CBSE SCREENING
MEDICAL ENTRANCE
SOLVED PAPER 2004

Physics

1. If λ_m denotes the wavelength at which the radiative emission from a black body at a temperature T K is maximum, then :
   (a) $\lambda_m \propto T^4$
   (b) λ_m is independent of T
   (c) $\lambda_m \propto T$
   (d) $\lambda_m \propto T^{-1}$

2. The ratio of the radii of gyration of a circular disc about a tangential axis in the plane of the disc and of a circular ring of the same radius about a tangential axis in the plane of the ring is :
   (a) 2 : 3 (b) 2 : 1
   (c) $\sqrt{5} : \sqrt{6}$ (d) $1 : \sqrt{2}$

3. A round disc of moment of inertia I_2 about its axis perpendicular to its plane and passing through its centre is placed over another disc of moment of inertia I_1 rotating with an angular velocity ω about the same axis. The final angular velocity of the combination of discs is :
   (a) $\frac{I_2\omega}{I_1 + I_2}$ (b) ω
   (c) $\frac{I_1\omega}{I_1 + I_2}$ (d) $\frac{(I_1 + I_2)\omega}{I_1}$

4. A ball of mass 2 kg and another of mass 4 kg are dropped together from a 60 feet tall building. After a fall of 30 feet each towards earth, their respective kinetic energies will be in the ratio of :
   (a) $\sqrt{2} : 1$ (b) 1 : 4
   (c) 1 : 2 (d) $1 : \sqrt{2}$

5. An electric dipole has the magnitude of its charge as q and its dipole moment is p. It is placed in a uniform electric field E. If its dipole moment is along the direction of the field, the force on it and its potential energy are respectively :
   (a) $2qE$ and minimum
   (b) qE and pE
   (c) zero and minimum
   (d) qE and maximum

6. A coil of 40 H inductance is connected in series with a resistance of 8 ohm and the combination is joined to the terminals of a 2 V battery. The time constant of the circuit is :
   (a) 5 s (b) 1/5 s (c) 40 s (d) 20 s

7. One mole of an ideal gas at an initial temperature of T K does $6R$ joules of work adiabatically. If the ratio of specific heats of this gas at constant pressure and at constant volume is 5/3, the final temperature of gas will be :
   (a) $(T + 2.4)$ K (b) $(T - 2.4)$ K
   (c) $(T + 4)$ K (d) $(T - 4)$ K

8. A battery is charged at a potential of 15 V for 8 H when the current flowing is 10 A. The battery on discharge supplies a current of 5 A for 15 H. The mean terminal voltage during discharge is 14 V. The "watt-hour" efficiency of the battery is :
   (a) 82.5% (b) 80%
   (c) 90% (d) 87.5%

9. The electric resistance of a certain wire of iron is R. If its length and raduis are both doubled, then :
   (a) the resistance will be doubled and the specific resistance will be halved
   (b) the resistance will be halved and the specific resistance will remain unchanged
   (c) the resistance will be halved and the specific resistance will be doubled
   (d) the resistance and the specific resistance, will both remain unchanged

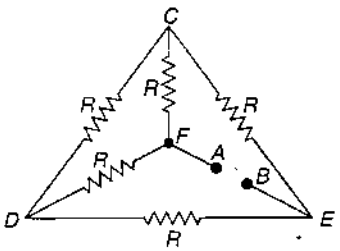
10. A galvanometer acting as a voltmeter will have :
(a) a high resistance in parallel with its coil
(b) a high resistance in series with its coil
(c) a low resistance in parallel with its coil
(d) a low resistance in series with its coil

11. When three identical bulbs of 60 W, 200 V rating are connected in series to a 200 V supply, the power drawn by them will be :
(a) 60 W (b) 180 W
(c) 10 W (d) 20 W

12. Resistances n, each of r ohm, when connected in parallel give an equivalent resistance of R ohm. If these resistances were connected in series, the combination would have a resistance in ohms, equal to :
(a) n^2R (b) R/n^2 (c) R/n (d) nR

13. The unit of permittivity of free space, ε_0, is :
(a) coulomb/newton-metre
(b) newton - metre^2/coulomb^2
(c) coulomb^2/ newton - metre^2
(d) coulomb^2/ (newton - metre)^2

14. Five equal resistances each of resistance R are connected as shown in the figure. A battery of V volts is connected between A and B. The current flowing in $AFCEB$ will be :

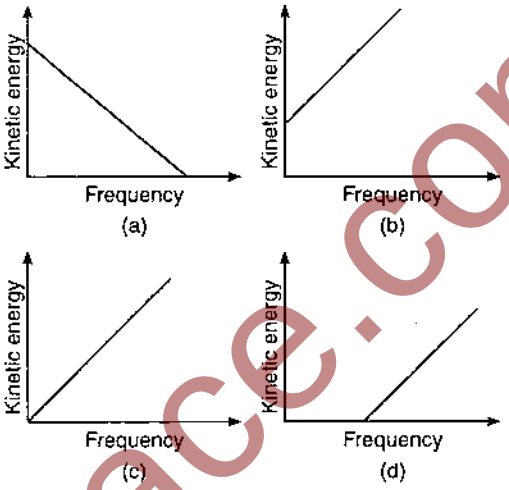


(a) $\frac{3V}{R}$ (b) $\frac{V}{R}$
(c) $\frac{V}{2R}$ (d) $\frac{2V}{R}$

15. A galvanometer of 50 Ω resistance has 25 divisions. A current of 4×10^{-4} A gives a deflection of one division. To convert this galvanometer into a voltmeter having a range of 25 V, it should be connected with a resistance of :
(a) 2500 Ω as a shunt
(b) 245 Ω as a shunt
(c) 2550 Ω in series
(d) 2450 Ω in series

16. A 6 V battery is connected to the terminals of a three metre long wire of uniform thickness and resistance of 100 Ω. The difference of potential between two points on the wire separated by a distance of 50 cm will be :
(a) 2 V (b) 3 V
(c) 1 V (d) 1.5 V

17. According to Einstein's photoelectric equation, the graph between the kinetic energy of photoelectrons ejected and the frequency of incident radiation is :



18. A nucleus represented by the symbol ${}^{A}_{Z}X$ has :
(a) Z neutrons and $A - Z$ protons
(b) Z protons and $A - Z$ neutrons
(c) Z protons and A neutrons
(d) A protons and $Z - A$ neutrons

19. The dimensions of universal gravitational constant are :
(a) $[M^{-1} L^3 T^{-2}]$ (b) $[ML^2 T^{-1}]$
(c) $[M^{-2} L^3 T^{-2}]$ (d) $[M^{-2} L^2 T^{-1}]$

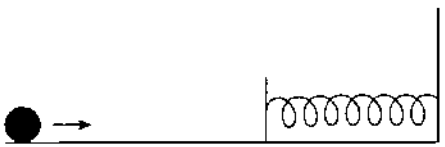
20. If in a nuclear fusion process, the masses of the fusing nuclei be m_1 and m_2 and the mass of the resultant nucleus be m_3, then :
(a) $m_3 = m_1 + m_2$ (b) $m_3 = |m_1 - m_2|$
(c) $m_3 < (m_1 + m_2)$ (d) $m_3 > (m_1 + m_2)$

21. In semiconductors at a room temperature :
(a) the valence band is partially empty and the conduction band is partially filled
(b) the valence band is completely filled and the conduction band is partially filled
(c) the valence band is completely filled
(d) the conduction band is completely empty

22. The peak voltage in the output of a half-wave diode rectifier fed with a sinusoidal signal without filter is 10V. The DC component of the output voltage is :

(a) $10/\sqrt{2}$ V (b) $10/\pi$ V
(c) 10 V (d) $20/\pi$ V

23. A mass of 0.5 kg moving with a speed of 1.5 m/s on a horizontal smooth surface, collides with a nearly weightless spring of force constant $k = 50$ N/m. The maximum compression of the spring would be :



(a) 0.15 m (b) 0.12 m
(c) 1.5 m (d) 0.5 m

24. The output of OR gate is 1 :

(a) only if both inputs are zero
(b) if either or both inputs are 1
(c) only if both inputs are 1
(d) if either input is zero

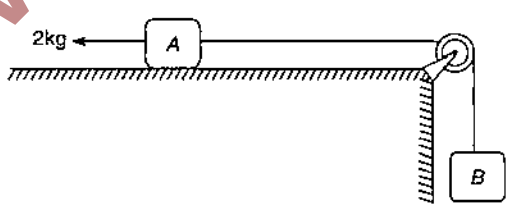
25. In a *p-n* junction photo cell, the value of the photo-electromotive force produced by monochromatic light is proportional to :

(a) the barrier voltage at the *p-n* junction
(b) the intensity of the light falling on the cell
(c) the frequency of the light falling on the cell
(d) the voltage applied at the *p-n* junction

26. The Bohr model of atoms :

(a) assumes that the angular momentum of electrons is quantized
(b) uses Einstein's photoelectric equation
(c) predicts continuous emission spectra for atoms
(d) predicts the same emission spectra for all types of atoms

27. The coefficient of static friction, μ_s, between block A of mass 2 kg and the table as shown in the figure, is 0.2. What would be the maximum mass value of block *B* so that the two blocks do not move ? The string and the pulley are assumed to be smooth and massless : ($g = 10$ m/s^2)



(a) 2.0 kg (b) 4.0 kg
(c) 0.2 kg (d) 0.4 kg

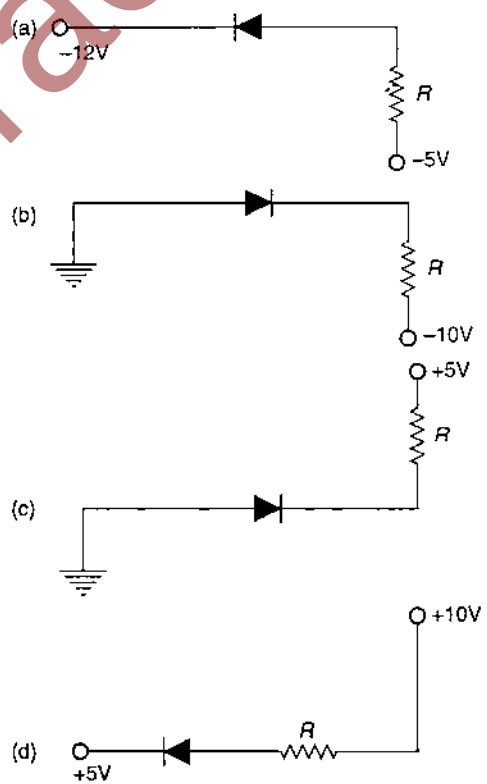
28. Which one of the following statements is true for the speed v and the acceleration a of a particle executing simple harmonic motion ?

(a) When v is maximum, a is maximum
(b) Value of a is zero, whatever may be the value of v
(c) When v is zero, a is zero
(d) When v is maximum, a is zero

29. Two springs of spring constants k_1 and k_2 are joined in series. The effective spring constant of the combination is given by :

(a) $\sqrt{k_1 k_2}$
(b) $(k_1 + k_2)/2$
(c) $k_1 + k_2$
(d) $k_1 k_2/(k_1 + k_2)$

30. Of the diodes shown in the following diagrams, which one is reverse biased ?



31. A wheel having moment of inertia 2 kg-m^2 about its vertical axis, rotates at the rate of 60 rpm about this axis. The torque which can stop the wheel's rotation in one minute would be :

(a) $\frac{2\pi}{15}$ N-m (b) $\frac{\pi}{12}$ N-m

(c) $\frac{\pi}{15}$ N-m (d) $\frac{\pi}{18}$ N-m

32. Consider a system of two particles having masses m_1 and m_2. If the particle of mass m_1 is pushed towards the mass centre of particles through a distance d, by what distance would the particle of mass m_2 move so as to keep the mass centre of particles at the original position ?

(a) $\frac{m_1}{m_1 + m_2} d$ (b) $\frac{m_1}{m_2} d$

(c) d (d) $\frac{m_2}{m_1} d$

33. If $|\vec{A} \times \vec{B}| = \sqrt{3}\, \vec{A} \cdot \vec{B}$, then the value of $|\vec{A} + \vec{B}|$ is :

(a) $(A^2 + B^2 + AB)^{1/2}$

(b) $\left(A^2 + B^2 + \frac{AB}{\sqrt{3}}\right)^{1/2}$

(c) $A + B$

(d) $(A^2 + B^2 + \sqrt{3}\, AB)^{1/2}$

34. A car is moving towards a high cliff. The car driver sounds a horn of frequency f. The reflected sound heard by the driver has a frequency $2f$. If v be the velocity of sound, then the velocity of the car, in the same velocity units, will be :

(a) $\frac{v}{\sqrt{2}}$ (b) $\frac{v}{3}$

(c) $\frac{v}{4}$ (d) $\frac{v}{2}$

35. A beam of light composed of red and green rays is incident obliquely at a point on the face of a rectangular glass slab. When coming out on the opposite parallel face, the red and green rays emerge from :

(a) two points propagating in two different non-parallel directions

(b) two points propagating in two different parallel directions

(c) one point propagating in two different directions

(d) one point propagating in the same direction

36. The density of newly discovered planet is twice that of earth. The acceleration due to gravity at the surface of the planet is equal to that at the surface of the earth. If the radius of the earth is R, the radius of the planet would be :

(a) $2R$ (b) $4R$

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

37. The refractive index of the material of a prism is $\sqrt{2}$ and its refracting angle is 30°. One of the refracting surfaces of the prism is made a mirror inwards. A beam of monochromatic light entering the prism from the other face will retrace its path after reflection from the mirrored surface if its angle of incidence on the prism is :

(a) 45° (b) 60°

(c) 0° (d) 30°

38. A stone is tied to a string of length l and is whirled in a vertical circle with the other end of the string as the centre. At a certain instant of time, the stone is at its lowest position and has a speed u. The magnitude of the change in velocity as it reaches a position where the string is horizontal (g being acceleration due to gravity) is :

(a) $\sqrt{2(u^2 - gl)}$ (b) $\sqrt{u^2 - gl}$

(c) $u - \sqrt{u^2 - 2gl}$ (d) $\sqrt{2gl}$

39. A particle of mass m_1 is moving with a velocity v_1 and another particle of mass m_2 is moving with a velocity v_2. Both of them have the same momentum but their different kinetic energies are E_1 and E_2 respectively. If $m_1 > m_2$ then :

(a) $E_1 < E_2$ (b) $\frac{E_1}{E_2} = \frac{m_1}{m_2}$

(c) $E_1 > E_2$ (d) $E_1 = E_2$

40. A bullet of mass 2g is having a charge of 2 μC. Through what potential difference must it be accelerated, starting from rest, to acquire a speed of 10 m/s ?

(a) 5 kV (b) 50 kV

(c) 5 V (d) 50 V

41. In India electricity is supplied for domestic use at 220 V. It is supplied at 110 V in USA. If the resistance of a 60 W bulb for use in India is R, the resistance of a 60 W bulb for use in USA will be :

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

42. The magnetic flux through a circuit of resistance R changes by an amount $\Delta\phi$ in a time Δt. Then the total quantity of electric charge Q that passes any point in the circuit during the time Δt is represented by :

(a) $Q = \frac{1}{R} \cdot \frac{\Delta\phi}{\Delta t}$ (b) $Q = \frac{\Delta\phi}{R}$

(c) $Q = \frac{\Delta\phi}{\Delta t}$ (d) $Q = R \cdot \frac{\Delta\phi}{\Delta t}$

43. The equation of state for 5g of oxygen at a pressure P and temperature T, when occupying a volume V, will be :

(a) $PV = (5/32)RT$ (b) $PV = 5RT$

(c) $PV = (5/2)RT$ (d) $PV = (5/16)RT$

44. The half-life of radium is about 1600 years. Of 100 g of radium existing now, 25 g will remain unchanged after :

(a) 4800 year (b) 6400 year

(c) 2400 year (d) 3200 year

45. M_p denotes the mass of a proton and M_n that of a neutron. A given nucleus, of binding energy B, contains Z protons and N neutrons. The mass $M(N, Z)$ of the nucleus is given by :

(a) $M(N, Z) = NM_n + ZM_p - Bc^2$

(b) $M(N, Z) = NM_n + ZM_p + Bc^2$

(c) $M(N, Z) = NM_n + ZM_p - B/c^2$

(d) $M(N, Z) = NM_n + ZM_p + B/c^2$

46. The phase difference between two waves, represented by

$y_1 = 10^{-6} \sin [100t + (x/50) + 0.5]$ m

$y_2 = 10^{-6} \cos [100t + (x/50)]$ m

where x is expressed in metres and t is expressed in seconds, is approximately :

(a) 1.07 rad (b) 2.07 rad

(c) 0.5 rad (d) 1.5 rad

47. A telescope has an objective lens of 10 cm diameter and is situated at a distance of one kilometre from two objects. The minimum distance between these two objects, which can be resolved by the telescope, when the mean wavelength of light is 5000 Å, of the order of :

(a) 0.5 m (b) 5 m

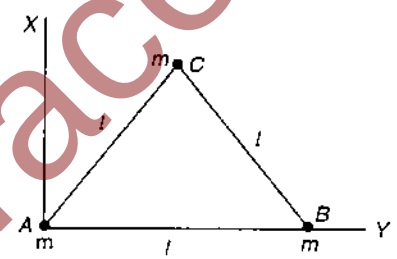
(c) 5 mm (d) 5 cm

48. A block of mass m is placed on a smooth wedge of inclination θ. The whole system is accelerated horizontally so that the block does not slip on the wedge. The force exerted by the wedge on the block (g is acceleration due to gravity) will be :

(a) $mg \cos\theta$ (b) $mg \sin\theta$

(c) mg (d) $mg/\cos\theta$

49. Three particles, each of mass m grams situated at the vertices of an equilateral triangle ABC of side l cm (as shown in the figure). The moment



of inertia of the system about a line AX perpendicular to AB and in the plane of ABC, in gram-cm^2 units will be :

(a) $(3/4)\, ml^2$ (b) $2\, ml^2$

(c) $(5/4)\, ml^2$ (d) $(3/2)\, ml^2$

50. Energy E of a hydrogen atom with principal quantum number n is given by $E = \frac{-13.6}{n^2}$ eV.

The energy of a photon ejected when the electron jumps from $n = 3$ state to $n = 2$ state of hydrogen, is approximately :

(a) 1.5 eV (b) 0.85 eV

(c) 3.4 eV (d) 1.9 eV

Chemistry

51. Among the following, the pair in which the two species are not isostructural, is :

(a) SiF_4 and SF_4 (b) IO_3^- and XeO_3

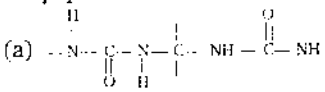
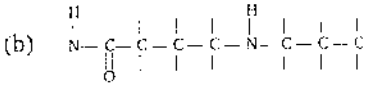
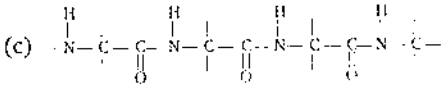
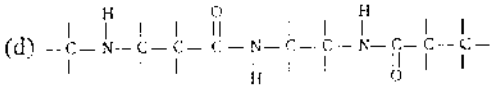
(c) BH_4^- and NH_4^+ (d) PF_6^- and SF_6

52. The rate of first order reaction is 1.5×10^{-2} mol L^{-1} min^{-1} at 0.5 M concentration of the reactant. The half-life of the reaction is :

(a) 0.383 min (b) 23.1 min

(c) 8.73 min (d) 7.53 min

53. Which of the following is responsible for depletion of the ozone layer in the upper strata of the atmosphere ?
(a) Polyhalogens (b) Ferrocenes
(c) Fullerenes (d) Freons

54. Which one of the following structures represents the peptide chain ?
(a) 
(b) 
(c) 
(d) 

55. Which one of the following can be oxidised to the corresponding carbonyl compound ?
(a) 2-hydroxy-propane
(b) *ortho*-nitro-phenol
(c) Phenol
(d) 2-methyl-2-hydroxy-propane

56. The —OH group of an alcohol or the —COOH group of a carboxylic acid can be replaced by —Cl using :
(a) phosphorus pentachloride
(b) hypochlorous acid
(c) chlorine
(d) hydrochloric acid

57. Reaction of HBr with propene in the presence of peroxide gives :
(a) isopropyl bromide
(b) 3-bromo propane
(c) allyl bromide
(d) *n*-propyl bromide

58. Which is the best description of behaviour of bromine in the reaction given below ?

$$H_2O + Br_2 \longrightarrow HBr + HOBr$$

(a) Proton accepted only
(b) Both oxidised and reduced
(c) Oxidised only
(d) Reduced only

59. In a regular octahedral molecule, MX_6 the number of $X - M - X$ bonds at 180° is :
(a) three (b) two
(c) six (d) four

60. Chloropicrin is obtained by the reaction of :
(a) steam on carbon tetrachloride
(b) nitric acid on chlorobenzene
(c) chlorine on picric acid
(d) nitric acid on chloroform

61. Aniline when diazotised in cold and then treated with dimethyl aniline gives a coloured product. Its structure would be :
(a) $CH_3NH-C_6H_4-N=N-C_6H_4-NHCH_3$
(b) $CH_3-C_6H_3-N=N-C_6H_4-NH_2$
(c) $(CH_3)_2N-C_6H_4-N=N-C_6H_5$
(d) $(CH_3)_2N-C_6H_4-N=N-C_6H_4-NH_2$

62. The standard emf of a galvanic cell involving cell reaction with $n = 2$ is found to be 0.295 V at 25° C. The equlibrium constant of the reaction would be :
(a) 2.0×10^{11} (b) 4.0×10^{12}
(c) 1.0×10^{2} (d) 1.0×10^{10}
(Given : $F = 96500$ C mol^{-1} ; $R = 8.314$ JK^{-1} mol^{-1})

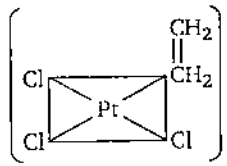
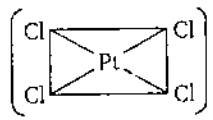
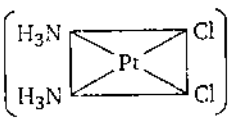
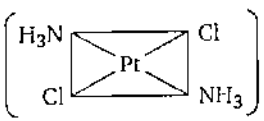
63. The solubility product of a sparingly soluble salt AX_2 is 3.2×10^{-11}. Its solubility (in mol/L) is :
(a) 5.6×10^{-6} (b) 3.1×10^{-4}
(c) 2×10^{-4} (d) 4×10^{-4}

64. Among K, Ca, Fe and Zn, the element which can form more than one binary compound with chlorine is :
(a) Fe (b) Zn
(c) K (d) Ca

65. Which one of the following statements about the zeolites is false ?
(a) They are used as cation exchangers
(b) They have open structure which enables them to take up small molecules
(c) Zeolites are aluminosilicates having three dimensional network
(d) Some of the SiO_4^{4-} units are replaced by AlO_4^{5-} and AlO_6^{9-} ions in zeolites

66. Which of the following will not form a yellow precipitate on heating with an alkaline solution of iodine ?
(a) $CH_3CH(OH)CH_3$
(b) $CH_3CH_2CH(OH)CH_3$
(c) CH_3OH
(d) CH_3CH_2OH

67. A sequence of how many nucleotides in messenger RNA makes a codon for an amino acid ?
(a) Three (b) Four (c) One (d) Two

68. Which of the following is considered to be an anticancer species ?
(a) 
(b) 
(c) 
(d) 

69. The hormone that helps in the conversion of glucose to glycogen is :
(a) cortisone (b) bile acids
(c) adrenaline (d) insulin

70. If the bond energies of H—H, Br—Br and H—Br are 433, 192 and 364 kJ mol^{-1} respecti- vely, then ΔH° for the reaction $H_2(g) + Br_2(g) \longrightarrow 2HBr(g)$ is :
(a) – 261 kJ (b) + 103 kJ
(c) + 261 kJ (d) – 103 kJ

71. A compound formed by elements *X* and *Y* crystallizes in a cubic structure in which the *X* atoms are at the corners of a cube and the *Y* atoms are at the face-centres. The formula of the compound is :
(a) XY_3 (b) X_3Y (c) XY (d) XY_2

72. Standard enthalpy and standard entropy changes for the oxidation of ammonia at 298 K are – 382.64 kJ mol^{-1} and – 145.6 J K^{-1} mol^{-1}, respectively. Standard Gibbs energy change for the same reaction at 298 K is :
(a) – 2221.1kJ mol^{-1}
(b) – 339.3 kJ mol^{-1}
(c) – 439.3 kJ mol^{-1}
(d) – 523.2 kJ mol^{-1}

73. The maximum number of molecules is present in :
(a) 15 L of H_2 gas at STP
(b) 5 L of N_2 gas at STP
(c) 0.5 g of H_2 gas
(d) 10 g of O_2 gas

74. The radioactive isotope $^{60}_{27}Co$ which is used in the treatment of cancer can be made by (*n*, *p*) reaction. For this reaction the target nucleus is :
(a) $^{59}_{28}Ni$ (b) $^{59}_{27}Co$ (c) $^{60}_{28}Ni$ (d) $^{60}_{27}Co$

75. The enzyme which hydrolyses triglycerides to fatty acids and glycerol is called :
(a) maltase (b) lipase
(c) zymase (d) pepsin

76. Which of the following co-ordination compounds would exhibit optical isomerism ?
(a) Pentaamminenitrocobalt (III) iodide
(b) Diamminedinitroplatinum (II)
(c) *trans*-dicyanobis (ethylenediamine)
(d) Tris-(ethylendiamine) cobalt (III) bromide

77. Among $[Ni(CO)_4]^{2-}$, $[Ni(CN)_4]^{2-}$, $[NiCl_4]^{2-}$ species, the hybridisation states of the Ni atom are, respectively : (At. no. of Ni = 28)
(a) sp^3, dsp^2 dsp^2 (b) sp^3, dsp^2, sp^3
(c) sp^3, sp^3, dsp^2 (d) dsp^2, sp^3, sp

78. Among the following series of transition metal ions, the one in which all metal ions have $3d^2$ electronic configuration is : (At. no. : Ti = 22; V = 23; Cr = 24; Mn = 25)
(a) Ti^{3+}, V^{2+}, Cr^{3+}, Mn^{4+}
(b) Ti^{+}, V^{4+}, Cr^{6}, Mn^{7+}
(c) Ti^{4+}, V^{3+}, Cr^{2+}, Mn^{3+}
(d) Ti^{2+}, V^{3+}, Cr^{4+}, Mn^{5+}

79. The rapid change of pH near the stoichiometric point of an acid base titration is the basis of indicator detection. pH of the solution is related to ratio of the concentrations of the conjugate acid (HIn) and base (In^-) forms of the indicator given by the expression :
(a) $\log\frac{[In^-]}{[HIn]} = pK_{In} - pH$
(b) $\log\frac{[Hn]}{[In^-]} = pK_{In} - pH$
(c) $\log\frac{[HIn]}{[In^-]} = pH - pK_{In}$
(d) $\log\frac{[In^-]}{[HIn]} = pH - pK_{In}$

80. CN^- is strong field ligand. This is due to the fact that :
(a) it carries negative charge
(b) it is a pseudohalide
(c) it can accept electrons from metal species
(d) it forms high spin complexes with metal species

81. Considering H_2O as weak field ligand, the number of unpaired electrons in $[Mn(H_2O)_6]^{2+}$ will be (At. no. of Mn = 25) :
(a) three (b) five
(c) two (d) four

82. Considering entropy (S) as a thermodynamic parameter, the criterion for the spontaneity of any process is :
(a) $\Delta S_{system} + \Delta S_{surroundings} > 0$
(b) $\Delta S_{system} - \Delta S_{surroundings} > 0$
(c) $\Delta S_{system} > 0$ only
(d) $\Delta S_{surroundings} > 0$ only

83. H_2O is dipolar, whereas BeF_2 is not. It is because :
(a) the electronegativity of F is greater than that of O
(b) H_2O involves hydrogen bonding whereas BeF_2 is a discrete molecule
(c) H_2O is linear and BeF_2 is angular
(d) H_2O is angular and BeF_2 is linear

84. Ionic radii are :
(a) inversely proportional to effective nuclear charge
(b) inversely proportional to square of effective nuclear charge
(c) directly proportional to effective nuclear charge
(d) directly proportional to square of effective nuclear charge

85. Which of the following does not have a metal-carbon bond ?
(a) $Al(OC_2H_5)_3$ (b) C_2H_5MgBr
(c) $K[Pt(C_2H_4)Cl_3]$ (d) $Ni(CO)_4$

86. Lanthanides are :
(a) 14 elements in the sixth period (atomic no. = 90 to 103) that are filling 4*f* sub-level
(b) 14 elements in the seventh period (atomic no. = 90 to 103) that are filling 5*f* sub-level
(c) 14 elements in the sixth period (atomic no. = 58 to 71) that are filling 4*f* sub-level
(d) 14 elements in the seventh period (atomic no. = 58 to 71) that are filling 4*f* sub-level

87. Which of the following forms cationic micelles above certain concentration ?
(a) Sodium ethyl sulphate
(b) Sodium acetate
(c) Urea
(d) Cetyltrimethylammonium bromide

88. Which one of the following is a chain growth polymer ?
(a) Starch (b) Nucleic acid
(c) Polystyrene (d) Protein

89. The correct statement in respect of protein haemoglobin is that it :
(a) functions as a catalyst for biological reactions
(b) maintains blood sugar level
(c) act as an oxygen carrier in the blood
(d) forms antibodies and offers resistance to diseases

90. The frequency of radiation emitted when the electron falls from $n = 4$ to $n = 1$ in a hydrogen atom will be (Given ionisation energy of H = $2.18\ 10^{-18}$ J atom^{-1} and $h = 6.625 \times 10^{-34}$ Js) :
(a) $1.54 \times 10^{15}\ s^{-1}$ (b) $1.03 \times 10^{15}\ s^{-1}$
(c) $3.08 \times 10^{15}\ s^{-1}$ (d) $2.00 \times 10^{15}\ s^{-1}$

91. Camphor is often used in molecular mass determination because :
(a) it is readily available
(b) it has a very high cryoscopic constant
(c) it is volatile
(d) it is solvent for organic substances

92. In an octahedral structure, the pair of *d* orbitals involved in d^2sp^3 hybridisation is :
(a) $d_{x^2-y^2}, d_{z^2}$ (b) $d_{xz}, d_{x^2-y^2}$
(c) d_{z^2}, d_{xz} (d) d_{xy}, d_{yz}

93. Number of chiral carbon atoms in $\beta - D +$ glucose is :
(a) five (b) six (c) three (d) four

94. The helical structure of protein is stabilized by :
(a) dipeptide bonds (b) hydrogen bonds
(c) ether bonds (d) peptide bonds

95. Which of the following is least reactive in a nucleophilic substitution reaction ?
(a) $(CH_3)_3C-Cl$ (b) $CH_2=CHCl$
(c) CH_3CH_2Cl (d) $CH_2=CHCH_2Cl$

96. The work done during the expansion of a gas from a volume of 4 dm^3 to 6 dm^3 against a constant external pressure of 3 atm, is :

(a) – 6 J (b) – 608 J
(c) + 304 J (d) – 304 J

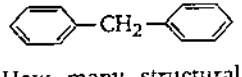
97. In BrF_3 molecule, the lone pairs occupy equatorial positions to minimize :

(a) lone pair-bond pair repulsion only
(b) bond pair-bond pair repulsion only
(c) lone pair-lone pair repulsion and lone pair-bond pair repulsion
(d) lone pair-lone pair repulsion only

98. Using anhydrous $AlCl_3$ as catalyst, which one of the following reactions produce ethylbenzene (PhEt) ?

(a) $H_3C-CH_2OH + C_6H_6$
(b) $CH_3-CH=CH_2 + C_6H_6$
(c) $H_2C=CH_2 + C_6H_6$
(d) $H_3C-CH_3 + C_6H_6$

99. The molecular formula of diphenyl methane

 is $C_{13}H_{12}$

How many structural isomers are possible when one of the hydrogen is replaced by a chlorine atom ?

(a) 6 (b) 4 (c) 8 (d) 7

100. A solid compound 'X' on heating gives CO_2 gas and a residue. The residue mixed with water forms on passing an excess of CO_2 through 'Y' in water, a clear solution, 'Z' is obtained. On boiling 'Z' compound 'X' is reformed. The compound 'X' is :

(a) $Ca(HCO_3)_2$ (b) $CaCO_3$
(c) Na_2CO_3 (d) K_2CO_3

Biology

101. One of the parents of a cross has mutation in its mitochondria. In that cross, that parent is taken as a male. During segregation of F_2 progenies that mutation is found in :

(a) one-third of the progenies
(b) none of the progenies
(c) all of the progenies
(d) fifty per-cent of the progenies

102. When a fresh water protozoan possessing a contractile vacuole, is placed in a glass containing marine water, the vacuole will :

(a) increase in number
(b) disappear
(c) increase in size
(d) decrease in size

103. One of the following is a very unique feature of the mammalian body :

(a) homeothermy
(b) presence of diaphragm
(c) four chambered heart
(d) rib cage

104. Chemically hormones are :

(a) biogenic amines only
(b) proteins, steroids and biogenic amines
(c) proteins only
(d) steroids only

105. When CO_2 concentration in blood increases, breathing becomes :

(a) shallower and slow
(b) there is no effect on breathing
(c) slow and deep
(d) faster and deeper

106. Which one of the following pairs is not correctly matched ?

(a) Vitamin B_{12} — Pernicious anaemia
(b) Vitamin B_6 — Loss of appetite
(c) Vitamin B_1 — Beri-beri
(d) Vitamin B_2 — Pellagra

107. Uricotelism is found in :

(a) mammals and birds
(b) fishes and fresh water protozoans
(c) birds, reptiles and insects
(d) frogs and toads

108. Duodenum has characteristic Brunner's glands which secrete two hormones called :

(a) kinase, estrogen
(b) secretin, cholecystokinin
(c) prolactin, parathormone
(d) estradion, progesterone

109. Mast cells of connective tissue contain :
(a) vasopressin and relaxin
(b) heparin and histamine
(c) heparin and calcitonin
(d) serotonin and melanin

110. Cancer cells are more easily damaged by radiation than normal cells because they are :
(a) starved of mutation
(b) undergoing rapid division
(c) different in structure
(d) non-dividing

111. Certain characteristic demographic features of developing countries are :
(a) high fertility, low or rapidly falling mortality rate, rapid population growth and a very young age distribution
(b) high fertility, high density, rapidly rising mortality rate and a very young age distribution
(c) high infant mortality, low fertility, uneven population growth and a very young age distribution
(d) high mortality, high density, uneven population growth and a very old age distribution

112. ATPase enzyme needed for muscle contraction is located in :
(a) actinin (b) troponin
(c) myosin (d) actin

113. Which one of the following is not correctly matched ?
(a) *Glossina palpalis* — Sleeping sickness
(b) *Culex pipiens* — Filariasis
(c) *Aedes aegypti* — Yellow fever
(d) *Anopheles culifacies* — Leishmaniasis

114. Which one of the following pairs is not correctly matched ?
(a) *Streptomyces* — Antibiotic
(b) *Serratia* — Drug addiction
(c) *Spirulina* — Single cell protein
(d) *Rhizobium* — Biofertilizer

115. A major component of gobar gas is :
(a) ammonia (b) methane
(c) ethane (d) butane

116. A free living nitrogen-fixing cyanobacterium which can also form symbiotic association with the water fern *Azolla* is :
(a) *Tolypothrix* (b) *Chlorella*
(c) *Nostoc* (d) *Anabaena*

117. In the ABO system of blood groups, if both antigens are present but no antibody, the blood group of the individual would be :
(a) B (b) O (c) AB (d) A

118. Which one of the following pairs correctly matches a hormone with a disease resulting from its deficiency ?
(a) Luteinizing hormone — Failure of ovulation
(b) Insulin – - Diabetes insipidus
(c) Thyroxine — Tetany
(d) Parathyroid hormone — Diabetes mellitus

119. Angiosperms have dominated the land flora primarily because of their :
(a) power of adaptability in diverse habitat
(b) property of producing large number of seeds
(c) nature of some pollination
(d) domestication by man

120. In a mutational event, when adenine is replaced by guanine, it is the case of :
(a) frameshift mutation
(b) transcription
(c) transition
(d) transversion

121. An ovule which becomes curved so that the nucellus and embryo sac lie at right angles to the funicle is :
(a) hemitropous (b) campylotropous
(c) anatropous (d) orthotropous

122. Ovulation in the human female normally takes place during the menstrual cycle :
(a) at the mid secretory phase
(b) just before the end of the secretory phase
(c) at the beginning of the proliferative phase
(d) at the end of the proliferative phase

123. Injury to vagus nerve in human is not likely to affect :
(a) tongue movements
(b) gastrointestinal movements
(c) pancreatic secretion
(d) cardiac movements

124. Which of the following hormones is not a secretion product of human placenta ?
(a) Human chorionic gonadotropin
(b) Prolactin
(c) Estrogen
(d) Progesterone

125. You are required to draw blood from a patient and to keep it in a test tube for analysis of blood corpuscles and plasma. You are also provided with the following four types of test tubes. Which of them will you not use for the prupose ?
(a) Test tube containing calcium bicarbonate
(b) Chilled test tube
(c) Test tube containing heparin
(d) Test tube containing sodium oxalate

126. The cardiac pace maker in a patient fails to function normally. The doctors find that an artificial pace maker is to be grafted in him. It is likely that it will be grafted at the site of :
(a) atrioventricular bundle
(b) Purkinje system
(c) sinuatrial node
(d) atrioventricular node

127. Blood analysis of a patient reveals an unusually high quantity of carboxyhaemoglobin content. Which of the following conclusions is most likely to be correct ? The patient has been inhailing polluted air containing usually high content of :
(a) carbon disulphide
(b) chloroform
(c) carbon dioxide
(d) carbon monoxide

128. What is a keystone species ?
(a) A species which makes up only a small proportion of the total biomass of a community, yet has a huge impact on the community's organization and survival
(b) A common species that has plenty of biomass, yet has a fairly low impact on the community's organization
(c) A rare species that has minimal impact on the biomass and on other species in the community
(d) A dominant species that constitutes a large proportion of the biomass and which affects many other species

129. DNA finger printing refers to :
(a) molecular analysis of profiles of DNA samples
(b) analysis of DNA samples using imprinting device
(c) techniques used for molecular analysis of different specimens of DNA
(d) techniques used for identification of finger prints of individuals

130. Flagella of prokaryotic and eukaryotic cells differ in :
(a) type of movement and placement in cell
(b) location in cell and mode of functioning
(c) micro-tubular organisation and type of movement
(d) micro-tubular organisation and function

131. In which one of the following enzymes, copper is necessarily associated as an activator ?
(a) Carbonic anhydrase
(b) Tryptophanase
(c) Lactic dehydrogenase
(d) Tyrosinase

132. The animal with bilateral symmetry in young stage, and radial pentamerous symmetry in the adult stage belong to the phylum :
(a) Annelida (b) Mollusca
(c) Cnidaria (d) Echinodermata

133. In Arthropoda, head and thorax are often fused to form cephalothorax, but in which one of the following classes, is the body divided into head, thorax and abdomen ?
(a) Insecta
(b) Myriapoda
(c) Crustacea
(d) Arachnida and Crustacea

134. Which one of the following is the correct matching of a vitamin, its nature and its deficiency disease ?
(a) Vitamin A — Fat soluble — Night blindness
(b) Vitamin K — Fat soluble — Beri-beri
(c) Vitamin A — Fat soluble —Beri-beri
(d) Vitamin K— Water soluble—Pellagra

135. Lack of independent assortment of two genes A and B in fruit fly *Drosophila* is due to :
(a) repulsion (b) recombination
(c) linkage (d) crossing over

136. In your opinion, which is the most effective way to conserve the plant diversity of an area ?
(a) By tissue culture method
(b) By creating biosphere reserve
(c) By creating botanical garden
(d) By developing seed bank

137. Which of the following is expected to have the highest value ($gm/m^2/yr$) in a grassland ecosystem ?
(a) Secondary production (SP)
(b) Tertiary production (TP)
(c) Gross production (GP)
(d) Net production (NP)

138. In 1984, the Bhopal gas tragedy took place because methyl isocyanate :
(a) reacted with DDT
(b) reacted with ammonia
(c) reacted with CO_2
(d) reacted with water

139. If by radiation all nitrogenase enzymes are inactivated, then there will be no :
(a) fixation of nitrogen in legumes
(b) fixation of atmospheric nitrogen
(c) conversion from nitrate to nitrite in legumes
(d) conversion from ammonium to nitrate in soil

140. Age of fossils in the past was generally determined by radio-carbon method and other methods involving radioactive elements found in the rocks. More precise methods, which were used recently and led to the revision of the evolutionary period for different groups of organisms, includes :
(a) study of carbohydrates/proteins in fossils
(b) study of the conditions of fossilization
(c) electron spin resonance (ESR) and fossil DNA
(d) study of carbohydrates/proteins in rocks

141. Lead concentration in blood is considered alarming if it is :
(a) 20µg / 100 ml (b) 30µg / 100 ml
(c) 4 - 6µg / 100 ml (d) 10µg / 100 ml

142. What kind of evidence suggested that man is more closely related with chimpanzee than with other hominoid apes ?
(a) Evidence from DNA from sex chromosomes only
(b) Comparison of chromosomes morphology only
(c) Evidence from fossil remains and the fossil mitochondrial DNA alone
(d) Evidence from DNA extracted from sex chromosome, autosomes and mitochondria

143. Anthesis is a phenomenon which refers to :
(a) reception of pollen by stigma
(b) formation of pollen
(c) development of anther
(d) opening of flower bud

144. One set of a plant was grown at 12 hours day and 12 hours night period cycles and it flowered while in the other set night phase was interrupted by flash of light and it did not produce flower. Under which one of the following categories will you place this plant ?
(a) Long day (b) Darkness neutral
(c) Day neutral (d) Short day

145. In which one of the following pairs is the specific characteristic of soil not correctly matched ?
(a) Laterite — Contains aluminium compound
(b) Terra rossa — Most suitable for roses
(c) Chernozems — Richest soil in the world
(d) Black soil — Rich in calcium carbonate

146. Recently Govt. of India has allowed mixing of alcohol in petrol. What is the amount of alcohol permitted for mixing in petrol ?
(a) 2.5% (b) 10-15%
(c) 10% (d) 5%

147. In a longitudinal section of a root, starting from the tip upward the four zones occur in the following order :
(a) root cap, cell division, cell enlargement, cell maturation
(b) root cap, cell division, cell maturation, cell enlargement
(c) cell division, cell enlargement, cell maturation, root cap
(d) cell division, cell maturation, cell enlargement, root cap

148. Presence of gills in the tadpole of frog indicates that :
(a) fishes were amphibious in the past
(b) fishes evolved from frog like ancestors
(c) frogs will have gills in future
(d) frogs evolved from gilled ancestors

149. An ecosystem which can be easily damaged but can recover after some time if damaging effect stops, will be having :
(a) low stability and high resilience
(b) high stability and low resilience
(c) low stability and low resilience
(d) high stability and high resilience

150. During transcription, the nucleotide sequence of the DNA strand that is being coded is ATACG, then the nucleotide sequence in the *m*-RNA would be :
(a) TATGC
(b) TCTGG
(c) UAUGC
(d) UATGG

151. Extranuclear inheritance is a consequence of presence of genes in :
(a) mitochondria and chloroplasts
(b) endoplasmic reticulum and mitochondria
(c) ribosomes and chloroplast
(d) lysosomes and ribosomes

152. Which one of the following hormones is a modified amino acid ?
(a) Epinephrine (b) Progesterone
(c) Prostaglandin (d) Estrogen

153. Viruses that infect bacteria, multiply and cause their lysis, are called :
(a) lysozymes (b) lipolytic
(c) lytic (d) lysogenic

154. The recessive genes located on X-chromosome in humans are always :
(a) lethal
(b) sub-lethal
(c) expressed in males
(d) expressed in females

155. In C_3 plants, the first stable product of photosynthesis during the dark reaction is :
(a) malic acid
(b) oxaloacetic acid
(c) 3-phoshoglyceric acid
(d) phosphoglyceraldehyde

156. Crossing over that results in genetic recombination in higher organisms occurs between :
(a) sister chromatids of bivalent
(b) non-sister chromatids of a bivalent
(c) two daughter nuclei
(d) two different bivalents

157. Which of the following statements is not true for retroviruses ?
(a) DNA is not present at any stage in the life cycle of retroviruses
(b) Retroviruses carry gene for RNA dependent DNA polymerase
(c) The genetic material in mature retroviruses is RNA
(d) Retroviruses are causative agents for certain kinds of cancer in man

158. Restriction endonucleases :
(a) are present in mammalian cells for degradation of DNA when the cell dies
(b) are used in genetic engineering for ligating two DNA molecules
(c) are used for *in vitro* DNA synthesis
(d) are synthesized by bacteria as part of their defence mechanism

159. In the resting state of the neural membrane, diffusion due to concentration gradients, if allowed, would drive :
(a) K^+ into the cell
(b) K^+ and Na^+ out of the cell
(c) Na^+ into the cell
(d) Na^+ out of the cell

160. The maximum growth rate occurs in :
(a) stationary phase
(b) senescent phase
(c) lag phase
(d) exponential phase

161. Diversification in plant life appeared :
(a) due to long periods of evolutionary changes
(b) due to abrupt mutations
(c) suddenly on earth
(d) by seed dispersal

162. The technique of obtaining large number of plantlets by tissue culture method is called :
(a) plantlet culture
(b) organ culture
(c) micro-propagation
(d) macro-propagation

163. Cell elongation in internodal regions of the green plants takes place due to :
(a) indole acetic acid
(b) cytokinins
(c) gibberellins
(d) ethylene

164. The most abundant element present in the plants is :
(a) carbon (b) nitrogen
(c) manganese (d) iron

165. Photosynthetically Active Radiation (PAR) represents the following range of wavelength :
(a) 500-600 nm (b) 450-950 nm
(c) 340-450 nm (d) 400-700 nm

166. A terrestrial animal must be able to :
(a) excrete large amounts of water in urine
(b) conserve water
(c) actively pump salts out through the skin
(d) excrete large amounts of salts in urine

167. A male human is heterozygous for autosomal genes A and B and is also hemizygous for haemophilic gene h. What proportion of his sperms will be abh ?
(a) $\frac{1}{8}$ (b) $\frac{1}{32}$ (c) $\frac{1}{16}$ (d) $\frac{1}{4}$

168. Edible part of mango is :
(a) endocarp (b) receptacle
(c) epicarp (d) mesocarp

169. In chloroplasts, chlorophyll is present in the :
(a) outer membrane
(b) inner membrane
(c) thylakoids
(d) stroma

170. In glycolysis, during oxidation electrons are removed by :
(a) ATP
(b) glyceraldehyde-3-phosphate
(c) NAD^+
(d) molecular oxygen

171. Dough kept over-night in warm weather becomes soft and spongy because of :
(a) absorption of carbon dioxide from atmosphere
(b) fermentation
(c) cohesion
(d) osmosis

172. In the somatic cell cycle :
(a) in G_1 phase DNA content is double the amount of DNA present in the original cell
(b) DNA replication takes place in S-phase
(c) a short interphase is followed by a long mitotic phase
(d) G_2 phase follows mitotic phase

173. A nutritonally wild type organism, which does not require any additional growth supplement is known as :
(a) phenotype (b) holotype
(c) auxotroph (d) prototroph

174. Which of the following propagates through leaf-tip ?
(a) Walking fern
(b) Sprout-leaf plant
(c) *Marchantia*
(d) Moss

175. Common indicator organism of water pollution is :
(a) *Lemna* pancicostata
(b) *Eichhornia* crassipes
(c) *Escherichia coli*
(d) *Entamoeba histolytica*

176. ELISA is used to detect viruses, where :
(a) DNA probes are required
(b) southern blotting is done
(c) alkaline phosphatase is the key reagent
(d) catalase is the key reagent

177. Phenetic classification of organisms is based on :
(a) observable characteristics of existing organisms
(b) the ancestral lineage of existing organisms
(c) dendrogram based on DNA characteristics
(d) sexual characteristics

178. If you are provided with root-tips of onion in your class and are asked to count the chromosomes, which of the following stages can you most conveniently look into ?
(a) Metaphase (b) Telophase
(c) Anaphase (d) Prophase

179. When a diploid female plant is crossed with a tetraploid male, the ploidy of endosperm cells in the resulting seed is :
(a) tetraploidy (b) pentaploidy
(c) diploidy (d) triploidy

180. India's wheat yield revolution in the 1960s was possible primarily due to :
(a) hybrid seeds
(b) increased chlorophyll content
(c) mutations resulting in plant height reduction
(d) quantitative trait mutations

181. The most likely reason for the development of resistance against pesticides in insect damaging a crop is :
(a) random mutations
(b) genetic recombination
(c) directed mutations
(d) acquired heritable changes

182. The following ratio is generally constant for a given species :
(a) A + G / C + T (b) T + C / G + A
(c) G + C / A + T (d) A + C / T + G

183. A self-fertilizing trihybrid plant forms :
(a) 8 different gametes and 64 different zygotes
(b) 4 different gametes and 16 different zygotes
(c) 8 different gametes and 16 different zygotes
(d) 8 different gametes and 32 different zygotes

184. Lichens are well known combination of an alga and a fungus where fungus has :
(a) a saprophytic relationship with the alga
(b) an epiphytic relationship with the alga
(c) a parasitic relationship with the alga
(d) a symbiotic relationship with the alga

185. In oogamy, fertilization involves :
(a) a small non-motile female gamete and a large motile male gamete
(b) a large non-motile female gamete and a small motile male gamete
(c) a large non-motile female gamete and a small non-motile male gamete
(d) a large motile female gamete and a small non-motile male gamete

186. Which one of the following is a living fossil ?
(a) *Cycas* (b) Moss
(c) *Saccharomyces* (d) *Spirogyra*

187. In which one of the following habitats does the diurnal temperature of soil surface vary most ?
(a) Shrub land (b) Forest
(c) Desert (d) Grassland

188. Which form of RNA has a structure resembling clover leaf ?
(a) *r*-RNA (b) *hn*-RNA
(c) *m*-RNA (d) *t*-RNA

189. The telomeres of eukaryotic chromosomes consists of short sequences of :
(a) thymine rich repeats
(b) cytosine rich repeats
(c) adenine rich repeats
(d) guanine rich repeats

190. After a mutation at a genetic locus the character of an organism changes due to the change in :
(a) protein structure
(b) DNA replication
(c) protein synthesis pattern
(d) RNA transcription pattern

191. During replication of a bacterial chromosome DNA synthesis starts from a replication origin site and :
(a) RNA primers are involved
(b) is facilitated by telomerase
(c) moves in one direction of the site
(d) moves in bi-directional way

192. Plants adapted to low light intensity have :
(a) larger photosynthetic unit size than the sun plants
(b) higher rate of CO_2 fixation than the sun plants
(c) more extended root system
(d) leaves modified to spines

193. The Ti plasmid, is often used for making transgenic plants. This plasmid is found in :
(a) *Azotobacter*
(b) *Rhizobium* of the roots of leguminous plants
(c) *Agrobacterium*
(d) Yeast as a 2 μm plasmid

194. In a plant, red fruit (R) is dominant over yellow fruit (r) and tallness (T) is dominant over shortness (t). If a plant with RRTt genotype is crossed with a plant that is rrtt. :
(a) 25% will be tall with red fruit
(b) 50% will be tall with red fruit
(c) 75% will be tall with red fruit
(d) all of the offspring will tall with red fruit

195. According to Oparin, which one of the following was not present in the primitive atmosphere of the earth ?
(a) Methane (b) Oxygen
(c) Hydrogen (d) Water vapour

196. Which one of the following precedes re-formation of the nuclear envelope during M phase of the cell cycle ?
(a) Decondensation from chromosomes and reassembly of the nuclear lamina
(b) Transcription from chromosomes and reassembly of the nuclear lamina
(c) Formation of the contractile ring and formation of the phragmoplast
(d) Formation of the contractile ring and transcription from chromosomes

197. The richest sources of vitamin-B_{12} are :
(a) goat's liver and *Spirulina*
(b) chocolate and green gram
(c) rice and hen's egg
(d) carrot and chicken's breast

198. The most thoroughly studied of the known bacteria-plant interactions is the :
(a) cyanobacterial symbiosis with some aquatic ferns
(b) gall formation on certain angiosperms by *Agrobacterium*
(c) nodulation of *Sesbania* stems by nitrogen fixing bacteria
(d) plant growth stimulation by phosphate solublising bacteria

199. In transgenics, expression of transgene in target tissue is determined by :
(a) enhancer (b) transgene
(c) promoter (d) reporter

200. A normal woman whose father was colourblind is married to a normal man. The sons would be :
(a) 75% colourblind (b) 50% colourblind
(c) all normal (d) all colourblind

ANSWERS

PHYSICS

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

CHEMISTRY

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

BIOLOGY

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

HINTS & SOLUTIONS

Physics

1. According to Wien's displacement law, the wavelength (λ_m) of maximum intensity of emission of black body radiation is inversely proportional to absolute temperature (T) of the black body. Therefore, Wien's law is

$$\lambda_m T = \text{constant}$$

or $$\lambda_m = \frac{\text{constant}}{T}$$

or $$\lambda_m \propto \frac{1}{T}$$

or $$\lambda_m \propto T^{-1}$$

2. **Key Idea :** *If a body has mass M and radius of gyration is K, then* $I = MK^2$.

Moment of inertia of a disc and circular ring about a tangential axis in their planes are respectively.

$$I_d = \frac{5}{4} M_d R^2$$

$$I_r = \frac{3}{2} M_r R^2$$

but $$I = MK^2$$

$$\Rightarrow \quad K = \sqrt{\frac{I}{M}}$$

$$\therefore \quad \frac{K_d}{K_r} = \sqrt{\frac{I_d}{I_r} \times \frac{M_r}{M_d}}$$

or $$\frac{I_d}{I_r} = \sqrt{\frac{(5/4) M_d R^2}{(3/2) M_r R^2} \times \frac{M_r}{M_d}} = \sqrt{\frac{5}{6}}$$

$$\therefore \quad I_d : I_r = \sqrt{5} : \sqrt{6}$$

3. **Key Idea :** *When no external torque acts on a system of particles, then the total angular momentum of the system remains always a constant.*

The angular momentum of a disc of moment of inertia I_1 and rotating about its axis with angular velocity ω is

$$L_1 = I_1 \omega$$

When a round disc of moment of inertia I_2 is placed on first disc, then angular momentum of the combination is

$$L_2 = (I_1 + I_2) \omega'$$

In the absence of any external torque, angular momentum remains conserved *i.e.*,

$$L_1 = L_2$$

$$I_1 \omega = (I_1 + I_2) \omega'$$

$$\Rightarrow \quad \omega' = \frac{I_1 \omega}{I_1 + I_2}$$

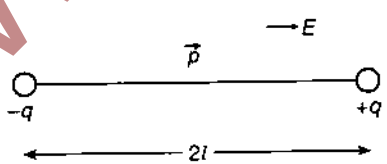
4. **Key Idea :** *In a free fall, two balls of different mass will acquire the same velocity after falling through same height.*

From key idea, $v_1 = v_2 = v$ at a 30 feet from falling point.

Here, $m_1 = 2\,\text{kg}$, $m_2 = 4\,\text{kg}$

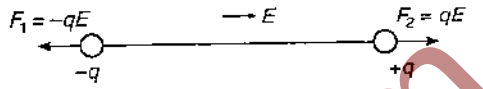
Thus, $$\frac{K_1}{K_2} = \frac{\frac{1}{2} m_1 v^2}{\frac{1}{2} m_2 v^2} = \frac{m_1}{m_2} = \frac{2}{4} = \frac{1}{2}$$

5. An electric dipole is an arrangement of two equal an opposite charges placed at a distance $2l$ The dipole is placed in electric field as such its dipole moment is in direction of electric field as shown in figure



Now force on the charge q is $F_2 = qE$ along the direction of E and force on charge $-q$ is $F_1 = -qE$ in the direction opposite to E.

Since forces on the dipole are equal and opposite, so net force on the electric dipole is zero.



Now potential energy of the dipole.

$$U = -pE \cos\theta$$

where θ is the angle between direction of electric field and direction of dipole moment.

$$\therefore \quad \theta = 0°$$

Hence, $U = -pE \cos 0° = -pE$ (minimum)

6. Time constant of L-R circuit is,

$$\tau = \frac{L}{R}$$

Here, $L = 40$ H, $R = 8\,\Omega$, $E = 2$ V

$$\therefore \quad \tau = \frac{40}{8} = 5\,\text{s}$$

NOTE : At a time equal to one time constant the current has risen to $\left(1 - \frac{1}{e}\right)$ or about 63% of its initial value i_0.

7. **Key Idea :** *In an adiabatic process, there is no heat transfer into or out of a system i.e., $Q = 0$*

In an adiabatic process

$$Q = 0$$

So, from Ist law of thermodynamics.

$$W = -\Delta U$$

$$= -nC_V \Delta T$$

$$= -n\left(\frac{R}{\gamma - 1}\right)(T_f - T_i)$$

$$= \frac{nR}{\gamma - 1}(T_i - T_f) \qquad \text{(i)}$$

Here : $W = 6R$ J, $n = 1$ mol,

$R = 8.31$ J/mol-K, $\gamma = \frac{5}{3}$, $T_i = T$ K

Substituting given values in Eq. (i), we get

$$\therefore \quad 6R = \frac{R}{(5/3 - 1)}(T - T_f)$$

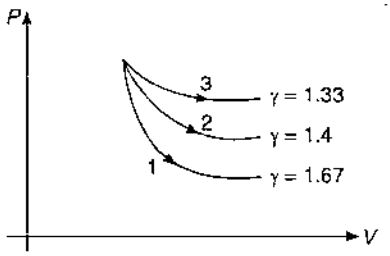
$$\Rightarrow \quad 6R = \frac{3R}{2}(T - T_f)$$

$$\Rightarrow \quad T - T_f = 4$$

$$\therefore \quad T_f = (T - 4)\,\text{K}$$

NOTE : Adiabatic expansions of mono, dia and polyatomic gases are shown below

1 → monoatomic
2 → diatomic
3 → polyatomic



8. **Key Idea :** *Watt-hour efficiency of a battery is the ratio of output energy to the input energy.*

Input energy when the battery is charged

$= Vit$

$= 15 \times 10 \times 8 = 1200$ W-h

Energy released when the battery is discharged

$= 14 \times 5 \times 15 = 1050$ W-h

Hence, W-h efficiency of battery is given by

$$= \frac{\text{energy output}}{\text{energy input}} = \frac{1050}{1200}$$

$= 0.875 = 87.5\%$

9. The formula for resistance of wire is

$$R = \frac{\rho l}{A}$$

where ρ = specific resistance of the wire

$$\Rightarrow \quad R \propto \frac{l}{A}$$

$$\Rightarrow \quad R \propto \frac{l}{r^2} \qquad (\because A = \pi r^2)$$

$$\therefore \quad \frac{R_1}{R_2} = \frac{l_1}{l_2} \times \frac{r_2^2}{r_1^2} \qquad \ldots(i)$$

Given, $l_1 = l$, $l_2 = 2l$, $r_1 = r$, $r_2 = 2r$, $R_1 = R$

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

$$\frac{R_1}{R_2} = \frac{l}{2l} \times \frac{(2r)^2}{r^2}$$

$$\frac{R_1}{R_2} = \frac{l}{2l} \times \frac{(2r)^2}{r^2}$$

$$\frac{R_1}{R_2} = 2$$

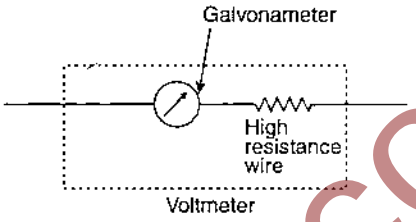
$$R_2 = \frac{R}{2}$$

Therefore, resistance will be halved.

Now the specific resistance of the wire does not depend on the geometry of the wire hence, it remains unchanged.

10. **Key Idea :** *To work as voltmeter, the resistance of galvanometer should be high.*

A voltmeter indeed is a modified form of a pivoted coil galvanometer. Since, the resistance of coil of galvanometer of its own is low, hence to convert a galvanometer into a voltmeter, its resistance is to be increased. For this an appropriate high resistance is joined in series with the galvanometer as shown in figure



The value of this resistance to be connected depends on the range of the voltmeter.

NOTE : A voltmeter is always connected in parallel in an electric circuit.

11. **Key Idea :** *In series order, the resistances of three bulbs must be added to give resultant resistance of the circuit.*

Let R_1, R_2 and R_3 are the resistances of three bulbs respectively.

In series order

$$R = R_1 + R_2 + R_3$$

but $R = \frac{V^2}{P}$ and supply voltage in series order is the same as the rated voltage.

$$\therefore \quad \frac{V^2}{P} = \frac{V^2}{P_1} + \frac{V^2}{P_2} + \frac{V^2}{P_3}$$

$$\text{or} \quad \frac{1}{P} = \frac{1}{60} + \frac{1}{60} + \frac{1}{60}$$

$$\text{or} \quad P = \frac{60}{3} = 20 \text{ W}$$

12. Equivalent resistance of n resistances each of r ohm in parallel is given by

$$\frac{1}{R} = \frac{1}{r} + \frac{1}{r} + \ldots\ldots\ldots + n \text{ times} = \frac{n}{r}$$

so, $\quad r = nR$

When these resistances are connected in series, effective resistance is

$R' = r + r + \ldots\ldots + n$ times $= nr$

$$\therefore \quad R' = n\,(nR) = n^2R$$

13. **Key Idea :** *Substitute the units for all the quantities involved in an expression written for permittivity of free space.*

By Coulomb's law, the electrostatic force

$$F = \frac{1}{4\pi\varepsilon_0} \times \frac{q_1 q_2}{r^2}$$

$$\Rightarrow \quad \varepsilon_0 = \frac{1}{4\pi} \times \frac{q_1 q_2}{r^2 F}$$

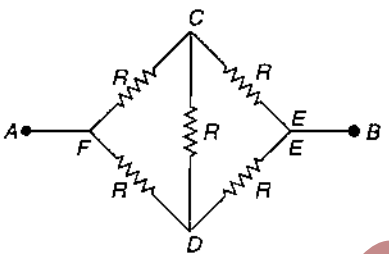
Substituting the units for q, r and F, we obtain unit of

$$\varepsilon_0 = \frac{\text{coulomb} \times \text{coulomb}}{\text{newton} - (\text{metre})^2} = \frac{(\text{coulomb})^2}{\text{newton} - (\text{metre})^2}$$

$$= C^2/\text{N-m}^2$$

14. The given circuit can be redrawn as shown.

From circuit,



$$\frac{FC}{CE} = \frac{FD}{DE} = 1$$

Thus, it is balanced Wheatstone's bridge, so resistance in arm CD is ineffective and so, current flows in this arm.

Net resistance of the circuit is

$$\frac{1}{R'} = \frac{1}{(R+R)} + \frac{1}{(R+R)}$$

$$= \frac{1}{2R} + \frac{1}{2R} = \frac{2}{2R} = \frac{1}{R}$$

$$\therefore \quad R' = R$$

So, net current drawn from the battery

$$i' = \frac{V}{R'} = \frac{V}{R}$$

As from symmetry, upper circuit $AFCEB$ is half of the whole circuit and is equal to $AFDEB$.

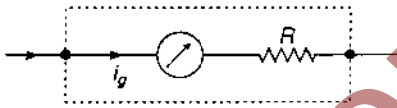
So, in both the halves half of the total current will flow.

Hence, in $AFCEB$, the current flowing is

$$i = \frac{i'}{2} = \frac{V}{2R}$$

15. To convert a galvanometer into voltmeter, high resistance should be connected in series with it. Let R is the resistance connected in series with the galvanometer.

Galvanometer current



$$i_g = \frac{V}{G+R}$$

or $$R = \frac{V}{i_g} - G$$

Given, $G = 50\,\Omega$,

$$i_g = 25 \times 4 \times 10^{-4} = 10^{-2}\text{ A}, V = 25\text{ V}$$

$$\therefore \quad R = \frac{25}{10^{-2}} - 50 = 2500 - 50 = 2450\,\Omega$$

16. Total current drawn from the battery

$$i = \frac{E}{R+r} = \frac{6}{100+0} = 0.06\text{ A}$$

Resistance of 50 cm wire is

$$R' = \frac{\rho l'}{A} = \left(\frac{\rho}{A}\right) l'$$

$$= \left(\frac{R}{l}\right) l' \qquad \left(\because R = \frac{\rho l}{A}\right)$$

$$= \frac{100}{300} \times 50$$

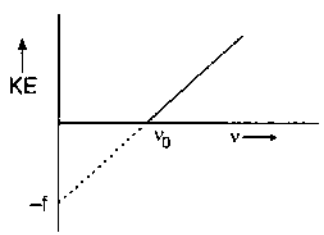
so, $$R' = \frac{50}{3}\,\Omega$$

Hence, the potential difference between two points on the wire separated by a distance l' is

$$V = iR' = 0.06 \times \frac{50}{3} = 1\text{ V}$$

17. **Key Idea :** *Compare the Einstein's photo-electric equation with the equation of straight line.*

Einstein's photoelectric equation is



$$KE = h\nu - \phi \qquad \text{...(i)}$$

where ϕ = work function of metal

Comparing above Eq. (i) with equation of a straight line

$$y = mx + c$$

we get $m = h,\ c = -\phi$

Therefore, if we draw a graph between kinetic energy and frequency, then a straight line cutting the frequency axis at ν_0 and giving an intercept of $(-\phi)$ on the kinetic energy axis, is obtained.

18. ${}_ZX^A$ has number of protons $= Z$

and number of neutrons $= A - Z$

where A is the total number of protons and neutrons *i.e.*, $A = Z + N$.

NOTE : The proton is nothing but the nucleus of hydrogen atom *i.e.*, a hydrogen atom from which the single orbital electron has been removed.

19. **Key Idea :** *Substitute the dimensions for the quantities involved in an expression written for gravitational constant.*

According to Newton's law of gravitation, the force of attraction between two masses m_1 and m_2 separated by a distance r is,

$$F = \frac{G\, m_1 m_2}{r^2} \quad \Rightarrow G = \frac{Fr^2}{m_1 m_2}$$

Substituting the dimensions for the quantities on the right hand side, we obtain

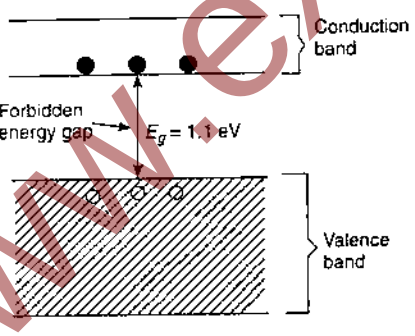
$$\text{dimensions of } G = \frac{[MLT^{-2}][L^2]}{[M^2]}$$

$$= [M^{-1} L^3 T^{-2}]$$

20. In a nuclear fusion, when two light nuclei of different masses are combined to form a stable nucleus, then some mass is lost and appears in the form of energy, called the mass defect. So, the mass of resultant nucleus is always less than the sum of masses of initial nuclei *i.e.*,

$$m_3 < (m_1 + m_2).$$

21. The energy band scheme of semiconductors is shown here.



In semiconductors, valence band and conduction band are separated by an energy gap called the forbidden energy gap. It is very small. At room temperature some electrons in valence band acquire thermal energy. This energy is more than forbidden energy gap E_g, thus they jump into the conduction band and leave their vacancy in the valence band which act as holes. Hence, at room temperature valence band is partially empty and conduction band is partially filled.

22. The output DC component

$$= \frac{\text{peak voltage}}{\pi} = \frac{10}{\pi}\text{ V}$$

23. **Key Idea :** *The kinetic energy of mass must be converted into energy stored in spring at the time mass strikes the spring.*

By the law of conservation of energy, kinetic energy of mass = energy stored in spring

i.e., $$\frac{1}{2} mv^2 = \frac{1}{2} kx^2$$

$$\therefore \quad x^2 = \frac{mv^2}{k}$$

$$\Rightarrow \quad x = \sqrt{\left(\frac{mv^2}{k}\right)}$$

$$\Rightarrow \quad x = \sqrt{\left(\frac{0.5 \times 1.5 \times 1.5}{50}\right)}$$

$$\therefore \quad = 0.15 \text{ m}$$

24. OR gate has two inputs A and B and a output Y. It follows a logic operation represented by '+'. Thus, its Boolean expression is

$$A + B = Y$$

The truth table of OR gate is

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

Thus, after observing its Boolean expression and its truth table, it is obvious that output of OR gate is 1 if either or both inputs are 1.

25. In a photoconductive cell, when monochromatic light is incident on the transparent metallic film, a force produced called the photo-electromotive, stimulates the

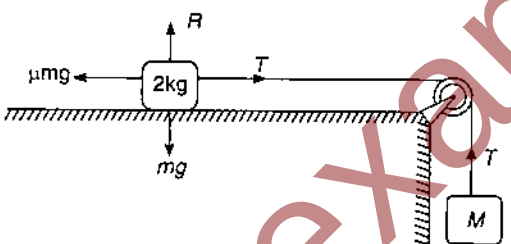
emission of an electric current when photovoltaic action creates a potential difference between two points. The magnitude of this current depends upon the intensity of incident light. Hence, photo-electromotive force produced by monochromatic light is proportional to the intensity of light falling on the cell.

26. According to Bohr's hypothesis, electron can revolve only in those orbits in which its angular momentum is an integral multiple of $\frac{h}{2\pi'}$ where h being the Planck's constant. In these orbits, angular momentum of electron can have magnitude as $\frac{h}{2\pi'}\frac{2h}{2\pi'}\frac{3h}{2\pi}$ ..... etc., but never as $\frac{1.5h}{2\pi'}, \frac{2.5h}{2\pi'}, \frac{3.5h}{2\pi}$ ..... etc.

This is called the quantisation of angular momentum.

27. **Key Idea :** *The tension in the string is equal to static frictional force between block A and the surface.*

Let the mass of the block B is M.



In equilibrium,

$$T - Mg = 0$$

$$\Rightarrow \quad T = Mg \qquad ...(i)$$

If blocks do not move, then

$$T = f_s$$

where f_s = frictional force $= \mu_s R = \mu_s\, mg$

$$\therefore \quad T = \mu_s\, mg \qquad ...(ii)$$

Thus, from Eqs. (i) and (ii), we have

$$Mg = \mu_s\, mg$$

or $\quad M = \mu_s\, m$

Given : $\mu_s = 0.2,\ m = 2$ kg

$$\therefore \quad M = 0.2 \times 2 = 0.4 \text{ kg}$$

28. In simple harmonic motion, the displacement equation is, $y = A \sin \omega t$

where A is amplitude of the motion.

Velocity, $\quad v = \frac{dy}{dt} = A\omega \cos \omega t$

$$v = A\omega \sqrt{1 - \sin^2 \omega t}$$

$$v = \omega \sqrt{A^2 - y^2} \qquad ...(i)$$

Acceleration, $a = \frac{dv}{dt} = \frac{d}{dt}(A\omega \cos \omega t)$

$$a = -A\omega^2 \sin \omega t$$

$$a = -\omega^2 y \qquad ...(ii)$$

When $\quad y = 0;\ v = A\omega = v_{max}$

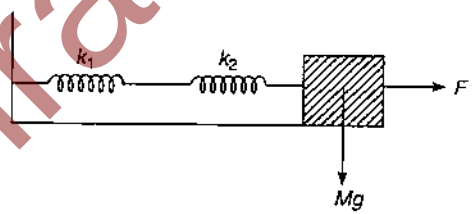
$$a = 0 = a_{min}$$

When $\quad y = A;\ v = 0 = v_{min}$

$$a = -\omega^2 A = a_{max}$$

Hence, it is clear that when v is maximum, then a is minimum (*i.e.*, zero) or *vice-versa*.

29. Let us consider two springs of spring constants k_1 and k_2 joined in series as shown in figure.



Under a force F, they will stretch by y_1 and y_2.

So, $\quad y = y_1 + y_2$

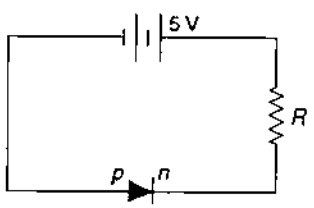
or $\quad \frac{F}{k} = \frac{F_1}{k_1} + \frac{F_2}{k_2}$

but as springs are massless, so force on them must be same *i.e.*, $F_1 = F_2 = F$.

So, $\quad \frac{1}{k} = \frac{1}{k_1} + \frac{1}{k_2} \quad$ or $\quad k = \frac{k_1 k_2}{k_1 + k_2}$

30. When a battery is connected to junction diode with p-side connected to negative terminal and n-side to the positive terminal, the junction diode is reverse biased.

The circuit shown in figure can be redrawn as



In the option (c), the p-end of the diode is connected to negative terminal of the battery, so the diode has been reverse biased.

31. Given : $I = 2\ \text{kg-m}^2$, $\omega_0 = \frac{60}{60} \times 2\pi$ rad/s,

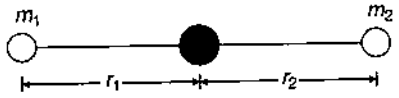
$\omega = 0$, $t = 60$ s

The torque required to stop the wheel's rotation is

$$\tau = I\alpha = I\left(\frac{\omega_0 - \omega}{t}\right)$$

$$\therefore \quad \tau = \frac{2 \times 2\pi \times 60}{60 \times 60} = \frac{\pi}{15}\ \text{N-m}$$

32. The system of two given particles of masses m_1 and m_2 are shown in figure.



Initially the centre of mass

$$r_{CM} = \frac{m_1 r_1 + m_2 r_2}{m_1 + m_2} \qquad ...(i)$$

When mass m_1 moves towards centre of mass by a distance d, then let mass m_2 moves a distance d' away from CM to keep the CM in its initial position.

So, $$r_{CM} = \frac{m_1 (r_1 - d) + m_2 (r_2 + d')}{m_1 + m_2} \qquad ...(ii)$$

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

$$\frac{m_1 r_1 + m_2 r_2}{m_1 + m_2} = \frac{m_1 (r_1 - d) + m_2 (r_2 + d')}{m_1 + m_2}$$

$$\Rightarrow \quad -m_1 d + m_2 d' = 0$$

$$\Rightarrow \quad d' = \frac{m_1}{m_2} d.$$

NOTE : If both the masses are equal *i.e.*, $m_1 = m_2$, then second mass will move a distance equal to the distance at which first mass is being displaced.

33. **Key Idea :** $\vec{A} \times \vec{B} = AB \sin\theta$

and $\vec{A} \cdot \vec{B} = AB \cos\theta$

Given, $|\vec{A} \times \vec{B}| = \sqrt{3}\, \vec{A} \cdot \vec{B}$ ...(i)

but $|\vec{A} \times \vec{B}| = |\vec{A}||\vec{B}| \sin\theta = AB \sin\theta$

and $\vec{A} \cdot \vec{B} = |\vec{A}||\vec{B}| \cos\theta = AB \cos\theta$

Make these substitution in Eq. (i), we get

$$AB \sin\theta = \sqrt{3}\, AB \cos\theta$$

or $$\tan\theta = \sqrt{3}$$

$$\therefore \quad \theta = 60°$$

The addition of vector $\vec{A}$ and $\vec{B}$ can be given by the law of parallelogram.

$$\therefore \quad |\vec{A} + \vec{B}| = \sqrt{A^2 + B^2 + 2AB \cos 60°}$$

$$= \sqrt{A^2 + B^2 + 2AB \times \frac{1}{2}}$$

$$= (A^2 + B^2 + AB)^{1/2}$$

34. When the sound is reflected from the cliff, it approaches the driver of the car. Therefore, the driver acts as an observer and both the source (car) and observer are moving.

Hence, apparent frequency heard by the observer (driver) is given by

$$f' = f\left(\frac{v + v_o}{v - v_s}\right) \qquad ...(i)$$

where v = velocity of sound,

v_o = velocity of car = v_s

Thus, Eq. (i) becomes

$$\therefore \quad 2f = f\left(\frac{v + v_o}{v - v_o}\right)$$

or $$2v - 2v_o = v + v_o$$

or $$3v_o = v$$

or $$v_o = \frac{v}{3}$$

35. In any medium other than air or vacuum, the velocities of different colours are different. Therefore, both red and green colours are refracted at different angles of refraction. Hence, after emerging from glass slab through opposite parallel face, they appear at two different points and move in the two different parallel directions.

36. **Key Idea :** *Acceleration due to gravity is the acceleration in vertically downward direction acting on every object on earth. Its value is given by Newton's second law which is*

$$g = \frac{F}{m}$$

The acceleration due to gravity on an object of mass m

$$g = \frac{F}{m}$$

but from Newton's law of gravitation

$$F = \frac{GMm}{R^2}$$

where M is the mass of the earth and R the radius of earth.

$$\therefore \quad g = \frac{GMm/R^2}{m} = \frac{GM}{R^2}$$

Given : $\rho_{planet} = 2\rho_{earth}$

Also, $g_{planet} = g_{earth}$

$$\frac{GM_p}{R_p^2} = \frac{GM_e}{R_e^2}$$

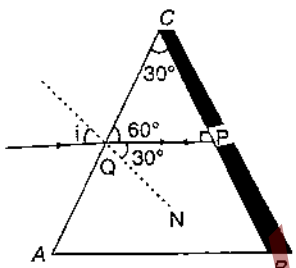
or $$\frac{G \times \frac{4}{3}\pi R_p^3 \rho_p}{R_p^2} = \frac{G \times \frac{4}{3}\pi R_e^3 \rho_e}{R_e^2}$$

or $$R_p \rho_p = R_e \rho_e$$

or $$R_p \times 2\rho_e = R_e \rho_e$$

or $$R_p = \frac{R_e}{2} = \frac{R}{2}$$

37. According to the given condition, the beam of light will retrace its path after reflection from BC. So



$$\angle CPQ = 90°$$

Thus, angle of refraction at surface AC

$$\angle PQN = \angle r = 90° - 60° = 30°$$

By Snell's law

$$\mu = \frac{\sin i}{\sin r}$$

$$\Rightarrow \quad \sqrt{2} = \frac{\sin i}{\sin 30°}$$

$$\therefore \quad \sqrt{2} \times \sin 30° = \sin i$$

$$\Rightarrow \quad \sqrt{2} \times \frac{1}{2} = \sin i$$

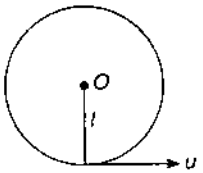
$$\Rightarrow \quad \sin i = \frac{1}{\sqrt{2}} = \sin 45°$$

$$\therefore \quad i = 45°$$

38. **Key Idea :** *When stone reaches a position where string is horizontal, it attains the energy partially as kinetic and partially as potential.*

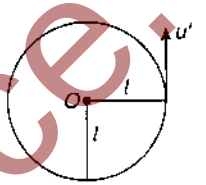
When stone is at its lowest position, it has only kinetic energy, given by

$$K = \frac{1}{2}mu^2$$



At the horizontal position, it has energy

$$E = U + K = \frac{1}{2}mu'^2 + mgl$$



According to conservation of energy,

$$K = E$$

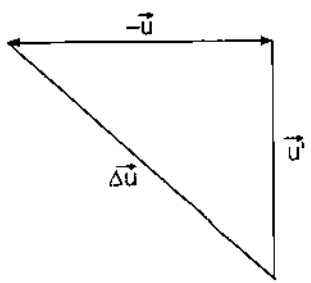
$$\therefore \quad \frac{1}{2}mu^2 = \frac{1}{2}mu'^2 + mgl$$

or $$\frac{1}{2}mu'^2 = \frac{1}{2}mu^2 - mgl$$

or $$u'^2 = u^2 - 2gl$$

or $$u' = \sqrt{u^2 - 2gl} \qquad ...(i)$$

So, the magnitude of change in velocity



$$|\Delta\vec{u}| = |\vec{u}| = \sqrt{u'^2 + u^2 + 2u'u\cos 90°}$$

$$|\Delta\vec{u}| = \sqrt{u'^2 + u^2}$$

$$= \sqrt{2(u^2 - gL)} \qquad \text{[from Eq. (1)]}$$

39. Kinetic energy is given by

$$E = \frac{1}{2}mv^2 = \frac{1}{2m}(mv)^2$$

but mv = momentum of the particle = p

$$\therefore \quad E = \frac{p^2}{2m} \quad \text{or} \quad p = \sqrt{2mE}$$

Therefore, $$\frac{p_1}{p_2} = \sqrt{\frac{m_1E_1}{m_2E_2}}$$

but it is given that, $p_1 = p_2$

$$\therefore \quad m_1E_1 = m_2E_2$$

or $$\frac{E_1}{E_2} = \frac{m_2}{m_1} \quad \ldots(i)$$

Now $m_1 > m_2$

or $$\frac{m_1}{m_2} > 1 \quad \ldots(ii)$$

Thus, Eqs. (i) and (ii) give

$$\frac{E_1}{E_2} < 1$$

or $$E_1 < E_2$$

40. **Key Idea :** *When bullet of mass m and charge q is accelerated through potential difference of V volt, then it attains a kinetic energy equal to qV.*

Kinetic energy of bullet = qV

i.e., $$\frac{1}{2}mv^2 = qV$$

$$\Rightarrow \quad V = \frac{mv^2}{2q}$$

Given, $m = 2g = 2 \times 10^{-3}$kg, $v = 10$ m/s,

$q = 2\mu C = 2 \times 10^{-6}$ C

Substituting the values in relation for V, we obtain

$$V = \frac{2 \times 10^{-3} \times (10)^2}{2 \times 2 \times 10^{-6}}$$

$$= 50 \times 10^3 \text{ V} = 50\text{kV}$$

41. Since, power rating of bulb in both the countries India and USA should be same, so

$$\frac{V_1^2}{R_1} = \frac{V_2^2}{R_2}$$

$$\Rightarrow \quad \frac{220 \times 220}{R_1} = \frac{110 \times 110}{R_2}$$

$$\Rightarrow \quad \frac{R_2}{R_1} = \frac{110 \times 110}{220 \times 220}$$

$$\Rightarrow \quad R_2 = \frac{R}{4} \qquad (\because R_1 = R)$$

42. **Key Idea :** *The charge passes through any point in the circuit is equal to the product of current flowing in the circuit and time interval.*

From Faraday's IInd law, emf induced in the circuit

$$e = \frac{\Delta\phi}{\Delta t}$$

If R is the resistance of the circuit, then

$$i = \frac{e}{R} = \frac{\Delta\phi}{R\,\Delta t}$$

Thus, charge passes through the circuit,

$$Q = i \times \Delta t$$

$$\Rightarrow \quad Q = \frac{\Delta\phi}{R\Delta t} \times \Delta t$$

$$\Rightarrow \quad Q = \frac{\Delta\phi}{R}$$

NOTE : The charge induced does not depend whether the flux change is slow or rapid. It depends only on the change in magnetic flux.

43. No. of moles $n = \dfrac{m}{\text{molecular weight}} = \dfrac{5}{32}$

So, from ideal gas equation

$$PV = nRT$$

$$\Rightarrow \quad PV = \frac{5}{32}RT$$

44. Amount of substance remained is

$$M = M_0\left(\frac{1}{2}\right)^n$$

Given, $M_0 = 100$ g, $M = 25$g, $T_{1/2} = 1600$ years

So, $$25 = 100\left(\frac{1}{2}\right)^n$$

or $$\frac{25}{100} = \left(\frac{1}{2}\right)^n$$

or $$\left(\frac{1}{2}\right)^2 = \left(\frac{1}{2}\right)^n$$

Comparing the power, we have

$$n = 2$$

or $$\frac{t}{T_{1/2}} = 2$$

or $$t = 2T_{1/2} = 2 \times 1600 = 3200 \text{ years}$$

45. Binding energy of a nucleus containing N neutrons and Z protons is

$$B = [NM_n + ZM_p - M(N, Z)]\,c^2$$

$$\Rightarrow \quad \frac{B}{c^2} = NM_n + ZM_p - M(N, Z)$$

$$\Rightarrow \quad M(N, Z) = NM_n + ZM_p - B/c^2$$

46. The given waves are

$$y_1 = 10^{-6} \sin [100t + (x/50) + 0.5] \text{ m}$$

and $$y_2 = 10^{-6} \cos[100t + (x/50)] \text{ m}$$

$$\Rightarrow \quad y_2 = 10^{-6} \sin \left[100t + (x/50) + \frac{\pi}{2}\right] \text{ m}$$

$$\left[\because \sin\left(\frac{\pi}{2} + \theta\right) = \cos\theta\right]$$

Hence, the phase difference between the waves is

$$\Delta\phi = \left(\frac{\pi}{2} - 0.5\right) \text{ rad}$$

$$= \left(\frac{3.14}{2} - 0.5\right) \text{ rad}$$

$$= (1.57 - 0.5) \text{ rad}$$

$$= (1.07) \text{ rad}$$

NOTE : The given waves are sine and cosine function, so they are plane progressive harmonic waves.

47. Resolving limit of telescope is

$$\theta \propto \frac{x}{D} = \frac{\lambda}{d}$$

$$\Rightarrow \quad x = \frac{\lambda D}{d}$$

Given, $\lambda = 5000 \text{ Å} = 5000 \times 10^{-10}$ m,

$D = 1$ km $= 1000$ m,

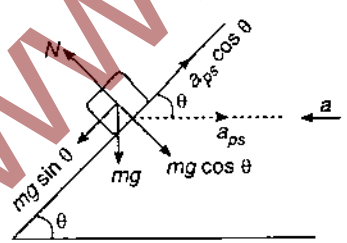
$d = 10$ cm $= 0.1$ m

Hence, $x = \dfrac{5000 \times 10^{-10} \times 1000}{0.1}$

$$= 5 \times 10^{-3} \text{ m}$$

$$= 5 \text{ mm}$$

48. Let an acceleration to the wedge is given towards left, then the block (being in non-inertial frame) has a pseudo acceleration to the right because of which the block is not slipping



$$\therefore \quad mg \sin\theta = a_{\text{pseudo}} \cos\theta$$

$$\Rightarrow \quad a_{\text{pseudo}} = \frac{mg \sin\theta}{\cos\theta}$$

Hence, total force exerted by the wedge on the block is

$$N = N_1 + N_2$$

$$= mg \cos\theta + a_{\text{pseudo}} \sin\theta$$

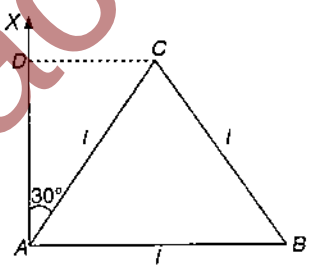
$$= mg \cos\theta + \frac{mg \sin\theta}{\cos\theta} \times \sin\theta$$

$$= \frac{mg \cos^2\theta + mg \sin^2\theta}{\cos\theta}$$

$$= \frac{mg}{\cos\theta}$$

NOTE : If the block is not given a horizontal acceleration i.e. the block is permanently at rest, the net force on it will be zero. Thus, in this case force exerted by the wedge on the block is mg (upwards).

49. Moment of inertia of the system about AX is given by

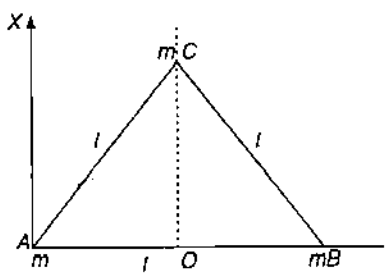


$$\text{MI} = m_A r_A^2 + m_B r_B^2 + m_C r_C^2$$

$$\text{MI} = m\,(0)^2 + m\,(l)^2 + m(l \sin 30°)^2$$

$$= ml^2 + \frac{ml^2}{4} = \frac{5}{4} ml^2$$

Alternative : Moment of inertia of a system about a line OC perpendicular to AB, in the plane of ABC is



$$I_{CO} = m \times 0 + m \times \left(\frac{l}{2}\right)^2 + m \times \left(\frac{l}{2}\right)^2$$

$$\therefore \quad I_{CO} = \frac{ml^2}{4} + \frac{ml^2}{4} = \frac{ml^2}{2}$$

According to parallel-axis theorem

$$I_{AX} = I_{CO} + Mx^2$$

where x = distance of AX from CO, M = total mass of system

$$I_{AX} = \frac{ml^2}{2} + 3m \times \left(\frac{l}{2}\right)^2$$

$$I_{AX} = \frac{ml^2}{2} + \frac{3ml^2}{4} = \frac{5}{4} ml^2$$

50. Given : $E_n = -\frac{13.6}{n^2}$ eV

Energy of photon ejected when electron jumps from $n = 3$ state to $n = 2$ state is given by

$$\Delta E = E_3 - E_2$$

$$\therefore \quad E_3 = -\frac{13.6}{(3)^2} \text{ eV} = -\frac{13.6}{9} \text{ eV}$$

$$E_2 = -\frac{13.6}{(2)^2} \text{ eV} = -\frac{13.6}{4} \text{ eV}$$

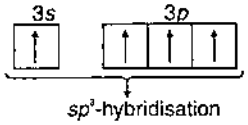
So, $\Delta E = E_3 - E_2 = -\frac{13.6}{9} - \left(-\frac{13.6}{4}\right)$

$= 1.9$ eV (approximately)

Chemistry

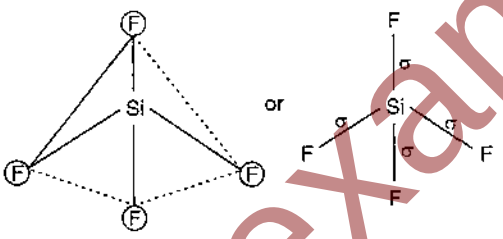
51. SiF_4 and SF_4 are not isostructural because SiF_4 is tetrahedral due to sp^3-hybridisation of Si.

$_{14}Si = 1s^2, 2s^2, 2p^6, 3s^2 3p^2$ (In ground state)



$_{14}Si = 1s^2, 2s^2 2p^6, 3s^1 3p^3$ (In excited state)

Hence, four equivalent sp^3-hybrid orbitals are obtained and they are overlapped by four p-orbitals of four fluorine atoms on their axes. Thus it shows following structure :



While SF_4 is not tetrahedral but it is distorted tetrahedral because in it S is sp^3d hybrid.

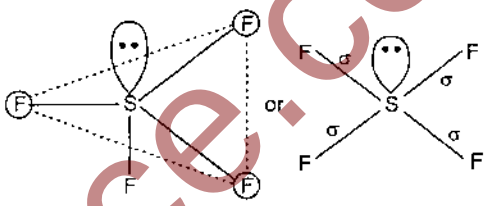
$_{16}S = 1s^2, 2s^2 2p^6, 3s^2 3p_x^2 3p_y^1 3p_z^1$

(In ground state)

$= 1s^2, 2s^2 2p^6, 3s^2 3p_x^1\ 3p_y^1\ 3p_z^1,\ 3d_{xy}^1$

sp^3d-hybridisation

(In first excitation state)



Hence, five sp^3d hybrid orbitals are obtained. One orbital is already paired and rest four are overlapped with four p-orbitals of four fluorine atoms on their axis in trigonal bipyramidal form.

This structure is distorted from trigonal bi-pyramidal to tetrahedral due to involvement of repulsion between lone pair and bond pair.

52. For the first order reaction

$$\text{Rate}\left(\frac{dx}{dt}\right) = k[A]$$

$[A]$ → concentration of reactant

k → rate constant

Given that

$$\frac{dx}{dt} = 1.5 \times 10^{-2} \text{ mol L}^{-1} \text{ min}^{-1}$$

$k = ?$ and $[A] = 0.5$ M

$$\therefore \quad 1.5 \times 10^{-2} = k \times 0.5$$

$$\therefore \quad k = \frac{1.5 \times 10^{-2}}{0.5} = 3 \times 10^{-2} \text{ min}^{-1}$$

For first order reaction

Half-life period $t_{1/2} = \frac{0.693}{k} = \frac{0.693}{3 \times 10^{-2}}$

$= 23.1$ min

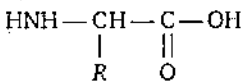
53. Freons or chlorofluoro carbons are responsible for depletion of the ozone layer in the upper strata of the atmosphere. They are used as propellants, aerosol spray caps, refrigerents, fire fighting reagents etc. They are stable and chemically inert compounds. They absorb UV-radiation and break down liberating free atomic chlorine which causes decomposition of ozone through free radical reaction. This results in the depletion of the ozone layer.

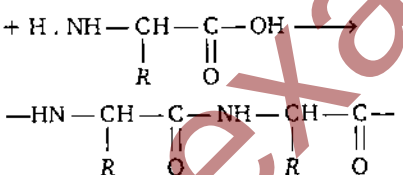
Freons are mainly Freon-1 ($CFCl_3$) and Freon-12 (CF_2Cl_2). They form free radical of chlorine in presence of UV-radiation. Such free radical decomposes O_3 as follows :

$$Cl^{\bullet} + O_3 \longrightarrow ClO^{\bullet} + O_2$$

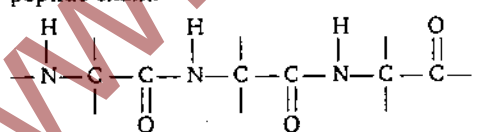
$$ClO^{\bullet} + O_3 \longrightarrow \underset{\text{Chlorine free radical}}{Cl^{\bullet}} + 2O_2$$

54. The peptide linkage (—NH — CO—) is formed by the condensation of amino acids molecules.

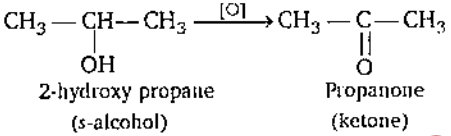




Hence, following structure represents the peptide chain.



55. 2-hydroxy propane or secondary alcohol is oxidised into propanone (corresponding cabonyl compound because in 2-hydroxy propane, secondary alcoholic group is present and it is oxidised into ketone).



2-hydroxy propane (*s*-alcohol) — Propanone (ketone)

56. The —OH group of alcohol or the —COOH group of a carboxylic acid is replaced by —Cl using phosphorus penta chloride (*i. e.*, PCl_5)

$$\underset{\text{Alcohol}}{ROH} + PCl_5 \longrightarrow RCl + POCl_3 + HCl$$

$$\underset{\text{Acid}}{RCOOH} + PCl_5 \longrightarrow RCOCl + POCl_3 + HCl$$

57. Reaction of HBr with propene in the presence of peroxide gives *n*-propyl bromide. This addition reaction is an example of Anti-Markownikoff addition reaction.

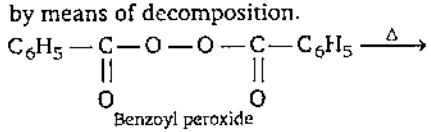
(*i.e.*, it is completed in form of free radical addition)

$$CH_3 - CH = CH_2 + HBr \xrightarrow{\text{Peroxide}} CH_3 - CH_2 - CH_2Br$$

n-propyl bromide

Mechanism of this reaction is represented as follows :

Step 1. Formation of free radical of peroxide by means of decomposition.



Benzoyl peroxide

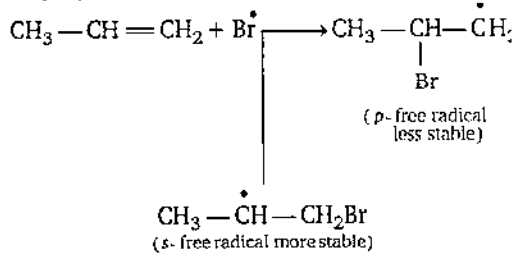
$$2C_6H_5 - \overset{\bullet}{C}OO$$

Benzoate free radical

Step 2. Benzoate free radical forms bromine free radical with HBr.

$$C_6H_5\overset{\bullet}{C}OO + HBr \longrightarrow C_6H_5COOH + \overset{\bullet}{Br}$$

Step 3. Bromine free radical attacks on C = C of propene to form intermediate free radical.



(p-free radical less stable)

(s-free radical more stable)

Hence, $CH_3-\dot{C}H-CH_2Br$ is the major product of this step.

Step 4. More stable free radical accept hydrogen free radical from benzoic acid and give final product of reaction.

$$CH_3-\dot{C}H-CH_2Br + C_6H_5COOH \longrightarrow$$

$$\underset{n\text{-propyl bromide}}{CH_3-CH_2-CH_2Br} + C_6H_5\dot{C}OO$$

Step 5. Benzoate free radicals are changed into benzoyl peroxide for the termination of free radical chain.

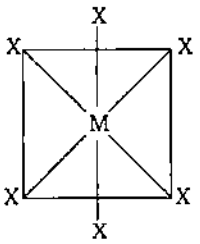
$$C_6H_5\dot{C}OO + C_6H_5\dot{C}OO \longrightarrow (C_6H_5CO)_2O_2$$

58. In reaction,

$$\overset{0}{H_2O} + \overset{0}{Br_2} \longrightarrow \overset{+1}{HO}\overset{-1}{Br} + \overset{-1}{H}Br$$

The oxidation number of bromine increases from 0 to + 1 and decreases from 0 to − 1, so due to this reason bromine is both oxidised as well as reduced in the above reaction.

59. In octahedral structure MX_6, the six hybrid orbitals (sp^3d^2) are directed towards the corners of a regular octahedral with an angle of 90°. According to following structure of MX_6, the number of $X-M-X$ bonds at 180° must be three.



60. Chloroform on reaction with nitric acid give chloropicrin (nitro chloroform) according to following reaction :

$$CHCl_3 + HNO_3 \longrightarrow \underset{\substack{\text{Nitrochloroform}\\(\text{chloropicrin})}}{C(NO_2)Cl_3} + H_2O$$

61. Aniline on diazotisation in cold (at 0° to 5° C) give benzene diazonium chloride.

$$C_6H_5NH_2 + NaNH_2 + 2HCl \xrightarrow[\text{Diazotization}]{0-5^\circ C} C_6H_5N{\equiv}NCl + NaCl + 2H_2O$$

Benzene diazonium chloride

This benzene diazonium chloride on coupling reaction with dimethyl aniline gives a coloured product *i.e.*, *p*–(N, N- dimethyl) amino azobenzene (azodye).

$$C_6H_5N{=}N{\cdot}Cl + H-C_6H_4-N(CH_3)_2 \xrightarrow{NaOH} C_6H_5-N{=}N-C_6H_4-N(CH_3)_2 + HCl$$

62. By Nernst equation,

$$E_{cell} = E^\circ_{cell} - \frac{2.303\,RT}{nF}\log_{10} K$$

At equilibrium $E_{cell} = 0$

Given that

$\therefore \quad R = 8.315\ JK^{-1}\ mol^{-1}$

$T = 25^\circ C + 273 = 298\ K$

$F = 96500\ C$ and $n = 2$

$$\therefore E^\circ_{cell} = \frac{2.303 \times 8.314 \times 298}{2 \times 96500}\log_{10} K$$

$$= \frac{0.0591}{2}\log_{10} K$$

$\because$ Given that $E^\circ_{cell} = 0.295\ V$

$$\therefore \quad 0.295 = \frac{0.0591}{2}\log_{10} K$$

$$\log_{10} K = \frac{0.295 \times 2}{0.0591} = 10$$

or antilog of $\log_{10} K$ = antilog 10

$$K = 1 \times 10^{10}$$

63. AX_2 is ionised as follows :

$$AX_2 \rightleftharpoons A^{2+} + 2X^-$$

S mol L^{-1} $\quad S \quad 2S$

Solubility product of AX_2

$$(K_{sp}) = [A^{2+}][X^-]^2 = S \times (2S)^2 = 4S^3$$

$\because \quad K_{sp}$ of $AX_2 = 3.2 \times 10^{-11}$

$$\therefore \quad 3.2 \times 10^{-11} = 4S^3$$

$$S^3 = 0.8 \times 10^{-11} = 8 \times 10^{-12}$$

Solubility $= 2 \times 10^{-4}$ mol/L

64. A binary compound is that compound which is formed by two different elements. Metals or elements which shows variable oxidation states can form more than one binary compound. In the given compound 'Fe' shows +2 and +3 oxidation states. So, it can form two binary compounds with chlorine as $FeCl_2$ and $FeCl_3$.

65. Zeolites are aluminosilicates having three dimensional open structure in which four or six membered rings predominates. Thus, due to open chain structure, they have cavities and can take up water and other small molecules.

66. An organic compound form yellow precipitate of iodoform with I_2 in presence of alkali, if it has CH_3CO group directly or it has $CH_3-\underset{\underset{OH}{|}}{\overset{\overset{H}{|}}{C}}-$ group

(a) $CH_3CH(OH)CH_3 + I_2 \xrightarrow{NaOH} CH_3COCH_3 + 2HI + 3NaI + CH_3COONa + 3H_2O$

$CH_3COCH_3 + 3I_2 + 4NaOH \longrightarrow \underset{\text{yellow ppt.}}{CHI_3\downarrow} + 3NaI + CH_3COONa + 3H_2O$

(b) $CH_3-CH_2CH(OH)\,CH_3 + I_2 \longrightarrow CH_3-CH_2-\underset{\underset{O}{\|}}{C}-CH_3 + 2HI$

Ethyl methyl kerone

It gives iodoform test.

$CH_3CH_2-\underset{\underset{O}{\|}}{C}-CH_3 + 3I_2 + 4NaOH \rightarrow \underset{\text{Yellow ppt.}}{CHI_3\downarrow} + 3NaI + CH_3CH_2COONa + 3H_2O$

(c) $CH_3OH + I_2 \longrightarrow HCHO + 2HI$

It does not have methyl ketonic group, so it does not give yellow ppt. with I_2 in presence of alkali.

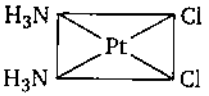
(d) $CH_3CH_2OH + I_2 \longrightarrow CH_3-\underset{\underset{O}{\|}}{C}-H + 2HI$

It gives iodoform test.

$CH_3-\underset{\underset{O}{\|}}{C}-H + 3I_2 + 4NaOH \longrightarrow \underset{\text{yellow ppt.}}{CHI_3} + HCOONa + 3NaI + 2H_2O$

67. A sequence of three nucleotides in messenger RNA makes a codon for an amino acid because four bases in messenger RNA adenine, cytosine, guanine and uracil have been shown to act in the form of triplet.

68. (c.) is isomer of $[Pt(NH_3)_2Cl_2]$ which is used as an anticancer drug for treating several types of malignant tumours.



(*cis*-platin)

69. Insulin hormone helps in the conversion of glucose into glycogen by the liver and skeletal muscle. Insulin is secreted by pancreas that lower blood glucose level.

70. For reaction

$H_2(g) + Br_2(g) \longrightarrow 2HBr(g)\ \Delta H^\circ = ?$

On the basis of bond energies of H_2, Br_2 and HBr, ΔH of above is calculated as follows :

$\Delta H = -[2 \times$ bond energy of HBr $-$ (bond energy of H_2 + bond energy of Cl_2)]

$\Delta H = -[2 \times (364) - (433) + 192]$ kJ

$= -[728 - (625)]$ kJ $= -103$ kJ

71. In unit cell, *X*-atoms at the corners

$= \frac{1}{8} \times 8 = 1$

Y-atoms at the face centres $= \frac{1}{2} \times 6 = 3$

Ratio of *X* and *Y* = 1 : 3.

Hence, formula is XY_3.

72. For the oxidation of ammonia at 298 K the standard enthalpy change (ΔH) and standard entropy change (ΔS) are -382.64 kJ mol^{-1} and -145.6 JK^{-1} mol^{-1} respectively. The relation- ship of Gibbs free energy (ΔG) with ΔH and ΔS is represented in form of following equation. $\Delta G = \Delta H - T \cdot \Delta S$

Given that

$\Delta H = -382.64$ kJ mol^{-1}

$\Delta S = -145.6$ J K^{-1} mol^{-1}

$= -145.6 \times 10^{-3}$ kJ K^{-1}

or $\Delta G = -382.64 - (298 \times -145.6 \times 10^{-3})$

$= -339.3$ kJ mol^{-1}

73. In 15 L of H_2 gas at STP, the number of molecules

$= \frac{6.023 \times 10^{23}}{22.4} \times 15$

$= 4.033 \times 10^{23}$

$$= \frac{6.023 \times 10^{23} \times 5}{22.4} = 1.344 \times 10^{23}$$

In 0.5g of H_2 gas $= \frac{6.023 \times 10^{23} \times 0.5}{2}$

$= 1.505 \times 10^{23}$

In 10g of O_2 gas $= \frac{6.023 \times 10^{23}}{32} = 1.882 \times 10^{23}$

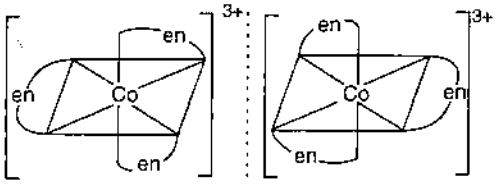
Hence, maximum molecules are present in 15 L of H_2 at STP.

74. $_{28}Ni^{60} + {}_0n^1 \underset{(n)}{\longrightarrow} {}_{27}Co^{60} + {}_1H^1 \underset{(p)}{}$

(n, p means that neutron attacks and proton liberates)

75.
$$\begin{array}{l} CH_2OOCR \\ | \\ CHOOCR \\ | \\ CH_2OOCR \end{array} + 3H_2O \xrightarrow[\text{Hydrolysis}]{\text{Lipase}} \begin{array}{l} CH_2OH \\ | \\ CHOH \\ | \\ CH_2OH \\ \text{Glycerol} \end{array} + \underset{\text{Fatty acid}}{RCOOH}$$

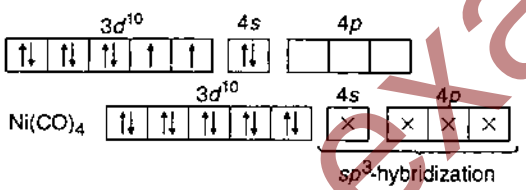
76. Tris-(ethylenediamine) cobalt (III) bromide ($[Co(en)_3]Br_3$) exhibits optical isomerism :



d-form Mirror *l*-form

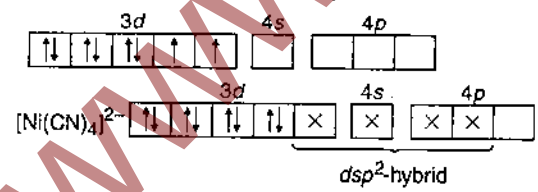
77. (I) In $Ni(CO)_4$, nickel is sp^3-hybrid because in it oxidation state of Ni is zero. So configuration of

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



(II) In $[Ni(CN)_4]^{2-}$, nickel is present as Ni^{2+}, so its configuration

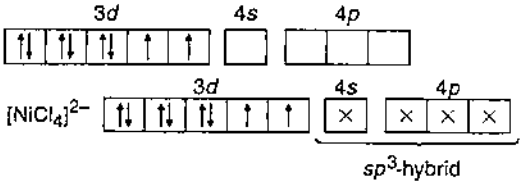
$= 1s^2, 2s^2 2p^6, 3s^2 3p^6\ 3d^8$



CN^- is strong field ligand, hence it makes Ni^{2+} electrons to be paired up.

(III) In $[NiCl_4]^{2-}$ species, nickel is present as Ni^{2+}, so its configuration

$= 1s^2, 2s^2 2p^6, 3s^2 3p^6, 3d^8$



Cl^- is weak field ligand, hence Ni^{2+} electrons are not paired.

78. $Ti^{2+} = 1s^2\ 2s^2 2p^6, 3s^2 3p^6 3d^2, 4s^0$

$V^{3+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6, 3d^2\ 4s^0$

$Cr^{4+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^2, 4s^0$

$Mn^{5+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^2, 4s^0$

79. Acid indicators are generally weak acid. The dissociation of indicator HIn takes place as follows :

$$HIn \rightleftharpoons H^+ + In^-$$

$$\therefore \quad K_{In} = \frac{[H^+]\,[In^-]}{[HIn]}$$

or $$[H^+] = K_{In} \cdot \frac{[HIn]}{[In^-]}$$

$$pH = -\log [H^+]$$

$$= -\log\left(K_{In} \cdot \frac{[HIn]}{[In^-]}\right)$$

$$= -\log K_{In} + \log \frac{[In^-]}{[HIn]}$$

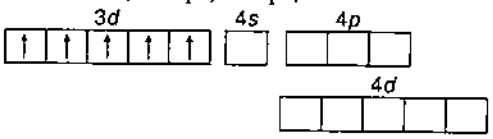
$$= pK_{In} + \log \frac{[In^-]}{[HIn]}$$

or $$\log \frac{[In^-]}{[HIn]} = pH - pK_{In}$$

80. CN^- is strong field ligand because it is an example of pseudohalide. Pseudohalide ions are stronger coordinating ligands and they have the ability to form σ bond and π bond.

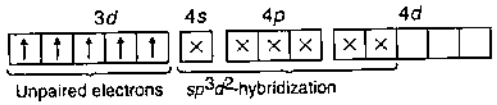
81. In $[Mn(H_2O)_6]^{2+}$, Mn is present as Mn^{2+} or Mn (II), so its electronic configuration

$= 1s^2, 2s^2 2p^6, 3s^2 3p^6, 3d^5$



In $[Mn(H_2O)_6]^{2+}$ the co-ordination number of Mn is six, but in presence of weak ligand field, there will be no pairing of electrons in 3d. So it will form high spin complex due to presence of five unpaired electron.

In $[Mn(H_2O)_6]^{2+}$



82. For spontaneous process, ΔS must be positive. In reversible process

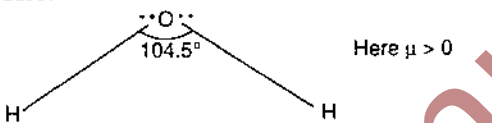
$$\Delta S_{system} + \Delta S_{surrounding} = 0$$

Hence, system is present in equilibrium.
(*i.e.*, it is not spontaneous process)
While in irreversible process

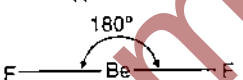
$$\Delta S_{system} + \Delta S_{surrounding} > 0$$

Hence, in the process ΔS is positive.

83. The structure of H_2O is angular V-shape and has sp^3-hybridisation and bond angle is 105°. Its dipole moment value is positive or more than zero.



but in BeF_2, structure is linear due to sp-hybridisation ($\mu = 0$)

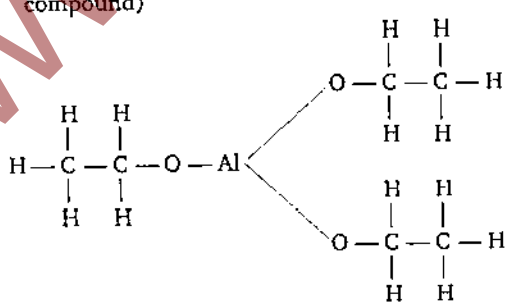


Thus, due to $\mu > 0$, H_2O is dipolar and due to $\mu = 0$, BeF_2 is non-polar.

84. Ionic radii $\propto \frac{1}{Z_{eff}}$

Z_{eff} →Effective nuclear charge
This Z_{eff} is calculated as follows :
$Z_{eff} = Z$ – screening constant (σ)
This value of screening constant is based upon the number of electrons in valence shell as well as in penultimate shells.

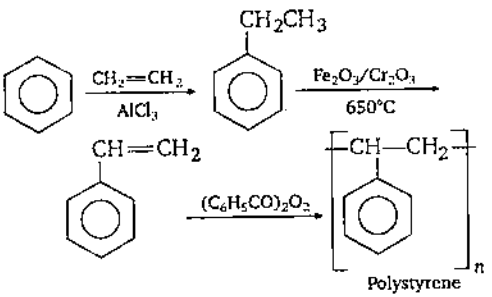
85. $Al(OC_2H_5)_3$ does not have metal-carbon bond (*i.e.*, it is not an example of organometallic compound)



86. Lanthanides are the 14 elements of IIIB group and sixth period (At. no. = 58 to 71) that are filling $4f$ sub-shell of antipenultimate shell from 1 to 14. Actually, they are placed below the periodic table in horizontal row as lanthanide series.

87. Sodium acetate forms cationic micells above a certain concentration. In the molecule of detergents and soap, the negative ions aggregate to form a micelle of colloidal size. In polar medium (like water), the negative ion has a long hydrocarbon chain and a polar group ($—COO^-$) at one end and on other end, it has Na^+ ions, thus cationic micelle is formed.

88. Chain growth polymerisation requires an initiator (such as organic peroxides) to produce a free radical to which the monomers are added in a chain fashion. Initiators are added in a very small quantities and are decomposed by heat, light or oxidation-reduction reaction to produce reactive species, *e.g.*, free radical.
Polystyrene is an example of chain growth polymer because in it styrene molecules are associated in the form of monomer.



89. Haemoglobin acts as oxygen carrier in the blood because four Fe^{2+} ions of each haemoglobin can bind with four molecules of O_2 and form oxyhaemoglobin.

$$4Hb + 4O_2 \longrightarrow \underset{\text{Oxy-haemoglobin}}{Hb_4O_8}$$

90. Ionisation energy of H = 2.18×10^{-18} J atom^{-1}
$\therefore E_1$ (Energy of Ist orbit of H–atom)
$= -2.18 \times 10^{-18}$ J · atom^{-1}

$$\therefore E_n = \frac{-2.18 \times 10^{-18}}{n^2} \text{ J} \cdot \text{atom}^{-1}$$

$Z = 1$ for H-atom
$\Delta E = E_4 - E_1$

$$= \frac{-2.18\times10^{-18}}{4^2} - \frac{-2.18\times10^{-18}}{1^2}$$

$$= -2.18\times10^{-18}\times\left[\frac{1}{4^2}-\frac{1}{1^2}\right]$$

$$\Delta E = h\nu = -2.18\times10^{-18}\times-\frac{15}{16}$$

$$= +2.0437\times10^{-18}\ \text{J atom}^{-1}$$

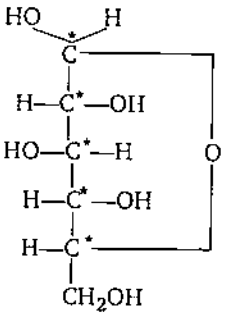
$$\therefore\ \nu = \frac{\Delta E}{h} = \frac{2.0437\times10^{-18}\ \text{J atom}^{-1}}{6.625\times10^{-34}\ \text{J s}}$$

$$= 3.084\times10^{15}\ \text{s}^{-1}\ \text{atom}^{-1}$$

91. Camphor is used in molecular mass determination due to volatile nature. The method is called Rast's camphor method. Camphor acts as a solid solvent which is volatile, hence can be removed easily.

92. In the formation of d^2sp^3 hybrid orbitals, two $(n-1)d$ orbitals of e_g set *i.e.*, $(n-1)\,d_{z^2}$ and $(n-1)\,d_{x^2-y^2}$ orbitals, one ns and three np (np_x, np_y and np_z) orbitals combine together and form six d^2sp^3 hybrid orbitals.

93. The number of chiral carbon atoms in β – *D*(+) glucose are five.



C* ⟶ Chiral (Asymmetric Carbon atom)

94. The helical structure of protein is stabilized by hydrogen bonds between amide group of the same peptide chain. These bonds are formed by – NH — group of one unit and oxygen of carbonyl group of the third unit. This H—bonding is responsible for holding helix in a position.

95. Chlorine of vinyl chloride ($CH_2=CHCl$) is non-reactive (less reactive) towards nucleophile in nucleophilic substitution reaction because it shows the following resonating structure due to +*M* effect of –Cl atom.

$$CH_2=CH-\ddot{\underset{\cdot\cdot}{Cl}}: \longleftrightarrow \overset{\delta-}{C}H_2-CH=\overset{\delta+}{Cl}$$

I II

In structure II, Cl-atom have positive charge and partial double bond character with C of vinyl group, so it is more tightly attracted towards the nucleus and it does not get replaced by nucleophile in S_N reaction.

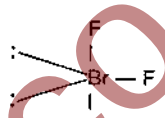
96. Work done $(W) = -P_{ext}\,(V_2 - V_1)$

$= -3\times(6-4) = -6$ L-atm

$= -6\times101.32$ J (∵ 1 L-atm = 101.32 J)

$= -607.92 \approx 608$ J

97. In BrF_3 molecule, Br is sp^3d hybrid, but geometry is *T*-shaped due to distortion of geometry from trigonal-bipyramidal to *T*-shaped by the involvement of lone pair-lone pair repulsion. Here

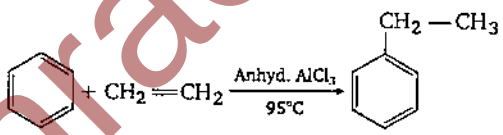


lp – lp repulsion = 0

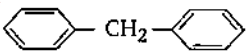
lp – bp repulsion = 4

bp – bp repulsion = 2

98. By the reaction of benzene with ethylene in presence of anhydrous, $AlCl_3$, ethylbenzene is produced.



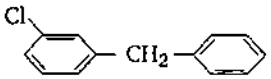
99. The molecular formula of diphenyl methane shows four isomers in form of mono chloro derivatives.

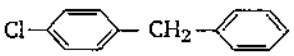


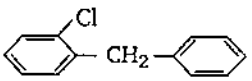
(Diphenyl methane)

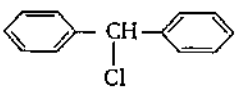
$C_{13}H_{12}$

Mono chloro derivatives

(i) 

(ii) 

(iii) 

(iv) 

100. Compound 'X' is-$CaCO_3$.

$$\underset{\text{'X'}}{CaCO_3} \xrightarrow{\Delta} \underset{\text{Residue}}{CaO} + CO_2\uparrow$$

$$\underset{\text{Residue}}{CaO} + H_2O \longrightarrow \underset{\text{'Y'}}{Ca(OH)_2}$$

$$\underset{\text{'Y'}}{Ca(OH)_2} + \underset{\text{Excess}}{CO_2} + H_2O \longrightarrow \underset{\text{'Z'}}{Ca(HCO_3)_2}$$

$$Ca(HCO_3)_2 \xrightarrow{\Delta} \underset{\text{'X'}}{CaCO_3} + H_2O + CO_2\uparrow$$

Biology

101. It is the female reproductive cell which usually carries more cytoplasm and cytoplasmic organelles than the male cell and hence, naturally would be expected to influence non-Mendelian traits. Since in the present case the male parent (not female) had mutation in mitochondria, there are neglible chances of the mutation being inherited.

102. Fresh water protozoans live in hypotonic solution so, for regulation of excess of water which comes in the protoplasm through the process of endosmosis, contractile vacuoles have developed. When these protozoans are placed in marine water *i.e.*, hypertonic water, the contractile vacuoles become disappear because the process of endosmosis does not happen and thus, water does not come in the protoplasm.

103. Homeothermy is found in birds also, similarly four chambered heart and rib cage is also characterised by other classes apart from mammals. But presence of diaphragm is a very unique feature of mammals which separates thoracic cavity from interior abdominal cavity.

104. Hormones are chemical messengers that are released into the blood stream and have a specific effect on body functions or on the other structures within the body.

Chemically hormones are of different nature like protein hormones (hypothalmic hormones), steroids (sex hormones) and biogenic amines (like thyroxin hormone).

105. When CO_2 concentration in blood increases breathing becomes faster and deeper. The effect of increased CO_2 is to decrease the affinity of haemoglobin for O_2. Thus due to Bohr's effect the CO_2 released in respiring tissue accelerates the delivery of oxygen by faster and deeper breathing.

106. Option (d) is not correctly matched because pellagra is a deficient disorder of vitamin B_5 (Niacin).

107. The animals which excrete mainly uric acid are uricotelic, and this phenomenon is called uricotelism. Uric acid is excreted by terrestrial reptiles (lizard, snakes etc.,) birds and insects to conserve water in their body.

Frog, mammals excrete urea and so they are called as ureotelic animals and this phenomenon is known as ureotelism.

108. Brunner's gland secrete large amount of mucus and bicarbonates to protect duodenal mucosa and to neutralize the acidic chyme. It also secretes two hormones :

(a) Secretin

(b) Cholecystokinin (CCK)

These stimulate—

(i) Secretion of pancreatic juice by pancreas.

(ii) Release of bile from gall bladder.

(iii) Formation of bile by liver and pancreatic juice.

109. Mast cells are granulated wandering leucocyte cells. Their granules contain histamine which is vasodilator and heparin (anticoagulant). These take part in body defence and allergic reaction.

110. Malignant cancer is caused by loss of control over cell's reproduction capacity. Therefore, they are more easily damaged by radiations than normal cells.

111. Developing countries show expanding population pyramid with maximum age distribution in pre-reproductive phase *i. e.*, a very young age distribution, high fertility and low mortality rate.

112. During muscular contraction myosin cross bridges heads. Myosin is not only an actin binding protein. It is also an ATPase (an enzyme) which is activated by Ca^{2+} and Mg^{2+} ions. Hence, ATPase enzyme is located in myosin.

113. Leishmaniasis or kala-azar is caused by *Leishmania donovani*. It is spread by sand fly. It is also known as dum-dum fever.

114. *Serratia* is a harmful human pathogen which has been known to cause urinary tract infections, wound infections, pneumonia. Hence, the uncorrectly matched option is (b).

115. Gobar gas consists of 50-70% CH_4 (Methane), 30-40% CO_2 and traces of hydrogen, nitrogen and H_2S.

116. *Anabaena* is a free living nitrogen fixing cyanobacterium which can form symbiotic association with water fern *Azolla*.

117.

Blood groups	Antigen on RBC	Antibodies in serum
A	A	anti b
B	B	anti a
AB	A & B	—
O	—	anti a & anti b

Hence, blood group AB has no antibodies in serum.

118. Ovulation occurs under the influence of LH and FSH of anterior pituitary gland.

Disease		Deficiency
Diabetes mellitus	—	Insulin
Tetany	—	Parathormone
Diabetes insipidus	—	ADH

119. Angiosperms are well adapted to terrestrial life and occur in diverse habitats like cold tundra to hot tropical and even desert areas. They also thrive well in aquatic habitat. Hence, they being the most successful to have dominated the land flora.

120. In case of transition, purine base is replaced by another purine (*e. g.*, A $\rightleftharpoons$ G and pyrimidine is replaced by another pyrimidine (*e. g.*, C $\rightleftharpoons$ T) and *vice-versa*. In case of transversion purine is replaced by a pyrimidine and *vice-versa*.

121. In hemianatropous type, the ovule becomes curved and nucellus and embryo sac lies at right angles to the funicle *e. g.*, Ranunculaceae while in campylotropous, the micropyle is directed forwards chalaza. Chalaza lies at right angle to funicle.

e. g., Leguminosae.

Fig : Anatropous type of ovule

122. Ovulation takes place under the influence of LH and FSH. It normally takes place at the end of proliferative *i.e.*, 14th day or mid way during menstrual cycle. The LH surge stimulates completion of reduction division of oocyte. Following ovulation, the Graffian follicle changes to corpus luteum.

123. Vagus nerve is a mixed cranial nerve, controlling much of the gut, ventilatory system and heart. It does not affect tongue movements. Tongue movement is controlled by glossopharyngial nerve.

124. Prolactin is secreted by anterior pituitary gland which stimulates mammary gland development during pregnancy and lactation after child birth. Placenta is a connection between the uterine wall of mother and their foetus. It helps in exchange of material between these two. Placenta secretes human chorionic gonadotropin, estrogen and progesterone.

125. Clotting of collected blood can be prevented by coating the test tubes with silicon or adding chelating agents. Citrate, oxalate-heparin and EDTA are anti-co agulants.

126. The pace maker creates the rhythmical impulse normally made by SA (sinuatrial) node. Hence, it is implanted at the site of SA node to mimic the action and to regulate the heart beat. SA node is found in the upper part of the right atrium of the heart. It is a specialized bundle of neurons (nerve cells).

127. Carbon monoxide forms a stable compound with haemoglobin called **carboxy haemoglobin** as affinity of Hb for CO is 210 times greater than its affinity for O_2. In this form haemoglobin does not carry oxygen resulting in death too.

$$\underset{\text{haemoglobin}}{Hb} + CO \rightleftharpoons \underset{\text{carboxy haemoglobin}}{Hb\,CO}$$

128. Species having much greater influence on community characteristics, relative to their low abundance or biomass are keystone species, removal of these cause serious disruption in functioning of community *e.g.*, In tropical forests, figs are keystone species.

129. Important for DNA finger printing are short nucleotide repeat that vary in number from person to person but are inherited. These are Variable Number Tandem Repeats or VNTRs and these can be recognized only through molecular analysis of DNA samples. **Alec Jeffreys** (1985, 86) discovered this technique for the first time.

130. Flagella of prokaryotic and eukaryotic species differ in micro-tubular organization and type of movement. In eukaryotes the arrangement is (9 + 2) and specialized while in prokaryotes arrangement is (9 + 0) and is simple.

131. Tyrosinase is a copper containing oxidase which is widely distributed in plants, animals including human. It oxidizes tyrosine to melanin in mammal and causes the cut surfaces of many fruits and vegetables to darken.

132. Echinoderms are triploblastic animals with organ system level of organization. Larval forms possess bilateral symmetry while adults have radial symmetry.

133. An arthropod body consists of head, thorax and abdomen, in some cases head and thorax may be fused to form cephalothorax, class Insecta have body divided into head, thorax and abdomen.

134. Fat soluble vitamins are A, D, E and K. Deficiency of vitamin A leads to night blindness or nyctalopia because vitamin A is essential for synthesis of visual pigments (rhodopsin).

135. W. Bateson (1905) explained the lack of independent assortment in sweet pea and T.H. Morgan (1910) in *Drosophila* due to linkage. When genes closely present adhere or link together in a group and transmitted as a single unit, the phenomenon is called linkage. It stops the process of independent assortment. Incomplete linkage is broken down due to the crossing over.

136. Biosphere reserve is an *in situ* conservation method. Hence, it is the most effective way among the four above for preserving genetic diversity by protecting wild population traditional life style and domesticated plant genetic resource.

137. The rate of total capture of energy or the rate of total production of organic material is gross primary productivity while the balance or biomass remaining after meeting the cost of respiration of producers is net primary productivity. Hence, gross productivity has highest value in grassland ecosystem.

138. Bhopal gas tragedy occurred **(3 Dec 1984)** when MIC (Methyl Isocyanate) reacted with water in a tank, an exothermic chemical reaction started and producing a lot of heat. As a result, the safety valve of tank burst because of increase in pressure. It gave rise to a heavy gas which rapidly rank to the ground.

139. The enzyme nitrogenase is required for the process of biological nitrogen fixation only. Fixation of atmospheric nitrogen occur through other route also. Neither nitrification (conversion of ammonium to nitrate) nor conversion of nitrate to nitrite require nitrogenase.

140. Electron Spin Resonance (ESR) measures number of charges occupying deep traps in crystal band gap. The basic principle of ESR is same as those for luminescence *i. e.*, electrons become trapped and stored as a result of ionising radiations *e.g.*, Dating of tooth enamel.

141. The concentration of lead in blood averages about 25 µg / 100ml. Increase to 70 µg / 100ml is generally associated with clinical symptoms. Hence, a level of 30 µg / 100ml is considered alarming. The chief sources of Pb in water are the effluents of lead and lead processing industries.

142. Chimpanzee is more closely related to man than other hominoids. It is evidenced by chromosome banding pattern, DNA extracted from sex chromosomes, autosomes and mitochondria. Molecular clock based on mitochondrial DNA are used to date recent events because this DNA mutates 5-10 times faster than nuclear DNA. Some similarities between human and chimpanzee are :

A. DNA matching shows human similarity with chimpanzee.
B. There is little difference in banding pattern in chromosomes 3 and 6 in human and chimpanzee.
C. Serum test indicate maximum homology between human and chimpanzee.

143. Anthesis is the opening of floral buds. Reception of pollen by stigma is called pollination. Formation of pollen is called micro-sporogenesis.

144. The condition shows that the plant require photoperiod shorter than the critical day length. This plant needs uninterrupted dark period for flowering. Therefore, it is a short day plant and these do not flower if the dark period is interrupted with flashes of light.

145. Black soil is dark or dark brown in colour. It is formed from basaltic rock under semi-arid condition. Black soil logically known as **regur** or black cotton soil.
Black soil is deficient in nitrogen and phosphorus and rich in potash and lime and not in calcium carbonate.

146. According to union petroleum minister, 5% of alcohol (ethanol) will be mixed in petrol for meeting energy needs.

147. In a longitudinal section of a root, starting from the tip upward the four zones occur in the following order :
Root cap → Zone of cell division → Zone of Cell enlargement → Zone of cell maturation

148. According to **biogenetic law of Ernst Haeckel (1866) ontogeny repeats phylogeny**. Ontogeny is the life history of an organism while phylogeny is the evolutionary history of the race of that organism. In other words we can say an organism repeats its ancestral history during its development. Hence, resemblance of Amphibia to fish is seen in most systems of the body both are cold blooded, both respire by gills (as tadpole of frog), both usually lay eggs in water leading to the conclusion that amphibians have originated from fishes.

149. Stability is the power of a system to be in their state against unfavourable factor. Resilience is the capability of regaining its original shape or position after being deformed. Hence, it has low stability and high resilience.

150. The formation of *m*-RNA from DNA is termed as transcription. This process takes place in the nucleus (eukaryotes) or in the cytoplasm (prokaryotes). The base sequence of *m*-RNA is complementary copy of the template DNA strand. If DNA has **ATACG** nucleotide sequence then the *m*-RNA would contain UAUGC nucleotide sequence.

151. Extranuclear or extra chromosomal or cytoplasmic or organellar inheritance is a consequence of presence of genes in mitochondrial and chloroplast DNA. Extra-chromosomal units functions either independently or in collaboration with nuclear genetic system.

152. Epinephrine is synthesized from amino acid tyrosine. While estrogen and progesterone are modified steroids and prostaglandins are basically fat.

153. When bacteriophage infects a bacterium, it entirely depends on the host for its multiplication. It utilizes the host machinery for replication and produce a large number of progeny (phage particles). The bacterium cell undergoes lysis and dies to liberate a large number of these phage particles which are each ready to start another cycle by infecting new bacterial cell. This cycle is known as lytic cycle.

154. The recessive genes located on X-chromosome in humans are always expressed in males because a female may be homozygous or heterozygous while male is always hemizygous (*i.e.*, only one allele is present). As Haemophilia, colourblindness are some human diseases which are frequently found in males.

155. In C_3 plants the first stable product formed during dark reaction is 3-phosphoglyceric acid. Since it is a 3- carbon compound hence, the pathway is referred as C_3 pathway. Oxaloacetic acid (OAA) is the first stable compound in C_4 plants. It is a 4C compound.

156. The process of crossing over takes place in pachytene stage of prophase I of meiosis I. In this process some genes of two non sister chromatids of a bivalent are exchanged.

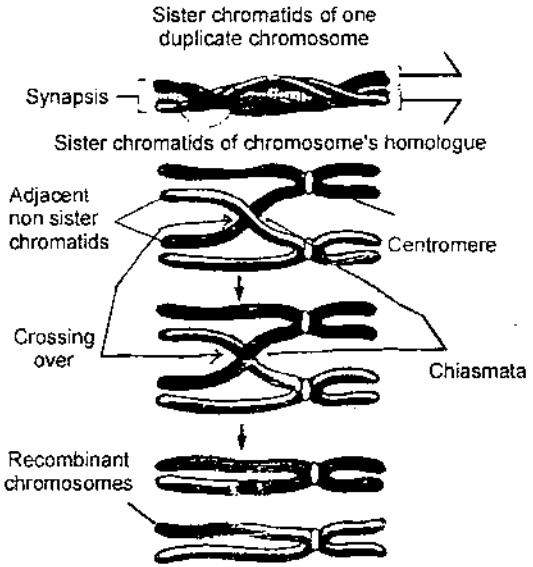


Fig : Crossing over between two non-sister chromatid of a bivalent

157. Retroviruses are so named becuase they contain enzyme reverse transcriptase or **RNA dependent DNA polymerase**. The genetic material of these viruses is RNA.
e.g., Rous Sarcoma virus.

158. Restriction enzymes are degradative enzymes which recognizes and cuts up DNA that is foreign to a cell. These enzymes protect bacteria against intruding DNA from other organisms such as virus or other bacterial cells.

159. In the resting nerve fibre, the cytoplasm inside the axon has a high concentration of K^+ and a low concentration of Na^+ in contrast to the fluid outside the axon. Thus if diffusion occurs then through concentration gradient Na^+ enters the fibre.

160. Exponential phase or log phase is characterized by rapid growth in population which continues till enough food is available.

161. Diversification in plants life appeared due to long periods of evolutionary changes. The evolutionary changes sequence is :

Bryophytes (Thalloid no vascular tissue) → Pteridophytes (Differentiation in vascular tissue begins) → Gymnosperms (no fruit formation) → Anigosperms (fruit present)

162. Micro-propagation is the latest method of obtaining a large number of plantlets through plant tissue culture. This can be done through culture of cells, callus, tissues, organ or sometimes whole plant.

163. Gibberellin promotes internodal elongation in a wide range of species. This internodal elongation phenomenon is known as **blotting**.
Gibberellin is a plant growth hormone which was first time obtained from a fungus *Gibbrella fujikuori (Fusarium monliformi)*.

164. Carbon is the most abundant element present in the plant. Other framework elements are hydrogen and oxygen.

165. Photosynthetically Active Region (PAR) of solar radiation is visible region. It consist of radiations having wavelength between 400 to 700 nm. Green plants use this wavelength in the process of manufacture of food *i.e.*, photosynthesis.

166. Since terrestrial animals do not have automatic access to either fresh or salt water, they must regulate water content in other ways, balancing off gains and loses.

167. The genotype of human male in question must be Aa Bb X^hY.
Hence $2 \times 2 \times 2 = 8$ types of gametes would be formed. AB X^h, ABY, aB X^h.

aBY, Ab X^h, AbY, ab X^h, abY.

Hence, 1/8 proportion of his sperms would be abh.

168. Mango is a drupe fruit and its edible part is mesocarp.

169. The thylakoids of chloroplast are flattened vesicles arranged as a membranous network within the stroma. 50% of chloroplast proteins and various components involved (namely chlorophyll, carotenoids and plastoquinone) are present in thylakoid membranes that are involved in photosynthesis.

170. When 3-phosphoglyceraldehyde is converted into 1,3 diphosphoglyceric acid, two electrons and two protons are released which are utilised to convert NAD^+ to NADH and one H^+.
$NAD^+ + 2H^+ + 2e^- \rightarrow NADH + H^+$

171. During the leavening process, the yeast breaks down the carbohydrates in the dough and generates CO_2 which more than doubles the size of the loaf giving the spongy structure. This process is called fermentation.

172. In somatic cell cycle the replication of DNA takes place in S phase.

173. An organism (such as bacterium) that will grow on a minimal medium is called a prototroph while a 'mutant' of it that will not grow on a minimal medium but requires the addition of some compound like an amino acid or vitamin is called auxotroph.

174. *Adiantum* is also called walking fern. In *Adiantum* the tips of the leaves, on coming in contact with the soil, give out adventitious roots which, in turn, produce new leaves and develop into new plants.

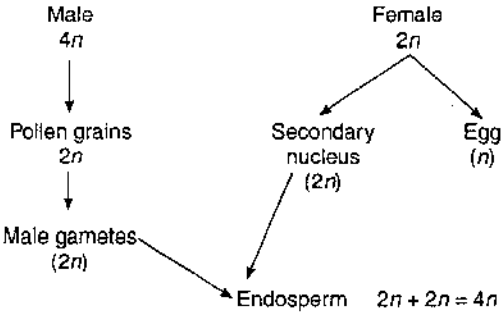
175. Since large populations of *Escherichia coli* are found in human colon, the presence of *E. coli* in water indicates that, it has been contaminated with faecal matter. Thus, *E. coli* is commonly known as indicator of water pollution.

176. The enzymes used for labelling in ELISA (Enzyme Linked Immunosorbent Assay) include horse radish peroxidase, alkaline phosphatase, β-galactosidase and lactoperoxidase.

177. Phenetics (Gr *Phainein* - to appear; the term phenotype is derived from this same root) dedicates texonomic affinities entirely on the basis of measurable similarities and differences.

178. At metaphase, the chromosome are clearly visible as composed of two closely associated halves (chromatids) and the chromosomes have undergone maximum contraction so these can be counted conveniently.

179. Secondary nucleus of female would have '2*n*' chromosome that would be fertilized by male gametes which in this case would be '2*n*' because it is formed from tetraploid male. Hence, endosperm would be $2n + 2n = 4n$.



180. In 1963, ICAR introduced many dwarf selections from CIMMYT, including those developed by Norman Borlaugh using Norin-10 as the source of dwarfing genes.

181. The environmental stress (as pesticides) does not cause or direct changes in genome, instead, it simply selects rather persisting mutations which result in phenotypes that are better adapted to the new environment (*e.g.*, certain pesticides).

182. The base ratio A + T / G + C may vary from one species to another, but is constant for a given species. It is rarely equal to one and varies between 0.4 and 1.9.

183. The genotype of trihybrid would be AaBbCc. Eight different types of gametes ABC, ABc, AbC, Abc, aBC, aBc, abC, abc would be formed. The number of zygotes would be $8^2 = 64$.

184. Lichens are composite organisms representing symbiotic association between phycobiont (algal component) and mycobiont (fungal component) —the two components together behave as a single organism. The phycobiont benefits the mycobiont by providing carbohydrate. The mycobiont on the other hand, provides protection, water, salts and nitrogenous substances to the phycobiont.

185. In oogamous type of sexual reproduction, the female gamete (ovum/egg) is big, passive while male gametes (spermatozoids) are smaller, active and motile.

186. The cycadales is an ancient group of gymnosperms exhibiting several primitive features—now having only a few living representative of once a large group of plants that glorified during the Mesozoic era.

187. Deserts have a very hot days and very cold nights. Due to bare plant cover, the soil of desert is much more exposed to these fluctuations as compared to that of other areas. During day time, the soil becomes hot and in night it frequently, becomes cool.

188. The basic plan of the structure of *t*-RNA assumes the pattern of a clover leaf. The structures of different *t*-RNAs for almost all amino acids are now available and all of these fit the clover leaf model.

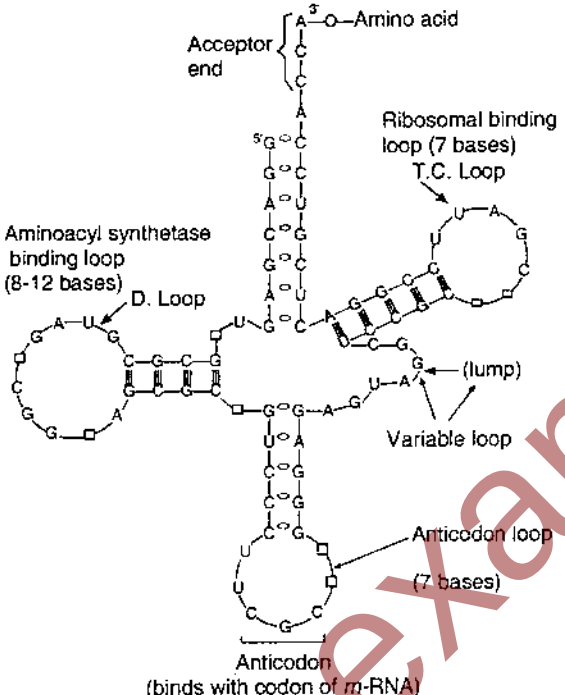


Fig : Clover leaf model of t-RNA

189. Telomeres have been shown to have unique structures that include short nucleotide sequences present as tandemly repeated units. The basic repeat sequence in all the species studied has the pattern $5' - T_{1-4}\ A_{0-1}\ G_{1-8} - 3'$. Same repeated sequence is found in at the end of all chromosomes in a species. Not only this, same telomere sequence may occur in widely divergent species (*e.g.*, Human beings, *Neurospora* and some acellular slime molds). Clusters of G residues in one strand and C residues in the other characterise telomeric DNA. Also, in some species the telomeres terminate with a single-stranded DNA (12-16

190. Normally, genetic information flows from DNA ⟶ *m*-RNA ⟶ protein. Hence, any change in nucleotides due to mutation, would result in change in the structure of protein/enzyme which might result in some change in the organism.

191. The events for initiation of DNA replication in prokaryotes may be classified into (a) pre-priming (occurring only at the origin); (b) priming (recurring with the initiation of each okazaki fragment during elongation phase. Unwinding of DNA is followed by the synthesis of RNA primers by RNA primase.

192. Shade tolerant plants have lower photosynthetic rates and hence, lower growth rates. On the other hand these plants have larger photosynthetic unit size than the sun plants..

193. A segment (T-DNA) of tumour-inducing plasmid (T_i) can be transformed from the bacterium *Agrobacterium* to plant cells at a wound site. This T_i plasmid is often used for developing transgenic plants.

194.

RRTt (Red tall) rrtt (Yellow dwarf) .... Parents

RT Rt rt rt .... Gametes

♂ \ ♀	rt	rt
RT	RrTt	RrTt
Rt	Rrtt	Rrtt

—F_1

Conclusion :

1. All plants are red.
2. 50 are red tall.
3. 50% are red dwarf.

195. According to Oparin, the atmosphere of primitive earth was reducing because H atoms were most numerous and most reactive. Large quantities of H_2, N_2 water vapour, CO_2, CH_4 and NH_3 were present but free oxygen was not present in significant amount.

196. At telophase state, nuclear membrane vesicles associate with the surface of individual chromosomes and fuse to reform the nuclear

membranes, which partially enclose clusters of chromosomes before coalescing to reform the complete nuclear envelope. During this process the nuclear pores reassemble and the dephosphorylated reassociate to form the nuclear lamina. One of the lamina proteins (lamina-B) remains with the nuclear membrane fragments throughout mitosis and may help nucleate reassembly. After the nucleus reforms, the pores pump in nuclear proteins, the chromosome decondense and RNA synthesis resumes, causing the nucleolus to reappear.

197. Vitamin B_{12} (cyanocobalamin) is only vitamin not found in vegetables. It is present in animal protein such as meat, liver, fish and *Spirulina* (single cell protein). It promotes DNA synthesis, maturation of RBCs and myelin formation.

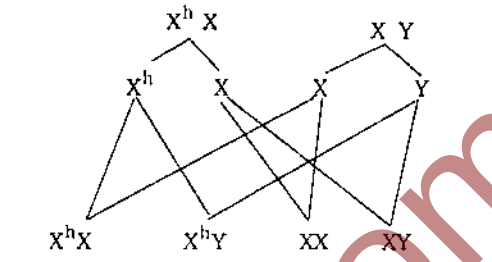
198. *Agrobacterium tumefaciens* is called natural plant genetic engineer. Its interaction with plants are most thoroughly studied amongest the four options given in the question.

199. Reporter genes are used to determine whether a particular DNA construct has been successfully introduced into a cell, organ or tissue.

200. The genotype of normal woman with colourblind father = XX^h

The genotype of normal man = XY

Normal woman × Normal man



Carrier daughter | Colourblind son | Normal daughter | Normal son

∴ 50% of the sons would be colourblind.

❑