since $-NH_3^+$ has – I effect (acid enhancing) which decreases with distance, therefore, effect is more pronounced in Z than in X. As a result, Z is more acidic than X. Hence the correct order is Y > Z > X.

83. **(3)** The larger the stability, the smaller the P.E.; hence I > II > III.

84. **(1)** Given reaction is

$IO_3^- + aI^- + bH^+ \longrightarrow cH_2O + dI_2$

Ist half reaction

$I^- \longrightarrow I_2$ ...(i)

– 1 0 (oxidation)

IInd half reaction

$IO_3^- \longrightarrow I_2$ ...(ii)

+ 5 0 (reduction)

On balancing equation (ii) we have

$10e^- + 2IO_3^- + 12H^+ \longrightarrow I_2 + 6H_2O$ ...(iii)

Now, balance equation (i)

$2I^- \longrightarrow I_2 + 2e^-$ ....(iv)

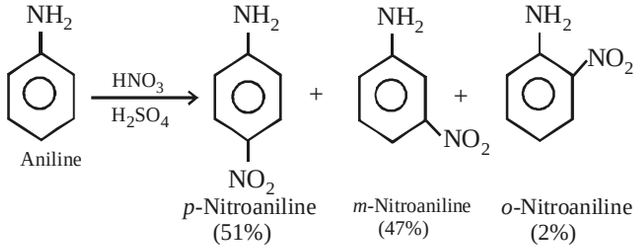
Multiply eqn (iv) by 5 and add it to eqn (iii), we get

$2IO_3^- + 10I^- + 12H^+ \longrightarrow 6I_2 + 6H_2O$

or, $IO_3^- + 5I^- + 6H^+ \longrightarrow 3I_2 + 3H_2O$

Hence a = 5, b = 6, c = 3, d = 3

85. **(4)**



The reason for this is that, in acidic condition, protonation of $-NH_2$ group gives anilinium ion ($\overset{+}{N}H_3$), which is of deactivating nature and *m*-directing.

86. **(4)** Carboxylic acids liberate CO_2 gas on reaction with sodium bicarbonate, while phenol does not.

87. **(3)** A reaction, in which a substance undergoes simultaneous oxidation and reduction, is called disproportionation reaction. In these reactions, the same substance simultaneously acts as an oxidising agent and as a reducing agent. Here Cl undergoes oxidation as well as reduction.

$$\overset{0}{2KOH + Cl_2} \rightarrow \overset{-1}{KCl} + \overset{+1}{KOCl} + H_2O$$

88. **(3)** $2C_6H_6 + 15O_2 \rightarrow 12CO_2 + 6H_2O$

2×78 g $\Rightarrow$ 15×22.4 litre of O_2 at STP

$$39 \text{ g} \Rightarrow \frac{15 \times 22.4 \times 39}{2 \times 78} = 84 \text{ litres of } O_2 \text{ at STP}$$

89. **(1)** Higher the value of reduction potential higher will be the oxidising power whereas the lower the value of reduction potential higher will be the reducing power.

90. **(1)** In Me– (3α –H) > CH_3–CH_2– (2α –H) > Me_2CH– (1α –H) > Me_3C– (no α –H)

PART C – BIOLOGY

91. **(3)** Cell wall and cell membrane are the cellular structures which play an important role in determining the movement of molecules in or out of the plant cell. Cell wall is the rigid layer of polysaccharides lying outside the plasma membrane of the cells of plants, fungi, and bacteria. In the algae and higher plants it consists mainly of cellulose. Cell membrane, composed of lipids and proteins, is the semipermeable membrane which surrounds the cytoplasm.

92. **(1)** Phenomenon of plasmolysis occurs when cells are kept in hypertonic (containing more solutes) solution. Plasmolysis is a process in which cell loses water (due to exosmosis) leading to shrinkage of plasma membrane or protoplast away from its cell wall.

93. **(3)** Some plants have additional structures associated with them that help in water and mineral absorption. Mycorrhiza is a symbiotic association of a fungus with a root system. In mycorrhiza a large number of fungal hyphae are associated with young root and also extend into soil. The hyphae have large surface area for absorption. The hyphae absorbs water and minerals and handed over them to root. Root provides the fungus with sugar and nitrogenous compound.

94. **(2)** The relation between source and sink is variable. The direction of movement of organic solutes in phloem can be upwards or downwards *i.e.*, bidirectional.

95. **(4)** In C_4 plants , the process by which C_4 acids are converted into C_3 acids in the bundle sheath cell is known as decarboxylation. In the typical C_4 cycle, the fixation reaction occurred in a mesophyll cell and the decarboxylation reaction occurred in a bundle sheath cell, Decarboxylation is a chemical reaction that removes a carboxyl group and releases carbon dioxide (CO_2).

96. **(4)**

97. **(4)** All the given factors affect transpiration. Transpiration is directly proportional to the light intensity, temperature, wind velocity, leaf surface area, root - shoot ratio and number, distribution and percent of stomata and inversely proportional to CO_2 concentration and atmospheric humidity.

98. **(1)** The loss of water in the guard cells causes them to shrink. This closes the stomatal pore.

99. **(3)** Micronutrients or trace elements are essential elements required by plants in traces only less than 10 mmole kg^{-1} of dry matter. These are eight in numbers (Zn, Mn, B, Cu, Mo, Cl, Ni, Fe).

100. **(1)** Nitrogen and phosphorous are the constituents of the proteins.

101. **(2)** Denitrification is a process by which soil anaerobic microbes convert nitrate (NO_3^-) or nitrite (NO_2^-) to the gases, nitrous oxide (N_2O) and molecular nitrogen (N_2), which are then lost in the atmosphere. It is carried out by bacteria *Pseudomonas* and *Thiobacillus*.

102. (1) Jan Ingenhousz showed that sunlight is essential to the plant process that somehow purifies the air fouled by burning candles or breathing animals. Ingenhousz in an experiment with an aquatic plant showed that in bright sunlight, small bubbles were formed around the green parts while in the dark they did not form any bubbles. Later he identified the bubbles as oxygen. Hence, he showed that it is only the green parts of the plants that could release oxygen.

103. (2) PS II is located on the inner surface of appressed parts of grana thylakoids. It comprises of about 200 chlorophylls, 50 caretonoids and one molecule P_{680}. P_{680} of PS-II absorbs light energy, gets excited and transfers its electrons to electron acceptor and becomes a strong oxidant. It paves the way for light dependent splitting of water called photolysis.

104. (3) Leghaemoglobin is red colour haemoglobin like pigment which absorbs oxygen and protect nitrogenase enzyme from the oxygen.

105. (1)

106. (4) Photosynthesis is the most important anabolic process on earth. It is defined as the transformation of photonic energy (i.e. light or radiant energy) into chemical energy by the given parts of the plants. In the process of photosynthesis, light energy drives the synthesis of carbohydrates from carbon dioxide and water with the generation of oxygen.

107. (2) Active transport is the absorption of nutrients from lower concentrated region to higher concentrated region (*i.e.* against concentration gradient). It requires energy.

108. (1) Pepsin is a protein- digesting enzyme, secreted in its inactive form (called pepsinogen) from gastric glands of stomach. The activated pepsin converts proteins into proteases and peptides.

109. (1) Bile is stored temporarily in the gall bladder until it is needed by the small intestine to emulsify fats. Removal of gall bladder would lead to impairment of digestion of fats.

110. (3) Saliva, secreted by the salivary glands contains a digestive enzyme called salivary amylase. This enzyme breaks down starch into sugar at pH 6.8. About 30% of starch is digested by amylase.Salivary amylase continues to act in the oesophagus, but its action stops in the stomach as the contents become acidic. Hence, carbohydrate-digestion stops in the stomach.

111. (2) In the fermentation of one glucose molecule, there is net gain of two molecules of ATP.

112. (1) Electron transport chain is a series of coenzymes and cytochromes that takes part in the passage of electrons from a chemical to its ultimate acceptor. It takes place on the cristae of mitochondria found on the inner surface of the membrane of mitochondria.

113. (4) Terminal cytochrome of respiratory chain is cyt a_3. cyt a_3 posseses two copper centres. It helps in transfer of electrons to oxygen.

114. (1) Arithmetic growth is a type of growth in which the rate of growth is constant and increase in growth occurs in arithmetic progression *i.e.*, 2, 4, 6, 8 etc. Here after mitosis, only one daughter cell continues to divide and other takes part in differentiation and maturation. Here a linear curve is obtained with positive value.

115. (4) Trachea is a membranous tube supported by "C" shaped cartilage ring. The cartilage ring protects the trachea from collapse and injury.

116. (4) Leucocytes are colourless, nucleated amoeboid cells found in blood which are devoid of haemoglobin and are capable of coming out of blood capillaries through the process of diapedesis. Fall of WBC count is called leucopenia, and occurs due to folic acid deficiency and AIDS, etc.

117. (4) ABO grouping is the classification of human blood based on the inherited properties of red blood cells (erythrocytes). It is determined by the presence or absence of the antigens A and B, which are carried on the surface of the red cells. Persons may thus have type A, type B, type O, or type AB blood. The A, B, and O blood groups were first identified by Austrian immunologist Karl Landsteiner in 1901.

118. (4) Gibberellins (GAs) are plant hormones that regulate growth and influence various developmental processes, including stem elongation, germination, dormancy, flowering, sex expression, enzyme induction, and leaf and fruit senescence. GA is also responsible for bolting (internode elongation just prior to flowering).

119. (4) Abscissic acid (ABA), also known as abscisin II and dormin. It is usually found in vascular plants, some fungi and some green algae. It acts as an inhibitor because it opposes the growth of promoting effect of auxins, GA and cytokinins, thus keep their activity under control. Leaf abscission, fruit fall and dormancy occurs due to abscissic acid.

120. (1) The period of daylight appears to initiate flowering in long-day plants or inhibit flowering in short-day plants. In actual fact, long-day plants will not flower if the dark period exceeds a certain maximum and conversely short-day plants will not flower unless the dark period exceeds a certain minimum. These periods are termed critical dark periods and must be continuous to have effect.

121. (4) The opening of hepato-pancreatic duct in the duodenum is guarded by sphincter of Oddi.

122. (2) Liver is the largest digestive gland. Hepatic lobules are the structural and functional unit of liver. Liver is basically an organ of homeostasis which controls many metabolic activities essential for maintaining constant blood composition.

Kupffer cells (present in the lining of blood spaces of liver) are phagocytic and involved in the breakdown of old red blood cells and ingestion of potentially harmful bacteria. Glissons capsule is a thin layer of dense connective tissue which surrounds the liver lobule enclosing branches of portal vein, the hepatic artery, the bile duct and lymphatic capsule. Crypts of

Lieberkuhn (present in the intestine) are tubular invagination of the epithelium around the villi, lined largely with younger epithelial cells which are involved primarily in secretion.

123. (4) Pancreatic juice contains variety of enzymes that help in the digestion of protein, fats and carbohydrates.

124. (4) Alveolar epithelium and endothelium of blood capillaries are two membranes which separate air in pulmonary alveoli from blood capillaries.

125. (3) Total lung capacity (TLC) is the total volume of air in the lungs after a maximum inspiration.
(RV + ERV + TV + IRV or VC + RV).

126. (2) Spirometer is an apparatus for measuring the volume of air inspired and expired by the lungs. It measures ventilation, the movement of air into and out of the lungs. There are various types of spirometers which use a number of different methods for measurement (pressure, transducers, ultrasonic, water gauge).

127. (3) Convoluted tubules is not a part of renal pyramid but a portion of the nephron in the kidney that functions in concentrating urine and in maintaining salt, water, and sugar balance. Renal pyramids (also called malpighian pyramids) consist mainly of tubules that transport urine from the cortical (or outer) part of the kidney, where urine is produced, to the calyces or cup-shaped cavities in which urine collects before it passes through the ureter to the bladder. The point of each pyramid, called the papilla, projects into a calyx.

128. (3) Bicuspid term is applied to a valve in heart and tooth surface.

129. (2) Hardening of arteries due to deposition of cholesterol is called atherosclerosis.

130. (2) The contraction starts shortly after the Q wave and marks the beginning of the systole.

131. (1) A two-chambered heart with the vena cava entering the auricle and the aorta leaving the ventricle would totally by pass the pulmonary circuit. As a result, the blood would never reach the lungs and would never pick up a fresh supply of oxygen to take to the cells.

132. (1) Bony fishes, aquatic amphibian and aquatic insects are called ammonotelic animals because these animals excrete ammonia as their nitrogenous waste products. Being the most toxic form ammonia requires large amount of water for its elimination. Aquatic animals, like crustaceans, bony fishes and amphibian larvae, generally are ammonotelic since ammonia diffuses more easily through membranes and it is more water-soluble than the other nitrogen wastes.

133. (4) (1) Myasthenia gravis is either an autoimmune or congenital neuromuscular disease that leads to fluctuating muscle weakness and fatigue.

(2) Gout is usually characterized by recurrent attacks of acute inflammatory arthritis-a red, tender, hot, swollen joint. It is caused by elevated levels of uric acid in the blood. The uric acid crystallizes, and the crystals deposit in joints, tendons, and surrounding tissues.

(3) Muscular dystrophy is a progressive degeneration of skeletal muscles mostly due to genetic disorder.

134. (4) Muscle contraction is triggered by a nerve releasing a neurotransmitter, which in turn triggers the sarcoplasmic reticulum to release calcium ions into the muscle interior where they bind to troponin, thus causing tropomyosin to shift from the face of the actin filament to which myosin heads need to bind to produce contraction.

135. (2) Central part of thick filament, not overlapped by thin filaments is called the 'H' zone. 'H' zone is also called Hensen's Line.

136. (1) The ascending limb of loop of Henle has a thin and a thick segment. The thin ascending limb is found in the medulla of the kidney, and the thick ascending limb can be divided into a part that is in the renal medulla and a part that is in the renal cortex. Through the thick segment of ascending limb of loop of Henle, the NaCl can pass by active transport from the filtrate to the interstitial fluid. The medullary ascending limb remains impermeable to water. Sodium, potassium (K^+) and chloride (Cl^-) ions are reabsorbed by active transport. K^+ is passively transported along its concentration gradient through a K^+ leak channel in the apical aspect of the cells, back into the lumen of the ascending limb.

137. (2) Movement of leucocyte, macrophages and cytoskeletal elements in our body exhibits amoeboid movement. It is a type of movement which occur with the help of pseudopodia formed by cytoplasmic streaming (as in *Amoeba*).

138. (3) Striated muscle fibres bear striations in the form of alternate light and dark bands.

139. (1) Long bones, like humerus, radius and ulna of forearm, femur, tibia and fibula of shank in adult mammals provides support.

140. (2) Aldosterone and ADH maintains the volume of urine. Aldosterone, produced by the adrenal cortex, causes the retention of water in the body by increasing the levels of sodium and potassium ions in the blood, which causes the body to reabsorb more water. Antidiuretic hormone (ADH) produced by the hypothalamus and released by the posterior pituitary, causes more water to be retained by the kidneys when water levels in the body are low.

141. (2) Micturition is the process by which the urine from the urinary bladder is excreted.

142. (4) Hydropnics or soilless culture helps to understand:
- The essentiality of mineral elements.
- The deficiency symptoms developed due to non-avaibility of particular nutrient.
- Toxicity to plant when element is present in excess.
- Possible interaction among different elements present in plants.
- The role of essential element in the metabolism of plant.

143. (1) During recovery, a nerve fibre becomes positively charged outside and negatively charged inside.

144. (1) Nuclei are areas of grey matter within the white matter, where nerve impulses are processed.

145. (3) Cornea is a transparent anterior portion of eye that lacks blood vessels and is nourished by lymph from the nearby area.

146. (2) In static condition, the body balance is sensed by macula. Macula provideS information on head position (static equilibrium), as well as linear acceleration and deceleration, a type of dynamic equilibrium. The macula consist of hair cells with hair bundles and supporting cells.

147. (4) Anterior lobe of pituitary secretes follicle stimulating hormones, growth hormone and luteinizing hormone.

148. (3) ADH (or vasopressin) is secreted by posterior pituitary gland. It acts on kidney tubule and blood capillaries and concentrates the urine by promoting the reabsorption of water and salts into the cortical collecting ducts.

149. (4) Receptors for protein hormone are found on the cell surface.

150. (4) Vasopressin and ADH are identical. Vasopressin or Anti-diuretic hormone (ADH) stimulates the reabsorption of water and electrolytes by DCT of kidney and thereby reduces diuresis (loss of water through urine).

151. (1)

152. (2) PTH (parathyroid hormone), also called Collip's hormone, is secreted from the parathyroid gland. It is responsible for the following functions like: release of calcium by ones into the blood streams, absorption of food by the intestine and conservation of calcium by the kidneys.

153. (1) Facilitated diffusion is the diffusion of hydrophilic substances along the concentration gradient through fixed membrane transport proteins without involving energy expenditure. It is very specific as it allows cell to select substances for uptake.

154. (4) In girdling or ringing experiments a ring of bark is cut form the stem. It also removes phloem. Nutrients collect above the ring where the bark also swells up and may give rise to adventitious roots. Growth is also vigorous above the ring. The tissues below the ring not only show stoppage of growth but also begin to shrivel. Roots can be starved and killed if the ring is not healed after some time. Killing of roots shall kill the whole plant clearly showing that bark or phloem is involved in the movement of organic solutes towards root.

155. (2) During aerobic respiration, O_2 is consumed and CO_2 is released. The ratio of the volume of CO_2 evolved to the volume of O_2 consumed in respiration over a period of time is called as respiratory quotient (RQ) or respiratory ratio.

$$RQ = \frac{\text{Volume of } CO_2 \text{ evolved}}{\text{Volume of } O_2 \text{ consumed}}$$

The respiratory quotient depends upon the type of respiratory substrate used during respiration.

(i) When carbohydrates are used as substrate and are completely oxidized, the RQ will be 1, because equal amounts of CO_2 and O_2 are evolved and consumed, respectively.

$$RQ = \frac{6CO_2}{6O_2} = 1.0$$

(ii) When proteins are the respiratory substrates, the ratio would be about 0.9.

156. (4) In the initial phase of glycolysis, the hexoses (i.e. glucose and fructose) are phosphorylated in a reaction that uses ATP at two steps : First in the conversion of glucose-6-phosphate and second in the conversion of fructose-6-phophaste to fructose-1, 6-biphosphate. These reactions are catalyzed by the hexokinase and phospho-fructokinase respectively.

$$\text{Glucose} + ATP \xrightarrow[Mg^{2+}]{\text{hexokinase}} \text{Glucose} - 6 - \text{phosphate} + ADP$$

$$\text{Fructose} - 6 - \text{phosphate} + ATP \xrightarrow[Mg^{2+}]{\text{Phospho fructokinase}}$$

$$\text{Fructose} - 1,6 - \text{biphosphate} + ADP$$

157. (1) Lateral meristem occurs on the sides and takes part in increasing the girth of the plant. Intra fascicular cambium is the primary lateral meritem which lies in vascular bundles of dicot and gymnosperm stems in between phloem and xylem. Examples of secondary lateral meristems are vascular cambium of the root, inter fascicular cambium of stem, cork cambium etc., that take part in the secondary growth.

158. (1) The enzyme nitrogenase is a Mo-Fe protein and catalyses the conversion of atmospheric N_2 to NH_3. This enzyme, if inactivated, will lead to no fixation of nitrogen in legumes.

159. (4) Ruben and Kamen (1941), while working on *Chlorella* found that oxygen liberated during photosynthesis comes from water.

(i) When normal H_2O and radioactive CO_2 were used, normal O_2 is evolved.

$$nCO_2^{18} + nH_2O \xrightarrow[\text{Chlorophyll}]{\text{Light}} \left(CH_2O^{18}\right)_n + nO_2 \uparrow (\text{normal}) + H_2O$$

(ii) When normal CO_2 and radioactive H_2O (i.e., H2O18) were used, radioactive O_2 (i.e., O_2^{18}) is evolved.

$$nCO_2 + nH_2O^{18} \rightarrow (CH_2O)_n + O_2^{18} \uparrow$$
$$(\text{radioactive oxygen}) + H_2O$$

160. (1) Both malic acid and aspartic acid are 4-carbon compounds formed in the mesophyll cells during C_4 cycle. These are transported to the bundle sheath cells through plasmodesmata. PGA (3-phosphoglyceric acid) is a the first stable product of Calvin cycle. RuRP (Ribulose - 1, 5-biphosphate) is a 5-carbon compound, which is the primary acceptor of CO_2 during C_3 cycle.

161. (1) Blood serum would not clot as it is blood plasma from which the fibrinogens and clotting factors have been removed.

162. (2) When the apical bud is removed, the lateral buds sprout. Apical bud inhibits the growth of lateral buds by releasing auxins. When a plant is decapitated i.e. its apical bud is removed then the lateral buds sprout, resulting in dense bushy growth. This phenomenon is widely used in the tea plucking and hedge making.

163. (4)

164. (2) Enterokinase is an enzyme present in intestinal juice. It helps in conversion of trypsinogen (inactive form of enzyme) into trypsin (active form of the enzyme) for protein digestion in the intestine.

165. (2) The volume of air inspired or expired during normal breath is called tidal volume. In an average young adult man it is about 500 mL of air.

166. (3) A chemosensitive area situated adjacent to the rythm centre is highly sensitive to changes in CO_2 and hydrogen ion concentrations in blood. Increase in CO_2 and H+ ions stimulate this centre, which in turn stimulate the rhythm centre to make necessary adjustments in the respiratory process by which these substances can be eliminated.

167. (1) Most reabsorption of the major substances from the glomerular filtrate takes place in proximal convoluted tubule. Podocytes are the special type of cells present in the visceral layer of Bowman's capsule. These cells have foot like processes called pedicels. The space between the pedicels are called slip pores through which the glomercular filtrate filters.

168. (2) Lymph is a fluid connective tissue containing lymph plasma and cells. The cells in lymph are floating amoeboid cells called WBCs (white blood cells) which are mostly lymphocytes. RBCs and platelets are absent in lymph.

169. (3) Aquatic animals are ammonotelic as they excrete ammonia. Frog, amphibians and humans are ureotelic as they excrete urea. Pigeon, lizards and cockroach are uricotelic as they excrete uric acid.

170. (1) A myofibril has dark and light bands. The dark bands are called A bands (anisotropic bands). Light bands are called I bands (isotropic bands).

171. (1) The afferent neuron receive signal from a sensory organ and transmits the impulse via a dorsal nerve root into CNS.

172. (1) The joint of radio-ulna with the upper arm is a hinge joint. This joint allows the movement only in a single plane.

173. (4) Synapse is a junction between the branches at the end of the axon of one neuron and the dendrites or cell body of another neuron. Through this junction nerve impulse transmits from one neuron to other.

174. (4) At resting potential (polarized phase), the inside of the plasma membrane is negatively charged (–70 mV). As the stimulus increases, it becomes positively charged (+45 mV, depolarized phase). As impulse passes away, it regains its original ionic distribution and again becomes negatively charged.

175. (2) Hormones recognize target organs by the presence of specific receptor molecules on the plasma membrane of target organs. If these receptor molecules are removed then a hormone will be unable to give any resp

176. (1) Both the scala vestibuli and scala tympani are connected with each other at the apex of the cochlea by a small canal called helicotrema.

177. (3) Endocrine glands lack ducts and pass their secretions into the surrounding blood for transport to the site of action. They are also called the ductless glands. Their secretions are known as hormones.

178. (4) The Brunner's glands present in the wall of the duodenum secrete the hormone secretin.

179. (4) Glucagon increases blood sugar level. It is secreted by α-cells of islets of Langerhans of pancreas (heterocrine gland)

180. (1) A lack of nitrogen in the soil causes the yellowing of leaves in tomato plant.