

# SOLUTIONS

## PHYSICS

1. (a) : Debye is the unit of electric dipole moment. Therefore length cannot be measured by debye.
2. (a) : Torque,  $\tau = \text{force} \times \text{distance}$ .  
Therefore dimension of torque = dimensions of force  $\times$  dimensions of distance =  $[MLT^{-2}] [L] = [ML^2T^{-2}]$ .
3. (a) : Vector  $\vec{P} = a\hat{i} + a\hat{j} + 3\hat{k}$   
and vector  $\vec{Q} = a\hat{i} - 2\hat{j} - \hat{k}$ .  
If two vectors are perpendicular to each other, then  
 $\vec{P} \cdot \vec{Q} = 0$  or  $(a\hat{i} + a\hat{j} + 3\hat{k}) \cdot (a\hat{i} - 2\hat{j} - \hat{k}) = 0$   
or  $a^2 - 2a - 3 = 0$ .  
Solving this quadratic equation, we get  $a = 3$  or  $-1$ . Therefore positive value of  $a$  is 3.
4. (b) : As the speed of an object, falling freely under gravity, depends only upon its height from which it is allowed to fall and not upon its mass. Since the paths are frictionless and all the objects are falling through the same vertical height, therefore their speeds on reaching the ground must be same. Or ratio of their speeds = 1 : 1 : 1.
5. (b) : Initial velocity ( $u$ ) = 0,  
Acceleration ( $a_1$ ) =  $2 \text{ m/s}^2$  and time during acceleration ( $t_1$ ) = 10 sec.  
Time during constant velocity ( $t_2$ ) = 30 sec and retardation ( $a$ ) =  $-4 \text{ m/s}^2$  (-ve sign due to retardation).  
Distance covered by the particle during acceleration,  
$$s_1 = ut_1 + \frac{1}{2}a_1t_1^2 = (0 \times 10) + \frac{1}{2} \times 2 \times (10)^2$$
$$= 100 \text{ m} \quad \dots (i)$$
  
And velocity of the particle at the end of acceleration,  
 $v = u + a_1t_1 = 0 + (2 \times 10) = 20 \text{ m/s}$ .  
Therefore distance covered by the particle during constant velocity ( $s_2$ ) =  $v \times t_2$   
$$= 20 \times 30 = 600 \text{ m} \quad \dots (ii)$$
  
Relation for the distance covered by the particle during retardation ( $s_3$ ) is  $v^2 = u^2 + 2a_2s_3$   
or,  $(0)^2 = (20)^2 + 2 \times (-4) \times s_3 = 400 - 8s_3$   
or,  $s_3 = 400/8 = 50 \text{ m} \quad \dots (iii)$   
Therefore total distance covered by the particle

$$s = s_1 + s_2 + s_3 = 100 + 600 + 50 = 750 \text{ m}.$$

6. (b) : From Hubble law, speed of a galaxy ( $v$ ) =  $Hr$  (where  $H$  = Hubble constant and  $r$  is its distance from earth). Thus Hubble's law is related with the speed of the galaxy.
7. (b) : At 0 K temperature, a pure semiconductor behaves as an insulator, because it has a few holes in its valence band. But there is no free electron in this state.
8. (a) : The depletion layer is the region at the junction of a diode which is devoid of ions. Therefore the potential barrier in the depletion layer is due to ions.
9. (a) : Wavelength ( $\lambda$ ) =  $10^{-10} \text{ m}$ .  
Velocity of the electron,  $v = h/m\lambda$

$$= \frac{6.6 \times 10^{-34}}{(9.1 \times 10^{-31})(10^{-10})} = 7.25 \times 10^6 \text{ m/s}.$$

where  $m$  = mass of electron equal to  $9.1 \times 10^{-31} \text{ kg}$  and  $h$  is Planck constant equal to  $6.6 \times 10^{-34} \text{ J-s}$ .

10. (b) : Charge on electron =  $e$   
Mass of electron =  $m$  and intensity of uniform electric field =  $E$ .  
Acceleration of the electron,  
$$a = \frac{\text{Force on the electron}}{\text{Mass of electron}}$$
$$= \frac{\text{Electric charge} \times \text{electric field}}{\text{Mass of electron}} = \frac{eE}{m}$$

11. (c) : Capacitance of capacitors  $C_1, C_3, C_4, C_5 = 4 \mu\text{F}$  each and capacitance of capacitor  $C_2 = 10 \mu\text{F}$ . If a battery is applied across  $A$  and  $B$ , the points  $b$  and  $c$  will be at the same potential (since  $C_1 = C_4 = C_3 = C_5 = 4 \mu\text{F}$ ). Therefore no charge flows through  $C_2$ . We have the capacitors  $C_1$  and  $C_5$  in series. Therefore their equivalent capacitance,

$$C' = \frac{C_1 \times C_5}{C_1 + C_5} = \frac{4 \times 4}{4 + 4} = 2 \mu\text{F}.$$

Similarly,  $C_4$  and  $C_3$  are in series. Therefore their equivalent capacitance,

$$C'' = \frac{C_3 \times C_4}{C_3 + C_4} = \frac{4 \times 4}{4 + 4} = 2 \mu\text{F}.$$

Now  $C'$  and  $C''$  are in parallel. Therefore effective capacitance between  $A$  and  $B$

$$= C' + C'' = 2 + 2 = 4 \mu\text{F}.$$

12. (d) : Actual power of bulb ( $P_1$ ) = 40 W

Actual voltage of bulb ( $V_1$ ) = 200 V and

supply voltage ( $V_2$ ) = 100 V.

$$\text{Power } (P) = \frac{V^2}{R} \propto V^2. \text{ Therefore } \frac{P_1}{P_2} = \frac{V_1^2}{V_2^2}$$

$$\text{or, } \frac{40}{P_2} = \frac{(200)^2}{(100)^2} = 4 \text{ or } P_2 = \frac{40}{4} = 10 \text{ W}$$

(where  $P_2$  = power when voltage is 100 V).

13. (c) : Angle through which magnet is deflected ( $\theta$ ) =  $30^\circ$  and horizontal magnetic field ( $B_H$ ) =  $0.34 \times 10^{-4}$  T.

$$\text{Magnetic intensity} = B_H \tan \theta = 0.34 \times 10^{-4} \times \tan 30^\circ \\ = (0.34 \times 10^{-4}) \times 0.577 = 1.96 \times 10^{-5} \text{ T}.$$

14. (a) : Change in magnetic flux ( $\phi$ ) =  $2 \times 10^{-2}$  Wb and change in current ( $I$ ) = 0.01 A.

Change in magnetic flux,  $\phi = 2 \times 10^{-2} = MI$

$$= M \times 0.01 \text{ or } M = \frac{2 \times 10^{-2}}{0.01} = 2 \text{ H}$$

(where  $M$  = coefficient of mutual inductance).

15. (d) : Light propagates rectilinearly. But it can take a slight turn at obstacles. This property of light is due to its wave nature.

16. (d) : Total internal reflection can occur only when a ray is incident on the surface of a medium whose refractive index is smaller than that of the medium in which the ray is travelling. Since the refractive index of air is 1.00029 and that of diamond is 2.42, therefore brilliance of diamond is due to total internal reflection.

17. (d) : Relation for velocity of light ( $c$ ) =  $\sqrt{\frac{1}{\epsilon_0 \mu_0}}$

(where  $\epsilon_0$  = permittivity constant equal to  $8.85 \times 10^{-12}$  F/m and  $\mu_0$  = permeability constant equal to  $1.26 \times 10^{-6}$  H/m.

$$\text{Numerically velocity of light } (c) = \sqrt{\frac{1}{\epsilon_0 \mu_0}} \\ = \sqrt{\frac{1}{(8.85 \times 10^{-12}) \times (1.26 \times 10^{-6})}} \approx 3 \times 10^8 \text{ m/s}.$$

18. (a) : The Cauchy's dispersion formula represents the dispersion of most of the substances with considerable accuracy. Also from the Cauchy's dispersion formula if  $n$  is refractive index and  $A$ ,  $B$  and  $C$  are constants, then  $n = A + B\lambda^{-2} + C\lambda^{-4}$ .

19. (b) : When a ray of light falls on sea shell, then its small amount first gets refracted (slightly polarised) and then almost gets reflected back (fully polarised). That is why, view of sea shell is golden due to polarisation.

20. (b) : At the uppermost point of a projectile, the vertical component of the velocity of projection becomes zero, while the horizontal component remains constant. And the acceleration (due to gravity) is always vertically downwards. Therefore at the uppermost point of a projectile, its velocity and acceleration are at an angle of  $90^\circ$ .

21. (c) : Initial kinetic energy ( $E_1$ ) =  $E$  and final kinetic energy ( $E_2$ ) =  $4E$ .

Kinetic energy of a body is  $\frac{1}{2}mv^2$

Since the value of  $m$  remains constant, therefore for the kinetic energy to be 4 times, the new value of velocity ( $v$ ) should be 2 times the initial value.

Initial linear momentum ( $p_1$ ) =  $mv$ .

$$\text{Therefore new linear momentum } (p_2) = m \times 2v \\ = 2mv = 2p_1.$$

22. (d) : When the net external torque acting on a system is zero, the total angular momentum of the system remains constant. Therefore the angular momentum of a moving body remains constant if net external torque is not applied.

23. (b) : Earth behaves as a huge magnet and has a tendency to attract all the objects due to gravitational force. Therefore gravitational force is a conservative force.

24. (d) : Kepler's second law states that the line between a planet and the sun sweeps out equal areas in equal times. Kepler's second law is based on law of conservation of angular momentum.

25. (b) : Radius of conducting sphere ( $R_1$ ) = 10 cm charge on the conducting sphere = 10  $\mu\text{C}$  and radius of uncharged sphere ( $R_2$ ) = 20 cm For a spherical conductor, the density of charge is proportional to its radius. Therefore ratio of density of charges of the spheres will be 1 : 2.

26. (d) : If the waves interfere destructively, then path difference is given by  $\frac{\lambda}{2}, \frac{3\lambda}{2}, \frac{5\lambda}{2}$  etc.

Therefore path difference of a destructive interference

is  $\frac{(2n+1)\lambda}{2}$  (where  $n = 1, 2, 3, \dots$ ) etc.

27. (a) : Frequency of siren ( $\nu$ ) = 800 Hz

Speed of siren ( $\nu_s$ ) =  $\nu - \nu_0 = 30$  m/s

Velocity of listener ( $\nu_0$ ) = 0 and velocity of sound ( $\nu$ ) = 330 m/s.

From the Doppler's law, frequency heard from siren when it is going away from a listener is

$$= \left( \frac{\nu - \nu_0}{\nu + \nu_s} \right) \times \nu = \left( \frac{330 - 0}{330 + 30} \right) \times 800 = 733.3 \text{ Hz.}$$

28. (b) : Initial length of string ( $l_1$ ) = 50 cm = 0.5 m

Initial fundamental frequency ( $n_1$ ) = 800 Hz and

final frequency ( $n_2$ ) = 1000 Hz.

Frequency of vibration of the string,  $n = \frac{1}{2l} \sqrt{\frac{T}{m}} \propto \frac{1}{l}$

$$\therefore \frac{n_1}{n_2} = \frac{l_2}{l_1} \quad \text{or} \quad l_2 = \frac{n_1 \times l_1}{n_2} = \frac{800 \times 50}{1000} = 40 \text{ cm.}$$

(where  $l_2$  = final length of the string).

29. (c) : Equation of sound wave is

$$y = 0.0015 \sin(62.4x + 316t).$$

Standard equation of a sound wave is

$$y = A \sin 2\pi \left[ \frac{x}{\lambda} + \frac{t}{T} \right].$$

Comparing the given equation with the standard equation, we get

$$2\pi/\lambda = 62.4 \quad \text{or} \quad \lambda = \frac{2\pi}{62.4} = 0.1 \text{ unit.}$$

(where  $\lambda$  = wavelength of the wave)

30. (a) : Wave number,  $\bar{\nu} = \frac{1}{\text{Angular frequency } (\omega)}$

The graph between wave number ( $\bar{\nu}$ ) and angular frequency ( $\omega$ ) is a straight line which always satisfies the equation  $y = mx + c$ , where  $m$  is slope of the line but not equal to zero. Therefore graph is a straight line as shown in option (a).

31. (c) : Orbital velocity of satellite =  $\nu_0$  and escape velocity from the earth =  $\nu_e$ .

We have orbital velocity ( $\nu_0$ ) =  $\sqrt{gR}$

and escape velocity ( $\nu_e$ ) =  $\sqrt{2gR}$

Therefore ratio of orbital velocity to escape velocity

$$\frac{\nu_0}{\nu_e} = \frac{\sqrt{gR}}{\sqrt{2gR}} = \frac{1}{\sqrt{2}} \quad \text{or} \quad \nu_e = \sqrt{2}\nu_0.$$

32. (b) : The stress at which rupture occurs in a material is called its breaking stress. It depends on the material of the wire.

33. (a) : Initial temperature ( $T_1$ ) = 0°C

Initial density ( $\rho_1$ ) = 10 g/cc

Final temperature ( $T_2$ ) = 100°C and

Final density ( $\rho_2$ ) = 9.7 g/cc.

Coefficient of volumetric expansion ( $\alpha_v$ ) =  $\frac{\Delta\rho}{\rho_1 \times \Delta T}$

$$= \frac{\rho_1 - \rho_2}{\rho_1(T_2 - T_1)} = \frac{10 - 9.7}{10(100 - 0)} = \frac{0.3}{1000} = 3 \times 10^{-4}.$$

Therefore coefficient of linear expansion,

$$\alpha_1 = \frac{\alpha_v}{3} = \frac{3 \times 10^{-4}}{3} = 10^{-4}.$$

34. (d) : A scent sprayer is an example of fall in pressure due to increase in velocity. Also as per Bernoulli's theorem that datum head, pressure head and velocity head of a flowing liquid is constant. Therefore scent sprayer is based on Bernoulli's theorem.

35. (d) : Wien's displacement law states that the absolute temperature of a black body and the peak wavelength of its radiations are inversely proportional. i.e.  $\lambda \propto 1/T$  or  $\lambda T = \text{constant}$ .

36. (d) : Temperature of a black body ( $T$ ) = 300 K. Stefan's law of radiation states that energy emitted by the black body ( $E$ )  $\propto T^4 \propto (300)^4$ .

37. (b) : Latent heat of vapourisation of water ( $L$ ) = 2240 J, mass of the water ( $m$ ) = 1 g and work done ( $dW$ ) = 168 J.

From first law of thermodynamics, heat supplied in vapourisation ( $dQ$ ) =  $mL = dU + dW$

$$\text{or} \quad 1 \times 2240 = dU + 168$$

$$\text{or} \quad dU = 2240 - 168 = 2072 \text{ J}$$

(where  $dU$  = increase in internal energy).

38. (c) : Velocity of sound in the gas of density  $\rho_1$  is  $\nu_1$  and velocity of sound in the gas of density  $\rho_2$  is  $\nu_2$ .

Velocity of sound in gas,  $\nu = \sqrt{\frac{\gamma P}{\rho}} \propto \sqrt{\frac{1}{\rho}}$ .

$$\text{Therefore} \quad \frac{\nu_1}{\nu_2} = \sqrt{\frac{\rho_2}{\rho_1}} = \sqrt{\frac{1}{4}} = \frac{1}{2}.$$

39. (d) : The property utilized in the manufacture of lead shots is surface tension of liquid lead. In this process, molten lead is made to pass through a sieve from a high tower and allowed to fall in water. The molten lead particles, while descending, assume a spherical shape and solidify in this form, before falling into water.

40. (a) : Initial radius of wire,  $r_1 = r$  and final radius of wire,  $r_2 = r/2 = 0.5r$ .

Since volume of the wire after stretch remains constant, therefore  $l_1 A_1 = l_2 A_2$

$$\text{or } \frac{l_1}{l_2} = \frac{A_2}{A_1} = \frac{r_2^2}{r_1^2} = \left(\frac{0.5r}{r}\right)^2 = \frac{1}{4}.$$

The resistance ( $R$ ) =  $\rho \frac{l}{A} \propto \frac{l}{A}$ .

$$\text{Therefore } \frac{R_1}{R_2} = \frac{l_1}{l_2} \times \frac{A_2}{A_1} = \frac{1}{4} \times \frac{1}{4} = \frac{1}{16}$$

$$\text{or } R_2 = 16R_1 = 16R.$$

41. (b) : A heavenly body revolving round the sun is called a planet and there are nine planets in our solar system. A heavenly body, made of gaseous material and luminous due to its own energy, is called a star. The sun is also a star and is nearest to earth.

42. (a) : The coloured spectrum is due to diffraction of white light on passing through fine slits made by fine threads in the muslin cloth.

43. (c) : The waves diffracted from the edges of circular obstacle, placed in the path of light, interfere constructively at the centre of the shadow resulting in the formation of a bright spot.

$$44. (c) : \text{Induced e.m.f. } (\epsilon) = \frac{L di}{dt}$$

$$\text{and current } (i) = \frac{\epsilon}{R} = \frac{1}{R} \times \frac{L di}{dt}$$

$$\text{or, } \frac{L}{R} = \frac{idt}{di} = \frac{\text{current} \times \text{time}}{\text{current}} = \text{time.}$$

In order to increase the rate of increase of current through a solenoid, we increase the time constant ( $L/R$ ). Since  $L$  of the given solenoid is constant, therefore we use a high resistance in series with it.

45. (d) : In a battery circuit, the point of lowest potential is the negative terminal of the battery. And the current flows from higher potential to lower potential.

46. (b) : A step-down transformer converts electrical energy from a high voltage to one at a low voltage. Accordingly the current in the secondary will be larger than that in the primary. In order to produce less heat in the secondary, we use a wire of lesser resistance i.e. thick wire. We also know that when the plane of the armature is parallel to the lines of force of magnetic field, the rate of change of magnetic flux linked with it is maximum. Therefore the e.m.f. induced in the armature in this orientation is maximum.

47. (d) : Magnetic poles always exist in pairs. However, one can imagine magnetic field configuration with three poles. When north poles of two magnets or south poles of two magnets are glued together, they provide a three pole field configuration. Also a bar magnet does not exert a torque on itself due to its own field.

48. (c) : The beautiful colours are seen on account of interference of light reflected from the upper and the lower surfaces of the thin film. As conditions for constructive and destructive interference depend upon the wavelength of light, therefore coloured interference fringes are observed.

49. (b) : A quasar is a very big source of radio waves and its size is very small as compared to the size of a galaxy. A radio galaxy emits radio waves which lie in the range  $10^{30}$  to  $10^{38}$  watt. A quasar emits radio waves which lie in the range of  $10^{37}$  to  $10^{38}$  watt.

50. (b) : A coherent system means a system based on a certain set of basic units from which all derived units are obtained by multiplication or division without introducing numerical factors. In S.I. system of units, heat energy, electric energy and mechanical energy are measured in joule (J). But in C.G.S. system, they have different units.

51. (a) : When brakes are on, there is no rolling of the wheels and the wheels slide. The sliding friction is greater than the rolling friction. Thus it is difficult to move a cycle along the road with its breaks on.

52. (c) : Faraday's laws involve conservation of mechanical energy into electrical energy. This is in accordance with the law of conservation of energy. We also know that in pure resistance, the e.m.f. is in phase with the current.

53. (c) : The speed of sound is 340 m/s and speed of light is  $3 \times 10^8$  m/s in air. Thus flash of lightning is seen before the sound of thunder is heard.

54. (a) : From Wien's displacement law, temperature ( $T$ )  $\propto 1/\lambda_m$  (where  $\lambda_m$  is the maximum wavelength). Thus temperature of a body is inversely proportional to the wavelength. Since blue star has smaller wavelength and red star has maximum wavelength, therefore blue star is at higher temperature than red star.

$$55. (a) : \text{Time-period of simple pendulum, } T = 2\pi\sqrt{\frac{l}{g}}$$

Thus time-period is inversely proportional to  $\sqrt{g}$  (where  $g$  is acceleration due to gravity). And as the value of  $g$  on a satellite is zero, therefore time-period of pendulum is infinity.

56. (b) : Stress is the internal force per unit area of a body. If the same force is applied to the rubber and steel, then strain in rubber is more. It means the rubber is more elastic than steel.

57. (d) : The billiard balls in an elastic collision are in a deformed state. And their total energy is in the form of P.E. and K.E. Thus K.E. is less than the total energy. The energy spent against friction is dissipated in the form of heat which is not available for doing work.

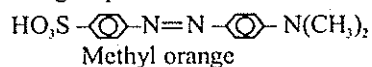
58. (a) : Heat radiated out by earth is reflected back by the atmosphere. In the absence of atmosphere, all the heat will escape from earth's surface which will make the earth inhospitably cold. The atmosphere helps in maintaining the temperature through convection of heat.

59. (b) : A particle is said to execute simple harmonic motion, if it moves to and fro about a fixed point under the action of a restoring force which is directly proportional to its displacement from the fixed point and is always directed towards the fixed point. Also the velocity of the particle when its displacement is  $x$ ,  $v = \omega \sqrt{k^2 - x^2}$ .

60. (a) : Woolen fibres enclose a large amount of air in them. Both wool and air are the bad conductors of heat and their coefficient of thermal conductivity is small. Thus they prevent any loss of heat from our body.

## CHEMISTRY

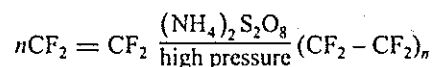
61. (d) : Methyl orange belongs to the group of azo dyes. It is also acidic in nature due to presence of sulphonc group.



62. (b) : Enzymes with two active sites are called allosteric enzymes. One of these sites is the catalytic site for the concerned reaction. Other site may be the site for inhibition of catalysis by enzyme or to activate the enzyme further.

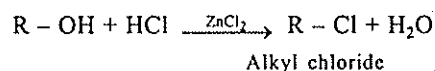
63. (a) : Teflon is polytetrafluoro ethylene and it

is prepared from tetrafluoro ethylene by heating under pressure in the presence of ammonium peroxydisulphate.



It is chemically inert and heat resistant polymer.

64. (a) : Lucas test - Alcohol reacts with concentrated hydrochloric acid in presence of anhydrous  $\text{ZnCl}_2$  to form alkyl halides. The three type of alcohols undergo this reaction at different rates. Order of rate of reaction is : tertiary > secondary > primary.



65. (b) : Aryl halides can be prepared by the decomposition of aryl diazonium salts in presence of copper halides solution dissolved in the corresponding halogen acid, the diazo group is replaced by a halogen atom. This reaction is known as Sandmeyer reaction.



Diazonium salts

Chloro benzene

66. (c) : Molecular weight of  $\text{C}_{60}\text{H}_{122} = 60 \times 12 + 1 \times 122 = 842$

$\therefore$  Weight of 1 mole of  $\text{C}_{60}\text{H}_{122}$  molecules = 842 g  
 $\Rightarrow$  Weight of  $6.023 \times 10^{23}$  molecules = 842 g

$\Rightarrow$  Weight of 1 molecule =  $\frac{842}{6.023 \times 10^{23}} = 1.4 \times 10^{-21}$  g

67. (b) : Magnetite -  $\text{Fe}_2\text{O}_3$   
 Limonite -  $\text{FeO}(\text{OH})$   
 Canerite is not an iron ore.

68. (a) : Ideal gas equation is given as :  
 $PV = nRT$   
 $P$  = Pressure of gas,  $V$  = volume of gas  
 $n$  = moles of gas,  $R$  = gas constant  
 $T$  = temperature

$\Rightarrow PV = \frac{w}{M} RT$       $w$  = mass of gas  
 $M$  = Molecular mass of gas

$$P = \left(\frac{w}{V}\right) \frac{RT}{M} \Rightarrow P = \rho \frac{RT}{M}$$

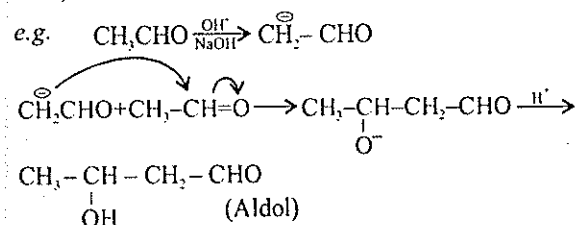
$$\left(\text{As } \rho = \frac{w}{V}\right)$$

$\Rightarrow P \propto \rho$

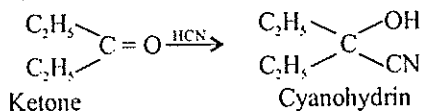
69. (b) : Each electron in an atom is designated by a set of four quantum numbers. According to Pauli's exclusion principle, no two electron in an atom have same values of all the four quantum numbers. Therefore consequently, an orbital accommodates two electrons with opposite spins, there two electron have the same value of quantum number 'n', 'l' and 'm' but value of 's' will be different.

70. (c) : The order of increasing energy of the subatomic orbitals is  $s < p < d < f$ . The energy in excited state is more than that in the ground state. Since option (c) is in an excited state, therefore it has maximum energy.

71. (b) : Aldol condensation : when a carbonyl compound containing  $\alpha$ -hydrogen is treated with a base, first of all carbanion is formed.

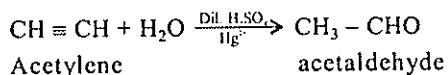


72. (c) : Cyanohydrin can be prepared easily by the reaction of HCN with carbonyl compounds (i.e. Ketones)



73. (b) : In the given reaction aldehyde ( $\text{C}_6\text{H}_5\text{CHO}$ ) reacts with aniline ( $\text{C}_6\text{H}_5\text{NH}_2$ ), they form amine ( $\text{C}_6\text{H}_5\text{N}=\text{CHC}_6\text{H}_5$ ) which is known as Schiff's base.

74. (b) : Acetylene is converted to acetaldehyde when acetylene is treated with dil.  $\text{H}_2\text{SO}_4$  and small amount of  $\text{HgSO}_4$ .



75. (e) :  $\text{CH}_3\text{COCH}_3$  can be converted to  $\text{CH}_3\text{CH}_2\text{CH}_3$  by reduction process in which the ketone is heated with hydroiodic acid and red phosphorus.



76. (b) :  $[\text{H}_3\text{O}^+] = 1 \times 10^{-6} \text{ mol L}^{-1}$   
or  $[\text{H}^+] = 1 \times 10^{-6} \text{ mol L}^{-1}$

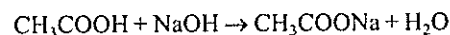
As for distilled water  $[\text{H}^+] = [\text{OH}^-]$

$$[\text{H}^+] = [\text{OH}^-] = 1 \times 10^{-6} \text{ mol L}^{-1}$$

$$\begin{aligned} K_w &= [\text{H}^+][\text{OH}^-] \\ &= 10^{-12} \text{ mol}^2 \text{ L}^{-2} \end{aligned}$$

77. (c) : According to Henderson's equation,

$$\text{pH} = \text{p}K_a + \log \frac{[\text{salt}]}{[\text{acid}]}$$



Putting the values, we get :

$$\text{pH} = 4.57 + \log \frac{0.10}{0.03}$$

$$\Rightarrow \text{pH} = 5.09$$

78. (d) : Let the oxidation state of Fe be  $x$

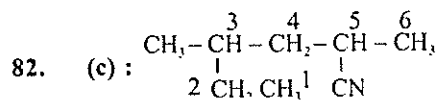
$$\Rightarrow 3x + 4(-2) = 0$$

$$\Rightarrow x = +\frac{8}{3}$$

79. (a) : Photochemical reaction between  $\text{H}_2$  and  $\text{Cl}_2$  is zero order reaction, the concentration of gases per unit volume in the gaseous phase will not change with time, although the quantities will change.

80. (b) : As the size of the noble gas atoms increases down the group, the polarisation of the electron cloud becomes easier. So heavier noble gas atoms are easily polarised in polar water.

81. (a) : Number of electrons in  $\text{Li}^{2+}$  is one similar to the hydrogen atom. One electron system shows similar kind of spectra. Many electron system spectra is complex due to inter-electronic repulsions.



Therefore, IUPAC name is 3-methyl - 5-cyano hexane.

83. (c) : The bond energies of F - F, C - C, N - N and O - O bonds are 33, 80, 39 and 34.2 kJ/mole respectively. Therefore molecule of C - C has the highest bond energy.

84. (a) : Heat of neutralization ( $\Delta H$ ) = 57 kJ, volume of  $\text{HNO}_3$  = 0.5 mole and volume of  $\text{NaOH}$  = 0.2 mole. When  $\text{HNO}_3$  solution is added to  $\text{NaOH}$  solution, then 0.2 mole of  $\text{HNO}_3$  solution will combine with 0.2 mole of  $\text{OH}^-$  ions of  $\text{NaOH}$  solution.

$$\therefore \text{Heat released} = \Delta H \times 0.2 = 57 \times 0.2 = 11.4 \text{ kJ.}$$

85. (a) :  $\text{CuBr} \rightarrow \text{Cu}^+ + \text{Br}^-$

Solubility of  $\text{CuBr}$  is  $2 \times 10^{-4} \text{ mol L}^{-1}$

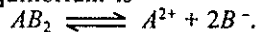
Therefore, solubility of  $\text{Cu}^+ = 2 \times 10^{-4} \text{ mol L}^{-1}$

$$\Rightarrow \text{Solubility product} = 2 \times 10^{-4} \times 2 \times 10^{-4}$$

$$= 4 \times 10^{-8} \text{ mol}^2 \text{ L}^{-2}$$

86. (a) : Schottky defect – If some of the lattice points are unoccupied, called vacancies or holes, the lattice becomes defective. Equal number of cations and anions usually absent so that the crystal remains neutral.

87. (b) : For an  $AB_2$  type structure, the equivalent equation at equilibrium is



For  $CaF_2$ , the equivalent equation at equilibrium is



Therefore  $CaF_2$  has an  $AB_2$  type structure.

88. (b) : Azimuthal quantum number defines the spatial distribution of electron cloud and angular momentum.

e.g.  $l = 0$ ,  $s$  – subshell  
 $l = 1$ ,  $p$  – subshell  
 $l = 2$ ,  $d$  – subshell

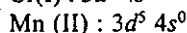
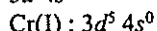
Orbital angular momentum of an electron is calculated using the expression.

$$= \sqrt{l(l+1)} \frac{h}{2\pi}$$

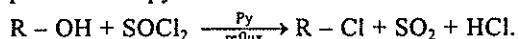
89. (d) : Phosphorus (P) has electronic configuration  $1s^2, 2s^2, 2p^6, 3s^2, 3p^3$

Therefore, no valence electron is present in the  $3d$ -subshell.

Fe (III) has electronic configuration :

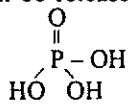


90. (c) : Derzen's method : Alkyl halides are prepared when thionyl chloride and alcohols are refluxed in presence of pyridine.



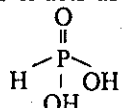
Byproducts of this reaction are gases ( $SO_2$ ,  $HCl$ ) so can be easily removed from the reaction mixture.

91. (b) :  $H_3PO_4$  is a tetrahedral structure molecule. It contains three  $-OH$  group so that three protons can be released. So it acts as a tribasic acid.



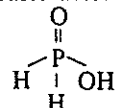
( $H_3PO_4$ )

(tribasic acid)



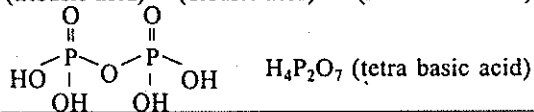
( $H_2PO_3$ )

(dibasic acid)

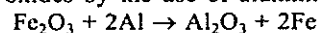


( $H_2PO_2$ )

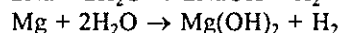
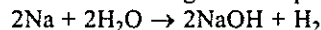
(monobasic acid)



92. (d) : Thermite process involved the reduction metal oxides by the use of aluminium powder.



93. (a) : Alkali and alkaline earth metals react with water to produce hydrogen gas and metal hydroxide. This is due to their high electropositive character.



94. (c) : Atomic mass of element = 100 g/mol

Cell edge = 400 pm =  $400 \times 10^{-12} = 4 \times 10^{-10}$

and number of atoms in BCC ( $Z$ ) = 2.

As the atomic mass of the metal is 100 gm/mol, therefore

$$\begin{aligned} \text{mass of each atom (m)} &= \frac{100}{6.023 \times 10^{23}} \\ &= 16.6 \times 10^{-23} \text{ g.} \end{aligned}$$

The volume of unit cell =  $(4 \times 10^{-8})^3 = 64 \times 10^{-24} \text{ cm}^3$ .

And mass of unit cell =  $Z \times m$

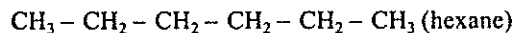
$$= 2 \times (16.6 \times 10^{-23}) = 33.2 \times 10^{-23} \text{ g.}$$

Therefore density of element =  $\frac{\text{Mass of unit cell}}{\text{Volume of unit cell}}$

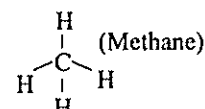
$$= \frac{33.2 \times 10^{-23}}{64 \times 10^{-24}} \approx 5.188 \text{ g/cm}^3$$

95. (c) : A system is said to be in colloidal state if particles of one or more components have the same size range  $10^{-6}$  m to  $10^{-9}$  m. In other words, the colloidal solution is a heterogenous dispersion of solute particles size ranging from  $10^{-6}$  m into the solvent. Particles are visible only with an ultra microscope.

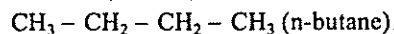
96. (d) : Chiral compound contains one or more 'Chiral' carbon atoms. Chiral carbon atoms usually are bonded to four different atoms or group of atoms.



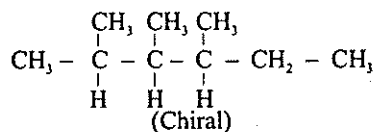
(Achiral)



(Achiral)

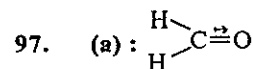


(Achiral)

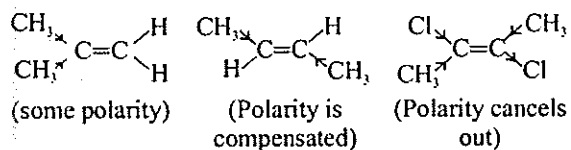


(Chiral)

2, 3, 4-trimethyl hexane

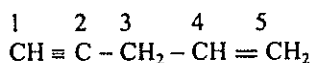


The electronegative oxygen atom is a strong electron withdrawing group. So there is polarity in the carbonyl compounds. This polarity is even greater than in the asymmetric alkene.



98. (c) : The bond length C - C (single bond as in ethane) is 1.54 Å and C = C (double bond as in ethene) is 1.33 Å. The carbonyl carbon bond length in benzene has been found to be 1.39 Å which lies between single and double bond length value.

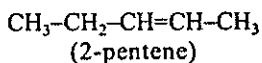
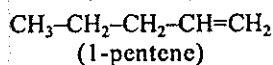
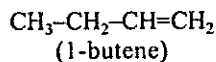
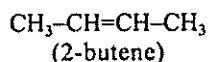
99. (a) : Pent - 4 - en - 1 - yne



No. of ( $\sigma$ ) bonds - 4 (C-C) + 6(C-H) = 10

No. of ( $\pi$ ) bonds - 1 (C=C) + 2(C $\equiv$ C) = 3

100. (d) :



According to Saytzeff rule, stability of alkenes depends upon the substitution on C=C bond. More of substitution by alkyl group, the more stable is the alkene.

101. (c) : In adiabatic process, no heat enters or leaves the system. The system is completely insulated from its surroundings. From first law of thermodynamics, change in internal energy,

$$\Delta E = q - W = 0 - W = -W.$$

Since the work is done at the expense of internal energy, therefore internal energy of the system decreases and hence temperature of the gas falls.

102. (a) : The valence shell electron in the alkali metals is so loosely held that even the low energy photons (light) can eject this electron from the metal surface. This phenomenon is called as photoelectric effect. K and Cs are used in photoelectric cells which are sensitive to blue light.

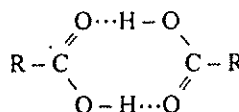
103. (c) : In physical absorption, the substance absorbed is retained not only on the surface but also more or less uniformly distributed throughout the entire body. And absorbed molecules are not broken under ordinary conditions.

104. (a) : Amides are R - CONH<sub>2</sub>

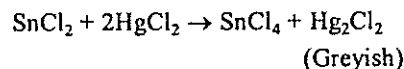
Acids are R - COOH

Due to the presence of -NH<sub>2</sub> group in amides there is stronger hydrogen bonding between the amide molecules than between the acid molecules. Some acids

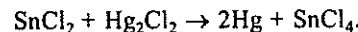
are rather present in dimers form due to the presence of intra molecular hydrogen bonding.



105. (c) : SnCl<sub>2</sub> (stannous chloride) on reaction with mercuric chloride (HgCl<sub>2</sub>), oxidises to SnCl<sub>4</sub> (stannic chloride)



So in this reaction, stannous chloride is acting as reducing agent that reduces Hg(II) to Hg(I) and then to Hg(0)



106. (d) : In the cell, DNA molecules (*i.e.* Deoxyribose Nucleic acid) are present predominately in the nucleus, some DNA is also present in the mitochondria in Eukaryotes.

RNA molecules (*i.e.* Ribose nucleic acid) are present in cytoplasm of the eukaryotes and in nucleus in some prokaryotes and virus.

107. (a) : All the halogens are coloured. The colour deepens with the rise of atomic number from fluorine to iodine.

The colour is due to the absorption of energy from visible light by their molecules or excitation of outer electrons to higher energy levels.

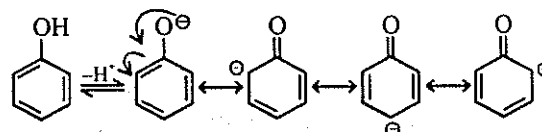
F	Cl	Br	I
Light yellow	Yellow green	Reddish brown	Deep violet.

108. (c) : Lower value of bond dissociation energy of fluorine is due to the high inter electronic repulsions between non-bonding electrons of the 2p-orbital of small sized fluorine. As a result F-F bond is weaker as comparison to Cl-Cl and Br-Br bonds.

*Bond dissociation energy*

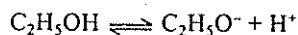
F-F	38 K cal/mole
Cl-Cl	57 K cal/mole
Br-Br	45.5 K cal/mole
I-I	35.6 K cal/mole

109. (d) : Phenol is a stronger acid than the ethanol. This is due to the resonance stabilisation of the phenolate ion which is produced after deprotonation.



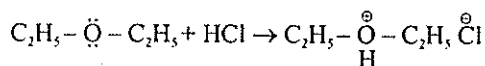


But there is no such stabilisation in the case of ethanol



The groups with +M and -I effect decrease the acidity at p-position, but at m-position the acidity is increased due to -I-effect.

110. (a) : Due to the presence of lone pair of electrons on oxygen atom, ethers behave as base and form stable oxonium salts with mineral acids.



Diethyl oxonium  
Chloride

111. (c) : The wavelength of the line can be calculated by the Ritz formula :

$$\frac{1}{\lambda} = R \left( \frac{1}{n_1^2} - \frac{1}{n_2^2} \right), \quad R = \text{Rydberg constant}$$

Therefore, for calculating highest wavelength in Balmer series ( $n_1 = 2$ ),  $n_2$  should be 3,4,5.

112. (c) : More is the surface area, fast is the rate of evaporation at a given temperature this is due to the fact that more surface area means more number of molecules at the surface which can then be evaporated easily. Strong inter-molecular forces of attraction slows down the rate of evaporation.

113. (b) : In diamond, each carbon atom is in  $sp^3$  hybridised state and linked to four other carbon atoms tetrahedrally by covalent bonds. Since there is no mobile electron present, diamond is bad conductor of heat and electricity.

In graphite each carbon atom is in  $sp^2$  hybridised state and is linked to three other carbon atoms in a hexagonal planar structure. The  $\pi$ -electrons are free to move throughout the entire layers, therefore graphite is good conductor of heat and electricity.

114. (c) : Atoms can neither be created nor destroyed. This is the statement of law of conservation of mass.

Under similar conditions of temperature and pressure, equal volume of gases contain equal number of atoms.

As,  $PV = nRT$ . (Ideal gas equation)

If, for 1st case,  $P_1V_1 = n_1RT_1$

for 2nd case,  $P_2V_2 = n_2RT_2$

$$\Rightarrow \frac{P_1V_1}{P_2V_2} = \frac{n_1RT_1}{n_2RT_2} \Rightarrow n_1 = n_2$$

115. (c) : Extensive properties are dependent upon the amount of the substance. e.g. mass, volume etc.

Intensive properties are independent of the amount of the substance. e.g. temperature, density.

116. (a) : Internal energy is given by :

$$E = E_{\text{translational}} + E_{\text{rotational}} + E_{\text{vibrational}} + E_{\text{bonding}} + E_{\text{electronic}}$$

Accurate measurement of some forms of energy which contribute to the absolute value of internal energy for a given substance in a given state is impossible. So difference of the initial state and final state is calculated and is denoted by

$$\Delta E = E_f - E_i$$

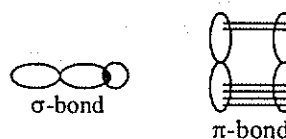
117. (c) : Cuprous ions ( $\text{Cu}^+$ ) is colourless because it has no unpaired electrons in the  $3d$  sub-shell as it has  $3d^{10}$  configuration. The cupric ion ( $\text{Cu}^{2+}$ ) has one unpaired electron as it has configuration  $3d^9$ . By absorbing the visible light, the unpaired electron can migrate from one set of  $d$ -orbitals to another under the applied field of water molecules. Hence cupric ion ( $\text{Cu}^{2+}$ ) in aqueous solution shows blue colour.

118. (b) : Oxygen is second most electronegative element after fluorine. So it can easily gain electrons to form dinegative anion ( $\text{O}^{2-}$ ) while sulphur is not so electronegative element as oxygen.

119. (c) : Sigma bonding involves end to end overlapping of the two atomic orbitals e.g. between  $s$  and  $s$ ,  $s$  and  $p$  and  $p$  and  $p$  orbitals.

Pi bonding ( $\pi$ ) involves sidewise overlapping of the two atomic orbitals e.g. between  $p$  and  $p$  orbitals.

Overlapping of orbitals is more effective in  $\sigma$  bonding than in  $\pi$ -bonding. Due to the geometry of overlapping of orbitals, rotation of one atom is not



possible around  $\pi$ -bonds.

120. (d) : Absorption spectrum is produced when white light is passed through a substance and transmitted light is analysed by a spectrograph. The dark spaces corresponds to the light radiation absorbed by the substance. And emission spectrum is produced by analysing the radiant energy emitted by an excited substance by a spectrograph. Thus discontinuous spectra consisting of a series of sharp lines and separated by dark bands are obtained.

**BIOLOGY**

121. (d) : Immune tolerance is acquired as an inability to react to particular self or non-self antigens. Both B-cells and T-cells display tolerance, generally to their specific antigen classes. Basically B-cells form a part of the humoral immune system and T-cells form a part of the cell-mediated immune system.

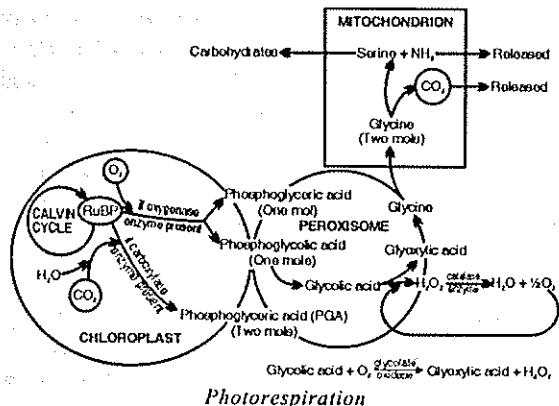
122. (b) : Cyclosporine is used as immunodepressant. This drug is derived from a fungus and is used to prevent rejection of kidney, heart and liver transplants. Cyclosporine inhibits the activity of helper T-cells.

123. (d) : *Neanderthal* man was the first human fossils discovered in 1856 having a cranial capacity of 1400 cc. African man (*Australopithecus*) was discovered in 1924 having a cranial capacity of 300-500 cc. Java ape man (*Pithecanthropus erectus*) discovered in 1920 and its cranial capacity was 900 cc whereas Peking man (*Sinanthropus pekinensis*) was discovered in 1924 and its cranial capacity was 1075 cc. These show that *Neanderthal* man has the largest cranial capacity.

124. (d) : Transversion are those base replacement where a purine is replaced by a pyrimidine and vice versa. It means that CG can be replaced by GC and vice versa. Similarly AT can be replaced by TA and vice versa.

125. (c) : The premolars and molars are called cheek teeth. These are also called lophodont teeth. Their free ends are flattened and bear transverse ridges to crush and grind the food.

126. (d) : The substrate for photorespiration is glycolate formed in chloroplasts. It changes enzymatically into glyoxylate inside peroxisomes where it is further converted into glycine. The glycine changes to serine inside the mitochondria.



127. (d) : Glycosylation is bonding of sugar residue to another organic compound. Glycoprotein are formed in the lumen of rough endoplasmic reticulum, but may subsequently be modified in the lumen of the golgi apparatus, where other amino acids of the protein may become glycosylated.

128. (b) : Frameshift mutation occurs when one or more nucleotides are either added or deleted from DNA. The result of such mutation is nonfunctioning of protein because the the sequence of codons is altered. Example of frameshift mutation due to deletion.

Original (wild type) message or reading frame

CAT GAT CAT GAT CAT GAT CAT

Deletion

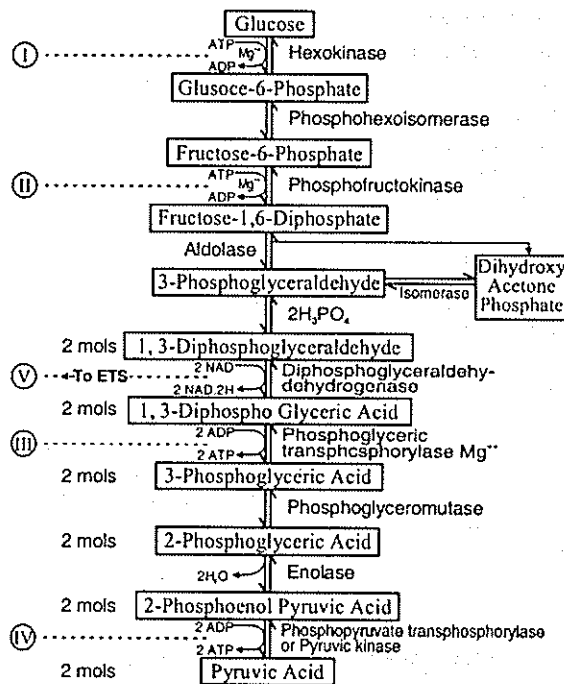
CAT GAT ATG ATC ATG ATC AT

Message out of frame

129. (c) : If centromere is truly terminal, i.e. situated at the tip of chromosome, the chromosome is said to be telocentric. Telocentric chromosome are very rare.

Telocentric chromosome

130. (c) : In glycolysis one molecule of hexose sugar (glucose/fructose), a 6C-compound is splitted to form two molecules of a 3C-compound, pyruvic acid (CH<sub>3</sub>COCOOH).



Different steps of EMP pathway of Glycolysis

131. (d) : In cockroach, excretion is mainly performed by one or two pairs of malpighian tubules. One of this pair opens into the middle region of intestine and other pair of coxal glands are located in prosoma and opens at bases of fifth walking legs.

132. (c) : Ambulacral grooves are found in the arms of an echinoderms lined by tube feet. Ambulacral grooves are absent in ophiuroidea which are covered by ossicles.

133. (d) : In frog, all nerve cells connecting to central nervous system (brain and spinal cord) with receptor and effectors constitute the peripheral nervous system. Some small masses of nerve cell bodies are called ganglia. They develop neural crest cells in frog.

134. (b) : Lysis is the death and subsequent breakdown of a cell. Under normal conditions such cells are engulfed by phagocytes and degraded by their lysosome. Lysis of foreign cell is mediated through IgM and IgG. These are called immunoglobulins.

135. (b) : Bile is alkaline viscous fluid, yellow to green in colour and having a pH of 7.8-8.6. Saliva is secreted by salivary gland and its pH is about 6.8. Gastric juice is secreted by the gastric gland in stomach and its pH value is 1-2.5 and pancreatic juice is colourless watery fluid and slightly alkaline. Its pH is 7.5-8.0. Therefore gastric juice has minimum pH value.

136. (d) : Technique for manipulating prokaryotic as well as eukaryotic DNA has witnessed a remarkable development. This has allowed breaking of a DNA molecule at two desired places to isolate a specific DNA segment and then its insertion in another DNA molecule at a desired position. The product thus obtained is called *r* DNA and the technique as genetic engineering.

137. (c) : Pure line is true breeding genotypes, a line that has been rendered homozygous for all genes under consideration in successive generations, a line in which homozygous individuals produce only homozygous offspring like parents. Thus pure line breed refers to homozygosity only.

138. (b) : When a homozygous red flower is crossed with homozygous white flower in  $F_1$  generation, then all red flowers are formed because red colour is dominant on white coloured flower.

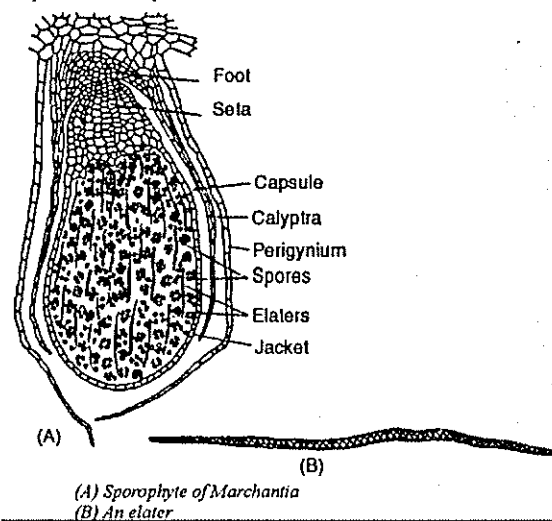
139. (a) : The bud dormancy is induced by abscisic acid (ABA). The level of endogenous ABA increases with the onset of dormant period and decreases when it is broken.

140. (d) : The effect of pollen on endosperm is called xenia whereas pollen of stomatic cell lying outside the endosperm is known as metaxenia.

141. (c) : Maximum solar energy is trapped by algae and hence they evolve maximum amount of oxygen by the process of photosynthesis. Therefore algae are useful because they purify the atmosphere by releasing oxygen.

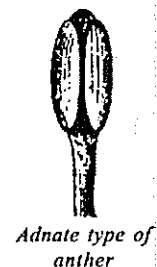
142. (d) : The gametophytic generation represents the dominant phase in the life cycle of bryophytes. The sporophyte phase is dependent on the gametophyte. That is why, the plant body of *Funaria* is predominantly gametophytic generation with sporophyte.

143. (d) : *Marchantia* is a liverwort. Its sporophyte contains elongated cells with spiral thickenings on its wall called elaters. These elaters are hygroscopic in nature. The resulting twisting movement helps in dispersal of spores.

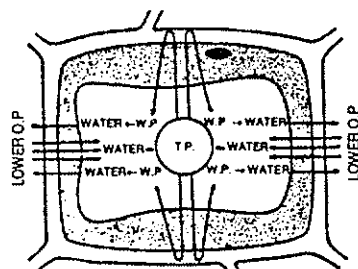


144. (d) : Megasporophyll of *Cycas* are born on female plant which produces ovule. Carpel is also a female reproductive organ of flowering plant. So both are of same nature. (i.e. female sex organ).

145. (a) : In adnate type filament attachment, the filament runs along the back of anther. It is found in *Michelia* (champa).



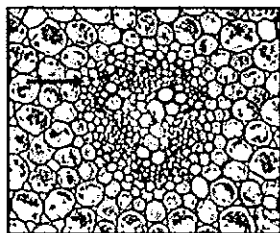
146. (c) : The pressure that develops in a cell from time to time due to osmotic diffusion of water molecules into a cell that causes stretching of the cell wall is



A diagrammatic representation of the relationship of osmotic pressure (OP), Turgor pressure (TP) and wall pressure (WP) the state of final equilibrium.

called turgor pressure. Due to turgor pressure, rigid cell wall offers resistance. This resistance works in a direction opposite to turgor pressure. But it is equal to turgor pressure and is called wall pressure. In this condition, no exchange of water takes place.

147. (b) : Passage cells are found in monocot root.



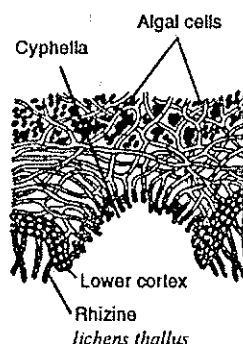
The arrow indicates a non lignified "passage cell" in the endodermis

It is an unthickened cell in the endodermis of a root, found opposite to the protoxylem element through which solutions can diffuse in the transverse direction.

148. (d) : Green plants are being planted around the road side to check the noise pollution. This is known as green muffler. Noise pollution is measured in decibels.

149. (a) : The functional role of a species in the community including activities and relationship is called niche. Niche is the social position held by an organism with respect to its associates. The abundance of a species population within its habitat is called niche density.

150. (c) : Cyphella are small depressions or cavity like opening into the medulla on the ventral surface



of the thallus of certain lichens. They perform respiratory functions.

151. (a) : In *Entamoeba histolytica*, the precystic or minute forms encyst only in the lumen of the intestine. In precystic stage, the chromatid bodies are found which disappear as the cysts mature.

152. (d) : *Euspongia* or *Spongia* is also called bath sponges. When it dries up, only its skeleton is left which is made up of spongin fibre.

153. (c) : In *Hydra* sensory cells are found in the gastrodermis. They are supposed to be stimulated by the entry of the prey into the gastrovascular cavity.

154. (d) : *Wuchereria bancrofti* is a dreaded human parasite. It is digenetic parasite completing its life cycle in two hosts, the final host is man harbouring the adult worm. The adult worms live coiled up in the gland and lymph vessels of man.

155. (c) : The development of *Ascaris* larva takes place outside the body of host in soil and their cleavage starts in shelled eggs. First moulting takes place in soil in shelled egg whereas second and third moulting takes place in alveoli and lung respectively. The final moulting takes place in intestine.

156. (d) : The triplet code is a degenerate one with many codons than the number of amino acid types coded. An explanation for this degeneracy is provided by the Wobble hypothesis proposed by F.H.C. Crick in 1966.

157. (c) : Uricotelic animals (living in dry conditions) are those animals which excrete uric acid as their excretory product e.g. lizard and crow. These animals conserve water in their bodies and synthesize crystals of uric acids from ammonia. These crystals can be

retained in the body (in solid form) for a considerable time before being discharged from the body.

158. (a) : Rennin is an enzyme found in gastric juices and are responsible for the coagulation of milk. It acts by hydrolysing peptide links. At 37°C, rennin can coagulate 10<sup>7</sup> times to that of its own weight of milk in ten minutes.

159. (b) : The amino acid tryptophan serves as a source material for the synthesis of nicotinamide which in turn forms two coenzymes NAD and NADP with metabolic roles.

160. (b) : Fehling's test is given only by reducing sugars. When Fehling's solution is added to any reducing sugar then a red precipitate is formed which shows that reduction has taken place. Sucrose does not give this test.

161. (a) : The advancement in the field of biology has reached to such an extent that it requires the basic knowledge of chemistry, physics and other basic sciences. It is a fact that living organisms are made up of atoms and molecules which follow chemical and physical laws. Therefore knowledge of chemistry and physics is essential.

162. (d) : Living organisms are regarded as open system as they can loose or gain the mass or energy from the surrounding environment. All living organisms restore their lost energy either from the sunlight or indirectly from the food material.

163. (a) : Death is regarded as the most important regulatory process on earth. It reduces the number of individuals in a population and avoids over-crowding caused by continuous reproduction. Over-crowding due to reproduction is countered by death as the ultimate termination of functional life.

164. (b) : During a wound, germs are removed by the process of phagocytosis by WBC. WBCs accumulate at the site of wound by diapedesis. Diapedesis is the squeezing of leucocytes out from the endothelium of capillaries to fight against foreign agent.

165. (a) : Specialization of cells into tissue, organ and organ systems is advantageous for the organism. It increases the operational efficiency through division of labour which avoids duplication of work.

166. (c) : To maintain the unequal distribution of

Na<sup>+</sup> and K<sup>+</sup> ion, the neuron uses chemical energy in the form of ATP to actively transport Na<sup>+</sup> ion out of the cell and move K<sup>+</sup> inside the cell.

167. (a) : The regulation of RBC production is accomplished by the hormone erythropoietin which is secreted by the juxtaglomerular cells of kidney. This hormone circulates to the red bone marrow, where it increases stem cell (myoblasts) mitosis and speeds the development of red blood cells. The sequence is myoblast → proerythroblast → erythroblast → normoblast (metaerythroblast) → reticulocyte → erythrocytes.

168. (b) : Lateral line system is a sensory system of fishes and aquatic and larval amphibians whose receptors are clusters of sensory cells derived from ectoderm. These clusters of sensory cells are called neuromast organs.

169. (a) : Histamine is a derivative of the amino acid histidine produced by damaged cells of vertebrates. When released, it has the effect of dilating capillaries and lowering blood pressure. Histamine is involved in allergic and inflammatory reactions.

170. (d) : The number of cells in a multicellular organism are directly proportional to the size of the body. On the other hand, it is a fact that cells vary greatly in their size. Mycoplasma cells are the smallest, ranging from 0.1 to 0.3 μm, whereas human cells generally range from 20 to 30 μm. Nerve cells are the longest.

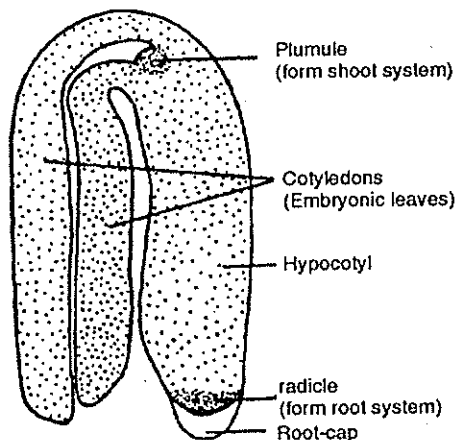
171. (b) : Taxonomy or systematics is the branch of biology for the classification of biological world of living organisms. The classification is the grouping of the organisms in an orderly manner. This grouping is based upon similarities and dissimilarities.

172. (d) : The diploid megaspore mother cell has a large nucleus and dense cytoplasm. This cell undergoes meiosis (reduction division) to produce a group of four haploid cells called megaspore.

173. (b) : In bacteria, the reaction centre is B-890 and photosynthesis occurs by utilizing wavelengths longer than 700 nm. The reductant is NADH + H<sup>+</sup>. In bacteria, the donor may be hydrogen sulphide or malate or succinate but not water.

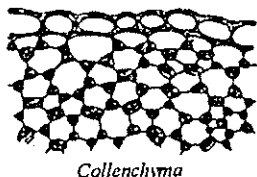
174. (b) : In the typical angiospermic plant, cotyledons in the seed are the embryonic leaves. The radicle of the embryo upon the seed germination

produces the root system and the plumule produces the shoot system. The radicle and plumule are contained in the embryo.



Mature dicotyledonous embryo

175. (a) : Collenchyma is a specialized type of parenchyma which functions as supporting tissue. The cell walls are irregularly thickened due to the deposition of cellulose and pectin. They are living tissue and possess the ability to divide.



Collenchyma

176. (c) : Clone is a group of cells descended from the same single parent cell. In most of the cases, nucleic acid sequences are said to be cloned when they are inserted into vectors such as plasmids and copied within host cells during gene manipulation.

177. (a) : The metabolic reactions of a living organisms can occur only in a delicately balanced environment in the non-living organisms. The cells are the life supporting chambers which have such a special environment. A living cell keeps its chemical composition steady within its boundary.

178. (c) : Plasmids are found mostly in prokaryotic cells and yeasts. They do not form a part of the normal chromosomal DNA of a cell and capable of replicating independently. It constitutes a form of extra-chromosomal DNA.

179. (d) : The mRNA attaches itself to the small subunit (30s) of the ribosome via its 5' end. This attachment is assisted by the G-cap nucleotide and

bases of sequence present on the messenger RNA systems where G-cap is present as in eukaryotes.

180. (b) : When six molecules of carbon dioxide enter calvin cycle, one hexose molecule is formed, whereas 18 ATP and 12 NADPH + H<sup>+</sup> molecules are used up. The light reaction of photosynthesis results in the formation of ATP and NADPH<sub>2</sub>.

### GENERAL KNOWLEDGE

181. (a) : According to The Guinness Book of World Records, the highest town in the world is Wenzhuan, which was founded in 1955 on the Qinghai-Tibet road north of the *Tangla mountain range*. It is 16,730 feet above sea level.

182. (a) : A great mass of black rock soaring to over 22,000 feet, Mt. Kailash has the unique distinction of being the world's most venerated holy place at the same time that it is the least visited. The supremely sacred site of four religions and billions of people, Kailash is seen by no more than a few thousand pilgrims each year. This curious fact is explained by the mountain's remote location in far western Tibet. Dhaulagiri Mountain is in Nepal. Everest was formed about 60 million years ago. It's summit ridge separates Nepal and Tibet. Mt Abu is in Rajasthan, India.

183. (d) : The Indian Army ( Adventure Wing) successfully scaled technically one of the most difficult peaks in the World, the ANNAPURNA-I located at a height of 8091 metre over Central Nepal on May 6, 2002. This was the first ever expedition to this peak by an Indian Team.

184. (a), (c) : *Copper T* is a small device which is placed into the uterine cavity. The vertical and horizontal arms of the IUD contain some copper. The IUD slowly releases copper into the uterine cavity. Copper stops sperm from making their way up through the uterus into the tubes, thus preventing fertilization. If fertilization were to occur, the IUD would prevent the fertilized egg from successfully implanting in the lining of the uterus.

185. (c)      186. (a)

187. (c) : After the death of GMC Balayogi in helicopter crash, M.M. Joshi was elected as 11<sup>th</sup> speaker of Lok Sabha.

188. (a)      189. (a)      190. (a)

191. (c)

192. (a) : The Welfare Portfolio Committee in collaboration with the SA Council for the Aged will host a special session in Parliament on 1 October 1996 to celebrate the International Day for the Aged.

The theme of the session, "Connecting the Generations in Praise of Age", aims to strengthen interaction and unity between older persons from various cultural groups, enhance their role in building the new democracy, and sharing between young and old.

193. (c) : Comets described as "big dirty snowballs." The "dirty" part refers to little bits of stone, not unlike sand, embedded in the comet's icy nucleus.

194. (b) : A surrogate mother is a woman who agrees, usually by contract and for a fee, to bear a child for a couple who are childless because the wife is infertile or physically incapable of carrying a developing fetus. Often the surrogate mother is the biological mother of the child, conceiving it by means of *artificial*

*insemination* with sperm from the husband. In gestational surrogacy, the wife is fertile but incapable of carrying a growing fetus; the child is conceived by *in vitro fertilization* using the wife's eggs and her husband's sperm, and the resulting embryo is implanted in the surrogate mother's uterus.

195. (c) : Ad hoc means for a particular purpose only.

196. (b) : There are a couple of sonnet structures, the most popular being the Shakespearean or English. It bears Shakespeare's name not because he was the first to use it but because his sonnets in this pattern are the most famous in English literature. Sonnets are written in iambic pentameter, have fourteen lines and a certain rhyme scheme.

197. (a)

198. (b) : Mount Kamet, which at 25,600 ft is the third highest peak in India after Mt Kanchanjunga and Mt Nanda Devi.

199. (c)      200. (d)

