



11. (a) : Any surface which has same electrostatic potential at every point is called an equipotential surface. Electric field is always perpendicular to an equipotential surface. Therefore  $x$ -direction is perpendicular only to  $yz$  plane.

12. (b) : According to Stefan's law, the radiation energy emitted per second per unit area of a black body =  $\sigma T^4$ , where  $\sigma$  is called Stefan's constant.

$$\text{Energy emitted} \propto AT^4 \Rightarrow E \propto 4\pi r^2 T^4$$

where  $A$  = area of the body,  $T$  = temperature in Kelvin. When sun expands such that its radius becomes 100 times its present radius and its surface temperature becomes half. Then energy emitted by it is

$$E' \propto 4\pi(100)^2 r^2 \left(\frac{T}{2}\right)^4$$

$$\propto \left(\frac{100}{4}\right)^2 E$$

Total energy emitted will be increased by

$$\frac{E'}{E} = \frac{(100/4)^2 E}{E} = 625.$$

13. (b) : The variation of specific resistance with temperature is given by

$$\rho = \rho_0 [1 + \alpha(T - T_0)]$$

where  $\alpha$  = temperature coefficient of resistance which is negative for semiconductor.

$$\rho = \rho_0 - \rho_0 \alpha (T - T_0)$$

Comparing with straight line equation,  $y = mx + c$

$\Rightarrow m$ , slope is negative.

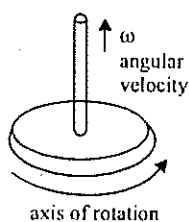
14. (c) : According to continuity theorem as  $av = \text{constant}$

as area increases velocity decreases. So when blood flows from narrow arteries to wider one, velocity decreases. According to Bernoulli's principle,

$$P + \frac{1}{2}\rho v^2 = \text{constant}$$

As velocity decreases, pressure increases. Thus when arteries become narrow, blood pressure increases.

15. (d) : According to the right hand rule wrap the right hand around the axis of rotation so that the fingers are pointing in the direction of rotation. The thumb points in the direction of angular velocity.



16. (d) : Magnetic field at a point on the axis of a loop is given by

$$B = \frac{\mu_0}{4\pi} \frac{2\pi IR^2}{(R^2 + r^2)^{3/2}}$$

When  $r \gg R$ ,

$$B = \frac{\mu_0}{4\pi} \frac{2\pi R^2 I}{r^3} = \frac{\mu_0 AI}{2\pi r^3}. \quad \text{Thus, } B \propto (1/r^3).$$

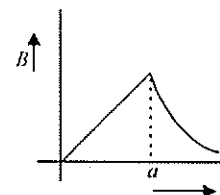
17. (a) : Sodium lamp light emits monochromatic light i.e. it is comprised of only one wavelength (deep yellow). This colour is scattered less in the foggy condition while other light sources produce light at many different discrete wavelengths and all provide some degree of colour rendering. Also sodium lamps emit light very near to the peak sensitivity of the human eye under normal viewing conditions.

18. (a) : Magnetic field at a point outside the straight conductor is

$$B = \frac{\mu_0 I}{2\pi r}$$

i.e.  $B \propto (1/r)$  ( $r > a$ ).

Magnetic field at a point lying inside the conductor is  $B \propto r$  ( $r < a$ ).



19. (b) : In the other graphs, at a particular time more than one velocity is shown which is not possible in realistic situation.

20. (d) : Velocity of second piece can be find out using conservation of momentum.

$$0 = m_1 v_1 + m_2 v_2 = 2 \times v_1 + 1 \times 80$$

$$\Rightarrow v_1 = -40 \text{ m/s.}$$

Negative sign showing that particle is moving in opposite direction of other particle direction.

Energy imparted to the fragments are converted into their kinetic energy.

$$\begin{aligned} \therefore \text{Total energy} &= \frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2 \\ &= \frac{1}{2} \times 2 \times 1600 + \frac{1}{2} \times 1 \times 6400 \\ &= 4800 \text{ J} = 4.8 \text{ kJ.} \end{aligned}$$

21. (c) : The presence of thin mica in the path of one of the interfering beams changes only the path difference between the beams due to which the pattern shifts upwards. But the fringe width remains the same. As monochromatic light is used, one cannot make out which is the central shift as all the fringes are having the same colour and intensity.

22. (d) : If the refractive index of two media are same, the surface of separation does not produce refraction or reflection which helps in visibility.

23. (c) : Human ear can hear frequencies upto 20,000 Hz. So for closed pipe,

$$\text{overtone, } v = \frac{nv}{4L} = n \times \text{fundamental frequency}$$

$$\therefore 20,000 = n \times 1500 \Rightarrow n \approx 13.$$

Maximum possible harmonics obtained

$$= 1, 3, 5, 7, 9, 11, 13 \dots\dots\dots$$

Therefore one can hear maximum upto 13<sup>th</sup> harmonics.

$$\text{Overtone} = 7 - 1 = 6.$$

24. (a) : MRI is extension of NMR or nuclear magnetic resonance imaging. Magnetic resonance imaging is a noninvasive technique which uses strong magnetic field for generating resonance at low radio frequency in the protons present in the body.

25. (b) : Using carbon dating, samples of wood, charcoal, bones, and shells have been identified as having lived 1000 to 25000 years ago.

26. (b) : The energy stored in capacitor =  $\frac{1}{2}CV^2$

$$= \frac{1}{2} \times 40 \times 10^{-6} \times (3000)^2$$

$$= 20 \times 9 \times 10^6 \times 10^{-6} = 180 \text{ J.}$$

The power delivered in 2 ms is

$$= \frac{180}{2 \times 10^{-3}} = 90 \times 10^3 \text{ W} = 90 \text{ kW.}$$

27. (a) : In each row all the 5000 electroplaques are connected in series.

$$\text{Therefore, equivalent emf} = 0.15 \times 5000 = 750 \text{ V.}$$

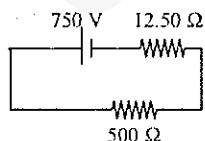
$$\text{Equivalent resistance} = 0.25 \times 5000 = 1250 \Omega.$$

All 100 rows are connected in parallel.

$$\text{Therefore voltage} = 750 \text{ V.}$$

$$\text{Equivalent resistance} = \frac{1250}{100} = 12.50 \Omega.$$

Thus resultant circuit of eel becomes



$$\text{Current across } 500 \Omega = \frac{V}{R} = \frac{750}{500 + 12.50} = 1.46 \text{ A}$$

$$I \approx 1.5 \text{ A.}$$

28. (b) : At A, temperature =  $T_0$ , volume =  $V_0$ , pressure =  $P_0$  for  $n$  moles of monoatomic gas.

$$\text{At A, } P_0 V_0 = nRT_0 \text{ (cold)}$$

$$\text{At B, } 2P_0 V_0 = nRT'_{\text{high}} \Rightarrow T' = 2T_0$$

Maximum thermal efficiency of the reversible engine of this Carnot's cycle

$$= \eta = 1 - \frac{T_c}{T_h} = 1 - \frac{T_0}{2T_0} = \frac{1}{2} = 50\%.$$

29. (b) : Molecular bonding of  $O_2$  based on orbitals show that  $O_2$  is paramagnetic, which is true experimentally.

30. (c) : This is made of optical fibres whose interior is coated with a refractive index greater than that of the outer cover, glass.

31. (b) : In electron microscope, electrons are used as the 'light source'. The resolving power of a microscope is approximately equal to that of wavelength of the light used. The de Broglie wavelength  $\lambda$  of a particle is related to its momentum  $p$  by

$$\lambda = \frac{h}{p} = \frac{h}{mv}$$

The speed of required electron is

$$v = \frac{h}{m\lambda} = \frac{6.63 \times 10^{-34} \text{ Js}}{9.11 \times 10^{-31} \text{ kg} \cdot 10^{-11} \text{ m}} = 7.28 \times 10^7 \text{ m/s}$$

This corresponds to kinetic energy of  $E = \frac{1}{2}mv^2$

$$= \frac{1}{2} \times 9.11 \times 10^{-31} \times (7.28 \times 10^7)^2 \times \frac{1 \text{ eV}}{1.6 \times 10^{-19} \text{ J}}$$

$$= 15.1 \text{ keV.}$$

32. (b) : In compact disc colour results due to phenomenon of diffraction, in which small ripples on the surface of it break up white light into the colour of rainbow.

33. (d) : The electrostatic force due to one  $Cs^+$  ion is balanced by diagonally opposite other  $Cs^+$ . Thus the net electrostatic force on  $Cl^-$  ion due to eight  $Cs^+$  ions is zero.

34. (a) : The graph showing that greater the binding energy per nucleon, the more stable the nucleus is. The graph has its maximum of 8.8 MeV/nucleon when the number of nucleons is 56. The nucleus that has 56 protons and neutron is  $^{56}_{26}\text{Fe}$ , an iron isotope. This is the most stable nucleus of them all, since maximum energy is needed to pull a nucleon away from it.

35. (d) : The magnetic moment of a current carrying conductor is  $i \cdot n \pi r^2 = niA$ .

$$\text{i.e. Magnetic moment} \propto r^2.$$

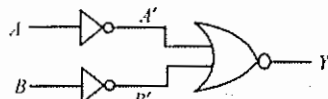
36. (d) : Cyclotron frequency

$$\nu = \frac{qB}{2\pi m} = \frac{1.6 \times 10^{-19} \times 1}{2 \times 3.14 \times 9.1 \times 10^{-31}}$$

$$= 28 \times 10^9 \text{ Hz} = 28 \text{ GHz.}$$

37. (c) : Truth table

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



Output of this is same as that of AND gate.

38. (a) : When Ge specimen is doped with Al, then concentration of acceptor atoms is also called concentration of holes.

Using formula,  $n_i^2 = n_0 p_0$ , where

$n_i$  = concentration of electron-hole pair =  $10^{19}/\text{m}^3$

$n_0$  = concentration of electron

$p_0$  = concentration of holes =  $10^{21} \text{ atom}/\text{m}^3$

$$\Rightarrow (10^{19})^2 = 10^{21} \times n_0 \Rightarrow n_0 = 10^{17}/\text{m}^3.$$

39. (b) :  $v_{rms} = \sqrt{\frac{3K_B T}{m}} = 1.73 \sqrt{\frac{K_B T}{m}}$

$$v_{av} = \sqrt{\frac{8K_B T}{\pi m}} = 1.60 \sqrt{\frac{K_B T}{m}}$$

$$v_{mp} = \sqrt{\frac{2K_B T}{m}} = 1.41 \sqrt{\frac{K_B T}{m}}$$

From these equations,  $v_{rms} > v_{av} > v_{mp}$ .

40. (b) : Force of attraction between two charges is given by

$$F = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^2}$$

$$\Rightarrow \epsilon_0 = \frac{1}{4\pi F} \frac{q_1 q_2}{r^2} = \frac{\text{A}^2 \text{T}^2}{\text{MLT}^{-2} \text{L}^2}$$

(where  $4\pi$  is dimensionless)

$$= \text{M}^{-1} \text{L}^{-3} \text{T}^4 \text{A}^2.$$

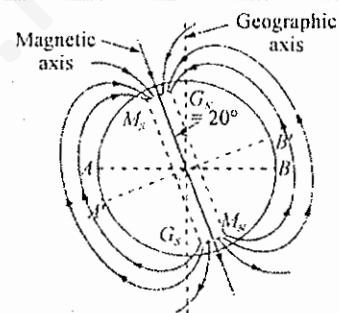
41. (d) : The electrical force of a cell or battery called electromotive force (emf). This force, which makes electrons flow around a circuit. Each kind of cell has a particular emf. The size of a cell has no effect on its emf. The chemicals in the cell determines its emf, but large cells last longer than small cells of same basic type. This means that from a large cell, we get a particular emf for more time as compared to small cell.

42. (b) : A red object reflects red colour from a light falling on it. Thus when this object is viewed in yellow light then it absorbs all yellow light falling on it and appears dark. From Rayleigh's scattering is inversely

proportional to  $\lambda^4$ . Red colour has largest wavelength; therefore this colour is scattered least as compared to other colours.

43. (c) : The pressure cooker works on the principle that boiling point of a liquid increases with increase of vapour pressure above the liquid. Water, along with food to be cooked are heated in a closed vessel, so that the confined water vapour raises the superincumbent pressure. As a result, water boils at a temperature higher than  $100^\circ\text{C}$ . When the cooker is removed from the stove and the lid is removed, pressure again decreases due to which its boiling point decreases and water starts boiling again.

44. (d) : From the compass we are able to know the direction of the magnetic poles. The north of compass points towards the magnetic south pole. If we know the magnetic declination at that particular place (which is angle between geographic meridian and magnetic meridian) we can easily find out the true geographic north-south direction.



Imaginary lines drawn along the earth's surface in the direction of the horizontal component of the magnetic field of the earth at all points passing through the north and south magnetic poles. This is similar to the longitudes of the earth, which pass through the geographic north and south poles.

45. (a) : Normally when a body is moving in a straight line, whatever be the internal changes, the centre of mass continuous in its trajectory with the same velocity and a system that is rotating continues to rotate with the same angular velocity and changes occur in such a way that the angular momentum is conserved. Classical physics, taking the whole of the earth as a system does not allow sporadic changes in the speed of the earth. However, according to the information on the earth's rotation by U.S. Naval observatory sporadic changes of the speed of rotation of the earth have been observed and this is attributed to the influence of the moon on the tides. This makes it necessary to take the earth and the moon (at least) as one system.

In the reason given, though normally when taking the

earth as a single system, internal changes do not affect the motion, now that one has to take the earth-moon system, the reason that the earth's angular velocity can also change due to the events on earth alone cannot be ruled out. Then the total angular momentum of the earth-moon system will be conserved. The reason is also right, though according to the rules of the game for the 12<sup>th</sup> class examinations, one can take only the earth as a whole as a system. In that case, both the assertion and reason are wrong.

46. (c) : The base is lightly doped and very thin, this constructional feature is key of transistor action due to which only few holes (less than 5%) are able to combine with the electron in base region. Most of the holes coming from the emitter are able to diffuse through the base region to the collector region.

47. (a) : Assertion is true.  ${}_{38}^{90}\text{Sr}$  decays to  ${}_{39}^{90}\text{Y}$  by the emission of  $\beta$ -rays. Sr gets absorbed in bones along with calcium.

Reason is also true.  ${}_{38}^{90}\text{Sr} \xrightarrow{\beta} {}_{39}^{90}\text{Y}$

Strontium decays to Yttrium. This emits  $\beta$ -rays of very high energy. Sr does not emit  $\gamma$ -rays. The damage is by the  $\beta$ -rays only.

48. (c) : Many Morpho butterflies are coloured in metallic, shimmering shades of blue and green. These colours are not due to pigmentation but due to iridescence: the extremely fine lamellated scales covering the Morpho's wings reflect incident light repeatedly at successive layers leading to interference effect that depends on both the wavelengths and angle of incidence. Thus the colours produced vary with viewing angle. However they are actually surprisingly uniform, perhaps due to the tetrahedral (diamond-like) structural arrangement of scales or diffraction from overlying cell layers. This structure may be called photonic crystal.

49. (a) : For the human eye, the resolving power or angular separation of objects changes as distance from the object changes. Thus when we are close to the painting our eyes can pick out the separate colours of dots. But when we move away from the painting, our eyes blend the dots and we see different colours.

50. (a) : Since superconductors exist only below a certain critical temperature and above that temperature they behave like normal materials. When magnet is placed above superconductor and cooled using liquid nitrogen.

The induced magnetic field inside the superconductor is exactly equal and opposite in direction to the applied magnetic field, so that they cancel within the superconductor. These poles will repel each other and the force of repulsion is enough to float the magnet.

51. (a) : When a heavy nucleus splits into two medium-sized ones, each of the new nuclei will have more binding energy per nucleon than the original nucleus. The extra energy will be given off. e.g. if the uranium nucleus  ${}_{92}^{235}\text{U}$  is broken into two small nuclei, the binding energy difference per nucleon is about 0.8 MeV. The total energy given off is therefore

$$\frac{0.8 \text{ MeV}}{\text{nucleon}} \times 235 \text{ nucleon} = 188 \text{ MeV}$$

52. (c) : The excess pressure inside the small drop is large as compared to the large drop because of which smaller drop of liquid resists deforming force better than the large drop.

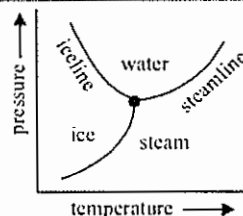
$$\text{Excess pressure} = \frac{2T}{r}$$

where  $T$  = surface tension

$r$  = radius of liquid drop.

Therefore excess pressure is inversely proportional to its radius and hence the surface area.

53. (b) :



It can be easily seen from the graph that as pressure increases the melting point of ice decreases.

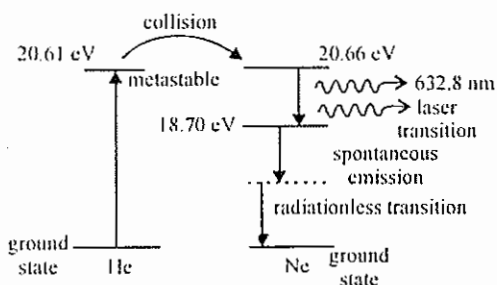
54. (a) : A bombarding particle gives up most energy when it makes an elastic collision with a particle of similar mass. For neutrons, hydrogen atoms would be most effective but unfortunately absorption occurs. However, deuterium (heavy water) and carbon (as graphite) are both suitable in which less absorption occurs. Therefore they are used as moderators.

55. (c) : If one takes two frames with origin  $O_1$  and  $O_2$  and if a body  $P$  is at rest, both according to  $O_1$  as well as  $O_2$ . The body is at rest. If the frame is moving with a constant velocity, the same observation will not be made. Therefore a frame moving with a constant velocity cannot be taken as an inertial frame. Assertion

is right.

But the reason given is wrong because the frame on which Newton's laws of motion are applicable is an inertial frame.

56. (b) : Helium-neon laser uses a gaseous mixture of helium and neon. An electric discharge in the gas pumps the helium atoms to higher energy level, (which is meta stable energy level).



Sequence of transitions in He-Ne laser.

Then these helium atom excite the neon atoms to higher level by collision and produce an inverted population of neon atom which emit radiation when they are stimulated to fall to lower level.

57. (b) : Input impedance of common emitter

$$\text{configuration} = \left. \frac{\Delta V_{BE}}{\Delta i_B} \right|_{V_{CE} = \text{constant}}$$

where  $\Delta V_{BE}$  = voltage across base and emitter,  
 $\Delta i_B$  = base current which is order of few microampere.

Thus input impedance of common emitter is low.

58. (a) : In an irreversible process, there always occurs some loss of energy. This is because energy spent in working against the dissipative force is not recovered back. Some irreversible processes occur in nature such as friction where extra work is needed to cancel the effect of friction. Salt dissolves in water but a salt does not separate by itself into pure salt and pure water.

59. (c) : For diffraction, the slit width should be of the order of the incident wavelength. The regular spacing of the atoms in crystal is of the order of wavelength of X-rays (0.1 nm) because of which X-rays are diffracted from the crystals.

60. (d) : Photoelectric effect can be explained on the

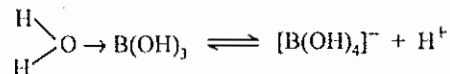
basis of quantum theory or particle nature of light where wave nature of light fails to explain the photoelectric effect. The number of photoelectrons is proportional to the intensity of incident light.

$I = n/h\nu$  where  $n$  is the number of photons emitted/absorbed per unit area per second.  $n$  and  $h\nu$  are independent factors.

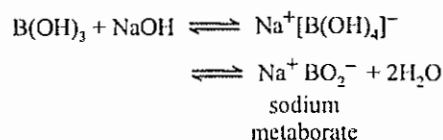
### CHEMISTRY

61. (c) :  $B(OH)_3$  in aqueous medium coordinates a molecule of water to form the hydrated species

$H \begin{array}{l} \diagup \\ O \\ \diagdown \\ H \end{array} \rightarrow B(OH)_3$ . In this species,  $B^{3+}$  ion, because of its small size, exercises a high polarizing power thereby pulling the sigma electron charge of the coordinated O atom towards itself. The coordinated oxygen, in turn, pulls the sigma electron charge of the OH bond of the attached  $H_2O$  molecule towards itself. This facilitates the removal of  $H^+$  ion from the O - H bond, as shown below.

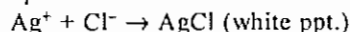


Thus the solution of  $B(OH)_3$  in water acts as a weak acid. That is why it reacts with NaOH solution to produce the sodium salt.

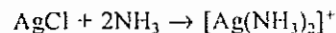


62. (b) : The total number of points of attachment to the central element is termed the coordination number and this can vary from 2 to as many as 16, but is usually 6. There is no way to predict the coordination number. The arrangement of coordination number 2 is not very common for first row transition metal ion complexes. Some of the best known examples for silver (I). For instance, a method often employed for the detection of chloride ions involves the formation of the linear diamminesilver(I) complex.

The first step is :



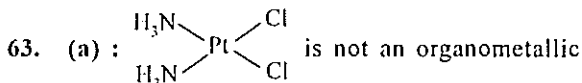
and to ensure that the precipitate is really the chloride salt, two further tests must be done:



and  $[Ag(NH_3)_2]^+ + HNO_3 \rightarrow AgCl \text{ (ppts.)}$

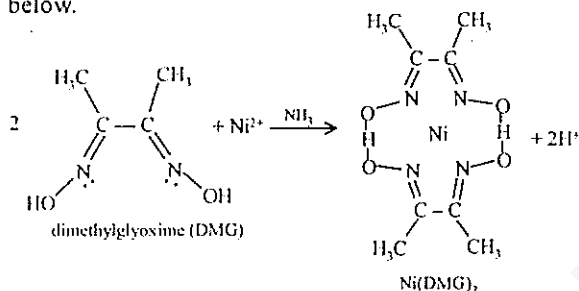
The reaction of a bidentate ligand such as

1,2-diaminoethane with  $\text{Ag}^+$  does not lead to chelated ring systems, but instead to linear two coordinate complexes. One reason for this is that bidentate ligands can not exist in trans arrangements that is they cannot span 180 degrees.



compound as it does not contain carbon-metal bond. Cisplatin is an inorganic compound, used as anticancer drug and falls into class of DNA damaging agents.

64. (d) : Nickel(II) forms a precipitate with the organic compound dimethylglyoxime,  $\text{C}_4\text{H}_6(\text{NOH})_2$ . The formation of the red chelate occurs quantitatively in a solution in which the pH is buffered in the range of 5 to 9. The chelation reaction that occurs is illustrated below.

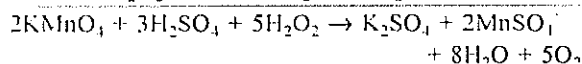
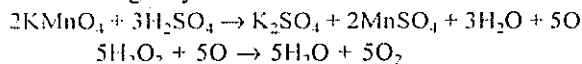


Although the loss of one proton occurs from one oxime group (NOH) on each of the two molecules of dimethylglyoxime, the chelation reaction occurs due to donation of the electron pairs on the four nitrogen atoms, not by electrons on the oxygen atoms. The reaction is performed in a solution buffered by either an ammonia or citrate buffer to prevent the pH of the solution from falling below 5. If the pH does become too low the equilibrium of the above reaction favors the formation of nickel(II) ion, causing the dissolution of  $\text{Ni}(\text{DMG})_2$  back into the mother liquor.

65. (a) : Stability of oxides of higher oxidation states decreases with increasing atomic number.

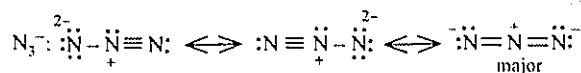
Nitrogen exhibits a large number of oxidation states such as -1, +2, +3, +4, +5 in  $\text{N}_2\text{O}$ , NO,  $\text{N}_2\text{O}_3$ ,  $\text{N}_2\text{O}_4$  and  $\text{N}_2\text{O}_5$ .

66. (c) : Acidified  $\text{KMnO}_4$  is decolourised by  $\text{H}_2\text{O}_2$  in following way.



Thus, for 2 moles of  $\text{KMnO}_4$  required  $\text{H}_2\text{O}_2 = 5$   
For 1 mole of  $\text{KMnO}_4$  required  $\text{H}_2\text{O}_2 = 5/2$  mole.

67. (c) : Azide ion is a linear molecule, it is a pseudo halide and formal oxidation state of N in azide ion is -1.



68. (a) : Optical isomerism is very common in octahedral complexes of general formulae,  $[\text{Ma}_2\text{b}_2\text{c}_2]^{n\pm}$ ,  $[\text{Mabcdef}]$ ,  $[\text{M}(\text{AA})_3]^{n\pm}$ ,  $[\text{M}(\text{AA})_2\text{a}_2]^{n\pm}$ ,  $[\text{M}(\text{AA})\text{a}_2\text{b}_2]^{n\pm}$ ,  $[\text{M}(\text{AA})_2\text{ab}]^{n\pm}$  and  $[\text{M}(\text{AB})_3]^{n\pm}$ , where AA is symmetrical bidentate ligand and AB is unsymmetrical bidentate ligand.

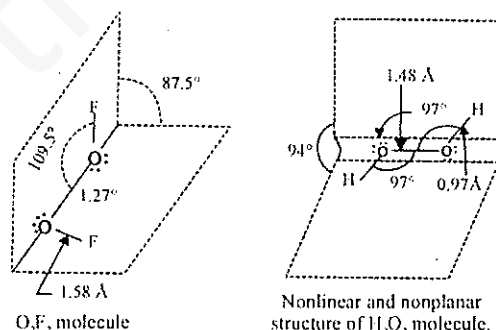
Octahedral complex of the type  $\text{Ma}_3\text{b}_2$  and  $\text{Ma}_3\text{b}_3$  exhibit geometrical isomerism.

69. (d) : 

	F	Cl	Br	I
Electron affinity	-3.6	-3.8	-3.5	-3.2

The low value of electron affinity of fluorine is probably due to small size of fluorine atom, i.e. electron density is high which hinders the addition of an extra electron.

70. (b) :  $\text{O}_2\text{F}_2$  and  $\text{H}_2\text{O}_2$ , both have open book type structure.



In  $\text{O}_2\text{F}_2$ , one O-O bond and two O-F bonds are lying in different planes, i.e. this molecule like  $\text{H}_2\text{O}_2$  has nonlinear and non-planar structure.

71. (a) : Gallium is a chemical element in the periodic table that has the symbol Ga and atomic number 31. A rare, soft silvery metallic poor metal, gallium is brittle at low temperature but is liquid above room temperature and can indeed melt in the hand.

Gallium metal expands by 3.1 percent when it solidifies, and therefore should not be stored in either glass or metal containers. Gallium also corrodes most other metals by diffusing into their metal lattice.

72. (c) : According to "solubility rule" following compounds are soluble in water:





86. (a)

87. (c) : Melting points are normally higher for primary amides due to presence of hydrogen bonding.

88. (d) : Pyridine chloro chromate (PCC)  $[C_5H_5NH^+ClCrO_3^-]$  selectively oxidizes primary alcohols to aldehydes. Secondary alcohols can be oxidized to ketones with PCC.

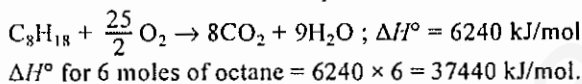
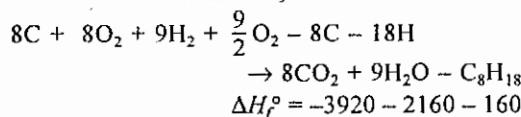
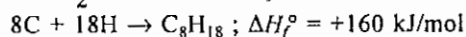
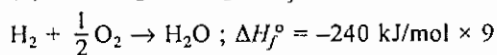
89. (d)

90. (b) :  $n = 4$ 

$$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14}$$

 $l = 3$  only for  $f$  orbital.Thus the total number of orbitals for  $l = 3$  is equal to 7 (because  $f$  contains seven orbitals).91. (b) :  $\pi = CRT$ 

$$C = \frac{\pi}{RT} = \frac{7.8}{0.082 \times 310} = 0.31 \text{ mol/L.}$$

92. (b) :  $C + O_2 \rightarrow CO_2$ ;  $\Delta H_f^\circ = -490 \text{ kJ/mol} \times 8$ 93. (b) :  $H_2O_{(l)} \rightleftharpoons H_2O_{(g)}$ This is a spontaneous process at standard conditions thus, the standard free energy change must be less than zero, i.e.  $\Delta G^\circ < 0$ .94. (b) : When  $a = b \neq c$ ,  $\alpha = \beta = 90^\circ$ ,  $\gamma = 120^\circ$ .

The given condition is characteristic of hexagonal system.

95. (c) :  $K = Ka_1 \times Ka_2 = 4.5 \times 10^{-3} \times 1.7 \times 10^{-10}$   
 $= 7.65 \times 10^{-13}$ 

$$[H^+] = \sqrt{KC} = \sqrt{7.65 \times 10^{-13} \times 0.01}$$

$$= \sqrt{7.65 \times 10^{-15}} = 0.87 \times 10^{-7}$$

$$pH = -\log 0.87 \times 10^{-7} = 7 - 0.93 = 6.07.$$

96. (c) : The given reaction is endothermic, so on increasing the temperature, it will shift in forward direction.

97. (c) : In Daniel cell, during the passage of electric current through external circuit, electrons flow from the zinc electrode to the copper electrode. At the zinc electrode, the zinc metal is oxidised to  $Zn^{2+}$  which gointo the solution. The electrons released at the electrode travel through the external circuit to the copper electrode where they are used in the reduction of  $Cu^{2+}$  ions to metallic copper which is deposited on the electrode.

98. (a) : The substance which is susceptible of degradation by biological processes, as by bacterial or other enzymatic action is known as biodegradable substance.

99. (d) :  $k = \frac{1}{t} \ln \frac{a \text{ (initial)}}{a-x \text{ (after time } t)}$ 

$$k_t = \ln \frac{[N_2O_5]_0}{[N_2O_5]_t}$$

100. (a) : Ozone depletion is caused by a number of pollutants like chlorofluorocarbons (14% of total depletion), nitrogen oxides, sulphur oxides,  $CCl_4$ ,  $Cl_2$  etc. Maximum ozone depleting potential or OPD is of chlorofluorocarbons ( $CF_2Cl_2$ ) due to release of chlorine by it. A single chlorine atom converts 1 lakh molecules of ozone to oxygen.

101. (b) : Greater the number of negative atoms present in the oxy-acid make the acid stronger.

In general, the strengths of acids that have general formula,  $(HO)_mZO_n$  can be related to the value of  $n$ . As the value of  $n$  increases, acidic character also increases. The negative atoms draw electrons away from the Z-atom and make it more positive. The Z-atom, therefore, becomes more effective in withdrawing electron density away from the oxygen atom that bonded to hydrogen. In turn, the electrons of H-O bond are drawn more strongly away from the H-atom. The net effect makes it easier from the proton release and increases the acid strength.102. (c) :  ${}_{24}Cr \rightarrow [Ar] 3d^4 4s^2$ Full-filled  $s$ -orbital has greater stability.103. (d) :  $[Ni(en)_3]Cl_2$  is a chelating compound and chelated complexes are more stable than similar complexes with unidentate ligands as dissociation of the complex involves breaking of two bonds rather than one.In  $[Ni(en)_3]Cl_2$ , Ni with  $d^8$  configuration shows octahedral geometry. Six electrons will occupy the  $t_{2g}$  orbitals and two electrons will occupy the  $e_g$  orbitals.104. (c) : Sb(III) is a basic radical of IIB group for which group reagent is  $H_2S$  in presence of dilute HCl. It is necessary to maintain the proper hydrogen ion

concentration for the precipitation of IIInd group cations and to check the precipitation of IV group cations.

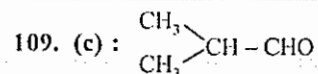
105. (d) : Binding energy per nucleon of  ${}^7_3\text{Li}$  (5.38 MeV) is lesser than  ${}^4_2\text{He}$  (7.08 MeV) as helium is found to be more stable than Li. As the atomic mass number increases, the binding energy per nucleon decreases. As the atomic number and the atomic mass number increase, the repulsive electrostatic forces within the nucleus increase due to the greater number of protons in the heavy elements. To overcome this increased repulsion, the proportion of neutrons in the nucleus must increase to maintain stability. This increase in the neutron-to-proton ratio only partially compensates for the growing proton-proton repulsive force in the heavier, naturally occurring elements. Because the repulsive forces are increasing, less energy must be supplied, on the average, to remove a nucleon from the nucleus. The BE/A has decreased. The BE/A of a nucleus is an indication of its degree of stability. Generally, the more stable nuclides have higher BE/A than the less stable ones. The increase in BE/A as the atomic mass number decreases from 260 to 60 is the primary reason for the energy liberation in the fission process. The increase in the BE/A as the atomic mass number increases from 1 to 60 is the reason for the energy liberation in the fusion process, which is the opposite reaction of fission.

106. (b) : Enamel, the hardest substance of the body is composed of fluorine not magnesium. Magnesium is an essential element as it acts as a factor of many enzymes of glycolysis and a number of other metabolic reactions dependent upon ATP.

107. (c) : Carboxypeptidase is an exopeptidase because it breaks the peptide chain at terminal ends. Carboxypeptidase cleaves carboxy-terminal amino acids that have aromatic or branched aliphatic side chains.

108. (a) : Sucrose is a non-reducing sugar as it does not reduce Tollen's or Fehling's reagent, due to absence of free aldehyde or ketone group. It contains stable acetal or ketal structure which cannot be opened into a free carboxyl group.

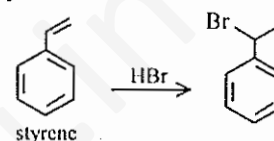
Sugar is composed of  $\alpha$ -D-glucopyranose unit and  $\beta$ -D-fructofuranose unit. These units are joined by  $\alpha$ - $\beta$ -glycosidic linkage between C-1 of the glucose unit and C-2 of the fructose unit.



Isobutanal has  $\alpha$ -hydrogen atom.

Acetaldehyde, acetone and methyl ketones having  $\text{CH}_3\text{CO}$  group undergo haloform reaction. The hydrogen atoms of the methyl group are first replaced by halogen atoms. This reaction is used as a test of  $\text{CH}_3\text{CO}$  - group. Due to absence of  $\text{CH}_3\text{CO}$  - group isobutanal does not give iodoform test.

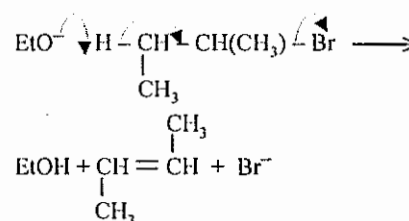
110. HBr adds to the double bond of the styrene forming 1-bromo-1-phenylethane.



This is an example of elimination-addition reaction.  
Note : Here given assertion is wrong.

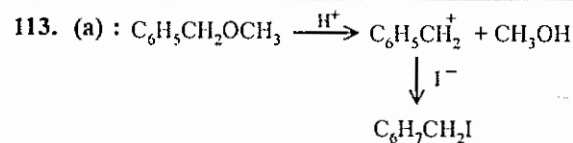
111. (c) : Lower the value of  $\text{p}K_a$ , more acidic will be the compound. Acetic acid is more acidic than phenol. This indicates that carboxylate ion should be more stable than the phenoxide ion and it is clear that carboxylate ion has more equivalent resonating structures than the phenoxide ion.

112. (d) : 2-bromobutane on reaction with sodium ethoxide in ethanol gives 2-butene as a major product.



This is according to Saytzeff's rule i.e. the predominant product is the most substituted alkene, i.e. are carrying the largest number of alkyl substituents of hydrogen is eliminated preferentially from the carbon atom joined to the least number of hydrogen atoms.

2-butene is more stable than 1-butene due to presence of large number of hyperconjugating structures in 2-butene.



This can be explained on the basis of  $\text{S}_{\text{N}}1$  mechanism, the carbonium ion produced being benzylium ion, since this type is more stable than alkylum ion.

114. (b) : Molar entropy of vaporization of water is more than ethanol, as water has greater forces of attraction than ethanol.

115. (a) : The colour of colloidal solution depends on the wavelength of light scattered by the dispersed particles. The wavelength of light further depends on the size and nature of the particles. The colour of colloidal solution also changes with the way the observer receives the light. Finest gold sol is red in colour. As size of the particles increases, it becomes purple, then blue and finally golden yellow.

116. (d) : Copper corrods at negligible rates in unpolluted air, water and deaerated non-oxidising acids. Pure copper and the high copper alloys can be considered to exhibit similar resistance to most corrosive environments. They possess excellent resistance to atmospheric environments. (corrosion is a spontaneous process for which free energy change must be negative.

117. (c) :  $K_{sp}$  of AgCl >  $K_{sp}$  of AgBr.  
For the precipitation to occur, its ionic product should exceed solubility product.

118. (b) : Zeolites are shape-selective porous solid acid catalysts, their catalytic activity originates from the presence of highly acidic Al – O(H) – Si hydroxyl in the framework.

119. (c) : Due to greater lone pair - bond pair repulsions than bond pair - bond pair repulsions, the F – S – F bond angle decreases from 180°.

120. (c) : Molecular size decreases from left to right while it increases in a group from top to bottom. Thus molecular size of nitrogen is greater than oxygen.

### BIOLOGY

121. (d) : Cotton and other monocultured crops require an intensive use of pesticides as various types of pests attack these crops causing extensive damage.

So far, the only successful approach to engineering crops for insect tolerance has been the addition of Bt toxin, a family of toxins originally derived from soil bacteria. The Bt toxin contained by the Bt crops is no different from other chemical pesticides, but causes much less damage to the environment. These toxins are effective against a variety of economically important crops pests but pose no hazard to non-target organisms like mammals and fish. The Bt gene was isolated and transferred from

a bacterium *Bacillus thuringiensis* to American cotton. The American cotton was subsequently crossed with Indian cotton to introduce the gene into native varieties. Bt toxin protects the cotton plants from bollworm (*A. lepidoptera*), a major pest of cotton. The worm feeding on the leaves of a Bt cotton plant becomes lethargic and sleepy, thereby causing less damage to the plant.

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

123. (d) : A synapse occurs where the axon of one neurone (the pre-synaptic neurone) meets either the dendrite or the cell body of another (the post-synaptic neurone). At the tip of the pre-synaptic axon is a button shaped swelling called a synaptic knob, inside which are numerous mitochondria and vesicles packed with a substance called a neurotransmitter is present.

This neurotransmitters at the time of nerve impulse diffuse across the space and bind to receptors in the membrane of the post-synaptic cell. This opens ion channels in the post-synaptic membrane of the post-synaptic cell resulting in a change in the post-synaptic cell's membrane potential and (if the cell is sufficiently excited) in the consequent generation of a nerve impulse.

124. (d) : The two DNA strands are held together by weak (hydrogen) bonds between the bases on each strand, forming base pairs. Genome size is usually stated as the total number of base pairs; the human genome contains roughly 3 billion base pairs.

125. (c) : The great Barrier Reef - the largest system of coral reefs in the world - is more than 2,000 km in length and comprises 2,900 separate reefs and 940 islands. Its high species diversity includes more than 400 species of coral, 4,000 species of molluscs, 1,500 species of fish, 6 species of turtles, 35 species of seabirds and 23 species of sea mammals. The Great Barrier Reef is one of the richest and most complex natural systems in the world. The Reef's diverse range of habitats all connect and support each other, which means they are all vital to the life of the Great Barrier Reef.

126. (d) : The species or taxa, which are in dangers of extinction and which may not survive if the adverse factors continue to operate or the species whose numbers have been reduced to a critical level or their habitats have

been drastically reduced in such a way that they are in instant danger of extinction are called endangered species. In India, aconite and horn bill are endangered species.

**127. (a) :** Amphetamines are powerful drugs (stimulant), they 'speed' up the whole body, increasing the heart rate, blood pressure and breathing. Amphetamines make the user feel excited, confident and energetic. Some people use amphetamines to suppress their appetite, so they can go for a long time without eating. There are many health risks from taking this type of drug. Long-term use can cause mental illness and will put a strain on the heart, due to increased blood pressure.

**128. (b) :** SA node or sino-atrial node is known as the pacemaker of heart because the cells in the SA node contract the most number of times per minute and because each wave of excitation begins here and acts as the stimulus for the next wave of excitation.

**129. (b) :** The photosynthetic bacteria (e.g. purple non-sulphur bacteria) photosynthesise using bacteriochlorophylls *a* and *b* in anoxic environments, such as the bottom mud of ponds and other stagnant water, although they are able to survive in air. The reducing agent involved is hydrogen rather than water, so oxygen is not produced. These bacteria efficiently use infrared light for photosynthesis.

**130. (c) :** There are some rare cases in medical literature which could be interpreted as atavisms, that is the reappearance of our ancestor's organs, in which more prolonged traits, already lost by human beings throughout evolution, are expressed again. Such is the case of supranumerary mammary glands, sacral tail etc.

**131. (a) :** The Virus Research Centre (VRC), Pune came to existence in 1952 under the joint auspices of the ICMR and the Rockefeller Foundation, as a part of the global programme of investigations on the arthropod - borne group of viruses. In view of its expanded scope and activities, the VRC was redesignated as the National Institute of Virology (NIV) in 1978. The NIV is identified today as the WHO collaborating centre for arbovirus reference and research. NIV also acts as the National Monitoring Centre for Influenza and Hepatitis.

**132. (c) :** Electron Beam Therapy or radiation therapy involves the use of radioactive waves to treat certain types of cancer. The therapy can be given with external beams of radiation. Electron beams are of low energy.

They are often used in skin conditions and cancers. The procedure to deliver external beam radiation is somewhat similar to giving an X-ray. The person is put into position, and the machine delivers the radiation to the desired area. This beam therapy involves iodine, cobalt, protons and electrons. This therapy is used in cancer of cervix, cancer of larynx, germ cell cancer, Hodgkin's lymphoma, prostate cancer, breast cancer, lung cancer etc.

**133. (b) :** SARS (severe acute respiratory syndrome) has now affected 30 countries on five continents, with more than 8,000 cases and more than 900 deaths. The disease is due to infection with the SARS coronavirus (SARS-CoV). The genome of this virus has been completely sequenced. When viruses resembling SARS-CoV were isolated from Himalayan palm civets found in a live animal market in the Guangdong Province of China; it implicated these animals as the reservoir of the virus.

**134. (c) :** A better understanding of the mode of action of vitamin K is made possible by the use of an anti-coagulant. One such naturally occurring antagonist of vitamin K is known as Dicumarol. The discovery of the anti-coagulating property of Dicumarol took place when it was established that consumption of improperly cured sweet clover hay caused cattle to develop the so-called "sweet clover disease" which is attributable to a serious alteration in the coagulability of the blood that, in turn, often result in fatal haemorrhage.

**135. (c)**

**136. (b) :** Sulfur and nitrogen oxides emitted into the atmosphere react to form compounds that are transported long distances and are subsequently deposited to the Earth's surface in wet and dry forms. Although the term "acid rain" is widely recognized, the dry deposition portion ranges from 20 to 60 percent of total pollutant deposition, and represents the particulate and gaseous forms. A more accurate description of the overall process is acid deposition rather than acid rain.

Dry deposition occurs when sulfur dioxide and nitrogen oxides react, but not with water. It settles out of the atmosphere as particle or gases.

The effects of acid deposition include acidification of lakes and streams, nutrient enrichment of coastal waters and large river basins, soil nutrient depletion and decline of sensitive forests, agricultural crop damage, and impacts on ecosystem biodiversity. Toxic pollutants and metals

also can be transported and deposited through atmospheric processes. Both local and long-range emission sources contribute to atmospheric deposition.

**137. (c) :** Domestic sewage rich in organic waste will exert a very high demand of oxygen in order to get biodegraded. Thus depleting the dissolved oxygen below critical level necessary to support aquatic life. Especially fish, which is very sensitive to the dissolved oxygen available in water, starts dying if the level goes below 4 mg/L.

**138. (b) :** The Minamata disease got its name from Minamata Bay in Southwestern Japan where it was first observed in nearby communities. It was officially discovered in 1956, and a few years later it was known to be caused by ingestion of fish that had been contaminated by mercury left off from a chemical manufacturing plant. Levels of methylmercury chloride were very high: upto 50 ppm in fish and 85 ppm in shellfish from the contaminated areas. 121 people were poisoned from eating the contaminated fish, 46 of which died. Dogs, cats, pigs, rats and birds that were living around the bay also showed the signs of mercury poisoning, and many died.

The initial symptoms were numbness of the limbs and the area around the mouth, sensory disturbance, and difficulty with everyday hand movements. Also there occurred a lack of coordination, weakness and tremor, slowed and slurred speech, and altered vision and hearing. These symptoms worsened and led to general paralysis, involuntary movements, difficulty in swallowing, convulsions, brain damage and death.

**139. (c) :** A pacemaker (or "artificial pacemaker"), is a medical device designed to regulate the beating of the heart. The purpose of an artificial pacemaker is to stimulate the heart when either the heart's native pacemaker is not fast enough or if there are blocks in the heart's electrical conduction system preventing the propagation of electrical impulses from the native pacemaker to the lower chambers of the heart, known as the ventricles. Generally, pacemakers do not treat fast rhythms of the heart.

**140. (c) :** On September 14, 1990 researchers at the U.S. National Institutes of Health performed the first (approved) gene therapy procedure on four-year old Ashanti DeSilva. Born with a rare genetic disease called severe combined immune deficiency (SCID), she lacked

a healthy immune system, and was vulnerable to every passing germ. Children with this illness usually develop overwhelming infections and rarely survive to adulthood. In this gene therapy procedure, doctors removed white blood cells from the child's body, let the cells grow in the lab, inserted the missing gene into the cells, and then infused the genetically modified blood cells back into the patient's blood stream. Laboratory test have shown that the therapy strengthened her immune system.

**141. (a) :** After entering the wall of the embryo sac the pollen tube during its entry into the embryo sac passes through the nucellar cells and the synergids, e.g. *Fagopyrum*. The pollen tubes passes between the egg and one synergid. In *Cardiospermum*, it passes between embryo sac wall and synergid. In *Oxalis*, it passes directly through a synergid. In *Viola* it enters a synergid and makes its way through the base of the synergid. In normal cases only one synergid destroys by the impact of the pollen tube and the other remains intact until sometimes afterwards.

**142. (d) :** Southern blotting was named after Edward M. Southern who developed this procedure in Edinburgh University in the 1970's. Southern blotting is designed to locate a particular sequence of DNA within a complex mixture. For example, Southern Blotting could be used to locate a particular gene within an entire genome. The amount of DNA needed for this technique is dependent on the size and specific activity of the probe. Before, starting the procedure, the desired DNA should be isolated from a specific nucleated cell.

**143. (d) :** Even a single dose of thalidomide can cause severe birth defects or fetal death, thalomid (a form of thalidomide) must not be used during pregnancy. Pregnancy must be ruled out 24 hours before starting therapy with thalidomide. Women must be monitored for pregnancy while using thalomid because it can give rise to underdeveloped limbs in fetus.

**144. (d)**

**145. (c) :** During inversion a segment of chromosome gets inverted in the process of reattachment. Thus a chromosome having the genes A B C D E F G H I in linear order may get the segment D E F inverted. The new arrangement will be A B C F E D G H I. It is a chromosome aberration entailing two breaks in a chromosome followed by a reversal of the segment and consequently of the gene sequence in the segment.

Pericentric inversion includes the centromere in the inverted segment, whereas paracentric inversions do not.

146. (b)

147. (b) : Passive immunity may be artificially acquired, particularly when antiserum or antibodies produced by one individual are transfused into a second individual. In all cases, passive immunity represents the passive acquisition of an immune response that was actively acquired by another individual. Passive immunity can last for at most months since antibodies have a finite life span within the body.

148. (b) : *Pseudomonas aeruginosa* is a Gram-negative, aerobic rod belonging to the bacterial family *Pseudomonadaceae*. These bacteria are common inhabitants of soil water. They occur regularly on the surfaces of plants and occasionally on the surfaces of animals.

- The bacterium will grow in the absence of  $O_2$  if  $NO_3^-$  is available as a respiratory electron acceptor.
- *P. aeruginosa* possesses the metabolic versatility. Organic growth factors are not required, and it can use more than thirty organic compounds for growth.
- *Pseudomonas aeruginosa* is often observed growing in "distilled water" which is evidence of its minimal nutritional requirements.
- It is able to grow at temperatures as high as 42 degrees.
- Its tolerance to a wide variety of physical conditions, including temperature, contributes to its ecological success and makes it suitable for decomposing a variety of organic compounds in varied environmental conditions.

149. (c) : DNA is present both in mitochondria and chloroplast. The DNA molecules are circular, relatively small, double stranded (except for the DNA of some algae and protozoans). The mitochondrial DNA varies in size starting from 5  $\mu m$  to 30  $\mu m$ . Average length of chloroplast DNA is 45  $\mu m$ .

150. (c) : Cytokinins are a group of phenyl urea derivatives of adenine, one of the molecules in DNA during pruning axillary bud, which is under repression due to effect of auxin, get sensitized to cytokinin, which releases it from apical dominance.

**Cytokinin functions**

- Cytokinins promote cytokinesis. They are found

primarily in root meristems, embryos and fruits, and migrate from roots to the shoot systems of plants in xylem tissue.

- Cytokinins can promote axillary bud growth by over-riding the apparent inhibiting effect of auxin. This is one of the ways in which plants balance root and shoot growth. Shoot tip auxins inhibit lateral bud activation. Cytokinins produced in root meristems travel upward in xylem and if in higher concentration counter the inhibition of auxins to activate lateral buds.
- Cytokinins also retard leaf senescence, probably by stimulating RNA and protein synthesis and delaying degradation of chlorophyll.

151. (a) : Guard cells are semilunar or kidney shaped cells which surrounds the minute apertures of epidermis called stomata. Guard cells are living and have chloroplast. In sugarcane and in some other monocots like doob, maize guard cells are dumb bell shaped.

152. (b) : Analogous organs are those organs, which are different in origin but similar in function. Potato and sweet potato are absolutely different in their origin as potato is modified underground stem (tuber), while sweet potato is tuberous root. It means both have edible parts, which are different organs.

153. (c) : In *Ulothrix* sexual reproduction is of isogamous type. Two isogametes of + and - strain come together and fuse as a result a quadriflagellate zygospore is formed which floats on water after sometime it rests on the bottom of the pond at this time its four flagella disintegrate and a wall is formed surrounding it from all sides. After taking rest for a long period this zygote divides meiotically and gives rise to 16 zoospores. These zoospores come out of sac and give rise to the new plants of *Ulothrix*.

154. (d) : Due to continued formation of secondary tissues in the older stem and roots however the epidermis gets stressed and ultimately tends to rupture and followed by death of epidermal cells and outer tissues, and a new protective layer is developed called periderm. Structurally it consists of three parts Phellogen or Cork cambium, phellem or cork and phelloderm.

Usually in the periderm of most plants, certain areas with loosely arranged cells have been found, which possess more or less raised and corky spots where the underneath tissues break through the epidermis. Such areas are universally found in the stems of woody plants. These broken areas are called lenticels, which perform

the function of exchange of gases in the absence of stomata.

155. (c) : Somaclonal variation refers to all types of variation occur in plants regenerated from cultured cells or tissues. Genetic changes take place in plant tissue culture and these changes are passed to their progenies. This technology can be used for disease resistance, improvement of quality and yield in plants.

156. (d)

157. (c) : The companion cells occur only in angiosperms where they accompany most sieve tube elements. Companion cell is a specialised type of parenchyma cell which is closely associated in origin, position and function with sieve tube elements. These cells are living having abundant granular cytoplasm and a prominent elongated nucleus. Usually, the nuclei of the companion cell serve for the nuclei of the sieve tubes as they lack them. The companion cells do not contain starch. They live only so long as the sieve tube element with which they are associated and they are crushed with those cells. Longitudinal division of the mother cell of the sieve tube element forms the companion cells. One daughter cell becomes a companion cell and other sieve tube element.

158. (a) : During fertilization ventral canal cell and the neck canal cell, along with tip of the neck disintegrate and the neck forms a canal like passage full of mucilage and some chemicals like malic acids. These chemicals attract antherozoids (chemotactic movement of antherozoids) and one of the male gametes fuses with the oospore forming a diploid oospore. Water is essential for this process.

159. (b) : Cork cambium is a secondary lateral meristem that may arise from permanent living cells of hypodermis or outer cortex. It is composed of a single layer of meristematic cells. Its cells divide tangentially and periclinally toward the outer face and produce cork cells. These cells are compactly arranged and have thin cellulose walls in the beginning. As they mature there is a gradual loss of living matter and cells get elongated radially, vertically or tangentially. The cell walls become thick because of development of fatty substance called Suberin, which is impervious to water.

160. (b) :

$$\begin{array}{ccc} \text{AABBCC} & \times & \text{aabbcc} \dots\dots\dots \text{P} \\ & \swarrow \quad \searrow & \\ & \text{AaBbCc} \dots\dots\dots \text{F}_1 & \end{array}$$

∴ Number of heterozygote is 3

∴ Number of progenies in  $F_1$  will be  $2^n$  or  $2^3 = 8$ .

161. (a) : DDT or dichloro-diphenyl trichloroethane was the first important synthetic pesticide (organo chlorine) discovered in 1939 by a Swiss chemist Paul Muller. It was toxic to wide range of insect pests ("broad spectrum") yet appeared to have low toxicity to mammals. It was persistent *i.e.* didn't break down rapidly in the environment, so that it didn't have to be reapplied often. DDT was so effective at killing pests and thus boosting crop yields and was so inexpensive to make that its use quickly spread over the globe. Farmers used more and more DDT throughout the 1950s and 1960s to get an increased yield of crop.

162. (b) : Antidiuretic hormone (ADH) or vasopressin is secreted from posterior pituitary gland. It is released in response to a fall in the water content of blood plasma and lead to an increase in the permeability to water of the distal and collecting tubules of the nephron. Deficiency or hyposecretion of ADH results in diabetes insipidus. Diabetes insipidus is characterised by micturating dilute urine several times a day which results in excessive thirst (polydipsia) and dehydration.

163. (c) : Oparin and Sydney Fox held that large organic molecules synthesised abiotically on primitive earth and formed large colloidal aggregates due to intermolecular attraction. These colloidal particles were called coacervates. In coacervates, lipid molecules are joined end to end forming a layer around each aggregate. This represents a single lipid membrane. Coacervates divide by budding like bacteria.

164. (c) : Tapeworm belonging to phylum platyhelminthes, pinworms and roundworm belonging to phylum nematoda, are all endoparasites. They all are intestinal parasites. In case of *Taenia solium* man gets infection by uncooked or improperly cooked measly pork. Cysticercus becomes active on reaching the intestine. Proscotex everts or evaginates in the intestinal wall. *Ascaris*, being an endoparasite inhabits the small intestine of man, more frequently of children than of adults. Man gets infection through skin contact. *Enterobius vermicularis* or pinworm live in caecum, appendix and at the junction of large and small intestine. They are transmitted by the improper sanitary condition.

165. (c) : The fish meal is prepared from the wastes of fish oil or canning industry or from the whole fish of

non-oil type. The protein content of this meal is highly digestible, nutritive and of biological importance. Fish meal is also used for domestic animals like pigs, poultry, cattle etc.

**166. (b) :** Adaptation is the most basic and rather self-evident concept. It is the morphological or physiological modification in an organism to adjust itself in a particular environment. In some animals, it is known as mimicry as for example praying mantis or stick insect. The stick insect or praying mantis having green body colour exhibits close resemblance with twigs and foliage. It is a type of protective mimicry. They exhibit close resemblances also with the twigs in having slender body, attenuated limbs, sympathetic colouration and slow movement.

**167. (a) :** Carolus Linnaeus called humans as *Homo sapiens* or wise men and placed them along with apes and monkeys. There are certain similarities between human and chimpanzee. These are -

- (i) RNA content of diploid cells is similar
- (ii) DNA matching shows that human similarity is 100 % with chimpanzee and
- (iii) banding pattern of chromosomes shows very little difference in chromosomes 3 and 6 between humans and chimpanzee.

Thus it can be concluded that among the primates, chimpanzee is the closest relative of the present day humans.

**168. (d) :** Dope test is an official test to discover whether a person or animal taking part in a competition has been given any drugs (such as anabolic steroids, erythropoietin etc.) to make their performance better or worse. It is a type of blood test. Alcohol is not used in this purpose. Alcohol has an effect on cerebellum and it results into imbalanced muscular activities, posture etc.

**169. (b) :** Queen is the only fertile female in beehive, having immensely developed ovaries. She lives for several successive years laying about 2000 or more eggs a day and upto about 1,500,000 eggs during her life time. The queen has a remarkable capacity of controlling the fertilization of its eggs. A fertilized egg is laid in a worker or queen cell or honey comb, while an unfertilized egg in a drone cell, the latter develops parthenogenetically. The queen mates only once in a life time. The sperms stored in her spermatheca fertilize her eggs as long as she lives.

**170. (d) :** Assertion is false as the humans would require more gestation period (should have been 21 months as compared to 9 months and will increase). Similarly the head size is increasing (especially the frontal brain) hence growth rate needs to increase but surprisingly most of the brain growth occurs after birth till 2 years (when the anterior fontanelle close at 18 months) and some more till 30 years when finally the cranial sutures close. Thus an increase in brain/skull size would require increase in gestation period, hence both assertion and reason are false.

**171. (a) :** The Darwin Wallace theory of Natural Selection can be generalised as the change in species by the survival of an organismal type exhibiting a natural variation that gives it an adaptive advantage in an environment. Thus leading to a new environmental equilibrium. The idea of the survival of the fittest explain the above evolution by natural selection. According to survival of fittest, some of the variations exhibited by living things make it easier for them to survive and reproduce thus more adaptive forms increase. Those which are not fit (or less adaptive) become eliminated.

**172. (b) :** Rhizome is normally a prostrate, thickened stem, creeping horizontally under the surface of the soil. The common example is ginger. It is provided with distinct node and long or short internode. It bears some scaly leaves at the nodes, possesses a bud in the axil of the scaly leaf and ends in a terminal bud.

The response of plant to gravity is called **geotropism**. The roots are *positively geotropic* and grow downwards, while the shoot is *negatively geotropic* and grows away from the gravitational pull from the centre of earth. Parts which show no effect of gravity are called **ageotropic**.

**173. (c) :** Flowering is a phytochrome regulated process. Phytochrome is a blue protein pigment with a molecular mass of about 125 k Da (kilodaltons). Phytochrome occurs in two interconvertible form  $P_R$  (which absorbs red light) and  $P_{FR}$  (which absorbs far red light). The studies with mutants of *Arabidopsis* support and prove that the  $P_{FR}$  is the active form of phytochrome. When  $P_R$  molecules are exposed to red light, most of them absorb it and converted to  $P_{FR}$ . This causes floral induction in the shoot. A night interruption inhibits flowering of short-day plants and promotes flowering of long-day plants. Red light is more effective with short-day plants and a mixture of red and far-red with long-day plants.



174. (b) : Cyclic pathway of photosynthesis is appeared first in some eubacterial species. It is supposed to be the first evidence of production of ATP in the presence of light. During non-cyclic photophosphorylation photolysis of water takes place. Under the influence of light energy and the catalytic action of chlorophyll, water, a substance of low energy value, is split up into oxygen and hydrogen. Oxygen is used in the chloroplast. Non-cyclic photophosphorylation is the only natural process which adds molecular oxygen to the atmosphere.

175. (d) : Symbiotic nitrogen fixation occurs in legume plants. It takes place in the *Rhizobium* bacteroids which are located within root nodules cells. *Rhizobium* is an aerobic bacteria and hence it survive in presence of oxygen. But the important enzyme *Nitrogenase* (synthesised by *Rhizobium*) that reduces  $N_2$ , is oxygen sensitive. It can only function at low oxygen concentration. This low oxygen concentration in bacteroid is provided by leghaemoglobin. Leghaemoglobin (pink in colour) is a form of haemoglobin found in the nitrogen fixing root nodules of legume. They bound oxygen and thus protect the nitrogen fixing enzyme, nitrogenase (that is oxygen sensitive). It regulates oxygen diffusion to bacteroids and nitrogenase.

176. (a) : In some species of red algae called coralline algae, the cell walls become hardened with calcium carbonate. These algae hence important for the formation of coral reefs.

Coral reefs are formed through the accumulation of calcareous exoskeletons of coral animals, calcareous red algae and molluscs. They form the foundation of reefs by secreting a calcium carbonate skeleton that provides protection for the coral polyps. Calcium carbonate is secreted continuously by the coral colony.

177. (d) : Insect visit flowers to get nectar. Nectar is contained in a special gland called nectary and sometimes in a special structure called spur.

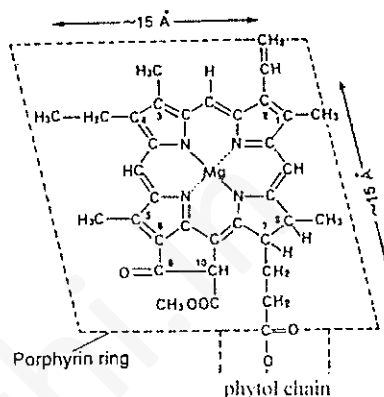
The attraction of flower in plants is not to diverge the insect from damaging other part, but to bring about pollination (*i.e.* transfer of pollen to the stigma). The pollen grains in insect pollinated flowers are either sticky or provided with spinous outgrowths. The stigma is also sticky. Insect often visit these flower for nectar and inadvertently bring about pollination.

178. (b) : Coconut require the hot and wet climate hence it is grown in coastal areas. It is widely grown in coastal and deltic regions of tropical and subtropical

countries.

Coconut fruit show hydrochory *i.e.* the dispersal takes place through water medium. Being the habitant of coastal area the fruit is so adapted that it can float and dispersed over thousand of kilometers before losing viability.

179. (e) : Sulphur is not a constituent of chlorophyll but it helps in chlorophyll formation. Due to the deficiency of sulphur, chlorosis often appears first in the young leaves. Mineral constituent of chlorophyll is magnesium which is situated in the centre of the porphyrin ring.



180. (b) : Superovulation is an effort to increase the fertility of cattle breeds. Inducing an animal to ovulate multiple oocytes can translate into producing more offsprings from selected females. Superovulation and embryo transfer involves the following steps.

- Donor cows of particularly fine pedigree are treated with hormones (mainly FSH and LH) to increase the number of eggs released at ovulation - multiple ovulation (MO)
- The cows are artificially inseminated using semen from a proven bull
- After 6 - 7 days the embryos are flushed out non-surgically, using a catheter placed into the uterus. This is possible because, in cattle, there is delay in embryos becoming implanted in the uterine wall. On average, 4-7 embryos are collected.
- The embryos may then be implanted into recipient cows whose oestrous cycle is at the correct receptive stage - usually as the result of hormonal manipulation.
- Embryos may be frozen and stored, using techniques similar to those applied to semen, (though precise control of the regime is somewhat more critical).

Farmers may, of course, buy-in embryos from sources anywhere in the world to transfer to their own recipient cows.

Embryo transfer has the potential to bring about genetic improvement twice as fast as AI (Artificial Insemination) alone.

**GENERAL KNOWLEDGE**

181. (d)

182. (a)

183. (b)

184. (c)

185. (a)

186. (a)

187. (a)

188. (b)

189. (d)

190. (b)

191. (b)

192. (a)

193. (c)

194. (d)

195. (b)

196. (a)

197. (b)

198. (d)

199. (a)

200. (c)

