

SOLUTIONS

PHYSICS

1. (d) : When one α -particle is emitted, the mass (A) is reduced by 4 and atomic no. (Z) is reduced by 2. Therefore for new nucleus, mass no. is ($A - 4$) and atomic no. is ($Z - 2$).

2. (b) : The velocity of sound in a gas is given by

$$v = \sqrt{\frac{\gamma p}{d}} \quad \text{where } \gamma = \frac{C_p}{C_v}$$

$$p = \text{pressure} \quad d = \text{density}$$

- \therefore For two gases at constant pressure,

$$\frac{v_1}{v_2} = \sqrt{\frac{d_2 \gamma_1}{d_1 \gamma_2}}$$

For a diatomic gas $\gamma_1 = \gamma_2 = \frac{7}{5}$

$$\therefore \frac{v_1}{v_2} = \sqrt{\frac{d_2}{d_1}}$$

3. (b) and (d) : From the given circuit, we find that R_{BD} is ineffective as it is a balanced wheatstone bridge. Since both the upper resistances are in a series combination, therefore their equivalent resistance (R_U) = $2 + 2 = 4 \Omega$. Similarly both the lower resistances are in a series combination, therefore their equivalent resistance (R_L) = $4 + 4 = 8 \Omega$. Now we see that both the resistance R_U & R_L are in a parallel combination. Therefore equivalent resistance between

$$A \text{ and } C = \frac{R_U \times R_L}{R_U + R_L} = \frac{4 \times 8}{4 + 8} = \frac{32}{12} \Omega = \frac{8}{3} \Omega.$$

4. (a)

5. (c) : Dynamo operates on the principle of the production of dynamically induced e.m.f. Therefore whenever flux is cut by the conductor, some e.m.f. is produced in it according to the law of electromagnetic induction.

6. (d)

7. (c) : Fusion of hydrogen nuclei into helium nuclei is continuously taking place in the sun, with the continuous liberation of energy. Thus energy produced in the sun is due to fusion reaction.

8. (b) : When both the grid and anode are positive, the maximum electrons will reach the plate. Thus the current will be maximum when both grid and anode are positive.

9. (b) : Seebeck discovered that on heating one of the junctions of a thermocouple, when keeping the other cold, a current is produced in the circuit. This effect is known as Seebeck effect. Therefore thermocouple thermometer is based on Seebeck effect.

10. (a) : The Wein's law states that the temperature (T) $\propto \frac{1}{\lambda_m}$. Therefore on increasing the temperature, the wavelength will decrease. Since the yellow colour is of lower minimum wavelength, therefore colour of substance becomes yellow.

11. (d) : The frequency of the source $\nu_0 = 240 \text{ Hz}$
 The velocity of the source $u_s = +20 \text{ m/s}$

(as it moves towards the observer)

The velocity of the observer $u_o = -20 \text{ m/s}$

(as it moves away from the source)

Applying Doppler's effect

$$\begin{aligned} \nu &= \nu_0 \left[\frac{\nu + u_o}{\nu - u_s} \right] \\ &= 240 \times \left[\frac{340 + (-20)}{340 - 20} \right] = 240 \text{ Hz} \end{aligned}$$

12. (b) : Wave speed (v) = $n\lambda \propto \lambda$. When light rays enter in a glass slab (*i.e.* relative denser medium), their velocity is decreased. Thus their wavelength also decreases.

13. (c) : Given: Focal length of a convex lens (f_1) = $40 \text{ cm} = 0.4 \text{ m}$ and focal length of a concave lens (f_2) = $-25 \text{ cm} = -0.25 \text{ m}$ (minus sign due to concave lens). We know that relation for the focal length of

$$\begin{aligned} \text{the combination of lenses } \frac{1}{f} &= \frac{1}{f_1} + \frac{1}{f_2} \\ &= \frac{1}{0.4} + \frac{1}{-0.25} \\ &= 2.5 - 4 = -1.5 \text{ D or power } (P) = \frac{1}{f} = -1.5 \text{ D.} \end{aligned}$$

14. (a) : Phenomenon of emission of electrons from a metallic surface, when light of suitable wavelength falls on it, is called photoelectric effect. And the incident light is in the form of small packets of light or bundle of particles known as photons. Therefore photoelectric effect of light is due to photons.

15. (d) : Extra pressure inside a soap bubble
 $(P) = \frac{4T}{r} \propto \frac{1}{r}$.

We know that the extra pressure inside a concave surface over the outside is given by $\frac{2T}{r}$. But since in the case of soap bubble, there are two surfaces (one inside and the other outside), therefore the total extra pressure in a soap bubble is $\frac{2T}{r} + \frac{2T}{r} = \frac{4T}{r}$.

16. (d) : Given: Mass (m) = 30 kg and spring constant (k) = 15 N/m. We know that in simple harmonic motion, time period (T) = $2\pi \sqrt{\frac{m}{k}} = 2\pi \sqrt{\frac{30}{15}} = 2\pi \sqrt{2}$ sec.

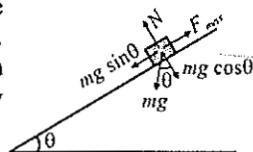
17. (b) : Given: Radius of first particle (r_1) = r and radius of second particle (r_2) = $2r$. We know that when a particle is moving in a circular path, then the centripetal force

$$(F) = \frac{mv^2}{r} \text{ or } F \cdot r \propto v^2 \text{ or } r \propto v^2. \text{ Therefore,}$$

$$\frac{r_1}{r_2} = \left(\frac{v_1}{v_2}\right)^2 \text{ or } \frac{v_1}{v_2} = \sqrt{\frac{r_1}{r_2}} = \sqrt{\frac{1}{2}} \text{ or } v_1 : v_2 = 1 : \sqrt{2}.$$

18. (a)

19. (b) : The situation of the body is shown in the figure. We know that the maximum force of friction is given by $F_{max} = \mu N = \mu mg \cos \theta$



Since the body is in equilibrium,

$$F_{max} = mg \sin \theta$$

$$\Rightarrow \mu mg \cos \theta = mg \sin \theta$$

$$\Rightarrow \tan \theta = \mu \Rightarrow \theta = \tan^{-1}(\mu)$$

20. (a)

21. (b) : If a body is in the projectile motion, then its velocity can be resolved into horizontal and vertical components. And the body is subjected to the acceleration due to gravity (g), which is vertically downwards. Therefore horizontal component remains constant, while vertical component first decreases, becomes zero and then increases in the magnitude.

22. (b)

23. (a) : Given: Equation of wave

$y = 10 \sin \left(\frac{2\pi t}{30} + \alpha \right)$; Displacement (y) = 5 cm; Initial time (t_1) = 0 and final time (t_2) = 7.5 sec. We know that displacement of the wave at $t = 0$,

$$y = a \sin \alpha = 10 \sin \alpha \text{ or } \sin \alpha = \frac{1}{2} \text{ or } \alpha = \frac{\pi}{6}. \text{ Therefore}$$

$$\text{total phase at } t = 7.5, \phi = \frac{2\pi \times 7.5}{30} + \frac{\pi}{6} = \frac{\pi}{2} + \frac{\pi}{6} = \frac{2\pi}{3}.$$

24. (b) : Given that displacement of the body,

$$y \propto t^3$$

$$\text{or } y = kt^3$$

$$\therefore v = \frac{dy}{dt} = 3kt^2$$

$$\text{or } a = \frac{dv}{dt} = 6kt \propto t$$

\therefore The magnitude of the acceleration of the body increases with time.

25. (d) : Due to 8 α -decays, the atomic mass decreases by 32 and atomic number will reduce by 16. And due to 6 β -decays, the atomic number increases by 6. Therefore resulting nucleus is ${}_{82}\text{U}^{206}$.

26. (d) : Given: Plate resistance of a triode (r_p) = $3.3 \times 10^3 \Omega$ and mutual conductance (g_m) = 3×10^3 mhos. We know that amplification factor (m) = $g_m \times r_p = (3 \times 10^3) \times (3.3 \times 10^3) = 10^1$.

27. (a) : The current depends on the intensity of the incident radiation. Therefore if the energy of radiation is more than work function (W), then the current will remain the same.

28. (b) : Given: Frequency of damped oscillator = ω ; Frequency of harmonic driving force = n and $n < \omega$. We know that if $n < \omega$, then vibrations are nearly in phase with the impressed force or the response of the oscillator is controlled by spring constant.

29. (a)

30. (b) : Given: Threshold frequency (f_0) = 10^{15} Hz and wavelength of light (λ) = 4000 Å. We know that

$$\text{threshold wavelength } (\lambda_0) = \frac{c}{f_0} = \frac{3 \times 10^8}{10^{15}} = 3 \times 10^{-7} \text{ m}$$

$$= 3000 \text{ Å. Since } \lambda > \lambda_0, \text{ therefore no photoemission will take place.}$$

31. (d) : Given: Change in volume of a gas (dV) = 0.25 m^3 and constant pressure (P) = 10^3 N/m^2 . We know that work done (W) = $P \cdot dV = 10^3 \times 0.25 = 250$ joule.

32. (c) : The energy of X-rays depends upon the characteristic of the target material. Therefore energy of the X-rays remains the same.

33. (d) : Given: Velocity of electromagnetic waves in free space (v) = 3×10^8 m/sec and wavelength (λ) = 150 m. We know that frequency (f) = $\frac{v}{\lambda} = \frac{3 \times 10^8}{150} = 2 \times 10^6$ Hz = 2 MHz.

34. (a) : The wavelength of microwave ranges from 1 mm (where it merges into infra-red) to 120 mm (where it merges into the radio waves). Therefore their wavelength is more than that of infra-red waves.

35. (b) : Given: Mass of boy (m) = 40 kg; Acceleration (a) = 9.8 m/s² and acceleration due to gravity (g) = 9.8 m/s². We know that apparent weight of the boy = $m(g - a) = 40(9.8 - 9.8) = 0$.

36. (b) : Given: Magnetic flux (ϕ) = $5t^2 + 3t + 16$. We know that the induced e.m.f. (E)

$$= \frac{d\phi}{dt} = \frac{d}{dt}(5t^2 + 3t + 16) = 10t + 3. \text{ Therefore induced}$$

e.m.f.; when $t = 3$, (E_3) = $(10 \times 3) + 3 = 33$ V and induced e.m.f. when $t = 4$, (E_4) = $(10 \times 4) + 3 = 43$ V. Therefore e.m.f. induced in the fourth sec = $E_4 - E_3 = 43 - 33 = 10$ V.

37. (c)

38. (d) : A tape is coated with tiny magnet particles. These particles get magnetized, when electric signal passes through them. Thus, a tape recorder records sound in the form of magnetic field on the tape.

39. (c) : H_α line is emitted, when the electron jumps from the $n = 3$ orbit (second excited state) to the $n = 2$ orbit (first excited state). And H_β line is also emitted, when the electron jumps from the $n = 4$ orbit to the $n = 2$ orbit.

40. (b) : When the source is moving away from the observer, then the frequency of sound heard by him, must be less than the actual frequency (i.e. 1990 Hz).

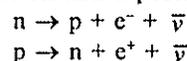
41. (c) : From the principle of calorimetry, the heat lost by a hot body is equal to heat gained by the cold body. Therefore during this process, heat exchange must be quick, otherwise some heat is lost due to radiations. As the metals are good conductors, therefore heat exchange will be quicker.

42. (d)

43. (d) : Given: Magnitude of first vector (\vec{A}) = 12; Magnitude of second vector (\vec{B}) = 18 and resultant of the given vectors (\vec{R}) = 24. We know that resultant

$$\begin{aligned} \text{vector } |\vec{R}| &= 24 = \sqrt{A^2 + B^2 + 2AB \cos \theta} \\ &= \sqrt{(12)^2 + (18)^2 + 2 \times 12 \times 18 \cos \theta} \text{ or} \\ (24)^2 &= 144 + 324 + 432 \cos \theta \text{ or } 432 \cos \theta = 108 \text{ or} \\ \cos \theta &= \frac{108}{432} = 0.25 \text{ or } \theta = \cos^{-1} 0.25 = 75^\circ 52'. \end{aligned}$$

44. (d) : β -decay is a process in which a neutron is converted into a proton and an electron or a proton into a neutron and a positron :



Now as the process of β -decay is associated with the increase of atomic number of the parent nucleus, so the charge of the nucleus changes by keeping the mass number constant as we lose a neutron and gain a proton.

45. (a) : Given: Current (I) = 4 A; Time (t) = 40 min = 2400 sec and weight deposited on cathode (m) = 4.5 g. We know from the Faraday's law of electrolysis that the weight deposited (m) = $4.5 = z \times I \times t$ or

$$z = \frac{4.5}{I \times t} = \frac{4.5}{4 \times 2400} = 47 \times 10^{-5} \text{ g/c.}$$

(where z is the electrochemical equivalent of zinc)

46. (a)

47. (c) : During the free expansion of a perfect gas, no work is done. Since no heat is supplied from outside and there is no change in internal energy, therefore there is no change in temperature.

48. (d)

49. (b) : The fundamental frequency of the closed organ pipe is given by

$$v_{\text{open}} = \frac{v}{2L}$$

The beat frequency is $v_{\text{open}} - v_{\text{close}} = 4$

Now if we increase the length of the closed pipe then the frequency v_{close} is going to decrease.

\therefore The beat frequency $v_{\text{open}} - v_{\text{close}}$ is going to increase.

50. (d) : A permanent magnet induces magnetic field only in ferromagnetic substances and visibly attracts them.

51. (b) : Because of the change of the refractive

index of the medium, the wavelength of light changes in different media. But as we know $c = v\lambda$

$$\Rightarrow v = \frac{c}{\lambda} = \frac{c'}{\lambda'}$$

Hence the frequency v remains constant.

52. (c) : A laser is a highly monochromatic and near-perfect parallel beam of light, due to which the beam can be focussed by a converging lens to a very small spot. As the intensity of the beam is too high, it can drill holes through a metal sheet even if the power is 0.2 W. But even a torch-light of 1000 W power cannot drill holes in such a metal sheet, because the light is less intense and the beam is not parallel.

53. (a) : A neutron star is composed of neutrons which behave as a degenerate fermi gas. Because of the action of the magnetic field inside a neutron star the ionized gas radiates light, radio waves and X-rays.

54. (b) : As the rest mass of a photon is zero, it always moves with the speed of light. And as we know that no material body can ever travel with a speed more than the speed of light in vacuum. Now as the two photons move with speed c of light opposite to each other, their relative velocity is also c .

55. (b) : In case of metals when we increase the temperature, the relative movement of the atoms as well the free electrons increase. Because of which there is more collisions and more loss of energy. Due to which the resistance increases and it gives a positive temperature coefficient of resistance for metals.

But in the case of a semiconductor (p -type or n -type) the charge carriers are electrons and holes. So the conductivity will depend upon the number of such electron-hole pairs. At any time this number of electron-hole pairs is proportional to $T^{3/2} e^{-\Delta E/2KT}$, where ΔE is the band gap. Now with increase of temperature, the concentration of the electron-hole pairs increases which leads to an increase of conductivity or conversely a decrease of resistivity. So, a p -type semiconductor has a negative temperature coefficient of resistance.

56. (d) : We know that $\gamma = \frac{C_p}{C_v}$ for a gas is given by $\gamma = 1 + \frac{2}{n}$ where n is the degrees of freedom. Now for a monatomic gas like hydrogen, $n = 3$

$$\therefore \gamma = 1 + \frac{2}{3} = 1.67$$

And for a diatomic gas, $n = 5$

$$\therefore \gamma = 1 + \frac{2}{5} = 1.4$$

$$\therefore \gamma_{Hc} < \gamma_{H}$$

57. (c) : All metals have got different physical characteristics, due to which they will be having different emissive and absorptive powers, so all metals cannot act as black bodies. But a hollow metallic closed container can act as a blackbody. If a small hole is made on the surface of the hollow container whose inner surface is painted black and the shape is as



shown in the figure, then any radiation that enters the hole has a good chance of being absorbed after multiple reflections taking place on the inner surface of the container. And thus it can act as a blackbody.

58. (b) : To make our calculations easy, let's that the semi major axis of the ellipse be equal to the average distance of the sun from the planet. By applying Newton's law,

$$\frac{Gmm}{a^2} = m(\omega^2 a)$$

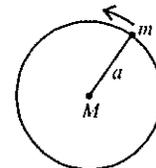
ω = angular velocity of the planet

$$= \frac{2\pi}{T} \quad (T = \text{time period of the planet})$$

$$\therefore \frac{Gmm}{a^2} = m \frac{(2\pi)^2}{T^2} a$$

$$\Rightarrow T^2 = \left(\frac{4\pi^2}{Gm} \right) a^3$$

$$\Rightarrow T^2 \propto a^3$$



59. (d) : Environmental damage has actually decreased the amount of ozone by making holes in the ozone layer because of which more UV radiation from sun enters our atmosphere.

60. (c) : The buoyancy of an object is the resultant of all the contact forces that are present at the points of contact of the body and hence the force of buoyancy depends upon the area of contact of the body with the fluid. The force of buoyancy is more in case of the needle than in the case of the ball. Now it might so happen that the force of buoyancy (B) is greater than the weight (mg) of the needle, in which case the needle might float. But in the case of the ball, $B < mg$, and so the ball sinks.

CHEMISTRY

61. (c) : Molecular weight of NaOH is 40

Atomic weight of oxygen is 16

$$\Rightarrow \text{Percentage of oxygen} = \frac{16}{40} \times 100 = 40\%$$

62. (d) : Relative lowering of vapour pressure is written as :

$$\frac{\Delta P}{P^0} = \frac{P^0 - P}{P^0}$$

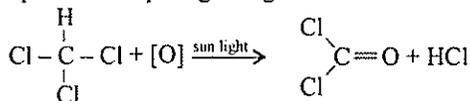
P^0 = Vapour pressure of pure component

P = Vapour pressure of component in solution

63. (d) : Molecular weight of water = 18

$$\begin{aligned} \therefore \text{No. of moles of water} &= \frac{\text{Mass}}{\text{Molecular mass}} \\ &= \frac{180}{18} = 10 \text{ moles} \end{aligned}$$

64. (d) : Chloroform in the presence of sun light and air, undergoes reaction with oxygen (in air) and forms poisonous phosgene gas.



65. (c) : Cu is below hydrogen in the electro-chemical series, so cannot liberate H_2 from dilute H_2SO_4 .

$$E^\circ (\text{Cu}^{2+}/\text{Cu}) = +0.34$$

66. (d) : Glycerol :

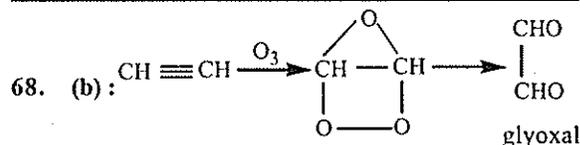
$$\begin{array}{c} \text{CH}_2\text{OH} \\ | \\ \text{CH}-\text{OH} \\ | \\ \text{CH}_2\text{OH} \end{array}$$

Its derivatives like trinitroglycerol are used as explosive.

67. (a) : $2\text{C}_6\text{H}_5\text{CHO} \xrightarrow{\text{alc. KCN}} \text{C}_6\text{H}_5\text{CH}(\text{OH})\text{COC}_6\text{H}_5$.

Benzaldehyde Benzoin

Thus in this reaction benzoin is formed. The reaction is known as benzoin condensation.



69. (c) : $\text{Cl}_2 + 2\text{Na}_2\text{S}_2\text{O}_3 \rightarrow \text{Na}_2\text{SO}_4 + 2\text{NaCl} + \text{SO}_2$

70. (b) : Reversible reactions are those reactions in which there is equilibrium established at every infinitesimal step.

But the rate of forward and backward reactions can be speed up by the influence of a catalyst.

71. (d) : Hall's and Bayer's processes are used if aluminium ore contains iron oxide as impurity, while Serpek's process is used when SiO_2 is present as an impurity.

72. (c) : 'Blister copper' is impure copper (98–99% Cu) obtained after treatment of sulphide ore.

73. (b) : The total kinetic energy of a molecule is the sum of its translational, vibrational and rotational kinetic energies. The monoatomic molecules do not possess vibrational and rotational kinetic energies. Hence noble gases (like He, Ar etc) fulfill the criteria.

74. (c) : Concentration of acetic acid = 0.001N for 10% dissociation, the effective concentration of H^+ is one-tenth of total concentration.

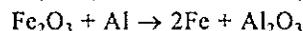
$$\begin{aligned} \text{Therefore effective concentration} &= \frac{1}{10} \times 0.001 \text{ N} \\ &= 0.0001 \text{ N} \end{aligned}$$

$$\Rightarrow \text{pH} = -\log[\text{H}^+] = 4$$

75. (b) : Strongest acid among HClO_4 , HClO_3 , HClO_2 and HClO is HClO_4 (due to greater no. of attached O-atoms) and weakest is HClO . But the corresponding conjugate base of HClO i.e. ClO^- is the strongest Bronsted base.

76. (a) : Intermolecular H-bonding raise the boiling point of a compound as more energy is required to break the Hydrogen bonding between the molecules.

77. (c) : Thermite is a mixture of Fe_2O_3 and Al in the ratio 3 : 1. Thermite reaction involves the displacement of a metal from its oxide by more electropositive metal releasing large amount of energy.



78. (b) : Silicon is present in soil, rocks etc. in the form of silica (SiO_2) or silicates or aluminosilicates.

79. (a) : Given: Volume of hydroxide solution = 100 ml. We know that molecular weight of ammonia (NH_3) = 17 and molecular weight of 2.5 M- NH_4OH = 42.5 g NH_3 in 1000 ml solution. Since 1000 ml contains 42.5 g of NH_3 , therefore 100 ml will contain = 4.25 gm NH_3 .

$$\text{Thus number of moles} = \frac{4.25}{17} = \frac{1}{4}$$

$$\text{of } \text{NH}_3 \text{ at STP} = \frac{22.4 \times 1}{4} = 5.6 \text{ litres.}$$

80. (a) : $N = \left(\frac{1}{2}\right)^n N_0$

N_0 = Initial amount, N = Amount at 't' time

n = no. of half lives.

$$\text{Given, } \frac{N}{N_0} = \frac{1}{8}$$

$$\Rightarrow \left(\frac{1}{2}\right)^n = \frac{1}{8} = \left(\frac{1}{2}\right)^3$$

$$\Rightarrow n = 3$$

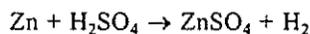
As by definition, $n = \frac{\text{total time}}{\text{half life time}}$

$$\Rightarrow \text{half life time} = \frac{96}{3} = 32 \text{ minutes.}$$

81. (c) : $l = 3$ corresponds to f -orbitals. Since there are seven f -orbitals and each orbital accommodates 2 electrons, so maximum no. of electrons is 14.

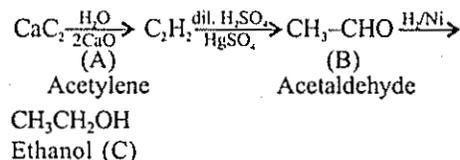
82. (a) : White vitriol : $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$

It is prepared by reacting zinc with dilute sulphuric acid.



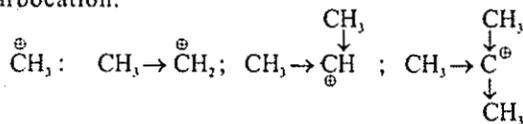
83. (d) : Weight of 6.023×10^{23} molecules of oxygen (O_2) = 32 g. Since the oxygen is diatomic, therefore weight of Avogadro's number of oxygen atom = $\frac{32}{2}$ = 16 g.

84. (c) : Reaction sequence is;



85. (a) : Equilibrium constant of reaction is independent of volume change.

86. (d) : Tertiary Carbocation is most stable as more electron releasing effect by methyl group to the carbocation.



87. (a) : $2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$

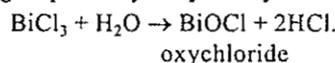
$$\text{g/L strength of H}_2\text{O}_2 = \frac{68}{22.4} \times V$$

$$\Rightarrow N = \frac{\text{Strength}}{\text{Equivalent mass}} = \frac{68}{22.4} \times \frac{V}{17} \Rightarrow$$

$$V = 5.6 \times \text{Normality} \\ = 5.6 \times 3 = 16.8 \text{ litres}$$

88. (d) : Hydride ion is a strong base, stronger than OH^- , OMe^- etc.

89. (c) : Except NF_3 and BF_3 , all other trihalides of this group are hydrolysed by water.



90. (c) : According to Ostwald's dilution law, the degree of dissociation of a weak electrolyte is proportional to the square root of dilution.

$$\alpha = \sqrt{\frac{K}{C}}$$

α = degree of dissociation, C = concentration
 K = Equilibrium constant (dissociation)

91. (a) : Vitamin B_{12} contains Cobalt, while Hemoglobin contains Iron and Chlorophyll contains Magnesium.

92. (c) : Chemical formula for magnetite is Fe_3O_4 , malachite is $\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$, carnallite is $\text{KCl} \cdot \text{MgCl}_2 \cdot 6\text{H}_2\text{O}$ and copper pyrites is CuFeS_2 . Therefore copper pyrites is a sulphide ore.

93. (c) : Human blood is slightly alkaline i.e. pH of 7.3 to 7.5 (pH=7 is neutral).

94. (b) : In isoelectronic species, the size of ions decreases as nuclear charge or atomic weight increases. (Atomic weight of P = 30, S = 32 and Cl = 35). Therefore $\text{Cl}^- < \text{S}^{2-} < \text{P}^{3-}$.

95. (c) : Absolute ether is 100% pure diethyl ether, totally free from any impurities.

96. (d) : Given: Weight of ammonia = 4.25 g. We know that 17 g of ammonia (NH_3) contains 6.02×10^{23} molecules. Therefore number of molecules in 4.25 g

$$\text{NH}_3 = \frac{6.02 \times 10^{23} \times 4.25}{17} = 1.50 \times 10^{23}$$

97. (c) : According to law of mass action, rate depends on active mass or simply concentration.

98. (c) : As the electron goes away from nucleus its energy increases sharply.

99. (c) : $\text{NH}_4\text{Cl} + \text{H}_2\text{O} \rightarrow \text{NH}_3 + \text{H}_2\text{O} + \text{HCl}$

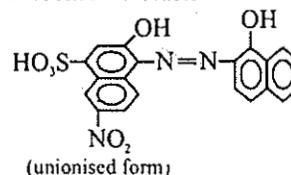
100. (d) : Fe ($Z = 26$); Co ($Z = 27$); Ni ($Z = 28$)

Fe ($Z = 26$); Atomic wt. = 55.85

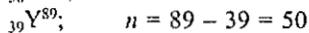
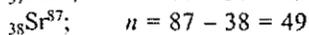
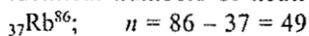
Co ($Z = 27$); Atomic wt. = 58.93

Ni ($Z = 28$); Atomic wt. = 58.69

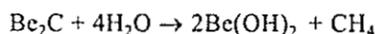
101. (c) : Eriochrome black - T :



102. (a) : Isotonic species are those which have identical numbers of neutrons.



103. (b) : Beryllium carbide (Be_2C), on hydrolysis evolves methane.

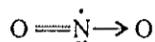


104. (a) : Given: Percentage of solution = 6 and active mass of the compound = 2 = 2M solution or 2 moles/litre. Since 100 ml solution contains 6 g, therefore

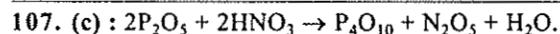
$$1000 \text{ ml solution contains} = \frac{6 \times 1000}{100} = 60 \text{ g, therefore}$$

$$\text{molecular weight of the compound} = \frac{60}{2} = 30.$$

105. (b) : NO_2 contains an unpaired electron so exhibit paramagnetism.

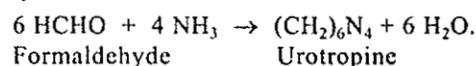


106. (c) : NaClO_4 , on hydrolysis, gives strongest acid HClO_4 as compared to other salts. This is strongly ionized and gives highest concentration of H^+ . Therefore aqueous solution of NaClO_4 will have lowest pH value.

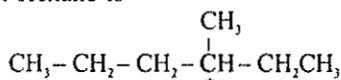


108. (d) : After the removal of electron, to form cation, there is more effective nuclear charge on remaining electrons in the cation. So size decreases.

109. (a) : When formaldehyde reacts with ammonia, it forms hexamethylene tetramine, which is known as urotropine



110. (a) : 3 - methyl Hexane is

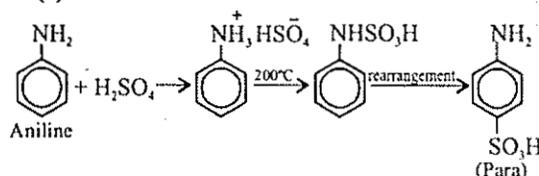


C^* = Chiral carbon atom (due to which it is optically active)

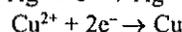
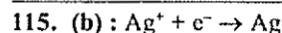
111. (d) : In crystal lattice tetrahedral void is smaller than the octahedral void due to the concerned geometry. Anions are larger in size than cations so anions occupy more space.

112. (c) : The heat of formation of all the elements in their standard states are arbitrarily assumed to be zero.

113 (d)



114. (a) : In covalent bonding, there is sharing of electrons between two atoms but this sharing may or may not be due to the differences in the electro negativities of two concerned atoms.



For deposition of Ag, 1 mole of electrons is required while for Cu, 2 moles of electrons are required. So quantity of electricity needed for depositing is different.

116. (c) : At elevated temperature or in the presence of catalyst, strong bonds between two N-atom rupture, and make N_2 molecule to active.

117. (a) : Ionisation of first electron requires lesser energy as compared to the second electron ionisation.

118. (a) : Hydrogen ions are discharged in preference to sodium normally but at mercury electrode, sodium ion are discharged first due to the formation of amalgam (Na / Hg).

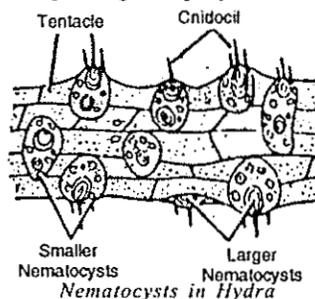
119. (d) : No transition can take place between $2p_x \rightarrow 2p_y$ as $2p_x$ and $2p_y$ are degenerate orbitals.

120. (b) : Due to high electronegativity and high heat of dissociation fluorine oxidise the elements to their highest oxidation state.

BIOLOGY

121. (b) : The amphids of *Ascaris* are chemoreceptors, while the other sensory papillae are tangoreceptors. Amphid is opening of an amphidial gland.

122. (b) : Nematocysts are stinging cells of (*Hydra*) coelenterates. The poison present in its hollow thread is helpful in capturing the prey.



123. (d) : Bone is a hard connective tissue that makes up most of the skeleton of vertebrates. It consists of fine-branched cells (osteoblasts) embedded in a matrix, which they have secreted. The matrix is made up of 30% protein (collagen) and 70% inorganic matter, mainly calcium phosphate.

124. (d) : The right and the left hepatic ducts join to form a common hepatic duct which again joins to the duct of gall bladder (Cystic duct) forming a common bile or ductus choledocus.

125. (b) : Corpora allata and corpora cardiaca glands are found in insects. They produce hormones that control factors like gamete production, metamorphosis, growth and moulting. General body growth is controlled by the corpora cardiaca and moulting and egg production by the corpora allata.

126. (c) : Chordae tendinae (tendinous cords) are tough strands of connective tissue that run from the underside of the bicuspid and tricuspid valves to muscles in the walls of the left ventricles of the heart respectively.

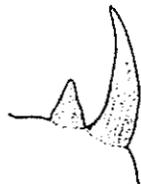
127. (b) : Saliva comes in mouth and is secreted by the salivary gland, which has ptyalin enzyme that is a starch splitting enzyme. Thus salivary secretion stands digestion of starch in mouth.

128. (d) : Ostrich, Emu, Kiwi all are flightless birds. They all are under subclass Neornithes. Tail is short and usually ended in a pygostyle. The retrices are arranged in a semicircle around the pygostyle.

129. (c) : Adipose tissue are modified areolar tissue. The type of tissues present in hump of camel is unilocular adipocytes, These are fatty tissues and can transform fat cells to water through oxidation whenever body needs it.

130. (a) : Wharton's duct is the duct of submandibular salivary gland, opening into the mouth at the side of the frenum linguae.

131. (c) : The horns of *Rhinoceros* are composed of keratin. It is generally known as keratin fibre horn. It has no skeletal element and made by keratinized cells of epidermis and consists of matted keratin fibres bound together. It is a permanent epidermal structure and if broken it grows again.

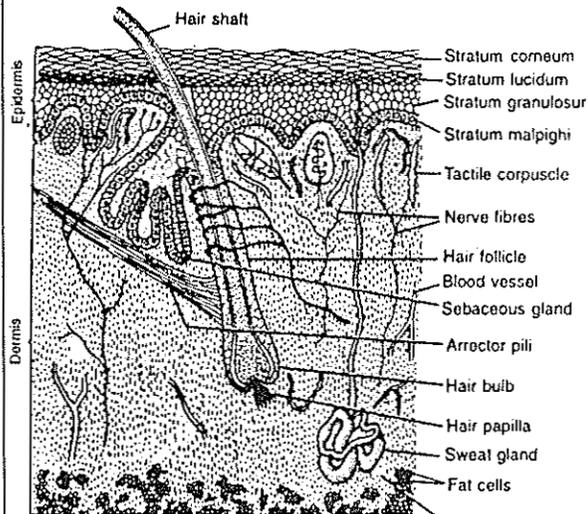


Fibre horn (*Rhinoceros*)

132. (b) : Sharpey's perforating fibres are collagenous fibres, which pass from the peridontal membrane into the cementum and jaw bones. It fixes the teeth firmly in the sockets.

133. (c) : Fluoride exposure disrupts the synthesis of collagen and leads to the breakdown of collagen in bone, tendon, muscle. Knock knee is a condition where the legs are bowed inwards in the standing position. The bowing usually occurs at or around the knee, so that on standing with the knees together, the feet are far apart.

134. (b) : Sweat glands are epidermal glands embedded in the dermis of the skin of mammals. It secretes a



T.S. of skin showing sweat gland

hypertonic solution of salts and other small molecules present in blood. It is a long coiled tubular gland.

135. (d) : Prussic acid is a toxic substance. Non-lethal amounts of prussic acid are rapidly detoxified in liver by reaction with sulphide and sulphocyanate is formed and is readily excreted in urine.

136. (a) : Choanocytes are also called collar cells, which are found in sponges. The flagellated collar cells in sponges, maintain the flow of food bearing water.

137. (a) : The function of contractile vacuole in protozoa is hydrostatic or osmoregulatory. The mechanism which is assumed to effect water regulation is the contractile vacuole. The vacuole periodically

increases in volume (diastole) to get filled with water and contracts (systole) to discharge its water content to the surrounding environment and this is the basic mechanism of osmoregulation, e.g. *Amoeba*.

138. (b) : Order rodentia includes rat and squirrel. It also includes gnawing mammals, with a pair of large continually growing chisel like incisors, in upper and lower jaws.

139. (d) : The number of milk teeth which are replaceable for the 2nd time is 20. In adult human, total number of teeth is 32. Therefore, the teeth that grow only once in the life of a man is $32 - 20$ or 12.

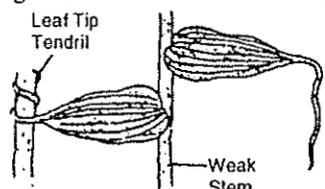
140. (a) : The glycosidic link is a link joining monosaccharides in polysaccharides (starch). It is broken during the digestion of starch.

141. (c) : The population of young children in next ten to fifteen years attains the reproductive age group. High birth rate and low mortality rate also contribute to increase the population size. But the increased reproductivity is the main reason.

142. (d) : The radial symmetry is characteristic of many sedentary animals as well as free living animals. e.g., coelenterata and echinodermata.

143. (b) : Asbestosis is caused by air pollutants. Workers in slate factories and other mines suffer heavily from respiratory ailments and lung cancer. Silicosis is also a lung disease caused by silica inhalation.

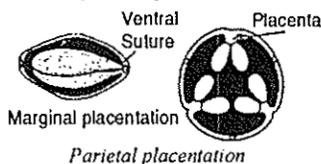
144. (d) : The leaf apices of *Gloriosa superba* are greatly elongated to function like the tendrils.



Leaf apices of *Gloriosa superba*

145. (d) : Pepsin is an enzyme that catalyses the partial hydrolysis of proteins to polypeptides. It is secreted by gastric gland.

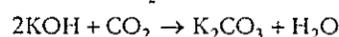
146. (b) : In parietal placentation, two or more longitudinal placentae develop along the wall of a syncarpous or compound pistil. The ovary is usually unilocular. In marginal placentation, a single



longitudinal placenta having one or two alternate rows of ovules occur along the wall of the ovary, called central suture. In superficial placentation, the ovules develop on the whole inner surface of the ovary including the septa, if present. In basal placentation, the pistil can be monocarpellary or syncarpous. The ovary is unilocular. It bears a single placenta at the base with generally a single ovule.

147. (c) : Bone marrow is of two types; red and yellow. The yellow marrow is found especially in medullary cavity of long bones, while red in spongy bones.

148. (c) : Like other alkali metals, potassium hydroxide combines with CO_2 as such :-



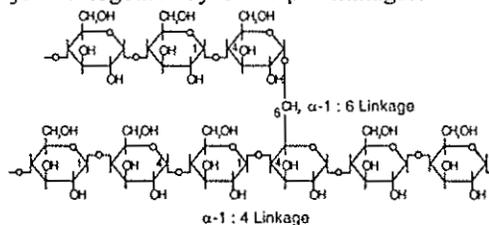
149. (d) : Lipid is stained with 'Sudan Black B' protein with bromophenol blue. And for nucleic acid Feulgen stain is used.

150. (a) : Biosphere is stretched above 9000 m above sea level to 11000 m below. But life is abundant in between 6000 m above sea level to 200 m below the sea level.

151. (a) : The flow of intrinsic information from DNA to mRNA and then to polypeptide is called central dogma of molecular biology.



152. (c) : Starch consists of two components amylose and amylopectin. Both amylose and amylopectin are formed by the condensation of α -D-glucose. A chain of cellulose molecule contains 6000 or more glucose residues. The successive glucose residues are joined together by 1 - 4 β - linkages.



Structure of starch

153. (c) : The amount of living or organic matter present in an organism is called biomass. It is measured both as fresh and dry weight. Pyramid of biomass is a graphic representation of biomass present sequence wise per unit area of different trophic levels with producers at the base and top carnivores kept at the tip. Maximum biomass occurs in producers. There is

a progressive reduction of biomass found in herbivores, primary carnivores, secondary carnivores.

154. (c) : Tropical rain forests are mainly found in central America, along Amazon and Orinoco rivers, South America, Congo river basin of Africa, Malagasy Republic and South east Asia including India. Diversity of life is so high that a hectare of the forest may have as many as 200 species of trees, 70% - 80% of all insects and 80 - 85% of all birds are known from tropical forests.

155. (b) : Distinct zonation and stratification are characteristic features of lakes and large ponds. The warmer upper part of the lake or epilimnion becomes temporarily isolated from the colder lower part or hypolimnion, by a thermocline zone that acts as a barrier to exchange of materials. Consequently, the supply of the oxygen in the hypolimnion and nutrients in the epilimnion may run short.

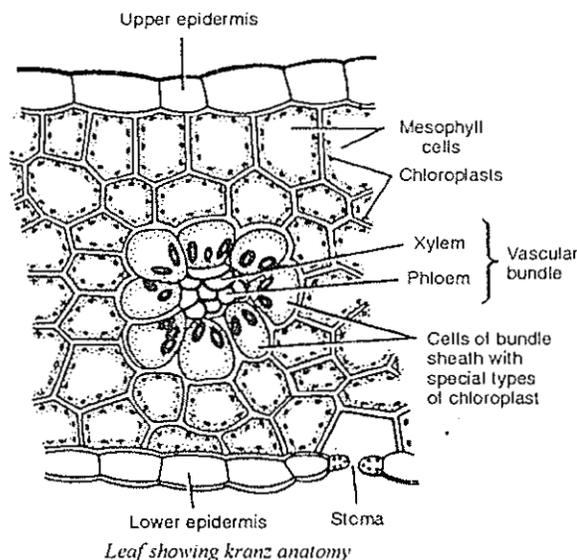
156. (a) : Red Data book is maintained by IUCN.

157. (c) : Red rust of tea is caused by an alga *Cephaleuros*, a green alga. It is parasitic on a number of higher plants. *Melampsora lini* causes rust of linseed. *Helminthosporium oryzae* causes leaf spot disease of rice commonly called sesame or brown leaf spot of rice. It causes Bengal famine in 1942 - 43. Circular necrotic dark brown or blackish leaf spot develop in groundnut due to *Cercospora* called as Tikka disease.

158. (d) : The electron transport system is a chain of carriers consisting of nicotinamide adenine dinucleotide (NAD), flavin nucleotides (FAD, sometimes FMN), coenzyme Q (CoQ) and the cytochromes (cyt *b, c, a, a₃*). Nonheme iron proteins also seem to be involved but their role is not known exactly.

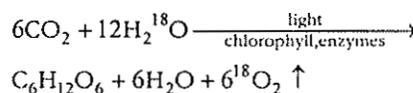
159. (d) The ovule of gymnosperms consists of a parenchymatous mass of cells called the nucellus or the megasporangium. The nucellus encloses a single diploid megaspore mother cell that undergoes meiosis to form a linear tetrad of 4 haploid megaspores, out of which only one remains functional, whereas the rest degenerate. The functional megaspore form female gametophyte. As the female gametophyte is formed prior to fertilization, therefore, endosperm is haploid in case of gymnosperm.

160. (d) : The leaves of C_4 plants are characterized by a sheath of parenchyma cells that are radially arranged around each vascular bundle. The vascular



bundle in turn is enclosed by loosely packed, "spongy" mesophyll cells. This is known as Kranz anatomy and is characteristic of C_4 plants such as sugarcane, sorghum, maize, various grasses originating in the tropics and indeed, many other species of plants.

161. (b) : Ruben and Kamen (1941) and Ruben *et al* (1941) suspended *Chlorella* in water having nonradioactive heavy isotope of oxygen, ^{18}O , instead of natural oxygen ^{16}O . The suspension was illuminated. Oxygen evolved was tested by means of mass spectrometer. It was found to be heavy isotope, ^{18}O . This is possible only if oxygen evolved during photosynthesis comes from splitting of water.



162. (c) : The habitat of an organism is the place where it lives. The ecological niche, however includes not only the physical space occupied by an organism but also its functional role in the community and its position in environmental gradients of temperature, moisture, pH, soil and other conditions of existence.

163. (c) : *Embllica officinalis* (amla) is the best source of vitamin C, though the citrus fruits also contain considerable amounts of the vitamin C.

164. (d)

165. (d) : One of the major consequences of shifting cultivation is that the top soil burnt during practice

requires long time to recover. It adversely effects the productivity of the land.

166. (c) The world's major supply of sugar at present comes from the culms of sugarcane (*Saccharum officinarum* L.) and a smaller proportion from sugarbeet root (*Beta vulgaris*) *Citrullus vulgaris* and *Annona squamosa* both are eaten as fruits.

167. (b) Antagonism is interference with, or inhibition of growth of one kind of organism by another through the creation of unfavourable condition, e.g. by exhaustion of food supply or by production of a specific antibiotic substance (e.g. penicillin). Amensalism is an interaction between two living individuals of different species in which an organism does not allow other organism to grow or live near it. Commensalism is the relationship between two living individuals of different species in which one is benefitted while the other is neither harmed nor benefitted except to a negligible extent.

168. (d) : The term albedo refers the reflected light from the earth surface into 100/incident light. Snow has high albedo whereas sea has less.

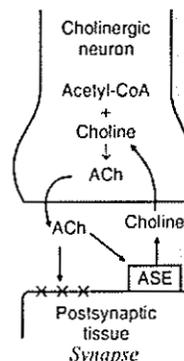
169. (d) For the relative degree of tolerance a series of terms have come into general use in ecology that use the prefixes steno -, meaning "narrow", and eury-, meaning "wide".

170. (c) *Adiantum* is a walking fern.

171. (a) : *Drosophila* may be the readily available insect but its main importance is the presence of a number of behavioural genes (mutants described as sluggish, non-climbing, flightless, easily shocked etc.) and marked sexual behaviour. The chromosomes present in it can be easily studied. In 1910, Morgan started his work on fruit fly.

172. (d) : Random fluctuation in allele frequencies is called genetic drift. The effect of genetic drift is negligible in large population but in small breeding population fixation or homozygosity would have occurred. So there is no question for speciation. On the other hand, according to Hardy Weinberg law at equilibrium, both gene frequencies and genotype frequencies will remain constant from generation to generation in an infinitely large interbreeding population in which mating is at random and no selection, migration or mutation occur.

173. (c) : Acetylcholine is secreted by cholinergic neurons. Acetylcholine made by these neurons taken up into synaptic vesicles by a vesicular transporter. It must be rapidly removed from the synapse if repolarization is to occur. The removal occurs by way of hydrolysis of acetylcholine to choline and acetate, a reaction catalysed by acetylcholinesterase.



174. (b) : The effect of collecting duct depends on the presence of vasopressin over there. This hormone increases the permeability of the collecting duct to water. Gradually the rate of reabsorption from the filtrate increases and it becomes hyperosmotic. There is graded increase in the osmolality of the interstitium of the pyramids. Na^+ , K^+ and Cl^- are transported out of the thick segment of the ascending limb. The Na^+ is actively transported out of the cells into the interstitium by Na^+K^+ ATPase.

175. (a) : The relative ratio of cytokinin (Kinetin) to auxin (IAA) was considered important in determining the nature of organogenesis in tobacco pith tissue. It was shown that high level of kinetin caused bud initiation, while high concentration of auxin favoured rooting.

176. (b) : Generally, a woman does not conceive during the lactation period. Lactation stimulates prolactin secretion and there is evidence that prolactin inhibits GnRH secretion, and antagonizes the action of gonadotropins on the ovaries. Ovulation is inhibited, and the ovaries are inactive, so estrogen and progesterone output falls to low levels. Thus during lactation a woman does not conceive. Only 5-10% chances are there during lactation period. This can also be interpreted as mechanism devised by nature so that mother can look after the new born child by providing it with milk.

177. (a) Pathogen free clones of plants can be obtained through shoot - tip culture because shoot apical meristem is usually free of the pathogens. The shoot tips are virus - free also and as shoot tips are grown in artificial medium, virus cannot grow there. Virus can grow in host cells only.

178. (a) In modern era a high yielding variety developed at one place is immediately distributed to

all parts of the globe. Naturally the low yielding wild varieties are discarded. The discarded wild varieties automatically disappear. They and their genes cannot be regained.

179. (b) Alpine tundra is the highest altitudinal biome which occurs near the top of very high mountains having permanent snow. i.e. at the height to approximate 3500 metres, i.g. in Himalayas "alpine tundra" vegetation is found. It is a treeless region and lies above the timber - line. Trees of lower region becomes tiny shrubs in this area (e.g. *Rhododendron*, *Juniperus*, *Abies*). Other constituents of alpine tundra are lichens, mosses, grasses, herbs and small shrubs like *Artemesia*, *Arenaria*, *Primula* and *Anemone*.

180. (c) Nitrogen fixing cyanobacteria (blue - green algae) form symbiotic association with several plants, e.g. cycad roots, lichens, liverworts, *Azolla*. Out of these, *Azolla - Anabaena* association is of great importance to agriculture. *Azolla pinnata* is a free floating fresh water form which multiplies rapidly, doubling every 5 - 7 days. *Anabaena azolla* resides in the leaf cavities of the fern. It fixes nitrogen. A part of the fixed nitrogen is excreted in the cavities and becomes available to the fern. The decaying fern plants release the same for utilization of the rice plants. When field is dried at the time of harvesting, the fern functions as the green manure, decomposing and enriching the field for the next crop.

GENERAL KNOWLEDGE

181. (c)

182. (a) : In 1940, the Muslim league led by Jinnah, passed a resolution demanding partition of the country and the creation of a new state called Pakistan after independence.

183. (c)

184. (c) : The Babar was a great scholar. His autobiography 'Tuzuk-i-Babri' is a classic of world literature.

185. (a)

186. (c) : The Hall of Nation's is located in Pragati Maidan in the capital of India i.e. New Delhi.

187. (a)

188. (c) : Earthquake is shaking of earth's crust sometimes accompanied by elevation or depression. But often no lasting effect is visible on the surface, except the damage done by shaking.

189. (c)

190. (a) : In cricket, when the batsman is out without scoring any run, it is called 'duck'.

191. (c)

192. (b) : A series of Russian moon probes luna-2 was the first probe to hit the moon on 3rd Sept. 1959. Luna-2 was the first to soft land on the moon in 1966.

193. (b)

194. (b) : Baikal lake is the deepest lake in the world, located in Siberia. It's average depth is 700 metres.

195. (a)

196. (c) : Ottawa, Rome, Tokyo and Copenhagen are the capitals of Canada, Italy, Japan and Denmark respectively.

197. (c)

198. (b) : Rana Pratap, the ruler of Mewar was defeated by the Mughal forces led by Mansingh and Asaf Khan.

199. (a)

200. (c) : The election commission recommends the disqualification of a member of parliament, while orders are issued by the president.

