SOLUTIONS

PHYSICS

1. **(b)** : For a projectile to leave the gravitational field of the earth, its kinetic energy would be at least equal to its potential energy. That is

$$\frac{1}{2}mv_e^2 = G\frac{Mm}{R} \quad \Rightarrow \quad v_e = \sqrt{\frac{2GM}{R}}$$

where G is the universal gravitational constant, M is the mass of the earth and R is the radius of the earth. Hence the escape velocity of a projectile is independent of its own mass.

2. **(a)**

3. **(d)** : As the laser beam is highly monochromatic, directional and coherent, it can be sharply focused and that is why it is used for carrying out surgery.

4. **(d)** : Let the original diameter of the wire be D. Therefore the new diameter is $D/2$.

Original area of cross-section is $\frac{\pi D^2}{4}$

and the final area of cross-section is $\frac{\pi D^2}{16}$

The new length of the wire is given by

$$L \times \frac{\pi D^2}{4} = L' \times \frac{\pi D^2}{16} \quad \Rightarrow \quad L' = \frac{16}{4}L = 4L$$

Now, we know that the resistance is given by $R = \rho\frac{L}{A}$

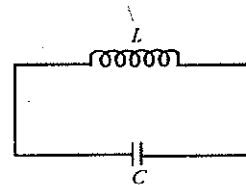$$\therefore \quad R' = \rho\frac{L'}{A'} = \rho\frac{4L}{A/4} = 16R$$

$$\left[\because A' = \frac{\pi D^2}{16} = \frac{A}{4}\right]$$

$$\therefore \quad R' = 16 \times 10 = 160\ \Omega.$$

5. **(c)** : The charge on a proton is equal to e, the electronic charge. The potential difference is $V = 1$ kV. Hence the kinetic energy of the proton is $E = 1$ keV.

6. **(a)** : If an electric dipole is placed in a non-uniform electric field, then the positive and the negative charges of the dipole will experience a net force. And as one end of the dipole is experiencing a force in one direction and the other end in the opposite direction, so the dipole will have a net torque also.

7. **(d)** : When the capacitor is connected to a d.c. source and then disconnected, it gets charged and then it starts discharging through the inductor. An induced emf is produced in the circuit which opposes the growth of current in L. When the capacitor is fully discharged, the electric energy stored in the capacitor (*i.e.* $1/2\ q^2/C$) gets converted fully into magnetic field energy ($1/2\ LI^2$). As soon as the discharge of the capacitor is complete, current stops and the magnetic flux linked with L starts collapsing. Therefore, an induced emf is again developed which starts recharging the capacitor in the opposite direction. When the recharging is completed, all magnetic energy stored in L appears as the electric energy between the plates of the capacitor. The entire process keeps on repeating and the energy taken from the cell keeps on oscillating between C and L. Hence the current in the circuit starts oscillating as soon as the d.c. source charging the capacitor is disconnected.

8. **(b)** : An intrinsic germanium have four outer electrons which they use to form bonds with four neighbouring Ge atoms. Gallium, being from group III is having three outer electrons. So when we add gallium atoms into germanium, some gallium atoms have a chance to replace some of the germanium atoms. But with gallium, only three neighbouring Ge atoms can make bonds with Ga. The bond with the fourth neighbouring Ge atom is broken as Ga is having a shortage of one outer electron. The broken bond can be filled up by an electron when the electron gets enough energy to jump from the valence bond creating a hole out there. So, we get a p-type semiconductor.
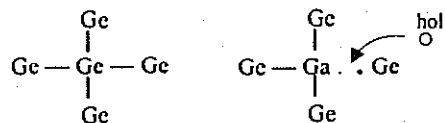
9. **(c)** : We know that the activity of radioactive substance, $A = A_0 e^{-\lambda t}$

$$\Rightarrow \quad \frac{A}{A_0} = e^{-\lambda t} = e^{-\frac{0.693}{T^{1/2}}t} \quad \left[\because T_{1/2} = \frac{0.693}{\lambda}\right]$$

$$\Rightarrow \quad \frac{1}{16} = e^{-\frac{0.693 \times 40}{T^{1/2}}} \quad \Rightarrow \quad \frac{0.693 \times 40}{T_{1/2}} = \ln 16$$

$$\Rightarrow \quad T_{1/2} = \frac{0.693 \times 40}{\ln 16} = 9.997 \approx 10 \text{ days.}$$

10. (b) : $(n) \longrightarrow (D)$

One deuteron consists of one proton and one neutron. As the mass of a proton and a neutron is approximately same ($\approx 1.67 \times 10^{-27}$ kg), we assume that the mass of the neutron be m and the mass of the deuteron be $2m$ as the electron mass is negligibly small compared to that of proton and neutron.

Let the initial velocity of the neutron be u. As the deuteron is initially at rest, the final velocity of the neutron is

$$v_1 = \left(\frac{m - 2m}{m + 2m}\right)u = -\frac{mu}{3m} = -\frac{u}{3}.$$

and the velocity of the deuteron is

$$v_2 = \frac{2m}{m + 2m}u = \frac{2}{3}u.$$

Total energy before collision is $E_1 = \frac{1}{2}mu^2$

After collision, the energy gained by the deuteron is

$$E_d = \frac{1}{2} \times (2m)v_2^2 = m \times \left(\frac{2}{3}u\right)^2 = \frac{4}{9}mu^2.$$

E_d is the amount of energy lost by the neutron. Therefore the fractional loss of energy of the neutron is

$$\frac{E_d}{E_1} = \frac{(4/9)mu^2}{(1/2)mu^2} = \frac{8}{9}.$$

11. (c)

12. (b) : Radius of one drop of mercury is R.

∴ The volume of one drop $= \frac{4}{3}\pi R^3$

∴ Total volume of the two drops,

$$V = 2 \times \frac{4}{3}\pi R^3 = \frac{8}{3}\pi R^3$$

Let the radius of the large drop formed be R'. The volume of the large drop is also V.

$$\therefore \quad \frac{4}{3}\pi R'^3 = \frac{8}{3}\pi R^3 \quad \Rightarrow \quad R'^3 = 2R^3 \quad \Rightarrow \quad R' = 2^{1/3}R.$$

Now the surface area of the two drops is

$$S_1 = 2 \times 4\pi R^2 = 8\pi R^2$$

and the surface area of the resultant drop is

$$S_2 = 4\pi R'^2 = 4\pi 2^{2/3}R^2$$

Let T be the surface tension of mercury. Therefore the surface energy of the two drops before coalescing is

$$U_1 = S_1T = 8\pi R^2 T$$

and the surface energy after coalescing,

$$U_2 = S_2T = 2^{2/3} \times 4\pi R^2 T$$

$$\therefore \quad \frac{U_1}{U_2} = \frac{8\pi R^2 T}{2^{2/3} \times 4\pi R^2 T} = \frac{2}{2^{2/3}} = 2^{1/3}.$$

13. (c) : The temperature of the black body is $T_1 = 227°C = 500$ K.

∴ Using Stefan's law, the rate of heat radiation per unit area per unit time is

$$E_1 = \sigma T^4 \quad \Rightarrow \quad 20 = \sigma(500)^4 \quad \Rightarrow \quad \sigma = \frac{20}{(500)^4}.$$

Now the temperature of the blackbody is raised to $T_2 = 727°C = 1000$ K

∴ Rate of heat radiation per unit area

$$E_2 = \sigma T_2^4 = \frac{20}{(500)^4} \times (1000)^4$$

$$= 20 \times 2^4 = 320 \text{ cal m}^{-2} \text{ s}^{-1}.$$

14. (c) : Let the mass m be displaced towards right by a distance x. Then the spring 1 will be extended and the spring 2 will be compressed by an amount of x each. The restoring force on mass m due to spring 1 is $F_1 = -kx$

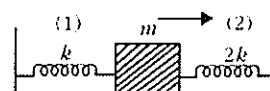And the restoring force due to spring 2 is

$$F_2 = -(2k)x$$

∴ Total force on the mass m is

$$F = F_1 + F_2 = -kx - 2kx = -3kx$$

$$\Rightarrow \quad m\frac{d^2x}{dt^2} = -3kx \quad \Rightarrow \quad \frac{d^2x}{dt^2} + \frac{3k}{m}x = 0$$

$$\Rightarrow \quad \frac{d^2x}{dt^2} + \omega^2 x = 0 \text{ where } \omega^2 = \frac{3k}{m} \Rightarrow \omega = \sqrt{\frac{3k}{m}}$$

$$\Rightarrow \quad f = \frac{\omega}{2\pi} = \frac{1}{2\pi}\sqrt{\frac{3k}{m}}.$$

15. (c) : For maximum accuracy in finding the position of an object using a light beam is achieved, when the light beam used is of shorter wavelength, because if the wavelength is longer, the spread in the wave will be more.

16. (c) : Wavelength $\lambda = 500$ nm $= 500 \times 10^{-9}$ m
Thickness of the film, $t = 2$ μm $= 2 \times 10^{-6}$ m
Refractive index $\mu = 1.5$
When there is no thin film placed in the path of any one of the two beams, the path difference between them is given by dy/D (considering the two beams meetings at a point P). In case we put a thin film in the path of one

of the beams, then the optical path of that beam gets longer.

Now for the central maximum, path difference in absence of the film

is $\Delta x = 0$. But when we put the film, the path difference becomes

$$\Delta x = \mu t - t = (\mu - 1)t$$
$$= (1.5 - 1) \times 2 \times 10^{-6} = 10^{-6}\, m = 1\, mm.$$

Now, $\Delta x = \dfrac{dy}{D} \Rightarrow y = \dfrac{D}{d}\Delta x = \dfrac{D}{d} \times 1\, \mu m$

And the fringe width is given by

$$W = \dfrac{D\lambda}{d} = \dfrac{D}{d} \times 500 \times 10^{-9}\, m = \dfrac{D}{d} \times 0.5 \times 1\, \mu m$$

$$\therefore \quad y = \dfrac{D}{d} \times 1\, \mu m = 2 \times \dfrac{D}{d} \times \dfrac{1}{2} \times 1\, \mu m = 2W.$$

As the film is placed in the path of the upper beam, the central maximum will shift upward by nearly two fringes.

17. **(b) :** The de-Broglie wavelength of a particle or a photon is given by $\lambda = h/p$

where h is the Planck's constant and p is the momentum. As the electron and the photon are having the same wavelength λ, the momentum of both of them will be the same.

18. **(b) :** When the high energy electron hits the target and takes out an electron from the inner orbit, there is a possibility of an outer electron to fall down to fill up that vacancy. And when such a transition of electron takes place from a higher energy level to a lower energy level, the difference of energy between the two levels is given off in the form of radiation known as characteristic X-rays.

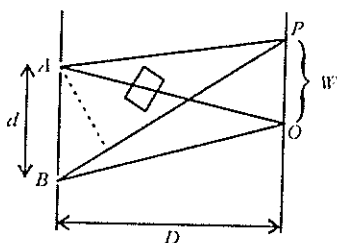**19.** **(c) :** The force experienced by A due to B is

$$F_1 = \dfrac{1}{4\pi\varepsilon_0}\dfrac{QQ}{a^2} \text{ along } \overline{AB} \text{ (attractive)}$$

The force experienced by A due to C is

$$F_2 = \dfrac{1}{4\pi\varepsilon_0}\dfrac{Q^2}{a^2} \text{ along }$$

$\overline{CA}$ produced (repulsive) Now the force $\vec{F_1}$ is having a component $F_1 \cos 30°$ along and the force $\vec{F_2}$ is having a

component $F_2 \cos 30°$ along $\overline{AE}$. $\overline{AE}$ and $\overline{AF}$ are both normal to $\overline{BC}$ but they are mutually opposite to each other. And as $|\vec{F_1}| = |\vec{F_2}|$, so the forces along $\overline{AE}$ and $\overline{AF}$ will both cancel each other. And so the force experienced by the charge at A in the direction normal to $\overline{BC}$ is zero.

20. **(c) :** $X_C = \dfrac{1}{\omega C} = \dfrac{1}{2\pi fC}$

$$= \dfrac{1}{2 \times 3.14 \times 1 \times 10^3 \times 2 \times 10^{-6}} = \dfrac{10^3}{4 \times 3.14}$$

Voltage, $V = i \times X_C = 2 \times 10^{-3} \times \dfrac{10^{-3}}{4 \times 3.14} = 0.16\, V.$

21. **(b) :** The magnetic field at the centre of a circular loop carrying current I is given by $B = \dfrac{m_0 I}{2r}$ where r is the radius of the circular loop. Given that $r = 5.0\, cm = 0.05\, m$.

Now, $B = \dfrac{\mu_0 I}{2r} = 0.5 \times 10^{-5}$

$$\Rightarrow \quad I = \dfrac{0.5 \times 10^{-5} \times 2 \times 0.05}{\mu_0} = \dfrac{0.5 \times 10^{-5} \times 0.1}{4\pi \times 10^{-7}}$$
$$= 0.3978 \approx 0.4\, Å.$$

22. **(a) :** In the presence of an external magnetic field, the atomic dipoles of paramagnetic substances are aligned along the field. The material gets magnetised and it produces an extra magnetic field in the material in the direction of the field. So for paramagnetic materials, the resultant field is greater than the applied field. As the body of a frog behaves like a paramagnetic substance, the smallest magnetic field on the body of the frog will be strong enough to lift it up.

23. **(c) :** From Wien's displacement law, we know that, $\lambda_m T =$ constant
which means that as temperature increases then the wavelength having the maximum intensity shifts towards left. Here, $T_2 > T_1$.

$\therefore \quad \lambda_{m T_2} < \lambda_{m T_1}$

But in plot (a) $\lambda_{m T_2} = \lambda_{m T_1}$, in plot (b) $\lambda_{m T_2} > \lambda_{m T_1}$ and in plot (d) $\lambda_{m T_2} > \lambda_{m T_1}$. Therefore the correct plot is (c) where $\lambda_{m T_2} < \lambda_{m T_1}$.

24. **(d) :** According to Gauss's law, the total electric flux through a closed surface is given by
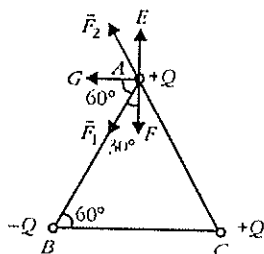
$$\phi = \oint_s \vec{E} \cdot d\vec{s} = \frac{Q}{\varepsilon_0}$$

where Q is the total charge enclosed by the surface. The total charge enclosed by the given surface is
$Q = +q - q = 0.$ ∴ The total flux $\phi = 0$.

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25. (c)

26. (a) : Nuclear fusion is possible only between light nuclei. The nuclear process of two light nuclei getting close enough to produce a larger nucleus is energetically favourable reaction.
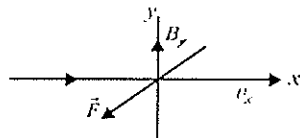
27. (b) : We know that the force on a charged particle e due to a magnetic field is given by

$$\vec{F} = e(\vec{v} \times \vec{B})$$

Here $\vec{v} = v_x = \hat{i}$ and $\vec{B} = B_y \hat{j}$

∴ $\vec{F} = ev_x B_y (\hat{i} \times \hat{j}) = ev_x B_y \hat{k}$

Therefore the subsequent motion of the charged particle will be a circle in the xz plane.

28. (b) : The sidereal day is about 4 min shorter than our normal solar 24-hour day, to be precise, the difference is 3 min 56 seconds.

29. (b) : For a body moving with constant acceleration a, $v = u + at$
Since the body starts from rest, $u = 0$
∴ $v = at$
which is a straight line passing through the origin. Hence the correct graph is (b).

30. (b) : As two like currents attract and unlike currents repel each other, the wire will attract the side A of the loop near the wire and parallel to it and the far side of the loop again parallel to the wire will be repelled. But the force of attraction will be more as that side of the loop is closer to the wire and so effectively the current loop will move towards the wire.

31. (d) : During the upward motion the speed of body decreases and will be zero at the highest point (since gravitational force acting downward), afterward the body start downward motion and its speed increases.

32. (c)   **33.** (d)

34. (c) : The resolving power of the eye is given by
$R = 1.22 \frac{\lambda}{b} \times D$

where λ is the wavelength of light, b is the diameter of the eye lens and D is the distance from the lens at which light is focused.
$D = 400$ km $= 400000$ m, $d = 5$ mm $= 5 \times 10^{-3}$ m
$\lambda = 500$ nm $= 500 \times 10^{-9}$ m

∴ $R = 1.22 \times \dfrac{500 \times 10^{-9} \times 4 \times 10^5}{5 \times 10^{-3}} = 48.8 \approx 50$ m.

35. (c) : Velocity of the S waves is $v_1 = 4.5$ km/s. The velocity of the P waves is $v_2 = 8.0$ km/s.
Let the time taken by the S and P waves to reach the seismograph be t_1 and t_2. It is given that
$t_1 - t_2 = 4$ min $= 4 \times 60 = 240$ sec ... (i)
Let the distance of the epicentre (km) be S. Then
$S = v_1 t_1 = v_2 t_2$

$\Rightarrow$ $4.5 \times t_1 - 8t_2 = 0 \Rightarrow t_2 = \dfrac{4.5}{8} t_1$ ... (ii)

Using (i) and (ii)

$$t_1 - t_2 = 240 \Rightarrow t_1\left(1 - \frac{4.5}{8}\right) = 240$$

$\Rightarrow$ $t_1 = \dfrac{240 \times 8}{3.5} = 548.5$ s.

∴ $S = v_1 t_1 = 4.5 \times 548.5 = 2468.6 \approx 2500$ km.

36. (a) : Initially due to the action of gravity, the lead shot will move with increasing velocity for some time. Then due to the viscosity of the glycerine column, the lead shot will attain a constant terminal velocity. As initially, there is some upthrust on the shot due to glycerine the increase of velocity will not be fully linear. So the variation is shown by plot (a).

37. (a) : If the height of the antenna is h, then the maximum distance upto which the TV transmission for a TV tower can be received is proportional to $h^{1/2}$.

Suppose that the height of the TV antena be h and the radius of the earth be R and $R >> h$. Let A be a receiving station. In the limit $h << R$, we can assume that BA is a tangent to the surface of the earth. Then $\angle BAO = 90°$ and so
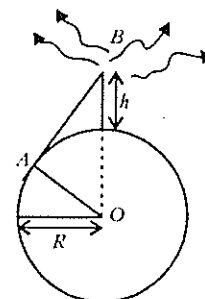$BO^2 = AB^2 + AO^2 \Rightarrow (R + h)^2 = AB^2 + R^2$
$\Rightarrow AB^2 = R^2 + h^2 + 2Rh - R^2 = 2Rh + h^2$
as $h << R$ we neglect h^2 and so
$AB^2 = 2Rh \Rightarrow AB = \sqrt{2Rh}$
∴ $AB \propto h^{1/2}$.

38. (a) : We know that the artificial frequency of a sky wave for reflection from an ionospheric layer of the atmosphere is given by, $\upsilon_c = 9n^{1/2}$

where n is the number density of electrons/m³.

It is given that $n = 10^{11}/m^3$

$\therefore \upsilon_c = 9 \times (10^{11})^{1/2} = 2.8 \times 10^6$ Hz = 2.8 MHz.

Hence the wave of frequency 2 MHz will be reflected back.

39. (c) : We know that the force per unit length of a wire carrying current due to another parallel wire carrying current is given by

$$\frac{dF}{dl} = \frac{\mu_0 i_1 i_2}{2\pi d} \Rightarrow \mu_0 = \frac{2\pi d}{i_1 i_2}\frac{dF}{dl}$$

$\therefore \quad [\mu_0] = \frac{[L]}{[A^2]}.\frac{[MLT^{-2}]}{[L]}$

or $[\mu_0] = [MLT^{-2}][A^{-2}] = [MLT^{-2}A^{-2}]$.

40. (c) : We know that the output voltage is given by,

$v_0 = v_i \times \beta \times \dfrac{R_L}{R_{BE}}$

Here, $v_i = 1$ mV, $\beta = 100$

$R_L = 10$ kΩ, $R_{BE} = 1$ kΩ

$\therefore \quad v_0 = 1 \times 10^{-3} \times 100 \times \dfrac{10}{1} = 1.0$ V.

41. (b)

42. (d) : One of the basic requirement of the existence of all planetary motions is the conservation of angular momentum. If this law is violated, then no gravitational law will be able to explain the behaviour of the planets and the satellites as they do.

43. (c) : The tube light is nothing but a gas discharge tube, which can emit light of different colours. This colour depends mainly upon the nature of the gas inside the tube and the nature of the glass. For neon gas the colour is bright red and for CO_2 it is bluish. Again the fluorescent glow looks yellowish green for soda glass. So it is the nature of the glass and the gas inside the tube which determines the colour of the fluorescent glow. As argon is filled inside a tube light, the colour of the light is white.

44. (c) : Nuclear stability depends upon the ratio of neutron to proton. If the n/p ratio is more than the critical value, then a neutron gets converted into a proton forming a β^- particle in the process.

$n \to p + e^-$
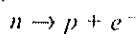
The β^- particle (e^-) is emitted from the nucleus in some radioactive transformation. So electrons do not exist in the nucleus but they result in some nuclear transformation.

45. (d) : With the increase of temperature, the average energy exchanged in a collision increases and so more valence electrons can cross the energy gap, thereby increasing the electron-hole pairs. As in a semiconductor, conduction occurs mainly through electron-hole pairs, so conductivity increases with increase of temperature. Which in turn implies that the resistivity of a semiconductor decreases with rise in temperature.

46. (d) : The dominating force in the universe is the gravitational force. Because the gravitational force of attraction exists between any two bodies in the universe. Moreover it is the weakest of all the four fundamental forces in nature.

47. (d) : Because of the gravitational pull of other planets in the solar system, the earth cannot get slowed down in rotation. Because, if it happens so, it will affect the conservation of angular momentum which is not possible.

48. (b) : According to classical physics, all moving charged particle radiate electromagnetic radiation. So moving electrons will also radiate energy. If we see the atomic structure we find that electrons revolve around the nucleus in some particular orbits. Bohr termed these orbits as the stationary orbits as the electrons do not radiate energy as long as they are moving in these orbits. This is one of Bohr's postulates. This postulate is based on the fact that if the moving electrons radiate thereby losing energy, they have got a chance to finally fall back onto the nucleus and the atom will be collapsed.

49. (a)

50. (b) : This is true that the stars are much bigger in size than the planets. But this is not the reason why the stars twinkle but the planets do not. Actually the planets do not have their own light to twinkle. As the stars have their own light, and as they are very much for away from us, the light coming from the stars has to travel a very long distance and for a very long time to arrive us. And so the light coming from the stars is found to change their intensities continuously and hence the stars are seen to be twinkling.

51. (b) : A radiation consists of a beam of charged

particles. Normally the radiation that is used for cancer treatment is a light energy radiation which when imposed upon the cancerous tissues, destroys the cancer cells.

52. (a) : A beetle's motion sends fast longitudinal and slower transverse waves along the sand's surface. The sand scorpion intercepts the longitudinal waves first and learns the direction of the beetle by noting which one of the eight legs of the scorpion is disturbed first by the pulses. Then the scorpion dashes towards the beetle to catch it.

53. (c)   **54.** (b)

55. (c) : There are two types of receptors in the eyes. One is called rods and other is cons. The rods are sensitive for dark light. As the owl has large number of cones in its retina and so the owl can move freely in the dark.

56. (c) : When we put a fire in a place, the air above the fire gets heated up. Hot air being light moves up. To fill up the gap cold air from the side of the fire rushes in. As the top of a fire is covered by hot air, it feels hotter over the top of the fire than at the same distance on the sides.

57. (c) : The amplitude of an oscillating pendulum decreases with time because of friction due to air. Frequency of simple pendulum is given by

$$f = \frac{1}{2\pi}\sqrt{\frac{g}{l}}$$

which is independent of amplitude and so even though the frequency remains the same, the amplitude keeps on decreasing till it becomes zero.

58. (d) : The quality of a communication system is determined by its information carrying capacity. The information carrying capacity is directly proportional to its bandwidth. The wider the bandwidth, the greater its information carrying capacity.

As the light frequencies used in optical fibre systems is much larger than the highest frequency microwave transmissions, so the bandwidth in case of optical communication systems is much larger than that in microwave communications. The bandwidth of the optical fibre systems is quite suitable for the present day communication needs and also for the future. That's why optical communication is preferred over microwave communication.
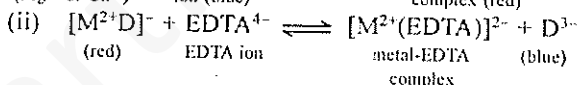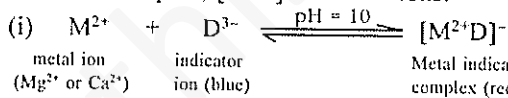
59. (b)

60. (a)

61. (a) : KO_2 is a superoxide of potassium containing superoxide ion, O_2^- which has a three electron bond.

Thus this ion can be represented as $\left[\ddot{\underset{..}{O}} \; \text{---} \; \ddot{\underset{..}{O}} \right]$.
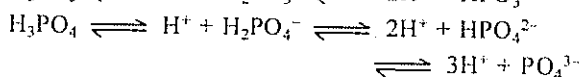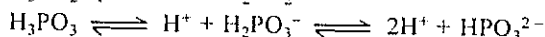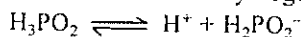
The presence of one unpaired electron in three electron bond makes this ion paramagnetic.

62. (b) : Disodium salt of ethylene diamine tetracetic acid has been used for the estimation of M^{2+} metal ions like Mg^{2+}, Ca^{2+} etc. by complexometric titrations.

In this titration, indicator ions (D^{3-} ions) form red-metal indicator complex, $[MD^-]$ with M^{2+} ions.

(i) $\underset{\substack{\text{metal ion} \\ (Mg^{2+} \text{ or } Ca^{2+})}}{M^{2+}}$ + $\underset{\substack{\text{indicator} \\ \text{ion (blue)}}}{D^{3-}}$ $\underset{}{\overset{pH = 10}{\rightleftharpoons}}$ $\underset{\substack{\text{Metal indicator} \\ \text{complex (red)}}}{[M^{2+}D]^-}$

(ii) $\underset{\text{(red)}}{[M^{2+}D]^-}$ + $\underset{\text{EDTA ion}}{EDTA^{4-}}$ $\rightleftharpoons$ $\underset{\substack{\text{metal-EDTA} \\ \text{complex}}}{[M^{2+}(EDTA)]^{2-}}$ + $\underset{\text{(blue)}}{D^{3-}}$
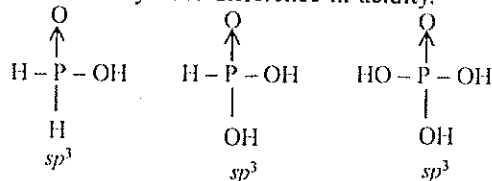
The release of the free indicator ion is marked by a change from red (colour of $[M^{2+}D]^-$ complex) to blue (colour of D^{3-} ion) colour.

63. (d) : H_3PO_2, H_3PO_3 and H_3PO_4 contain one, two and three ionisable hydrogen atoms respectively.

$H_3PO_2 \rightleftharpoons H^+ + H_2PO_2^-$

$H_3PO_3 \rightleftharpoons H^+ + H_2PO_3^- \rightleftharpoons 2H^+ + HPO_3^{2-}$

$H_3PO_4 \rightleftharpoons H^+ + H_2PO_4^- \rightleftharpoons 2H^+ + HPO_4^{2-}$
$\rightleftharpoons 3H^+ + PO_4^{3-}$
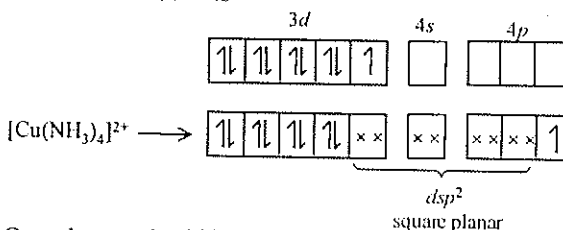
But there is very little difference in acidity.

As sp^3 hybridised, therefore all are tetrahedral.

64. (c) : $[Cu(NH_3)_4]^{2+}$
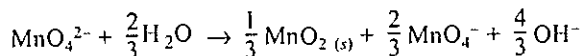$Cu^{2+} \rightarrow 3d^9 \, 4s^0$

One electron is shifted from $3d$ to $4p$ orbital.

65. (b) : Cis-$[PtCl_2(NH_3)_2]$ is used as an anti-cancer

80. (d) : More the number of attached methyl groups better is the nucleophilicity due to +I-effect.

81. (b) :
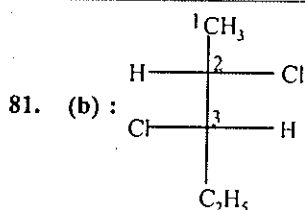
Nomenclature is according to Cahn - Ingold-Prelog method *i.e.,* priority rule.

82. (c) : One molecule of haemoglobin has 4 haeme groups, and each of them is capable of taking up one molecule of O_2; therefore, oxyhemoglobin may be depicted as $Hb(O_2)_4$.

83. (b) : Only $CH_3COOC_2H_5$ will give ethanol, C_2H_5OH after hydrolysis (which can give positive iodoform test).

$CH_3COOCH_3 \rightarrow CH_3COOH + CH_3OH$
$CH_3COOC_2H_5 \rightarrow CH_3COOH + CH_3CH_2OH$
$C_6H_5COOCH_3 \rightarrow C_6H_5COOH + CH_3OH$
$CH_3COOC_6H_5 \rightarrow CH_3COOH + C_6H_5OH$

84. (c) : 2-ethylalanine ;

 (Chiral)

2-methylglycine ;

 (Chiral)

2-hydroxymethylserine ;

 (Achiral)

tryptophan ;

 (Chiral)

85. (d) :
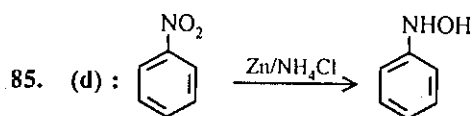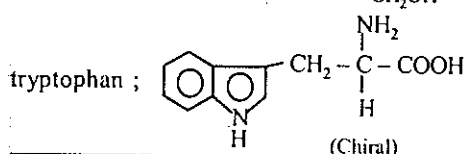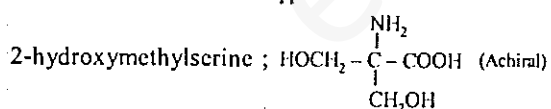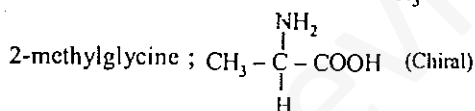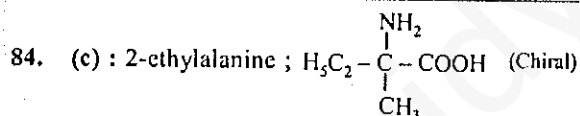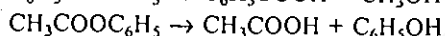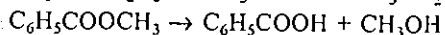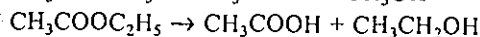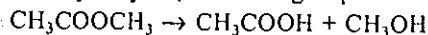
86. (c) : Hydroboration yields 1° alcohol from alkenes.

$3CH_3CH = CH_2 \xrightarrow[\text{THF}]{BH_3 \text{ in}} (CH_3CH_2CH_2)_3B$

$\xrightarrow{3H_2O_2} 3CH_3CH_2CH_2OH + H_3BO_3$
$\qquad\qquad\qquad\text{1-propanol}$
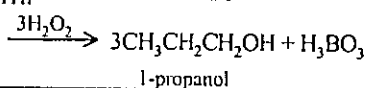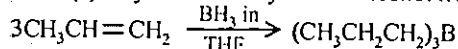
87. (b) : The values of dipole moments of methyl halides:

CH_3F - 1.51 D ; CH_3Cl - 1.56 D;
CH_3Br - 1.4 D ; CH_3I - 1.29 D
$\therefore \quad CH_3Cl > CH_3F > CH_3Br > CH_3I$.
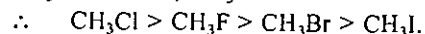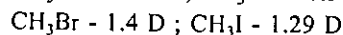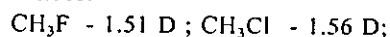
88. (b) : Na_2O has antifluorite structure. O^{2-} ions constitute a ccp lattice and Na^+ ions occupy the tetrahedral voids, each O^{2-} ion is in contact with 8 Na^+ ions and each Na^+ ion is in contact with 4 O^{2-} ions. Thus C.N. of sodium in $Na_2O = 4$.

89. (a) : Bond dissociation energy for C – H are given below in the given molecules.

$C_6H_5CH_3$ — - 85 Kcal/mol
C_6H_6 — - 110 Kcal/mol
$CH_3CH_2CH_2CH_2CH_3$ — - 98 Kcal/mol

 — - 92 Kcal/mol
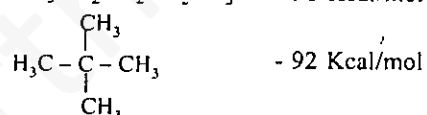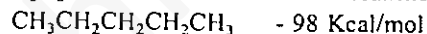
90. (d) : Heat of decomposition, $\Delta E = m \cdot s \cdot \Delta T$
$= 1 \times 1.23 \times 6.12 = 7.5276$ kJ.
Molar heat of decomposition for NH_4NO_3
$= 7.5276 \times 80 = 602.2$ kJ.

91. (d) : Boiling point of a pure solvent increases by increase in number of soluble particles present in it. So by addition of toluene, boiling point of pure benzene increases.

92. (c) : Fuel cells are galvanic cells in which chemical energy of fuels is directly converted into electrical energy. e.g., Hydrogen - oxygen fuel cell.

93. (d) : Buffer solutions can be obtained by mixing a weak acid with its salt formed with a strong base or by mixing a weak base with its salt formed with a strong acid.
As $HClO_4$ is a strong acid, therefore equimolar mixture of $HClO_4$ and its salt $KClO_4$ is not a buffer solution.

94. (c) : Here, the number of product species is greater than the number of reactant species. So it leads to positive value of entropy.

95. (c) : This quantum number describes the orientation or distribution of electron cloud.

96. (b) : To act as surfactant, there should be both polar and non-polar ends in the molecules.

97. (b) : $Al^{3+} + 3e^- \rightarrow Al$
For deposition of 1g equivalent $\equiv 96500$ C

For deposition of 1 millimole $\equiv 96.500$ C

As $Q = It \Rightarrow t = \dfrac{Q}{I} = \dfrac{96.5}{9.65} = 10$ s.

98. (b) : Acetic acid is a weak acid while sodium hydroxide is a strong base. Therefore at the equivalent point, there will be enough hydroxide ions left.

99. (d) : Carbon dioxide, water vapours and methane are all green house gases.

100. (c) : ΔH = activation energy of forward reaction – activation energy of backward reaction

$\therefore \quad \Delta H = b - a = c.$

101. (a) : Na_2CrO_4 solution in water is yellow in colour, when acidified changes to orange colour (due to the formation of $Cr_2O_7^{2-}$ ions).

$Na_2CrO_4 + H_2SO_4 \rightarrow Na_2Cr_2O_7 + Na_2SO_4 + H_2O$
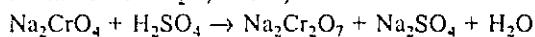
Oxidation state : Na_2CrO_4

Let oxidation state of Cr be x.

$\Rightarrow \quad 2(+1) + x + 4(-2) = 0 \Rightarrow x = +6.$

102. (c) : Due to high electronegativity of F-atoms, the lone pair of N-atom in NF_3 molecule cannot be ligated easily.
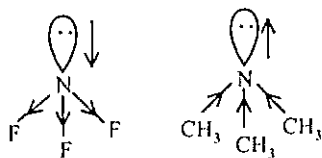
Except, nitrogen fluoride, all other halides hydrolyse in water.

$$NCl_3 + 3H_2O \rightarrow NH_3 + 3HClO.$$
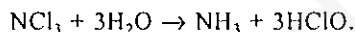
103. (d) : Due to screening effect, down the group, lower oxidation states become more stable. e.g., Pb(II) is more stable than Pb(IV). But small, highly electronegative elements like F-atoms can somewhat stabilise its higher oxidation state.

104. (d) : $_{11}Na^{22} \rightarrow _{12}Mg^{22} + _{-1}\beta^0$
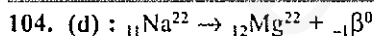
It involves β-particle emission.

While positron emission is due to the conversion of proton into neutron.

$$_1^1p \rightarrow _0^1n + _1^0\beta$$
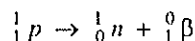
105. (a) : Ba - (Xe) $6s^2$

It shows oxidation state of +II only.

106. (c) : Haemoglobin is the oxygen carrier in the human blood. It consists of four subunits and one molecule of haemoglobin can carry 4 molecules of O_2. O_2 binds to Fe of heme part.

107. (d) : Glycosides are formed by treating glucose with CH_3OH in the presence of dry HCl gas and can be hydrolysed by strong reagents like HCN, NH_2OH and $C_6H_5NHNH_2$. Also, glycosides are known as hemi-acetals.

108. (a) :
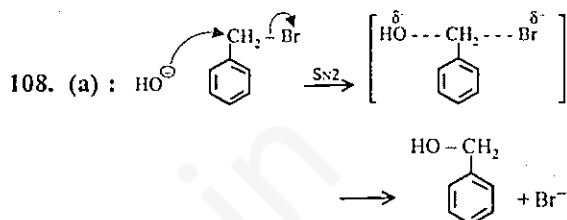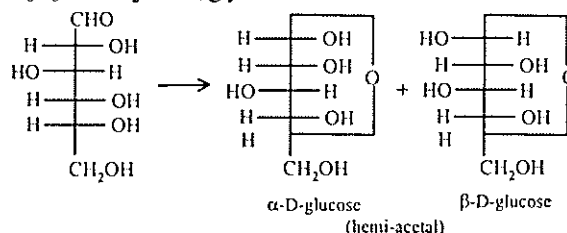
109. (b) : Enzymes are proteins which act as catalyst for bio-chemical reactions. pH affect their activity as protonation-deprotonation may cause denaturation of the protein structure. Solubility is also affected.

110. (b) : The monoalkyl derivative first formed readily undergoes further alkylation at a still greater speed to produce polysubstituted products, and alkyl halide employed may also undergo an isomeric change. Due to these difficulties alkyl benzene is not generally prepared by Friedel-Craft's alkylation of benzene.

111. (a) : Grignard reagents are very reactive. Hence the Grignard reagents will react with hydroxyl group.

112. (c) : With *trans*-2-butene, the product of Br_2 addition is optically inactive due to the formation of symmetric *meso* compounds.
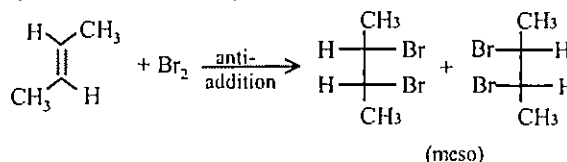
113. (d) : *Cis*-1,3-dihydroxycyclohexane exists in chair form as intramolecular H-bonding is possible only in chair form.

114. (a) : At 373 K or 100°C, the water starts boiling and at this temperature the vaporization of water is an isothermal process.

The internal energy change (ΔE), depend only on

temperature, it follows that at constant temperature, the internal energy of the gas remains constant, *i.e.* ΔE is zero.

115. (a) : $BaCO_3 + 2HNO_3 \rightarrow Ba(NO_3)_2 + H_2O + CO_2$.
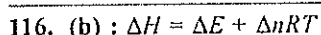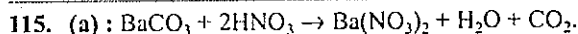
116. (b) : $\Delta H = \Delta E + \Delta n RT$
Δn = change in number of moles of products and reactant species.

$$N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)}$$

$\Delta n = 2 - 2 = 0$
$\Delta H = \Delta E + 0 \times RT$ or, $\Delta H = \Delta E$.
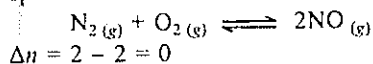
117. (b) : $NO_2 + $ U.V. light $\rightarrow NO + O$
Atomic oxygen produced as above reacts with hydrocarbons to give a variety of free hydrocarbon radicals aldehyde, ketones, O_3, peroxyacetyl nitrate (PAN) etc. PAN mixes with the fog and gets condensed on smoke or dust particles in the air to for a smog which is called photochemical smog.

118. (b) : According to Clapeyron-Clausius equation,

$$\frac{dT}{dP} = \frac{T(V_l - V_s)}{\Delta H_f}$$

Since density of ice is less than that of water, V_s is greater than V_l. In other words, the expression on the right hand side of the above equation is negative. This means that the increase of pressure must lower and decrease of pressure must raise the freezing point.

119. (b) : Micelle is formed if molecules with polar and non-polar ends assemble in bulk to give non-polar interior and polar exterior.

120. (d) : O_2F_2 has the similar structure as that of H_2O_2 but the O – O bond length is shorter in O_2F_2 than in H_2O_2. This is due to the high electronegativity of attached F-atoms.

BIOLOGY

121. (b) : The crystal of lead zirconate is a key component of electrocardiography. It is a piezoelectric material (the material which has a net dipole moment and which can produce electricity when subjected to pressure or stress), crystal or ceramic in nature. The thickness of this material is the critical factor in allowing proper vibrational frequency, most common material used is lead zirconate titanate. Electrocardiography is a commonly used, non-invasive procedure for recording electrical changes in the heart.

122. (b) : Normal blood sugar level in adult human varies from 80-100 mg/100 ml (fasting) to 100-120 mg/100 ml (after meal).
Normal blood urea is 20-40 mg/dl
Total blood volume is 4-5 litres
ESR in wintrobe method is 0-9 mm in male and 0 - 20 mm in female.

123. (d) : Gene pool is the total gene present in a population. Genome is the total genetic constitution of an organism. Codon is the basic unit of genetic code, a sequence of three adjacent nucleotide in DNA or *m*RNA that code for an amino acid. Gene is the basic unit of heredity; a sequence of DNA nucleotide that encodes a protein.
Cistron is a segment of DNA nucleotides that codes for a polypeptide chain. Triplet is a three nucleotides sequence coding for an amino acid.
Therefore,   codon $\approx$ triplet
                    cistron $\approx$ gene
DNA fingerprinting is technically called DNA profiling or DNA typing.

124. (a) : The gradually increasing contraction of ventricular muscles during systole first causes the closure of bicuspid and tricuspid valves (AV valves), producing a low-pitched "lubb" sound. Later, it causes the opening of the semilunar valves of systemic and pulmonary aorta. At the end of ventricular systole, semilunar valves shut, producing the second, louder heart sound, the "dup". Thus each heart beat is accompanied by a "lubb-dup" sound.

125. (c) : Mr. X eating curd / yoghurt should be considered as occupying third trophic level. Producers or green plants (first trophic level) are consumed by herbivore (second trophic level). And from them curd, yoghurt (made from dairy breed) is consumed by third trophic level like man.

126. (a) : World population day - 11th July
No tobacco day - 31st May
World environment day - 5th June
World health day - 7th April.

127. (b) : To measure water pollution, Biological Oxygen Demand or BOD test is made. In this test, amount of oxygen sufficient to degrade waste organic matter by bacteria in a sample is measured. The more oxygen used up by the bacteria to degrade the organic matter in the sample, the greater the BOD would be.

128. (b) : Patella is a sesamoid bone. Sesamoid bones are formed by ossification of a tendon where the tendon moves over a bony surface.

129. (c) : Both corpus luteum and macula lutea are characterised by a yellow colour. After an egg is released from the ovary, the cells that line the ovarian follicle change shape and colour to become a corpus luteum (yellow body). Macula lutea is the yellowish spot present at the posterior pole of eye. Lutein, zeaxanthin, α-carotene and β-cryptoxanthin are responsible for its yellow colouration.

130. (b) : In the process of photorespiration oxygen combines with RUBP (Ribulose-biphosphate) in chloroplast as following

$$O_2 + RUBP \xrightarrow{Rubisco} 3\text{-Phosphoglycerate} +$$

$$2\text{-Phosphoglycolate} \longrightarrow CO_2$$

Phosphoglycolate enters in peroxisomes and is finally converted to CO_2.

Overview of photorespiration

131. (d) : *Xenopsylla* or rat flea transmits the pathogen *Yersinia pestis*, responsible for plague. Like this, the sand fly *Phlebotomus* transmits the protozoa *Leishmania donovani* which is the causative agent of *Kala azar*, oriental sore etc.

132. (c) : Cholesterol is a soft waxy substance that is a natural component of the fats in the blood-stream and in all the cells of the body. In our body 8% to 10% of the saturated fatty acids are coming from animal product, such as butter, egg, red meat. Continued consumption of this type of diet leads to hypercholesterolemia due to the presence of excess amount of saturated fatty acid.

133. (d)

134. (b) : Vasopressin or ADH secreted from posterior pituitary stimulates reabsorption of water by the distal convoluted tubule and the collecting renal tubules and thus regulates urine volume. It has no such important effect on glucose metabolism. Therefore, a person whose blood glucose level is normal, but passes much urine and drinks much water has a reduction in vasopressin secretion which ultimately leads to diabetes insipidus.

135. (a) : tRNA has four recognition sites among these one is the amino acid attachment site. It has the amino acid attachment site with the 3′ terminal - CCA sequence.

Recognition sites on t RNA

136. (a) : An example of competitive inhibition of an enzyme is the inhibition of succinic dehydrogenase by malonic acid. It is the simple type of competitive inhibition. A competitive inhibitor resembles the substrate and binds to the active site of the enzyme. The substrate is then prevented from binding to the same active site.

Competitive inhibitor

137. (b) : The association between fungi and algae in lichen is regarded as the true mutual relationship, in which both the partners are benefitted. In lichen, fungus lives on the algae which manufactures food by virtue of the chlorophyll present in its cells, while the algae enjoys the protection afforded by the fungal envelope, to live in very dry conditions.

138. (a) : Photochemical smog mainly consists of ozone, peroxyacetyl nitrate and different oxide of nitrogen and hydrocarbons released from different engines. Nitric oxide (NO) is formed by reaction between oxygen and nitrogen. This reacts with air forming nitrogen dioxide (NO_2). This gas absorbs light due to which nitric oxide (NO) and a molecule of nascent oxygen [O] are formed.

$$NO_2 \longrightarrow NO + [O]$$
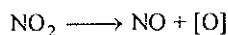
This atomic oxygen reacts with unburnt hydrocarbons to give rise to peroxy radicals which after reaction with oxygen form ozone or reacting with NO_2 give rise to peroxyacetyl nitrate (PAN).

139. (a) : In almost all Indian metropolitan cities like Delhi, the major atmospheric pollutants are SO_2, NO_2 and particulate matter in which the SPM (Suspended Particulate Matter) in Delhi's air exceeds the permitted levels by over 100%.

140. (b) : Excessive stimulation of vagus nerve in humans may lead to peptic ulcer. Vagal stimulation increases peristalsis which in excess, secretes more HCl and pepsin from stomach. These causes erosion through protective barrier of mucus and muscularis mucosa into the submucosa which leads to peptic ulcer.

141. (a) : Restriction enzymes are endonucleases which cleave DNA at specific sites. They are originally extracted from the bacterium *E.coli*. Type I restriction enzymes bind to a recognition site of a duplex DNA and cleave one strand only. Type II restriction enzymes are more valuable in gene manipulation and cleave the duplex at specific target sites at or near the binding site.

142. (a) : The wild ass, once widely distributed in north-western arid zone; now confined to Runn of Kutchchh and Pakistan.

143. (d) : Replication takes place discontinuously and short pieces called okazaki fragments are synthesized. One strand may synthesize a continuous strand and the other okazaki fragments, or both strands may

DNA replication
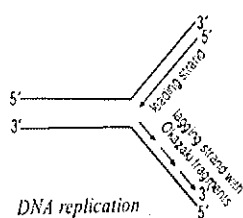
synthesize okazaki fragments. Both new strands are synthesized in 5'-3' direction. Thus one strand is synthesized forwards and the other backwards.

144. (a) : UGU codes for the same information as UGC as both codes for cystine. UGA and UAG are non-sense codons and UGG codes for tryptophan.

145. (c) : As the person uses spectacles having concave lens, he must be suffering from myopia or short-sightedness. Here the eyeballs become elongated, so that parallel rays are focussed in front of retina.

Myopia - correction by concave lens (Wintom & Bayliss)
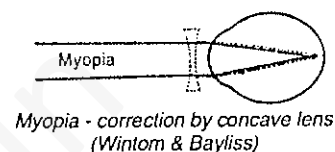
146. (b)

147. (b) : The phase of menstrual cycle in humans that last for 7-8 days is ovulatory phase. During this phase production of FSH decreases while that of LH increases which leads to ovulation on about the 14th day. But it may range from 9th to 16th day (approximately).

148. (d) : The source of somatostatin is same that of vasopressin and oxytocin. Somatostatin is produced from hypothalamus (somatostatin neuron) and oxytocin and vasopressin are also produced in the nuclei of hypothalamus, though later they are stored and released from posterior pituitary.
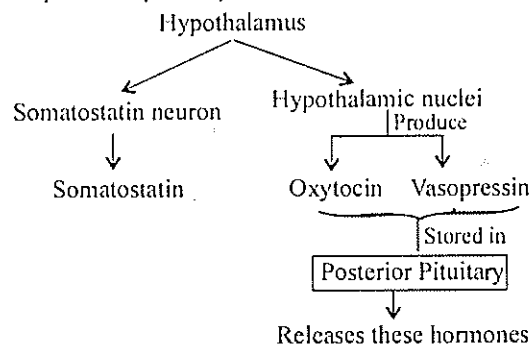
149. (b) : *Spirulina* is a blue-green algae. *Spirulina platensis* is one of the richest source of protein, containing 40-50 percent crude protein on dry weight basis which under favourable condition may reach upto 70 percent. Its protein has balanced composition containing all essential amino-acids and lysine and tryptophan being present in sufficient quantities. *Spirulina* is also rich in vitamins, particularly Vit. B_{12}, which is not common in plant products and contains considerable amounts of

fats, carbohydrates and minerals. It's lipids are made up of unsaturated fatty acids that do not form cholesterol.

150. (a) : Viroids are a group of pathogens of some higher plants that are smaller or simpler than any of the known virus. They consist of single stranded linear or circular RNA molecules without a protein coat.

151. (c) :
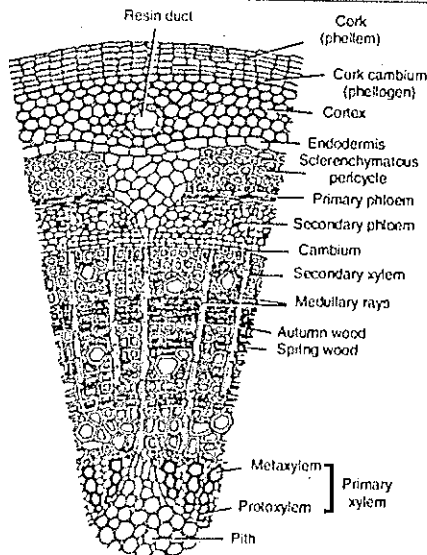
A portion of T.S. of typical dicot stem with secondary growth

152. (d) : Hill reaction is the light phase or photochemical phase of photosynthesis which consists of light driven splitting of water or photolysis, evolution of oxygen and synthesis of assimilatry power (ATP and NADPH). An enzyme complex, Mn, Cl and ferricyanides are required for this reaction. An overview of hill reaction is as
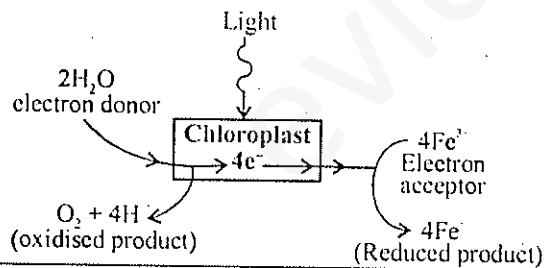
153. (b) : Mycorrhiza is an example of mutualism. It is an association between a fungus and the root of a higher plant. eg., Pine, Birch. The fungus obtains shelter and food from root and helps the root in absorption of water, dissolution and absorption of inorganic nutrients locked in organic matter (especially nitrogen and phosphorus) and protection from other fungi.

154. (c) : Exine is outer layer of pollen grain which is acetolysis resistant layer. It is also resistant to physical and biological degradation. Because of this property of exine, pollen grains are found well preserved for long periods in fossil deposits.

**155. (b) :** The most common form of red-green colour blindness is an 'X chromosome linked recessive' disorder. The 'red' and 'green' genes are known to reside at the tip of the long arm of the X chromosome. Women have two copies of the X-chromosome, and so they may have normal colour vision, even if they carry one copy of the defective gene. Men have only one X-chromosome, and so will be colour blind.

156. (d) : During the embryonic development in humans, cleavage division results in a hollow ball of cells called morula. Solid mass of 32 cells formed from zygote after successive mitotic division (after 3rd division of cleavage) is called morula.

157. (d) : A characteristic of most plant cells is the presence of cytoplasmic material that establish continuity between adjacent cells. These bridges are called plasmodesmata. These permit the free circulation of fluid, which is essential to the maintenance of plant cell toxicity.
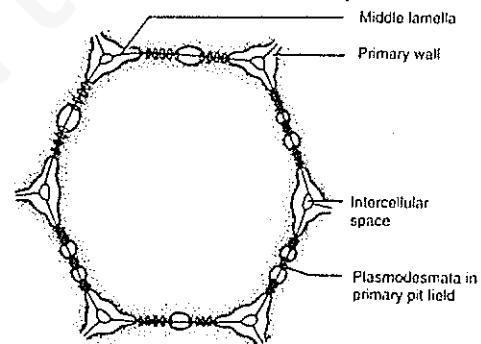
Parenchyma cell with pit fields and plasmodesmata

158. (c) : A zone of inactive cells is present in the central part of the root apex called quiscent centre. It is a hemispherical region of inactive cells present in

Root apex organization according to quiescent centre concept

between the root cap and the active meristematic region of root apex. This zone contains several hundred cells

which are characterized by having lower concentration of DNA, RNA and protein. The quiescent centre acts as reservoir of cells and becomes active whenever the previously active initials get damaged or during the establishment of the secondary roots.

159. (c) : *Azolla* is a pteridophyte and used as a biofertilizer because it has association with nitrogen-fixing cyanobacteria *Anabaena azollae.*

160. (d)

161. (a) : Mast cells act on body's defense mechanism. When some allergens like different pollutants, smog, smoke, pollen grains etc. come in contact with mast cell, they stimulate the mast cells. The allergic reaction is triggered by cross linking of IgE molecules on the surface of mast cells by allergen. And ultimately mast cells release excessive amounts of inflammatory chemicals which cause allergic reactions.

162. (b) : The direct application of fertilizers to crop or soils is a simple route to increase crop yield.
Average yield per hectare has increased from 1.1 tons in 1950 to 2.3 tons in 1986 by the use of inorganic fertilizers. Irrigation is very important in increasing crop productivity as water is an essential component of vital activities of a plant.

163. (c) : The basal metabolic rate is defined as the energy requirement of the human body at rest and reflects the caloric needs of the body. BMR can be determined by total body weight and the amount of muscle mass. BMR is inversely related with the weight or volume of an organism, i.e. smaller the organism, higher is the basal metabolic rate and vice versa.
Heart rate of six month old baby is 110-112 beats/min. Though it is higher than normal adult person, but it is lower than the old person. At the age of 60, a man may have maximum heart rate of 160 beats/min (avg 120 beats/min.)

164. (b) : Bats and whales are classified as mammal because they possess the essential mammalian characteristics like presence of milk gland or mammae, presence of pinnae, viviparous nature, hairs on body, presence of diaphragm etc. Though bats and whales have four chambered heart, it cannot be considered as the main characteristic of being mammals because it is also present in some reptiles (e.g. crocodile) and all birds.

165. (b) : SARS, a severe acute type of 'Atypically

atypical pneumonia' caused by metapneumo virus (a type of corona virus) was first reported (WHO) in China (Beijing, Guangdong, HongKong, Taiwan etc.) Though China is the most populated country of the world, it is not directly responsible for the origin of SARS. The killer pneumonia virus is responsible for SARS origin.

166. (c) : Organochlorine pesticides are organic compounds or hydrocarbons to which are added several atoms of chlorine through the process called chlorination. Rate of degradation of organochlorines is very low. eg.; DDT, BHC.
Fenitrothion is organophosphate pesticide which is the organic ester of phosphoric acid and its derivatives. These pesticides are very toxic but are not persistant.

167. (c) : In holoblastic cleavage, the cleavage furrows bisect the entire egg, or in other words, entire egg divides by each cleavage furrow. In placental mammals having isolecithal or microlecithal egg, the holoblastic cleavage produces blastomeres of equal or approximately equal size.
Centrolecithal eggs are found in insects and in some hydrozoa. Here, yolk is concentrated at the centre of egg and the cytoplasm is present surrounding it. Meroblastic cleavage occurs in them.

168. (b) : Inhabitants close to very busy airports are likely to experience health hazards. Because maximum acceptable range of sound is 80-90 dB. But in the places like airports this level is always exceeds thus it creates sound pollution and related health hazards like auditory fatigue, deafness etc.
Jet planes generally produce sound above 160 dB which is much more than normal level, thus they also produce sound pollution. But as jet aeroplanes are used for some special purposes, they normally do not land in common (very busy) airports (without emergency). Thus it has no direct relation in causing sound pollution and related hazards in areas nearby very busy airports.

169. (c) : Koel and cuckoo need not build nests because they transfer their responsibilities to build nests, incubate eggs and nurture hatchlings to other birds specially crows. Thus they are called as "brood parasites". Being the brood parasite of the crow, the koel's breeding cycle synchronizes with that of crow. Both the koel's and crow's eggs are grey-green with rusty brown markings. Tailor bird is a garden bird which makes its nest by sewing, it has no direct relation with koel and cuckoo.

170. (c) : Old age is the result of ageing or senescence which may be defined as the progressive deterioration in structure and function of the body cells, tissues, organs and organ systems of the organism with their advancing age. Here, the body's immune system loses its ability to effectively deal with the antigens. This reduces the resistance as well as adaptation of the body. Cessation of mitosis is not as such a genetically programmed event. During ageing, there is a decrease in multiplication of cells, though it differs in various tissues.

171. (a) : The structure of cell membrane can be described by the fluid-mosaic model. The essential feature of fluid-mosaic model (by Singer and Nicolson, 1972) is that cell membranes are considered to be quasifluid structures in which the lipids and proteins are in mosaic manner. The Singer-Nicolson model considered the lipid-protein association (mosaic) to be hydrophobic. The fluidity of the membrane is the result of this hydrophobic interaction, thus a cell membrane shows fluid behaviour.
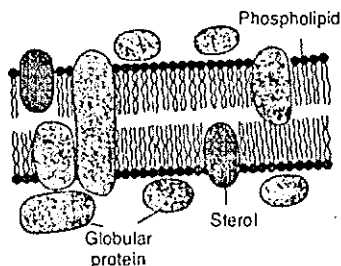
Schematic representation of a section through a eukaryote fluid mosaic membrane

172. (a) : Any viable somatic cell of a plant has the ability to form full fledged plants. This ability of plant cell is known as cellular totipotency.

173. (c) : Anthocyanin is a colouring pigment of certain higher plants that imparts a bluish or reddish colour. Rhoeo leaves contain anthocyanin pigments in epdiermal cells.

174. (b) : The apoplast is the system of adjacent cell walls which is continuous through the plant. As water evaporates from the mesophyll cell walls into the intercellular air spaces, tension develops in the continuous stream of water in the apoplast, and water is drawn through the walls in a mass flow by the cohesion of water molecules. When water moving through spaces in the cell wall reaches the endodermis, it's progress is stopped by a waterproof substance called suberin which is deposited in cell walls in the form of bands called casparian strips. Therefore water and solutes must pass through the cell surface membrane and into the cytoplasm of the cells of the endodermis.
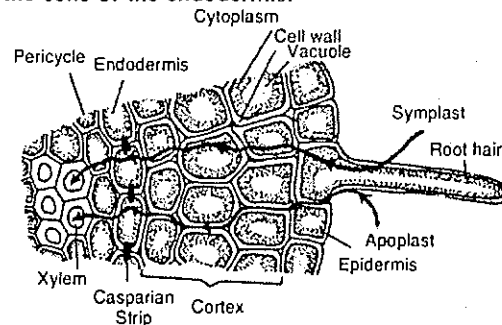
Diagram showing symplast and apoplast pathwaty of water moment in root.

175. (a) : The main function of sieve tube is the transport of food products from green and storage organs of the plant to other organs of the plant. The sieve elements are sieve tubes arranged one above the other and have sieve plates (oblique or transverse perforated septa) on their end walls. The cytoplasm occur in the form of a thin living layer along the inner side of cellulose wall. The nucleus disappears in mature sieve elements.

176. (b) : Some trees of hill like oak, ash, elm, hickory, pecan and mountain cedar produce allergic pollen grains which cause allergy to people. The signs and symptoms of pollen allergy are
-   sneezing
-   itching eyes, nose and throat
-   dark circles under the eyes caused by restricted blood flow near the sinuses
-   watering eyes
-   conjunctivities

Conifer trees produce a large quantity of wind borne pollen grains because many pollen grains are destroyed in the process of pollination done by wind.

177. (c) : Yeast such as *Saccharomyces cerevisiae* is used in baking industry. The yeast ferments glucose to yield ethyl alcohol and carbon dioxide. This carbon dioxide is used in baking industry for raising dough. Kneading, stretching and folding of the dough develops the protein structure to improve its elastic properties and its ability to hold gas. This improved gluten properties enable better retention of the gases within the dough as the structure expands and the cell walls become thinner.

178. (a) : In a food chain the number of animals and biomass at the lower trophic level is abundant. Successive links of carnivores decrease rapidly in number until there are very few carnivores at the top.

179. (c) : Tropical rain are disappearing fast from developing countries such as India. Forest lands are converting into agricultural and industrial lands to fulfil the requirements of increasing population. Tropical rain forests are rich in biodiversity.

180. (a) :

(A) Walking leaf insect (*phyllium*) showing resemblance with a green leaf (an example of concealing mimicry). (B) Caterpillar of geometrid moth showing resemblance to a twig.

Mimicry is a process by which two or more organisms independently derive protection from predation. This may be done by acquiring body colour blending with the surrounding or sometimes they bring resemblance to a distasteful, poisonous or harmful organisms. Leaf butterfly and stick insect show the colour of leaf, stem etc. by which they can dodge their enemies and predator.

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

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