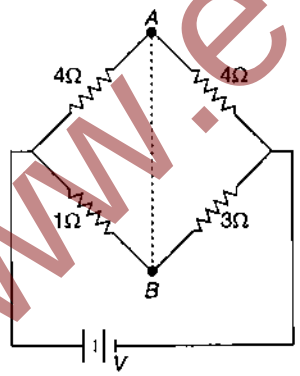
CBSE SCREENING
MEDICAL ENTRANCE
SOLVED PAPER 2006

Physics

1. In producing chlorine through electrolysis 100 W power at 125 V is being consumed. How much chlorine per min is liberated ? ECE of chlorine is 0.367×10^{-6} kg/C :
(a) 17.6 mg (b) 21.3 mg
(c) 24.3 mg (d) 13.6 mg

2. In the circuit shown, if a conducting wire is connected between points *A* and *B*, the current in this wire will :



(a) flow from *A* to *B*
(b) flow in the direction which will be decided by the value of *V*
(c) be zero
(d) flow from *B* to *A*

3. A rectangular block of mass *m* and area of cross-section *A* floats in a liquid of density ρ. If it is given a small vertical displacement from equilibrium it undergoes oscillation with a time period *T*. Then :
(a) $T \propto \sqrt{\rho}$ (b) $T \propto \frac{1}{\sqrt{A}}$
(c) $T \propto \frac{1}{\rho}$ (d) $T \propto \frac{1}{\sqrt{m}}$

4. A Carnot engine whose sink is at 300 K has an efficiency of 40%. By how much should the temperature of source be increased so as to increase its efficiency by 50% of original efficiency ?
(a) 275 K (b) 325 K
(c) 250 K (d) 380 K

5. When a charged particle moving with velocity $\vec{\mathbf{v}}$ is subjected to a magnetic field of induction $\vec{\mathbf{B}}$, the force on it is non-zero. This implies that :
(a) angle between $\vec{\mathbf{v}}$ and $\vec{\mathbf{B}}$ is necessarily 90°
(b) angle between $\vec{\mathbf{v}}$ and $\vec{\mathbf{B}}$ can have any value other than 90°
(c) angle between $\vec{\mathbf{v}}$ and $\vec{\mathbf{B}}$ can have any value other than zero and 180°
(d) angle between $\vec{\mathbf{v}}$ and $\vec{\mathbf{B}}$ is either zero or 180°

6. Two cells, having the same emf, are connected in series through an external resistance *R*. Cells have internal resistances r_1 and r_2 ($r_1 > r_2$) respectively. When the circuit is closed, the potential difference across the first cell is zero. The value of *R* is :
(a) $r_1 - r_2$ (b) $\frac{r_1 + r_2}{2}$
(c) $\frac{r_1 - r_2}{2}$ (d) $r_1 + r_2$

7. A black body at 1227°C emits radiations with maximum intensity at a wavelength of 5000 Å. If the temperature of the body is increased by 1000°C, the maximum intensity will be observed at :
(a) 4000 Å (b) 5000 Å
(c) 6000 Å (d) 3000 Å

8. Two circular coils 1 and 2 are made from the same wire but the radius of the 1st coil is twice that of the 2nd coil. What is the ratio of potential difference applied across them so that the magnetic field at their centres is the same ?
(a) 3 (b) 4 (c) 6 (d) 2

9. A transistor-oscillator using a resonant circuit with an inductor L (of negligible resistance) and a capacitor C in series produce oscillations of frequency f. If L is doubled and C is changed to $4C$, the frequency will be :
(a) $f/4$ (b) $8f$
(c) $f/2\sqrt{2}$ (d) $f/2$

10. The binding energy of deuteron is 2.2 MeV and that of $^4_2$He is 28 MeV. If two deuterons are fused to form one $^4_2$He then the energy released is :
(a) 25.8 MeV (b) 23.6 MeV
(c) 19.2 MeV (d) 30.2 MeV

11. In a radioactive material the activity at time t_1 is R_1 and at a later time t_2, it is R_2. If the decay constant of the material is λ, then :
(a) $R_1 = R_2\, e^{-\lambda(t_1 - t_2)}$
(b) $R_1 = R_2\, e^{\lambda(t_1 - t_2)}$
(c) $R_1 = R_2\,(t_2 / t_1)$
(d) $R_1 = R_2$

12. Ionization potential of hydrogen atom is 13.6 eV. Hydrogen atoms in the ground state are excited by monochromatic radiation of photon energy 12.1 eV. According to Bohr's theory, the spectral lines emitted by hydrogen will be :
(a) two (b) three
(c) four (d) one

13. The potential energy of a long spring when stretched by 2 cm is U. If the spring is stretched by 8 cm the potential energy stored in it is :
(a) $4U$ (b) $8U$
(c) $16U$ (d) $U/4$

14. For angles of projection of a projectile at angles $(45° - \theta)$ and $(45° + \theta)$, the horizontal ranges described by the projectile are in the ratio of :
(a) 1 : 1 (b) 2 : 3
(c) 1 : 2 (d) 2 : 1

15. A body of mass 3 kg is under a constant force which causes a displacement s in metres in it, given by the relation $s = \frac{1}{3}t^2$, where t is in s. Work done by the force in 2 s is :
(a) $\frac{5}{19}$ J (b) $\frac{3}{8}$ J
(c) $\frac{8}{3}$ J (d) $\frac{19}{5}$ J

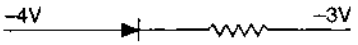
16. A particle moves along a straight line OX. At a time t (in seconds) the distance x (in metres) of the particle from O is given by
$$x = 40 + 12t - t^3$$
How long would the particle travel before coming to rest ?
(a) 24 m (b) 40 m
(c) 56 m (d) 16 m

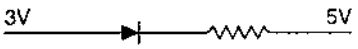
17. The velocity v of a particle at time t is given by $v = at + \frac{b}{t + c}$, where a, b and c are constants.
The dimensions of a, b and c are respectively :
(a) $[LT^{-2}]$, [L] and [T]
(b) $[L^2]$, [T] and $[LT^2]$
(c) $[LT^2]$, [LT] and [L]
(d) [L], [LT] and $[T^2]$

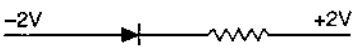
18. A microscope is focussed on a mark on a piece of paper and then a slab of glass of thickness 3 cm and refractive index 1.5 is placed over the mark. How should the microscope be moved to get the mark in focus again ?
(a) 1 cm upward (b) 4.5 cm downward
(c) 1 cm downward (d) 2 cm upward

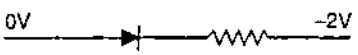
19. 300 J of work is done in sliding a 2 kg block up an inclined plane of height 10 m. Taking $g = 10$ m/s^2, work done against friction is :
(a) 200 J (b) 100 J
(c) zero (d) 1000 J

20. A transistor is operated in common emitter configuration at constant collector voltage $V_c = 1.5$ V such that a change in the base current from 100 μA to 150 μA produces a change in the collector current from 5 mA to 10 mA. The current gain (β) is :
(a) 67 (b) 75
(c) 100 (d) 50

21. A forward biased diode is :
(a) 

(b) 

(c) 

(d) 

22. A photo-cell employs photoelectric effect to convert :
(a) change in the frequency of light into a change in electric voltage
(b) change in the intensity of illumination into a change in photoelectric current

(c) change in the intensity of illumination into a change in the work function of the photocathode
(d) change in the frequency of light into a change in the electric current

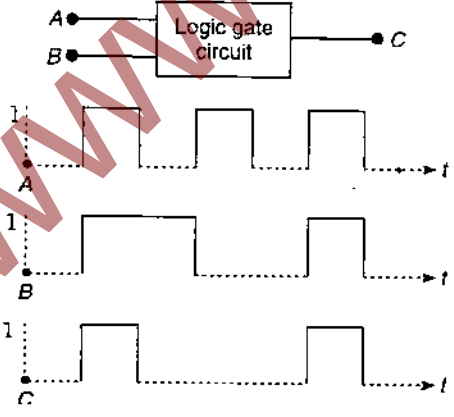
23. The core of a transformer is laminated because :
(a) energy losses due to eddy currents may be minimised
(b) the weight of the transformer may be reduced
(c) rusting of the core may be prevented
(d) ratio of voltage in primary and secondary may be increased

24. Two coils of self-inductances 2 mH and 8 mH are placed so close together that the effective flux in one coil is completely linked with the other. The mutual inductance between these coils is :
(a) 10 mH (b) 6 mH
(c) 4 mH (d) 16 mH

25. In a discharge tube ionization of enclosed gas is produced due to collisions between :
(a) positive ions and neutral atoms/molecules
(b) negative electrons and neutral atoms/molecules
(c) photons and neutral atoms/molecules
(d) neutral gas atoms/molecules

26. When photons of energy $h\nu$ fall on an aluminium plate (of work function E_0), photoelectrons of maximum kinetic energy K are ejected. If the frequency of the radiation is doubled, the maximum kinetic energy of the ejected photoelectrons will be :
(a) $K + E_0$ (b) $2K$
(c) K (d) $K + h\nu$

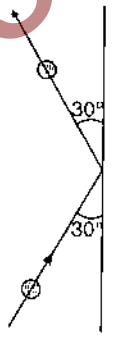
27. The following figure shows a logic gate circuit with two inputs A and B and the output C. The voltage waveforms of A, B and C are as shown below :



The logic circuit gate is :
(a) AND gate
(b) NAND gate
(c) NOR gate
(d) OR gate

28. A coil of inductive reactance 31 Ω has a resistance of 8Ω. It is placed in series with a condenser of capacitative reactance 25 Ω. The combination is connected to an a.c. soruce of 110 V. The power factor of the circuit is :
(a) 0.56 (b) 0.64
(c) 0.80 (d) 0.33

29. A 0.5 kg ball moving with a speed of 12 m/s strikes a hard wall at an angle of 30° with the wall. It is reflected with the same speed and at the same angle. If the ball is in contact with the wall for 0.25 s, the average force acting on the wall is :



(a) 48 N
(b) 24 N
(c) 12 N
(d) 96 N

30. The moment of inertia of a uniform circular disc of radius R and mass M about an axis touching the disc at its diameter and normal to the disc is :
(a) MR^2 (b) $\frac{2}{5}MR^2$
(c) $\frac{3}{2}MR^2$ (d) $\frac{1}{2}MR^2$

31. The momentum of a photon of energy 1 MeV in kg m/s, will be :
(a) 0.33×10^6 (b) 7×10^{-24}
(c) 10^{-22} (d) 5×10^{-22}

32. The radius of germanium (Ge) nuclide is measured to be twice the radius of $^9_4$Be. The number of nucleons in Ge are :
(a) 73 (b) 74
(c) 75 (d) 72

33. The molar specific heat at constant pressure of an ideal gas is (7/2)R. The ratio of specific heat at constant pressure to that at constant volume is :
(a) 7/5 (b) 8/7
(c) 5/7 (d) 9/7

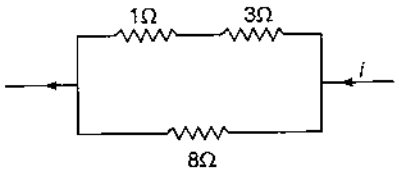
34. The earth is assumed to be a sphere of radius R. A platform is arranged at a height R from the surface of the earth. The escape velocity of a body from this platform is fv_e, where v_e is its escape velocity from the surface of the earth. The value of f is :

(a) $\sqrt{2}$ (b) $\frac{1}{\sqrt{2}}$ (c) $\frac{1}{3}$ (d) $\frac{1}{2}$

35. Two sound waves with wavelengths 5.0 m and 5.5 m respectively, each propagate in a gas with velocity 330 m/s. We expect the following number of beats per second :

(a) 12 (b) 0 (c) 1 (d) 6

36. Power dissipated across the 8 Ω resistor in the circuit shown here is 2 W. The power dissipated in watt units across the 3 Ω resistor is :



(a) 2.0 (b) 1.0 (c) 0.5 (d) 3.0

37. Kirchhoff's first and second laws for electrical circuits are consequences of :

(a) conservation of energy
(b) conservation of electric charge and energy respectively
(c) conservation of electric charge
(d) conservation of energy and electric charge respectively

38. A transverse wave propagating along x-axis is represented by :

$$y(x, t) = 8.0 \sin\left(0.5\pi x - 4\pi t - \frac{\pi}{4}\right)$$

where x is in metres and t is in seconds. The speed of the wave is :

(a) 4π m/s (b) 0.5π m/s
(c) $\frac{\pi}{4}$ m/s (d) 8 m/s

39. The time of reverberation of a room A is one second. What will be the time (in seconds) of reverberation of a room, having all the dimensions double of those of room A ?

(a) 2 (b) 4
(c) $\frac{1}{2}$ (d) 1

40. Which one of the following statements is true ?

(a) Both light and sound waves in air are transverse
(b) The sound waves in air are longitudinal while the light waves are transverse
(c) Both light and sound waves in air are longitudinal
(d) Both light and sound waves can travel in vacuum

41. Above Curie temperature :

(a) a ferromagnetic substance becomes paramagnetic
(b) a paramagnetic substance becomes diamagnetic
(c) a diamagnetic substance becomes paramagnetic
(d) a paramagnetic substance becomes ferromagnetic

42. A convex lens and a concave lens, each having same focal length of 25 cm, are put in contact to form a combination of lenses. The power in diopters of the combination is :

(a) 25 (b) 50
(c) infinite (d) zero

43. An electric dipole of moment $\vec{\mathbf{p}}$ is lying along a uniform electric field $\vec{\mathbf{E}}$. The work done in rotating the dipole by 90° is :

(a) $\sqrt{2}\,pE$ (b) $\frac{pE}{2}$
(c) $2pE$ (d) pE

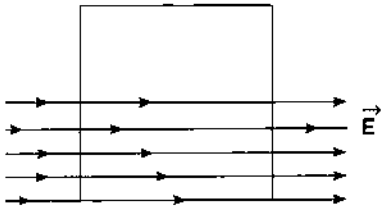
44. A parallel plate air capacitor is charged to a potential difference of V volts. After disconnecting the charging battery the distance between the plates of the capacitor is increased using an insulating handle. As a result the potential difference between the plates :

(a) decreases (b) does not change
(c) becomes zero (d) increases

45. A car runs at a constant speed on a circular track of radius 100 m, taking 62.8 s for every circular lap. The average velocity and average speed for each circular lap respectively is :

(a) 0, 0 (b) 0, 10 m/s
(c) 10 m/s, 10 m/s (d) 10 m/s, 0

46. A square surface of side L m is in the plane of the paper. A uniform electric field $\vec{\mathbf{E}}$ (V/m), also in the plane of the paper, is limited only to the lower half of the square surface, (see figure). The electric flux in SI units associated with the surface is :



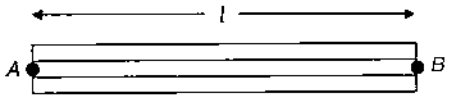
(a) $EL^2/(2\varepsilon_0)$ (b) $EL^2/2$
(c) zero (d) EL^2

47. A tube of length L is filled completely with an incompressible liquid of mass M and closed at both the ends. The tube is then rotated in a horizontal plane about one of its ends with a uniform angular velocity ω. The force exerted by the liquid at the other end is :

(a) $\frac{ML\omega^2}{2}$ (b) $\frac{ML^2\omega}{2}$
(c) $ML\omega^2$ (d) $\frac{ML^2\omega^2}{2}$

48. A uniform rod of length l and mass m is free to rotate in a vertical plane about A. The rod initially in horizontal position is released. The initial angular acceleration of the rod is :

(Moment of inertia of rod about A is $\frac{ml^2}{3}$)



(a) $\frac{3g}{2l}$ (b) $\frac{2l}{3g}$
(c) $\frac{3g}{2l^2}$ (d) $mg\frac{l}{2}$

49. The vectors $\vec{A}$ and $\vec{B}$ are such that :

$$\left|\vec{A}+\vec{B}\right| = \left|\vec{A}-\vec{B}\right|$$

The angle between the two vectors is :
(a) 90° (b) 60°
(c) 75° (d) 45°

50. Two bodies, A (of mass 1 kg) and B (of mass 3 kg) are dropped from heights of 16 m and 25 m, respectively. The ratio of the time taken by them to reach the ground is :
(a) 5/4 (b) 12/5
(c) 5/12 (d) 4/5

Chemistry

51. Identify the correct statement for change of Gibbs energy for a system (ΔG_{system}) at constant temperature and pressure :
(a) If $\Delta G_{system} > 0$, the process is spontaneous
(b) If $\Delta G_{system} = 0$, the system has attained equilibrium
(c) If $\Delta G_{system} = 0$, the system is still moving in a particular direction
(d) If $\Delta G_{system} < 0$, the process is not spontaneous

52. A solution containing 10g per dm^3 of urea (molecular mass = 60 g mol^{-1}) is isotonic with a 5% solution of a non-volatile solute. The molecular mass of this non-volatile solute is :
(a) 250 g mol^{-1} (b) 300 g mol^{-1}
(c) 350 g mol^{-1} (d) 200 g mol^{-1}

53. A plot of log x/m *versus* log p for the adsorption of a gas on a solid gives a straight line with slope equal to :
(a) – log k (b) n
(c) $\frac{1}{n}$ (d) log k

54. Assume each reaction is carried out in an open container. For which reaction will $\Delta H = \Delta E$?
(a) $H_2(g) + Br_2(g) \longrightarrow 2HBr(g)$
(b) $C(s) + 2H_2O(g) \longrightarrow 2H_2(g) + CO_2(g)$
(c) $PCl_5(g) \longrightarrow PCl_3(g) + Cl_2(g)$
(d) $2CO(g) + O_2(g) \longrightarrow 2CO_2(g)$

55. In a set of reactions propionic acid yielded a compound D.

$$CH_3CH_2COOH \xrightarrow{SOCl_2} B \xrightarrow{NH_3} C \xrightarrow[Br_2]{KOH} D$$

The structure of D would be :
(a) $CH_3CH_2CH_2NH_2$ (b) $CH_3CH_2CONH_2$
(c) $CH_3CH_2NHCH_3$ (d) $CH_3CH_2NH_2$

56. During the process of digestion, the proteins present in food materials are hydrolysed to amino acids. The two enzymes involved in the process

Proteins $\xrightarrow{\text{Enzyme } (A)}$ Polypeptides
$\xrightarrow{\text{Enzyme } (B)}$ Amino acids,

are respectively :
(a) amylase and maltase
(b) diastase and lipase
(c) pepsin and trypsin
(d) invertase and zymase

57. The human body does not produce :
(a) DNA (b) vitamins
(c) hormones (d) enzymes

58. CsBr crystallises in a body centred cubic lattice. The unit cell length is 436.6 pm. Given that the atomic mass of Cs = 133 and that of Br = 80 amu and Avogadro number being 6.02×10^{23} mol^{-1}, the density of CsBr is :
(a) 42.5 g/cm^3 (b) 0.425 g/cm^3
(c) 8.25 g/cm^3 (d) 4.25 g/cm^3

59. More number of oxidation states are exhibited by the actinoids than by the lanthanoids. The main reason for this is :
(a) more energy difference between 5*f* and 6*d* orbitals than that between 4*f* and 5*d* orbitals
(b) lesser energy difference between 5*f* and 6*d* orbitals than that between 4*f* and 5*d* orbitals
(c) greater metallic character of the lanthanoids than that of the corresponding actinoids
(d) more active nature of the actinoids

60. Given : The mass of electron is 9.11×10^{-31} kg
Planck constant is 6.626×10^{-34} Js,
the uncertainty involved in the measurement of velocity within a distance of 0.1 Å is :
(a) 5.79×10^{6} ms^{-1} (b) 5.79×10^{7} ms^{-1}
(c) 5.79×10^{8} ms^{-1} (d) 5.79×10^{5} ms^{-1}

61. Copper sulphate dissolves in excess of KCN to give :
(a) CuCN (b) $[Cu(CN)_4]^{3-}$
(c) $[Cu(CN)_4]^{2-}$ (d) $Cu(CN)_2$

62. In which of the following pairs are both the ions coloured in aqueous solution ?
(a) Ni^{2+}, Ti^{3+} (b) Sc^{3+}, Ti^{3+}
(c) Sc^{3+}, Co^{2+} (d) Ni^{2+}, Cu^{+}
(At. no. : Sc = 21, Ti = 22, Ni = 28, Cu = 29, Co = 27)

63. Al_2O_3 can be converted to anhydrous $AlCl_3$ by heating :
(a) Al_2O_3 with HCl gas
(b) Al_2O_3 with NaCl in solid state
(c) a mixture of Al_2O_3 and carbon in dry Cl_2 gas
(d) Al_2O_3 with Cl_2 gas

64. The enthalpy and entropy change for the reaction :
$$Br_2(l) + Cl_2(g) \rightarrow 2BrCl(g)$$
are 30 kJ mol^{-1} and 105 JK^{-1} mol^{-1} respectively. The temperature at which the reaction will be in equilibrium is :
(a) 285.7 K (b) 273 K
(c) 450 K (d) 300 K

65. The appearance of colour in solid alkali metal halides is generally due to :
(a) F-centres (b) Schottky defect
(c) Frenkel defect (d) Interstitial positions

66. The general molecular formula, which represents the homologous series of alkanols is :
(a) $C_nH_{2n}O_2$ (b) $C_nH_{2n}O$
(c) $C_nH_{2n+1}O$ (d) $C_nH_{2n+2}O$

67. If $E^\circ_{Fe^{2+}/Fe} = -0.441$ V and $E^\circ_{Fe^{3+}/Fe^{2+}} = 0.771$ V, the standard emf of the reaction :
$$Fe + 2Fe^{3+} \rightarrow 3Fe^{2+}$$
will be :
(a) 0.330 V (b) 1.653 V
(c) 1.212 V (d) 0.111 V

68. For the reaction
$$2A + B \rightarrow 3C + D$$
which of the following does not express the reaction rate ?
(a) $-\frac{d[C]}{3dt}$ (b) $-\frac{d[B]}{dt}$
(c) $\frac{d[D]}{dt}$ (d) $-\frac{d[A]}{2dt}$

69. For the reaction,
$CH_4(g) + 2O_2(g) \rightleftharpoons CO_2(g) + 2H_2O(l)$, $\Delta_r H = -170.8$ kJ mol^{-1}
Which of the following statements is not true ?
(a) At equilibrium, the concentrations of $CO_2(g)$ and $H_2O(l)$ are not equal
(b) The equilibrium constant for the reaction is given by $K_p = \frac{[CO_2]}{[CH_4][O_2]}$
(c) Addition of $CH_4(g)$ or $O_2(g)$ at equilibrium will cause a shift to the right
(d) The reaction is exothermic

70. $[NH(CH_2)NHCO(CH_2)_4CO]_n$ is a :
(a) co-polymer
(b) addition polymer
(c) thermo-setting polymer
(d) homopolymer

71. A carbonyl compound reacts with hydrogen cyanide to form cyanohydrin which on hydrolysis forms a racemic mixture of α-hydroxy acid. The carbonyl compound is :

(a) acetaldehyde (b) acetone
(c) diethyl ketone (d) formaldehyde

72. Which one of the following is a peptide hormone ?

(a) Glucagon (b) Testosterone
(c) Thyroxin (d) Adrenaline

73. The major organic product in the reaction,
$CH_3 - O - CH(CH_3)_2 + HI \rightarrow$ Product is :

(a) $CH_3OH + (CH_3)_2CHI$
(b) $ICH_2OCH(CH_3)_2$
(c) $CH_3O\underset{\underset{I}{|}}{C}(CH_3)_2$
(d) $CH_3I + (CH_3)_2CHOH$

74. Nucleophilic addition reaction will be most favoured in :

(a) $CH_3 - CH_2 - CH_2\overset{\overset{O}{\|}}{C} - CH_3$
(b) $(CH_3)_2C = O$
(c) CH_3CH_2CHO
(d) CH_3CHO

75. The enthalpy of combustion of H_2, cyclohexene (C_6H_{10}) and cyclohexene (C_6H_{12}) are – 241, –3800 and –3920 kJ per mol respectively. Heat of hydrogenation of cyclohexene is :

(a) –121 kJ per mol
(b) + 121 kJ per mol
(c) + 242 kJ per mol
(d) –242 kJ per mol

76. Self condensation of two moles of ethyl acetate in presence of sodium ethoxide yields :

(a) ethyl butyrate (b) acetoacetic ester
(c) methyl acetoacetate (d) ethyl propionate

77. Consider the reaction

$$N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$$

The equality relationship between $\frac{d[NH_3]}{dt}$ and $-\frac{d[H_2]}{dt}$ is :

(a) $\frac{d[NH_3]}{dt} = -\frac{1}{3}\frac{d[H_2]}{dt}$
(b) $+\frac{d[NH_3]}{dt} = -\frac{2}{3}\frac{d[H_2]}{dt}$
(c) $+\frac{d[NH_3]}{dt} = -\frac{3}{2}\frac{d[H_2]}{dt}$
(d) $\frac{d[NH_3]}{dt} = -\frac{d[H_2]}{dt}$

78. Which of the following is not chiral ?

(a) 2-butanol
(b) 2, 3-dibromopentane
(c) 3-bromopentane
(d) 2-hydroxypropanoic acid

79. $[Co(NH_3)_4(NO_2)_2]Cl$ exhibits :

(a) linkage isomerism, ionization isomerism and optical isomerism
(b) linkage isomerism, ionization isomerism and geometrical isomerism
(c) ionization isomerism; geometrical isomerism and optical isomerism
(d) linkage isomerism, geometrical isomerism and optical isomerism

80. $[Cr(H_2O)_6]Cl_3$ (at. no. of Cr = 24) has a magnetic moment of 3.83 BM, the correct distribution of 3*d* electrons in the chromium of the complex is :

(a) $3d^1_{x^2-y^2}, 3d^1_{z^2}, 3d^1_{xz}$
(b) $3d^1_{xy}, 3d^1_{x^2-y^2}, 3d^1_{yz}$
(c) $3d^1_{xy}, 3d^1_{zy}, 3d^1_{xz}$
(d) $3d^1_{xy}, 3d^1_{yz}, 3d^1_{z^2}$

81. 1.00 g of a non-electrolyte solute (molar mass 250g mol^{-1}) was dissolved in 51.2 g of benzene. If the freezing point depression constant, K_f of benzene is 5.12 K $kg\ mol^{-1}$, the freezing point of benzene will be lowered by :

(a) 0.4 K (b) 0.3 K
(c) 0.5 K (d) 0.2 K

82. Which of the following pairs constitutes a buffer ?

(a) HNO_2 and $NaNO_2$
(b) NaOH and NaCl
(c) HNO_3 and NH_4NO_3
(d) HCl and KCl

83. The hydrogen ion concentration of a 10^{-8} M HCl aqueous solution at 298 K ($K_w = 10^{-14}$) is :

(a) 1.0×10^{-6} M (b) 1.0525×10^{-7} M
(c) 9.525×10^{-8} M (d) 1.0×10^{-8} M

84. A solution of acetone in ethanol :

(a) shows a negative deviation from Raoult's law
(b) shows a positive deviation from Raoult's law
(c) behaves like a near ideal solution
(d) obeys Raoult's law

85. A hypothetical electrochemical cell is shown below

$$A\,|\,A^+\ (xM)\,||\,B^-\ (yM)\,|\,B$$

The emf measured is + 0.20V. The cell reaction is :

(a) $A^+ + B \longrightarrow A + B^+$

(b) $A^- + e^- \longrightarrow A$; $B^+ + e^- \rightarrow B$

(c) the cell reaction cannot be predicted

(d) $A + B^+ \longrightarrow A^+ + B$

86. Ethylene oxide when treated with Grignard reagent yields :

(a) secondary alcohol
(b) tertiary alcohol
(c) cyclopropyl alcohol
(d) primary alcohol

87. During osmosis, flow of water through a semi-permeable membrane is :

(a) from solution having higher concentration only
(b) from both sides of semi-permeable membrane with equal flow rates
(c) from both sides of semi-permeable membrane with unequal flow rates
(d) from solution having lower concentration only

88. Which of the following is more basic than aniline ?

(a) Diphenylamine (b) Triphenylamine
(c) *p*-nitroaniline (d) Benzylamine

89. In which of the following molecules are all the bonds not equal ?

(a) ClF_3 (b) BF_3
(c) AlF_3 (d) NF_3

90. The electronegativity difference between N and F is greater than that between N and H yet the dipole moment of NH_3 (1.5 D) is larger than that of NF_3 (0.2 D). This is because :

(a) in NH_3 as well as in NF_3 the atomic dipole and bond dipole are in the same direction
(b) in NH_3 the atomic dipole and bond dipole are in the same direction whereas in NF_3 these are in opposite directions
(c) in NH_3 as well as NF_3 the atomic dipole and bond dipole are in opposite directions
(d) in NH_3 the atomic dipole and bond dipole are in the opposite directions whereas in NF_3 these are in the same directions

91. The correct order of the mobility of the alkali metal ions in aqueous solution is :

(a) $Li^+ > Na^+ > K^+ > Rb^+$
(b) $Na^+ > K^+ > Rb^+ > Li^+$
(c) $K^+ > Rb^+ > Na^+ > Li^+$
(d) $Rb^+ > K^+ > Na^+ > Li^+$

92. The corect order regarding the electronegativity of hybrid orbitals of carbon is :

(a) $sp > sp^2 < sp^3$ (b) $sp > sp^2 > sp^3$
(c) $sp < sp^2 > sp^3$ (d) $sp < sp^2 < sp^3$

93. Which of the following species has a linear shape ?

(a) NO_2^- (b) SO_2 (c) NO_2^+ (d) O_3

94. Which of the following is the most basic oxide ?

(a) Al_2O_3 (b) Sb_2O_3 (c) Bi_2O_3 (d) SeO_2

95. The orientation of an atomic orbital is governed by :

(a) azimuthal quantum number
(b) spin quantum number
(c) magnetic quantum number
(d) principal quantum number

96. Which of the following is ***not*** a correct statement ?

(a) The electron-deficient molecules can act as Lewis acids
(b) The canonical structures have no real existence
(c) Every AB_5 molecule does in fact have square pyramid structure
(d) Multiple bonds are always shorter than corresponding single bonds

97. The number of unpaired electrons in a paramagnetic diatomic molecule of an element with atomic number 16 is :

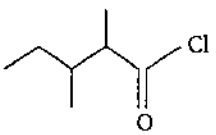
(a) 2 (b) 3 (c) 4 (d) 1

98. Which one of the following orders is not in accordance with the property stated against it ?

(a) $F_2 > Cl_2 > Br_2 > I_2$: Oxidising power
(b) $HI > HBr > HCl > HF$: Acidic property in water
(c) $F_2 > Cl_2 > Br_2 > I_2$: Electronegativity
(d) $F_2 > Cl_2 > Br_2 > I_2$: Bond dissociation energy

99. Which of the following is not isostructural with $SiCl_4$?

(a) SCl_4 (b) SO_4^{2-} (c) PO_4^{3-} (d) NH_4^+

100. The IUPAC name of  is :

(a) 3, 4-dimethylpentanoyl chloride
(b) 1-chloro-1-oxo-2, 3-dimethylpentane
(c) 2-ethyl-3-methylbutanoyl chloride
(d) 2, 3-dimethylpentanoyl chloride

101. What would be the number of chromosomes in the cells of the aleurone layer in a plant species with 8 chromosomes in its synergids ?
(a) 16 (b) 24
(c) 32 (d) 8

102. Pineapple (annanas) fruit develops from :
(a) a unilocular polycarpillary flower
(b) a multipistillate syncarpous flower
(c) a cluster of compactly borne flowers on a common axis
(d) a multilocular monocarpillary flower

103. Golden rice is a promising transgenic crop. When released for cultivation, it will help in :
(a) alleviation of vitamin- A deficiency
(b) pest resistance
(c) herbicide tolerance
(d) producing a petrol-like fuel from rice

104. Parthenocarpic tomato fruits can be produced by :
(a) removing androecium of flowers before pollen grains are released
(b) treating the plants with low concentrations of gibberellic acid and auxins
(c) raising the plants from vernalized seeds
(d) treating the plants with phenylmercuric acetate

105. How does pruning help in making the hedge dense ?
(a) It induces the differentiation of new shoots from the rootstock
(b) It frees axillary buds from apical dominance
(c) The apical shoot grows faster after pruning
(d) It releases wound hormones

106. The 'blue baby' syndrome results from :
(a) excess fo chloride
(b) methaemoglobin
(c) excess of dissolved oxygen
(d) excess of TDS (Total Dissolved Solids)

107. Praying mentis is a good example of :
(a) mullerian mimicry
(b) warning colouration
(c) social insects (d) camouflage

108. Which one of the following statements is correct ?
(a) Neurons regulate endocrine activity, but not vice versa
(b) Endocrine glands regulate neural activity and nervous system regulates endocrine glands
(c) Neither hormones control neural activity nor the neurons control endocrine activity
(d) Endocrine glands regulate neural activity but not vice versa

109. Examination of blood of a person suspected o having anaemia, shows large, immature nucleated erythrocytes without haemoglobin Supplementing his diet with which of th following, is likely to alleviate his symptoms ?
(a) Thiamine
(b) Folic acid and cobalamine
(c) Riboflavin
(d) Iron compounds

110. Farmers in a particular region were concerne that pre-mature yellowing of leaves of a puls crop might cause decrease in the yield. Whicl treatment could be most beneficial to obtai maximum seed yield ?
(a) Frequent irrigation of the crop
(b) Treatment of the palnts with cytokinin alongwith a small dose of nitrogenou fertilizer
(c) Removal of all yellow leaves and sprayin the remaining green leaves with 2, 4 5-trichlorophenoxy acetic acid
(d) Application of iron and magnesium t promote synthesis of chlorophyll

111. In which of the following fruits is the edibl part the aril ?
(a) Custard apple (b) Pomegranate
(c) Orange (d) Litchi

112. Which one of the following aminoacids wa not found to be synthesized in Miller experiment ?
(a) Glycine (b) Aspartic acid
(c) Glutamic acid (d) Alanine

113. Crop plants grown in monoculture are :
(a) low in yield
(b) free from intraspecific competition
(c) characterised by poor root system,
(d) highly prone to pests

114. Montreal protocol which calls for appropriate action to protect the ozone layer from human activities was passed in the year :
(a) 1986 (b) 1987
(c) 1988 (d) 1985

115. The formula for exponential population growth is :
(a) $dt/dN = rN$ (b) $dN/rN = dt$
(c) $rN/dN = dt$ (d) $dN/dt = rN$

116. Which one of the following is not used for construction of ecological pyramids ?
(a) Dry weight
(b) Number of individuals
(c) Rate of energy flow
(d) Fresh weight

117. Niche overlap indicates :
(a) active co-operation between two species
(b) two different parasites on the same host
(c) sharing of one or more resources between the two species
(d) mutualism between two species

118. In photosystem-I, the first electron acceptor is :
(a) ferredoxin
(b) cytochrome
(c) plastocyanin
(d) an iron-sulphur protein

119. Treatment of seed at low temperature under moist conditions to break its dormancy is called :
(a) scarification (b) vernalization
(c) chelation (d) stratification

120. Which one of the following is the most suitable, medium for culture of *Drosophila melanogaster* ?
(a) Moist bread (b) Agar agar
(c) Ripe banana (d) Cow dung

121. Which one of the following is not included under *in situ* conservation ?
(a) Sanctuary
(b) Botanical garden
(c) Biosphere reserve
(d) National park

122. Which antibiotic inhibits interaction between *t*-RNA and *m*-RNA during bacterial protein synthesis ?
(a) Erythromycin (b) Neomycin
(c) Streptomycin (d) Tetracycline

123. Phenotype of an organism is the result of :
(a) mutations and linkages
(b) cytoplasmic effects and nutrition
(c) environmental changes and sexual dimorphism
(d) genotype and environment interactions

124. Photochemical smog pollution does not contain :
(a) ozone
(b) nitrogen dioxide
(c) carbon dioxide
(d) PAN (Peroxy Acyl Nitrate)

125. Moss peat is used as a packing material for sending flowers and live plants to distant places because :
(a) it is easily available
(b) it is hygroscopic
(c) it reduces transpiration
(d) it serves as a disinfectant

126. A common structural feature of vessel elements and sieve tube elements is :
(a) thick secondary walls
(b) pores on lateral walls
(c) presence of P-protein
(d) enucleate condition

127. The thalloid body of a slime mould (*Myxomycetes*) is known as :
(a) protonema (b) Plasmodium
(c) fruiting body (d) mycelium

128. In which mode of inheritance do you expect more maternal influence among the offspring ?
(a) Autosomal (b) Cytoplasmic
(c) Y-linked (d) X-linked

129. What type of placentation is seen in sweet pea ?
(a) Basal (b) Axile
(c) Free central (d) Marginal

130. Long filamentous threads protruding at the end of a young cob of maize are :
(a) anthers (b) styles
(c) ovaries (d) hairs

131. Conifers differ from grasses in the :
(a) production of seeds from ovules
(b) lack of xylem tracheids
(c) absence of pollen tubes
(d) formation of endosperm before fertilization

132. How many different kinds of gametes will be produced by a plant having the genotype AABbCC ?
(a) Three (b) Four
(c) Nine (d) Two

133. In maize, hybrid vigour is exploited by :
(a) bombarding the protoplast with DNA
(b) crossing of two inbreed parental lines
(c) harvesting seeds from the most productive plants
(d) inducing mutations

134. Which of the following statements regarding mitochondrial membrane is not correct ?
(a) The outer membrane is permeable to all kinds of molecules
(b) The enzymes of the electron transfer chain are embedded in the outer membrane
(c) The inner membrane is highly convoluted forming a series of infoldings
(d) The outer membrane resembles a sieve

135. Amino acid sequence, in protein synthesis is decided by the sequence of :
(a) *t*-RNA (b) *m*-RNA
(c) *c*-DNA (d) *r*-RNA

136. How many ATP molecules could maximally be generated from one molecule of glucose, if the complete oxidation of one mole of glucose to CO_2 and H_2O yields 686 kcal and the useful chemical energy available in the high energy phosphate bond of one mole of ATP is 12 kcal ?
(a) Two (b) Thirty
(c) Fifty seven (d) One

137. An organic substance bound to an enzyme and essential for its acvity is called :
(a) coenzyme (b) holoenzyme
(c) apoenzyme (d) isoenzyme

138. Bowman's glands are found in :
(a) olfactory epithelium
(b) external auditory canal
(c) cortical nephrons only
(d) juxtamedullary nephrons

139. The bacterium *(Clostridium botulinum)* that causes botulism is :
(a) a facultative anaerobe
(b) an obligate anaerobe
(c) a facultative aerobe
(d) an obligate aerobe

140. Which one of the following is the correctly matched pair of an endangered animal and a National Park ?
(a) Lion – Corbett National Park
(b) Rhinoceros – Kaziranga National Park
(c) Wild ass – Dudhwa National Park
(d) Great Indian bustard – Keoladeo National Park

141. A person showing upredictable moods, outbursts of emotion, quarrelsome behaviour and conflicts with others is suffering from :
(a) schizophrenia
(b) borderline personality disorder (BPD)
(c) mood disorders
(d) addictive disorders

142. Sulphur is an important nutrient for optimum growth and productivity in :
(a) pulse crops (b) cereals
(c) fibre crops (d) oilseed crops

143. Pentamerous, actinomorphic flowers, bicarpillary ovary with oblique septa, and fruit a capsule or berry, are characteristic features of :
(a) Asteraceae (b) Brassicaceae
(c) Solanaceae (d) Liliaceae

144. In a moss the sporophyte :
(a) is partially parasitic on the gametophyte
(b) produces gametes that give rise to the gametophyte
(c) arises from a spore produced from the gametophyte
(d) manufactures food for itself, as well as for the gametophyte

145. Curing of tea leaves is brought about by the activity of :
(a) bacteria (b) mycorrhiza
(c) viruses (d) fungi

146. People living at sea level have around 5 million RBC per cubic millimeter of their blood whereas those living at an altitude of 5400 metres have around 8 million. This is because at high altitude :
(a) people get pollution-free air to breathe and more oxygen is available
(b) atmospheric O_2 level is less and hence more RBCs are needed to absorb the required amount of O_2 to survive
(c) there is more UV radiation which enhances RBC production
(d) people eat more nutritive food, therefore more RBCs are formed

147. An important evidence in favour of organic evolution is the occurrence of :
(a) homologous and vestigial organs
(b) analogous and vestigial organs
(c) homologous organs only
(d) homologous and analogous organs

148. Which one of the following is not a living fossil ?
(a) King crab (b) *Sphenodon*
(c) *Archaeopteryx* (d) *Peripatus*

149. Annual migration does not occur in the case of :
(a) salmon (b) Siberian crane
(c) salamander (d) arctic tern

150. A major breakthrough in the studies of cells came with the development of electron microscope. This is because :
(a) the resolution power of the electron microscope is much higher than that of the light microscope
(b) the resolving power of the electron microscope is 200 – 350 nm as compared to 0.1 – 0.2 nm for the light microscope
(c) electron beam can pass through thick materials, whereas light microscopy requires thin sections
(d) the electron microscope is more powerful than the light microscope as it uses a beam of electrons which has wavelength much longer than that of photons

151. Which one of the following is a matching set of a phylum and its three examples ?
(a) Cnidaria — *Bonellia, Physalia, Aurelia*
(b) Platyhelminthes — *Planaria, Schistosoma, Enterobius*
(c) Mollusca — *Loligo, Teredo, Octopus*
(d) Porifera — *Spongilla, Euplectella, pennatula*

152. Metameric segmentation is the characteristic of :
(a) Platyhelminthes and Arthropoda
(b) Echinodermata and Annelida
(c) Annelida and Arthropoda
(d) Mollusca and Chordata

153. Which of the following pairs of an animal and a plant represents endangered organisms in India ?
(a) *Bentinckia nicobarica* and red panda
(b) Tamarind and rhesus monkey
(c) *Cinchona* and leopard
(d) Banyan and black buck

154. Jurassic period of the Mesozoic era is characterised by :
(a) gymnosperms are dominant plants and first birds appear
(b) radiation of reptiles and origin of mammal like reptiles
(c) dinosaurs become extinct and angiosperms appear
(d) flowering plants and first dinosaurs appear

155. What is common about *Trypanosoma, Noctiluca, Monocystis* and *Giardia* ?
(a) These are all unicellular protists
(b) They have flagella
(c) They produce spores
(d) These are all parasites

156. Which of the following statements regarding cilia is not correct ?
(a) The organized beating of cilia is controlled by fluxes of Ca^{2+} across the membrane
(b) Cilia are hair-like cellular appendages
(c) Microtubules of cilia are composed of tubulin
(d) Cilia contain an outer ring of nine doublet microtubules surrounding two single microtubules

157. Microbes found to be very useful in genetic engineering are :
(a) *Escherichia coli* and *Agrobacterium tumefaciens*
(b) *Vibrio cholerae* and a tailed bacteriophage
(c) Diplococcus sp. and *Pseudomonas* sp.
(d) Crown gall bacterium and *Caenorhabditis elegans*

158. Which of the following environmental conditions are essential for optimum growth of *Mucor* on a piece of bread ?
A. Temperature of about 25°C
B. Temperature of about 5°C
C. Relative humidity of about 5%
D. Relative humidity of about 95%
E. A shady place
F. A brightly illuminated place
Choose the answer from the following options :
(a) A, C and E only (b) A, D and E only
(c) B, D and E only (d) B, C and F only

159. Evolutionary history of an organism is known as :
(a) Phylogeny (b) Ancestry
(c) Paleontology (d) Ontogeny

160. Which of the following is considered a hot-spot of biodiversity in India ?
(a) Western ghats (b) Indo-Gangetic plain
(c) Eastern ghats (d) Aravalli hills

161. During photorespiration, the oxygen consuming reaction(s) occur in :
(a) stroma of chloroplasts and mitochondria
(b) stroma of chloroplasts and peroxisomes
(c) grana of chloroplasts and peroxisomes
(d) stroma of chloroplasts

162. Which one of the following is an example of polygenic inheritance ?
(a) Flower colour in *Mirabilis jalapa*
(b) Production of male honey bee
(c) Pod shape in garden pea
(d) Skin colour in humans

163. Which one of the following not act as a neurotransmitter ?
(a) Acetylcholine (b) Epinephrine
(c) Nor epinephrine (d) Cortisone

164. Sertoli cells are regulated by the pituitary hormone known as :
(a) FSH (b) GH
(c) Prolactin (d) LH

165. A steroid hormone which regulates glucose metabolism is :
(a) cortisol
(b) corticosterone
(c) 11-deoxycorticosterone
(d) cortisone

166. The contractile protein of skeletal muscle involving ATPase activity is :
(a) tropomyosin (b) myosin
(c) α-actinin (d) troponin

167. Which one of the following is not a second messenger in hormone action ?
(a) cGMP (b) Calcium
(c) Sodium (d) cAMP

168. In Mendel's experiments with garden pea, round seed shape (RR) was dominant over wrinkled seeds (rr), yellow cotyledon (YY) was dominant over green cotyledon (yy). What are the expected phenotypes in the F_2 generation of the cross RRYY × rryy ?
(a) Only round seeds with green cotyledons
(b) Only wrinkled seeds with yellow cotyledons
(c) Only wrinkled seeds with green cotyledons
(d) Round seeds with yellow cotyledons and wrinkled seeds with yellow cotyledons

169. One gene – one enzyme hypothesis was postulated by :
(a) R. Franklin (b) Hershey and Chase
(c) A. Garrod (d) Beadle and Tatum

170. One turn of the helix in a B-form DNA is approximately :
(a) 20 nm (b) 0.34 nm
(c) 3.4 nm (d) 2 nm

171. Test cross involves :
(a) crossing between two genotypes with recessive trait
(b) crossing between two F_1 hybrids
(c) crossing the F_1 hybrid with a double recessive genotype
(d) crossing between two genotypes with dominant trait

172. Antiparallel strands of a DNA molecule means that :
(a) one strand turns anti-clockwise
(b) the phosphate groups of two DNA strands, at their ends, share the same position
(c) the phosphate groups at the start of two DNA strands are in opposite position (pole)
(d) one strand turns clockwise

173. Areolar connective tissue joins :
(a) fat body with muscles
(b) integument with muscles
(c) bones with muscles
(d) bones with bones

174. Mast cells secrete :
(a) hippurin (b) myoglobin
(c) histamine (d) haemoglobin

175. If a colourblind woman marries a normal visioned man, their sons will be :
(a) all normal visioned
(b) one-half colourblind and one-half normal
(c) three-fourths colourbling and one-fourth normal
(d) all colourblind

176. Cri-du-chat syndrome in humans is caused by the :
(a) fertilization of an XX egg by a normal Y-bearing sperm
(b) loss of half of the short arm of chromosome 5
(c) loss of half of the long arm of chromosome 5
(d) trisomy of 21st chromosome

177. Restriction endonuclease :
(a) cuts the DNA molecule randomly
(b) cuts the DNA molecule at specific sites
(c) restricts the synthesis of DNA inside the nucleus
(d) synthesizes DNA

178. Antibodies in our body are complex :
(a) lipoproteins (b) steroids
(c) prostaglandins (d) glycoproteins

179. Limit of BOD prescribed by Central Pollution Control Board for the discharge of industrial and municipal waste water into natural surface water, is :
(a) < 3.0 ppm (b) < 10 ppm
(c) < 100 ppm (d) < 30 ppm

180. Earthworms are :
(a) ureotelic when plenty of water is available
(b) uricotelic when plenty of water is available
(c) uricotelic under conditions of water scarcity
(d) ammonotelic when plenty of water is available

181. Which of the following is an accumulation and release centre of neurohormones ?
(a) Posterior pituitary lobe
(b) Intermediate lobe of the pituitary
(c) Hypothalamus
(d) Anterior pituitary lobe

182. Withdrawal of which of the following hormones is the immediate cause of menstruation ?
(a) Eastrogens (b) FSH
(c) FSH-RH (d) Progesterone

183. Which one of the following statements is incorrect ?
(a) The residual air in lungs slightly decreases the efficiency of respiration in mammals
(b) The presence of non-respiratory air sacs, increases the efficiency of respiration in birds
(c) In insects, circulating body fluids serve to distribute oxygen to tissues
(d) The principle of countercurrent flow facilitates efficient respiration in gills of fishes

184. Which one of the following has an open circulatory system ?
(a) *Pheretima*
(b) *Periplaneta*
(c) *Hirudinaria*
(d) *Octopus*

185. Which hormone causes dilation of blood vessels, increased oxygen consumption and glycogenolysis ?
(a) ACTH (b) Insulin
(c) Adrenalin (d) Glucagon

186. The causative agent of mad-cow disease is a :
(a) bacterium (b) prion
(c) worm (d) virus

187. The translocation of organic solutes in sieve tube members is supported by :
(a) root pressure and transpiration pull
(b) P-proteins
(c) mass flow involving a carrier and ATP
(d) cytoplasmic streaming

188. Biradial symmetry and lack of cnidoblasts are the characteristics of :
(a) Starfish and sea anemone
(b) *Ctenoplana* and *Beroe*
(c) *Aurelia* and *Paramecium*
(d) *Hydra* and starfish

189. The arrangement of the nuclei in a normal embryo sac in the dicot plants is :
(a) 2+4+2 (b) 3+2+3
(c) 2+3+3 (d) 3+3+2

190. An enzyme that can stimulate germination of barley seeds is :
(a) α-amylase (b) lipase
(c) protease (d) invertase

191. In a cereal grain the single cotyledon of embryo is represented by :
(a) coleorhiza
(b) scutellum
(c) prophyll
(d) coleoptile

192. The majority of carbon dioxide produced by our body cells is transported to the lungs :
(a) dissolved in the blood
(b) as bircarbonates
(c) as carbonates
(d) attached to haemoglobin

193. *Triticale*, the first man-made cereal crop, has been obtained by crossing wheat with :
(a) rye
(b) pearl millet
(c) sugarcane
(d) barley

194. In order to obtain virus-free plants through tissue culture the best method is :
(a) protoplast culture
(b) embryo rescue
(c) anther culture
(d) meristem culture

195. HIV that causes AIDS, first starts destroying :
(a) B-lymphocytes
(b) leucocytes
(c) thrombocytes
(d) helper T-lymphocytes

196. In which one of the following sets of animals do all the four give birth to young ones ?
(a) Lion, bat, whale, ostrich
(b) Platypus, penguin, bat, hippopotamus
(c) Shrew, bat, cat, kiwi
(d) Kangaroo, hedgehog, dolphin, loris

197. Sickle cell anaemia has not been eliminated from the African population because :
(a) it is controlled by recessive genes
(b) it is not a fatal disease
(c) it provides immunity against malaria
(d) it is controlled by dominant genes

198. Two common characters found in centipede, cockroach and crab are :
(a) compound eyes and anal cerci
(b) jointed legs and chitinous exoskeleton
(c) green gland and tracheae
(d) book lungs and antennae

199. Both sickle cell anaemia and Huntington's chorea are :
(a) bacteria-related diseases
(b) congenital disorders
(c) pollutant-induced disorders
(d) virus-related diseases

200. Angiotensinogen is a protein produced and secreted by :
(a) macula densa cells
(b) endothelial cells (cells lining the blood vessels)
(c) liver cells
(d) juxtaglomerular (JG) cells

ANSWERS

PHYSICS

1.	(a)	2.	(d)	3.	(b)	4.	(c)	5.	(c)	6.	(a)	7.	(d)	8.	(b)	9.	(c)	10.	(b)
11.	(a)	12.	(b)	13.	(c)	14.	(a)	15.	(c)	16.	(c)	17.	(a)	18.	(a)	19.	(b)	20.	(c)
21.	(d)	22.	(b)	23.	(a)	24.	(c)	25.	(b)	26.	(d)	27.	(a)	28.	(c)	29.	(b)	30.	(c)
31.	(d)	32.	(d)	33.	(a)	34.	(b)	35.	(d)	36.	(d)	37.	(b)	38.	(d)	39.	(a)	40.	(b)
41.	(a)	42.	(d)	43.	(d)	44.	(d)	45.	(b)	46.	(c)	47.	(a)	48.	(a)	49.	(a)	50.	(d)

CHEMISTRY

51.	(b)	52.	(b)	53.	(c)	54.	(a)	55.	(d)	56.	(c)	57.	(b)	58.	(d)	59.	(b)	60.	(a)
61.	(b)	62.	(a)	63.	(c)	64.	(a)	65.	(a)	66.	(d)	67.	(c)	68.	(a)	69.	(b)	70.	(a)
71.	(a)	72.	(a)	73.	(d)	74.	(d)	75.	(a)	76.	(b)	77.	(b)	78.	(c)	79.	(b)	80.	(c)
81.	(a)	82.	(a)	83.	(b)	84.	(b)	85.	(d)	86.	(d)	87.	(d)	88.	(d)	89.	(a)	90.	(b)
91.	(d)	92.	(b)	93.	(c)	94.	(c)	95.	(c)	96.	(c)	97.	(a)	98.	(d)	99.	(a)	100.	(d)

BIOLOGY

101.	(b)	102.	(c)	103.	(a)	104.	(b)	105.	(b)	106.	(b)	107.	(c)	108.	(a)	109.	(d)	110.	(d)
111.	(d)	112.	(c)	113.	(d)	114.	(b)	115.	(d)	116.	(d)	117.	(b)	118.	(d)	119.	(d)	120.	(c)
121.	(b)	122.	(d)	123.	(d)	124.	(c)	125.	(b)	126.	(b)	127.	(b)	128.	(b)	129.	(d)	130.	(b)
131.	(d)	132.	(d)	133.	(b)	134.	(b)	135.	(b)	136.	(b)	137.	(a)	138.	(a)	139.	(b)	140.	(b)
141.	(a)	142.	(a)	143.	(c)	144.	(a)	145.	(a)	146.	(b)	147.	(a)	148.	(c)	149.	(c)	150.	(a)
151.	(c)	152.	(c)	153.	(a)	154.	(a)	155.	(a)	156.	(c)	157.	(a)	158.	(b)	159.	(a)	160.	(a)
161.	(b)	162.	(d)	163.	(d)	164.	(a)	165.	(a)	166.	(b)	167.	(c)	168.	(d)	169.	(d)	170.	(c)
171.	(c)	172.	(c)	173.	(b)	174.	(c)	175.	(d)	176.	(b)	177.	(b)	178.	(d)	179.	(b)	180.	(d)
181.	(c)	182.	(d)	183.	(a)	184.	(b)	185.	(c)	186.	(b)	187.	(c)	188.	(b)	189.	(b)	190.	(a)
191.	(b)	192.	(b)	193.	(a)	194.	(d)	195.	(d)	196.	(d)	197.	(c)	198.	(b)	199.	(b)	200.	(c)

HINTS & SOLUTIONS

Physics

1. **Key Idea :** *The mass of a substance deposited or liberated at an electrode is directly proportional to the quantity of electricity i.e., charge passed through the electrolyte.*

Power consumed in electrolysis, $P = 100$ W

Voltage applied, $V = 125$ V

So, current in the solution,

$$i = \frac{P}{V} = \frac{100}{125} = 0.8 \text{ A}$$

According to first law of Faraday, mass liberated at an electrode is directly proportional to charge passed through the electrolyte *i.e.*,

$$m \propto Q \Rightarrow m = zQ$$

where z is a constant called 'electro chemical equivalent' (ECE).

Also $Q = it$

$\therefore$ $m = zit$

Given,

$z = 0.367 \times 10^{-6}$ kg/C, $I = 0.8$ A, $t = 60$ s

Hence, $m = 0.367 \times 10^{-6} \times 0.8 \times 60$

$= 17.6 \times 10^{-6}$ kg

$= 17.6$ mg

NOTE : Faraday has also discovered law of electromagnetic induction so while talking about 'Faraday's law' one must specify 'electrolysis' or 'electromagnetic induction'.

2. **Key Idea :** *Current will flow from higher to lower potential.*

Resistances 4 Ω and 4 Ω are connected in series, so their effective resistance is

$$R' = 4 + 4 = 8\Omega$$

Similarly, 1 Ω and 3 Ω are in series

So, $R'' = 1 + 3 = 4\Omega$

Now R' and R'' will be in parallel, hence effective resistance

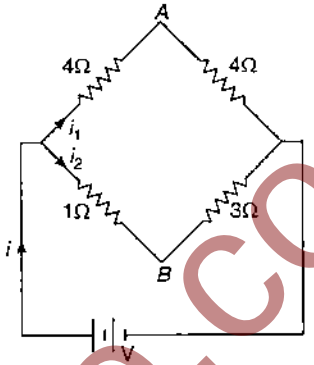
$$R = \frac{R' \times R''}{R' + R''}$$

$$= \frac{8 \times 4}{8 + 4} = \frac{32}{12} = \frac{8}{3}\Omega$$

Current through the circuit, from Ohm's law

$$i = \frac{V}{R} = \frac{3V}{8} \text{ A}$$

Let currents i_1 and i_2 flow in the branches as shown.



$\therefore$ $8i_1 = 4i_2$

$\Rightarrow$ $i_2 = 2i_1$ ...(i)

Also $i = i_1 + i_2$

$\Rightarrow$ $\frac{3V}{8} = i_1 + 2i_1$

$\Rightarrow$ $i_1 = \frac{V}{8}$ A

and $i_2 = \frac{V}{4}$ A

Potential drop at A, $V_A = 4 \times i_1 = \frac{4V}{8} = \frac{V}{2}$

Potential drop at B, $V_B = 1 \times i_2 = 1 \times \frac{V}{4} = \frac{V}{4}$

Since, drop of potential is greater in 4 Ω resistance so. It will be at lower potential than B, hence, on connecting wire between points A and B, the current will flow from B to A.

3. **Key Idea :** *Force applied on the body will be equal to upthrust for vertical oscillations.*

Let block is displaced through x m, then weight of displaced water or upthrust (upwards)

$= -Ax\rho g$

where A is area of cross-section of the block and ρ is its density. This must be equal to force ($=ma$) applied, where m is mass of the block and a is acceleration.

$\therefore$ $ma = -Ax\rho g$

or $$a = -\frac{A\rho g}{m}x = -\omega^2 x$$

This is the equation of simple harmonic motion.

Time period of oscillation

$$T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{m}{A\rho g}}$$

$$\Rightarrow \quad T \propto \frac{1}{\sqrt{A}}$$

4. The efficiency of Carnot engine is defined as the ratio of work done to the heat supplied *i.e.*,

$$\eta = \frac{\text{Work done}}{\text{Heat supplied}} = \frac{W}{Q_1} = \frac{Q_1 - Q_2}{Q_1}$$

$$= 1 - \frac{Q_2}{Q_1} = 1 - \frac{T_2}{T_1}$$

Here, T_1 is the temperature of source and T_2 is the temperature of sink

As given, $\eta = 40\% = \frac{40}{100} = 0.4$

and $T_2 = 300$ K

So, $0.4 = 1 - \frac{300}{T_1}$

$$\Rightarrow \quad T_1 = \frac{300}{1 - 0.4} = \frac{300}{0.6} = 500 \text{ K}$$

Let temperature of the source be increased by x K, then efficiency becomes

$$\eta' = 40\% + 50\% \text{ of } \eta$$
$$= \frac{40}{100} + \frac{50}{100} \times 0.4$$
$$= 0.4 + 0.5 \times 0.4$$
$$= 0.6$$

Hence, $0.6 = 1 - \frac{300}{500 + x}$

$$\Rightarrow \quad \frac{300}{500 + x} = 0.4$$

$$\Rightarrow \quad 500 + x = \frac{300}{0.4} = 750$$

$$\therefore \quad x = 750 - 500 = 250 \text{ K}$$

NOTE : All reversible heat engines working between same temperatures are equally efficient and no heat engine can be more efficient than Carnot engine (as it is ideal).

5. When a charged particle q is moving in a uniform magnetic field $\vec{\mathbf{B}}$ with velocity $\vec{\mathbf{v}}$ such that angle between $\vec{\mathbf{v}}$ and $\vec{\mathbf{B}}$ be θ, then due to interaction between the magnetic field produced due to moving charge and magnetic field applied, the charge

If $\theta = 0°$ or $180°$, then $\sin\theta = 0$

$$\therefore \quad F = qvB \sin\theta = 0$$

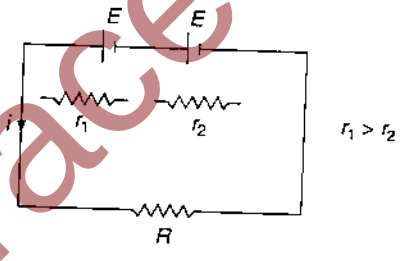
Since, force on charged particle is non-zero, so angle between $\vec{\mathbf{v}}$ and $\vec{\mathbf{B}}$ can have any value other than zero and 180°.

NOTE : Force experienced by the charged particle is Lorentz force.

6. **Key Idea :** *Current in the circuit is given by Ohm's law.*

Net resistance of the circuit $= r_1 + r_2 + R$

Net emf in series $= E + E = 2E$



Therefore, from Ohm's law, current in the circuit

$$i = \frac{\text{Net emf}}{\text{Net resistance}}$$

$$\Rightarrow \quad i = \frac{2E}{r_1 + r_2 + R} \qquad \text{...(i)}$$

It is given that, as circuit is closed, potential difference across the first cell is zero. That is,

$$V = E - ir_1 = 0$$

$$\Rightarrow \quad i = \frac{E}{r_1} \qquad \text{...(ii)}$$

Equating Eqs. (i) and (ii), we get

$$\frac{E}{r_1} = \frac{2E}{r_1 + r_2 + R}$$

$$\Rightarrow \quad 2r_1 = r_1 + r_2 + R$$

$\therefore$ R = external resistance $= r_1 - r_2$

NOTE : The question is wrong as the statement is when the circuit is closed, the potential difference across the first cell is zero which implies that in a series circuit, one part cannot conduct current which is wrong. Kirchhoff 's law is violated. The question must have been modified.

7. **Key Idea :** *The product of wavelength corresponding to maximum intensity of radiation*

where λ_m is wavelength corresponding to maximum intensity of radiation and T is temperature of the body in Kelvin.

$$\therefore \quad \frac{\lambda_{m'}}{\lambda_m} = \frac{T}{T'}$$

Given, $T = 1227 + 273 = 1500$ K,

$T' = 1227 + 1000 + 273 = 2500$ K

$\lambda_m = 5000$ Å

Hence, $\lambda_{m'} = \frac{1500}{2500} \times 5000 = 3000$ Å

8. Magnetic field at the centre of a circular coil is

$$B = \frac{\mu_0}{4\pi} \times \frac{2\pi i}{r}$$

where i is current flowing in the coil and r is radius of coil.

At the centre of coil -1,

$$B_1 = \frac{\mu_0}{4\pi} \times \frac{2\pi i_1}{r_1} \quad ...(i)$$

At the centre of coil-2

$$B_2 = \frac{\mu_0}{4\pi} \times \frac{2\pi i_2}{r_2} \quad ...(ii)$$

but $B_1 = B_2$

$$\therefore \quad \frac{\mu_0}{4\pi}\frac{2\pi i_1}{r_1} = \frac{\mu_0}{4\pi}\frac{2\pi i_2}{r_2}$$

or $\frac{i_1}{r_1} = \frac{i_2}{r_2}$

As $r_1 = 2r_2$

$$\therefore \quad \frac{i_1}{2r_2} = \frac{i_2}{r_2}$$

or $i_1 = 2i_2 \quad ...(iii)$

Now, ratio of potential differences

$$\frac{V_2}{V_1} = \frac{i_2 \times r_2}{i_1 \times r_1} = \frac{i_2 \times r_2}{2i_2 \times 2r_2} = \frac{1}{4}$$

$$\therefore \quad \frac{V_1}{V_2} = \frac{4}{1}$$

9. In a series LC circuit, frequency of LC oscillations is given by

$$f = \frac{1}{2\pi\sqrt{LC}}$$

or $f \propto \frac{1}{\sqrt{LC}}$

$$\Rightarrow \quad \frac{f_1}{f_2} = \sqrt{\frac{L_2C_2}{L_1C_1}}$$

Given, $L_1 = L, C_1 = C, L_2 = 2L, C_2 = 4C, f_1 = f$

$$\frac{f}{f_2} = \sqrt{\frac{2L \times 4C}{\quad}} = \sqrt{8}$$

$$\Rightarrow \quad f_2 = \frac{f}{2\sqrt{2}}$$

10. The reaction can be written as :

$${}_1H^2 + {}_1H^2 \longrightarrow {}_2He^4 + \text{energy}$$

The energy released in the reaction is difference of binding energies of daughter and parent nuclei.

Hence, energy released

= binding energy of ${}_2He^4$

$-2 \times$ binding energy of ${}_1H^2$

$= 28 - 2 \times 2.2 = 23.6$ MeV

11. The decay rate R of a radioactive materialis the number of decays per second.

From radioactive decay law.

$$-\frac{dN}{dt} \propto N \text{ or } -\frac{dN}{dt} = \lambda N$$

Thus, $R = -\frac{dN}{dt}$ or $R \propto N$

or $R = \lambda N$ or $R = \lambda N_0 e^{-\lambda t} \quad ...(i)$

where $R_0 = \lambda N_0$ is the activity of the radioactive material at time $t = 0$.

At time t_1, $R_1 = R_0 e^{-\lambda t_1} \quad ...(ii)$

At time t_2, $R_2 = R_0 e^{-\lambda t_2} \quad ...(iii)$

Dividing Eq. (ii) by (iii), we have

$$\frac{R_1}{R_2} = \frac{e^{-\lambda t_1}}{e^{-\lambda t_2}} = e^{-\lambda(t_1 - t_2)}$$

or $R_1 = R_2 e^{-\lambda(t_1 - t_2)}$

12. Ionization energy corresponding to ionization potential $= -13.6$ eV

Photon energy incident $= 12.1$ eV

So, the energy of electron in excited state

$$= -13.6 + 12.1 = -1.5 \text{ eV}$$

i.e., $E_n = -\frac{13.6}{n^2}$ eV

$$-1.5 = \frac{-13.6}{n^2}$$

$$\Rightarrow \quad n^2 = \frac{-13.6}{-1.5} \approx 9$$

$$\therefore \quad n = 3$$

i.e., energy of electron in excited state corresponds to third orbit.

The possible spectral lines are when electron jumps from orbit 3rd to 2nd; 3rd to 1st and 2nd to 1st. Thus, 3 spectral lines are emitted.

13. Let extension produced in a spring be x initially. In stretched condition spring will have potential energy

$$\frac{1}{2}$$

$$\therefore \quad \frac{U_1}{U_2} = \frac{x_1^2}{x_2^2} \qquad \ldots(i)$$

Given, $U_1 = U$, $x_1 = 2$ cm, $x_2 = 8$ cm

putting these values in Eq. (i), we have

$$\frac{U}{U_2} = \frac{(2)^2}{(8)^2} = \frac{4}{64} = \frac{1}{16}$$

$$\therefore \quad U_2 = 16U$$

14. Key Idea : *For complementary angles of projection, their horizontal ranges will be same.*

We know that, horizontal ranges for complementary angles of projection will be same.

The projectiles are projected at angles $(45° - \theta)$ and $(45° + \theta)$ which are complementary to each other *i.e.*, two angles add up to give 90°. Hence, horizontal ranges will be equal. Thus, the required ratio is 1 : 1.

Alternative : Horizontal range of projectile = Horizontal component of velocity (u_x) × Time of flight (T)

$$R = u\cos\alpha \times \frac{2u\sin\alpha}{g}$$

or $$R = \frac{u^2 \sin 2\alpha}{g}$$

For $\alpha = (45° - \theta)$, $R_1 = \frac{u^2 \sin 2(45° - \theta)}{g}$

$$= \frac{u^2 \sin (90° - 2\theta)}{g}$$

$$= \frac{u^2 \cos 2\theta}{g}$$

For $\alpha = (45° + \theta)$, $R_2 = \frac{u^2 \sin 2(45° + \theta)}{g}$

$$= \frac{u^2 \sin (90° + 2\theta)}{g}$$

$$= \frac{u^2 \cos 2\theta}{g}$$

Hence, $$\frac{R_1}{R_2} = \frac{1}{1}$$

or $$R_1 : R_2 = 1 : 1$$

NOTE : In the alternative method, we used the identity $\sin(90° - \theta) = \cos\theta$ and $\sin(90° + \theta) = \cos\theta$.

15. Key Idea : *If a constant force is applied on the object causing a displacement in it, then it is said that work has been done on the body to displace it.*

Work done by the force = Force × Displacement

But from Newton's 2nd law, we have

Force = Mass × Acceleration

i.e., $$F = ma \qquad \ldots(ii)$$

Hence, from Eqs. (i) and (ii), we get

$$W = mas = m\left(\frac{d^2s}{dt^2}\right)s \qquad \ldots(iii) \left(\because a = \frac{d^2s}{dt^2}\right)$$

Now, we have, $$s = \frac{1}{3}t^2$$

$$\therefore \quad \frac{d^2s}{dt^2} = \frac{d}{dt}\left[\frac{d}{dt}\left(\frac{1}{3}t^2\right)\right]$$

$$= \frac{d}{dt} \times \left(\frac{2}{3}t\right)$$

$$= \frac{2}{3}\frac{dt}{dt}$$

$$= \frac{2}{3}$$

Hence, Eq. (iii) becomes

$$W = \frac{2}{3}ms = \frac{2}{3}m \times \frac{1}{3}t^2$$

$$= \frac{2}{9}mt^2$$

We have given

$$m = 3\text{ kg}, t = 2\text{ s}$$

$$\therefore \quad W = \frac{2}{9} \times 3 \times (2)^2 = \frac{8}{3}\text{ J}$$

16. Key Idea : *Velocity is rate of change of distance or displacement.*

Distance travelled by the particle is

$$x = 40 + 12t - t^3$$

We know that, velocity is rate of change of distance *i.e.*, $v = \frac{dx}{dt}$.

$$\therefore \quad v = \frac{d}{dt}(40 + 12t - t^3)$$

$$= 0 + 12 - 3t^2$$

but final velocity $v = 0$

$$\therefore \quad 12 - 3t^2 = 0$$

or $$t^2 = \frac{12}{3} = 4$$

or $$t = 2\text{ s}$$

Hence, distance travelled by the particle before coming to rest is given by

$$x = 40 + 12(2) - (2)^3$$

$$= 40 + 24 - 8 = 64 - 8$$

$$= 56\text{ m}$$

17. Key Idea : *According to principle of homogeneity of dimensions, the dimensions of*

same.

The given expression is

$$v = at + \frac{b}{t + c}$$

From principle of homogeneity

$$[a][t] = [v]$$

$$[a] = \frac{[v]}{[t]} = \frac{[LT^{-1}]}{[T]} = [LT^{-2}]$$

Similarly, $[c] = [t] = [T]$

Further, $\frac{[b]}{[t + c]} = [v]$

or $[b] = [v][t + c]$

or $[b] = [LT^{-1}][T] = [L]$

NOTE : If a physical quantity depends on more than three factors, then relation among them cannot be established because we can have only three equations by equalising the powers of M, L and T.

18. Apparent depth of mark as seen through a glass slab of thickness x and refractive index μ is

$$\text{Apparent depth} = \frac{\text{Real depth}}{\text{Refractive index}}$$

or $$x' = \frac{x}{\mu} = \frac{3}{1.5} = 2 \text{ cm}$$

As image appears to be raised by 1 cm, therefore, microscope must be moved upward by 1 cm.

19. Net work done in sliding a body up to a height h on inclined plane

= Work done against gravitational force + Work done against frictional force

$$\Rightarrow \quad W = W_g + W_f \qquad ...(i)$$

but $W = 300$ J

$$W_g = mgh = 2 \times 10 \times 10 = 200 \text{ J}$$

putting in Eq. (i), we get

$$300 = 200 + W_f$$

$$\Rightarrow \quad W_f = 300 - 200 = 100 \text{ J}$$

20. AC current gain β is defined as the ratio of the collector to the base current at constant collector voltage,

$$\beta = \left(\frac{\Delta i_C}{\Delta i_B}\right)_{V_c}$$

Given, $\Delta i_C = 10 \text{ mA} - 5 \text{ mA} = 5 \text{ mA}$

$\Delta i_B = 150 \ \mu\text{A} - 100 \ \mu\text{A} = 50 \ \mu\text{A}$

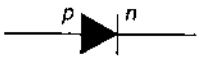
$$\therefore \quad \beta = \frac{5 \text{ mA}}{50 \times 10^{-3} \text{ mA}} = 100$$

NOTE : In common emitter amplifier, the output voltage signal is 180° out of phase with the input voltage signal.

21. **Key Idea :** *For forward biasing of diode, p-side of diode should be at higher potential than n-side.*

The p-n junctioni diode can be shown as :

If p-side of p-n junction diode is given more



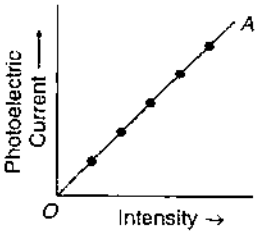
positive potential than n-side, then it is forward biased.

In option (d), p-side is at 0V and n-side at –2V, so p is at higher potential. Hence, it is forward biased.

NOTE : p-n junction diode is mainly used as a rectifier.

22. In a photoelectric effect when monochromatic radiations of suitable frequency fall on the photo-sensitive plate called cathode, the photoelectrons are emitted which get accelerated towards anode. These electrons flow in the outer circuit resulting in the photoelectric current.

Using the incident radiations of a fixed frequency, it is found that the photoelectric current increases linearly with the intensity of incident light as shown in figure. Hence, a photocell employs photo-electric effect to convert change in the intensity of illumination into a change in photo-electric current.



23. When magnetic flux linked with a coil changes, induced emf is produced in it and the induced current flows through the wire forming the coil. In 1895, Focault experimentally found that these induced currents are set up in the conductor in the form of closed loops. These currents look like eddies or whirl pools and likewise are known as eddy curents. They are also known as Focault's current. These currents oppose the cause of their origin,

therefore, due to eddy currents, a great amount of energy is wasted in form of heat energy. If core of transformer is laminated, then their effect can be minimised.

24. When the total flux associated with one coil links with the other *i.e.*, a case of maximum flux linkage. then

$$M_{12} = \frac{N_2 \phi_{B_2}}{i_1} \text{ and } M_{21} = \frac{N_1 \phi_{B_1}}{i_2}$$

Similarly, $L_1 = \frac{N_1 \phi_{B_1}}{i_1}$ and $L_2 = \frac{N_2 \phi_{B_2}}{i_2}$

If all the flux of coil 2 links coil 1 and *vice-versa* then

$$\phi_{B_2} = \phi_{B_1}$$

Since, $M_{12} = M_{21} = M$, hence we have

$$M_{12} M_{21} = M^2 = \frac{N_1 N_2 \phi_{B_1} \phi_{B_2}}{i_1 i_2} = L_1 L_2$$

$$\therefore \quad M_{max} = \sqrt{L_1 L_2}$$

Given, $L_1 = 2$ mH, $L_2 = 8$ mH

$$\therefore \quad M_{max} = \sqrt{2 \times 8} = \sqrt{16} = 4 \text{ mH}$$

25. In a discharge tube, after being accelerated though a high potential difference the ions in the gas strike the cathode with huge kinetic energy. This collision liberates electrons from the cathode. These free electrons can further liberate ions from gas molecules through collisions. The positive ions are attracted towards the cathode and negatively electrons move towards anode. Thus, ionization of gas results.

26. **Key Idea :** *The energy of photon is used in liberating the electron from metal surface and in imparting the kinetic energy to emitted photoelectron.*

According to Einstein's photoelectric effect energy of photon = KE of photoelectron + work function of metal

i.e., $h\nu = \frac{1}{2} m v^2 + E_0$

or $h\nu = K_{max} + E_0$ ...(i)

Now, we have given,

$$\nu' = 2\nu$$

Therefore, $K'_{max} = h(2\nu) - E_0$

$$K'_{max} = 2h\nu - E_0 \quad ...(ii)$$

From Eqs. (i) and (ii), we have

$$K'_{max} = 2(K_{max} + E_0) - E_0$$
$$= 2K_{max} + E_0$$
$$= K_{max} + (K_{max} + E_0)$$
$$= K_{max} + h\nu \quad \text{[From Eq. (i)]}$$

putting $K_{max} = K$

$$\therefore \quad K'_{max} = K + h\nu$$

NOTE : The photoelectric emission is an instantaneous process. The time lag between the incidence of radiations and emission of photoelectrons is very small, less than even 10^{-9} second.

27. The Boolean expression which satisfies the output of this logic gate is $C = A \cdot B$, which is for AND gate.

28. **Key Idea :** *Power factor ($\cos\phi$) is a ratio of resistance and impedance of AC circuit.*

Power factor of AC circuit is given by

$$\cos\phi = \frac{R}{Z} \quad ...(i)$$

where R is resistance employed and Z the impedance of the circuit.

$$Z = \sqrt{R^2 + (X_L - X_C)^2} \quad ...(ii)$$

Eqs. (i) and (ii) meet to give,

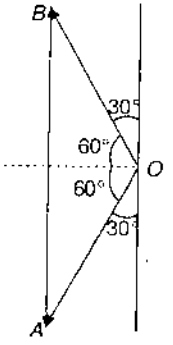
$$\cos\phi = \frac{R}{\sqrt{R^2 + (X_L - X_C)^2}} \quad ...(iii)$$

Given, $R = 8\Omega$, $X_L = 31\Omega$, $X_C = 25\Omega$

$$\therefore \quad \cos\phi = \frac{8}{\sqrt{(8)^2 + (31 - 25)^2}}$$
$$= \frac{8}{\sqrt{64 + 36}}$$

Hence, $\cos\phi = 0.80$

29. The vector $\vec{OA}$ represents the momentum of the object before the collision, and the vector $\vec{OB}$ that after the collision. The vector $\vec{AB}$ represents the change in momentum of the object $\Delta \vec{p}$.



As the magnitudes of $\vec{OA}$ and $\vec{OB}$ are equal, the components of $\vec{OA}$ and $\vec{OB}$ along the wall are equal and in the same direction, while those perpendicular to the wall are equal and opposite. Thus, the change in momentum is due only to the change in direction of the perpendicular components.

Hence, $\Delta p = OB \sin 30° - (-OA \sin 30°)$

$= mv \sin 30° - (-mv \sin 30°)$

$= 2mv \sin 30°$

Its time rate will appear in the form of average force acting on the wall.

$\therefore \quad F \times t = 2mv \sin 30°$

or $\quad F = \dfrac{2mv \sin 30°}{t}$

Given, $m = 0.5$ kg, $v = 12$ m/s, $t = 0.25$ s

$\theta = 30°$

Hence, $\quad F = \dfrac{2 \times 0.5 \times 12 \sin 30°}{0.25} = 24$ N

30. The moment of inertia about an axis passing through centre of mass of disc and perpendicular to its plane is

$$I_{CM} = \frac{1}{2} MR^2$$

where M is the mass of disc and R its radius.

According to theorem of parallel axis, MI of circular disc about an axis touching the disc at its diameter and normal to the disc is

$$I = I_{CM} + MR^2$$

$$= \frac{1}{2} MR^2 + MR^2$$

$$= \frac{3}{2} MR^2$$

31. Energy of photon is given by

$$E = \frac{hc}{\lambda} \qquad ...(i)$$

where h is Planck's constant, c the velocity of light and λ its wavelength.

de-Broglie wavelength is given by

$$\lambda = \frac{h}{p} \qquad ...(ii)$$

p being momentum of photon.

From Eqs. (i) and (ii), we can have

$$E = \frac{hc}{h/p} = pc$$

or $\quad p = E/c$

Given, $E = 1$ MeV $= 1 \times 10^6 \times 1.6 \times 10^{-19}$ J

$c = 3 \times 10^8$ m/s

Hence, after putting numerical values, we obtain

$$p = \frac{1 \times 10^6 \times 1.6 \times 10^{-19}}{3 \times 10^8} \text{ kgm/s}$$

$$= 5 \times 10^{-22} \text{ kgm/s}$$

32. Let radius of ${}^{9}_{4}\text{Be}$ nucleus be r. Then radius of germanium (Ge) nucleus will be $2r$.

Radius of a nucleus is given by

$$R = R_0 A^{1/3}$$

$$\therefore \quad \frac{R_1}{R_2} = \left(\frac{A_1}{A_2}\right)^{1/3}$$

$$\Rightarrow \quad \frac{r}{2r} = \left(\frac{9}{A_2}\right)^{1/3} \qquad (\because A_1 = 9)$$

$$\Rightarrow \quad \left(\frac{1}{2}\right)^3 = \frac{9}{A_2}$$

Hence, $\quad A_2 = 9 \times (2)^3$

$= 9 \times 8$

$= 72$

Thus, in germanium (Ge) nucleus number of nucleons is 72.

33. We have given molar specific heat at constant pressure

$$C_P = \frac{7}{2} R$$

Mayor's relation can be written as :

Molar specific heat at constant pressure − Molar specific heat at constant volume = Gas constant

i.e., $\quad C_P - C_V = R$

$$\Rightarrow \quad C_V = C_P - R$$

$$= \frac{7}{2} R - R = \frac{5}{2} R$$

Hence, required ratio is

$$\gamma = \frac{C_P}{C_V} = \frac{(7/2)R}{(5/2)R} = \frac{7}{5}$$

34. **Key Idea :** *If energy in the form of kinetic energy which is equal to binding energy, is supplied to the sphere, it leaves the gravitational field of earth.*

At a platform at a height h,

escape energy = binding energy of sphere

or $\quad \frac{1}{2} m v_e'^2 = \dfrac{GMm}{R + h}$

or $\quad v_e' = \sqrt{\dfrac{2GM}{R + h}} = \sqrt{\dfrac{2GM}{2R}} \qquad (\because h = R)$

But at surface of earth,

$$v_e = \sqrt{\frac{2GM}{R}}$$

As given, $\quad v_e' = f v_e$

Hence, $\quad \sqrt{\dfrac{2GM}{2R}} = f \sqrt{\dfrac{2GM}{R}}$

or $$\frac{1}{2R} = \frac{f^2}{R}$$

$$\therefore \quad f = \frac{1}{\sqrt{2}}$$

35. Let $\lambda_1 = 5.0$ m, $v = 330$ m/s and $\lambda_2 = 5.5$ m
The relation between frequency, wavelength and velocity is given by

$$v = n\lambda$$

$$\Rightarrow \quad n = \frac{v}{\lambda} \qquad ...(i)$$

The frequency corresponding to wavelength λ_1,

$$n_1 = \frac{v}{\lambda_1} = \frac{330}{5.0} = 66 \text{ Hz}$$

The frequency corresponding to wavelength λ_2,

$$n_2 = \frac{v}{\lambda_2} = \frac{330}{5.5} = 60 \text{ Hz}$$

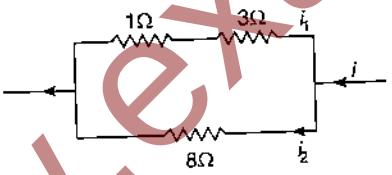
Hence, no. of beats per second

$$= n_1 - n_2$$
$$= 66 - 60$$
$$= 6$$

36. Resistances 1Ω and 3Ω are connected in series, so effective resistance

$$R' = 1 + 3 = 4\Omega$$

Now, R' and 8Ω are in parallel. We know that potential difference across resistacnes in parallel order is same



Hence, $$R' \times i_1 = 8i_2$$

or $$4 \times i_1 = 8i_2$$

or $$i_1 = \frac{8}{4} i_2 = 2i_2$$

or $$i_1 = 2i_2 \qquad ...(i)$$

Power dissipated across 8Ω resistance is

$$i_2^2 (8)t = 2 \text{ W}$$

or $$i_2^2 t = \frac{2}{8} = 0.25 \text{ W} \qquad ...(ii)$$

Power dissipated across 3Ω resistance is

$$H = i_1^2 (3)t$$
$$= (2i_2)^2 (3)t$$
$$= 12 i_2^2 t$$

but $$i_2^2 t = 0.25 \text{ W}$$

$$\therefore \quad H = 12 \times 0.25 = 3 \text{ W}$$

37. Kirchhoff's first law is junction rule, according to which the algebraic sum of the currents into any junction is zero. The junction rule is based on conservation of electric charge. No charge can accumulate at a junction, so the total charge entering the junction per unit time must equal to charge leaving per unit time.
Kirchhoff's second law is loop rule according to which the algebraic sum of the potential difference in any loop including those associated emf's and those of resistive elements, must equal zero.
This law is basically the law of conservation of energy.

38. **Key Idea :** *The standard transverse wave propagating along x-axis can be written as*

$$y = a \sin (kx - \omega t + \phi)$$

The given equation is

$$y(x, t) = 8.0 \sin \left(0.5\pi x - 4\pi t - \frac{\pi}{4}\right) \qquad ...(i$$

The standard wave equation can be written as

$$y = a \sin (kx - \omega t + \phi) \qquad ...(ii$$

where a is amplitude, k the propagation constant and ω the angular frequency comparing the Eqs. (i) and (ii), we have

$$k = 0.5\pi, \ \omega = 4\pi$$

$\therefore$ Speed of transverse wave

$$v = \frac{\omega}{k} = \frac{4\pi}{0.5\pi}$$

$$= 8 \text{ m/s}$$

39. Sabine's formula for reverberation time is

$$T = \frac{0.16\, V}{\Sigma as}$$

where V is volume of hall in m^3.

$$\Sigma as = a_1 s_1 + a_2 s_2 + \ldots\ldots\ldots\ldots =$$

total absorption of the hall (room)

Here, $s_1, s_2, s_3 \ldots\ldots$ are surface areas of t absorbers and $a_1, a_2, a_3 \ldots\ldots$ are th respective absorption coefficients

$$\therefore \quad \frac{T'}{T} = \frac{V'}{s'} \times \frac{s}{V}$$

$$= \frac{(2)^3}{(2)^2} = \frac{8}{4} = 2$$

Hence, $$T' = 2T = 2 \times 1 = 2 \text{ s}$$

40. In a longitudinal wave, the particles of the medium oscillate about their mean or equilibrium position along the direction of propagation of the wave itself. Sound waves are longitudinal in nature. In transverse wave, the particles of the medium oscillate about their mean or equilibrium position at right angles to the direction of propagation of wave itself. Light waves being electromagnetic are transverse waves.

41. Ferromagnetism decreases with rise in temperature. If we heat a ferromagnetic substance, then at a definite temperature the ferromagnetic property of the substance suddenly disappears and the substance becomes paramagnetic. The temperature above which a ferromagnetic substance becomes paramagnetic is called the Curie temperature of the substance.

NOTE : The Curie temperature of iron is 770°C and that of nickel in 358°C.

42. Focal length of combination of lenses placed in contact is

$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$$

For convex lens, $f_1 = 25$ cm

For concave lens, $f_2 = -25$ cm

Hence, $$\frac{1}{F} = \frac{1}{25} + \frac{1}{-25}$$

$$= \frac{1}{25} - \frac{1}{25} = 0$$

$\therefore$ $$F = \frac{1}{0} = \infty$$

Hence, power of combination,

$$P = \frac{1}{F} = 0\,\text{D}$$

NOTE : As a convex and a concave lens of same focal lens are placed in contact, so we get achromatism *i.e.*, combination is free from chromatic aberration.

43. When an electric dipole is placed in an electric field $\vec{\mathbf{E}}$, a torque $\vec{\tau} = \vec{\mathbf{p}} \times \vec{\mathbf{E}}$ acts on it. This torque tries to rotate the dipole through an angle.

If the dipole is rotated from an angle θ_1 to θ_2, then work done by external force is given by

$$W = pE\,(\cos\theta_1 - \cos\theta_2) \qquad \ldots(i)$$

putting $\theta_1 = 0°$, $\theta_2 = 90°$ in the Eq. (i), we get

$$W = pE\,(\cos 0° - \cos 90°)$$

$$= pE\,(1 - 0)$$

$$= pE$$

44. **Key Idea :** *Charge remains constant after charging.*

If the battery is removed after charging then the charge stored in the capacitor remains constant.

$$q = \text{constant}$$

Change in capacitance

$$C' = \frac{\varepsilon_0 A}{d'}$$

As $d' > d$,

hence, $C' < C$

Hence, potential difference between the plates

$$V' = \frac{q}{C'}$$

or $$V' \propto \frac{1}{C'}$$

As capacitance decreases, so potential difference increases.

NOTE : If the battery remains connected, the charge stored increases. Also the potential difference V becomes constant.

45. **Key Idea :** *In completing a circular lap, car's displacement is zero.*

Average velocity is defined as the ratio of displacement to time taken while the average speed of a particle in a given interval of time is defined as the ratio of distance travelled to the time taken.

On a circular path in completing one turn, the distance travelled is $2\pi r$ while displacement is zero.

Hence, average velocity $= \dfrac{\text{displacement}}{\text{time-interval}}$

$$= \frac{0}{t} = 0$$

Average speed $= \dfrac{\text{Distance}}{\text{Time-interval}}$

$$= \frac{2\pi r}{t} = \frac{2 \times 3.14 \times 100}{62.8}$$

$$= 10\ \text{m/s}$$

NOTE : If a particle moves in a straight line without change in direction, the magnitude of displacement is equal to the distance travelled otherwise it is always less than it. Thus,

$$|\text{displacement}| \leq \text{distance}$$

46. Electric flux (ϕ_e) is a measure of the number of field lines crossing a surface. The number of field lines passing through unit area (N/S) will be proportional to the electric field, or,

$$\frac{N}{S} \propto E \Rightarrow N \propto ES$$

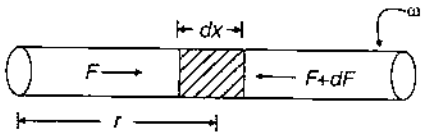
surface S.

As we have seen in the problem that, lines of force that enter the closed surface leave the surface immediately, so no electric flux is bound to the system. Hence, electric flux is zero.

47. Let the length of a small element of tube be dx.

Mass of this element

$$dm = \frac{M}{L}\,dx$$



where M is mass of filled liquid and L is length of tube.

Force on this element

$$dF = dm \times x\omega^2$$

$$\int_0^F dF = \frac{M}{L}\omega^2 \int_0^L x\,dx$$

or $$F = \frac{M}{L}\omega^2\left[\frac{L^2}{2}\right] = \frac{ML\omega^2}{2}$$

or $$F = \frac{1}{2}ML\omega^2$$

48. The moment of inertia of the uniform rod about an axis through one end and perpendicular to length is

$$I = \frac{ml^2}{3}$$

where m is mass of rod and l its length.

Torque ($\tau = I\alpha$) acting on centre of gravity of rod is given by

$$\tau = mg\,\frac{l}{2}$$

or $$I\alpha = mg\,\frac{l}{2}$$

or $$\frac{ml^2}{3}\alpha = mg\,\frac{l}{2}$$

$$\therefore \quad \alpha = \frac{3g}{2l}$$

49. As we have given

$$|\vec{A} + \vec{B}| = |\vec{A} - \vec{B}|$$

or $$\sqrt{A^2 + B^2 + 2AB\cos\theta}$$

$$= \sqrt{A^2 + B^2 - 2AB\cos\theta}$$

where θ is the angle between $\vec{A}$ and $\vec{B}$.

Squaring both sides, we have

$$A^2 + B^2 + 2AB\cos\theta = A^2 + B^2 - 2AB\cos\theta$$

or $$4AB\cos\theta = 0$$

As $$AB \neq 0$$

$$\therefore \quad \cos\theta = 0 = \cos 90^\circ$$

$$\therefore \quad \theta = 90^\circ$$

Hence, angle between $\vec{A}$ and $\vec{B}$ is 90°.

50. Key Idea : *As bodies are dropped from a certain height, their initial velocities are zero i.e., $u = 0$.*

For free fall from a height $u = 0$ (initial velocity).

From second equation of motion

$$h = ut + \frac{1}{2}gt^2$$

or $$h = 0 + \frac{1}{2}gt^2$$

$$\therefore \quad \frac{h_1}{h_2} = \left(\frac{t_1}{t_2}\right)^2$$

Given, $h_1 = 16$ m, $h_2 = 25$m

$$\therefore \quad \frac{t_1}{t_2} = \sqrt{\frac{h_1}{h_2}} = \sqrt{\frac{16}{25}} = \frac{4}{5}$$

NOTE : Time taken by the object in falling does not depend on mass of object.

Chemistry

51. If the Gibbs free energy for a system (ΔG_{system}) is equal to zero, then system is present in equilibrium at a constant temperature and pressure.

52. 10 g per dm^3 of urea is isotonic with 5% solution of a non-volatile solute. Hence, between these solution osmosis is not possible so their molar concentrations are equal to each other,

Thus, molar concentration of urea solution

$$= \frac{10\ \text{g/dm}^3}{\text{Mol. wt. of urea}}$$

$$= \frac{10}{60}\ \text{M} = \frac{1}{6}\ \text{M}$$

Molar concentration of 5% non-volatile solute

$$= \frac{50\ \text{g/dm}^3}{\text{mol. wt. of non-volatile solute}}$$

$$= \frac{50}{m}\ \text{M}$$

Both solutions are isotonic to each other, therefore

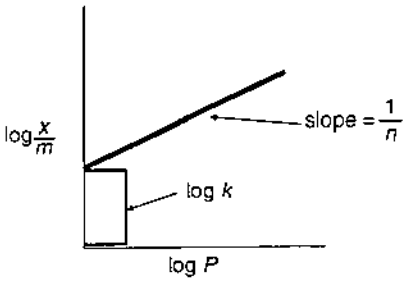
$$\frac{1}{6} = \frac{50}{m}$$

or $m = 50 \times 6 = 300\ \text{g mol}^{-1}$

53. The empirical relation $\frac{x}{m} = k\, p^{\frac{1}{n}}$, put forward by Freundlich is known as Freundlich adsorption isotherm. Taking logarithm

$$\log \frac{x}{m} = \log k + \frac{1}{n} \log p$$

If a following curve is plotted



54. As we know that

$$\Delta H = \Delta E + P\Delta V$$

or $\Delta H = \Delta E + \Delta nRT$

where $\Delta H \rightarrow$ change in enthalpy of system (standard heat at constant pressure)

$\Delta E \rightarrow$ Change in internal energy of system (Standard heat at constant volume)

$\Delta n \rightarrow$ no. of gaseous moles of product − no. of gaseous moles of reactant

$R \rightarrow$ gas constant

$T \rightarrow$ absolute temperature

If $\Delta n = 0$ for reactions which is carried out in an open container, therefore $\Delta H = \Delta E$

So for reaction (1) $\Delta n = 2 - 2 = 0$

Hence, for reaction (1), $\Delta H = \Delta E$

55. For reaction,

$$\underset{\text{'A'}}{CH_3CH_2COOH} \xrightarrow[-HCl]{SOCl_2,\ SO_2} \underset{\text{'B'}}{CH_3CH_2COCl}$$

$$\xrightarrow[-HCl]{NH_3} \underset{\text{'C'}}{CH_3CH_2CONH_2} \xrightarrow[(-2KBr,\ -K_2CO_3,\ -2H_2O)]{4KOH,\ +Br_2} \underset{\text{'D' (Ethyl amine)}}{CH_3CH_2NH_2}$$

(Hofmann-Bromamide reaction)

Hence, compound '*D*' is $CH_3 - CH_2 - NH_2$.

56. In the process of digestion the proteins present in food material are hydrolysed to amino acid. In this process two enzymes pepsin and trypsin are involved as follows :

$$\text{Proteins} \xrightarrow[\text{(Enzyme 'A')}]{\text{Pepsin}} \text{Polypeptide} \xrightarrow[\text{(Enzyme 'B')}]{\text{Trypsin}} \text{Amino acid}$$

57. The organic compounds other than carbohydrates proteins, which maintain normal growth and nutrition in the human body (but not produced in human body) are called vitamins.

58. Density of CsBr $= \frac{Z \times M}{a^3 \times N_0}$

$Z \rightarrow$ no. of atoms in the *bcc* unit cell = 2

$M \rightarrow$ molar mass of CsBr = 133 + 80 = 213

$a \rightarrow$ edge length of unit cell

$= 436.6\ \text{pm}$

$= 436.6 \times 10^{-10}\ \text{cm}$

$$\therefore \text{Density} = \frac{2 \times 213}{(436.6 \times 10^{-10})^3 \times 6.02 \times 10^{23}}$$

$$= 8.50\ \text{g/cm}^3$$

For a unit cell $= \frac{8.50}{2} = 4.25\ \text{g/cm}^3$

59. More number of oxidation states are exhibited by the actinoids than by the lanthanoids due to lesser energy difference between 5*f* and 6*d* orbitals than that between 4*f* and 5*d* orbitals.

60. By Heisenberg's uncertainty principle

$$\Delta p \times \Delta x \geq \frac{h}{4\pi}$$

or $\Delta v \times \Delta x \geq \frac{h}{4\pi m}$

$\Delta p \rightarrow$ uncertainty in momentum

$\Delta x \rightarrow$ uncertainty in position

$\Delta v \rightarrow$ uncertainty in velocity

$m \rightarrow$ mass of particle

Given that,

$\Delta x = 0.1\ \text{Å} = 0.1 \times 10^{-10}$ m

$m = 9.11 \times 10^{-31}$ kg

h = Planck constant $= 6.626 \times 10^{-34}$ Js

$\pi = 3.14$

In uncertain position $\Delta v \times \Delta x = \dfrac{h}{4\pi m}$

$$\Delta v \times 0.1 \times 10^{-10} = \frac{6.626 \times 10^{-34}}{4 \times 3.14 \times 9.11 \times 10^{-31}}$$

$$\Delta v = \frac{6.626 \times 10^{-34}}{4 \times 3.14 \times 9.11 \times 10^{-31} \times 0.1 \times 10^{-10}}\ \text{ms}^{-1}$$

$= 5.785 \times 10^{6}\ \text{ms}^{-1}$

$= 5.79 \times 10^{6}\ \text{ms}^{-1}$

61. Copper sulphate on reaction with KCN to give cupric cyanide precipitates firstly which reduce into Cu_2CN_2 and dissolve in excess of KCN to give soluble $K_3[Cu(CN)_4]$ complex salt

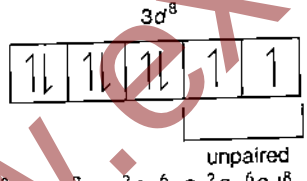
$$[CuSO_4 + 2KCN \rightarrow \underset{\text{Cupric cyanide}}{Cu(CN)_2} + K_2SO_4] \times 2$$

$$2Cu(CN)_2 \rightarrow Cu_2(CN)_2 + \underset{\text{Cyanogen}}{NC-CN}$$

$$Cu_2(CN)_2 + 6KCN \rightarrow \underset{\text{soluble complex salt}}{2K_3[Cu(CN)_4]}$$

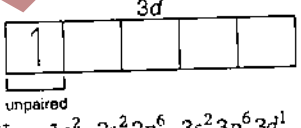
$$2CuSO_4 + 10KCN \rightarrow 2K_3[Cu(CN)_4] + 2K_2SO_4 + (CN)_2$$

62. $_{28}Ni = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^8, 4s^2$



$Ni^{2+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^8$

$_{22}Ti = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^2, 4s^2$



$Ti^{3+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^1$

$_{21}Sc = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^1, 4s^2$

$Sc^{3+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6$

(unpaired electron in d-orbital is not possible)

$_{29}Cu = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^{10}, 4s^1$

$Cu^{+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^{10}$

(complete d-orbital)

Hence, in above ions, Ni^{2+} and Ti^{3+} ions are coloured ions in aqueous solution due to presence of unpaired electrons in d-sub-shell.

63. Al_2O_3 may be converted to anyhydrous $AlCl_3$ by heating of mixture of Al_2O_3 and carbon in dry chlorine

$$Al_2O_3 + 3C + \underset{\text{Hot and dry}}{3Cl_2} \longrightarrow \underset{(\text{Anhydrous } AlCl_3)}{Al_2Cl_6}$$

Note : Anhydrous $AlCl_3$ exists in form of dimer as Al_2Cl_6.

64. At equilibrium Gibbs free energy change ($\Delta G°$) is equal to zero. The following thermodynamic relation is used to show the relation of $\Delta G°$ with enthalpy change ($\Delta H°$) and entropy change ($\Delta S°$)

$\Delta G° = \Delta H° - T\Delta S$

$0 = 30 \times 10^3\ (\text{J mol}^{-1}) - T \times 105\ (\text{J K}^{-1}\ \text{mol}^{-1})$

$$\therefore T = \frac{30 \times 10^3}{105}\ \text{K} = 285.71\ \text{K}$$

65. The appearance of colour in solid alkali metal halides is generally due to F-centres.

66. Alkanols are the derivatives of alkanes which are derived by the replacement of —H of alkanes with —OH (hydroxyl groups)

$$\underset{\text{Alkanes}}{C_nH_{2n+2}} \xrightarrow[+OH]{-H} C_nH_{2n+1}OH \text{ or } C_nH_{2n+2}O$$

67. Given that $E°_{Fe^{2+}/Fe} = -0.441$ V

So, $Fe \rightarrow Fe^{2+} + 2e^-, E° = +0.441$ V ...(i)

and $E°_{Fe^{3+}/Fe^{2+}} = 0.771$ V

So, $Fe^{3+} + e^- \rightarrow Fe^{2+}, E° = 0.771$ V ...(ii)

Cell reaction

(i) $Fe \rightarrow Fe^{2+} + 2e^-$, $E° = 0.441$ V

(ii) $2Fe^{3+} + 2e^- \rightarrow 2Fe^{2+}$, $E° = +0.771$ V

$Fe + 2Fe^{3+} \longrightarrow 3Fe^{2+}$, $E°_{cell} = 1.212$ V

or

So, on the basis of cell reaction following half-cell reactions are written

At anode :

(1) $Fe \rightarrow Fe^{2+} + 2e^-$ (oxidation)

At cathode :

(2) $2Fe^{3+} + 2e^- \rightarrow 2Fe^{2+}$ (reduction)

So, $E°_{cell} = E°_{cathode} - E°_{anode}$

$= E°_{Fe^{3+}/Fe^{2+}} - E°_{Fe^{2+}/Fe}$

68. For the reaction $2A + B \rightarrow 3C + D$

The reaction rate is written as follows :

The reaction rate w.r.t. $A = -\frac{1}{2}\frac{d[A]}{dt}$

The reaction rate w.r.t $B = -\frac{d[B]}{dt}$

The reaction rate w.r.t $C = +\frac{1}{3}\frac{d[C]}{dt}$

The reaction rate w.r.t $D = \frac{d[D]}{dt}$ for product we take + sign because concentration of product increases with time

Hence, the answer (a) is not correct expression to represent the rate of reaction.

69. For the reaction,

$$CH_4(g) + 2O_2(g) \rightleftharpoons CO_2(g) + 2H_2O(l)$$
$$\Delta H_r = -170.8 \text{ kJ mol}^{-1}$$

This equilibrium is an example of heterogeneous chemical equilibrium. Hence, for it

$$K_c = \frac{[CO_2]}{[CH_4][O_2]^2} \quad ...(i)$$

(Equilibrium constant on the basis of conc.)

and $$K_p = \frac{P_{CO_2}}{P_{CH_4} \times P_{O_2}^2} \quad ...(ii)$$

(Equilibrium constant according to partial pressure)

Thus in it concentration of $CO_2(g)$ and $H_2O(l)$ are not equal at equilibrium

The equilibrium constant $(K_p) = \frac{[CO_2]}{[CH_4][O_2]}$ is not correct expression

In addition of $CH_4(g)$ or $O_2(g)$ at equilibrium K_c will be decreased according to expression (i) but K_c remains constant at constant temperature for a reaction, so for maintaining the constant value of K_c, the concentration of CO_2 will increased in same order. Hence, on addition of CH_4 or O_2 equilibrium will cause to the right. This reaction is an example of exothermic reaction.

70. $+NH(CH_2)_2\,NHCO(CH_2)_4CO+_n$ is a copolymer because polymers whose repeating structural units are derived form two or more types of monomer units are called **copolymer.**

$$nH_2N(CH_2)_2NH_2 + nHOOC(CH_2)_4COOH \xrightarrow[-nH_2O]{\text{Polymerisation}} \left[NH(CH_2)_2NHCO(CH_2)_4CO\right]_n$$

71. $>C=O + HCN \longrightarrow >C(OH)(CN) \xrightarrow{H_2O} >C(OH)(COOH)$

(It is α-hydroxy acid)

If it is racemic mixture, therefore such 'C' atom must be asymmertic carbon atom.

$$CH_3(H)C=O + HCN \longrightarrow CH_3(H)C(OH)(CN)$$

Acetaldehyde

$$\xrightarrow{H_2O} H-\underset{COOH}{\overset{CH_3}{C}}-OH + HO-\underset{COOH}{\overset{CH_3}{C}}-H$$

d- l-

Racemic mixture

$$(CH_3)_2C=O + HCN \longrightarrow (CH_3)_2C(OH)(CN)$$

Acetone

$$\xrightarrow{H_2O} (CH_3)_2C(OH)(COOH)$$

It is not optical active

$$(C_2H_5)_2C=O + HCN \longrightarrow (C_2H_5)_2C(OH)(CN)$$

Diethyl ketone

$$\xrightarrow{H_2O} (C_2H_5)_2C(OH)(COOH)$$

It is not optical active

$$H_2C=O + HCN \longrightarrow H_2C(OH)(CN)$$

Formaldehyde

$$\xrightarrow{H_2O} H_2C(OH)(COOH)$$

It is not optical active

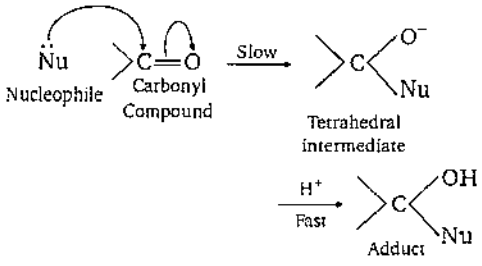
72. Glucagon is a peptide hormone because in it peptide linkage is present.

73. $CH_3-O-CH(CH_3)_2 + HI \xrightarrow{373\,K} H_3CI + (CH_3)_2CHOH$

(unsymmetrical ether)

In case of unsymmertical ether, the alkyl halide is always formed from smaller alkyl group. This happen so, because I^- ion being larger in size approaches smaller alkyl group to

74.



The carbonyl compounds undergo nucleophilic addition reaction, because oxygen is more electronegative than carbon. As such, it withdraws shared π electron pair towards itself and gets partial negative charge, therefore carbon get partial positive charge and becomes susceptible to nucleophilic attack.

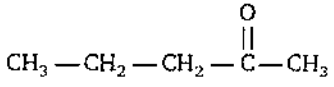
Aldehydes are more reactive than ketones towards nucleophiles. This can be explained on the basis of inductive effect as well as steric effect. The addition of nucleophiles is based upon the positive charge present on carbon atom of $>C=O$ group. In aldehyde $>C=O$ group has the presence of at least one alkyl group (except formaldehyde) which has $+I$ effect (electron donating effect) and which decreases the positive charge of carbon, thereby making the attack to nucleophile difficult. The nucleophilic attack becomes more difficult in ketones having minimum of two alkyl groups. Hence, by means of attachment of alkyl groups (due to $+I$ effect) rate of nucleophilic addition decreases.

Order of $+I$ effect in alkly group

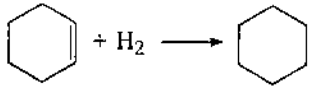
$$-CH_3 < R-CH_2 < \underset{R}{\overset{R}{>}}CH- < \underset{R}{\overset{R}{>}}C-$$

order of nucleophilic addition in given carbonyl compound is

$$CH_3CHO > CH_3-CH_2-CHO > (CH_3)_2CO >$$



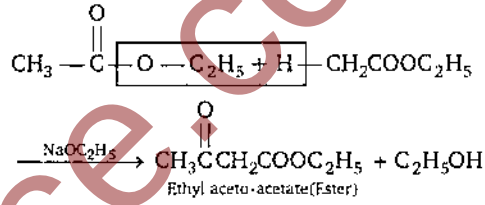
75.



$\Delta H = ?$

ΔH = [ΔH of combustion of cyclohexane
– [ΔH of combustion of cyclohexene
= – [– 3920 – (3800 – 24)] kJ
= – [3920 + 4041] kJ
= – [121] kJ
= – 121 kJ

76. On condensation of two moles of ethyl acetate in presence of sodium ethoxide, gives ethyl aceto-acetate (ester). This condensation is an example of Claisen condensation because it is possible in those ester which have α-hydrogen atom.



77. For the reaction,

$N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$

The rate of reacion w.r.t $N_2 = -\frac{d[N_2]}{dt}$

The rate of reacion w.r.t $H_2 = -\frac{1}{3}\frac{d[H_2]}{dt}$

The rate of reacion w.r.t $NH_3 = +\frac{1}{2}\frac{d[NH_3]}{dt}$

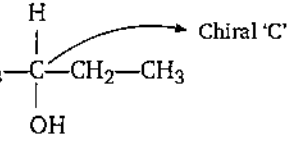
Hence, at a fixed time

$$-\frac{d[N_2]}{dt} = -\frac{1}{3}\frac{d[H_2]}{dt} = +\frac{1}{2}\frac{d[NH_3]}{dt}$$

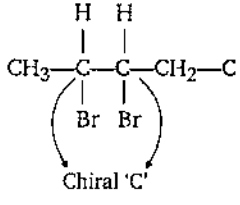
or $$+\frac{d[NH_3]}{dt} = -\frac{2}{3}\frac{d[H_2]}{dt}$$

or $$-\frac{2d[N_2]}{dt}$$

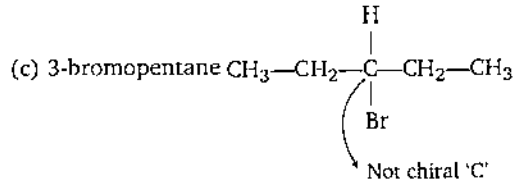
78. (a) 2-butanol



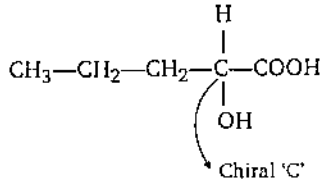
(b) 2,3-dibromopentane



(c) 3-bromopentane

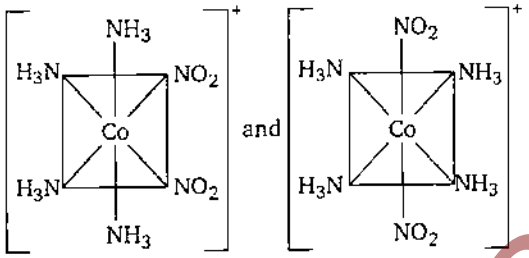


(d) 2-hydroxy propanoic acid



Hence, in these 3-bromopentane is not a chiral molecule due to absence of chiral 'C' atom.

79. The compound $[Co(NH_3)_4(NO_2)_2]Cl$ exhibits linkage, ionisation and geometrical isomerism.
Hence, its linkage isomers are
(i) $[Co(NH_3)_4(NO_2)_2]Cl$ and $[Co(NH_3)_4(ONO)_2]Cl$
(ii) its ionisation isomers are $[Co(NH_3)_4(NO_2)Cl]NO_2$ and $[Co(NH_3)_4(NO_2)_2]Cl$
(iii) its geometrical isomers are



Cis-isomer *Trans*-isomer

80. Magnetic moment $(\mu) = \sqrt{n(n+2)}$ BM

or $3.83 = \sqrt{n(n+2)}$

or $3.83 \times 3.83 = n^2 + 2n$

$14.6689 = n^2 + 2n$

on solving this, we get $n = 3$

Hence, number of unpaired electrons in *d*-sub-shell of penultimate shell of chromium (Cr= 24).

So, the configuration of chromium ion is

$Cr^{3+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^3$

In $[Cr(H_2O)_6]Cl_2$ oxidation state of Cr is +3)

Hence, in $3d^3$ the distribution of electrons

$3d^1_{xy}, 3d^1_{yz}, 3d^1_{zx}, 3d^0_{x^2-y^2}, 3d^0_{z^2}$

81. Molality of non-electrolyte solute

$$= \frac{\text{weight of solute in gram}}{\text{molecular weight of solute}} \Big/ \text{weight of solvent in kg}$$

$$= \frac{1}{0.0512} = \frac{1}{250 \times 0.0512} = 0.0781 \text{ m}$$

$\Delta T_f = k_f \times$ molality of solution

$= 5.12 \times 0.0781 = 0.4$ K

82. A pair constituent with a HNO_2 and $NaNO_2$ because HNO_2 is weak acid and $NaNO_2$ is a salt of weak acid (HNO_2) with strong base (NaOH). Hence, it is an example of acidic buffer solution.

83. In aqueous solution of 10^{-8} M HCl, $[H^+]$ is based upon the concentration of H^+ ion of 10^{-8} M HCl and concentration of H^+ ion of water

K_w of $H_2O = 10^{-14} = [H^+][OH^-]$

or $[H^+] = 10^{-7}$ M (due to its neutral behaviour)

So, in aqueous solution of 10^{-8} M HCl,

$[H^+] = [H^+]$ of HCl + $[H^+]$ of water

$= 10^{-8} + 10^{-7} = 11 \times 10^{-8}$ M

$\approx 1.10 \times 10^{-7}$ M

Hence, answer is nearer to (b).

84. A solution of acetone in ethanol shows a positive deviation from Raoults' law due to miscibility of these two liquids with difference of polarity and length of hydrocarbon chain.

85. Electrochemical cell

$$A \mid A^- (xM) \mid\mid B^+ (yM) \mid B$$

The emf of cell is + 0.20 V. So cell reaction is possible. The half cell reaction are given as follows :

(i) At negative pole :

$$A \longrightarrow A^+ + e^- \qquad \text{(oxidation)}$$

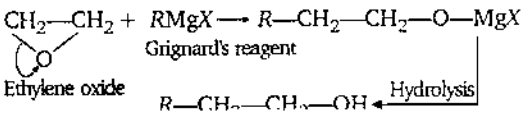
(ii) At positive pole :

$$B^- + e^- \longrightarrow B \qquad \text{(reduction)}$$

Hence, cell reaction is

$$A + B^- \rightarrow A^+ + B^-, E^\circ_{cell} = +0.20 \text{ V}$$

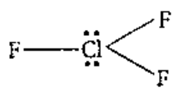
86. Ethylene oxide on treatment with Grignard reagent to give additive product which on hydrolysis to give primary alcohol as final product.



87. During osmosis, flow of water through a semi-permeable membrane is from solution having lower concentration only.

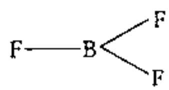
88. Benzyl amine $C_6H_5CH_2 \rightarrow \ddot{N}H_2$ is more basic than aniline because benzyl group $C_6H_5CH_2$ — is electron donating group due to $+I$ effect. So, it is able to increase the electron density of N of $—NH_2$ group. Thus due to higher electron density rate of donation of free pair of electron is increased *i.e.*, basic character is higher. Phenyl and nitro group are electron attractive groups, so they are able to decrease the electron density of N of $—\ddot{N}H_2$ group. Hence, they are less basic with aniline.

89. In ClF_3 all bonds are not equal due to trigonal-bipyramidal (sp^3d-hybridisation) geometry of ClF_3 molecule.

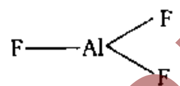


Trigonal-bipyramidal geometry

BF_3 and AlF_3 show trigonal symmetric structure due to sp^2-hybridisation.

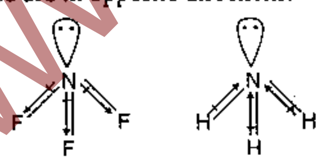


and



NF_3 shows pyramidal geometry due to sp^3 hybridisation.

90. Electronegativity of N is greater than that of H, but in NF_3 electronegativity of F is greater than that of N. So, in NH_3 the atomic dipole and bond dipole are in the same direction whereas in NF_3 these are in opposite directions.



$\mu = 0.2$ D $\quad \mu = 1.5$ D

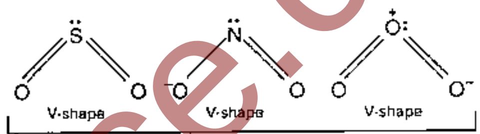
91. The correct order of the mobility of the alkali metal ions in aqueous solutions. $Rb^+ > K^+ > Na^+ > Li^+$ due to following order of hydration energy of these ions $Li^+ > Na^+ > K^+ > Rb^+$ and due to hydration of ion mobility decreases.

92. The correct order regarding the electronegativity of hybrid orbitals of carbon is $sp > sp^2 > sp^3$ because in sp, sp^2 an sp^3 hybrid orbitals s-orbital character is 50%, 33.3% and 25% respectively and due to higher s-orbital character electron attraction tendency *i.e.*, electronegativity increases.

93. $\overset{+}{N}O_2$ has linear shape due to sp-hybridisation of N of $\overset{+}{N}O_2$

$O = \overset{+}{N} = O$

While SO_2, NO_2^- and O_3 have angular shape



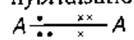
Angular shape (due to sp^2-hybridisation of central atom or ion)

94. In Al_2O_3, Sb_2O_3, Bi_2O_3 and SeO_2. Bi_2O_3 is most basic oxide due to higher reactivity with acid

$Bi_2O_3 + 6HCl \longrightarrow 2BiCl_3 + 3H_2O$

95. The orientation of an atomic orbital is governed by magnetic quantum number.

96. Every AB_5 molecule does not in fact have square pyramidal structure but AB_5 molecules have trigonal bipyramidal structures due to sp^3d hybridisation.

97. 

(Due to presence of two unpaired electrons it shows paramagnetic character).

98. Incorrect order of bond dissociation energy $F_2 > Cl_2 > Br_2 > I_2$ due to following order of size $I > Br > Cl > F$.

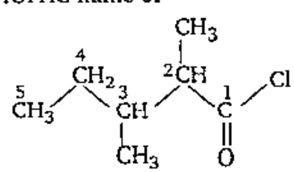
99. SCl_4 is not isostructural of $SiCl_4$ because it shows square planar structure due to involvement of repulsion between lone pair and bond pair of electrons.

SO_4^{2-} shows tetrahedral structure due to sp^3 hybridisation

PO_4^{3} shows tetrahedral structure due to sp^3 hybridisation

NH_4^+ shows tetrahedral structure due to sp^3 hybridisation

100. IUPAC name of



2, 3-dimethyl pentanoyl chloride

101. Synergids are two, short-lived, haploid cells lying close to the egg in mature embryosac of flowering plant ovule. While the endosperm is a triploid tissue formed after triple fusion. Thus, if the synergids have 8 chromosomes, the aleurone layer (part of endosperm) will have just triple of that of chromosomes in the synergids *i.e.*, 24 chromosomes.

102. The fruit of *Ananas comosus* (pineapple or ananas) is sorosis, (a type of multiple fruits), developing from spike, spadix or catkin. In this type, the flowers associate by their succulent petals, the axis bearing them grows and becomes fleshy or woody, thus, the whole inflorescence turns into a compact fruit.

103. A plant in which a gene has been transferred through genetic engineering is called a **transgenic plant** and the gene, so transferred is called a **transgene**. **Golden rice** is a promising transgenic crop which when released for cultivation will help in alleviation of vitamin A deficiency.

104. **Parthenocarpy** is the development of fruits without prior fertilization which results in the formation of seedless fruits. In some plant species, parthenocarpic (seedless) fruits may be produced naturally or they may be induced by treatment of the unpollinated flowers with auxin. *e.g.*, Parthenocarpic tomato fruits can be produced by treating the plants with low concentration of **gibberellic acid** (promotes fruit set) and **auxin** (completes the development process).

Removal of androecium, before pollen release is called emasculation which is helpful in preventing unwanted pollination.

Vernalized seeds are the chill treated seeds for breaking dormancy.

Phenyl mercuric acetate is an antitranspirant.

105. Pruning helps in making the hedge dense as it frees the axillary buds from apical dominance. In fact, the apices of the plant axis (*e.g.* Shoot apex) has the highest concentration of auxin which suppresses the axillary buds while promotes the growth of apical bud. When the shoot apex is cut down through pruning, the axillary buds grow and the hedge becomes dense.

106. The disease **"blue baby syndrome"** or cyanosis results from methaemoglobin. The main cause of this disease are the **nitrate fertilizers** on soil which enter the human body through water and converted to nitrites by microbial flora of intestine. The nitrites combine with haemoglobin to form **methaemoglobin** causing **methaemoglobinaemia** in adults and **blue baby syndrome** in newly borne babies or infants.

107. Praying mantis *(Mantis religiosa)* is a large social insect. It has small triangular head, a long prothorax and abdomen consisting of 10 segments. The wings are well developed and the pincer-like forelegs are modified for grasping prey. It usually inhabits plantation areas. It destroys certain harmful insects so it is useful.

108. The autonomous nervous system regulates the secretion of glands whereas the glands do not regulate the nervous system.

109. **Anaemia** refers to any condition in which there is an abnormally low haemoglobin concentration and/or blood cell count. The most common cause is deficiency of iron which is an essential element of haemoglobin molecule. Thus, the **iron compounds** in the diet will help to alleviate the symptoms of anaemia.

Thiamine (vitamin B_1), deficiency causes beri-beri.

Riboflavin (vitamin B_2) deficiency causes cheilosis and skin diseases.

110. If a pulse crop possesses premature yellowing of leaves and decrease in yield application of **magnesium and iron** to promote synthesis of chlorophyll may become most beneficial to overcome the problem and to obtain maximum seed yield.

Magnesium is an important part of ring structure of chlorophyll molecule and its deficiency causes chlorosis and premature leaf abscission.

In **iron** deficiency also, the leaves become chlorotic because iron is required for the synthesis of some of the chlorophyll protein complexes in the chloroplast.

111. Aril is the edible part in the fruit of litchi. The aril is an accessory seed covering often formed from an outgrowth at the bare of the ovule.

112. Miller and Urey were the two scientists who recreated the conditions of primitive earth in laboratory and abiotically synthesized amino acids and bases. They synthesized glycine, aspartic acid and alanine in abundant quantities while glutamic acid was not synthesized in their experiment.

113. **Monoculture** involves the exclusive cultivation of a single crop over wide areas. It is an efficient way to use certain kinds of soils but the crop plants grown in monoculture are highly prone to pests and thus, it carries the risk of an entire crop being destroyed with the appearance of a single pest species or disease.

114. In 1987, twenty seven industrialized countries signed the **Montreal Protocol** for reduction in production and release of CFCs (chlorofluoro carbons) depleting ozone layer, into the atmosphere. It was followed by increasingly stringent amendments in London in 1990 and in Copenhagen in 1992.

115. In J-shaped form of population growth, the density increases in an exponential manner and then a crash occurs or the increase stops abruptly as environmental resistance becomes effective. This is mathematically described by an **equation of exponential or geometric increase,** which is as follows :

$$\frac{dN}{dt} = rN$$

where, d = rate of change

t = time

N = number of females at a particular time

r = biotic potential of each female

(N can also be considered as the total population and r as the biotic potential of each individual).

116. Ecological pyramids are the graphical representation of the trophic structure and function at successive trophic levels. Ecological pyramids are of three general types, listed as here under :

(i) **Pyramid of numbers,** showing the

(ii) **Pyramid of biomass,** showing the total **dry weight** of living matter.

(iii) **Pyramid of energy,** showing the **rate of energy flow**/productivity at successive trophic levels.

Thus, fresh weight is not used for the construction of ecological pyramids.

117. Niche overlap is a measure of the association of two or more species. This indicate their similar habitat requirement and may also indicate competition if trophic niche/spatial niche is same and food/space is limiting *e.g.*, two different parasites on the same host.

118. In photogystem I, the primary electron acceptor is probably a Fe – S protein. The reduced primary acceptor transfers the electrons to secondary electron acceptor (most probably P_{430}). The sequence of electron transfer is as follows :

$$\underset{\text{(Chl. a)}}{P_{700}} \xrightarrow{e^-} \underset{\text{(phylloquinone)}}{A_1} \xrightarrow{e^-} \underset{\text{(Fe – S protein)}}{A_2} \xrightarrow{e^-} \underset{(P_{430})}{A_3}$$

The reduced P_{430} passes its electrons to ferredoxin (Fd) present at outer surface of thylakoid membrane.

119. **Stratification** involves the treatment of seed at low temperature (5–10°C) under sufficiently moist conditions to break its dormancy and to induce germination.

Scarification involves any damage or breakage of seed coat by physical methods (*e.g.*, Use of scalpel, wooden hammer etc.) or chemical methods (use of mild acids) to break seed dormoney.

Vernalization and **Chelation** is the chill treatment of plant in its early stages of life history to stimulate or induce early flowering.

120. *Drosophila melanogaster* is commonly called as fruitfly and is often used in genetic and developmental biology researches. The ripe banana is the most suitable medium for the culture of this fly.

Moist bread is a culture medium for the fungus *Rhizopus* while agar-agar is used as a tissue culture medium.

121. **Botanical gardens** (*i.e.*, institutions that maintain living plant collections representing a large number of species, genera and families) are the means of *ex situ* conservation (*i.e.*, conservation outside the natural habitats).

In *situ* conservation involves the conservation of genetic resources through their maintenance within natural or even human-made ecosystems in which they occur. It includes **National parks, Sanctuaries, Biosphere reserves**, Nature Reserves, Natural Monuments, Cultural Landscapes etc.

122. Tetracyclin interfere with the attachment of *t*-RNA carrying the amino acid to the *m*-RNA-ribosome complex preventing the addition of amino acids to the growing polypeptide chain. Streptomycin interfere with the initial steps of protein synthesis by changing the shape of 30S portion of 70S prokaryotic ribosome.

Erythromycin reacts with 50S portion of the 70S prokaryotic ribosome.

123. Phenotype is the observable characteristics or the total appearance of an organism. It is determined by its genes, the dominance relationships between the alleles and by the interaction during development between its genetic constitution (genotype) and the environment.

Mutation leads to sudden change or variation and linkage leads to store genotype. Cytoplasmic effect and nutrition generally do not determine the phenotype.

124. **Photochemical smog** is highly oxidising polluted atmosphere comprising largely of ozone (O_3), oxides of nitrogen (NO_x), hydrogen peroxide (H_2O_2), organic peroxides, peroxy acetyl nitrate (PAN) and peroxy benzyl nitrate (PB_zN).

Some sulphates and nitrates can also be formed in photochemical smog due to oxidation of sulphur containig components (SO_2, H_2S) and NO_x (N_2O_5, NO_2) but it does not contain carbon di-oxide (CO_2). Photochemcial smog materials causes damage to plants, human health hazards and corrosion problems.

125. *Sphagnum* is a bryophyte, commonly called as **bog moss** or **peat moss**. It is hygroscopic and possesses a remarkable water holding capacity. Hence, it is used as a packing material in the transportation of flowers, live plants, tubers, bulbs, seedlings etc. It is also used in seedbeds and in moss-sticks.

126. The wall of both vessel and sieve tube elements are perforated by large opening. Due to these adaptation the cell to cell contact is possible.

The vessels are nucleated whereas the sieve tube elements are enucleated.

127. The members of **Myxomycetes** are called **slime molds** because they contain and secrete slime. They are included in lower fungi. Their somatic phase is a multinucleate, diploid holocarpic **Plasmodium** (a product of syngamy).

In Plasmodium, propagation occurs through fission or thick walled cysts or sclerotium like structures. Reproduction takes place by the formation of uninucleate, thick walled resting spores which are produced within minute fruiting bodies like structures i.e., the sporangia, however, the true fruiting bodies are absent in slime molds.

Fruiting bodies and mycelium are absent in lower fungi. **Protonoma** is not formed in fungi.

128. The more **maternal influence** can be expected in the **cytoplasmic inheritance** (*i.e.*, the inheritance of genes contained in the cytoplasm of a cell, rather than the nucleus). The reason is that the female reproductive cell or the egg has a large amount of cytoplasm containing many such organelles which contain their own genes and can reproduce independently (*e.g.*, mitochondria and chloroplast) and which are consequently incorporated into the cytoplasm of all the cells of the embryo. The male reproductive cells (sperm or pollen) consist almost solely of a nucleus. Cytoplasmic organelles are thus, not inherited from the male parent. This is why, the cytoplasmic inheritance is also called **maternal inheritance**.

Genes located on *Y*-chromosome are called *Y*-genes and their in heritance is called ***Y*-linked inheritance**. This carries the paternal influences.

A gene located in the *X*-chromosome is said to be *X*-linked and its inheritance is called X-linked in heritance. In this, a male transmits his *X*-chromosome only to his daughters while a female transmits one of her *X*-chromosomes to the offspring of both sexes.

129. In sweet pea *(Pisum sativum)*, the placentation is **marginal**, in which, the placenta develops along the junction of two carpels, in a unilocular ovary.

In **basal placentation,** the ovules are few or reduced to one and are borne at the base of overy *e.g.*, compositae.

In **axile placentation,** margins of carpels fold inwards, fusing together in centre of ovary to form a single central placenta. Ovary is divided into as many locules, as there are carpels *e.g.*,

Hibiscus, Asphodelus. Free-central **placentation** possesses a placenta arises as a central upgrowth from ovary base *e.g., Stellaria.*

130. In a cob of maize, each ovary has a long silky (hairy) **style**, called as **corn silk**. Collectively these styles protrude at the end of a young cob. The grains are formed on the cob which remain covered by the leafy bracts.

131. The conifers (gymnosperm) differ from the grasses (angiosperm) in the formation of **endosperm before fertilization**. In fact, in gymnosperms, the endosperm is formed before the fertilization, thus, it is a haploid tissue while in angiosperms, endosperm is formed after fertilization as a result of triple fusion or double fertilization, thus, it is a triploid tissue.

In both conifers and grasses seeds are produced from ovules.

Xylem tracheids are present in both conifers and grasses.

Pollen tubes are also formed in both conifers and grasses.

132. The types of gametes produced by a plant depend upon the number of hetrozygous pair.

Number of types of gametes = 2^n

n = number of heterozygous pair

$2^1 = 2$

The gametes are – ABC and AbC.

133. G.H. Shull (1909) has shown that the hybrid vigour in maize is exploited by crossing of inbred parental line.

134. In mitochondria, the enzymes of electron transport chain are found in the inner membrane while outer membrane contains enzymes involved in mitochondrial lipid synthesis and those enzymes that convert lipid substrates into forms that are subsequently metabolized in the matrix.

The outer membrane resembles a sieve that is permeable to all molecules of 10,000 daltons mole. weight or less including small proteins.

The inner membrane is impermeable and highly convoluted, forming a series of infoldings, known as cristae, in the matrix space.

135. In the process of protein synthesis, the messenger RNA (*m*-RNA) is responsible for carrying the genetic code transcribed from DNA to specialized sites within the cell (called ribosomes) where the information is translated into protein composition. The sequence of amino acids in a particular protein is determined by the sequence of nucleotides in *m*-RNA.

Sequence of *t*-RNA, *c*-DNA or *r*RNA do not decide the amino acid sequence in protein synthesis.

136. 30 ATP molecules could be generated from 686 Kcal energy.

137. **Coenzyme** is an organic nonprotein molecule that associates with an enzyme molecule in catalysing biochemical reactions. It usually participates in the substrate-enzyme interaction by donating or accepting certain chemical groups.

Holoenzyme is a complex comprising of enzyme molecule and its cofactor. The enzyme is catalytically active in this state.

Apoenzyme is an inactive enzyme that must associate with a specific cofactor molecule in order to function.

Isoenzyme or **isozyme** is one of the several forms of an enzyme that catalyse the same reaction but differ from each other in such properties as substrate affinity and maximum rates of enzyme-substrate reaction.

138. Bowman's glands tubular mucus glands (olfactory glands) occur below the **olfactory epithelia**. Their ducts open on the olfactory epithelial surface. These glands secrete watery mucus to protect and keep the epithelium moist.

139. The bacterium *Clostridium batulinum,* causing botulism (a form of food poisoning) is an obligate anaerobic, endospore forming, grampositive, rod shaped bacterium found in soil and in many fresh water sediments.

This bacterium produces a toxin, called botulinum toxin which is the most toxic substance known (cause fatal food poisoning) but in minute doses it is used to treat certain conditions involving muscle dysfunction.

140. Rhinoceros *(Rhinoceros unicornis)* is an endangered animal and conserved in Kaziranga National Park.

141. **Schizophrenia** is any of a group of severe mental disorders that have in common, symptoms as hallucinations., delusions, blunted emotions, disordered thinking and a withdrawl from reality.

142. Sulphur is constituent of certain amino acids. The amino acids form the protein by polymerisation. The pulses are rich in protein.

143. Family **Solanaceae** possesses pentamerous, actinomorphic, hypogynous, hermaphrodite, complete flowers, bicarpellary, syncarpous, superior, bilocular ovary with axile placentation and oblique septa. The fruit is a berry or septicidal capsule.

In **Asteraceae,** ovary is bicarpellary, suncarpous, inferior, unilocular and fruit is cypsela.

In **Brassicaceae,** ovary is bicarpellary, syncarpous, superior, unilocular but later becomes bilocular due to false septum, fruit is siliqua or silicula.

In **Liliaceae,** flowers are usually trimerous, ovary is tricarpellary, syncarpous, superior, trilocular and fruit is fleshy berry or capsule.

144. In mosses, the sporophyte developing from the embryo is a simple structure without rhizoids and is differentiated into foot, seta and capsule. It is parasitic (partially or wholly) on the gametophyte as it is organically attached and is nutritionally dependent upon the gametophyte.

145. **Curing** of tea leaves is brought about by the activity of **bacteria**. It is essentially an oxidation dry fermentation process, during which, water is driven off, the green colour is lost and the leaves assume a tougher texture and undergo chemical changes.

Mycorrhiza is mutually beneficial association between fungi and the roots of higher plants. Virsus and fungi are not involved in the curing process of tea leaves.

146. At high altitudes, the atmospheric O_2 level is less and hence, more RBCs are needed to absorb the required amount of O_2 to survive. That is why, the people living at sea level have around 5 million RBC/mm^3 of their blood whereas those living at an altitude of 5400 meters have around 8 million RBC/mm^3 of their blood.

147. An important evidence in favour of **organic evolution** is the occurrence of homologous and vestigial organs. **Homologous organs** are those which have the common origin and are built on the same fundamental pattern but they perform different functions and have different appearences *e.g.*, whale's flipper, bat's wings, cat's paw, horse's front leg, bird's wing, ox's front leg and human hand.

Vestigial organs in animals are those having no function now, in them, but had important functions in their ancestors.

Analogous organs are quite different in fundamental structure and embryonic origin but perform the same function. The study of analogous organs illustrates the occurrence of **convergent evoution.**

148. *Archaeopteryx lithographica* is not a living fossil. It is a fossil bird that lived in Jurassic period about 180 million years ago. Its fossil displays the characters of both reptiles (*e.g.*, Long tail, bones not pneumatic, jaws with teeth, fingers terminating into claw, presence of weak sternum, free caudal vertebra etc.,) and birds (*e.g.*, presence of feathers, jaws modified into beak, fore limbs modified into wings, intimate fusion of skull bones etc.) King krab, *Sphenodon* and *Peripatus* are the living fossils.

149. Salamander is semiterrestrial lizard-like tailed amphibian lives under stones, logs and inside crevices. They show hibernation.

Salmon are **anadromous** *i.e.*, they spend their adult lives at sea but return to fresh water to spawn. The pacific species is legandry : after migrating downstream as a smolt a sockeye salmon ranges many hundreds of miles over the pacific for nearly four year and than returns to spawn in the head waters of its parent stream.

Migration is characterstic feature of birds. **Arctic tern** travels about 1100 miles during winter and return back during summer.

150. A major break through in the studies of cell came with the development of electron microscope because the resolution power of the electron microscope is much higher than that of the light microscope.

As an average the resolving power of a light microscope is 0.25μm—0.3μmwhile of electron microscope, is 2–10Å though theoritically, it is 0.25Å. The magnification range of light microscope is 2000-4000 while of electron microscope is 1,00,000-3,00,000.

151. *Loligo, Teredo* and *Octopus* are the members of phylum **Mollusca.**

Loligo is commonly called squid or sea arrow and is gregarious, fast swimmer in the open water of the sea and is carnivorous, feeding on crabs and fishes.

Octopus (Devil fish) is found at the bottom of the sea. It is nocturnal and feeds on crabs, fishes and other molluscs.

Teredo or shipworm is a marine bivalve which has small anterior shell and long slender body with a small foot functioning as adhesive structure.

152. Metameric segmentation is the characteristic of **Annelida** (*e.g.*, earthworm) and **Arthropoda** (*e.g.*, Cockroach).

In **earthworm**, body consists of 100-120 ring like segments or somites called **metameres**. It shows **true segmentation** *i.e.*, external segmentation corresponds with internal segmentation..

Cockroach also shows the metameric segmentation. Its anterior few segments are specialized to form head. Such metamerism is called **heteronomous metamerism**.

Metameric segmentation is absent in platyhelminthes, Echinodermata, Mollusca etc.

153. Endangered species is a plant or animal species defined by IUCN as being in immediate danger of extinction because its members have reached a critical level or their habitats have been drastically reduced.

A plant. *Bentinckia condapanna/nicobarica* (member of family Arecaceae) and the animal, Red panda, both are declared as endangered in India.

Tamarind. Banyan etc. are not endangered in India.

154. Jurassic period is the second geological period of Mesozoic era. In this period, the **gymnosperms** were dominant and the plants included ferns, cycads, *Ginkgo*, rushes and conifers, among animals, important invertebrates included ammonites, corals, brachiopods, bivalves and echinoids. Reptiles dominated the vertebrates and the **first flying reptiles** the pterosaurs appeared.

The **first primitive bird,** *Archaeopteryx*, also made its appearance.

155. *Trypanosoma*, *Noctiluca*, *Monocystis* and *Giardia* are all unicellular protists.

Trypanosoma gambiense is the single celled, parasitic zooflagellate causing **trypanosomiasis** or **sleeping sickness.**

Giardia or the 'Grand old man of the intestine' is a diplomonadid parasitic flagellate occurring in the intestine of man and other animals and causes giardiasis or diarrhoea *(i.e.,* very loose and frequent stool containing large quantity of fat).

Noctiluca is a marine, colourless dinoflagellate. It is a voracious predator and has a long, motile tentacle, near the base of which, its single short

Monocystis is a microscopic, unicellular endoparasitic protozoan found in the coelom and seminal vesicles of earthworm. As it is an endoparasite, it does not possess any special structure for locomotion.

156. Cilia are minute, harilike processes on the surface of protozoans or of metazoans cells which by their motion accomplish locomotion or produce a current. Each cilium contains a peripheral circle of nine doublet microtubules arranged around two single microtubules. Each microtubule is composed of tubulin proteins.

Although the mechanism of ciliary movement is not completely under stood. It is known that the microtubules behave as sliding filament that move past one another much like the sliding filaments of vertebrate skeletal muscle. The fluxes of Ca^{2+} across the membrance is not responsible for controlling the organized beating of cilia.

157. *Escherichia coli* and *Agrobacterium tumefaciens* are the microbes found to be very useful in genetic engineering.

E. coli is a motile, gram negative, rod shaped bacterium which is a normal inhabitant of human colon. It is most extensively used in bacterial genetics and molecular biology.

Agrobacterium tumefaciens is a soil bacterium. It has Ti plasmid (Tumour inducing plasmid) and it can be used for the transfer of a desired gene in dicot plants.

158. *Mucor* is a saprophytic fungus belonging to the order **Mucorales** and family **Mucoraceae** and grows on decaying dung and on some food stuffs.

Mucor shows the best growth on a piece of bread at a temperature of about 25°C, relative humidity of about 95% in a moist and shady place.

159. Phylogeny (Gr. *Phylon* = tribe or race; *geneia* = origin) is the origin and diversification of any taxon or the evolutionary history of its origin and diversification. It is usually represented as a diagrammatic phylogenetic tree (that traces putative evolutionary relationships) *i.e.*, dendrogram.

Palaentology is the study of fossils. **Ontogeny** is the whole course of an individual's development and life history.

160. Concept of hot spots was developed by Norman Meyer. **Hot spots** are the areas with high density of diversity or megadiversity which are also the most threatened ones. Today, the number of hot spots identified by ecologists are 25 in the world of which two hot spots are present in India *i.e.*, **Western Ghats** and **Eastern Himalayas**. Western Ghats occur along the western coast of India for a distance of about 1600 km in Maharashtra, Karnataka, Tamil Nadu and Kerala extending over to Srilanka.

Eastern Himalayas hot spot extends from Bhutan to Myanmar covering most of north-east. In India, Indo-Gangetic plain, Eastern ghats and Aravali hills are mainly not considered as hot spot of biodiversity.

161. The first reaction of photorespiration occur in stroma of chloroplast. In this reaction the RuBP (Ribulose 1-5 biphosphate) consume one oxygen molecule in presence of enzyme Rubisco.

In peroxisome the glycolate transfered from chloroplast takes up O_2 and formed the glyoxylate whereas the H_2O_2 release as byproduct.

162. **Polygenic inheritance** involves the determination of a particular phenotypic characteristic by many genes, called **polygenes** (*i.e.*, the group of genes influencing a quantitative characteristic), each having a small effect individually.

The characteristics controlled in this way show continuous variation and are called **polygenic characters** *e.g.*, **height** and **skin colour** in humans.

The polygenic inheritance is called **multifactorial inheritance** or **quantitative inheritance.**

The pink flower colour in *Mirabilis jalapa* is an example of incomplete dominance while production of male honey bee is an example of parthenogenesis.

163. **Cortisone** is a corticosteroid that is itself biologically inactive and is formed naturally in the adrenal gland (adrenal cortex) from the active hormone cortisol. Cortisol promotes the synthesis and storage of glucose and important in the normal responce to stress, suppresses inflammation and regulates deposition of fat in body.

Acetylcholine is a neurotransmitter secreted from the nerve endings.

Epinephrine and **nor-epinephrine** are secreted from the medulla of adrenal gland and these also act as neurotransmitter.

164. **Sertoli cells** are the cells that line the seminiferous tubules in the testes. These cells protect the spermatids and convey nutrients to both the developing and mature spermatozoa. Sertoli cells are regulated by **FSH (follicle stimulating hormone)** as the FSH receptors are confined to the sertoli cells.

FSH stimulates sertoli cells to produce androgen-binding protein and inhibin; and together with testosterone, promotes the proliferation of sertoli cells.

165. **Cortisol** or hydrocortisone is the principal glucocorticoid hormone of many mammals including humans (corticosterone is more abundant in some small mammals). It regulates the glucose metabolism and promotes gluconeogenesis, especially during starvation and raises blood pressure. **Cortisone** is an inactive form of cortisol.

166. The kinesin, myosin and dynein proteins of skeletal muscle involve ATPase activity. This cause the contraction of skeletal muscles, propelling action of cillia and flagella and the intracellular transport of organelles.

167. Second messengers are the organic molecules and sometimes the metal ions, acting as intracellular signals, whose production or release usually amplifies a signal such as a hormone, received at the cell surface.

Sodium (Na) is not a second messenger in hormone action.

Cyclic Adenosine Monophosphate (cAMP) was the first "second messenger" to be discovered.

In addition to cyclic AMP, **Cyclic Guanosine Monophosphate** (cGMP) functions as a second messenger in certain cases.

Calcium ions (Ca^{2+}) also act as second messenger in phospholipase C – Ca^{+} second messenger system.

168. When a cross (dihybrid) is made between plants bearing round yellow (RRYY) and wrinkled green (rryy) seeds, all the plants in F_1 generation are with yellow round seeds (showing the genotype RrYy). The phenotype in F_2 will be as follows :

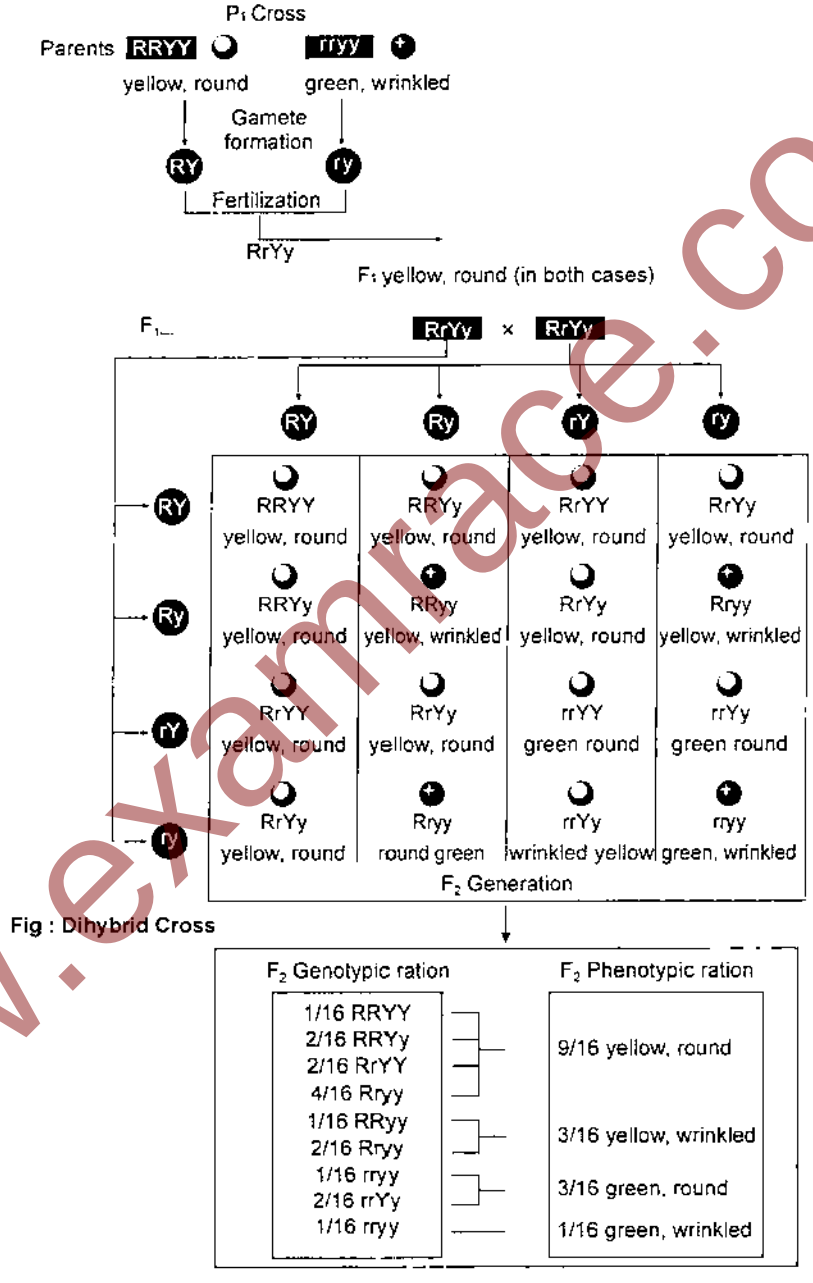


Fig : Dihybrid Cross

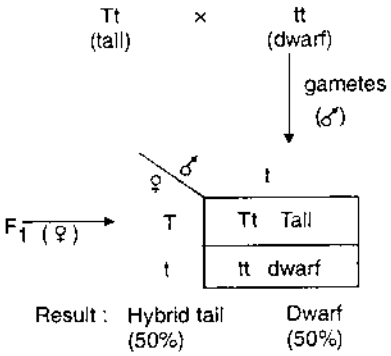
169. 'One gene-one enzyme' hypothesis was given by Beadle and Tatum (1948) which states that particular gene controls the synthesis of specific enzyme. Later, it was modified to 'one gene-one polypeptide hypothesis' by Yanofsky *et.al.* (1965).

170. B-DNA is helical structure with 20Å diameter

3.4 Å and there are 10 base pairs in each turn or pitch (one round). Hence, one turn of the helix is approximately 34Å or 3.4 nm (10Å = 1.0 nm)

171. The test cross involves the crossing of F_1 hybrid with a double recessive genotypic parent. By test cross, the heterozygocity and homozygocity of the organism can be tested.

Thus, the offspring will be 100% dominant, if the individual which crossed with recessive parent *i.e.*, (tt) was homozygous dominant and ratio will be 50% dominant and 50% recessive if the individual was heterozygous dominant. In dihybrid test cross, ratio will be 1:1:1:1.



172. J.D. Watson and F.H.C. Crick (1953) showed that DNA has a double helical structure with two polynucleotide chains connected by hydrogen bonds and running in opposite directions (antiparallel). The antiparallel strands of a DNA molecule means that the phosphate groups at the start of two DNA strands are in opposite position (pole).

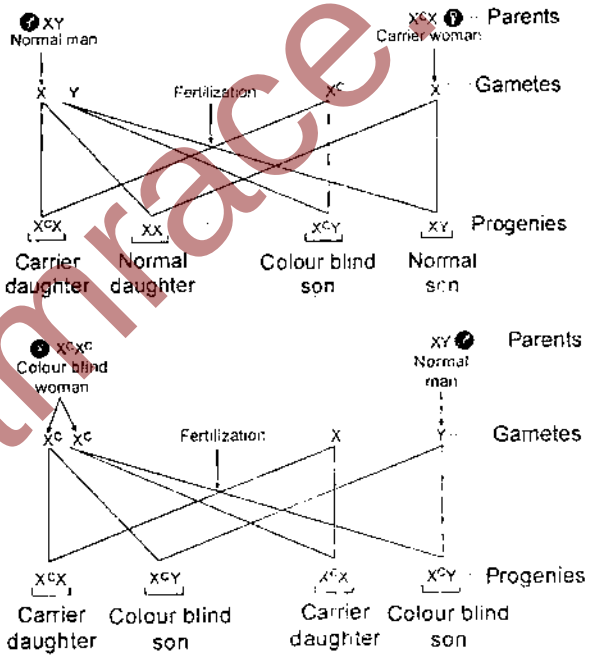
173. Loose or areolar connective tissue is the most generalized connective tissue, which is spread extensively throughout the body — under the skin and epithelia, around and in between the muscles, around nerves and blood vessels between lobes and lobules of compound glands, in the submucosa of respiratory and gastrointestinal tracts.

It functions mainly for binding the parts together but also helps in sliding movement of epithelia, muscles and other parts and also forms the internal histological framework or stroma of many solid organs.

174. **Histamine** is a protein, acting as a vasodilator (widening of blood vessels) in inflammatory and allergic reactions and also increases the permeability of small vessels. It is secreted from the mast cells which widely occur in the areolar connective tissue.

Two other active substances secreted by mast cells are **Heparin**, a proteoglycan, which prevents coagulation of blood vessels and **Serotonin**, a protein, which acts as vasoconstrictor to stop bleeding and to increase blood pressure.

175. Colourblindness is a disease in which a person is unable to differentiate between red and green colour. The gene for this disease is located on the X-chromosome. So, if a colourblind woman marries a normal man, it will produce all the sons colourblind (X^cY). In case of a carrier woman the probability of a colourblind and a normal son is 50 : 50.



176. Cri du chat (cat cry) syndrome in human is caused by the deletion of short arm of chromosome **5**. The affected new born cries like mewing of cat.

The trisomy of 21st chromosome cause down syndrome (mongolism).

177. **Restriction endonuclease** is a type of enzyme that can cleave molecules of DNA at a particular site called **Restriction site** having palindronic sequence. These enzymes are produced by many bacteria and protect the cell by cleaving and destroying the DNA of invading viruses. Now a days, restriction enzymes are widely used in the techniques of genetic engineering.

178. **Antibodies** are the proteins **(glycoproteins)** called immunoglobulins. These are produced by the lymphocytes in response to entry of a foreign substance or antigen into the body. **Lipoproteins** are the micellar complex of protein and lipids.

Steroids are a group of lipids derived from a saturated compound cyclopentano perhydrophenanthrene which has a nucleus of four rings.

Prostaglandin is a group of organic compounds derived from essential fatty acids and causing a range of physiological effects in animals.

179. The central pollution control board prescribed the BOD limit for the discharge of industrial and municipal waste water as < 10 ppm.

180. Class **Oligochaeta** includes terrestrial earthworms and some other species that live in fresh water. Aquatic oligochaetes excrete **ammonia** while terrestrial oligochaetes excrete **urea** but *Lumbricus* produces both ammonia and urea.

181. Almost all secretion by the pituitary gland are controlled by hormonal signal from hypothalamus. The neurohormones are secreted and accumulated by hypothalamus.

182. Menstruation is caused by the reduction of estrogen and progesterone, **especially progesterone** at the end of monthly ovarian cycle. The first effect is decreased stimulation of the endometrial cells by these two hormones followed rapidly by involution of the endometrium itself to about 65% of its previous thickness.

183. Residual air is the air that remains in lungs after the most forceful expiration. It is about 1200 ml. As the residual air remains in the lungs therefore it has no effect on respiration efficiency.

184. In open circulatory system, the blood flows in open spaces like lacunae and sinuses and it bathes the cells directly *e.g.,* arthropods (cockroach or *Periplaneta*).

Octopus and *Sepia* are the cephalopods in which the circulatory system is of completely closed type.

Pheretima and *Hirudinaria* are the annelids. Annelids possess the closed circulatory system, in which the blood circulates inside the blood vessels without coming in direct contact of body cells.

185. **Adrinaline** (epinephrine) is a hormone produced by adrenal medulla and is secreted in great amounts during emotional stress. It elevates the glucose level in blood stream (by **glycogenolysis**) which is accompanied by **increase in oxygen consumption,** body temperature, heat production. Adrenaline also cause an increase in the flow of blood by dilating the blood vessels.

Insulin regulates the glucose level in blood.

ACTH (Adreno Corticotropic Hormone) is secreted by anterior pituitary and stimulates the adrenal cortex.

Glucagon is a polypeptide hormone secreted by the alpha cells of islets of langerhans of pancreas . It acts to promote glycogenolysis.

186. **"Prions"** are the infective proteinaceous particles. This term was proposed by Prusiner. The prions cause some neurological diseases in animals (including humans) *e.g.,* **Mad cow disease** in cattle and in humans it causes Kuru disease, Kreutzfeldt-Jacob disease etc.

187. According to mass flow hypothesis the transport of organic solutes takes place from source to sink this transport also depends on metabolic energy.

According to cytoplasmic streaming hypothesis (put forward by de Vries 1885) the transport of organic solutes takes place by combination of diffusion and cytoplasmic streaming. Cytoplasmic streaming carry organic solutes from one end the other end of sieve tube.

P proteins has a role as defence against phloem feeding insects and sealing of damaged sieve tubes.

Protein is absent in monocots and gymnosperms.

188. *Ctenoplana* and *Beroe* lack cnidoblasts and have biradial symmetry. These belong to phylum **Ctenophora**.

Hydra Sea anemone, *Aurelia* are coelentrates which have cnidoblasts. Although sea anemone has biradial symmetry.

189. In angiosperms (dicots), the *Polygonum* type of embryosac is most common. In this embryosac, the arrangement of the nuclei is 3 + 2 + 3*i.e.*, 3 in antipodal cells, 2 as polar nuclei (which later fuse and form a diploid secondary nucleus); and 3 in egg appratus (2 in synergids and 1 in egg cell).

190. Barley seeds are rich in carbohydrate (Starch). The starch is hydrolysed by α-amylase to monosaccharides unit at the time of germination of seeds.

191. In a cereal grain (*e.g.*, wheat), the single cotyledon of embryo is represented by the **scutellum**. Scutellum is specialized for nutrient absorption from the endosperm.

Coleoptile is a modified ensheathning leaf that covers and protects the young primary leaves of a grass seedling.

Coleorhiza is a sheath like structure found on the radicle which covers and protects it during the growth into the soil.

192. In our body, the blood transports the CO_2 in three ways :

(i) Majority of carbon dioxide produced (70%) in our cells is transported in the form of **bicarbonates**. In this way first, the CO_2 that dissolves in blood plasma reacts with water forming carbonic acid which dissociates into hydrogen and bicarbonate ions.

$$CO_2 + H_2O \rightleftharpoons H_2CO_3$$

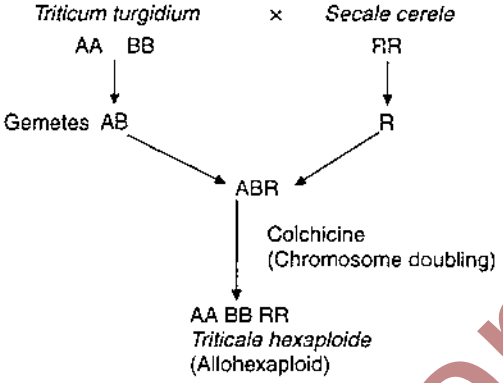
(Carbonic acid)

$$H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$$

(ii) About 7% of all the CO_2 of transported by blood from tissues to the lungs is in dissolved state in plasma.

(iii) About 23% of CO_2, collected from cells through tissue fluids, is transported by blood in the form of carbamino compound, carbamino-haemoglobin (CO_2HHb).

193. *Triticale* is the first man-made cereal crop. It has been obtained by crossing wheat (*Triticum* sp.) with rye *(Secale cereale)*.



194. In **meristem culture**, the shoot apical meristem alongwith some surrounding tissue is grown *in vitro*. It is used for clonal propagation and recovery of **virus free plants.** It is also potentially useful in germ plasm exchange and long term storage of germ plasm through freeze preservation.

Protoplast culture involves the culture of protoplasts (Plant cell without cell wale) on suitable medium.

Embryo rescue is the culture of incised immature embryo to raise new plants.

Anther culture involves the culture of anthers on artificial culture medium. It is helpful in obtaining haploid plants.

195. AIDS (Acquired immuno deficiency syndrome) is caused by HIV (Human immuno deficiency virus). **T_4 lymphocytes** are the principal target cells of HIV.

B-lymphocytes represent about 5-15% of circulating lymphoid proof and are classically defined by the presence of endogenously produced immunoglobulins (antibody).

Leucocytes or white blood cell are the nucleated blood corpuscles lacking haemoglobin.

Thrombocytes or platelets are small cell like blood borne fragments shed from megakaryocytes in vertebrate bone marrow and essential to normal blood clotting.

196. Kangaroo, Hedge Hog, Dolphin and Loris are all mammals. These give birth to young ones.

197. Sickle cell anemia (in which RBCs become sickle shaped and stiff) is a genetic disorder that is autosomal and linked to a recessive allele. It has not been eliminated from the african population because it provides immunity against malaria. People who are heterozygous for sickle cell allele are much less susceptible for falciparum malaria which is one of the main causes of illness and death in them. Thus, the sickle cell allele is maintained at high levels in populations where falciparum malaria is common.

198. Crab, centipede and cockroach belong to phylum Arthropoda. These have jointed appendages and chitinous exoskelton.

199. Both sickle cell anaemia and Huntington's chorea are **congenital genetic disorders**.

Sickle cell anaemia was first reported by James Herrick (1904). In this disease the patient's haemoglobin level reduced to half of the normal and the RBCs become sickle shaped. A single mutation in a gene can cause sickle cell anaemia.

Huntington's chorea is caused by autosomal mutation which is dominant. The gene is present on chromosome number 4.

200. Angiotensinogen is a plasma protein produced and secreted by the liver cells. Renin secreted from juxtaglomerular cells and acts enzymaticaly on angiotensinogen to release 10 amino acid peptide angiotensin I.

Macula densa is actualy a plaque in wall at the end of thick assending limb of nephrons.

❑