SOLUTIONS

PHYSICS

1. (a) : Focal length of a convex lens having power 2.5 D, $= \frac{1}{2.5}$ m

Also focal length of a lens in a medium of refractive index μ is given by

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\Rightarrow 2.5 = \frac{1}{f} = \left(\frac{3}{2} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) \quad \text{.... (i)} \quad \text{(in air)}$$

$$\Rightarrow \frac{1}{f'} = \left(\frac{3}{4} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) \quad \text{...(ii)} \quad \left[\because {}^{l}\mu_{g} = \frac{3}{4}\right] \text{ in liquid}$$

Dividing the two, $2.5f' = \frac{0.5}{-0.25}$

$$\Rightarrow \frac{1}{f'} = \frac{-5}{25 \times 0.25} = -1.25\,\text{D}$$

2. (a) : Magnetic moment associated with electrons orbitting around the nucleus is given in terms of Bohr magneton (μ_B)

$$\mu_B = \frac{eh}{2m_e}$$

e = electronic charge, m_e = electronic mass.
In nuclear physics, magnetic moments associated with the spins of protons and neutrons are expressed in nuclear magnetons (μ_N)

$$\mu_N = \frac{eh}{2m_p}$$

m_p = mass of a proton.

$$\Rightarrow \frac{\mu_B}{\mu_N} = \frac{m_p}{m_e}$$

3. (c) : If we make a truth table for the outputs given in the question. It matches with the truth table of an NOR gate.

$Y = \overline{A + B}$

A	B	Y (output)
1	0	0
0	1	0
0	0	1

4. (c) : $\lambda \propto \frac{1}{\sqrt{T}}$

5. (b) : Specific resistance $\rho = \frac{RA}{l}$

$= [ML^2T^{-3}A^{-2}]\,[L]$

$= [ML^3T^{-3}A^{-2}]$

6. (c) : The reciprocal of impedance is admittance.

7. (c) : Let the reaction be represented as

$$^{220}_{Z}X \longrightarrow {}^{216}_{Z-2}Y + {}^{4}_{2}He$$

$\because$ energy released in the reaction is 5 MeV

$$\Rightarrow \frac{1}{2}m_Y v^2{}_Y + \frac{1}{2}m_\alpha v_\alpha^2 = 5\ \text{MeV}$$

$$\Rightarrow \frac{1}{2}(216)v_Y^2 + \frac{1}{2}4(v_\alpha)^2 = 5\ \text{MeV} \quad \text{...(i)}$$

Also using conservation of linear momentum.

$$m_Y v_Y = -m_\alpha v_\alpha \Rightarrow v_Y = \frac{-m_\alpha}{m_Y}v_\alpha$$

$$v_Y = \frac{-4}{216}v_\alpha = \frac{-1}{54}v_\alpha$$

Putting in eqn. (i)

$$\frac{1}{2}(216)\left(\frac{v_\alpha}{54}\right)^2 + \frac{1}{2}4(v_\alpha)^2 = 5\ \text{MeV}$$

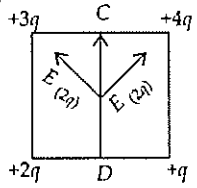
$$\frac{1}{2}(216)\left(\frac{v_\alpha}{54}\right)^2 + \text{K.E.}_\alpha = 5\ \text{MeV}$$

$$\Rightarrow \frac{1}{2} \times 4\,\frac{v_\alpha^2}{54} + \text{K.E.}_\alpha = 5\ \text{MeV}$$

$$\Rightarrow \frac{1}{54}(\text{K.E.}_\alpha) + \text{K.E.}_\alpha = 5\ \text{MeV}$$

$$\text{K.E.}_\alpha = \frac{5 \times 54}{55} = \frac{54}{11}\ \text{MeV}$$

8. (a) : The resultant electric fields due to diagonally opposite charges will act as shown below.



Hence the resultant field is along DC.

9. (a) : Wavelengths of the K_α lines for given isotopes of lead (Pb) can be given by a general expression

$$\frac{1}{\lambda} = R(Z-1)^2\left(\frac{1}{1^2} - \frac{1}{2^2}\right)$$

where R = Rydberg's constant, Z = atomic number of the isotopes. Though Pb^{208}, Pb^{206} and Pb^{204} have different atomic masses, Z will be same for them *i.e.* 82.

$$\therefore \frac{1}{\lambda_1} = R(82-1)^2\left(\frac{1}{1^2} - \frac{1}{2^2}\right) = \frac{3}{4}R(81)^2$$

$$\frac{1}{\lambda_2} = \frac{3}{4}R(81^2) \text{ and } \frac{1}{\lambda_3} = \frac{3}{4}R(81^2)$$

$$\Rightarrow \left(\frac{1}{\lambda_2}\right)^2 = \frac{1}{\lambda_1} \times \frac{1}{\lambda_3} \Rightarrow \lambda_2 = \sqrt{\lambda_1\lambda_3}$$

10. **(a)** : Work done by force = Area under force-displacement graph.

$$= 3\times3 + \frac{1}{2}\times3\times3 = 9 + 4.5 = 13.5 \text{ J}$$

11. **(d)** : Since $k \propto \frac{1}{l}$

12. **(c)** : At maximum compression the whole kinetic energy of ball = potential energy of spring.

$$\frac{1}{2}mv^2 = \frac{1}{2}kx^2 \Rightarrow x = v\sqrt{\frac{m}{k}}$$

$$x = 1.5\times\sqrt{\frac{5}{5}} = 1.5 \text{ m}$$

13. **(c)**

14. **(d)** : Radiation pressure P_{rad} due to light falling on a non-reflecting surface at normal incidence is given by

$$P_{rad} = \frac{\text{Energy flux}}{\text{Speed of light}} = \frac{18 \text{ W/cm}^2}{3\times10^8 \text{ m/s}}$$

$$= \frac{18\times10^4 \text{ W/m}^2}{3\times10^8 \text{ m/s}} = 6\times10^{-4} \text{ N/m}^2$$

15. **(a)**

16. **(b)** : After 0.7 sec the horizontal velocity component of the body $= 4\sqrt{2}$ m/sec since there is no change in velocity in horizontal direction.

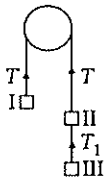
The vertical velocity component after 0.7 seconds $= 0 + gt = 0 + 0.7 \times 10$

$= 7$ m/sec

$\therefore$ resultant velocity of the body $= \sqrt{(4\sqrt{2})^2 + 7^2}$

$= \sqrt{32+49} = 9$ m/sec

17. **(d)** : Three equal weights of 3 kg each are hanging on a string passing over a pulley as shown in figure.



If a is the common acceleration.

$T - 3g = 3a$ (For mass I)

$3g + T_1 - T = 3a$ (For mass II)

$3g - T_1 = 3a$ (For mass III)

Adding, above three equations

$3g = 9a$, $a = g/3$

$T_1 = 3g - 3a = 3g - g = 2g = 20$ N

18. **(a)** : The ball falls a distance h from its highest (rest) position and rebounds a distance $(h - d)$.

Thus the coefficient of restitution $e = \sqrt{\frac{h-d}{h}}$

$$e^2 = \frac{h-d}{h} \quad \text{or} \quad h = \frac{d}{1-e^2}$$

19. **(a)** : The capacitances of two are $C_1 = 4\pi\varepsilon_0 R$ and $C_2 = 4\pi\varepsilon_0 (2R)$

Initial energy $= E_i = \frac{Q^2}{2C_1}$

Final energy $= E_f = \frac{Q^2}{2C_2}$

Heat produced $= E_i - E_f$

$$= \frac{Q^2}{2}\left[\frac{1}{4\pi\varepsilon_0 R} - \frac{1}{2\times4\pi\varepsilon_0 R}\right]$$

$$= \frac{1}{4\pi\varepsilon_0}\cdot\frac{Q^2}{2R}\left[1 - \frac{1}{2}\right]$$

$$= \frac{1}{4\pi\varepsilon_0}\cdot\frac{Q^2}{4R}$$

20. **(b)** : $\lambda_m T = 2.898 \times 10^{-3}$ mK

$$\lambda_m = \frac{2.9\times10^{-3}}{10^6} = 2.9\times10^{-9} \text{ m} = 2.9 \text{ nm}$$. It lies in the X-ray region of the electromagnetic spectrum.

21. **(a)** : The terminal velocity of the spherical raindrop of radius r is given by

$v_t = \frac{2r^2\rho g}{9\eta}$ where ρ is the density of water and η the viscosity of air. Substituting $r = 0.3$ mm $= 0.3 \times 10^{-3}$ m, $\rho = 10^3$ kg/m^3, $g = 9.8$ m/s^2 and $\eta = 1.8 \times 10^{-5}$ N s/m^2, we get

$$v_t = \frac{2\times(0.3)^2\times10^{-3}\times9.8}{9\times1.8\times10^{-5}}$$

$= 10.9 \text{ m s}^{-1}$

22. **(b) :** Let the simple harmonic equation for the particle be $x = l\sin\omega t$ ... (i)

where ω is its angular velocity.

Since the S.H.M. of the rod has the same period and amplitude and its vibration is perpendicular to that of the particle, its equation is $y = l\cos(\omega t + \phi)$ where ϕ is the initial phase difference (phase angle for y). But both the particle as well as the rod pass through the mean position simultaneously. Hence $\phi = \pi/2$ since $x = y = 0$ at $t = 0$.

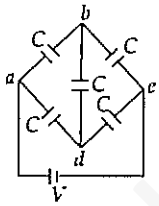
So, $y = l\cos(\omega t + \pi/2) = -l\sin\omega t$ ... (ii)

Eliminating t between (i) and (ii), we have

$y = -x$

which is the equation to a straight line at angle $\pi/4$ to the rod.

23. **(a) :** Network is redrawn as shown in figure.

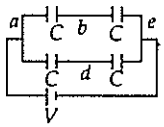


This is a balanced Wheatstone's network.

Equivalent capacitance $C_{eq} = C$

Charge on capacitor between the terminals a and b

$$\frac{Q}{2} = \frac{CV}{2}$$



Energy stored in that capacitor

$$= \frac{1\left(\frac{Q}{2}\right)^2}{2C} = \frac{Q^2}{8C} = \frac{C^2V^2}{8C} = \frac{CV^2}{8}$$

Given: $C = 1\ \mu\text{F}$, $V = 10$ V

$$= \frac{(1\times10^{-6})\times10^2}{8}$$

$$= \frac{100}{8}\times10^{-6} = 12.5\ \mu\text{J}$$

24. **(b) :** $H = I^2Rt = mc\Delta\theta$

$\therefore\ \Delta\theta \propto I^2$

Hence $\frac{\Delta\theta_2}{\Delta\theta_1} = \left(\frac{I_2}{I_1}\right)^2$ or $\frac{\Delta\theta_2}{3} = \left(\frac{3I}{I}\right)^2$

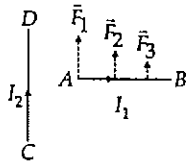
or $\Delta\theta_2 = 9\times3 = 27°\text{C}$

25. **(a) :** According to positive Thomson's effect the potential at a point of lower temperature is lower than at the point at higher temperature which is at higher potential. When current is passed from lower temperature to higher temperature of a metal, work is to be done, hence energy is absorbed.

26. **(b) :** $I_g = 0.1I$, $I_s = 0.9I$; $S = I_g\,G/I_s$

$= 0.1\times900/0.9 = 100\ \Omega$

27. **(c) :** Since the magnetic field, due to current through wire CD at various locations on wire AB is not uniform, therefore, the wire AB, carrying current I_1 is subjected to variable magnetic field due to which, neither the force nor the torque on the wire AB will be zero. As a result of which the wire AB will have both translational and rotational motions.



28. **(b) :** Inductance of a coil is given by

$$L = \frac{1}{2}\mu_0\pi N^2R \Rightarrow \frac{L_2}{L_1} = \frac{N_2^2}{N_1^2}$$

$$\therefore\ L_2 = L_1\frac{N_2^2}{N_1^2} = \left(\frac{500}{100}\right)^2 15\text{ mH} = 375\text{ mH}$$

29. **(c) :** As $V_R = V_L = V_C$

$R = X_L = X_C$, $Z = R$

$V = IR = 10$ volt

When capacitor is short circuited,

$$Z = \sqrt{R^2 + X_L^2} = \sqrt{R^2 + R^2} = R\sqrt{2}$$

New current $I' = V/Z = V/R\sqrt{2} = \frac{10}{R\sqrt{2}}$

Potential drop across inductance

$$= I' X_L = I' R = \frac{10 \times R}{R\sqrt{2}} = \frac{10}{\sqrt{2}} \text{ volt}$$

30. (d)

31. (d)

32. (a) : When sources are coherent, intensity at mid point is

$I_{max} = (a + a)^2 = 4a^2$

When sources are incoherent, no interference occurs. Intensity at mid point is

$I = I_1 + I_2 = a^2 + a^2 = 2a^2$

$\therefore \frac{I_{max}}{I} = \frac{4a^2}{2a^2} = 2:1$

33. (b) : $\lambda = \frac{h}{mv} = \frac{h}{\sqrt{2mE}}$ or $\lambda \propto \frac{1}{\sqrt{E}}$

$\therefore \frac{\lambda'}{\lambda} = \sqrt{\frac{E}{E'}} = \sqrt{\frac{1}{16}} = \frac{1}{4}$

% change in wavelength $= \left(\frac{\lambda - \lambda'}{\lambda}\right) \times 100$

$= \left(1 - \frac{\lambda'}{\lambda}\right) \times 100 = \left(1 - \frac{1}{4}\right) \times 100 = 75\%$

34. (a) : $T = \frac{T_\alpha T_\beta}{T_\alpha + T_\beta} = \frac{4 \times 12}{4 + 12}$

$n = \frac{t}{T} = \frac{12}{3} = 4$

$\frac{N}{N_0} = \left(\frac{1}{2}\right)^n = \left(\frac{1}{2}\right)^4 = \frac{1}{16} = 6.25\%$

35. (c) : Here p-n junction is forward biased. If p-n junction is ideal, its resistance is zero. The effective resistance across A and B

$= \frac{10 \times 10}{10 + 10} = 5 \text{ K}\Omega$

Current in the circuit

$I = \frac{30}{(10 + 5) \times 10^3} = \frac{2}{10^3}$

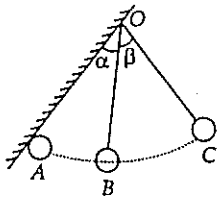
$\therefore$ Current in each arm $= \frac{I}{2} = \frac{1}{10^3}$ A.

Pot. diff. across A and B

$= \frac{1}{10^3} \times 10 \times 10^3 = 10 \text{ V}$

36. (a) : $\theta = \theta_0 \sin \omega t \quad \omega = \sqrt{\frac{g}{L}}$

$\because T = 2\pi\sqrt{\frac{L}{g}}$



When $\beta > \alpha$, time taken by pendulum from B to C and C to B

$t_1 = \frac{T}{2} = \frac{1}{2} \times 2\pi\sqrt{\frac{L}{g}} = \pi\sqrt{\frac{L}{g}}$

Time taken by pendulum from B to A and A to B

$t_2 = 2t = \frac{2}{\omega}\sin^{-1}\left(\frac{\alpha}{\beta}\right)$ using $\theta = \theta_0 \sin \omega t$

$\alpha = \beta \sin \omega t$ or $t = \frac{1}{\omega}\sin^{-1}\left(\frac{\alpha}{\beta}\right)$

$\therefore$ Time period of motion

$T = t_1 + t_2 = \sqrt{\frac{L}{g}}\left[\pi + 2\sin^{-1}\frac{\alpha}{\beta}\right]$

37. (d) : Maximum number of nuclei will be present, when rate of decay = rate of formation

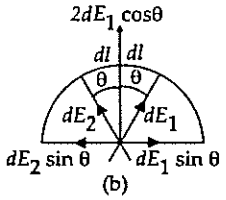
$\lambda \cdot N = \alpha, \quad N = \frac{\alpha}{\lambda}$

38. (c) : Consider two small elements each of length $dl = rd\theta$ symmetrically.

$\pi r = l$

Resolve the elemental field intensities

$\because |dE_1| = |dE_2|$



(b)

$dE = 2dE_1 \cos\theta = \frac{2Grd\theta}{r^2}\cos\theta$

G = Gravitational constant

λ = Linear mass density $= \frac{m}{l}$

or $dE = \frac{2\lambda G}{r}\int_0^{90°} \cos\theta d\theta = \frac{2\lambda G}{r} = \frac{2\pi G m}{l^2}$

39. (a) : Using $\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$

Given $u = f + d_1 \qquad v = f + d_2$

$$f=\frac{uv}{u+v}=\frac{(f+d_1)(f+d_2)}{(f+d_1)+(f+d_2)}$$

On solving $f=\sqrt{d_1d_2}$

40. (c) : Use $\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$

Find v_1, when $u = d$ and v_2, when $u = d + l$

Size of image $= v_1 - v_2 = l\left(\frac{f}{d-f}\right)^2$

41. (c) : When a solid changes into a liquid, the work done against the attraction of molecules is stored in the form of potential energy.

42. (b) : When ball is completely filled with water, the centre of gravity of the pendulum is at the centre of the ball when water starts flowing out, the centre of gravity shifts below, thus increasing the length of pendulum, and increasing time period. When ball is more than half empty the centre of gravity again rises up so length of pendulum decreases and time period also decreases.

43. (c) : Electric potential of earth is taken as zero, because the capacitance of earth is taken infinite.

44. (d) : A charge, whether stationary or in motion, produces an electric field around it. If it is in motion, then in addition to the electric field, it also produces a magnetic field, because moving charges produce magnetic field in the surrounding space.

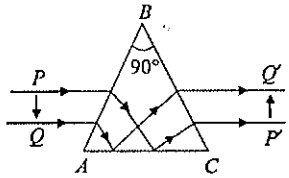
45. (c) : Magnetic susceptibility (χ_m) is defined as the ratio of the intensity (I) of magnetisation to the magnetic intensity (H) of the magnetising field, that is

$$\chi_m = \frac{I}{H}$$

It is a pure number, because I and H have the same unit. Its value for vacuum is zero as there can be no magnetisation in vacuum.

46. (a) : Transformers which convert low voltages into higher ones are called step-up transformers, while those which convert high voltages into lower ones are called step-down transformers. This is possible only for a.c. source and not for d.c. source.

47. (a) :



Beam of light incident on face AB, suffers refraction from air to glass and strikes the face AC suffering total internal reflection. The beam now strikes the face BC of the prism at an angle of incidence less than the critical angle hence it suffers refraction from glass to air and bends away from the normal. The beam emerges out parallel to the base. As a result of refraction, on emergence the rays are inverted.

48. (a) : The rays or all colours incident on a concave mirror at the same angle are reflected at the same angle. Hence image formed by reflection does not suffer chromatic aberration.

49. (a) : Equivalent mass of photon (m) is given from equation

$E = mc^2 = h\upsilon \;\therefore\; m=\frac{h\upsilon}{c^2}$

Where E is energy, m is mass, c is speed of light, h is Planck's constant, υ is frequency.

$\therefore$ Momentum of photon $= m\times\frac{h\upsilon}{c^2}\times c=\frac{h\upsilon}{c}$

50. (b) : Photo-conductive cell is based on the principle that when light is incident on some semiconductor, its electrical resistance is reduced. Such cells are used in solar batteries. Whereas photocell is used in electrolyte for giving theft warning in banks treasuries, etc., when the thief throws torch light on the cash box, the light is incident on a photocell placed there and a bell at some particular place rings.

51. (b) : The nuclei having mass number A ≈ 60 have maximum binding energy per nuclean (about 8.7 MeV). So, these nuclei are most stable.

52. (c) : We know that

$\alpha=\frac{\Delta i_C}{\Delta i_E}$ and $\beta=\frac{\Delta i_C}{\Delta i_B}$

Also $\beta = \frac{\alpha}{1-\alpha} = \frac{0.98}{1-0.98} = 49$

$\therefore$ Voltage gain $= \beta = \frac{R_2}{R_1} = 49 \times 1000 = 49 \times 10^3$

53. (a) : Most amplifiers use the common emitter circuit configuration because the cricuit offers both current and voltage gains resulting in much higher power gain that can be obtained by a common-base amplifier. The other consideration for the use of the common-emitter amplifier is that its input resistance is higher and of the order of load resistance.

54. (b) : In case of an ideal gas internal energy depends only upon the temperature of the gas. Therefore, if an ideal gas undergoes an isothermal process, there will be no change in its internal energy

($\Delta U = 0$) Then $Q = W$.

55. (c) : When we pour hot water in beaker, the inner surface of the glass expands on heating. But heat from inside does not reach quickly the outer surface of the glass, because glass is a bad conductor of heat. Hence, the outer surface does not expand and the glass cracks.

56. (a) : Upto ordinary heights the change in the distance of a projectile from the centre of the earth is negligible compared to the radius of the earth. Hence projectile moves under a nearly uniform gravitational force and its path is parabolic. But for projectiles going to great heights, the gravitational force decreases in inverse poroportion to the square of the distance of the projectile from the centre of the earth. Under such a variable force the path of projectile is elliptical.

57. (a) : According to law of conservation of angular momentum, when sum of external torques acting on a system is zero, then the total angular momentum of the system remains constant.
$\tau = 0$, $L = I\omega$ = Constant
If I increases, ω decreases and vice versa.

58. (a)

59. (a) : Impulse = Force × time duration
= Change in momentum
A large force acting for a short time to produce a finite change in momentum is called an impulsive force.

60. (c) : Both the quantities are dimensionless.
Resistance × conductance = $R \times 1/R = (M^0L^0T^0)$ = 1 and Dielectric constant K is dimensionless.

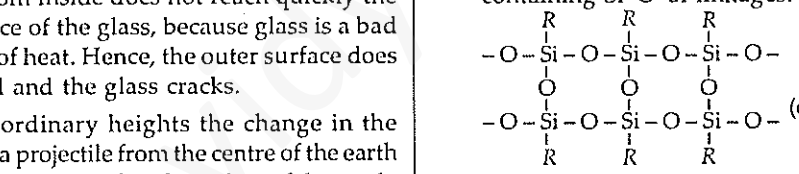
CHEMISTRY

61. (c) : The fluoride ion, by a process of hydrogen bonding, forms the anion, HF_2^-. The compound is written as $K^+[HF_2]^-$.

62. (b)

63. (d) : $2KI + H_2SO_4 + H_2O_2 \longrightarrow K_2SO_4 + 2H_2O + I_2$
$2Na_2S_2O_3 + I_2 \longrightarrow Na_2S_4O_6 + 2NaI$
milli eq. of H_2O_2 in 50 ml = milli eq. of I_2
= milli eq. of $Na_2S_2O_3$
milli eq. of H_2O_2 in 25 ml = $20 \times 0.3 = 6$
milli eq. of H_2O_2 in 1000 ml $= \frac{6}{25} \times 1000 = 240$
Equivalent per litre $= \frac{240}{1000}$
Gram per litre of H_2O_2 $= \frac{240}{1000} \times 17 = 4.08$ g/L
(Equivalent weight of $H_2O_2 = \frac{34}{2} = 17$).

64. (c): Silicones are organic silicon polymers containing Si–O–Si linkages.


(cross linked silicone)

65. (c): $\alpha = \sqrt{\frac{K_a}{C}} = \sqrt{\frac{6.6 \times 10^{-4}}{0.01}} = \sqrt{6.6 \times 10^{-2}} = 0.257$
$[H^+] = C\alpha = 0.01 \times 0.257 = 2.57 \times 10^{-3}$
pH = 3 – log2.5 = 2.60

66. (a):

	A	$\longrightarrow$	B	+	C	+	D
Initial	a		0		0		0
After time t	$a-x$		x		x		x

It is given that $a = P_0$ ...(i)
$a - x + x + x + x = P$
or $a + 2x = P$ ...(ii)
From (i),
$P_0 + 2x = P$ or $x = \frac{P - P_0}{2}$
From rate equation
$k = \frac{2.303}{t} \log \frac{a}{a-x}$
$= \frac{2.303}{t} \log \frac{P_0}{P_0 - \left(\frac{P - P_0}{2}\right)} = \frac{2.303}{t} \log \frac{2P_0}{3P_0 - P}$

67. **(b)**

68. **(d) :**

	$2SO_{3(g)}$	$\rightleftharpoons$	$2SO_{2(g)}$	+	$O_{2(g)}$
Initial conc.	1.0 mole		0.0 mole		0.0 mole
Equilibrium	0.4 mole		0.6 mole		0.3 mole

$\Rightarrow$ Equilibrium constant is given by :

$$K = \frac{[SO_2]^2[O_2]}{[SO_3]^2} = \frac{(0.6)^2(0.3)}{(0.4)^2} = 0.675 = 0.68$$

69. **(d) :** If acid is 4.5% ionized then $\alpha = 0.45$.
ΔT_f = molality $\times K_f = 0.1 \times 1.86 = 0.186$
$\Delta T_{exp} = \Delta T_N(1 + \alpha) = 0.186(1 + 0.45) = 0.269°C$

70. **(d) :** Diopside $\rightarrow CaMg[(SiO_3)_2]$.

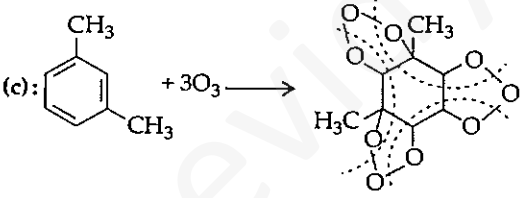
71. **(a)**

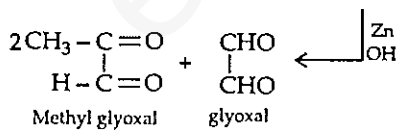
72. **(b) :** Tincture of iodine is an aqueous solution of I_2 in KI.

73. **(b) :** We know that
specific conductance =
Cell constant × conductance
$\Rightarrow$ Cell constant =
Resistance × sp. conductance
$= 55 \times 0.0112 = 0.616\ cm^{-1}$

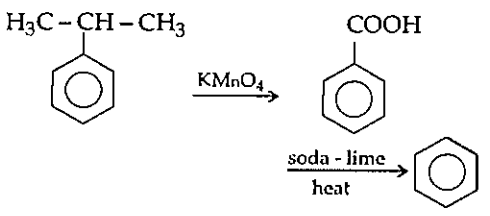
74. **(b) :** The dispersal of the charge stabilizes the carbocation. More the number of electron donating groups are present, greater the dispersal of positive charge and therefore more the stability of carbocation can be observed.
So, the order is
$CH_3 - \overset{+}{C}H - OCH_3 > CH_3 - \overset{+}{C}H - CH_3$
$> CH_3 - \overset{+}{C}H - COCH_3$

75. **(c):**



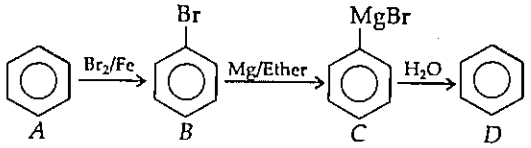


76. **(c):**



77. **(a):** Benzene can be prepared by cyclization of long chain alkanes on heating at 500 - 550°C under high pressure in presence of catalyst Cr_2O_3 supported on alumina or $Pt - Al_2O_3$ (*i.e.*, catalytic reforming)

$$\underset{n\text{-hexane}}{C_6H_{14}} \xrightarrow[\text{at high pressure}]{\underset{773\ K}{Cr_2O_3/Al_2O_3}} \underset{A}{C_6H_6} + 4H_2$$



78. **(b)**

79. **(b)**

80. **(c):** Molarity

$$= \frac{\text{wt. of solute}}{\text{mol. wt.}} \times \frac{1000}{\text{vol. of solution (in ml.)}}$$

(Volume of solution $= \frac{\text{mass}}{\text{density}} = \frac{100}{1.84} = 54.34$ ml)

Now molarity $= \frac{98}{98} \times \frac{1000}{54.34} = 18.4$ M

81. **(b) :** In solution, $x_A = 0.30$; $x_B = 0.70$
In vapour phase, $x'_A = 0.60$; $x'_B = 0.40$
Using Dalton's law and Raoult's law

$$x'_A = 0.60 = \frac{p_A}{P} = \frac{p_A}{p_A + p_B} = \frac{0.30\ p^\circ_A}{0.30\ p^\circ_A + 0.70\ p^\circ_B}$$

$$x'_B = 0.40 = \frac{p_B}{P} = \frac{p_B}{p_A + p_B} = \frac{0.70\ p^\circ_B}{0.30\ p^\circ_A + 0.70\ p^\circ_B}$$

$$\frac{x'_A}{x'_B} = \frac{0.60}{0.40} = \frac{0.30\ p^\circ_A}{0.70\ p^\circ_B}$$

$$\frac{p^\circ_A}{p^\circ_B} = \frac{0.60 \times 0.70}{0.40 \times 0.30} = \frac{7}{2} = 3.5$$

82. **(b) :** For n moles of an ideal gas $PV = nRT$
or $V = n\frac{RT}{P}$
Differentiating with respect to T at constant P, we have

$$\left(\frac{\partial V}{\partial T}\right)_P = \frac{nR}{P} = \frac{V}{T}$$

$$\alpha = \frac{1}{V}\left(\frac{\partial V}{\partial T}\right)_P = \frac{1}{V} \times \frac{V}{T} = \frac{1}{T}$$

83. **(a):** SeF_4 and XeO_2F_2 are both sp^3d hybridized, trigonal bipyramidal and see-saw shaped with 1 lone pair of electrons each.
SF_4 has 1 lone pair, XeF_2 has 3 lone pairs. $XeOF_4$

is square pyramidal with 1 lone pair, TeF_4 is see-saw shaped with 1 lone pair, $SeCl_4$ has see-saw shape with 1 lone pair, XeF_4 has planar shape with 2 lone pairs.

84. **(c):** Stability of superoxides increases with increase in size and electropositivity of the metal. Hence the order $CsO_2 > RbO_2 > KO_2$.

85. **(b)**

86. **(c):** $(CH_3)_3CO^-$ is a better base than a nucleophile. Hence elimination occurs. The product formed is resonance stabilised.

87. **(a):** Equivalent weight of metal carbonate = 20 + 30 = 50

2.5 g of metal carbonate $= \frac{2.5}{50} = 0.05$ eq.

Number of equivalent of H_2SO_4 would have reacted = 0.05

Number of equivalent of H_2SO_4 taken

$= \frac{100 \times 1}{1000} = 0.1$

Number of equivalent of H_2SO_4 remains unreacted = 0.1 – 0.05 = 0.05 eq.

∴ Number of equivalent of alkali consumed = 0.05 eq.

milli eq. = Normality × Volume in mL

∴ $1.0 \times V = 0.05 \times 1000$

$V = \frac{0.05 \times 1000}{1.0} = 50$ ml

88. **(c):** In methyl alcohol, F^- ion is solvated but in DMSO or CH_3CN (aprotic solvent) F^- ion is not solvated. Unsolvated F^- ion acts more efficiently as a nucleophile.

89. **(d) :** Being covalent, BeF_2 has the lowest melting point (800°C) while other fluorides melt at around 1300°C.

90. **(b) :** Because of its smallest size, Li^+ has highest hydration energy and hence the highest stability of hydrated Li^+ ion.

91. **(d) :** When the ends of alkene containing n double bonds are different, the number of geometrical isomers is 2^n. Thus for

$CH_3 - CH = CH - CH = CH - Cl$.

Number of geometrical isomers = $2^2 = 4$

When the ends of alkene containing n double bonds are same, then the number of geometrical isomers = $2^{n-1} + 2^{p-1}$

where $p = \frac{n}{2}$ for even n and $\frac{n+1}{2}$ for odd n, thus for

$CH_3 - CH = CH - CH = CH - CH_3$

Number of geometrical isomers

$= 2^{2-1} + 2^{\frac{2}{2}-1} = 2^1 + 2^0 = 2 + 1 = 3.$

92. **(a) :**

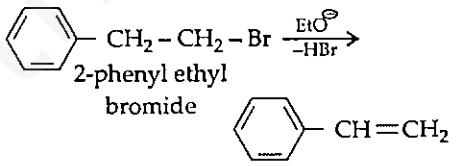
	α-D glucose	⇌	β-D glucose
Initial	1		0
At equilibrium	1 – α		α

$K = \frac{\alpha}{1-\alpha} = 1.8$

Solving α = 0.642

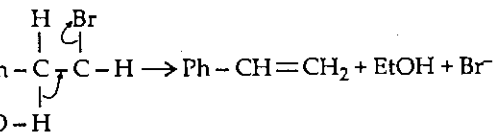
1 – α = 0.358

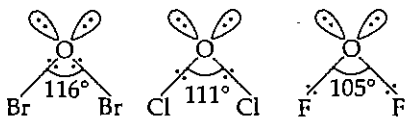
Percent of α-D glucose remaining at equilibrium = 35.8%.

93. **(b) :** 

2-phenyl ethyl bromide

It is a primary bromide. So it will undergo elimination either by E2 or E1cB. Since there is no deuterium exchange in C_2H_5OD solvent, C – H bond is not broken to form carbanion. Hence the actual mechanism is E2 only.



94. **(a):** 

In OF_2 repulsion between lone pairs is greater than that between bond pair since electrons are away from O and nearer to F. In Cl_2O, bonding electrons are nearer to O than to Cl, so the bond angle is greater than 109°28′. In Br_2O, the bonding electrons are more closer to oxygen than in Cl_2O, so the bond angle is largest (116°).

95. **(a):** $\alpha = \frac{\Lambda_c}{\Lambda^\circ_m} = \frac{176.2\ \Omega^{-1}\ cm^2\ mol^{-1}}{405.2\ \Omega^{-1}\ cm^2\ mol^{-1}} = 0.435$

$K = \frac{[H^+][F^-]}{[HF]} = \frac{C\alpha^2}{1-\alpha} = \frac{(0.002\ M)(0.435)^2}{1-0.435}$

96. **(c):** In Oppenauer's oxidation, secondary alcohol is oxidised to corresponding ketone in the presence of aluminium tertiary butoxide. Other oxidisable groups are not affected.

$$\begin{matrix}R_1\\R_2\end{matrix}\!\!>\!CHOH + [(CH_3)_3C-O]_3Al \xrightarrow{CH_3COCH_3}$$

$$\begin{matrix}R_1\\R_2\end{matrix}\!\!>\!C=O + CH_3CHOH-CH_3$$

97. **(c):** $GeCl_4$ is more stable than $GeCl_2$. Ge has greater tendency to form +4 state than +2 state.

98. **(a):** The entropy change for a process, when T and P are the variables is given by

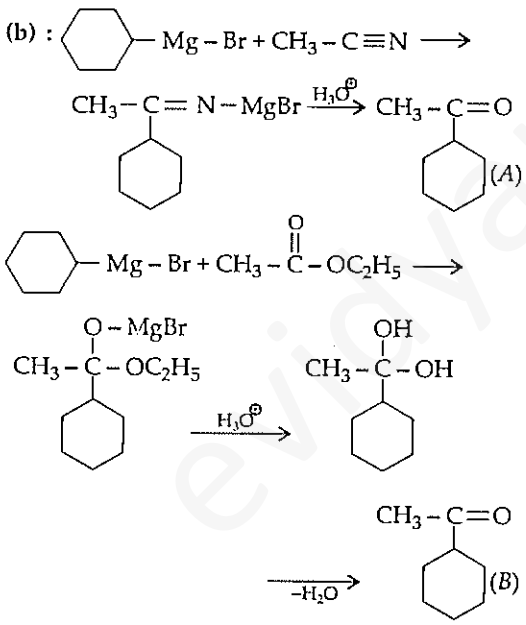
$$\Delta S = C_p \ln\frac{T_2}{T_1} - R\ln\frac{P_2}{P_1}$$

For an isobaric process $P_1 = P_2$. Hence the above equation reduces to

$$C_p \ln\frac{T_2}{T_1} = \Delta S.$$

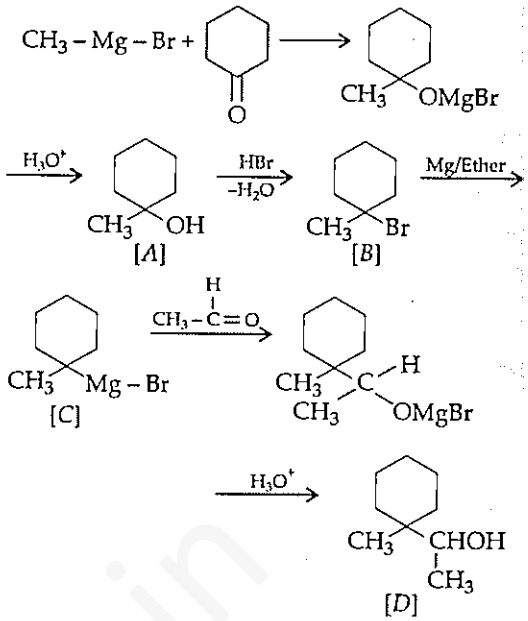
or $\Delta S = 2.303\, C_p \log\frac{T_2}{T_1}$.

99. **(b) :**



Thus in both cases, the same product, cyclohexyl methyl ketones is formed.

100. **(a):** Alkyl halides are starting materials for Grignard reagents which are used for preparing number of organic compounds.



101. **(a):** It is a temporary effect. It comes into play instantaneously at the demand of the attacking reagent and as soon as the attacking reagent is removed the original condition is restored.

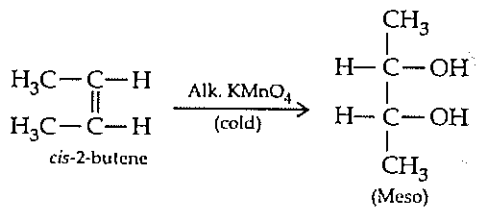
$$A \overset{\curvearrowright}{=} B \rightleftharpoons A^+ - B^-$$

This effect is applicable on a multiple bond.

102. **(c):** $CaCl_2$ forms addition products with alcohol and ammonia. ($CaCl_2.4NH_3$ or $CaCl_2.4C_2H_5OH$).

103. **(a)**

104. **(c):**

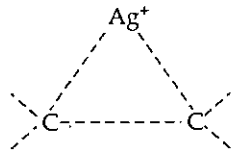


Alkaline $KMnO_4$ always gives *cis*-addition on olefins.

105. **(a)**

106. **(a)**

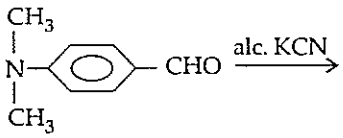
107. **(b) :** Ag^+ forms complex with the alkene by $p\pi$-$d\pi$ bonding giving an ion and the solubility increases.

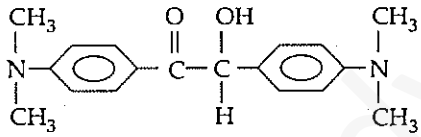


108. (c): $\Delta G = \Delta H - T\Delta S$
$-ve = \Delta H - [T\ (-ve)]$ (as spontaneous)
Exothermic reactions may be accompanied by increase or decrease of randomness.

109. (a): In case of H_2, compressibility factor increases with the pressure. At 273 K, $Z > 1$ which shows that it is difficult to compress the gas as compared to ideal gas. In this case, repulsive force dominates.

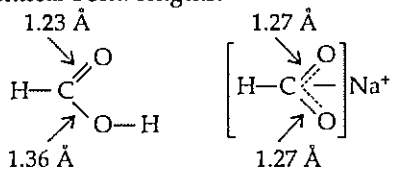
110. (b) :





111. (c): As atoms in S_8 molecule undergo sp^3 hybridisation and contain two lone pairs of electrons on each and exists as staggered 8 atoms-rings.

112. (a): Formate ion shows resonance and gives rise to identical bond lengths.



Sodium formate

113. (b) : The lone pair electrons on N atom in $AgNO_2$ attacks C_2H_5Br to form nitroethane as the major product.

114. (d) : Increase in pressure favours melting of ice into water because at higher pressure melting point of ice is lowered.
According to Le-Chatelier's principle, if pressure is increased the equilibrium will shift in direction which produces smaller number of moles.

115. (b) : Ebonite is a very hard rubber contains 30-40% sulphur.

116. (c): B does not have vacant *d*-orbitals (sub-shell) as its valence shell.

117. (c): It is known that esters with α-hydrogens form carbanion when treated with base. It brings about nucleophilic substitution at the carbonyl group of the other molecule of the ester to yield β-keto ester. $LiAlH_4$ reduces esters to alcohols.

118. (d) : In a titration of strong base and weak acid phenolphthalein is used as indicator.
Methyl orange changes its colour in pH of range 3 to 5.

119. (b) : Millon's test is used for proteins. When Millon's reagent is added to the aqueous solution of a protein, a white precipitate is formed.

120. (a)

BIOLOGY

121. (d) : WBCs can change their shape like *Amoeba* and are thus, capable of amoeboid movement. This enables them to squeeze out of blood capillaries into the tissues. This process is called diapedesis.

122. (b) : Valium is a benzodiazephine (sedative) that gives a feeling of relaxation, calmness or drowsiness in the body. Morphine is the main opium alkaloid that depresses respiratory centre and contributes to the fall in blood pressure. Amphetamines are synthetic drugs and are stimulant in nature. Hashish is a hallucinogen.

123. (b) : The organ of Corti consists of outer hair cells, inner hair cells, inner pillar cells, outer pillar cells, tunnel of Corti, phalangeal cells (cells of Deiters), cells of Hensen and cells of Claudius. The sensory hairs project from the outer ends of the hair cells into the scala media, while from the inner end of the cells nerve fibres arise, which unite to form the cochlear nerve.

124. (b)

125. (a): *Homo erectus* appeared about 1.7 million years ago in middle pleistocene. *H. erectus* evolved from *Homo habilis*. He was about 1.5–1.8 metres tall.

126. (d)

127. (c): *Entamoeba histolytica* is a monogenetic parasite, *i.e.*, living in a single host, in the large intestine

of humans. It causes amoebiasis or amoebic dysentery.

128. **(b)** : The ventral nerve cord, as its name suggests, is a cord of nervous tissue that runs the length of the animal in the lower part of its body. It is the characteristic of lower chordates like leech, cockroach and scorpion.

129. **(c)**: Ciliated epithelium is a region of epithelium consisting of columnar or cuboidal cells bearing hairlike appendages that are capable of beating rapidly. Ciliated epithelium performs the functions of moving particles of fluids over the epithelial surface. Cuboidal ciliated epithelium occurs in certain parts of uriniferous tubules whereas columnar ciliated epithelium occurs in fallopian tubules, nasal passages, bronchioles, small bronchi and buccopharyngeal cavity of frog. It often occurs in the vicinity of mucus secreting goblet cells.

130. **(a)**: Borderline personality disorder (BPD) is a serious mental illness. Borderline describing a personality disorder characterized by unstable and intense relationships, exploiting and manipulating other people, rapidly changing moods, recurrent suicidal or self injuring acts & a prevasive inner feelings of emptiness & boredom.
A mood disorder is a condition where the prevailing emotional moods are distorted or inappropriate to the circumstances. Addiction is a state of dependence produced by the habitual taking of drugs, alcohol etc. Schizophrenia is a group of severe mental disorders characterized by disturbances of languages and communications, thought disturbances that may involve distortion of reality, misperceptions, delusions and hallucination, mood changes etc.

131. **(b)** : At sexual maturity, the undifferentiated primordial germ cells divide several times by mitosis to produce a large number of spermatogonia. Each spermatogonium then actively grows to a larger primary spermatocyte. Each primary spermatocyte undergoes two successive divisions, called maturation divisions. The first maturation division is reductional or meiotic. Hence, the primary spermatocyte divides into the haploid daughter cells called secondary spermatocytes.

132. **(d)** : Oral contraceptive pills inhibit ovulation and implantation. They have to be taken daily for 21 days starting within the first five days of menstrual cycle. After a gap of 7 days, it has to be repeated.

133. **(b)** : Patella is a sesamoid bone. Sesamoid bones are small rounded masses of bones formed in tendons at the joints where they are subjected to great pressure.

134. **(a)**

135. **(b)** : Secretin and cholecystokinin are secreted by Brunner's gland located in duodenum. Secretin causes the pancreas to secrete alkaline pancreatic juice and stimulates bile production in the liver. Cholecystokinin induces the gall bladder to contract and eject bile into the intestine and stimulates the pancreas to secrete its digestive enzymes.

136. **(c)**: The chromosome complement of *Triticum aestivum* (2n = 26) is similar to that of *Gossypium* whose ploidy level is also 2n = 26. *Zea mays* has ploidy level of 2n = 20. *Secale* and *Aegilops* both have the similar ploidy level of 2n = 14.

137. **(b)** : Eugenics is the study of methods of improving the quality of human populations by the application of genetic principles. Positive eugenics would seek to do this by selective breeding programmes. Negative eugenics aims to eliminate harmful genes (*e.g.*, those causing haemophilia and colour blindness) by counselling any prospective parents who are likely to be carriers.

138. **(c)**: DNA polymerase can polymerize nucleotides only in 5′ → 3′ direction on 3′ → 5′ strand because it adds them at the 3′ end. Since the two strands of DNA run in antiparallel directions, the two templates provide different ends for replication. Replication over the two templates thus proceeds in opposite directions. One strand with polarity 3′ → 5′ forms its complementary strand continuously because 3′ end of the latter is open for elongation. It is called leading strand. Replication is discontinuous on the other template with polarity 5′ → 3′ because only a short segment of DNA strand can be built in 5′ → 3′ direction due to exposure of a small stretch of template at one time. Short segments of replicated DNA are called Okazaki fragments.

139. **(d)** : Photosystem I is located in the nonappressed part of grana thylakoids as well as stroma thylakoids. In this photosystem chlorophyll :

carotenoid content is high. Its photocentre is P_{700}. Pigment molecules of PS I absorb at or below 700 nm wavelenth of light. It receives electrons from photosystem II. Photosystem I is involved in both cyclic and non cyclic photophosphorylation. It is not connected with photolysis of water. Usually it hands over its electron to $NADP^+$.

140. (d) : Bark is a loose term and is used to define all the tissues outside vascular cambium. It is differentiated into outer bark or rhytidome (consisting of dead cells) and inner bark (of living cells, *i.e.*, periderm, cortex, pericycle and secondary phloem). The outer layers of the bark are being constantly peeled off on account of the formation of new secondary vascular tissues in the interior. Bark is insect repellent, decay proof, fire-proof and acts as a heat screen.

141. (a): The cotton fibres represent epidermal prolongations of seed coat cells. A raw cotton fibre, on average, gives the following values on analysis : cellulose, 94%, protein - 1.3%, pectic substances - 0.9%, ash - 1.2%, wax - 0.6%, sugars - 0.3% and traces of pigments and mineral matter.

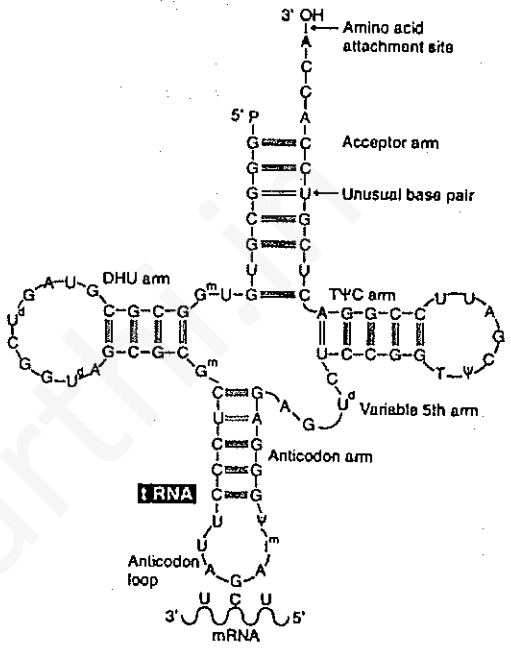
142. (b) : Mycoplasma are the smallest and simplest free living Gram negative prokaryotes or monerans. A cell wall is absent. Plasma membrane forms the outer boundary of the cell. A substantial amount of polysaccharides having acetyl glucosamine are associated with cell membrane.

143. (a): Sexual reproduction *in Spirogyra* takes place by the process of conjugation. In *Spirogyra*, the process of conjugation may be of two types – scalariform conjugation and lateral conjugation. Scalariform conjugation occurs in heterothallic species. Lateral conjugation occurs between the adjacent cells of the same filament of homothallic species of *Spirogyra*. Lateral conjugation are of two types. They are indirect lateral conjugation (chain type) and direct lateral conjugation.

144. (c): Sucrose, glucose and fructose, all the three sugars are found in plants. Sucrose is the commercial sugar which is obtained from sugarcane. Glucose is the main respiratory substrate in plants and animals. Fructose can also function similarly. Moreover fructose is also the common fruit sugar.

Lactose or milk sugar is found naturally in milk. It is reducing sugar which is formed in the mammary glands of mammal through condensation of two hexose molecules.

145. (d) : The binding site of *t*RNA with *m*RNA is anticodon loop and with amino acid is CCA end, as shown in the figure.



146. (d) : 1 map unit or centimorgan is equivalent to 1% recombination between two genes. The frequency of recombination can be used to depict the arrangement of the genes.

Recombination frequency between three genes is

A – B = 9%
A – C = 17% and
B – C = 26%

By manipulating the three possibilities of their arrangements A – B – C, A – C – B and B – A – C, it was found that the three gene must be arranged in the order B – A – C with distance between B – A being 9 cM and A – C being 17 cM and the distance between B – C being 26 cM.

147. (d) : Spike is a racemose inflorescence that bears sessile flowers in an acropetal fashion, *e.g.*, chaff flower (*Achyranthes*), bottle brush (*Callistemon*), *Adathoda vasica*, *Amaranthus*.

148. (b) : Lignin is a complex organic polymer that is deposited within the cellulose of plant cells. The lignin content is high in jute fibres which causes deterioration very quickly.

149. (d) : Sclereids are highly thickened dead sclerenchyma cells with very narrow cavities. They may also be branched. They provide stiffness to the parts in which they occur. Sclereids are of many types: brachysclereids, macrosclereids, osteosclereids, astrosclereids, trichosclereids and filiform sclereids. Astrosclereids are star-shaped, having various branches or arms. They are found in intercellular spaces of leaves and stems of many hydrophytes like *Nymphaea*.

150. (c): Oxalosuccinate is decarboxylated to form α-ketoglutarate through the enzyme decarboxylase. It is one of the step involved in Krebs' cycle. It releases one molecule of CO_2.

$$\text{Oxalosuccinate} \xrightarrow[Mg^{2+}]{\text{Decarboxylase}} \alpha\text{-ketoglutarate} + CO_2$$

151. (c): In electron transport chain electrons transport through a series of carriers. H^+ of $NADH^+$ (received from Krebs cycle) is accepted by FAD as a result of which FAD is reduced to $FADH^+$ and $NADH^+$ is oxidised to NAD. Reduced $FADH^+$ is oxidised by CoQ, with the formation of $CoQH^+$. H^+ ions then move to Cyt b, then Cyt c, Cyt a and Cyt aa_3. Ultimately these H^+ are acceped by O_2 and H_2O is formed.

152. (d) : Plants require many organic and inorganic nutrients to complete their life-cycle. It has been established that some elements are required by plants in relatively large amount and are called major elements or macronutrients, *e.g.*, C, H, O, N, S, P, K, Ca and Mg.
Microelements or minor elements or trace elements are required by plants in very small amount, less than 1ppm. *E.g.*, Fe, Cu, B, Zn, Mn, Mo, Cl. Thus Cr is not a microelement.

153. (c): The common peafowl or peacock, *Pavo cristatus*, called 'Mor' or Mayur' in hindi, is the national bird of India. It occurs throughout India upto 1650 meters in the himalayas. It displays a well-marked sexual dimorphism, the male having a gorgeous ocellated tail.

154. (d) : Acid rain is rainfall and other forms of precipitation with a pH less than 5. pH of normal rain is 5.6 – 6.5. It is caused by the large scale emission of acidic gases into the atmosphere from thermal power plants, industries and automobiles.

155. (d) : Interferon is a group of proteins that increases the resistance of cells to viral infection. Interferon also acts as cytokines and can enhance some immune responses. Three types of interferons have so far been discovered, alpha, beta and gamma, all of which have immune-modulating effects. Interferons are used in the treatment of cancer and autoimmune diseases.

156. (d) : Bacteria become resistant to antibiotic by either producing enzymes or forming impermeable capsule and modifying the target of the drug.

157. (b) : Active transport is the uphill movement of materials across the membrane where the solute particles move against their concentration gradient or electro-chemical gradient. It takes place through the agency of special organic molecules called carrier molecules, carrier particles or carrier proteins. There is a special carrier molecule for each solute particle (ion or molecule). The carrier has its binding site on two surfaces of the membrane. The solute particle (or substrate) combines with the carrier to form carrier solute complex. In the bound state the carrier undergoes a conformational change which transports the solute to the other side of the membrane. Here the solute is released. Energy is used in bringing about the conformational change in the carrier. It is provided by ATP.

158. (d) : Co-dominance is the phenomenon when the two genes neither show dominant-recessive relationship nor show intermediate condition, but both of them express themselves simultaneously. This has been reported in roan character of cattle (*i.e.*, patches of 2 different colours on the skin).

159. (a): The first bioherbicide is devine, which is a mycoherbicide, based on fungus *Phytophthora palmivora*. It is being used since 1981 to control *Morrenia odorata* (milkweed vines) in *Citrus* orchards.

160. (c): Ripened ovary or fertilized ovary is called fruit. The wall of the ovary forms fleshy or dry fruit wall known as pericarp. It means that the pericarp is developed from pistil or carpel.

161. (a) : Biotic or ecological succession is the formation of a series of biotic communities at the same site over a period of time one after the other, till a stable climax community develops over the area. It occurs generally in bare areas. Primary succession

takes place on a biological sterile soilless primary barren area. Secondary succession takes place in a recently denuded area which still contains a lot of organic debris, remains and propagules of previous living organisms. The area has become bared due to destruction of the community previously present. The baring of an area can be caused due to forest fire, deforestation for wood, timber and habitat, overgrazing, landslides or earthquakes, excessive and repeated droughts, fallowing a cropland and repeated floods.

162. **(d)** : Connective tissue consists of variously shaped cells lying in an extracellular material called matrix. It joins one tissue to another in the organs. Connective tissue is absent inside the central nervous system i.e. brain and spinal cord and thus has no function in the conduction of nerve impulse.The nerve cells of the brain and spinal cord are held together by supporting cells called neuroglia cells.

163. **(a)**: Based on the mode of secretion, the glands are of three types : mesocrine, apocrine and holocrine. Mammary glands that are present in mammals to feed the young ones with milk are the example of apocrine glands. In apocrine glands, the secretion accumulates as secretory granules in the distal part of the cell. This part later breaks down and leaves as a secretion.

164. **(b)** : Application of cytokinins to marketed vegetables can keep them fresh for several days. Shelf life of cut shoots and flowers is prolonged by employing the hormone cytokinin. The reason is that the cytokinin increases retention of chlorophyll and delayed senescence in leaves. Cytokinin as the name suggests, is essential for cell division or cytokinesis. It promotes cell division along with auxin by controlling the activity of cyclin dependent kinases.

165. **(c)**: Angina pectoris literally means "pain in the chest". It results from arteriosclerosis of the arteries that supply the heart muscle itself, i.e., the coronary arteries. Arteriosclerosis is the hardening of arteries and arterioles due to thickening of the fibrous tissue, and the consequent loss of elasticity.
Due to the lack of required expansion, the arteries are unable to carry extra blood to the heart muscle at the time of stress when the heart is beating more vigorously. Deprived of oxygen the heart muscle experiences constricting pain.

166. **(b)** : Most of the animals have sex organs. They are either males or females. But in some lower animals, the organs of both the sexes are found in the same individual. These are called bisexual or monoecious animals or hermaphrodites. In these animals, testes and ovaries do not mature simultaneously. For example in earthworm, testes mature earlier, while in others, *e.g.*, sea-squirt, ovaries mature earlier. These conditions are respectively called protandry and protogyny. They ensure cross fertilization. Cross fertilization is a process in which gametes derived from different individuals are united to form zygote. It involves the mixing of two different genetic materials. This is better than self-fertilization as it introduces variation by combining traits of two individuals.

167. **(d)** : A small, glandular, blind pouch of lymphatic tissue, the bursa lies on the dorsal side of the cloaca. It is lined with endoderm, and opens into the proctodaeum. In a young bird, bursa fabricii forms lymphocytes, and probably it produces antibodies and protects against local infection, but it atrophies in the adult before sexual maturity. It is also called cloacal thymus, because like thymus, it secretes lymphocytes. Thus it is not related with flight adaptation, rather it helps in immunity.

168. **(d)** : Glycolysis is the process of breakdown of glucose or similar hexose sugar into two molecules of pyruvic acid through a series of enzyme mediated reactions, releasing energy (ATP) and reducing power ($NADH_2$). It is the first step of respiration, which occurs inside the cytoplasm and is independent of O_2. In glycolysis, two molecules of ATP are consumed during double phosphorylation of glucose to form fructose 1, 6 diphosphate. Four molecules of ATP are produced in the conversion of 1, 3-diphosphoglycerate to 3-phosphoglycerate and phosphenol pyruvate to pyruvate whereas, two molecules of $NADH_2$ are formed during oxidation of glyceraldehyde 3-phosphate to 1, 3-diphosphoglycerate. Since, each NADH is equivalent to 3 ATP, so net gain in glycolysis is 8 ATP.

169. **(c)**: Restriction enzyme, a type of endonuclease, functions by "inspecting" the length of a DNA sequence. Once it finds a recognition sequence,

it binds and cut each of the two strands of the double helix at specific point leaving single stranded portions at the ends. This results in overhanging stretches called sticky ends. These are named so because they form hydrogen bonds with their complementary counter parts *i.e.* they can join similar complementary ends of DNA fragment from some other source with the help of DNA ligase. This stickiness of the ends facilitates the action of the enzyme DNA ligase, not DNA polymerase.

170. (a): Excess of nitrates in drinking water are harmful for human health and may be fatal for infants. Excessive use of fertilizers often leads to accumulations of nitrates in water. In infants excess nitrate reacts with haemoglobin to form nonfunctional methaemoglobin that impairs oxygen transport. This condition is termed as methaemoglobinemia or blue baby syndrome. The disease can damage respiratory and vascular systems and even cause suffocation.

171. (b) : Amniocentesis is a foetal sex determination and disorder test based on the chromosomal pattern in the amniotic fluid surrounding the developing embryo. It is withdrawal of a sample of the amniotic fluid surrounding the embryo in the uterus by piercing the amniotic sac through the abdominal wall. Amniotic fluid drawn from the uterus contains cells from the embryo (mostly shed from the skin). Cell cultures enable chromosome patterns to be studied so that prenatal diagnosis of chromosomal abnormalities (such as Down's syndrome) can be made. Metabolic errors and other diseases such as spina bifida, can also be diagnosed prenatally from the biochemistry of the cells.

172. (d) : Primary sporogenous cell gives rise to microspore mother cells or pollen mother cells (PMCs). They are sporophytic in nature *i.e.*, diploid. These cells undergo meiosis (reduction division) which gives rise to 4 microspores or pollens and this formation of microspores or pollens is called microsporo-genesis. Microspores represent the beginning of the gametophytic phase and they are haploid in nature.

173. (b) : Nucleus is the controlling centre of a cell as it contains chromosomes and genes. Chromosomes contain the DNA which by transcription prepare RNA which in turn leads to the formation of proteins by translation. These proteins regulate the various metabolic processes going in the cell. Besides this, nucleus contains genetic information for reproduction, development & behaviour of an organism.
Nuclear membrane is double layered, semipermeable and is perforated by minute, circular nuclear pores. The pore controls the passage of macromolecules like tRNAs, mRNAs, ribosomal proteins, enzymes etc. during different processes of transcription, translation etc.

174. (a): Calcitonin or thyrocalcitonin is secreted by parafollicular cells of thyroid stroma. It retards bone dissolution and stimulates excretion of calcium in urine. Thus, it lowers calcium level in extra cellular fluid (ECF). Parathormone is secreted by chief cells of parathyroid gland and is also known as Collip's hormone. It maintains blood calcium level by increasing its absorption from food in intestine and its reabsorption from nephrons in the kidney. Maintenance of proper calcium level is in fact, a combined function of parathormone and calcitonin. When calcium level falls below normal then parathormone maintains it by promoting its absorption, reabsorption and also by demineralization of bones. When blood calcium level exceeds above normal then calcitonin hormone increases excretion of calcium in urine.

175. (d) : Dark reaction is also known as light-independent phase. Unlike, light reaction, it does not require light as an essential factor. Thus can takes place both in the presence or absence of light. The term dark reaction does not mean that it takes place only in dark period or at night. CO_2 fixation occurs in both C_3 and C_4 cycle. In C_3 cycle, CO_2 is added by the enzyme, RuBisco to a 5 carbon compound RuBP that is converted to 2 molecules of 3-carbon PGA. In C_4 cycle the first product of CO_2 fixation (takes place in mesophyll) is a 4-carbon compound, oxaloacetic acid. It is seen in some tropical plants.

176. (c): The lightest atoms of nitrogen, carbon etc. formed the primitive atmosphere. Hydrogen atoms were most numerous and most reactive in primitive atmosphere. Hydrogen atoms combined with all oxygen atoms to form water leaving no free oxygen. Thus primitive atmosphere was reducing atmosphere (without free oxygen) unlike the present oxidising atmosphere (with free oxygen).

Formation of ozone layer is the consequence of modern oxidizing atmosphere having plenty of free oxygen. As more oxygen accumulated in the atmosphere (due to photosynthesis) ozone began to appear in the top layers.

177. **(b)** : The fossil of Java Ape-man was discovered from pleistocene rocks in central Java. The fossil of Peking man was discovered from the lime stone caves of Choukoutien near Peking while that of Heidelberg man was discovered in mid pleistocene. All these three fossils come under the category of *Homo erectus*.
Homo erectus appeared about 1.7 million years ago in middle pleistocene. *H. erectus* evolved from *Homo habilis*. He was about 1.5–1.8 metres tall. He had erect posture. His skull was flatter than that of modern man. He had protruding jaws, projecting brow ridges, small canines and large molar teeth. He made more elaborate tools of stones and bones, hunted big game and perhaps knew use of fire.

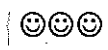
178. **(b)** : Hydrostatic pressure is the pressure which develops in an osmotic system due to osmotic entry or exit of water from it.
Loss of water produces a negative hydrostatic pressure or tension. It develops in xylem due to loss of water in transpiration. This is very important in transport of sap over long distances in plants.
A positive pressure develops in a plant cell or system due to entry of water into it. Positive hydrostatic pressure is also called turgor pressure. Due to turgor pressure the protoplast of a plant cell wall press the cell wall to the outside. The cell wall, being elastic, presses the protoplast with an equal and opposite force. The force exerted by the cell wall over the protoplast is called wall pressure (WP). Normally wall pressure is equal and opposite to turgor pressure except when the cell becomes flaccid.

179. **(d)** : Hyaluronidase, a hydrolytic enzyme is an acrosomal content in mammalian sperm. It helps at the time of fertilization during the penetration of sperm into ovum. Based on the amount of yolk mammalian eggs are alecithal means egg without yolk. Microlecithal eggs are with very little yolk e.g., sea urchin, starfish. On the basis of distribution of yolk telolecithal eggs are those eggs in which the yolk is concentrated towards the vegetal pole and cytoplasm and nucleus lie near the animal pole e.g., birds and reptiles.

180. **(c)**: The law of segregation states that the two alleles controlling each character maintain indentity in the organism but during the formation of gametes or spores by meiosis move apart due to separation of the homologous chromosomes which bear them, so that each gamete or spore receives only one allele of each character on random basis. Since the gametes or spores possess one allele of each character, they are always pure. The law of segregation is, therefore, also called the law of purity of gametes/spores. Mendel's second law or the law of independent assortment states that the alleles of different characters located in different pairs of homologous chromosomes are independent of one another in their segregation during gamete formation and in coming together into the offspring by fertilization, both processes occurring randomly.

GENERAL KNOWLEDGE

181. (a)	**182.** (b)	**183.** (d)	**184.** (a)	**185.** (c)
186. (b)	**187.** (d)	**188.** (d)	**189.** (d)	**190.** (b)
191. (a)	**192.** (a)	**193.** (c)	**194.** (b)	**195.** (a)
196. (a)	**197.** (c)	**198.** (b)	**199.** (a)	**200.** (b)



Chapterwise Index - '10

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Use the index for topicwise analysis of this year's AIIMS paper and refer to these questions when you are practising MCQs chapterwise.

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