

NEET - 11

FULL SYLLABUS

DATE : 18-01-2024

Explanations

Physics

$$1. (b) \Delta W_{\text{cyclic}} = \pi \left(\frac{3p_0 - p_0}{2} \right) \left(\frac{2V_0 - V_0}{2} \right)$$

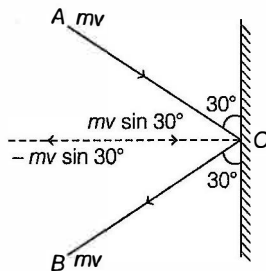
$$= \frac{\pi p_0 V_0}{2} = \frac{\pi p_0 V_0}{m} \text{ (given)}$$

$$\therefore m = 2$$

2. (b) Change in momentum,

$$\Delta p = p_f - p_i$$

$$= -mv \sin 30^\circ - mv \sin 30^\circ$$



$$\text{or } \Delta p = -2mv \sin 30^\circ$$

$$= -2 \times 2 \times 100 \times \frac{1}{2} = -200 \text{ kg ms}^{-1}$$

The force exerted by the ball on the wall,

$$F = \frac{-\Delta p}{\Delta t} = \frac{200}{0.4} = 500 \text{ N}$$

3. (c) Magnetic field at O,

$$B = \frac{\mu_0}{4\pi a} \cdot i (\sin \phi_1 + \sin \phi_2)$$

$$\text{But } \phi_1 = 90^\circ - \theta_1$$

$$\text{and } \phi_2 = 90^\circ - \theta_2$$

$$\therefore B = \frac{\mu_0}{4\pi a} [\sin(90^\circ - \theta_1) + \sin(90^\circ - \theta_2)]$$

$$= \frac{\mu_0}{4\pi a} \cdot i (\cos \theta_1 + \cos \theta_2)$$

4. (b) Refractive index is given by

$${}_g\mu_a = \frac{\sin i}{\sin r}$$

$$\Rightarrow \frac{1}{{}_a\mu_g} = \frac{\sin i}{\sin 2i} \quad (\because 2i = r)$$

$$\Rightarrow \frac{1}{16} = \frac{\sin i}{2 \sin i \cos i}$$

$$\Rightarrow \frac{1}{16} = \frac{1}{2 \cos i}$$

$$\frac{1}{\cos i} = \frac{5}{4}$$

$$\Rightarrow \cos i = \frac{4}{5}$$

$$\text{Now, } \sin i = \sqrt{1 - \cos^2 i}$$

$$\Rightarrow \sin i = \sqrt{1 - \frac{16}{25}} = \frac{3}{5}$$

$$\Rightarrow i = \sin^{-1} \left(\frac{3}{5} \right)$$

5. (b) Minimum kinetic energies are at highest point,

$$\frac{\frac{1}{2} m u_1^2 \cos^2 \theta_1}{\frac{1}{2} m u_2^2 \cos^2 \theta_2} = \frac{4}{1} \Rightarrow \frac{u_1 \cos \theta_1}{u_2 \cos \theta_2} = 2 \quad \dots(i)$$

and ratio of the maximum height,

$$\frac{u_1^2 \sin^2 \theta_1}{u_2^2 \sin^2 \theta_2} = \frac{4}{1} \Rightarrow \frac{u_1 \sin \theta_1}{u_2 \sin \theta_2} = \frac{2}{1} \quad \dots(ii)$$

From Eqs. (i) and (ii), we get

$$\frac{u_1 \sin \theta_1 \cdot u_1 \cos \theta_1}{u_2 \sin \theta_2 \cdot u_2 \cos \theta_2} = \frac{4}{1}$$

$$\left(\frac{gR_1}{2} \right) = 4 \Rightarrow \frac{R_1}{R_2} = \frac{4}{1}$$

$$\left(\frac{gR_2}{2} \right) = 1$$

$$6. (b) \frac{1}{2} m v^2 - \frac{GMm}{R} = - \frac{GMm}{(R+h)}$$

$$\Rightarrow v^2 = \frac{2GM}{R} \left(\frac{h}{R+h} \right) \quad \dots(i)$$

$$\text{Now, escape velocity, } v_e = \left(\frac{2GM}{R} \right)^{1/2}$$

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

So, from Eq. (i), we get

$$\frac{1}{4} \frac{2GM}{R} = \frac{2GM}{R} \left(\frac{h}{R+h} \right)$$

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

$$\Rightarrow \frac{h}{R} = \frac{1}{3}$$

Problem Solving Tactics

If a body is thrown up from the surface of the earth, then $K_i + U_i = K_f + U_f$

7. (b) Here, $d = \sqrt{d_1 d_2}$
 $= \sqrt{0.03 \times 0.12} = 0.06 \text{ mm} = 6 \times 10^{-5} \text{ m}$

\therefore Fringe width, $\beta = \frac{D\lambda}{d}$
 $= \frac{2 \times 400 \times 10^{-9}}{6 \times 10^{-5}}$

$= 1.33 \times 10^{-2} \text{ m} = 13.3 \text{ mm}$

8. (b) We know that, $\alpha = \frac{dl}{l \times dt}$

where, dl = change in length,
 l = initial length

and dt = change in temperature.

So, $dt = \frac{dl}{l \times \alpha}$

In this case, $\alpha = 2 \times 10^{-5} / ^\circ \text{C}$,

$l = 1 \text{ m}, t = 20^\circ \text{C}$

$dl = 1 \text{ mm} = 1 \times 10^{-3} \text{ m}$

$dt = \frac{1 \times 10^{-3}}{1 \times 2 \times 10^{-5}}$

We get, $dt = 50^\circ \text{C}$

Since, present temperature = 20°C

The final temperature should be -30°C .

9. (d) Decrease in kinetic energy = Increase in internal energy of the gas

$\frac{1}{2} m v_0^2 = n C_V \Delta T = \frac{m}{M} \left(\frac{5}{2} R \right) \Delta T$

$\Rightarrow \Delta T = \frac{M v_0^2}{5R}$

10. (c) Given, radius of first Bohr orbit for electron in a hydrogen atom, $r = 0.53 \text{ \AA}$

and its ground state energy, $E_0 = -13.6 \text{ eV}$

Charge of muon = Charge of electron

Mass of muon = $207 \times$ (Mass of electron)

\therefore When electron is replaced by muon, then first Bohr

radius, $r_1' = \frac{0.530 \text{ \AA}}{207} = 2.56 \times 10^{-13} \text{ m}$

and ground state energy, $E_1' = -13.6 \times 207$

$= -2815.2 \text{ eV} = -2815 \text{ keV}$

$\approx -2.8 \text{ keV}$

11. (b) Given, $\sqrt{i} = t - 1 \Rightarrow i = t^2 - 2t + 1$

\therefore Charge transfer in first second,

$q = \int_0^1 i dt = \int_0^1 (t^2 - 2t + 1) dt$

$= \left[\frac{t^3}{3} - t^2 + t \right]_0^1 = \frac{1}{3} = 0.33 \text{ C}$

12. (c) $x = \alpha t^3 \Rightarrow v_x = \frac{dx}{dt} = 3\alpha t^2$

$y = \beta t^3 \Rightarrow v_y = \frac{dy}{dt} = 3\beta t^2$

$v = \sqrt{v_x^2 + v_y^2} = 3t^2 \sqrt{\alpha^2 + \beta^2}$

13. (a) Potential energy (PE) = W

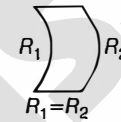
Here, $2eV = \frac{k(Ze)(e)}{d}$

$\therefore d = \frac{9 \times 10^9 \times Z \times e \times 2e}{2eV}$

$d = \frac{9 \times 10^9 \times 16 \times 10^{-19} \times Z}{V}$

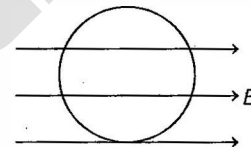
$d = 14.4 \times 10^{-10} \left(\frac{Z}{V} \right) \text{ m} = 14.4 \frac{Z}{V} \text{ \AA}$

14. (d) In option (d), the radii of two curvature of two faces (convex and concave) of a lens are equal. i.e., $R_1 = R_2$



So, the incident and emergent rays will be parallel.

15. (a) Magnetic moment of the ring is given by



$\mathbf{M} = \mathbf{I} \cdot \mathbf{A}$

$= 4 \times \pi (0.5)^2 (-\hat{k}) = -\pi \hat{k} \text{ A}\cdot\text{m}$

Torque acting on the ring,

$\tau = \mathbf{M} \times \mathbf{B} = (-\pi \hat{k}) \times (10 \hat{i}) = -10\pi \hat{j}$

So, axis of rotation is along τ , i.e., negative Y -axis.

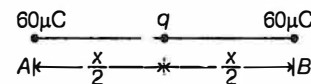
Moment of inertia of ring about Y -axis,

$I = \frac{1}{2} MR^2 = \frac{1}{2} \times 2 \times (0.5)^2 = \frac{1}{4} \text{ kg}\cdot\text{m}^2$

$\tau = I\alpha \Rightarrow \alpha = \frac{\tau}{I} = \frac{10\pi}{1/4}$

$\alpha = 40\pi \text{ rad/s}^2$

16. (d) For equilibrium, net force on charge A must be zero,



i.e. $\frac{1}{4\pi\epsilon_0} \cdot \frac{60 \times 10^{-6} \cdot q}{\left(\frac{x}{2}\right)^2} + \frac{1}{4\pi\epsilon_0} \cdot \frac{(60 \times 10^{-6})^2}{x^2} = 0$



$$\begin{aligned} \Rightarrow 4q &= -60 \times 10^{-6} \\ \Rightarrow q &= -15 \times 10^{-6} \\ \Rightarrow q &= -15 \mu\text{C} \end{aligned}$$

17. (c) $s = ut + \frac{1}{2}at^2$

$$0.5 = 0 \times t + \frac{1}{2} \times a \times (4)^2 \Rightarrow a = \frac{0.5 \times 2}{16} = \frac{1}{16} \text{ms}^{-2}$$

$$\text{But, } a = \frac{g \sin \theta}{1 + \frac{I}{MR^2}} = \frac{g \sin \theta}{1 + \frac{\frac{2}{5}MR^2}{MR^2}}$$

$$= \frac{5}{7}g \sin \theta \Rightarrow \frac{1}{16} = \frac{5}{7} \times g \times 0.02$$

$$\Rightarrow g = \frac{7}{5 \times 16 \times 0.02} = 4.375 \text{ms}^{-2}$$

18. (b) Electromagnetic waves are self-sustaining oscillation of electric and magnetic fields in free space or vacuum. They differ from all other waves we have studied so far, in respect that no material medium is involved in the vibration of electric and magnetic fields.

19. (d) Moment of inertia of each disc about the axis through the centre is given by

$$I_A = I_B = \frac{1}{2}MR^2$$

From theorem of parallel axes,

$$I'_A = \frac{1}{2}MR^2 + M(2R)^2 = \frac{9}{2}MR^2$$

$$\therefore I = I'_A + I_B = \frac{9}{2}MR^2 + \frac{1}{2}MR^2$$

$$I = 5MR^2$$

20. (a) If an experiment is performed to find the refractive index of glass using a travelling microscope, distances are measured by a vernier scale which is provided on the microscope.

21. (d) When axis of dipole is parallel to the direction of electric field, then potential energy is minimum.

$$\text{i.e., } \phi = 0^\circ$$

$$\therefore U = -pE \cos 0^\circ = -pE$$

22. (a) $\tan \phi = \frac{\frac{1}{\omega C} - \omega L}{R}$

$$\phi = 45^\circ$$

$$\therefore \tan 45^\circ = \frac{\frac{1}{\omega C} - \omega L}{R} \Rightarrow 1 = \frac{\frac{1}{\omega C} - \omega L}{R}$$

$$\Rightarrow R = \frac{1}{\omega C} - \omega L \Rightarrow \omega C = \frac{1}{\omega L + R}$$

$$\Rightarrow C = \frac{1}{\omega(\omega L + R)} \quad (\because \omega = 2\pi f)$$

$$= \frac{1}{2\pi f(2\pi fL + R)}$$

23. (a) Truth table of given combination is

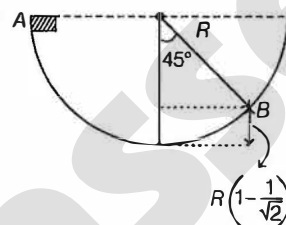
A	B	Y'	Y
0	0	1	0
0	1	1	0
1	0	1	0
1	1	0	1



The diagram performs logic function of AND gate.

24. (c) Total energy at point A = Total energy at point B

$$0 + mgR = \frac{1}{2}mv_B^2 + mgR\left(1 - \frac{1}{\sqrt{2}}\right)$$



$$\therefore v_B = \sqrt{\sqrt{2}gR} = 3.76 \text{ms}^{-1} (\because R = 1 \text{m, given})$$

25. (a) When n resistors are connected in series, then

$$A = nR \quad \dots(i)$$

When n resistors are connected in parallel, then

$$B = \frac{R}{n} \quad \dots(ii)$$

From Eqs. (i) and (ii), we get

$$AB = R^2$$

$$\Rightarrow R = \sqrt{AB}$$

26. (c) Induced emf is given by $e = -\frac{d\phi}{dt}$

$$\text{As, } i = \frac{e}{R} = -\frac{1}{R} \frac{d\phi}{dt}$$

$$\therefore \text{Total charge induced} = \int idt$$

$$= -\int \frac{1}{R} \frac{d\phi}{dt} dt = -\frac{1}{R} \int_{\phi_1}^{\phi_2} d\phi$$

$$= -\frac{1}{R} [\phi_2 - \phi_1] = \frac{1}{R} (\phi_1 - \phi_2)$$

Thus, the induced charge in a conducting loop, moving in a magnetic field depends on the total change in magnetic flux.

27. (c) We know that, energy stored in capacitor,

$$E_C = \frac{1}{2}CV^2$$

and energy stored in inductor,

$$E_L = \frac{1}{2}LI^2$$



$$\text{Thus, } \frac{LI^2}{CV^2} = \frac{\frac{1}{2}LI^2}{\frac{1}{2}CV^2} = \frac{E_L}{E_C} = \frac{[ML^2T^{-2}]}{[ML^2T^{-2}]} \\ = [M^0L^0T^0A^0]$$

28. (b) Magnetic field at A due to current carrying loop B ,

$$B_A = \frac{\mu_0 IR^2}{2(R^2 + x^2)^{\frac{3}{2}}}$$

Magnetic flux passing through loop A ,

$$\phi_A = B_A \cdot \pi r^2 \text{ and } e_A = -\frac{d\phi_A}{dt}$$

Induced emf will be maximum, if

$$\frac{d}{dx} e_A = \frac{d}{dx} \left(\frac{-d\phi_A}{dt} \right) = 0$$

[where, e_A = Induced emf in loop A]

On solving, we get $x = \frac{R}{2}$

29. (c) Current through resistance of $1 \text{ k}\Omega$,

$$i = \frac{25 - 12}{1 \times 10^3} \text{ A} = 13 \text{ mA}$$

But current through

$$2 \text{ k}\Omega = \frac{V_{2 \text{ k}\Omega}}{(2 \times 10^3)} = \frac{12}{2 \times 10^3} \text{ A} = 6 \text{ mA}$$

\therefore Current through zener diode = $13 \text{ mA} - 6 \text{ mA} = 7 \text{ mA}$

30. (b) Given $q = -2\mu\text{C}$

$$v = (2\hat{i} + 3\hat{j}) \times 10^6 \text{ ms}^{-1}$$

$$B = 2 \text{ T along } y\text{-direction}$$

$$B = 2\hat{j} \text{ T}$$

\therefore Magnetic force, $\mathbf{B} = q(\mathbf{v} \times \mathbf{B})$

$$= [-2 \times 10^{-6}] [(2\hat{i} + 3\hat{j}) \times 10^6 \times 2\hat{j}] \\ = (-2 \times 10^{-6}) [4(\hat{i} \times \hat{j}) \times 10^6] \quad [\hat{j} \times \hat{j} = 0] \\ = -8\hat{k} = 8 \text{ N in } -z\text{-direction.}$$

31. (c) Magnitude of velocity of particle, when it is at displacement x from mean position

$$= \omega \sqrt{A^2 - x^2}$$

Also, magnitude of acceleration of particle in

$$\text{SHM} = \omega^2 x$$

Given, when $x = 2 \text{ cm}$, $|v| = |a|$

$$\Rightarrow \omega \sqrt{A^2 - x^2} = \omega^2 x \Rightarrow \omega = \frac{\sqrt{A^2 - (2)^2}}{2} = \frac{\sqrt{9-4}}{2}$$

$$\Rightarrow \text{Angular velocity, } \omega = \frac{\sqrt{5}}{2} \text{ rad/s}$$

$$\therefore \text{Time period of motion, } T = \frac{2\pi}{\omega} = \frac{4\pi}{\sqrt{5}} \text{ s}$$

32. (c) Due to random motion of thermal electrons, net flow of charge through any cross-section of conducting wire is zero, hence in the absence of external electric field, net current flowing through it is zero.

33. (a) Energy level of H-atom is given by

$$E_n = \frac{-13.6}{n^2} \text{ eV}$$

Photons are emitted only when electron jumps from higher energy level to lower energy level.

Hence, options (b) and (c) are wrong.

$$\Delta E_{2 \rightarrow 1} = 13.6 \left(\frac{1}{1^2} - \frac{1}{2^2} \right) \text{ eV} = 10.2 \text{ eV}$$

$$\Delta E_{6 \rightarrow 2} = 13.6 \left(\frac{1}{2^2} - \frac{1}{6^2} \right) = 3.02 \text{ eV}$$

Hence, $\Delta E_{2 \rightarrow 1}$ is maximum.

34. (b) The body will be weightless if weight is balanced by centrifugal force.

$$\text{i.e. } mR\omega^2 = mg \Rightarrow \omega = \sqrt{\frac{g}{R}}$$

$$T = 2\pi \sqrt{\frac{R}{g}} = 2 \times \frac{22}{7} \times \sqrt{\frac{6400 \times 10^3}{9.8}}$$

$$\approx 5080 \text{ s} \approx 14 \text{ h}$$

35. (d) $\mathbf{v}_{b/g} = 3\hat{i} + 4\hat{j}$

$$\mathbf{v}_{w/g} = -3\hat{i} - 4\hat{j}$$

$$\mathbf{v}_{b/w} = \mathbf{v}_{b/g} - \mathbf{v}_{w/g} = 6\hat{i} + 8\hat{j}$$

36. (a) The voltage drop across $1 \text{ k}\Omega$, $V_2 = 15 \text{ V}$

The current through $1 \text{ k}\Omega$,

$$I_1 = \frac{15 \text{ V}}{1 \times 10^3 \Omega} = 15 \times 10^{-3} \text{ A} = 15 \text{ mA}$$

The voltage drop across 250Ω

$$= 20 \text{ V} - 15 \text{ V} = 5 \text{ V}$$

The current through 250Ω ,

$$I = \frac{5 \text{ V}}{250 \Omega} = 0.02 \text{ A} = 20 \text{ mA}$$

The current through zener diode,

$$I_2 = I - I_1 = (20 - 15) \text{ mA} = 5 \text{ mA}$$

37. (c) For closed organ pipe, frequency of closed organ pipe is given by

$$f = \frac{v}{4L} \quad (f = \text{fundamental frequency})$$

$$f = \frac{340}{(4 \times 0.85)} = 100 \text{ Hz}$$

Natural frequency of closed organ is

$$f_n = (2n-1)f \Rightarrow \text{for } n = 1, 2, 3, 4, 5, 6, \dots$$

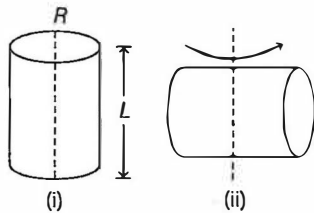
$$f_n = 100 \text{ Hz, } 300 \text{ Hz, } 500 \text{ Hz, } 700 \text{ Hz, } 900 \text{ Hz, } 1100 \text{ Hz}$$

So, number of possible natural oscillation below 1250 Hz is 6.



38. (b) Moment of inertia of a cylinder about an axis passing through its centre and parallel to its length

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



Moment of inertia about its centre and perpendicular to its length

$$= M \left(\frac{L^2}{12} + \frac{R^2}{4} \right)$$

According to question,

$$\frac{ML^2}{12} + \frac{MR^2}{4} = \frac{MR^2}{2} \Rightarrow L = \sqrt{3}R$$

39. (c) Given, $E = 50 \text{ V/m}$

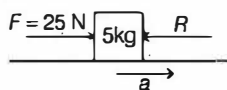
$$\therefore \epsilon_r = 1 + \chi$$

where, χ is electrical susceptibility and ϵ_r is dielectric constant.

$$6.5 = 1 + \chi \Rightarrow \chi = 5.5$$

$$\therefore \text{Polarisation, } P = \chi E = 5.5 \times 50 = 275$$

40. (a) $a = \frac{25}{5+4+1} = 25 \text{ ms}^{-2}$



The equation of motion is

$$F - R = ma$$

$$25 - R = 5 \times 25 \Rightarrow R = 125 \text{ N}$$

41. (c) For a pendulum, the time period,

$$T = 2\pi \sqrt{\frac{l}{g}}$$

$$g = \frac{4\pi^2 l}{T^2} \Rightarrow \frac{\Delta g}{g} = \frac{\Delta l}{l} + 2 \frac{\Delta T}{T}$$

$$= \frac{0.1}{100} + \frac{2(0.1)}{2(100)} = 0.002$$

Therefore, the accuracy in the value of

$$g = \frac{\Delta g}{g} \times 100 = 0.2\%$$

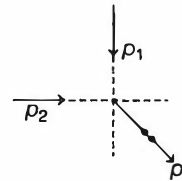
42. (a) According to given situation,

$$\lambda_1 = \frac{h}{p_1} \text{ and } \lambda_2 = \frac{h}{p_2}$$

$$\Rightarrow p_1 = \frac{h}{\lambda_1} \text{ and } p_2 = \frac{h}{\lambda_2}$$

where, p_1 and p_2 are momentum of the particle.

Given that, particles are moving perpendicular to each other and collide inelastically. So, they move as a single particle.



So, by conservation of momentum and vector addition law, net momentum after collision,

$$p_{\text{net}} = p' = \sqrt{p_1^2 + p_2^2 + 2p_1 p_2 \cos 90^\circ}$$

$$= \sqrt{p_1^2 + p_2^2}$$

$$\text{Since, } p_1 = \frac{h}{\lambda_1} \text{ and } p_2 = \frac{h}{\lambda_2}$$

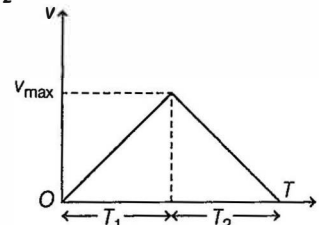
$$\therefore p' = \sqrt{\frac{h^2}{\lambda_1^2} + \frac{h^2}{\lambda_2^2}} \quad \dots(i)$$

\therefore de-Broglie wavelength of final particle after collision,

$$\lambda' = \frac{h}{p'} = \frac{h}{\sqrt{\frac{h^2}{\lambda_1^2} + \frac{h^2}{\lambda_2^2}}} = \frac{\lambda_1 \lambda_2}{\sqrt{\lambda_1^2 + \lambda_2^2}}$$

43. (b) Let, T_1 be the time of acceleration and T_2 for deceleration, then

$$T_1 + T_2 = T$$



$$\text{From figure, } \alpha = \frac{v_{\text{max}}}{T_1} \Rightarrow T_1 = \frac{v_{\text{max}}}{\alpha}$$

$$\text{and } \beta = \frac{v_{\text{max}}}{T_2} \Rightarrow T_2 = \frac{v_{\text{max}}}{\beta}$$

$$\therefore \frac{v_{\text{max}}}{\alpha} + \frac{v_{\text{max}}}{\beta} = T \Rightarrow v_{\text{max}} = \frac{\alpha\beta T}{\alpha + \beta}$$

44. (b) Common potential,

$$V = \frac{C_1 V_1 + C_2 V_2}{C_1 + C_2}$$

$$\Rightarrow 2 = \frac{C_0 K \times 0 + C_0 \times 50}{C_0 K + C_0}$$

$$\Rightarrow 2 = \frac{50}{K + 1} \Rightarrow 2K + 2 = 50$$

$$\Rightarrow K = 24$$



45. (c) $I_{\text{rms}} = \frac{I_0}{\sqrt{2}}$ and

$$I_{\text{avg}} = \frac{\int_{T/8}^{T/4} I_0 \sin \omega t}{\left(\frac{T}{4} - \frac{T}{8}\right)} = I_0 \frac{\left[-\cos \omega t\right]_{T/8}^{T/4}}{\left(\frac{T}{4} - \frac{T}{8}\right)}$$

$$= -I_0 \frac{\left[\cos \frac{2\pi}{T} \times \frac{T}{4} - \cos \frac{2\pi}{T} \times \frac{T}{8}\right]}{\frac{T}{8}} \quad \left(\because \omega = \frac{2\pi}{T}\right)$$

$$= \frac{-I_0 \left[0 - \frac{1}{\sqrt{2}}\right]}{\frac{T}{8}} = \frac{4I_0}{\sqrt{2\pi}}$$

$$\therefore \frac{I_{\text{rms}}}{I_{\text{avg}}} = \frac{\frac{I_0}{\sqrt{2}}}{\frac{4I_0}{\sqrt{2\pi}}} = \frac{\pi}{4}$$

46. (c) $T = \frac{40\text{s}}{20} = 2\text{s}$

Further, $t = nT = 20T$

or $\Delta t = 20 \Delta T$

$$\therefore \frac{\Delta t}{t} = \frac{\Delta T}{T} \text{ or } \Delta T = \frac{T}{t} \cdot \Delta t = \left(\frac{2}{40}\right) (1) = 0.05\text{s}$$

Further, $T = 2\pi \sqrt{\frac{l}{g}}$ or $g \propto T^{-2}$

$$\therefore \left[\frac{\Delta g}{g} \times 100\right]_{\text{max}} = 2 \left[\frac{\Delta T}{T} \times 100\right]$$

$$= \frac{2 \times 0.05}{2} \times 100 = 5\%$$

47. (b) Let, radius of larger drop is R and each of small drop is r .

As per given condition,

$$\frac{4}{3} \pi R^3 = 2 \cdot \frac{4}{3} \pi r^3$$

So, $R = 2^{1/3} r$

Surface energy,

$$W_1 = T \cdot A = 4\pi R^2 T = 4\pi 2^{2/3} r^2 T$$

$$W_2 = 4\pi r^2 T \Rightarrow \frac{W_1}{W_2} = \frac{2^3}{1}$$

$$\Rightarrow W_1 : W_2 = 2^{2/3} : 1$$

48. (b) When the conductor is stretched to double, then its resistance becomes 4 times and area becomes half.

$$I = neAv_d$$

$$\Rightarrow \frac{V}{R} = neAv_d$$

$$\Rightarrow v_d = \frac{V}{neAR}$$

$$\Rightarrow v_d \propto \frac{1}{AR}$$

$$\Rightarrow \frac{v_{d1}}{v_{d2}} = \frac{A_2 R_2}{A_1 R_1} = \frac{\frac{A_1}{2} \cdot 4R_1}{A_1 R_1} = 2$$

$$\Rightarrow v_{d2} = \frac{v_{d1}}{2} = \frac{3.6}{2} = 1.8\text{ m/s}$$

49. (c) Intensity of transmitted light from polaroid P_1 ,

$$I_1 = \frac{I_0}{2}$$

Intensity of transmitted light from polaroid P_3 ,

$$I_3 = I_1 \cos^2 45^\circ = \frac{I_0}{2} \times \frac{1}{2}, I_3 = \frac{I_0}{4}$$

Intensity of transmitted light from polaroid P_2 ,

$$I_2 = I_3 \cos^2 45^\circ = \frac{I_0}{4} \cdot \frac{1}{2}$$

$$I_2 = \frac{I_0}{8}$$

$$\therefore \frac{I_2}{I_0} = \frac{1}{8}$$

50. (b) Current density is given by

$$J = \frac{I}{A} = nev_d$$

For first wire, $A = \pi \left(\frac{d}{2}\right)^2 = \frac{\pi d^2}{4}$

$$\therefore \frac{4I}{\pi d^2} = nev \quad \dots(i)$$

For second wire,

$$A = \pi \left(\frac{d}{4}\right)^2 = \frac{\pi d^2}{16}$$

$$\therefore \frac{16I}{\pi d^2} = nev' \quad \dots(ii)$$

From Eqs. (i) and (ii), we get

$$\frac{4I}{16I} = \frac{v}{v'}$$

$$\Rightarrow v' = 4v$$

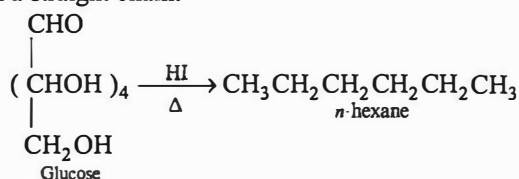


Chemistry

51. (c) When the forces of attractions between like molecules are identical with those between unlike molecules, Raoult's law is obeyed by each constituent of a binary liquid solution.

In such case, the total vapour pressure of the solution is the sum of the partial vapour pressures of components of the solution.

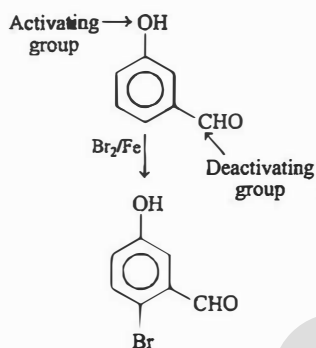
52. (a) On prolonged heating with HI, glucose forms *n*-hexane, suggesting that all 6 carbon atoms are linked in a straight chain.



Problem Solving Tactics

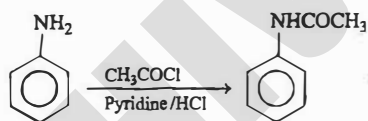
Firstly, consider the role of given reagents. HI is a reducing agent. It reduces primary alcohol, secondary alcohol and aldehyde group.

53. (b) The complete reaction can be written as



∴ Strongly activating group generally dominates over the deactivating group and —OH is *ortho/para*-directing group and *p*-product predominants.

54. (d)



Formation of *N*-acetylated product is due to presence of lone pair of electrons on nitrogen atom.

55. (b) The correct option is A-IV, B-III, C-I, D-II.

A. Saturated solution	IV. Solution which contains the maximum amount of solute at a given temperature.
B. Binary solution	III. Solution with two components.
C. Isotonic solution	I. Solution having the same osmotic pressure at a given temperature as that of the given solution.
D. Hypotonic solution	II. Solution whose osmotic pressure is less than that of another.

56. (b) In the carbonyl group, carbon atom is in a state of sp^2 -hybridisation one sp^2 -hybrid orbital overlap with an unhybridised *p*-orbital of oxygen to form C—O σ -bond. The remaining two sp^2 -orbitals of carbon form σ -bonds with two alkyl groups. Here, all the groups lie on the same plane.

Also, there is difference in electronegativity of oxygen and carbon so bond is polar.

Hence, (b) is the correct statement.

57. (a) α -*D*-(+)-glucose and β -*D*-(+)-glucose are anomers. The structure of anomeric saccharide changes at only the anomeric carbon. Hence, they both differ at carbon-1 only.

58. (b) Given, half-life time of a first order reaction

$$= 1.26 \times 10^{14} \text{ s}$$

Half-life for a first order reaction is given by,

$$t_{1/2} = \frac{0.693}{k}$$

where, k = rate constant, $t_{1/2}$ = half-life time

$$k = \frac{0.693}{1.26 \times 10^{14}} = 5.5 \times 10^{-15} \text{ s}^{-1}$$

59. (a) By graph, $\ln[A_t] = -kt + \ln[A_0]$

$$\therefore \ln \left[\frac{A_t}{A_0} \right] = -kt \quad \dots (i)$$

$k \rightarrow$ Rate constant = slope of graph $[A_t], [A_0] \rightarrow$ concentrations of reactant at time t and at $t = 0$.

It is a first order reaction.

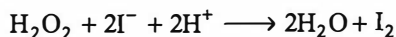
∴ The slope represents change in concentration over time. [from (i)]



60. (b) In transition series, oxidation state first increases from Sc to Mn due to increase in number of unpaired electrons and then decreases because pairing takes place.

61. (d) Structure of boric acid consist of number of layer hence known as layered structure. Each layers are linked together by van der Waals' force of attraction. Each layer has various trigonal planar $B(OH)_3$ units.

62. (b) In the above experiment, the reaction occurs



I_2 liberates in this reaction and it reacts with sodium thiosulphate solution and is reduced to iodide ions.



63. (b) The change in Gibbs free energy is given by

$$\Delta H = \Delta U + \Delta n_g RT$$

Here, R = gas constant taken as = 2 cal

But, $\Delta H = (2.1 \times 10^3) + (2 \times 2 \times 300) = 3300$ cal

Hence, $\Delta G = \Delta H - T\Delta S$

$$\Delta G = 3300 - (300 \times 20)$$

$$\Delta G = -2700 \text{ cal} = -2.7 \text{ kcal}$$

64. (d) Solutions having same number of ions will exert equal osmotic pressure and expected to be isotonic.



Osmotic pressure of $Ca(NO_3)_2 = i \times CRT = 3 \times CRT$

Osmotic pressure of $Na_2SO_4 = i \times CRT = 3 \times CRT$

As osmotic pressure are equal, so they are isotonic.

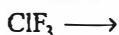
While in other options value of i is different, so value of osmotic pressure is also different. Hence, they are not isotonic.

Problem Solving Tactics

The solutions having the same concentration of salts are known as isotonic solutions.

Due to same concentrations the isotonic solutions have the same osmotic pressure.

65. (c) Options (c) is the answer which is incorrectly matched with its explanation.



It has 3 bond pairs and 2 lone pairs.

66. (c) $E_{Ni^{2+}/Ni}^\circ = -0.24$ V $E_{Fe^{2+}/Fe}^\circ = -0.44$ V

$$E_{\text{cell}}^\circ = E_{Ni^{2+}/Ni}^\circ - E_{Fe^{2+}/Fe}^\circ$$

$$= -0.24 + 0.44 = 0.20 \text{ V}$$

Fe electrode is anode, Ni electrode is cathode.

$\Delta G^\circ < 0$ and $E_{\text{cell}}^\circ > 0$ for working of cell.

Hence, (A) is false but (R) is true.

67. (a) The expression for the standard free energy change is $\Delta G^\circ = -nFE^\circ$ but it is equal to xF .

$$\text{Hence, } x = \frac{-nFE^\circ}{F} = -nE^\circ$$

But for the given half reaction, $n = 3$ and

$$E^\circ = E_{MnO_4^-/Mn^{2+}}^\circ - E_{MnO_2/Mn^{2+}}^\circ = 1.5 - 1.25 = 0.25 \text{ V}$$

Hence, $x = -nE^\circ = -3 \times 0.25 = -0.75$

68. (a) For a salt of weak acid and weak base.

$$pH = \frac{1}{2} [\log K_a + \log K_w - \log K_b]$$

$$= \frac{1}{2} pK_a + \frac{1}{2} pK_w - \frac{1}{2} pK_b$$

$$= \frac{1}{2} \times 4.92 + 7 - \frac{1}{2} \times 4.81$$

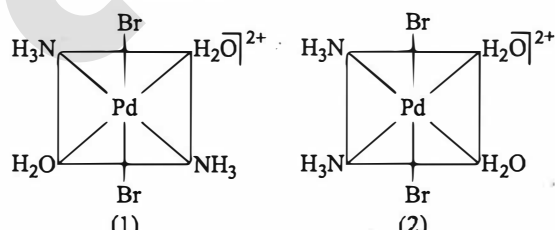
$$= 7.055 \approx 7.05$$

69. (a) K_{sp} of group I metal chlorides is $\leq 10^{-4}$, K_{sp} of other metal chloride is more than 10^{-4} .

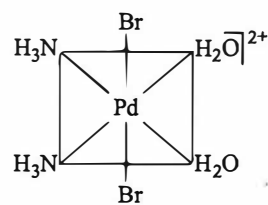
Hence, other metal chlorides are not precipitated by dil. HCl.

70. (b) Six stereoisomers are possible for $[Pd(NH_3)_2(H_2O)_2Br_2]^{2+}$.

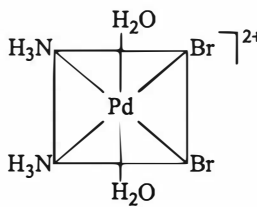
They are as follows



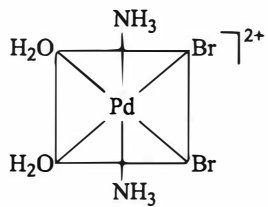
(1)



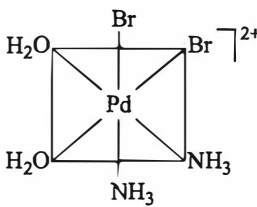
(2)



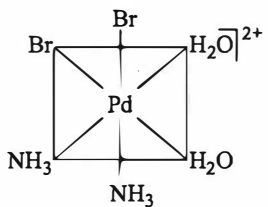
(3)



(4)



(5)

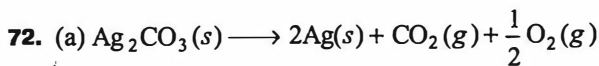


(6)

(1) to (5) are geometrical isomers, (5) and (6) are optical isomers.



71. (a) The vector sum of all polar bonds in *trans*-pent-2-ene is not zero but the vector sum is zero in *trans*-but-2-ene.



Molecular weight of $\text{Ag}_2\text{CO}_3 = 276$ g
and, molecular weight of $\text{Ag} = 2 \times 108 = 216$ g
276 g of Ag_2CO_3 give 216 gm of Ag
Then, 2.76 g of Ag_2CO_3 on heating will give
 $\Rightarrow \frac{216}{276} \times 2.76$ g

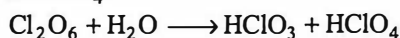
$\text{Ag} = 2.16$ gm of Ag as residue

73. (b) Molecular weight of $\text{CH}_4 = 16$ g
Heat liberated in the combustion of 0.4 g of $\text{CH}_4 = -0.25$ kcal
So, in the combustion of 16 g CH_4 heat liberated
 $= -\frac{0.25}{0.4} \times 16 = -10$ kcal

Hence, the heat of combustion of CH_4 is 10 kcal where the (-ve) sign showing that heat is liberated.

74. (b) Greater the electronegativity difference of $M-H$ bond, more is acidic nature or a strong acid has weak conjugate base and *vice-versa*. So, the correct order will be: $\text{CH}_3\text{NH}_2 < \text{CH}_3\text{OH} < \text{CH}_3\text{SH}$.

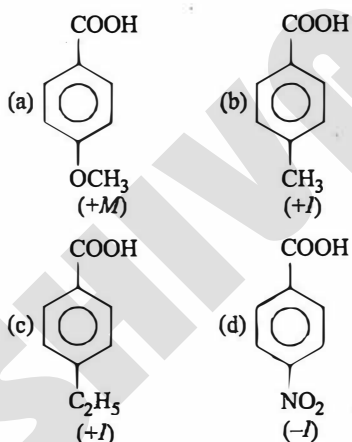
75. (b) Cl_2O_6 (dimer of ClO_3) is a mixed anhydride of HClO_3 and HClO_4 .



76. (b) Statement I is true but Statement II is false. The correct Statement of II is:

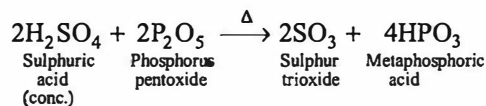
The length of one helix in B-DNA is 34 Å or 3.4 nm.
The width of the DNA is around 20 Å.

77. (c)



So, due to (+I) effect (b) and (c) has very less acidic character but in between them (c) has least one due to bulky group (C_2H_5).

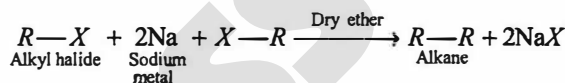
78. (d) When conc. H_2SO_4 is heated with P_2O_5 , the acid is converted to sulphur trioxide. The reaction is as follows



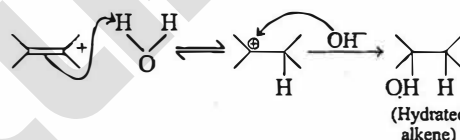
79. (a) K_2SO_4 raises the boiling point of H_2SO_4 while CuSO_4 act as a catalyst.

Baeyer test is used for the determination of presence of carbon-carbon double bonded compounds or carbon-carbon triple bonded compounds by using alkaline potassium permanganate. Hence, both Statement I and Statement II are false.

80. (c) Wurtz reaction is a nucleophilic substitution reaction as it involves exchange of halogen and metal with the involvement of radical species R to form $C-C$ bond.



Hydration of alkene involves act of adding electrophilic hydrogen on nucleophilic alkenes. So, it is a electrophilic addition reaction.



Nitration of alkane involves substitution of H^+ from alkene by a nitro group (electrophile). So, it is a electrophilic substitution reaction.

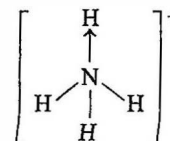
Reaction of alkene with NBS involves formation of free radical $Br\cdot$ from NBS reagent and hydrogen atom at allylic position will get substitution by bromine radical. So, it is a type of free radical substitution reaction.

Hence, the correct match is A-(ii), B-(i), C-(iv), D-(iii).

81. (d) The σ -bond is stronger than π -bond as in σ -bond co-axial bonding overlap of orbital takes place whereas in π -bond lateral overlapping of orbital takes place. Hence, (a) is incorrect.

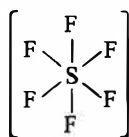
HF is more polar than HI as electronegativity between H and F is more than H and I . Hence, (b) is incorrect.

In NH_4^+ , there is only one coordinate bond as shown below.



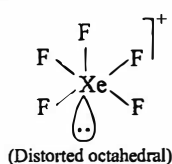
Hence, (c) is also incorrect.

In SF₆ all S—F bond are equivalent and of same length in octahedral geometry.



Hence, (d) is the correct statement.

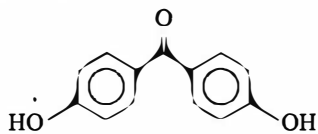
82. (c) Even though the molecule contains polar bond but it will be non-polar if net dipole moment is zero. XeF₅⁺ undergoes sp³d²-hybridisation with one lone pair. Thus, due to lone pair on Xe, it creates lone pair-bond pair repulsion, which distorts the shape.



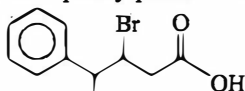
Hence, statement I is false but statement II is true.

83. (c) HClO₄ is not formed in the reaction between Cl₂ and H₂O. Instead, the following reaction is used to form HClO₄.
- $$\text{NaClO}_4 + \text{HCl} \longrightarrow \text{NaCl} + \text{HClO}_4$$

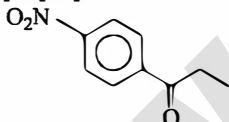
84. (d) (A) *p*, *p*-dihydroxy benzophenone



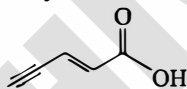
- (B) 3-bromo-4-phenylpentanoic acid



- (C) *p*-nitropropiophenone



- (D) Hex-2-en-4-ynoic acid



Hence, the correct match is A-(ii), B-(iii), C-(i), D-(iv).

85. (b) Aromatic aldehydes and formaldehydes don't contain α-hydrogen and thus undergo Cannizzaro reaction. Formaldehyde is more reactive than aromatic aldehyde in nucleophilic addition reactions. This is due to electron-donating resonance effect of aromatic ring which makes carbon less electrophilic.

Hence, Statement I is true but Statement II is false.

Problem Solving Tactics

Cannizzaro reaction involves the base-induced disproportionation of two molecules of aldehyde (which does not contain α-hydrogen) to yield a carboxylic acid and a primary alcohol.

86. (d) Statements given in I, II and III are correct while IV and V are incorrect. Chelating ligands have more than one donor atom. They are non-linear and they must form bonds with reasonable angles at the metal atom. Ethylene diamine is a bidentate chelating ligand.

They have higher affinity for a metal ion than monodentate ligands also they form more stable complex than monodentate ligand.

87. (a) We know that, $\Delta S_{\text{fus}} = \frac{\Delta H_{\text{fus}}}{T_{\text{fus}}}$
- $$= \frac{6000 \text{ J mol}^{-1}}{273 \text{ K}} = 21.98 \text{ JK}^{-1} \text{ mol}^{-1}$$

88. (d) The correct option is (d) I, II, III are the correct statements.

The correct statement of IV is :

Nitrogen has a higher electron affinity than Be.

89. (a) Percentage of N = $\frac{1.4 \times \text{Milliequivalent of H}_2\text{SO}_4 \text{ used to neutralise NH}_3}{\text{Weight of compound}}$

Millimoles of H₂SO₄ = 20

Milliequivalent of H₂SO₄ = 20 × 2 = 40

Percentage of N = $\frac{14 \times 40}{2.8} = 20\%$

90. (d) For a hydrogen atom, the energies that an electron can have are given by the expression, $E = -13.58/n^2$ eV, where *n* is an integer.

For first energy level,

$$E_1 = -13.58/1^2 \text{ eV} = -13.58 \text{ eV}$$

For second energy level,

$$E_2 = -13.58/2^2 \text{ eV} = -3.395 \text{ eV}$$

The difference $E_2 - E_1 = -3.395 \text{ eV} - (-13.58 \text{ eV}) = 10.185 \approx 10.19 \text{ eV}$

91. (d) Atomic number of the element.

$$[\text{Rn}] 5f^{14} 6d^1 7s^2 = 86 + 14 + 1 + 2$$

$$= 103$$

So, IUPAC name = Unniltrium.

92. (d) $\text{Cl}^- + \text{Na}^+ \longrightarrow \text{NaCl} \xrightarrow{\text{AgNO}_3} \text{AgCl}$ (white ppt.)
(Neutral) (Insoluble in dil. HNO₃)



93. (d)

Compound	Calculation	Oxidation state of iodine
I ₂		0
ICl	$x - 1 = 0; x = +1$	+1
HI	$+1 + x = 0; x = -1$	-1
HIO ₄	$+1 + x + (-2)4 = 0; x = +7$	+7

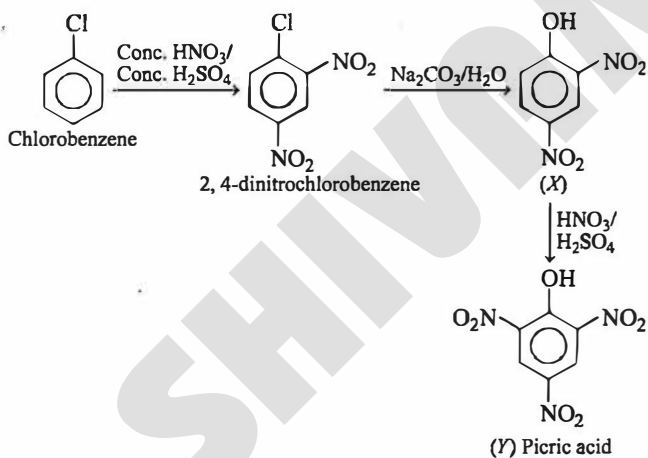
Hence, correct sequence is HI < I₂ < ICl < HIO₄.

94. (a) A-III, B-I, C-IV, D-II

A. [Cr(NH ₃) ₄ Cl ₂]Cl	Paramagnetic and exhibits <i>cis-trans</i> isomerism.
B. [Ti(H ₂ O) ₅ Cl](NO ₃) ₂	Paramagnetic and ionisation isomerism.
C. [Pt(en)(NH ₃)Cl]NO ₃	Diamagnetic and ionisation isomerism.
D. [Co(NH ₃) ₄ (NO ₃) ₂]NO ₃	Diamagnetic and <i>cis-trans</i> isomerism.

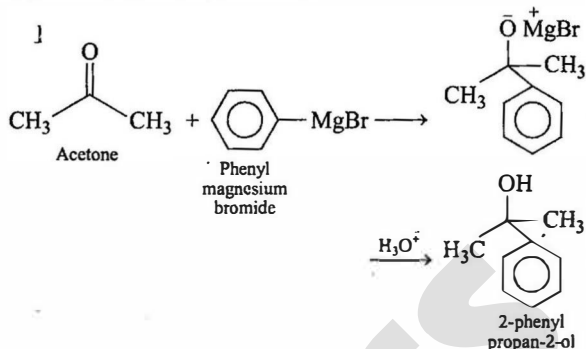
95. (d) Chlorobenzene undergoes nitration reaction. It gives 2,4-dinitrochlorobenzene which further reacts with sodium carbonate to form X, i.e. 2,4-dinitrophenol. 'X' further undergoes nitration reaction to form 2,4,6-trinitrophenol 'Y'.

The given reaction is



96. (b) Acetone reacts with phenyl magnesium bromide followed by acidic hydrolysis to give 2-phenyl propan-2-ol.

The given reaction is as follows



97. (b) Be₂ having bond order zero does not exist in nature.

98. (a) Methylphenylether is obtained by the reaction of phenolate ions and methyl iodide.

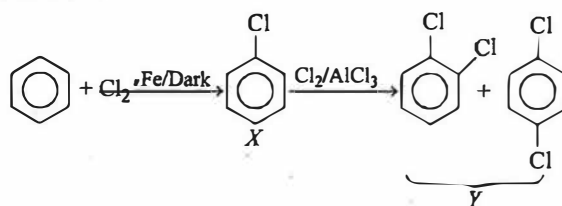


99. (a) Number of lone pair of electrons on the central atom
 Number of valence electrons on central atom - 2 (Number of bivalent atoms) - (Number of monovalent atoms)

Species	No. of lone pair
XeF ₂	$n = (8 - 2) / 2 = 3$
XeO ₂ F ₂	$n = \frac{8 - (2 \times 2) - 2}{2} = 1$
XeO ₃ F ₂	$n = \frac{8 - (2 \times 3) - 2}{2} = 0$
XeF ₄	$n = \frac{8 - 4}{2} = 2$

Hence, the correct match is A-(iv), B-(ii), C-(i), D-(iii).

100. (d) In first step, chlorobenzene is formed. In second step, chlorination of chlorobenzene occur at *ortho* and *para*-position as Cl⁻ group is *ortho* and *para*-directing in nature.



Biology

Botany

- 101.** (d) The maximum number of trophic levels in an ecosystem is limited by energy availability. Loss of energy at each trophic level is the reason which limits the number of trophic levels in a food chain.
- 102.** (b) *Mangifera indica* having common name mango, belongs to family–Anacardiaceae, order–Sapindales and class– Dicotyledonae.
- 103.** (c) The RNA polymerase-I transcribes rRNA includes 28S, 18S and 5.8S. While RNA polymerase-III is responsible for transcription of tRNA, 5S rRNA and snRNAs.
- 104.** (d) Ciliated protozoans are aquatic and are actively moving organisms because of the presence of thousands of cilia. They have a cavity (gullet) that opens to the outside of the cell surface, e.g. *Paramecium*.
- 105.** (a) Statement I is incorrect, but statement II is correct. The incorrect statement can be corrected as Bioethics is the branch of ethics, philosophy and social commentary that deals with biological sciences and their potential impact on society.
- 106.** (c) Dinoflagellates are mostly marine and photosynthetic. Their cell wall has stiff cellulosic plates on the outer surface. They release toxins that may even kill other marine animals.
- 107.** (b) The members of Phaeophyceae or brown algae have a cellulosic wall usually covered on the outside by a gelatinous coating of algin. The food is stored as laminarin.
- 108.** (c) *Laminaria* and *Fucus* belong to Phaeophyceae. They have pyriform (pear-shaped) gametes and bear two laterally attached flagella.
- 109.** (d) Statements I, IV and V are correct, while statements II and III are incorrect and these can be corrected as
- Promoter sequences are present upstream of structural gene (towards the 5' region of sense strand).
 - The nascent RNA synthesised by the RNA polymerase-II and is called hnRNA.
- 110.** (a) The seeds of *Cheiranthus cheiri* belong to family Cruciferae also known as Brassicaceae. They are useful in bronchitis and fever.
- 111.** (d) A is true, but R is false. R can be corrected as Vessels form an efficient system for transporting water and minerals from root to the leaves and other parts of the plant.
- 112.** (b) Statements III and V are correct. Rest statements are incorrect and can be corrected as
- Auxin translocation is polar.
 - Abscisic acid is transported through xylem.
 - During differentiation cells undergo few to major structural changes both in their cell walls and protoplasm. For example, to form a tracheary element, the cells would lose their protoplasm.
- 113.** (d) Statement I is correct, but statement II is incorrect. It can be corrected as
- In basal placentation, the placenta develops at the base of ovary and a single ovule is attached to it, as in sunflower and marigold.
- 114.** (c) Statements I, IV and V are correct. Rest of the statements are incorrect and can be corrected as
- Transformation is a process in which a piece of DNA is directly introduced in a host bacterium. Whereas transduction is the process by which a virus transfers the genetic material from one bacterium to another.
 - The techniques of genetic engineering such as gene cloning and gene transfer allow us to isolate and introduce desirable genes without introducing undesirable genes into target organism.
- 115.** (b) The final stage of meiotic prophase-I is diakinesis. This is marked by terminalisation of chiasmata. During this phase the chromosomes are fully condensed and meiotic spindle is assembled to prepare the homologous chromosomes for separation.
- 116.** (b) The virus of AIDS contains a single-strand of RNA enclosed in an envelope.
- 117.** (b) Both statement I and statement II are correct.
- To fix CO₂ Hatch and Slack pathway is the alternate to the C₃ cycle. This pathway is slightly common in several grasses, maize, sugarcane and *Sorghum*.
- Whereas, Calvin pathway is common to both C₃ and C₄ plants. In C₃ plants, it occurs in all mesophyll cells while in C₄ plant it takes place in bundle sheath cells only.
- 118.** (b) Statement is option (b) is incorrect and can be corrected as
- Ovule is a small structure attached to the placenta by means of a stalk called funicle. The body of the ovule fuses with funicle in the region called hilum. Rest are correct statements.
- 119.** (b) There is a characteristic distribution of the cells within the embryo sac. Three cells are grouped together at the micropylar end and constitute the egg apparatus. The egg apparatus consists of two synergids and one egg cell (ovum).



120. (b) The synergids have special cellular thickenings at the micropylar tip called filiform apparatus, which play an important role in guiding the pollen tubes into the synergids.

121. (b) Statements III and IV are incorrect and can be corrected as

- Multiple alleles are present on the same locus of homologous chromosome.
- Crossing-over will be more frequent if the distance between two genes is more.

122. (c) The correct match is A-1, B-2, C-3, D-4.

- Intrafascicular cambium is present between xylem and phloem.
- Interfascicular cambium refers to the parenchymatous cells of medullary rays.
- There are more than six (polyarch) xylem bundles in the monocot root.
- Heartwood is physiologically inactive.

123. (d) A is true, but R is false. R can be corrected as

The living differentiated cells, that by now have lost the capacity to divide can regain the capacity of division under certain conditions. This is seen in the formation of meristem from fully differentiated parenchyma cells.

124. (b) Cortical layers are present below hypodermis that consist of rounded thin walled parenchymatous cells with conspicuous intercellular spaces.

125. (a) The ring arrangement of vascular bundles is a characteristic of dicot stem. Each vascular bundle is conjoint, open and with endarch protoxylem.

126. (a) In his experiment Mendel studied two contrasting trait, i.e. one dominant and another recessive.

Characters	Dominant/ Recessive
1. Stem height	Tall / Dwarf
2. Flower colour	Violet / White
3. Flower position	Axial / Terminal
4. Pod shape	Inflated / Constricted
5. Pod colour	Green / Yellow
6. Seed shape	Round / Wrinkled
7. Seed colour	Yellow / Green

127. (c) Statements I, III and V are correct, whereas statements II and IV are incorrect. These can be corrected as

- The cell wall provide shape to the cell, protects the cell from mechanical damage and infection. It also helps in cell to cell interaction.

- The middle lamella is a layer of calcium pectate, which holds or glues the different neighbouring cells together.

128. (d) Coenzyme/cofactors are organic substances which are loosely attached with apoenzymes. The factors which are tightly attached with apoenzymes are prosthetic groups. These are basically the category of cofactor.

129. (a) At the end of prophase, when cells are viewed under the microscope, the Golgi complexes, endoplasmic reticulum, nucleolus and the nuclear envelope are not seen.

130. (c) Green seed and constricted pod are the recessive characters used by the Mendel during his experiment. Green seed and wrinkled seeds were recessive to yellow and round seeds. Whereas, yellow and constricted pods were recessive to green and inflated pods.

131. (d) In the presence of an inducer such as lactose or allolactose, the repressor is inactivated by interaction with inducer. This allows RNA polymerase access to the promoter and transcription proceeds.

132. (d) Population of organisms evolves to maximise their reproductive fitness, i.e. Darwinian fitness in the habitat in which they live.

Under a particular set of selection pressures organisms evolve towards most efficient reproductive strategy. Life history traits of organisms have evolved in relation to the constraints imposed by components of habitat in which they live.

However loss of energy does not relate to evolving populations.

133. (c) In Hatch and Slack pathway, the 4-carbon compounds like malic acid or aspartic acid are formed in the mesophyll cells, which are then transported to the bundle sheath cells.

134. (a) If we use DNA polymerase, isolated from normal soil bacterium, in PCR, we cannot obtain even a single copy of DNA.

This is because normal DNA polymerase cannot withstand high temperature of PCR and gets denatured.

135. (b) Most aerobic respiration takes place in the cell's mitochondria. So, the final product of glycolysis, pyruvate is transported to mitochondria.

136. (c) Statement in option (c) is incorrect and can be corrected as

In *Spirogyra* vegetative reproduction usually takes place by fragmentation or by formation of different types of spores.



137. (b) Electron micrographs of zygotene stage indicate that chromosome synapsis is accompanied by the formation of complex structure called synaptonemal complex.
138. (d) During protein formation, amino acid condense to produce protein and molecule of water is eliminated, i.e. dehydration takes place.
Glycosidic bond is also formed by the removal of a molecule of water.
139. (d) Xenogamy is a type of cross-pollination in which pollens are transferred from anther of the different plants to the stigma of a different flower as seen in grasses.
140. (b) Calvin cycle requires 3 ATP, 2 NADPH molecules and one CO₂ for a single turn of the cycle.
141. (b) Beetles are coleopterans, which are killed by *Bacillus thuringiensis* (*Bt*). The bacterium is also toxic to nematodes.
142. (b) Statement in option (b) is incorrect. It can be corrected as
The standing crop is measured as the mass of living organisms or the number in a unit area.
143. (b) Kogl and Haagen Smith found that human urine contained a growth substance, which was isolated and given the name auxin, a auxentriolic acid.
144. (a) Oxidative phosphorylation refers to the formation of ATP from ADP and Pi in the presence of O₂. The synthesis of ATP is driven by proton motive force developed during oxidation of reducing powers NADH and FADH₂ through electron transport chain. The use of proton motive force to drive transport of protons down the concentration gradient and simultaneous ADP phosphorylation represents chemiosmosis.
145. (b) Statements III, IV and V are correct. Statements I and II are incorrect and can be corrected as
- Western ghats have a greater amphibian species diversity than the Eastern ghats.
 - Mangroves, coral reefs, wetlands and alpine meadows has a greater ecosystem diversity than a Scandinavian country like Norway.
146. (a) The correct matches are A-2, B-3, C-4, D-1.
- Golden rice is rich in vitamin-A. It is a genetically modified crop.
 - Cry protein is a crystal protein that is poisonous to insects and is expressed by the *cry* gene of *B. thuringiensis*. This is because it is also known as *Bt* toxin.
 - RNA interference is known as gene silencing. It involves silencing of a specific mRNA due to complementary dsRNA molecule that binds to mRNA and prevents its translation.
 - Tobacco budworm and army worm are lepidopteran insects.
147. (b) Both A and R are true, and R is the correct explanation of A. The *Bt* toxin genes are isolated from *B. thuringiensis* and incorporate into several crop plant to kill the targeted pests or insect of that crop.
148. (a) The correct match is A-4, B-1, C-2, D-3.
Spirogyra is an example of green algae. *Marchantia*, *Polytrichum*, *Dictyota* are the examples of liverworts, moss and brown algae, respectively.
149. (a) Statements II and III are incorrect and can be corrected as
- Genera like *Selaginella* and *Salvinia* produces two kinds of spores, macro and micro spores. Thus, they are known as heterosporous.
 - The predominant stage of the life cycle of a moss is the gametophyte which consists of two stages.
150. (c) *C* represents coleoptile, which is a protective covering for plumule in the embryo.

Zoology

151. (b) An adult human haemoglobin consists of 4 subunits, two α -type subunits and two β -type subunits.
152. (c) Enhancers are DNA sequences that facilitate the expression of a given gene. They may be located few hundreds base pairs away from the gene. Whereas, promoter is a DNA sequence at which RNA polymerase may bind, leading to the initiation of transcription.
153. (d) Statement I is correct, but statement II is incorrect and can be corrected as
Glycosylation is the formation of glycoprotein from protein.
154. (a) Marshall Nirenberg's cell free system for protein synthesis finally helped the code to be deciphered.
155. (b) The ABO blood group in humans is an example of codominance. In codominance, there is joint expression of both alleles in a heterozygote. In this situation, alleles of a single gene are responsible for producing distinct and detectable gene products.
156. (d) Thyroxine is formed by the amino acid tyrosine.
157. (c) Both A and R are true, but R is not the correct explanation of A.
Three types of cells are present in aerolar tissue namely mast cell, macrophages and fibroblasts. Aerolar tissue consists of two types of fibre, i.e. yellow elastin fibres and white collagen fibres.
White collagen fibres are found at the site of injury during tissue repair.
158. (b) Hepatic portal system (*A*) is a special venous connection between the liver and intestine.



Renal portal system (B) is a special venous connection between kidney and lower part of the body.

159. (c) Total volume of air a person can inspire after a normal expiration is called Inspiratory Capacity (IC). This include Tidal Volume and Inspiratory Reserve Volume (TV + IRV).
160. (c) Brown sugar is also called smack. It is an opioid derivative, derived from morphine. Its chemical name is diacetyl morphine hydrochloride and is more powerful analgesic than morphine.
161. (b) The *Bt* toxin genes are produced by a bacterium called *Bacillus thuringiensis*. The toxin is coded by *cry* gene. *cry* IAc and *cry* II Ab control the cotton bollworms and *cry* I Ab controls the corn borer.
162. (d) A is true, but R is false and R can be corrected as
The members of class-Reptilia like *Hemidactylus*, *Calotes*, *Crocodilus*, etc. are oviparous and show direct development.
163. (c) Statement in option (c) is incorrect and can be corrected as
In acrocentric chromosome the centromere is present near the end of chromosome. It forms a very short p arm and a very long q arm, thus both arms are not equal, e.g. 13th, 14th, 15th, 21st, 22nd and Y-chromosomes are acrocentric in humans.
164. (b) The stroke volume multiplied by the heart rate (no. of beats per minute) gives the cardiac output.
165. (c) Statements III and IV are incorrect.
The incorrect statements can be corrected as
- Mitochondria in the middle piece produces energy for the mobility of sperm.
 - The corpus luteum secretes large amount of progesterone for the maintenance of endometrium.
- Rest other statements are correct.
166. (b) Statement III is incorrect. It can be corrected as
Human placenta is known as chorionic placenta. The fetal part of placenta is known as the chorion.
167. (a) The midbrain (Pons, Cerebellum and Medulla oblongata) and hindbrain together form the brain stem. Hypothalamus forms a part of forebrain.
168. (b) The descending limb of loop of Henle is permeable to water, but almost impermeable to electrolytes. This concentrates the filtrate as it moves down.
169. (a) Fibres of the tracts are covered with the myelin sheath, which constitute the inner part of cerebral hemisphere. They give an opaque white appearance and are called white matter.

170. (b) Cerebellum is involved in loss of control when a person consumes alcohol, as it maintains the equilibrium, posture and orientation of the body.
171. (a) The ion gradients across the resting membrane are maintained by active transport of ions which transports 3Na^+ outwards for 2K^+ into the cell.
172. (a) The trachea is supported by C-shaped rings of cartilage, which hold them in place when there is less air inside it. This prevents their collapse.
173. (b) Insulin increases glucose uptake in adipose tissue and smooth, cardiac and skeletal muscles. It does not do so in brain, liver cell, intestinal mucosa and RBCs.
174. (a) Statement I is incorrect, but statement II is correct. The incorrect statement can be corrected as
In juxtamedullary nephrons, the blood first passes through the capillaries of glomerulus and then through the vasa recta.
175. (d) A is true, but R is false and it can be corrected as
Decomposers produce inorganic raw materials for recycling.
176. (d) All the statements are correct, except statement in option (d) and it can be corrected as
In grazing food chains, the size of parasites gradually decreases in successive trophic levels.
177. (a) Statement I is incorrect, but statement II is correct. The incorrect statement can be corrected as
The first transgenic cow, Rosie's milk contains the human gene α -lactalbumin.
178. (c) Both A and R true, but R is not the correct explanation of A. The bioresources are analysed for the identification of valuable biomolecules. Analysing bioresources for biomolecules is essential for disease diagnostics, food safety inspection, environmental monitoring and pharmaceutical development.
179. (c) The correct matches are A-4, B-1, C-2, D-3.

Diseases	Symptoms
Typhoid	Sustained high fever (39°C - 40°C) stomach pain, headache, etc.
Pneumonia	Fever, chills, finger nails turn gray to bluish in colour, etc.
Ascariasis	Muscular pain, internal bleeding, blockage of intestinal passage, etc.
Filariasis	Genital organs are also affected resulting in gross deformities.



- 180.** (a) The correct matches are A-2, B-3, C-4, D-1.
- Pineal gland secretes a hormone called melatonin and is present on the dorsal side of forebrain.
 - The thyroid gland is composed of follicles and stromal tissue.
 - Parathyroid gland secretes parathyroid hormone that increases Ca^{2+} levels in blood.
 - Thymus gland secretes the peptide hormone thymosin that plays a major role in differentiation of T-lymphocytes.
- 181.** (c) Both statement I and statement II are incorrect and can be corrected as In urochordates like *Salpa*, *Ascidia*, etc. notochord is present only in larval tail, while in cephalochordates like *Branchiostoma* notochord extends from head to tail region and is persistent throughout their life.
- 182.** (a) Statement I is incorrect, but statement II is correct. The incorrect statement can be corrected as TSH stands for Thyroid Stimulating Hormone. It controls the secretion of thyroid hormone.
- 183.** (b) Organisms like reptiles, birds and land snails, etc. excrete nitrogenous waste as uric acid in the form of pellet with a minimum loss of water, they are known as uricotelic animals.
- 184.** (c) Oral contraceptive pill is a popular method of contraception used by females. They work by inhibiting ovulation and implantation. Saheli is a new oral contraceptive pill for females that contain a non-steroidal preparation. It is once a week pill with very few side effects and high contraceptive value.
- 185.** (c) In glomerulus, the afferent arteriole is shorter and wider than efferent arterioles, which is longer and narrower.
- 186.** (c) The set of organs having different structures, but evolving for the same function and hence have similarity are known as analogous organs, e.g. eye of mammals and octopus, flippers of penguins and dolphins, etc.
- 187.** (b) Statements I and IV are incorrect. These can be corrected as
- Columnar or cuboidal cells bearing cilia on their surface are called ciliated epithelium.
 - The cuboidal epithelium lines salivary gland and pancreatic ducts.
- Rest other statements are correct.
- 188.** (d) The correct match is A-3, B-1, C-4, D-2.
- Golden rice is a genetically modified variety of rice, which is enriched with vitamin - A.
 - Alpha (α)-1 - antitrypsin helps in the treatment of emphysema.
 - *Flavr Savr* is a genetically modified variety of tomato, which is modified to increase the shelf life.
 - First transgenic cow, Rosie produced human protein enriched milk (2.4 gms per litre).
- 189.** (a) The statement is option (a) is correct as the volume of blood pumped out by the right and left ventricles are same.
- 190.** (b) Both A and R are true and R is the correct explanation of A. This can be explained as The size of chromosome is measured best during metaphase as during this phase the chromosomes are in most condensed and coiled stage and are also aligned at the equator.
- 191.** (a) Statements III and IV are incorrect and can be corrected as
- The centrosomes are surrounded by amorphous pericentriolar materials.
 - The inclusion bodies like gas vacuoles, cyanophycean granules, etc. are not bound by any membrane system and lie free in the cytoplasm.
- Rest all statements are correct.
- 192.** (b) Both statement I and statement II are correct. Both the strands of DNA are antiparallel and have opposite polarity, i.e. one, $5' \rightarrow 3'$ and the other $3' \rightarrow 5'$. One of the two strands is known as coding strand and the other is known as template strand.
- 193.** (b) Antrum is the fluid-filled cavity found in ovarian follicles, which is rich in hyaluronan and proteoglycans.
- 194.** (b) In *Drosophila* the female has a pair of XX chromosome (homogametic) and the male has XY chromosomes (heterogametic) composition.
- 195.** (c) The correct matches are A - 2, B - 1, C - 4, D - 3.
- In 1830s Mathias Schleiden and Theodore Schwann formulated the cell theory.
 - Rudolf Virchow (1855) first explained that cells divide and new cells are formed from pre-existing cells (*Omnis cellula -e-cellula*)
 - Singer and Nicolson (1972) gave the fluid mosaic model of the structure of cell membrane.
 - Robert Brown in 1831 discovered the nucleus.



196. (c) The vertebral column is differentiated into five groups. The first 7 are called cervical vertebrae, the next 12 are called thoracic vertebrae, the next 5 are lumbar vertebrae, the next 1 is sacral vertebrae and the next 1 is coccygeal vertebrae starting from the skull to the spine.
197. (c) *Salmonella typhi* causes typhoid fever. These pathogens generally enter the small intestine through food and water and migrate to other organs through blood.
198. (a) The side effects of anabolic steroids in females include masculinisation (features like males), excessive hairs on face, mood swings, enlargement of clitoris, abnormal menstrual cycles and deepening of voice.
199. (d) The option (d) is incorrectly matched pair. It can be corrected as

Dengue is a viral infection caused by the dengue virus transmitted to humans through the bite of infected *Aedes* mosquitoes.

200. (a) The correct matches are A-2, B-3, C-1, D-4.

Hormones		Functions	
A.	Human chorionic gonadotrophin	1.	Maintains corpus luteum
B.	Progesterone	2.	Suppress uterine contractions
C.	Oestrogen	3.	Promotes growth of myometrium
D.	Relaxin	4.	Softens cervix to prepare for dilation