Answers With Explanations

1. (1) From thermol effect,

$$T_i - T_n = T_n - T.$$

Where T_i = temp. of inversion.

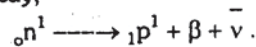T_n = Neutral temp.

T = temp. of cold junction

$\Rightarrow \quad 2T_n = T_i - T.$

But $T = 0$,

$\therefore \quad T_n = \dfrac{T_i}{2}$

2. (2) In β – decay,

$$_0n^1 \longrightarrow \,_1p^1 + \beta + \bar{v}.$$

So, the neutron given β - particle

3. (3) According to question

$$\tan\theta = \dfrac{3}{\sqrt{3}} = \sqrt{3} = \tan 60^\circ$$

$\therefore \quad \theta = 60^\circ$

4. (2) The shunt resistance

$$S = \dfrac{i \times R}{i - i_a}$$

where i = total current

i_a = ammeter current

$\Rightarrow \quad S = \dfrac{100 \times 13}{750 - 100}$

$= \dfrac{1300}{650}$

$= 2\Omega.$

5. (2) $\phi = \phi + 4t$

$\therefore \quad Vp = \dfrac{d\phi}{dt} = 4.$

Again, $\quad n_p = 50, n_s = 1500$

and $\quad \dfrac{Vs}{Vp} = \dfrac{n_s}{n_p}$

$\therefore \quad Vs = Vp \times \dfrac{n_s}{n_p}$

$= 4 \times \left(\dfrac{1500}{50}\right)$

$= 120$

6. (3) Since $Y = a.\sin\omega t$

at $Y = a/2$

$\dfrac{a}{2} = a.\sin\omega t$

$\Rightarrow \quad \sin\omega t = \dfrac{1}{2} = \dfrac{\pi}{6}$

$\therefore \quad t - \dfrac{\pi}{6\omega} = \dfrac{T}{12}$

7. (1) In this diagram, the conduction band came near the valence band.

8. (4) Since, $N = N_o.e^{-\lambda t}$

$\therefore \quad N_1 = N_o e^{-5\lambda t}$

and $\quad N_2 = N_o e^{-\lambda t}$

$\therefore \quad \dfrac{N_1}{N_2} = \dfrac{e^{-5\lambda t}}{e^{-\lambda t}} = e^{-4\lambda t}$

$\Rightarrow \quad \dfrac{N_1}{N_2} = \left(\dfrac{1}{e^{4\lambda t}}\right)$

A.T.Q :

$\dfrac{N_1}{N_2} = \dfrac{1}{e^2}$

$\therefore \quad \dfrac{1}{e^{4\lambda t}} = \dfrac{1}{e^2}$

$\therefore \quad 4\lambda t = 2$

$\Rightarrow \quad t = \dfrac{2}{4\lambda} = \dfrac{1}{2\lambda}$

9. (1) Since $I = \dfrac{q}{t} = q \times \dfrac{\omega}{2\pi}.$

and $\quad \omega = \dfrac{V}{R}$

$\therefore \quad I = \dfrac{qv}{2\pi R.}$

$\therefore$ magnetic moment

$= \mu = I.A$

$= \dfrac{qv}{2\pi R} \times \pi R^2$

$= \dfrac{1}{2} qvR.$

10. (2) Since $L = mvr.$

So, for the same distance,

$$L_A = L_B.$$

11. (2) Since $F = k.a$

A.T.Q :- $F = ma$

$\therefore \quad ka = mg$

$\Rightarrow \quad a = \dfrac{mg}{k} = \dfrac{2 \times 10}{200}$

$= 10cm$

12. ...etic field only the particle moves in circular path.

13. (3) A . C. power $\dfrac{= \Delta V_c}{\Delta V_i} \times \dfrac{\Delta i_c}{\Delta i_b}$

$\qquad = \dfrac{\Delta V_c}{\Delta V_i} \times \dfrac{\Delta i_c}{\Delta i_b}$

$\qquad = A_V \times \beta_{AC}$

$\therefore \qquad A_V = \beta_{AC} \times$ resistance gain

$\therefore \qquad \beta_{AC} = \dfrac{A_V}{r} = \dfrac{50 \times 100}{200}$

$\qquad = 25$.

14. (1) The instantaneous velocity and acceleration of a particle executing S . H . M is $90°$

15. (4) Since $R = \dfrac{V}{i} = \dfrac{W}{qi}$

$\qquad = \dfrac{ML^2T^{-2}}{[IT].[I]}$

$\qquad = ML^2T^{-3}.I^{-2}$

16. (3) $C = \dfrac{\theta}{l.\alpha} =$

where, $\qquad \theta =$ angle of rotation

$\qquad \qquad \alpha =$ specific rotation

$\therefore \qquad C = \dfrac{0.4}{0.25 \times 0.01} = 160 \, kg/m^3$

$\therefore \qquad$ purity of sugar solution

$\qquad = \dfrac{160}{200} \times 100 = 80\%$

17. (3) Air resistance for streamlined surface is minimum. and maximum resistance for maximum surface.

18. (1) Since

$\qquad \dfrac{1}{F} = \dfrac{1}{f_1} + \dfrac{1}{f_2}$

$\qquad = \dfrac{1}{\infty} + \dfrac{1}{f}$

$\qquad = \dfrac{1}{f}$

$\therefore \qquad F = f.$

Again, $\dfrac{1}{F} = \dfrac{1}{f'_1} + \dfrac{1}{f'_2}$

$\qquad = \dfrac{1}{f} - \dfrac{1}{f}$

$\therefore \qquad F' = \infty$

19. (3)

20. (3) The gas behaves ideally. There is no deviation in the value of $\dfrac{pV}{nT}$ for different temperatures T_1

and T_2 for increasing pressure is represented by dotted line. Hence, dotted line corresponds to 'ideal' gas behaviour.

(ii) Higher the temperature lesser is deviation of gas. Deviation of $T_2 >$ Deviation of T_1

Hence, $\qquad T_1 > T_2$

(iii) Since the point of intersection lies on dotted line, the value of $\dfrac{pV}{nT}$ at that point on the y-axis is same for all gases.

21. (2) Since, $n = \dfrac{\sin i}{\sin r} = \dfrac{\theta}{r}.$ (For small angles)

$\therefore \qquad d = t\left(\theta - \dfrac{\theta}{n}\right)$

$\qquad = t\theta\left(1 - \dfrac{1}{n}\right)$

$\qquad = \dfrac{t\theta(n-1)}{n}$

22. (3) From law of conservation of energy .

$\qquad K.E + P.E = const$

$\dfrac{1}{2}mV_i^2 - \dfrac{GM_E.m}{10.R} = \dfrac{1}{2}mV_f^2 - \dfrac{G.M_E m}{R}$

$\Rightarrow \dfrac{1}{2}mV_f^2 = \dfrac{1}{2}mV_i^2 + \dfrac{G.M_E m}{R} - \dfrac{G.M_E m}{10R}$

$\Rightarrow V_f^2 = V_i^2 + \dfrac{2G.M_E}{R_E} - \dfrac{2G.M_E}{10R}$

$\qquad = V_i^2 + \dfrac{2G.M_E}{R_E}\left(1 - \dfrac{1}{10}\right)$

23. (2) According to Fleming's left hand rule .

24. (4)   **25.** (1)

26. (1)

27. (1) From conservation of energy

$\qquad mgh = \dfrac{1}{2}mv^2 + mgh_2$

$\Rightarrow \qquad mg(h - h_2) = \dfrac{1}{2}mv^2$

$\therefore \qquad v = \sqrt{2g(100 - 20)}$

$\qquad = \sqrt{2 \times 10 \times 80}$

$\qquad = 40 \, m/sec.$

28 (1) This figure is not exact but it is correct .

29. (4) Since $\beta = a \log\left(\dfrac{I}{I'}\right)$

$\therefore \qquad \beta_1 = 10\log\left(\dfrac{I}{I_0}\right)$

and $\quad \beta_2 = 10 \log\left(\dfrac{I'}{I_o}\right)$

$\therefore \quad \beta_2 - \beta_1 = 20$

$\therefore \quad 20 = 10.\log\left(\dfrac{I'}{I}\right)$

$\Rightarrow \quad I' = 100\, I.$

30. (1) Here all the plates except last one is taking part in formation of capacitor so, these capacitors are in parallel and n plates forms (n – 1) no. of capacitors.

So, the equivalent capacitance
$$= (n-1).C.$$

31 (2) Since $\quad I = I_o.\cos^2\theta$

$\therefore \quad$ The graph for intensity and angle is of type (2).

32 (1) Time constant of RC circuit
$$= \tau = RC = 10^4 \times 10^{-10}$$
$$= 10^{-6}\text{sec.}$$

For demodulation

$\Rightarrow \quad f_c \gg \dfrac{1}{RC.}$

$\Rightarrow \quad f_c \gg 10^6 \text{Hz}$

$\Rightarrow \quad f_c \gg 1\text{MHz}$

33. (2) $V = \dfrac{\text{Volt}}{\text{emf}} \times \text{rpm}$

$$= \dfrac{120}{100} \times 1500$$
$$= 1800\text{rpm}.$$

34. (3) No. of photons reaching

$= n = \dfrac{\text{Energy Received from sun}}{\text{Energy of one photon}}$

$$= \dfrac{E}{hc/\lambda}$$

$$= \dfrac{E \times \lambda}{hc}$$

$$= \dfrac{8.4 \times 5500 \times 10^{-10}}{6.6 \times 10^{-34} \times 3 \times 10^8}$$

$$= 2.3 \times 10^{19}$$

35. (1) Binding Energy $= \dfrac{hc}{\lambda} - E$

Since energy of incident photon

$= E = \dfrac{hc}{\lambda} = \dfrac{6.6 \times 10^{-34} \times 3 \times 10^8}{4.9 \times 10^{-10}}$

$$= 2.54 \text{ kev}.$$

Now for cloud chamber, the energy is

$$E = \dfrac{R_2}{\propto} = \dfrac{2.02}{1} = 2.02\text{kev}$$

$\therefore$ Binding Energy $= 2.54 - 2.02$
$$= 0.52\text{kev}$$

36. (1) Since $\lambda_{min.} = \dfrac{hc}{b}$

$$= \dfrac{4.14 \times 10^{-15} \times 3 \times 10^8}{35 \times 10^3}$$

$$= 3.55 \times 10^{-11}\text{m}.$$

$$= 35.5\text{pm}.$$

37. (2) Change in temp.

$$\Delta T = \dfrac{Q/m}{s}$$

where S = specific heat.

$\therefore \quad \Delta T = \dfrac{3}{4180} = 7.2 \times 10^{-4}\text{k}$

$$= 700\mu\text{k}.$$

38. (4) The no. of argon atom present

$$N_{Ar} = N_o - N$$
$$= N_o - N_o.e^{-\lambda t}$$
$$N_o e^{-\lambda t} = N_o - N_{Ar}$$

$\Rightarrow \quad e^{-\lambda t} = \left(1 - \dfrac{N_{Ar}}{N_o}\right)$

Taking log on both the sides, we get

$$-\lambda t = \ln\left(1 - \dfrac{N_{Ar}}{N_o}\right)$$

$\Rightarrow \quad \lambda t = \ln\left(1 + \dfrac{N_{Ar}}{N_o}\right)$

$\therefore \quad t = \dfrac{\ln\left(1 + \dfrac{N_{Ar}}{N_o}\right)}{\lambda}$

$$= \dfrac{T_{1/2}\ln\left(1 + N_{Ar}/N_o\right)}{\ln 2}$$

$$= \dfrac{(1.25 \times 10^9) \times [\ln(1 + 10.3)]}{\ln 2}$$

$$= 4.37 \times 10^9 \text{years}.$$

39. (1) Here the positive velocity represents upward motion and negative velocity represents downward motion.

40. (1) Since $v \propto [g]^a[h]^b[\lambda]^c$.

$$ML^1T^{-1} = k[MT^{?}]^a[ML^{3}]^b[L]^c$$

$$= k.[M]^{a+b}[L]^{-3b+c}[T]^{-2a}$$

Equating the power on both the sides, we get

$$a + b = 0.$$
$$-3b + c = 1$$
$$-2a = -1$$

$$\therefore \quad a = \frac{1}{2},$$

$$b = -\frac{1}{2},$$

$$c = -\frac{1}{2},$$

$$\therefore \quad v \propto \sigma^{1/2}.\rho^{-1/2}.\lambda^{-1/2}.$$

$$\Rightarrow \quad v^2 \propto \frac{\sigma}{\rho\lambda}.$$

41. (1) When a person is high up on the ladder, then a large torque is produced due to his weight about the point of contact between the ladder and the floor. Whereas when he starts climbing up, the torque is small . Due to this reason the ladder is more apt to slip, when one is high up on it .

42 (4) The period of the liquid executing SHM in a U-tube does not depend upon the density of the liquid.

So, as the pendulum oscillates, its amplitude goes on decreasing .

43. (1) The average density of cargo vessels must be less than that of water so, the concrete cargo vessels did not sink .

44. (2) The antenna of portable AM radio is sensitive to only magnetic components of electromagnetic waves.

45. (1) The greenhouse effect is the rise in temperature that the Earth experiences because certain gases in the atmosphere (water vapor, carbon dioxide, nitrous oxide, and methane, for example) trap energy from the sun. Without these gases, heat would escape back into space and Earth's average temperature would be about 60°F colder. Because of how they warm our world, these gases are referred to as greenhouse gases.

46. (1) In LED (Light emitting diode) the energy is released at the junction due to the recombination of electron and holes in forward biased .

The LED is a specialised form of PN junction that uses a compound junction. The semiconductor material used for the junction must be a compound semiconductor. The commonly used semiconductor materials including silicon and germanium are simple elements and junction made from these materials do not emit light. Instead compound semiconductors including gallium arsenide, gallium phosphide and indium phosphide are compound

semiconductors and junctions made from these materials do emit light.

47. (1) Optical communication is a system by which we transfer the informations over any distance from one location to other through optical range of frequency using optical fibre. The optical interference between fibres is zero. Hence, optical fibre communication has immunity to cross talk. Optical fibres are almost completely immune from external fields. They do not suffer from cross-talk, radio interference, etc.

48. (3) The term Albedo explains the reflecting power of planet to reflect the light which is incident on it. Albedo (Al-bee-dough): the fraction of the incident sunlight that is reflected. When an object reflects most of the light that hits it. it looks bright and it has a high albedo. When an object absorbs most of the light that hits it, it looks dark.   Dark objects have low albedos. With the knowledge of Albedo we can confirm the presence of atmosphere clouds at the planet.

49. (2) The energy gap between valence band and conduction band in germanium is 0.76 eV and the energy gap between valence band and conduction band in silicon is 1.1 eV . Also it is true that thermal energy produces fewer minority carriers in silicon than in germanium.

50. (4) When some medium of refractive index μ and thickness 't' is placed between the path then the effective path of ray of light increases as $(\mu - 1)$.

But the zero fringe made by the two wave which shifts by the similar path. So, there is no shift in central fringe.

51. (4) From lens maker formula.

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

So for the biconvex lens the formula remains same.

52. (4) For inclined plane, the reactional force

$$= R = mg\cos\theta.$$

Again, the resultant force .

$$f = F - \mu R$$
$$ma. = mg\sin\theta - \mu mg\cos\theta$$
$$= mg(\sin\theta - \mu\cos\theta)$$
$$\therefore \quad a = g.(\sin\theta - \mu\cos\theta)$$

53. (2) There are two types of electron microscope :

(i) Transmission Electron Microscope (TEM) : It is used to study internal structure of the specimen . and gives 2 D view . The transmission electron microscope (TEM) operates on the same basic principles as the light microscope but

uses electrons instead of light. What you can see with a light microscope is limited by the wavelength of light. TEMs use electrons as "light source" and their much lower wavelength makes it possible to get a resolution a thousand times better than with a light microscope.

You can see objects to the order of a few angstrom (10-10 m). For example, you can study small details in the cell or different materials down to near atomic levels.

Transmission Electron Microscopy (TEM) does give high-resolution information of a sample, but the three-dimensional information is projected into a 2D image.

(ii) Scanning Electron Microscope (SEM) : it is for examining the surface of a specimen and gives three dimensional (3D) surface view . Scanning Electron Microscopy (SEM) can provide a high-resolution image of a surface in three dimensions (topography), but the material below the surface is not imaged.
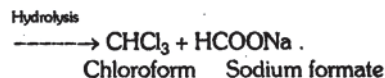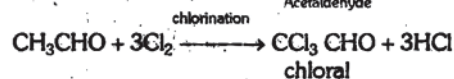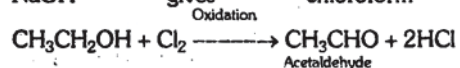
54. (1) We know that to measure thermal conductivity of liquids experimentally, they must be heated from the top i.e. upper layer is kept hot and lower layer is kept cold, so as to prevent convection in liquids .

55. (4) According to second law of thermodynamics, there is a net transfer of heat from a body at lower temperature to a body at higher temperature without the aid of an external agent. Since the given information produces a contradiction in second law of thermodynamics, it is not possible to produce temperature of 8000 k by collecting the sun rays with a lens.

56. (2) From the Gay Lussac's law, $p \propto T$.

So, that when temperature increases the pressure also increase.

57. (1) Waves produced on the surface of water are transverse in nature. When such ways are produced in water they spread out. Till the ocean waves reach the beach-shore, they acquire such a large radius of curvature that they may be assumed as plane waves. Hence, ocean waves hit the beach normally to the shore.

58. (1) Due to induction the opposite charge develops at the sharp edge which ejects the charge and neutralizes the cloud. This sharp edge protects the buildings .

59. (1) We observe that both the magnets exert equal. and opposite force/ torque on each other . Hence. net force/ torque on cork will be zero .

60. (3) According to principle of conservation of angular momentum. "in the absence of external torque the total angular momentum L of the system remains conserved" i.e. $L = I\omega$ = constant (where I

is moment of inertia & ω be the angular velocity). If one of the parameter (i.e. I or ω) increases then other decreases and vice-versa in order to conserve angular momentum. So, the angular velocity ω will remain constant as long as moment of inertia I remains constant from the principle of conservation of angular momentum. In the wohrlwind in a tornado, the air from nearby regions gets concentrated in a small space thereby decreasing the value of tis moment of inertia considerably and resulting in increase in angular speed.

When no external torque acts then $\tau = 0$.

$$\Rightarrow \qquad \frac{dL}{dt} = 0 \quad \Rightarrow \quad L = \text{constant.}$$

61. (4) When C_2H_5OH reacts with chlorine it gives trichloro acetaldehyde (CCl_3CHO), it is also known as chloral . Chloral further in the presence of NaOH gives chloroform

$$CH_3CH_2OH + Cl_2 \xrightarrow{\text{Oxidation}} CH_3CHO + 2HCl$$
Acetaldehyde

$$CH_3CHO + 3Cl_2 \xrightarrow{\text{chlorination}} CCl_3 CHO + 3HCl$$
chloral

$$CCl_3CHO + NaOH$$

$$\xrightarrow{\text{Hydrolysis}} CHCl_3 + HCOONa .$$
Chloroform   Sodium formate

62. (4) $CH_3 - \overset{+}{CH} - OCH_3$ is resonance stabilised as,

$$CH_3 - \overset{+}{CH} - \overset{..}{\underset{..}{O}} - CH_3 \longleftrightarrow CH_3 - CH = \overset{+}{\underset{..}{O}} - CH_3$$
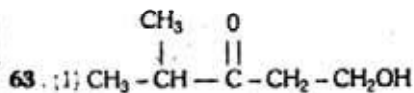
Due to such resonance stability the formed carbocation is most stable among all the given carbocations .

$CH_3 - \overset{+}{CH} - CH_3$ is less stable than earlier but

more stable than $CH_3 - \overset{+}{CH} - COCH_3$ it is due to the fact that in early case there is no electron withdrawing group hence more stable than the later because later contains $-\overset{\overset{\displaystyle O}{\displaystyle ||}}{C}-$ (carbonyl) group which is electron withdrawing in nature. The correct order of stability is II > I > III

63. (1) $CH_3 - \overset{\overset{\displaystyle CH_3}{\displaystyle |}}{CH} - \overset{\overset{\displaystyle O}{\displaystyle ||}}{C} - CH_2 - CH_2OH$
1-hydroxy - 4 - methyl pentane - 3- one.

64. (1) PbO is commonly known as Litharge . PbO get used in glass making (specially flint glass) . It is an amphoteric oxide which can react both with acid as well as alkali

65. (3) For the reaction

$$N_2O_5 \longrightarrow 2NO_2 + \frac{1}{2}O_2$$
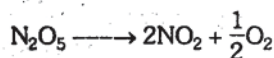
$t_{1/2} = 2.4$ hr. ; Total No of half Life $= \frac{9.6}{2.4} = 4$

Since 10.8 g gives 0.8 g oxygen at 1st half life .

0.8 g of oxygen $= \frac{22.4}{40}$ Litre

Total volume of oxygen obtained after 4 half life .

$$= \frac{22.4}{40} + \frac{22.4}{80} + \frac{22.4}{160} + \frac{22.4}{320}$$

$$= 1.05 \text{ Litre}$$

66. (4) CO_3^{2-} ,BF_3 and $N(SiH_3)_3$ shows planar structure B in BF_3 and C in CO_3^{2-} are sp^2 hybridized hence shows planar geometry. N in $N(SiH_3)_3$ is sp^3 hybridised but due to steric effect of butyl (SiH_3) - group make the molecule planar in shape.

67. (3) Basic strength depends up on the availability of lone pair of electrons. The correct increasing order of basic strength is as follows
$H_2O < CH_3OH < OH^- < CH_3O^-$.
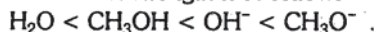
H—Ö—H has two lone pair 1 of electrons that is why it behaves as base, H—Ö—CH_3 has two lone pair of electrons with one electron pumping group, therefore, this compound is more basic than H_2O .

H—Ö: has one negative charge and two lone pair of electron that is why availability of lone pair is greater than early two cases hence, more basic than early two compounds.

CH_3→Ö: has one negative charge, two lone pair of electrons and one electron pumping group. All these combination makes this species most basic among the given species compounds .

68. (2) For each central atom there are two tetrahedral voids in AgI crystal . The number of Ag^+ ion is equal to number of I^- ion. It means only 50% of the void will be occupied by Ag^+ ion

69. (3) Molecular mass $= \frac{RTd}{P}$

$$= \frac{0.0821 \times 273 \times 1.293}{1} \text{ ; (d = 1.293 g/L)}$$

$$= 28.98 \text{ g/mol}$$

Molecular mass $= 2 \times$ vapour density

vapour density $= \frac{28.98}{2} = 14.49$

70. (2) $As_2O_3 \rightleftharpoons 2As^{3+} + 3O^{2-}$

$$Ksp = (2S)^2(3S)^3$$
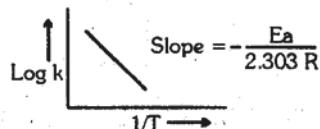
$$10.8 \times 10^{-19} = 108 \, S^3$$

$$S = 10^{-2}.$$

Solubility will be 2×10^{-2} if dissociation is 50% .

71. (2) According to Arrhenius equation

$k = Ae^{-Ea/RT}$ (where E_a is energy of activation)

E_a can be calculated with the help of slope by plotting the curve between log k and $\frac{1}{T}$


72. (2) Higher oxidation state of compound favours the covalent character. I_2O_9 and I_2O_7 does not exist therefore I_2O_5 is only oxide of iodine which is at its highest oxidation states .

73. (4) When H_2S gas is passed through the HCl containing aqueous solution of $CuCl_2$, $HgCl_2$, $BiCl_3$ and $COCl_2$ few compound precipitated out viz, CuS ,HgS and Bi_2S_3 but CoS will not be precipitated out by the same . It is due to the fact that the solubility product of sulphide of II nd group is lesser than the solubility product of sulphide of group IV, therefore, Cobalt sulphide will not be precipitated out.

74. (4) $_{28}Ni \Rightarrow 3d^8 4s^2$ configuration

For Ni^{2+} ion $\Rightarrow 3d^8 4s^0$ configuration .As we know chloride is weak Ligand, therefore, it is not capable to pair up the valence shell electron of nickel ion .
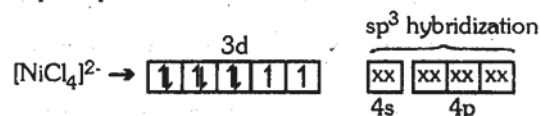
Since, Cl^-ion, is unable to pairup the valence shell electron, therefore, the lone pair of electrons of Cl^- ion enters in to the outer orbital of Ni^{2+} ion viz, 4s and 4p . The structure of sp^3 hybrid orbital is tetrahedral .

75. (4) In general, a metal oxide with more ionic character will be more basic. Larger the size of cation greater be the ionic character. The correct order of ionic radii .

$$Ti^{2+} > V^{2+} > Cr^{2+} > Fe^{2+}.$$

Ionic character of oxide will follow the same trend as

$$TiO > VO > CrO > FeO.$$

76. and para -amino benzoic acid does not exist as zwitter ion . It is because lone pair of elec-

tron of $-\overset{\cdot\cdot}{N}H_2$ group delocalizes in resonance. – COOH group becomes less acidic because benzene ring after receiving lone pair of electron from $-NH_2$ group does not behave as electron withdrawing group . Due to non-availability of lone pair of electron on $-NH_2$ group and less acidic nature of $-COOH$ group Zwitter formation is simply difficult .

77 . (1) Benzene ring is aromatic conjugated system in which the ring is resonance stabilized, hence, does not react with alkaline $KMnO_4$. It does not contain acidic hydrogen, therefore, it does not react with ammoniacal $AgNO_3$ solution .

78 . (3) Poly methyl methacrylate (PMMA) is used in making Light Weight Lenses and aircraft wind screen etc. Its trade name is Plexiglas.

79 . (3) $CH_3OH(c) + \dfrac{3}{2}O_2(g) \longrightarrow CO_2(g) + 2H_2O(l)$
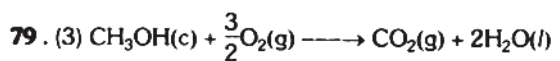
$$\Delta H = -723 \text{ kJ}$$

$\dfrac{3}{2}O_2$ combustion gives $= -723$ kJ .

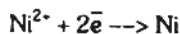$1O_2$ combustion gives $= \dfrac{-723 \times 2}{3} = -482$ kJ

80 . (1) The actual enthalpy of hydrogenation of C_6H_6

$$\Delta Ha = [3 \times (-119.5)] - (-150.4)$$
$$= -208.1 \text{ kJ/mol}$$

81 . (2) No .of moles of $Ni(NO_3)_2$

$$= \dfrac{2 \times 500}{1000} = 1 \text{mole} .$$

On reduction of Ni^{2+}

$$Ni^{2+} + 2\bar{e} \longrightarrow Ni$$

Moles deposited $= \dfrac{104220}{2 \times 96500} = 0.54$ mol

No of mol left $= 1 - 0.54 = 0.46$ mol

Molarity of $Ni(NO_3)_2 = 2 \times 0.46 = 0.92$ mol/litre

82 . (2) If iron reacts with dil . H_2SO_4 it replaces hydrogen. Lead when reacts with dil. H_2SO_4 it also replaces hydrogen but such replacement of hydrogen is not continuous, after formation of $PbSO_4$ on the lead surface replacement of hydrogen stops. Copper and mercury does not replaces hydrogen when reacts with dil H_2SO_4.

83 . (3) Supercritical CO_2 is used as a solvent for extraction of organic compounds from natural sources.
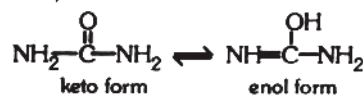
84 . (4) $E° cell = \dfrac{2.303RT}{nF} \log Keq$.

$$0.295 = \dfrac{2.303 \times 8.314 \times 298}{2 \times 96500} \log Keq$$
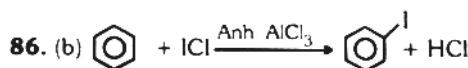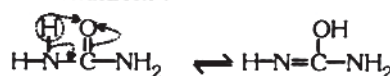
$$\log Keq = \dfrac{2.303 \times 96500 \times 0.295}{2.303 \times 8.314 \times 298} = 10$$

$$Keq = \text{antilog } 10 = 1 \times 10^{10}$$

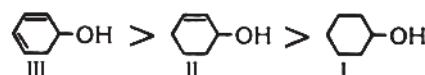**85 .** (4) Urea shows tautomerism (dynamic equilibrium isomerism)

keto form   enol form

Mechanism :-

86. (b)

Here, in this reaction Cl is more electronegative that is why iodine will behave as electrophile. The path will be electrophillic substitution reaction .

87 . (2)

III > II > I

Ease of dehydration is directly proportional to number of unsaturation . Conjugated diene dehydrates easily than normal diene .

88 . (4)

Isobutyraldehyde
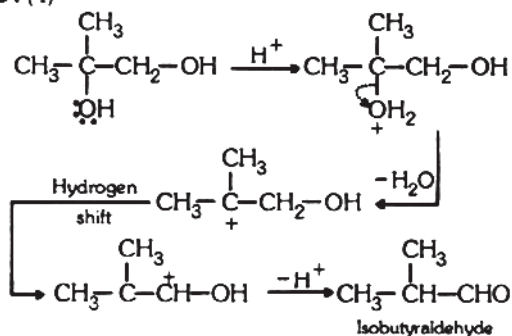
89 . (3) On hydrolysis ester gives acid and alcohol .

$$\text{Ester} \xrightarrow{\text{hydrolysis}} \text{Acid + Alcohol.}$$

Methyl acetate gives methanol and ethyl acetate gives ethanol. Methanol does not gives holoform (Iodoform test) where as ethanol gives iodoform test .

90 . (3) $C_2H_5 - NH_2 + S = C = S$

$$\xrightarrow{\text{HgCl}_2} \text{HgS} + 2\,\text{HCl} + \underset{\textit{ethyl isothiocyanate}}{\text{C}_2\text{H}_5 - \text{N} = \text{C} = \text{S}}$$
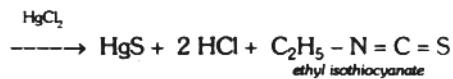
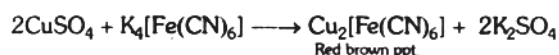The formed compound i-e ., ethyl isothiocyanate, is having mustard oil like odour, this reaction that is why known as Hofmann's mustard oil reaction .

91 . (3) Protein can be denatured by heat. It can also be denatured by strong alkali or strong acids, even strong electrolyte is also capable to denature the protein .

92 . (3) Acetyl salicylate or aspirin is used as analgesic and blood thinning agent as well .

93 . (4)

$$2\text{CuSO}_4 + \text{K}_4[\text{Fe(CN)}_6] \longrightarrow \underset{\text{Red brown ppt}}{\text{Cu}_2[\text{Fe(CN)}_6]} + 2\text{K}_2\text{SO}_4$$

94 . (4) On electric discharge at low pressure through neon gas at very low pressure an orange coloured glow can be seen . Such kind of lamp is used in electric line tester. Commercial hoardings of sign boards generally contains neon lamp .

95 . (2) Any catalyst lowers the activation energy of the reaction. The catalysis follows the adsorption phenomenon, which provide the space for reactants to react with each other by avoiding random movement .

96 . (2)) According to Langmuir adsorption isotherm,

$$\frac{x}{m} \text{ (extent of adsorption)} = \frac{aP}{1 + bP}$$

At high pressure, $1 + bp. = bp$

or, $\quad \dfrac{x}{m} = \dfrac{aP}{bP} = \dfrac{a}{b}$

97 . (1) Molar concentration of urea $= \dfrac{10}{60}$ per dm^3
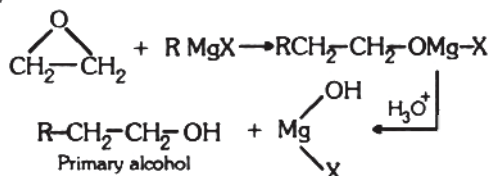
Molar concentration of volatile solute solution

$= \dfrac{5}{M}$ per 100 ml. or, $\dfrac{50}{M}$ per dm^3 .

For solution of same concentration
or, isotonic solution at same temperature .

$$\frac{10}{60} = \frac{50}{M} \quad \text{or, } M = 300 \text{ g mol}^{-1} .$$

98 . (4)

R–CH$_2$–CH$_2$–OH + Mg
Primary alcohol

99 . (3) Saponification value :– It is the number of mg of KOH (milligrams of KOH) required to neutralize completely the fatty acid resulting from the complete hydrolysis of 1 gram of fat or oil .

100 . (2) Rayon resembles silk in appearance, hence, it is called as artificial silk . It is man made fibre.

$$\underset{\text{(pulp)}}{\text{Cellulose}} \xrightarrow[\text{CS}_2]{\text{NaOH}} \underset{\text{(spinner)}}{\text{Viscose Pulp}} \xrightarrow[\text{(silk thread)}]{\text{dil .H}_2\text{SO}_4} \text{Rayon}$$

101 . (3) If the size of central atom increases bond angle decreases it is due to the fact that lone pair (lp) bond pair (bp) repulsion is strong in larger bond length and vice-versa .

102 . (2) The quantity of radioactive substance decayed during its average life is calculated by using equation

$$\lambda = \frac{0.693}{t_{1/2}} = \frac{2.303}{1.44\, t_{1/2}} \log \frac{100}{Nt}$$

103 . (a) According to van der Waals' equation

$$\left(P + \frac{a}{V^2}\right)(v - b) = RT.$$

at very high pressure $P(V - b) = RT$.

or, $\qquad PV - Pb = RT$

$$\frac{PV}{RT} = \left(1 + \frac{Pb}{RT}\right)$$

$$Z = \left(1 + \frac{Pb}{RT}\right) \quad \left| \text{where } Z = \left(\frac{PV}{RT}\right) \right|$$

104 . (2) Any fluid (Liquid and gas) absorbs heat energy and due to this kinetic energy or motion (random motion) increases, which leads to decrease in viscosity of the liquid .
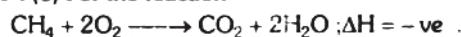
105 . (4) $\text{CaF}_2 \rightleftharpoons \text{Ca}^{2+} + 2\text{F}^-$

$$K = \left(\frac{10^{-6}}{2}\right)\left(\frac{10^{-6}}{2}\right)^2 = 1.25 \times 10^{-19} < \text{Ksp}.$$

Precipitation will not form because ionic product is less than solubility product (Ksp)

106 . (2) Common ion adsorb on the surface of precipitate . Due to repulsion between adsorbed ions, the precipitates undergo fragmentation resulting in colloidal state.

107 . (1) For the reaction
$\text{CH}_4 + 2\text{O}_2 \longrightarrow \text{CO}_2 + 2\text{H}_2\text{O} \; ; \Delta H = -ve$.
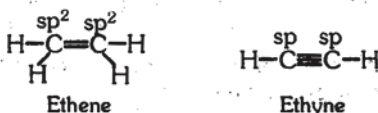
$\Delta H = \Delta E + \Delta nRT$.

$\Delta n = n_p - n_r = 1 - 3 = -2$

$\Delta H = \Delta E - 2T$

$\Delta H < \Delta E$.

108 . (1) Electric current carried by cation (+ve ion) and anion (– ve ion) is equal to their transport number .

109. (2) In the case of ethene carbon atom is sp^2 hybridized and in ethyne carbon atom is sp hybridized.

$$\underset{\text{Ethene}}{\overset{\displaystyle H}{\underset{\displaystyle H}{H-\overset{sp^2}{C}=\overset{sp^2}{C}-H}}} \qquad \underset{\text{Ethyne}}{H-\overset{sp}{C}\equiv\overset{sp}{C}-H}$$

110. (4) Mercury vapour are invisible as no metallic bonding is possible in vapour phase.

111. (3) H_3PO_3, Orthophosphoric acid is a dibasic acid (two replaceable hydrogen atom attached to – O –H bond with central). Its structure is

Replaceable H-atom
Non-replaceable H-atom
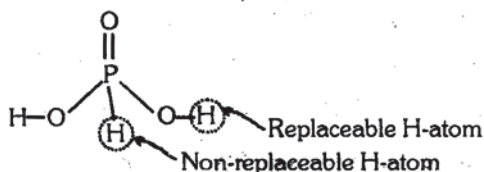
112. (4) In F_2 molecule F–F bond is weaker than Cl – Cl bond of Cl_2 molecule. This anomalous behaviour of F-F bond strength against small bond length is due to repulsion of electrons (lone pair) of one F atom with the other.

113. (1) During the electrolysis of NaCl (aq), sodium is preferentially discharged at mercury cathode forming sodium amalgam (Hg– Na), it is due to this fact hydrogen has a high over voltage at Hg – cathode.

114. (4) KCN form complex compound with Cu^+ and Cd^{2+} as $K_3[Cu(CN)_4]$ and $K_2[Cd(CN)_4]$ respectively. When H_2S gas pass through these, Cd^{2+} complex gets decomposed to yellow Cadmium sulphide precipitate .

115. (1) It is true that amines are more basic than esters / ethers due to the nitrogen atom is less electronegative than oxygen .

116. (3) Due to the presence of intermolecular H-bonding in alcohol its boiling point is higher . But this type of intermolecular hydrogen bonding does not exist in ether that is why their boiling point is less .

117. (1) $NaCNS + FeCl_3 \longrightarrow Fe(CNS)_3 + 3NaCl$
red colour

118. (3) $\underset{\text{pure}}{NaCl} + HCl \longrightarrow NaCl + H^+ + Cl^-$.

Pure form of NaCl can be obtained when HCl gas is passed in a saturated solution of NaCl, because the value of $[Na^+]$ and $[Cl^-]$ > Ksp of NaCl .

119. (4) Chlorine is good oxidizing agent . Fluorine not good oxidizing agent because fluorine is high electronegative element.

120. (1) During hydrolysis H_2O is taken in large excess, therefore its concentration does not change.

121. (3) The heart's "natural" pacemaker is called the sinoatrial (SA) node or sinus node. It's a small mass of specialized cells in the top of the right atrium (upper chamber of the heart). It produces the electrical impulses that cause your heart to beat.

A chamber of the heart contracts when an electrical impulse or signal moves across it. For the heart to beat properly, the signal must travel down a specific path to reach the ventricles (the heart's lower chambers). Heart rhythm problems may occur when the natural pacemaker is defective, causing the heartbeat to be too fast, too slow or irregular. Rhythm problems also can occur because of a blockage of your heart's electrical pathways.

Artificial pacemaker : A device that uses electrical impulses to regulate the heart rhythm or to reproduce that rhythm. An internal pacemaker is one in which the electrodes into the heart, the electronic circuit and the power supply are implanted (internally) within the body.
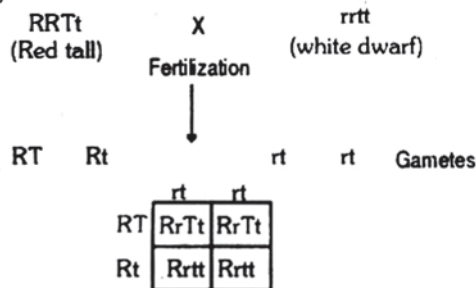
Although there are different types of pacemakers, all are designed to treat bradycardia, a heart rate that is too slow. Pacemakers may function continuously and stimulate the heart at a fixed rate or at an increased rate during exercise.

122. (2) DNA replication is semiconservative. Semiconservative replication would produce molecules with both old and new DNA, but each molecule would be composed of one old strand and one new one. The newly synthesized strand of DNA would be normal while the strand obtained from parent molecule would be radioactive.

123. (2) A plasmid is an independent, circular, self-replicating DNA molecule that carries only a few genes. The number of plasmids in a cell generally remains constant from generation to generation. Plasmids are autonomous molecules and exist in cells as extrachromosomal genomes, although some plasmids can be inserted into a bacterial chromosome, where they become a permanent part of the bacterial genome. It is here that they provide great functionality in molecular science.

Plasmids used in genetic engineering are called vectors. They are used to transfer genes from one organism to another and typically contain a genetic marker conferring a phenotype that can be selected for or against. Most also contain a polylinker or multiple cloning site (MCS), which is a short region containing several commonly used restriction sites allowing the easy insertion of DNA fragments at this location.

124. (3)

```
RRTt            X            rrtt
(Red tall)                   (white dwarf)
            Fertilization
                 ↓

 RT    Rt              rt    rt    Gametes
```

	rt	rt
RT	RrTt	RrTt
Rt	Rrtt	Rrtt

Phenotype of different plants is
(i) All plants contain red fruits
(ii) 50% plants are tall with red fruits
(iii) 50% plants are dwarf with red fruits.

125. (2) **Na⁺ ions** are found in higher concentrations outside the cell, and in low concentration inside the cell. Conversely, **K⁺ ions** are distributed in high concentration inside the cell and in low concentration outside the cell. When the neuron is excited, there is a marked change in the potential from the resting level to zero and it become 20 or 30 mV. When a stimulus is provided, there is a rapid inward movement of Na⁺ ions to make the inside positively charged. When the outflux of K⁺ ions can no longer keep pace with the faster influx of Na⁺. This causes an action potential.

126. (2) Cholera is an acute diarrhoeal infection caused by ingestion of the bacterium *Vibrio cholerae*. Transmission occurs through direct faecal-oral contamination or through ingestion of contaminated water and food. The disease is characterized in its most severe form by a sudden onset of acute watery diarrhoea that can lead to death by severe dehydration and kidney failure. More commonly, the disease progresses from the first liquid stool to shock in 4 to 12 hours, with death following in 18 hours to several days without rehydration treatment

Rehydration is the replenishment of water and electrolytes lost through dehydration. It can be performed by oral rehydration therapy (drinking an electrolyte solution) or by intravenous therapy (adding fluid and electrolytes directly into the blood stream). Administration of saline not only supports sodium-potassium pump through which water in cell is restored, but glucose is also absorbed along with sodium.

127. (1) The schematic growth curve shown below is associated with simplistic conditions known as a batch culture. It refers to a single bacterial culture, introduced into and growing in a fixed volume with a fixed (limited) amount of nutrient.
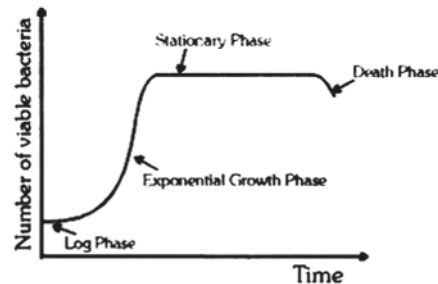
Lag Phase: Bacteria are becoming "acclimated" to the new environmental conditions to which they have been introduced (pH, temperature, nutrients, etc.). There is no significant increase in numbers with time.

Exponential Growth Phase: The living bacteria population increases rapidly with time at an exponential growth in numbers, and the growth rate increasing with time. Conditions are optimal for growth.

Stationary Phase: With the exhaustion of nutrients and build-up of waste and secondary metabolic products, the growth rate has slowed to the point where the growth rate equals the death rate. Effectively, there is no net growth in the bacteria population.

Death Phase: The living bacteria population decreases with time, due to a lack of nutrients and toxic metabolic by-products.

128. (1) Xylem vessels – consist of dead hollow cells because the walls are lignified and the cell contents disintegrate. The lignin makes the cell wall impermeable so they are in effect water proof. It also makes the vessels extremely strong and prevents them from collapsing. They have a wide lumen and are linked end to end to create a long, hollow tube since the end cell walls have one or many perforations in them. This allows the transport of large volumes of water. The sidewalls have bordered pits (unlignified areas) to allow lateral movement of water. Xylem vessels are found in angiosperms.

Tracheids – similar to vessels but with narrower lumens and connected by pits. They have tapered ends so that they dovetail together. Tracheids are found in conifers.

129. (1) During the process of translation an initial complex is formed between mRNA, 30S ribosomal subunit and methionyl tRNA. This complex is formed due to association of $1F_1$, $1F_2$, $1F_3$ initiation factors and GTP molecule.

Initiation – Small subunit of ribosome (30s) attached to the 5' end of mRNA and with the first codon of mRNA (AUG) forms the initiation complex. The large subunit of ribosome combines with

the initiation complex GTP and three protein factors IF, IF_2 and IF_3, loosely associated with the small ribosomal subunit are involved in the initiation of polypeptide chain formation.

130. (1) People with Down Syndrome have 3 copies of chromosome 21. For this reason, Down Syndrome is also called "Trisomy 21". In 90% of Trisomy 21 cases, the additional chromosome comes from the mother's egg.
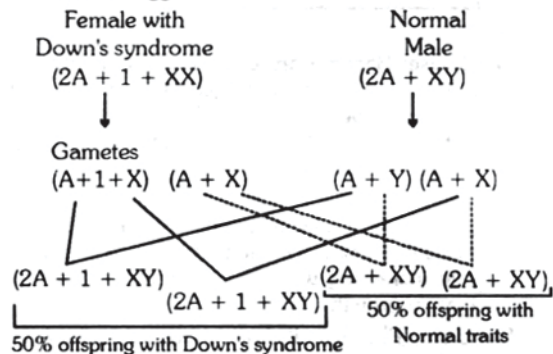
131. (3) A species is often defined as a group of organisms capable of interbreeding and producing fertile offspring. The plant tobacco (*Nicotiana*) has two different species and these two species cannot reproduce freely.

132. (1) A keystone species is a species whose very presence contributes to a diversity of life and whose extinction would consequently lead to the extinction of other forms of life. Keystone species help to support the ecosystem (entire community of life) of which they are a part.

Example: Elephants as Keystone Species in Grasslands

Elephants appear to be keystone species in African grasslands. That is, without elephants (or some other player to fill the elephants' role), the grasslands actually cease to exist as grasslands. Take away the elephants, and the grasslands, which overgrow with woody plants, convert to forests or to shrub-lands.

133. (3) Electron Spin Resonance Dating falls into the group of dating methods that uses radiation exposure to date many materials found at archaeological sites. It is also known as a Radiometric Dating Method. This technique is mostly used to date minerals. It has been used to date such things as sedimentary quartz, fossilized teeth, flint, and calcium carbonate in limestone, coral and egg shells.

This method works by using radiation to cause electrons to separate from the atoms. These electrons then become trapped in the crystal lattice of minerals. This changes the magnetic field of the material at a rate that is predictable, allowing it

be used to date an item. It can be used to date when mineralization, sedimentation, or the last heating of minerals took place. It is often used to date quartz from meteorite strikes, and places where earthquake activity has taken place.

Fossil DNA is a potential source of information on the evolution, population dynamics, migrations, diets and diseases of animals and humans. But if it is not well preserved or becomes contaminated by modern DNA, the results are uninterpretable. It was in 1986 that Weiner first reported the existence of crystal clusters in fresh bones. Now, almost 20 years later, Weiner and Salamon have returned to these findings, reasoning that fossil bones might possess such crystal structures containing preserved ancient DNA.

134. (4) A telomere is a region of highly repetitive DNA at the end of a linear chromosome that functions as a disposable buffer. Every time linear chromosomes are replicated during late S phase, the DNA polymerase complex is incapable of replicating all the way to the end of the chromosome; if it were not for telomeres, this would quickly result in the loss of vital genetic information, which is needed to sustain a cell's activities. Every time a cell with linear chromosomes divides, it will lose a small piece of one of its strands of DNA.

Like the rest of a chromosome and its genes, telomeres are sequences of DNA - chains of chemical code. Like other DNA, they are made of four nucleic acid bases: G for guanine, A for adenine, T for thymine and C for cytosine.

Telomeres are made of repeating sequences of TTAGGG on one strand of DNA bound to AATCCC on the other strand. Thus, one section of telomere is a "repeat" made of six "base pairs."

135. (4) Thymus: A lymphoid organ situated in the center of the upper chest just behind the sternum (breastbone). It is in the thymus that lymphocytes mature, multiply, and become T cells. (That is why they are called T cells. The T is for thymus.)

Congenital absence of the thymus (congenital athymia) or loss of the thymus in the newborn period (neonatal thymectomy) results in complete lack of functional T cells and immune deficiency.

136. (1) In certain species of diatoms, auxospores are specialised cells that are produced at key stages in their cell cycle or life history. Auxospores typically play a role in growth processes, sexual reproduction or dormancy ("resting spores".)

Bozi (1914) and Fremi (1930) reported Cell division crosswise to the trichome length of *Wertiella lanosa*. Reproduction by (3-13-celled) hormocysts, which arise at the ends of branches, solitary or up to four in series cells in hormocysts wider than in

mination of hormocysts, the single heterocytes usually develop (both heteropolar or isopolar germlings arise).

137. (1) The visible spectra or photosynthetic active radiation has a range of wavelength of 380 nm to 760 nm, which is part of electromagnetic spectrum responsible for photosynthesis.

138. (4) Magnesium is a critical structural component of the chlorophyll molecule and is necessary for functioning of plant enzymes to produce carbohydrates, sugars and fats. It is used for fruit and nut formation and essential for germination of seeds. Deficient plants appear chlorotic, show yellowing between veins of older leaves; leaves may droop. Magnesium is leached by watering and must be supplied when feeding. It can be applied as a foliar spray to correct deficiencies

Iron is necessary for many enzyme functions and as a catalyst for the synthesis of chlorophyll. It is essential for the young growing parts of plants. Deficiencies are pale leaf color of young leaves followed by yellowing of leaves and large veins. Iron is lost by leaching and is held in the lower portions of the soil structure. Under conditions of high pH (alkaline) iron is rendered unavailable to plants. When soils are alkaline, iron may be abundant but unavailable. Applications of an acid nutrient formula containing iron chelates, held in soluble form, should correct the problem.

139. (2) Inbreeding depression is usually defined as the lowered fitness or vigour of inbred individuals compared with their non-inbred counterparts, observed in many (but by no means all) organisms. Its converse is heterosis, the 'hybrid vigour' manifested in increased size, growth rate or other parameters resulting from the increase in heterozygosity in F_1 generation crosses between inbred lines. In maize, hybrid vigour is exploited by crossing to two inbred parental lines.

140. (1) tRNA is the information adapter molecule. It is the direct interface between amino-acid sequence of a protein and the information in DNA. Therefore it decodes the information in DNA.

Messenger or mRNA is a copy of the information carried by a gene on the DNA. The role of mRNA is to move the information contained in DNA to the translation machinery.

Three of the rRNA molecules are synthesized in the nucleolus, and one is synthesized elsewhere.

The Peptidyl transferase is an aminoacyltransferase and the primary enzymatic function of the ribosome which forms peptide links between adjacent amino acids using tRNAs during the translation process of protein biosynthesis.

141. (1) Hybridoma cells are cells that have been engineered to produce a desired antibody in large amounts. To produce monoclonal antibodies, B-cells are removed from the spleen of an animal that has been challenged with the relevant antigen. These B-cells are then fused with myeloma tumor cells that can grow indefinitely in culture (myeloma is a B-cell cancer). This fusion is performed by making the cell membranes more permeable. The fused hybrid cells (called hybridomas), being cancer cells, will multiply rapidly and indefinitely and will produce large amounts of the desired antibodies

142. (3)

143. (2) Definitions of lung volumes

Lung volume	Definition
Tidal volume (TV)	The volume of air moved during normal quiet breathing (about 0.5 L).
Inspiratory reserve volume (IRV)	The volume of air that can be forcefully inspired following a normal quiet inspiration. (about 2.5 - 3.5 L).
Expiratory reserve volume (ERV)	The volume of air that can be forcefully expired after a normal or resting expiration (about 1.0 L).
Residual volume (RV)	The volume of air remaining in the lungs after a forceful expiration (about 1.0 L).
Vital capacity (VC)	The greatest extreme in air volume moved between inspiration and expiration (about 4.5 L).
Inspiratory capacity (IC)	The amount of air that the lungs will hold after a normal expiration (i.e. inspiratory reserve + tidal volume).
Functional residual capacity (FRC)	The amount of air remaining in the lungs after a normal quiet expiration (i.e. expiratory reserve volume + residual volume).

144. (1) Nitrogen is a major component of proteins, hormones, chlorophyll, vitamins and enzymes essential for plant life. Nitrogen metabolism is a major factor in stem and leaf growth (vegetative growth). Too much can delay flowering and fruiting. Deficiencies can reduce yields, cause yellowing and stunt growth.

145. (3) Arothropods have jointed appendages, usually one pair to a somite.

146. (1) Diphtheria is a bacterial infection that spreads easily and occurs quickly. It mainly affects the nose and throat.

In its early stages, diphtheria can be mistaken for a bad sore throat. A low-grade fever and swollen neck glands are the other early symptoms.

The toxin, or poison, caused by the bacteria can lead to a thick coating in the nose, throat, or airway. This coating is usually fuzzy gray or black and can cause breathing problems and difficulty in swallowing. The formation of this coating (or membrane) in the nose, throat, or airway makes a diphtheria infection different from other more common infections (such as strep throat) that cause sore throat.

147. (1) Biogenetic law : a law stating that the earlier stages of embryos of species advanced in the evolutionary process, such as humans, resemble the embryos of ancestral species, such as fish. The law refers only to embryonic development and not to adult stages; as development proceeds, the embryos of different species become more and more dissimilar. An early form of the law was devised by the 19th-century Estonian zoologist K. E. von Baer, who observed that embryos resemble the embryos, but not the adults, of other species. A later, but incorrect, theory of the 19th-century German zoologist Ernst Heinrich Haeckel states that the embryonic development (ontogeny) of an animal recapitulates the evolutionary development of the animal's ancestors (phylogeny).

148. (3) Activated sludge is a process dealing with the treatment of sewage and industrial waste waters. Atmospheric air or pure oxygen is bubbled through primary treated sewage (or industrial waste water) combined with organisms to develop a biological floc which reduces the organic content of the sewage. The combination of raw sewage (or industrial waste water) and biological mass is commonly known as Mixed Liquor. In all activated sludge plants, once the sewage (or industrial waste water) has received sufficient treatment, excess mixed liquor is discharged into settling tanks and the treated supernatant is run off to undergo further treatment before discharge. Part of the settled material, the sludge, is returned to the head of the aeration system to re-seed the new sewage (or industrial waste water) entering the tank. This fraction of the floc is called Return Activated Sludge (R.A.S.). Excess sludge which eventually accumulates beyond what is returned is called Waste Activated Sludge (W.A.S.). W.A.S is removed from the treatment process to keep the ratio of biomass to food supplied (sewage or waste water) in balance. This is called the F:M ratio. W.A.S is stored away from th

main treatment process in storage tanks and is further treated by digestion, either under anaerobic or aerobic conditions prior to disposal

149. (4) Cellulose is an organic compound with the formula $(C_6H_{10}O_5)_n$. It is a structural polysaccharide derived from beta-glucose. Cellulose is the primary structural component of green plants. The primary cell wall of green plants is made of cellulose; acetic acid bacteria are also known to synthesize cellulose, as well as many forms of algae, and the oomycetes.

Cellulose is derived from (ß-glucose), which condense through $ß(1\rightarrow 4)$-glycosidic bonds. This linkage motif contrasts with that for $a(1 \rightarrow 4)$-glycosidic bonds present in starch and other carbohydrates. Cellulose is a straight chain polymer: unlike starch, no coiling occurs, and the molecule adopts an extended rod-like conformation.

150. (2) A blood glucose test measures the amount of a type of sugar, called glucose, in your blood. Glucose comes from carbohydrate foods. It is the main source of energy used by the body. Insulin is a hormone that helps your body's cells use the glucose. Insulin is produced in the pancreas and released into the blood when the amount of glucose in the blood rises. Normally, the blood glucose level is maintained between 70 to 150 mg/dL.

Several different types of blood glucose tests are used.

1. Fasting blood sugar (FBS) measures blood glucose after you have not eaten for at least 8 hours. It often is the first test done to check for diabetes. (70 to 100 mg/dL)
   * From 70 to 109 mg/dL normal glucose tolerance
   * From 110 to 125 mg/dL impaired glucose tolerance
   * 126 mg/dL and above probable diabetes
2. 2-hour postprandial blood sugar measures blood glucose exactly 2 hours after you eat a meal.
   * Less than 140 mg/dL normal glucose tolerance
   * From 140 to 200 mg/dL impaired glucose tolerance
   * Over 200 mg/dL probable diabetes
3. Random blood sugar (RBS) measures blood glucose regardless of when you last ate. (70 to 150 mg/dL)

151. (3) Hypercholesterolemia is a condition characterized by very high levels of cholesterol in the blood. Cholesterol is a waxy, fat-like substance that is produced in the body and obtained from foods that come from animals (particularly egg yolks, meat, poultry, fish, and dairy products). The body needs this substance to build cell membranes, make certain hormones, and produce compounds that aid in fat digestion. Too much cholesterol, however, increases a person's risk of developing heart disease.

People with hypercholesterolemia have a high risk of developing a form of heart disease called coronary artery disease. This condition occurs when excess cholesterol in the bloodstream is deposited in the walls of blood vessels, particularly in the arteries that supply blood to the heart (coronary arteries). The abnormal buildup of cholesterol forms clumps (plaque) that narrow and harden artery walls. As the clumps get bigger, they can clog the arteries and restrict the flow of blood to the heart. The buildup of plaque in coronary arteries causes a form of chest pain called angina and greatly increases a person's risk of having a heart attack.

152. (2) *Rhizobium* (a nitrogen fixing bacteria) lives in symbiotic association in the root nodules of leguminous plants.

Yeast - fermentation (production of alcohol)

Myxomycetes is a class of fungi containing the slime molds, which occur on rotting vegetation but are not pathogenic for humans.

Ringworm, also known as "Tinea", is an infection of the skin, characterized by a reddish to brownish raised or bumpy patch of skin that may be lighter in the center, giving the appearance of a 'ring'. Contrary to its name, ringworm is not caused by a worm but by parasitic fungi (Dermatophytosis).

A mycorrhiza is a symbiotic (occasionally weakly pathogenic) association between a fungus and the roots of a plant. In a mycorrhizal association the fungus may colonize the roots of a host plant either intracellularly or extracellularly.

This mutualistic association provides the fungus with relatively constant and direct access to mono- or dimeric carbohydrates, such as glucose and sucrose produced by the plant in photosynthesis. The carbohydrates are translocated from their source location (usually leaves) to the root tissues and then to the fungal partners. In return, the plant gains the use of the mycelium's very large surface area to absorb water and mineral nutrients from the soil, thus improving the mineral absorption capabilities of the plant roots

153. (1) National Institute of Virology – Pune

National Institute of Communicable disease – N.Delhi

National Institute of Nutrition – Hyderabad

Central Drug Research Institute – Lucknow

154. (3) Eutrophication is a process whereby water bodies, such as lakes, estuaries, or slow-moving streams receive excess nutrients that stimulate excessive plant growth (algae, periphyton attached algae, and nuisance plants weeds). This enhanced plant growth, often called an algal bloom, reduces dissolved oxygen in the water when dead plant material decomposes and can cause other organ-

isms to die. Nutrients can come from many sources, such as fertilizers applied to agricultural fields, golf courses, and suburban lawns; deposition of nitrogen from the atmosphere; erosion of soil containing nutrients; and sewage treatment plant discharges. Water with a low concentration of dissolved oxygen is called hypoxic.

155. (4) Thalidomide, 2-(2,6-dioxopiperidin-3-yl)-1H-isoindole-1,3(2H)-dione, is a sedative, hypnotic, and multiple myeloma medication. Thalidomide was chiefly sold and prescribed during the late 1950s and early 1960s to pregnant women, as an antiemetic to combat morning sickness and as an aid to help them sleep. Before its release inadequate tests were performed to assess the drug's safety, with catastrophic results for the children of women who had taken thalidomide during their pregnancies. From 1956 to 1962, approximately 10,000 children were born with severe malformities, including phocomelia, because their mothers had taken thalidomide during pregnancy. Phocomelia is a congenital disorder involving the limbs

156. (2) Cretinism is a condition of severely stunted physical and mental growth due to untreated congenital deficiency of thyroid hormones (hypothyroidism).

The thymus is an endocrine gland of a pinkish-gray color, soft, and lobulated on its surfaces. At birth it is about 5 cm in length, 4 cm in breadth, and about 6 mm in thickness. The organ enlarges during childhood, and atrophies at puberty.

Parathormone (PTH) is made by the parathyroid glands, which are four pea-sized glands that lie behind the thyroid gland. If the blood calcium level is too low, the parathyroid glands release more PTH. This causes the bones to release more calcium into the blood and reduces the amount of calcium released by the kidneys into the urine. Also, vitamin D is converted to a more active form, causing the intestines to absorb more calcium and phosphorus. If the calcium level is too high, the parathyroid glands release less PTH, and the whole process is reversed.

The delta cells secrete somatostatin. This consists of two polypeptides, one of 14 amino acids and one of 28. Somatostatin has a variety of functions. Taken together, they work to reduce the rate at which food is absorbed from the contents of the intestine. Somatostatin is an inhibitor of the pituitary hormone somatotropin

157. (2) Blue Baby Syndrome - An illness that begins when large amounts of nitrates in water are ingested by an infant and converted to nitrite by the digestive system. The nitrite then reacts with oxyhemoglobin (the oxygen-carrying blood protein) to form methglobin which cannot carry oxygen. If a large amount of methglobin is formed in

the blood, body tissues may be deprived of oxygen, causing the infant to develop a blue coloration of their mucous membranes and possibly digestive and respiratory problems. This condition is also known as methemoglobinemia.

158. (2) A polygene, multiple factor, or quantitative gene is a group of nonallelic genes that together influence a phenotypic trait. This results in the occurrence of intermediate forms between the parental type. In case of crossing between AABBCC (dark colour) and aabbcc (light colour), in F_2 generation seven phenotypes will be obtained in the ratio of 1 : 6 : 15 : 20 : 15 : 6 : 1. The total number of progeny is 64, out of which only two will be likely resemble with either parents i.e. < 5%.

159. (3) UAA is the 'stop' codon, hence, polypeptide chain will not grow after 24th amino acid. In the absence of new initiating codon rest of codons will not be able to translate.

160. (3) Y-chromosome plays no role in sex determination in Drosophila. Male determiners are located on autosomes. But in human beings Y-chromosome is required for development of a male sex character.

161. (2) Euglena is a genus of microscopic, one-celled organisms in the Protista kingdom. The name protozoa means "first animals." . Some taxonomists consider it a plants (due to presence of photosynthetic pigments) while others include them under animal kingdom along with protozoans because of their locomotion by flagella.

Protists are grouped into three major, unofficial categories based on means by which they obtain nutrition. These are the Protozoa, the Algae, and the Fungus-like

162. (2) Fungi reproduce by producing spores which are little more than a fragment of the parent fungus cell. Sexual reproduction is possible for some Fungi under certain conditions, but is infrequent. In most cases spores are produced without any cross-fertilization and, except for mutations, most spore are genetically identical to the parent cell. There are gradual and progressive simplification and ultimate elimination of the sexual apparatus from the lower to higher forms of fungi. In case of algae, the sexual apparatus increases in complexity from the simple to higher forms.

163. (1) All organisms that do not posses a membrane-bound nucleus, including the Schizomycetes, or bacteria, the Cyanophyta, or blue-green algae, and the Prochlorophyta, are classified as belonging to the Kingdom Monera, and are referred to as being prokaryotic (meaning "having a primitive nucleus"). In addition to lacking a nuclear membrane, prokaryotic cells do not possess most of the other membrane-bound structures found in eukaryotic cells, or those cells that have a true nucleus. Prokaryotic cells lack endoplasmic reticulum, Golgi apparatus, and lysosomes. They also lack mitochondria although the inner surface of the prokaryotic cell membrane carries out a similar ATP-producing function.

164. (3) The resting potential is what would be maintained were there no action potentials, synaptic potentials, or other changes to the membrane potential. In neurons the resting potential is approximately -70 mV (the negative sign signifies excess negative charge inside the cell relative to the outside). At the resting potential, the net movement of sodium into the cell equals the net movement of potassium out of the cell.

165. (4) Arachidic acid, also called eicosanoic acid, is a saturated fatty acid found in peanut oil. Its name derives from the Latin arachis — peanut. It can be formed by the hydrogenation of arachidonic acid. It is practically insoluble in water, and stable under normal conditions.

In unsaturated fatty acids one or more alkenyl functional groups exist along the chain, with each alkene substituting a single-bonded " $-CH_2-CH_2-$" part of the chain with a double-bonded "$-CH=CH-$" portion (that is, a carbon double-bonded to another carbon).

166. (3) A non-protein component of an enzyme, which is required for catalytic activity, is known as co-enzyme or prosthetic group

Apoenzyme : It is the protein component of an enzyme, to which the coenzyme attaches to form an active enzyme. i.e. enzymes that require a cofactor but do not have one bound are called apoenzymes. An apoenzyme together with its cofactor(s) is called a holoenzyme (this is the active form).

167. (1) The genetic code is the set of rules by which information encoded in genetic material (DNA or RNA sequences) is translated into proteins (amino acid sequences) by living cells. Specifically, the code defines a mapping between tri-nucleotide sequences called codons and amino acids; every triplet of nucleotides in a nucleic acid sequence specifies a single amino acid. Translation starts with a chain initiation codon (start codon). The mRNA sequence AUG, which specifies methionine, the first amino acid used in the translation process. (Occasionally GUG, valine, is recognized as an initiation codon).

Amber codon is the polypeptide chain-termination messenger-RNA codon UAG, which brings about the termination of protein translation. It a a nonsense codon. One of the mRNA sequences (UAA, UAG, UGA) that signals the termination of translation. A codon for which no normal tRNA molecule exists. The presence of a nonsense codon causes

termination of translation (ending polypeptide chain synthesis). There are three nonsense codons are called amber(UAG) ochre(UAA) and opal (UGA). UAG is amber, UGA is opal (sometimes also called umber), and UAA is ochre.

168. (1) In cymose tap root system, the primary root itself stops growing after some time and secondary root carry on further growth of the root system. In cymose tap root system oldest branch lies very near the growing point of the root while the youngest one is farthest away from it. It is found in shallow rooted plants such as pea, gram etc.

169. (3) The female gametophye, the embryosac was first observed by Hofmeister. Embryo sac are of two types : allium-type and polygonum-type.

The female gametophyte of angiosperms, generally an eight-nucleate, seven-celled structure. The seven cells are the egg cell, two synergids and three antipodals (each with a single nucleus), and the central cell (with two nuclei). In the polygonum-type, megasporogenesis results in four well-defined megaspores, one of which gives rise to the embryo sac. Most commonly the megaspore farthest from the micropyle is functional. The definitive feature of the allium-type arises from abortion of one of the two dyad cells produced after the first meiotic division of the megasporocyte. The nucleus of the surviving dyad cell divides to form two haploid nuclei, which are interpreted as megaspore nuclei.

170. (1) Root Tip: the end 1 cm of a root contains young tissues that are divided into the root cap, quiescent center, and the subapical region. Quiescent Center: behind the root cap is the quiescent center, a region of inactive cells. They function to replace the meristematic cells of the rootcap meristem. The quiescent center is also important in organizing the patterns of primary growth in the root.

171. (3) Formative phase is also known as phase of cell formation or cell division. In this, new cells are formed from pre-existing cells through mitotic division. Cell division phase occurs in actively growing regions such as shoot apex and root apex.

172. (1) Oxygen is required to generate sufficient respiratory energy to drive N_2 fixation. But too much oxygen inactivates nitrogenase. Biological Nitrogen Fixation (BNF) occurs when atmospheric nitrogen is converted to ammonia by a pair of bacterial enzymes called nitrogenase

In root nodules the O_2 level is regulated by a special hemoglobin - leghemoglobin. The globin protein is encoded by plant genes but the heme cofactor is made by the symbiotic bacteria. This is produced only when the plant is infected with Rhizobium. The plant root cells convert sugar to organic acids which they supply to the bacteroids

exchange, the plant receives amino-acids (rather than free ammonia).

173. (3) **Imbibition** – Adsorption of water by the dry hydrophilic colloids is called imbibition. It is a physical process which is involved in the movement of water. For example if a piece of dry wood is put in water, it swells in size because of imbibition. This is because wood is made up of cellulose, lignin or pectin and other substances which are hydrophilic colloids. Dry seed imbibe large amount of water, which helps in breaking of the seed coat. Such a substance which imbibes water is called **imbibant**. During imbibition the imbibant increases in volume, thus develops pressure called **imbibition pressure**. The increase in the volume of pea seeds results in blowing off the lid placed over the tin.

174. (2) Cyclic pathway of photosynthesis appeared first in some eubacterial species for ATP production. Non cyclic photophosphorylation is the only natural process which adds molecular oxygen to the atmosphere by the photolysis of water.

175. (3) Organochlorines are basically organic compounds that have been chlorinated and have very low bio-degradation and gets accumulated in environment.

Fenitrothion is the common name for O,O-dimethyl-O-(4-nitro-meta-tolyl) It is a broad-spectrum organophosphorus pesticide.

176. (3) Tropical rain forests once blanketed the Earth like a wide green belt around the equator. Just a few thousand years ago rain forests covered 14 percent of the Earth's land surface, or 5 billion acres.

Humans already have destroyed half of this forest area, with most damage occurring in the last 200 years. With just 2.5 million square miles (647 million hectares) of tropical rain forest remaining, we continue to lose an estimated 93,000 square miles (150,000 square km) a year.

Although tropical rain forests now cover just 2 percent of the globe, they are home to more than half the world's living plant and animal species.

177. (2) Gene flow—also called migration—is any movement of genes from one population to another. Gene flow includes lots of different kinds of events, such as pollen being blown to a new destination or people moving to new cities or countries. If genes are carried to a population where those genes previously did not exist, gene flow can be a very important source of genetic variation. This migration affects the allele frequency of both donor and recipient populations.

178. (1) A cell found in connective tissue that contains numerous basophilic granules and releases substances

stances such as heparin and histamine in response to injury or inflammation of bodily tissues. Also called labrocyte, mastocyte. Mast cells and basophils play a central role in inflammatory and immediate allergic reactions. They are able to release potent inflammatory mediators, such as histamine, proteases, chemotactic factors, cytokines and metabolites of arachidonic acid that act on the vasculature, smooth muscle, connective tissue, mucous glands and inflammatory cells. Mast cells settle in connective tissues and usually do not circulate in the blood stream.

179. (1) The muscles of alimentary canal are made of smooth muscle, under involuntary control. It can be subdivided into circular muscle (which squeezes the gut when it contracts) and longitudinal muscle (which shortens the gut when it contracts). The combination of these two muscles allows a variety of different movements. These muscles facilitate the movement of food particles through alimentary canal. Large food particles are broken down into small, semi liquid particles by the action of these muscles. Later also help in the forward flow of food material (peristalsis) and mixing of enzymes coming from different glands related to alimentary canal.

180. (1) Phenylketonuria (PKU) is a genetic disorder that is characterized by an inability of the body to utilize the essential amino acid, phenylalanine. Amino acids are the building blocks for body proteins. 'Essential' amino acids can only be obtained from the food we eat as our body does not normally produce them. In 'classic PKU', the enzyme that breaks down phenylalanine phenylalanine hydroxylase, is completely or nearly completely defi-cient. This enzyme normally converts phenylalanine to another amino acid, tyrosine. Without this enzyme, phenylalanine and its' breakdown chemicals from other enzyme routes, accumulate in the blood and body tissues Although the term 'hyperphenylalaninemia' strictly means elevated blood phenylalanine, it is usually used to describe a group of disorders other than classic PKU. These other disorders may be caused by a partial deficiency of the phenylalanine breakdown enzyme or the lack of another enzyme important to the processing of this amino acid. It results in a high level of phenylalanine in blood, other body fluids and urine.

181 . (2) convex
182 . (1) A.B. Vajpayee
183 . (2) days are nights are equal
184 . (2) Sarojini Naidu
185 . (2) attains enlightenment
186 . (4) emitting of light by a red hot platinum wire
187 (2) Anil Kumble
188 . (2) U.S.
189 . (1) Nalanda
190 . (1) conduction
191 . (3) Calculator
192 . (1) semi conductor
193 . (3) abstract thought
194 . (1) wax
195 . (3) glaucoma
196 . (2) BCG
197 . (3) keratin proteins
198 . (3) Chief Election Commissioner
. (1) A period during the Gupta period