# CBSE

MEDICAL ENTRANCE

SOLVED PAPER / 2001

Physics

1. Planck's constant has the dimensions of :
   (a) linear momentum
   (b) angular momentum
   (c) energy
   (d) power

2. If $\vec{A}$ and $\vec{B}$ are two vectors such that $|\vec{A} + \vec{B}| = |\vec{A} - \vec{B}|$, the angle between vectors $\vec{A}$ and $\vec{B}$ is :
   (a) 0°
   (b) 60°
   (c) 90°
   (d) 120°

3. A stone is thrown vertically upwards. When stone is at a height half of its maximum height, its speed is 10 m/s; then the maximum height attained by the stone is ($g = 10$ m/s^2) :
   (a) 8 m
   (b) 10 m
   (c) 15 m
   (d) 20 m

4. 1 kg body explodes into three fragments. The ratio of their masses is 1 : 1 : 3. The fragments of same mass move perpendicular to each other with speeds 30 m/s, while the heavier part remains in the initial direction. The speed of heavier part is :
   (a) $\dfrac{10}{\sqrt{2}}$ m/s
   (b) $10\sqrt{2}$ m/s
   (c) $20\sqrt{2}$ m/s
   (d) $30\sqrt{2}$ m/s

5. A particle of mass M is revolving along a circle of radius R and another particle of mass m is revolving in a circle of radius r. If time periods of both particles are same, then the ratio of their angular velocities is :
   (a) 1
   (b) $\dfrac{R}{r}$
   (c) $\dfrac{r}{R}$
   (d) $\sqrt{\dfrac{R}{r}}$

6. A wheel of bicycle is rolling without slipping on a level road. The velocity of the centre of mass is v_{cm}; then true statement is :
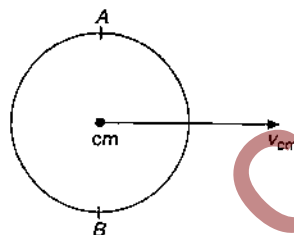
   (a) the velocity of point A is $2v_{cm}$ and velocity of point B is zero
   (b) the velocity of point A is zero and velocity of point B is $2v_{cm}$
   (c) the velocity of point A is $2v_{cm}$ and velocity of point B is $-v_{cm}$
   (d) the velocities of both A and B are v_{cm}

7. A child is swinging a swing. Minimum and maximum heights of swing from earth's surface are 0.75 m and 2 m respectively. The maximum velocity of this swing is :
   (a) 5 m/s
   (b) 10 m/s
   (c) 15 m/s
   (d) 20 m/s

8. In SHM restoring force is $F = -kx$, where k is force constant, x is displacement and A is amplitude of motion, then total energy depends upon :
   (a) k, A and M
   (b) k, x, M
   (c) k, A
   (d) k, x

9. A stone is thrown at an angle of 45° to the horizontal with kinetic energy K. The kinetic energy at the highest point is :
   (a) $\dfrac{K}{2}$
   (b) $\dfrac{K}{\sqrt{2}}$
   (c) K
   (d) zero

10. A player takes 0.1 s in catching a ball of mass 150 g moving with velocity of 20 m/s. The force imparted by the ball on the hands of the player is :
    (a) 0.3 N
    (b) 3 N
    (c) 30 N
    (d) 300 N

11. A body attains a height equal to the radius of the earth. The velocity of the body with which it was projected is :
    (a) $\sqrt{\dfrac{GM}{R}}$
    (b) $\sqrt{\dfrac{2GM}{R}}$
    (c) $\sqrt{\dfrac{5}{4}\dfrac{GM}{R}}$
    (d) $\sqrt{\dfrac{3GM}{R}}$

12. Equations of two progressive waves are given by $y_1 = a \sin(\omega t + \phi_1)$ and $y_2 = a \sin(\omega t + \phi_2)$. If amplitude and time period of resultant wave are same as that of both the waves, then $(\phi_1 - \phi_2)$ is :
    (a) $\dfrac{\pi}{3}$
    (b) $\dfrac{2\pi}{3}$
    (c) $\dfrac{\pi}{6}$
    (d) $\dfrac{\pi}{4}$

13. A block of mass 1 kg is placed on a truck which accelerates with acceleration 5 m/s^2. The coefficient of static friction between the block and truck is 0.6. The frictional force acting on the block is :
    (a) 5 N
    (b) 6 N
    (c) 5.88 N
    (d) 4.6 N

14. A wave enters to water from air. In air frequency, wavelength, intensity and velocity are n_1, λ_1, I_1 and v_1 respectively. In water the corresponding quantities are n_2, λ_2, I_2 and v_2 respectively; then :
    (a) $I_1 = I_2$
    (b) $n_1 = n_2$
    (c) $v_1 = v_2$
    (d) $\lambda_1 = \lambda_2$

15. A force of 250 N is required to lift a 75 kg mass through a pulley system. In order to lift the mass through 3 m, the rope has to be pulled through 12 m. The efficiency of system is :
    (a) 50%
    (b) 75%
    (c) 33%
    (d) 90%

16. Two springs A and B have force constants k_A and k_B such that $k_B = 2k_A$. The four ends of the springs are stretched by the same force. If energy stored in spring A is E, then energy stored in spring B is :
    (a) $E/2$
    (b) $2E$
    (c) E
    (d) $4E$

17. The wavelength corresponding to maximum intensity of radiation emitted by a source at temperature 2000 K is λ, then what is the wavelength corresponding to maximum intensity of radiation at temperature 3000 K ?
    (a) $\dfrac{2}{3}\lambda$
    (b) $\dfrac{16}{81}\lambda$
    (c) $\dfrac{81}{16}\lambda$
    (d) $\dfrac{4}{3}\lambda$

18. The temperatures of source and sink of a heat engine are 127°C and 27°C respectively. An inventor claims its efficiency to be 26% then :
    (a) it is impossible
    (b) it is possible with high probability
    (c) it is possible with low probability
    (d) data are insufficient

19. The equation of a wave is given by :
    $y = a \sin\left(100t - \dfrac{x}{10}\right)$, where x and y are in metre and t in second; then velocity of wave is :
    (a) 0.1 m/s
    (b) 10 m/s
    (c) 100 m/s
    (d) 1000 m/s

20. The frequency of a vibrating wire is n. If tension is doubled, density is halved and diameter is doubled, then new frequency will be :
    (a) n
    (b) $\dfrac{n}{\sqrt{2}}$
    (c) $2n$
    (d) $4n$

21. Which of the following phenomena exhibits particle's nature of light ?
    (a) Interference
    (b) Diffraction
    (c) Polarisation
    (d) Photoelectric effect

22. Transmission of light in optical fibre is due to :
    (a) scattering
    (b) diffraction
    (c) polarisation
    (d) multiple total internal reflections

23. Ozone layer in atmosphere is useful, because it :
    (a) stops ultraviolet radiation
    (b) absorbs polluent gases
    (c) stops green house effect
    (d) stops increase in temperature of atmosphere

24. Refractive index of water is 5/3. A light source is placed in water at a depth of 4 m. Then what must be the minimum radius of disc placed on water surface so that the light of source can be stopped ?
    (a) 3 m
    (b) 4 m
    (c) 5 m
    (d) ∞

25. A light source is at a distance d from a photoelectric cell, then the number of photoelectrons emitted from the cell is n. If the distance of light source and cell is reduced to half, then the number of photoelectrons emitted will become :
(a) $\frac{n}{2}$
(b) $2n$
(c) $4n$
(d) n

26. Tangent galvanometer measures :
(a) capacitance
(b) current
(c) resistance
(d) potential difference

27. The reactance of a capacitor of capacitance C is X. If both the frequency and capacitance be doubled, then new reactance will be :
(a) X
(b) $2X$
(c) $4X$
(d) $\frac{X}{4}$

28. Which of the following is positively charge ?
(a) α-particle
(b) β-particle
(c) γ-rays
(d) X-rays

29. In a parallel plate capacitor, the distance between the plates is d and potential difference across plates is V. Energy stored per unit volume between the plates of capacitor is :
(a) $\frac{Q^2}{2V^2}$
(b) $\frac{1}{2}\varepsilon_0\frac{V^2}{d^2}$
(c) $\frac{1}{2}\frac{V^2}{\varepsilon_0 d^2}$
(d) $\frac{1}{2}\varepsilon_0\frac{V^2}{d^2}$

30. A charge $q\mu C$ is placed at the centre of a cube of a side 0.1 m, then the electric flux diverging from each face of the cube is :
(a) $\frac{q\times10^{-6}}{24\varepsilon_0}$
(b) $\frac{q\times10^{-4}}{\varepsilon_0}$
(c) $\frac{q\times10^{-6}}{6\varepsilon_0}$
(d) $\frac{q\times10^{-4}}{12\varepsilon_0}$

31. In which type of material the magnetic susceptibility does not depend on temperature ?
(a) Diamagnetic
(b) Paramagnetic
(c) Ferromagnetic
(d) Ferrite

32. Torque acting on electric dipole of dipole moment $\vec{p}$ placed in uniform electric field $\vec{E}$ is :
(a) $\vec{p}\times\vec{E}$
(b) $\vec{p}\cdot\vec{E}$
(c) $\vec{p}\times\vec{E}\times\vec{p}$
(d) $\frac{\vec{E}\cdot\vec{p}}{p^2}$

33. Current is flowing in a coil of area A and number of turns N, then magnetic moment of the coil M is equal to :
(a) NiA
(b) $\frac{Ni}{A}$
(c) $\frac{Ni}{\sqrt{A}}$
(d) N^2Ai

34. Si and Cu are cooled to a temperature of 300 K, then resistivity :
(a) for Si increases and for Cu decreases
(b) for Cu increases and for Si decreases
(c) decreases for both Si and Cu
(d) increases for both Si and Cu

35. In a Wheatstone's bridge resistance of each of the four sides is $10\,\Omega$. If the resistance of the galvanometer is also $10\,\Omega$, then effective resistance of the bridge will be :
(a) $10\,\Omega$
(b) $5\,\Omega$
(c) $20\,\Omega$
(d) $40\,\Omega$

36. In an inductor of self-inductance $L=2$ mH, current changes with time according to relation $i=t^2e^{-t}$. At what time emf is zero ?
(a) 4 s
(b) 3 s
(c) 2 s
(d) 1 s

37. Resistivity of potentiometer wire is 10^{-7} ohm-metre and its area of cross-section is 10^{-6} m^2. When a current $i=0.1$ A flows through the wire, its potential gradient is :
(a) 10^{-2} V/m
(b) 10^{-4} V/m
(c) 0.1 V/m
(d) 10 V/m

38. In X-rays diffraction experiment distance between atomic lattice planes of diffraction grating is 2.8×10^{-10} m, then the maximum wavelength of X-rays (in metre) is :
(a) 2.5
(b) 5.6×10^{-10}
(c) 4×10^{-10}
(d) 4.6×10^{-10}

39. Rate of heat flow through a cylindrical rod is H_1. Temperatures of ends of rod are T_1 and T_2. If all the dimensions of rod become double and temperature difference remains same and rate of heat flow becomes H_2. Then :
(a) $H_2=2H_1$
(b) $H_2=\frac{H_1}{2}$
(c) $H_2=\frac{H_1}{4}$
(d) $H_2=4H_1$

40. In a certain region of space electric field $\vec{E}$ and magnetic field $\vec{B}$ are perpendicular to each other and an electron enters in region perpendicular to the direction of $\vec{B}$ and $\vec{E}$ both and moves undeflected, then velocity of electron is :

(a) $\dfrac{|\vec{E}|}{|\vec{B}|}$

(b) $\vec{E} \times \vec{B}$

(c) $\dfrac{|\vec{B}|}{|\vec{E}|}$

(d) $\vec{E} \cdot \vec{B}$

41. A charged particle of charge q and mass m enters perpendicularly in a magnetic field $\vec{B}$. Kinetic energy of the particle is E; then frequency of rotation is :

(a) $\dfrac{qB}{m\pi}$

(b) $\dfrac{qB}{2\pi m}$

(c) $\dfrac{qBE}{2\pi m}$

(d) $\dfrac{qB}{2\pi E}$

42. In a common-base configuration of a transistor $\dfrac{\Delta i_C}{\Delta i_E} = 0.98$, then current gain in common emitter configuration of transistor will be :

(a) 49

(b) 98

(c) 4.9

(d) 24.5

43. If internal resistance of cell is negligible, then current flowing through the circuit is :
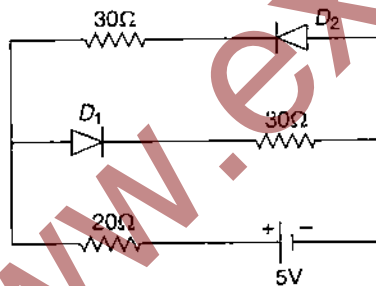
(a) $\dfrac{3}{50}$ A

(b) $\dfrac{5}{50}$ A

(c) $\dfrac{4}{50}$ A

(d) $\dfrac{2}{50}$ A

44. The truth table given below represents :

Input		Output
A	B	Y
1	1	0
0	1	1
1	0	1
0	0	1

(a) NOT gate

(b) OR gate

(c) XOR gate

(d) NAND gate

45. m_p and m_n are masses of proton and neutron respectively. An element of mass M has Z protons and N neutrons then :

(a) $M > Zm_p + Nm_n$

(b) $M = Zm_p + Nm_n$

(c) $M < Zm_p + Nm_n$

(d) M may be greater than, less than or equal to $Zm_p + Nm_n$, depending on nature of element

46. In nuclear fission process, energy is released because :

(a) mass of products is more than mass of nucleus

(b) total binding energy of products formed due to nuclear fission is more than the parent fissionable material

(c) total binding energy of products formed due to nuclear fission is less than parent fissionable material

(d) mass of some particles is converted into energy

47. Half-life period of a radioactive substance is 6h. After 24 h activity is 0.01 μC, what was the initial activity ?

(a) 0.04 μC

(b) 0.08 μC

(c) 0.24 μC

(d) 0.16 μC

48. Half-life of a radioactive substance is 12.5 h and its mass is 256 g. After what time, the amount of remaining substance is 1g ?
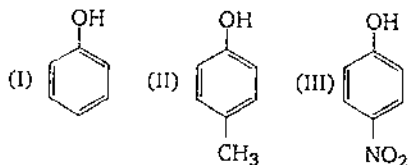
(a) 75 h

(b) 100 h

(c) 125 h

(d) 150 h

49. In compound $X(n, \alpha) \rightarrow {}_3Li^7$, the element X is :

(a) ${}_2He^4$ (b) ${}_5B^{10}$ (c) ${}_5B^9$ (d) ${}_4Be^{11}$

50. In bcc structure of lattice constant 'a', the minimum distance between atoms is :

(a) $\dfrac{\sqrt{3}}{2}a$ (b) $\sqrt{2}a$ (c) $\dfrac{a}{\sqrt{2}}$ (d) $\dfrac{a}{2}$
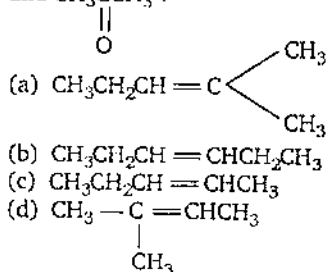
51. The correct acidic order of following is :

(I) OH (phenol)   (II) OH with CH$_3$ (III) OH with NO$_2$

(a) I > II > III   (b) III > I > II
(c) II > III > I   (d) I > III > II

52. CH_3—CH_2—$\underset{\underset{Cl}{|}}{CH}$—$CH_3$ obtained by

chlorination of *n*-butane, will be :
(a) meso form   (b) racemic mixture
(c) *d*-form   (d) *l*-form

53. Which alkene on ozonolysis gives CH_3CH_2CHO and $CH_3\underset{\underset{O}{||}}{C}CH_3$?

(a) $CH_3CH_2CH = C\big\langle\begin{smallmatrix}CH_3\\CH_3\end{smallmatrix}$

(b) $CH_3CH_2CH = CHCH_2CH_3$
(c) $CH_3CH_2CH = CHCH_3$
(d) $CH_3 - \underset{\underset{CH_3}{|}}{C} = CHCH_3$

54. Intermediates formed during reaction of $R\underset{\underset{O}{||}}{C}NH_2$ with Br_2 and KOH are :

(a) $RCONHBr$ and $RNCO$
(b) $RNHCOBr$ and $RNCO$
(c) $RNHBr$ and $RCONHBr$
(d) $RCONBr_2$

55. An organic compound $A(C_4H_9Cl)$ on reaction with Na/diethyl ether gives a hydrocarbon which on monochlorination gives only one chloro derivative then, A is :
(a) *t*-butyl chloride   (b) *sec.* butyl chloride
(c) iso butyl chloride (d) *n*-butyl chloride

56. Which of the following is incorrect ?
(a) $FeCl_3$ is used in detection of phenol
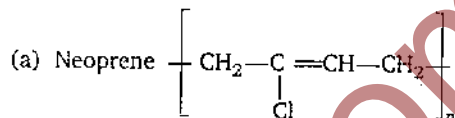(b) Fehling solution is used in detection of glucose
(c) Tollen's reagent is used in detection of unsaturation
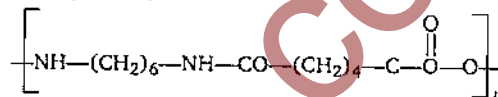(d) $NaHSO_3$ is used in detection of carbonyl compound

57. Which one of the following gives positive Fehling's solution test ?
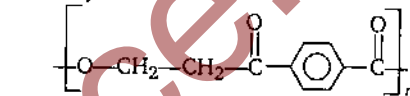(a) Sucrose   (b) Glucose
(c) Fats   (d) Protein

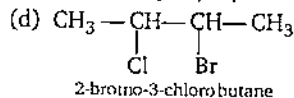**58.** Which one of the following is not correctly matched ?

(a) Neoprene $\left[CH_2-\underset{\underset{Cl}{|}}{C}=CH-CH_2\right]_n$

(b) Nylone-6, 6
$[NH-(CH_2)_6-NH-CO-(CH_2)_4-C\overset{O}{\underset{}{-}}O-O]_n$

(c) Terylene
$[O-CH_2-CH_2-\underset{\underset{}{}}{C}\overset{O}{-}\bigcirc\overset{O}{-}C]_n$

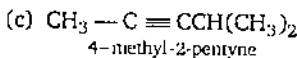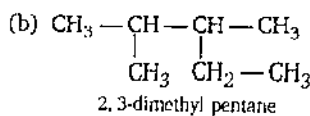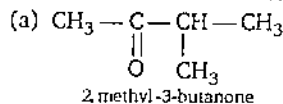(d) PMMA $\left[CH_2-\underset{\underset{COOCH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-\right]_n$

59. Which of the following is correct ?
(a) Cycloheptane is an aromatic compound
(b) Diastase is an enzyme
(c) Acetophenone is an ether
(d) All of the above

60. The incorrect IUPAC name is :
(a) $CH_3-\underset{\underset{O}{||}}{C}-\underset{\underset{CH_3}{|}}{CH}-CH_3$
2 methyl-3-butanone

(b) $CH_3-\underset{\underset{CH_3}{|}}{CH}-\underset{\underset{CH_2-CH_3}{|}}{CH}-CH_3$
2, 3-dimethyl pentane

(c) $CH_3-C \equiv CCH(CH_3)_2$
4−methyl-2-pentyne

(d) $CH_3-\underset{\underset{Cl}{|}}{CH}-\underset{\underset{Br}{|}}{CH}-CH_3$
2-bromo-3-chloro butane

61. In preparation of alkene from alcohol using Al_2O_3 which is effective factor ?
(a) Porosity of Al_2O_3
(b) Temperature
(c) Concentration
(d) Surface area of Al_2O_3

62. Which one of the following is correct ?
(a) On reduction of any aldehyde gives secondary alcohol
(b) Reaction of vegetable oil with H_2SO_4 gives glycerin
(c) Alcoholic iodine with NaOH gives iodoform
(d) Sucrose on reaction with NaCl gives invert sugar

63. Which of the following is correct about H-bonding in nucleotide ?
(a) A–T, G–C   (b) A–G, T–C
(c) G–T, A–C   (d) A–A, T–T

64. Which of the following is correct statement ?
(a) Starch is polymer of α-glucose
(b) Amylose is a component of cellulose
(c) Protiens are composed of only one type of amino acid
(d) In cyclic structure of fructose, there are four carbons and one oxygen atom

65. Which statement is incorrect about peptide bond $- \overset{\overset{\displaystyle O}{||}}{C} - \overset{\displaystyle \cdot\cdot}{N}H -$?
(a) C–N bond length in proteins is longer than usual bond length of N-bond
(b) Spectroscopic analysis show planar structure of $- \overset{|}{\underset{\underset{\displaystyle O}{||}}{C}} - NH -$ group
(c) C–N bond length in proteins is smaller than usual bond length of C–N bond
(d) None of the above

66. In steam distillation of toluene, the pressure of toluene in vapour is :
(a) equal pressure of barometer
(b) less than pressure of barometer
(c) equal to vapour pressure to toluene in simple distillation
(d) more than vapour pressure of toluene in simple distillation

67. A compound of molecular formula C_7H_{16} shows optical isomerism, compound will be :
(a) 2, 3-dimethyl pentane
(b) 2, 2-dimethyl butane

(c) 2-methyl hexane
(d) none of the above

68. Change in enthalpy for reaction
$$2H_2O_2(l) \longrightarrow 2H_2O(l) + O_2(g)$$
if heat of formation of $H_2O_2(l)$ and $H_2O(l)$ are –188 and –286 kJ/mol respectively :
(a) – 196 k J/mol   (b) + 196 k J/mol
(c) + 948 k J/mol   (d) – 948 k J/mol

69. When 1 mole gas is heated at constant volume, temperature is raised from 298 to 308K. Heat supplied to the gas is 500 J. Then which statement is correct ?
(a) $q = w = 500J$, $\Delta U = 0$
(b) $q = \Delta U = 500$ J, $w = 0$
(c) $q = w = 500$ J, $\Delta U = 0$
(d) $\Delta U = 0$, $q = w = -500$ J

70. Enthalpy of $CH_4 + \frac{1}{2}O_2 \to CH_3OH$ is negative. If enthalpy of combustion of CH_4 and CH_3OH are x and y respectively. Then which relation is correct ?
(a) $x > y$ (b) $x < y$ (c) $x = y$ (d) $x \geq y$

71. For the reactions $2N_2O_5 \to 4NO_2 + O_2$ rate and rate constant are 1.02×10^{4} and 3.4×10^{-5} s^{-1} respectively, then conc. of N_2O_5 at that time will be :
(a) 1.732   (b) 3
(c) 1.02×10^{-4} (d) 3.4×10^{5}

72. A human body required the 0.01 M activity of radioactive substance after 24 hour. Half-life of radioactive is 6 hour. Then injection of maximum activity of radioactive substance that can be injected :
(a) 0.08   (b) 0.04
(c) 0.16   (d) 0.32

73. When a biochemical reaction is carried out in laboratory from out side of human body in the absence of enzyme then rate of reaction obtained is 10^{-6} times, then activation energy of reaction in the presence of enzyme is :
(a) $\frac{6}{RT}$
(b) P is required
(c) Different from E_a obtained in laboratory
(d) Cannot say any things

74. Molarity of liquid HCl if density of solution is 1.17 g/cc :
(a) 36.5   (b) 18.25
(c) 32.05   (d) 42.10

75. Percentage of Se in peroxidase anhydrous enzyme is 0.5% by weight (at. wt. = 78.4), then minimum molecular weight of peroxidase anhydrous enzyme is :
    (a) 1.568×10^4 (b) 1.568×10^3
    (c) 15.68 (d) 2.168×10^4

76. Specific volume of cylindrical virus particle is 6.02×10^{-2} cc/g whose radius and length are 7Å and 10Å respectively. If $N_A = 6.02 \times 10^{23}$ find molecular weight of virus :
    (a) 15.4 kg/mol
    (b) 1.54×10^4 kg/mol
    (c) 3.08×10^4 kg/mol
    (d) 3.08×10^3 kg/mol

77. Pure water can be obtained from sea water by :
    (a) centrifugation   (b) plasmolysis
    (c) reverse osmosis   (d) sedimentation

78. Standard electrode potentials are :
    Fe^{2+}/Fe. $E° = -0.44$
    Fe^{3+}/Fe^{2+}, $E° = 0.77$
    Fe^{2+}, Fe^{3+} and Fe block are kept together, then :
    (a) Fe^{3+} increases
    (b) Fe^{3+} decreases
    (c) $\dfrac{Fe^{2+}}{Fe^{3+}}$ remains unchanged
    (d) Fe^{2+} decreases

79. Which is not correct regarding the adsorption of a gas on surface of solid ?
    (a) On increasing temperature adsorption increases continuously
    (b) Enthalpy and entropy change is -ve
    (c) Adsorption is more for some specific substance
    (d) Reversible

80. $PbO_2 \longrightarrow PbO$ $\Delta G_{298} < 0$
    $SnO_2 \longrightarrow SnO$ $\Delta G_{298} > 0$
    Most probable oxidation state of Pb and Sn will be :
    (a) Pb^{4+}, Sn^{4+} (b) Pb^{4+}, Sn^{2+}
    (c) Pb^{2+}, Sn^{2+} (d) Pb^{2+}, Sn^{4+}

81. Which of the following two are isostructural ?
    (a) XeF_2, IF_2^- (b) NH_3, BF_3
    (c) CO_3^{2-}, SO_3^{2-} (d) PCl_5, ICl_5

82. In which of the following, bond angle is maximum ?
    (a) NH_3 (b) NH_4^+
    (c) PCl_3 (d) SCl_2

83. Which of the following statements is not correct ?
    (a) $La(OH)_3$ is less basic than $Li(OH)_3$
    (b) In lanthanide series ionic radius of Ln^{3+} ion decreases
    (c) La is actually an element of transition series rather lanthanide
    (d) Atomic radius of Zn and Hf are same because of lanthanide contraction

84. Correct order of Ist ionisation potential (I.P.) among following elements Be, B, C, N, O is :
    (a) $B < Be < C < O < N$
    (b) $B < Be < C < N < O$
    (c) $Be < B < C < N < O$
    (d) $Be < B < C < O < N$

85. Which one of the following will give maximum number of isomers ?
    (a) $[Co(NH_3)_4Cl_2]$
    (b) $[Ni(en)(NH_3)_4]^{2+}$
    (c) $[Ni(C_2O_4)(en)_2]^{2-}$
    (d) $[Cr(SCN)_2(NH_3)_4]^-$

86. Co-ordination number of Ni in $[Ni(C_2O_4)_3]^{4-}$ is :
    (a) 3   (b) 6
    (c) 4   (d) 2

87. Which of the following organometallic compound has σ and π bond ?
    (a) $[Fe(\eta^5 - C_5H_5)_2]$
    (b) $K[PtCl_3(\eta^2 - C_2H_4)]$
    (c) $[Co(CO)_5NH_3]^{2+}$
    (d) $Fe(CH_3)_3$

88. Which statements is incorrect ?
    (a) $Ni(CO)_4$-Tetrahedral, paramagnetic
    (b) $Ni(CN)_4^{2-}$-Square planar, diamagnetic
    (c) $Ni(CO)_4$-Tetrahedral, diamagnetic
    (d) $[Ni(Cl)_4]^{2-}$ Tetrahedral, paramagnetic

89. In $X - H - - - Y$, X and Y both are electronegative elements :
    (a) electron density on X will increase and on H will decrease
    (b) in both electron density will increase
    (c) in both electron density will decrease
    (d) on X electron density will decrease and on H increase

90. Main axis of a diatomic molecule is z, molecular orbital p_x and p_y overlaps to form, which of the orbital ?
    (a) π-molecular orbital
    (b) σ-molecular orbital
    (c) δ-molecular orbital
    (d) No bond will form

91. Which of the following will exhibit maximum ionic conductivity ?
    (a) $K_4[Fe(CN)_6]$ (b) $[Co(NH_3)_6]Cl_3$
    (c) $[Cu(NH_3)_4]Cl_2$ (d) $[Ni(CO)_4]$

92. The following quantum numbers are possible for how many orbital $n = 3, l = 2, m = +2$:
    (a) 1   (b) 2
    (c) 3   (d) 4

93. In HS^-, I^-, RNH_2, NH_3 order of proton accepting tendency will be :
    (a) $I^- > NH_3 > RNH_2 > HS^-$
    (b) $NH_3 > RNH_2 > HS^- > I^-$
    (c) $RNH_2 > NH_3 > HS^- > I^-$
    (d) $HS^- > RNH_2 > NH_3 > I^-$

94. The beans are cooked earlier in pressure cooker, because :
    (a) bp increase with increasing pressure
    (b) bp decrease with increasing pressure
    (c) extra pressure of pressure cooker, softens the beans
    (d) internal energy is not lost while cooking in pressure cooker

95. The most convenient method to protect the bottom of ship made of iron is :
    (a) coating it with red lead oxide
    (b) white tin plating

(c) connecting it with Mg block
(d) connecting it with Pb block

96. Zn convert its melted state to its solid state, it has *hcp* structure then find out number of nearest atom :
    (a) 6   (b) 8   (c) 12   (d) 4

97. Nitrogen forms N_2, but phosphorus when form P_2 readily converted into P_4 , reason is :
    (a) triple bond present between phosphorus atom
    (b) $P_\pi - P_\pi$ bonding is weak
    (c) $P_\pi - P_\pi$ bonding is strong
    (d) multiple bond form easily

98. Ionisation constant of CH_3COOH is 1.7×10^{-5} and concentration of H^+ ions is 3.4×10^{-4}. Then find out initial concentration of CH_3COOH molecules :
    (a) 3.4×10^{-4} (b) 3.4×10^{-3}
    (c) 6.8×10^{-4} (d) 6.8×10^{-3}

99. Solubility of a M_2S salt is 3.5×10^{-6}, then find out solubility product :
    (a) 1.7×10^{-6} (b) 1.7×10^{-16}
    (c) 1.7×10^{-18} (d) 1.7×10^{-12}

100. If $_b^a X$ species emit firstly a positron, then two α and two β and in last one α is also emitted and finally convert in $_d^c Y$ species so correct relation is :
    (a) $a = c + 12, d = b - 5$
    (b) $a = c - 8,   d = b - 1$
    (c) $a = c - 6,   d = b - 0$
    (d) $a = c - 4,   a = b - 2$

Biology

101. Water enters a cell due to :
    (a) O.P.   (b) S.P.
    (c) T.P.   (d) W.P.

102. Proteinaceous pigment which controls the activities concerned with light is :
    (a) phytochrome   (b) chlorophyll
    (c) anthocyanin   (d) carotenoids

103. Glycolate induces opening of stomata in :
    (a) presence of oxygen
    (b) low CO_2 concentration

(c) high CO_2 concentration
(d) absence of CO_2

104. Enzyme first used for nitrogen fixation is :
    (a) nitrogenase   (b) nitroreductase
    (c) transferase   (d) transaminase

105. Passive absorption of minerals depends on :
    (a) temperature
    (b) temperature and metabolic inhibitor
    (c) metabolic inhibitor
    (d) humidity

106. Maximum number of bases in plasmids discovered so far is :
   (a) 50 kilo base   (b) 500 kilo base
   (c) 5000 kilo base   (d) 5 kilo base

107. Half life period of C^{14} is :
   (a) 500 years   (b) 5000 years
   (c) 50 years   (d) 5×10^{14} years

108. Which one is correctly matched ?
   (a) Vit. E–Tocopherol
   (b) Vit. D–Riboflavin
   (c) Vit. B–Calciferol
   (d) Vit. A–Thiamine

109. Ratio of complementary genes is :
   (a) 9 : 3 : 4   (b) 12 : 3 : 1
   (c) 9 : 3 : 3 : 4   (d) 9 : 7

110. When dominant and recessive alleles express together it is called :
   (a) co-dominance
   (b) dominance
   (c) amphidominance
   (d) pseudodominance

111. A and B genes are linked. What shall be the genotype of progeny in a cross between AB/ab and ab/ab ?
   (a) AAbb and aabb
   (b) AaBb and aabb
   (c) AABB and aabb
   (d) None of the above

112. Which statement is correct about centre of origin of plants ?
   (a) More diversity in varieties
   (b) Frequency of dominant gene is more
   (c) Climatic conditions more favourable
   (d) None of the above

113. Probability of four sons to a couple is :
   (a) $\frac{1}{4}$ (b) $\frac{1}{8}$ (c) $\frac{1}{16}$ (d) $\frac{1}{32}$

114. Before the European invaders which vegetable was/were absent in India ?
   (a) Potato and tomato
   (b) Simla mirch and brinjal
   (c) Maize and chichinda
   (d) Bitter gourd

115. Which of the following is the pair of biofertilizers ?
   (a) *Azolla* and BGA
   (b) *Nostoc* and legume
   (c) *Rhizobium* and grasses
   (d) *Salmonella* and *E. coli*

116. Two non-allelic genes produce the new phenotype when present together but fail to do so independently, it is called :
   (a) epistasis
   (b) polygene
   (c) non-complementary gene
   (d) complementary gene

117. Which of the following cut the DNA at specific places ?
   (a) Restriction endonuclease EcoRI
   (b) Ligase
   (c) Exonuclease
   (d) Alkaline phosphatase

118. Tetradyanamous condition occurs in :
   (a) Cruciferae   (b) Malvaceae
   (c) Solanaceae   (d) Lilliaceae

119. Which is correct pair for edible part ?
   (a) Tomato   — Thalamus
   (b) Maize   — Cotyledons
   (c) Guava   — Mesocarp
   (d) Date palm — Pericarp

120. Edible part of banana is :
   (a) epicarp
   (b) mesocarp and less developed endocarp
   (c) endocarp and less developed mesocarp
   (d) epicarp and mesocarp

121. Bicarpellary gynoecium and oblique ovary occurs in :
   (a) mustard   (b) banana
   (c) *Pisum*   (d) brinjal

122. In *Hydra*, waste material of food digestion and nitrogenous waste material are removed from :
   (a) mouth and mouth
   (b) body wall and body wall
   (c) mouth and body wall
   (d) mouth and tentacles

123. What is the best pH of the soil for cultivation of plants ?
   (a) 3.4 – 5.4   (b) 6.5 – 7.5
   (c) 4.5 – 8.5   (d) 5.5 – 6.5

124. Which fish selectively feeds on the larva of mosquito ?
   (a) *Gambusia*   (b) Rohu
   (c) *Clarias*   (d) *Exocoetus*

125. Which one of the following is correct match ?
   (a) Reserpine   — Tranquiliser
   (b) Cocain   — Opiatic narcotic
   (c) Morphine   — Hallucinogenic
   (d) Bhang   — Analgesic

126. What is BOD ?
    (a) The amount of O_2 utilized by organisms in water
    (b) The amount of O_2 utilized by micro-organisms for decomposition
    (c) The total amount of O_2 present in water
    (d) All of the above

127. In grasses what happens in micro-spore mother cell for the formation of mature pollen grains ?
    (a) One meiotic and two mitotic divisions
    (b) One meiotic and one mitotic division
    (c) One meiotic division
    (d) One mitotic division

128. What is the intensity of sound in normal conversation ?
    (a) 10-20 dB   (b) 30-60 dB
    (c) 70-90 dB   (d) 120-150 dB

129. Adventive embryony in citrus is due to :
    (a) nucellus   (b) integuments
    (c) zygotic embryo   (d) fertilized egg

130. LSD is :
    (a) hallucinogenic   (b) sedative
    (c) stimulant   (d) tranquiliser

131. Which set is similar ?
    (a) Corpus leuteum — Graafian follicles
    (b) Sebum   — sweat
    (c) Bundle of His   — pace maker
    (d) Vit. B_7 — niacin

132. *Salmonella* is related with :
    (a) typhoid   (b) polio
    (c) TB   (d) tetanus

133. Difference in Gram + and Gram – bacteria is due to :
    (a) cell wall   (b) cell membrane
    (c) ribosome   (d) cytoplasm

134. What is sarcomere ?
    (a) Part between two H-lines
    (b) Part between two A-lines
    (c) Part between two I-bands
    (d) Part between two Z-lines

135. Which statement is correct for muscle contraction ?
    (a) Length of H-zone is decreased
    (b) Length of A-band remains constant
    (c) Length of I-band gets increased
    (d) Length of two Z-line get increased

136. Frequency of an allele in an isolated population may change due to :
    (a) genetic drift   (b) gene flow
    (c) mutation   (d) natural selection

137. In Lederberg's replica plating experiment what was used to obtain streptomycin resistant strain ?
    (a) Minimal medium and streptomycin
    (b) Complete medium and streptomycin
    (c) Only minimal medium
    (d) Only complete medium

138. Forthcoming generations are less adaptive than their parental generation due to :
    (a) natural selection
    (b) mutation
    (c) genetic drift
    (d) adaptation

139. During regeneration, modification of an organ to other organ is known as :
    (a) morphalogenesis   (b) epimorphosis
    (c) morphallaxis   (d) acretionary growth

140. Occurrence of endemic species in South America and Australia is due to :
    (a) extinction of these species from other regions
    (b) continental separation
    (c) absence of terrestrial route to these places
    (d) retrogressive evolution

141. If Darwin's theory of pangenesis shows similarity with theory of inheritance of acquired characters then what shall be correct according to it ?
    (a) Useful organs become strong and developed while useless organs become extinct. These organs help in struggle for survival
    (b) Size of organs increase with ageing
    (c) Development of organs is due to will power
    (d) There should be some physical basis of inheritance

142. In which of the following animal, post anal tail is found ?
    (a) Earthworm   (b) Lower invertebrate
    (c) Scorpion   (d) Snake

143. In which of the following chlorocruorin pigment is found ?
    (a) Annelida   (b) Echinodermata
    (c) Insecta   (d) Lower Chordata

144. Anemophilous type of pollination is found in :
    (a) *Salvia*   (b) Bottle brush
    (c) *Vallisneria*   (d) Coconut

145. What is the eye of potato ?
    (a) Axillary bud   (b) Accessory bud
    (c) Adventitious bud (d) Apical bud

146. Due to discovery of which of the following in 1980's the evolution was termed as RNA world ?
    (a) m-RNA, t-RNA, r-RNA synthesize proteins
    (b) In some viruses, RNA is genetic material
    (c) Some RNAs have enzymatic property
    (d) RNA is not found in all cells

147. Which pair is wrong ?
    (a) C_3—Maize
    (b) C_4—Kranz anatomy
    (c) Calvin cycle—PGA
    (d) Hatch and Slack cycle—OAA

148. Which breaks dormancy of potato tuber ?
    (a) Gibberellin
    (b) IAA
    (c) ABA
    (d) Zeatin

149. Hormone responsible for senescence is :
    (a) ABA   (b) auxin
    (c) GA   (d) cytokinin

150. Which of the following prevents the fall of fruits ?
    (a) GA_3 (b) NAA
    (c) Ethylene   (d) Zeatin

151. Loading of phloem is related to :
    (a) increase of sugar in phloem
    (b) elongation of phloem cell
    (c) separation of phloem parenchyma
    (d) strengthening of phloem fiber

152. Which pigment system is inactivated in red drop ?
    (a) PS-I and PS-II   (b) PS-I
    (c) PS-II   (d) none of these

153. Which plant is LDP ?
    (a) Tobacco   (b) *Glycine max*
    (c) *Mirabilis jalapa* (d) Spinach

154. Photolithotrophs :
    (a) obtain energy from radiations and hydrogen from organic compounds
    (b) obtain energy from radiations and hydrogen from inorganic compounds
    (c) obtain energy from organic compound
    (d) obtain energy from inorganic compounds

155. In which of the following plant sunken stomata are found ?
    (a) *Nerium*   (b) *Hydrilla*
    (c) Mango   (d) Guava

156. Characteristics feature of human cornea is that :
    (a) it is secreted by conjuctiva and glandular tissue
    (b) It is lacrimal gland which secretes tears
    (c) blood circulation is absent in cornea
    (d) in old age it become hard and white layer deposits on it which causes the cataract :

157. Which of these is most infectious disease ?
    (a) Hepatitis-B   (b) AIDS
    (c) Cough and cold (d) Malaria

158. Interferons are synthesized in response to :
    (a) mycoplasma   (b) bacteria
    (c) viruses   (d) fungi

159. Cauliflower mosaic virus contains :
    (a) ss RNA   (b) ds RNA
    (c) ds DNA   (d) ss DNA

160. Reason of lung cancer :
    (a) coal mining
    (b) calcium fluoride
    (c) cement factory
    (d) bauxite mining

161. *E. coli* about to replicate was placed in a medium containing radioactive thymidine for five minutes. Then it was made to replicate in a normal medium. Which of the following observation shall be correct ?
    (a) Both the strands of DNA will be radioactive
    (b) One strand radioactive
    (c) Each strand half radioactive
    (d) None is radioactive

162. Most abundant organic compound on earth is :
    (a) protein   (b) cellulose
    (c) lipids   (d) steroids

163. Male XX and female XY sometime occur due to :
    (a) deletion
    (b) transfer of segments in X and Y chromosomes
    (c) aneuploidy
    (d) hormonal imbalance

164. Number of Barr bodies in XXXX female :
    (a) 1   (b) 2
    (c) 3   (d) 4

165. Types of RNA polymerase required in nucleus for RNA synthesis :
    (a) 1   (b) 2
    (c) 3   (d) 4

166. What is true for archaebacteria ?
(a) All are halophilic
(b) All are photosynthetic
(c) All are fossils
(d) These are oldest living beings

167. Extranuclear inheritance occurs in :
(a) Killer *Paramecium*
(b) Killer *Amoeba*
(c) *Euglena*
(d) *Hydra*

168. Extranuclear chromosomes occur in :
(a) peroxisome, ribosome
(b) chloroplast and mitochondria
(c) mitochondria and ribosome
(d) chloroplast and lysosome

169. Spoilage of oil can be detected by which fatty acid ?
(a) Oleic acid   (b) Linolenic acid
(c) Linoleic acid   (d) Erusic acid

170. When we migrate from dark to light, we fail to see for some time but after a time visibility becomes normal. It is an example of :
(a) accomodation   (b) adaptation
(c) mutation   (d) photoperiodism

171. In plants, inulin and pectin are :
(a) reserve materials
(b) wastes
(c) excretory material
(d) insect-attracting material

172. Gene and cistron words are sometimes used synonymously because :
(a) one cistron contains many genes
(b) one gene contains many cistrons
(c) one gene contains one cistron
(d) one gene contains no cistron

173. Element necessary for the middle lamella :
(a) Ca   (b) Zn
(c) K   (d) Cu

174. *Cycas* has two cotyledons but is not included in angiosperms because of :
(a) naked ovules   (b) stems like monocot
(c) circinate ptyxis (d) compound leaves

175. Plant decomposers are :
(a) Monera and fungi
(b) Fungi and plants
(c) Protista and Animalia
(d) Animalia and Monera

176. What is true for cyanobacteria ?
(a) Oxygenic with nitrogenase
(b) Oxygenic without nitrogenase
(c) Non-oxygenic with nitrogenase
(d) Non-oxygenic without nitrogenase

177. m-RNA is synthesized on DNA template in which direction ?
(a) $5' \rightarrow 3'$ (b) $3' \rightarrow 5'$
(c) Both (a) and (b) (d) Any

178. Cytochrome is :
(a) metallo flavoprotein
(b) Fe containing porphyrin pigment
(c) glycoprotein
(d) lipid

179. Which of the following are less general in characters as compared to genus ?
(a) Species   (b) Division
(c) Class   (d) Family

180. Adhesive pads of fungi penetrate the host with the help of :
(a) mechanical pressure and enzymes
(b) hooks and suckers
(c) softening by enzymes
(d) only by mechanical pressure

181. Microtubules are absent in :
(a) mitochondria   (b) flagella
(c) spindle fibres   (d) centriole

182. Which aquatic fern performs nitrogen fixation ?
(a) *Azolla*   (b) *Nostoc*
(c) *Salvia*   (d) *Salvinia*

183. Roots of which plant contains a red pigment which have affinity for oxygen ?
(a) Carrot   (b) Soyabean
(c) Mustard   (d) Radish

184. Triticale is obtained by crossing wheat with :
(a) oat   (b) barley
(c) maize   (d) rye

185. At the time of organogenesis, genes regulate the process at different levels and at different time due to :
(a) promoter   (b) regulator
(c) intron   (d) exon

186. A mutant strain of T_4-bacteriophage R-II, fail to lyse the *E.coli* but when two strains R - II and R - II^y are mixed then they lyse the *E.coli*. What may be the possible reason ?
(a) Bacteriophage transforms in wild
(b) It is not mutated
(c) Both strains have similar cistrons
(d) Both strains have different cistrons

187. Reason of diversity in living beings is :
    (a) mutation
    (b) long term evolutionary change
    (c) gradual change
    (d) short term evolutionary change

188. Sickle cell anaemia is due to :
    (a) change of amino acid in α-chain of haemoglobin
    (b) change of amino acid in β-chain of haemoglobin
    (c) change of amino acid in both α and β chains of haemoglobin
    (d) change of amino acid in either α or β chain of haemoglobin

89. Similarities in organisms with different genotypes indicates :
    (a) micro-evolution
    (b) macro-evolution
    (c) convergent evolution
    (d) divergent evolution

90. What is correct for blood group 'O' ?
    (a) No antigens but both a and b antibodies are present
    (b) A antigen and b antibody
    (c) Antigen and antibody both absent
    (d) A and B antigens and a, b antibodies

91. Which of the following is closest relative of man ?
    (a) Chimpanzee
    (b) Gorilla
    (c) Orangutan
    (d) Gibbon

92. Which of the following is correct order of the evolutionary history of man ?
    (a) Peking man, Homo sapiens, Neanderthal man, Cro-Magnon man
    (b) Peking man, Neanderthal man, Homo sapiens, Cro-Magnon man
    (c) Peking man, Hedelberg man, Neanderthal man, Cro-Magnon man
    (d) Peking man, Neanderthal man, Homo sapiens, Hedelberg man

93. Which cells do not form layer and remains structurally separate ?
    (a) Epithelial cells
    (b) Muscle cells
    (c) Nerve cells
    (d) Gland cells

194. During an injury nasal septum gets damaged. For it's recovery which cartilage is preferred ?
    (a) Elastic cartilage
    (b) Hyaline cartilage
    (c) Calcified cartilage
    (d) Fibrous cartilage

195. First life on earth was :
    (a) cyanobacteria
    (b) chemoheterotrophs
    (c) autotrophs
    (d) photoautotrophs

196. Plasmid is :
    (a) fragment of DNA which acts as vector
    (b) a fragement which joins two genes
    (c) m-RNA which acts as carrier
    (d) autotrophic fragment

197. Monoclonal antibodies :
    (a) are obtained from a cell and act on one antigen
    (b) are obtained from a group of cells and act on more than one antigens
    (c) are obtained from a group of same type of cells and act on single antigen
    (d) are obtained from a group of same type of cells and act one more than one antigens

198. Which of these do not follow independent assortment ?
    (a) Genes on non-homologous chromosomes and absence of linkage
    (b) Genes on homologous chromosomes
    (c) Linked genes on same chromosomes
    (d) Unlinked genes on same chromosome

199. In his experiment, Mendel obtained wrinkled pea. The wrinkling was due to deposition of sugar instead of starch. This happened due to the enzyme :
    (a) amylase
    (b) invertase
    (c) diastase
    (d) absence of starch-branching enzyme

200. In negative operon :
    (a) co-repressor binds with repressor
    (b) co-repressor does not bind with repressor
    (c) co-repressor binds with inducer
    (d) c–AMP has negative effect on lac operon

ANSWERS

➡ PHYSICS

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

➡ CHEMISTRY

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

➡ BIOLOGY

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

HINTS & SOLUTIONS

Physics

1. $E = h\nu$

$\Rightarrow h$ = Planck's constant = $\dfrac{E}{\nu}$

$\therefore \quad [h] = \dfrac{[E]}{[\nu]} = \dfrac{[ML^2T^{-2}]}{[T^{-1}]} = [ML^2T^{-1}]$

(a) Linear momentum = mass × velocity

or $\qquad p = m \times v$

or $\qquad [p] = [m] \times [v] = [M][LT^{-1}] = [MLT^{-1}]$

(b) Angular momentum = moment of inertia

$\qquad\qquad\qquad\qquad$ × angular velocity

or $\qquad L = I \times \omega = mr^2\omega \qquad [\because I = mr^2]$

$\therefore \qquad [L] = [M][L^2][T^{-1}] = [ML^2T^{-1}]$

(c) Energy $[E] = [ML^2T^{-2}]$

(d) Power = force × velocity

or $\qquad P = F \times v$

$\therefore \qquad [P] = [MLT^{-2}][LT^{-1}] = [ML^2T^{-3}]$

Hence, option (b) is correct.

NOTE : According to homogeneity of dimensions, the dimensions of all the terms in a physical expression should be same. For example, in the physical expression $s = ut + \dfrac{1}{2}at^2$, the dimensions of s, ut and $\dfrac{1}{2}at^2$ all are same.

2. We have given

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

Squaring both the sides, we obtain

$$|\vec{A} + \vec{B}|^2 = |\vec{A} - \vec{B}|^2$$

or $\quad (\vec{A} + \vec{B}) \cdot (\vec{A} + \vec{B}) = (\vec{A} - \vec{B}) \cdot (\vec{A} - \vec{B})$

or $\quad \vec{A} \cdot \vec{A} + \vec{A} \cdot \vec{B} + \vec{B} \cdot \vec{A} + \vec{B} \cdot \vec{B} = \vec{A} \cdot \vec{A} - \vec{A} \cdot \vec{B}$
$$- \vec{B} \cdot \vec{A} + \vec{B} \cdot \vec{B}$$

or $\quad \vec{A} \cdot \vec{B} + \vec{A} \cdot \vec{B} = -\vec{A} \cdot \vec{B} - \vec{A} \cdot \vec{B}$

$$(\because \vec{B} \cdot \vec{A} = \vec{A} \cdot \vec{B})$$

or $\quad 4 \vec{A} \cdot \vec{B} = 0$

or $\quad \vec{A} \cdot \vec{B} = 0$

Since, dot product of $\vec{A}$ and $\vec{B}$ is zero hence, $\vec{A}$ and $\vec{B}$ are mutually perpendicular, *i.e.*, angle between $\vec{A}$ and $\vec{B}$ is 90°.

3. Let u be the initial velocity and H the maximum height attained.

When at height $h = \dfrac{H}{2}$, we have

$$v = v_1 = 10 \text{ m/s}$$

From third equation of motion

$$v_1^2 = u^2 - 2gh$$

or $\quad (10)^2 = u^2 - 2g \dfrac{H}{2}$ ...(i)

At height H, $\quad v_2 = 0$

$$v_2^2 = u^2 - 2gH$$

or $\quad 0 = u^2 - 2gH$ ...(ii)

Subtract Eq. (ii) from Eq. (i), we get

$$(10)^2 = 2g \dfrac{H}{2}$$

or $\quad H = \dfrac{(10)^2}{g}$

or $\quad H = \dfrac{(10)^2}{10} = 10 \text{ m}$

Alternative : Maximum height attained by the stone

$$H = \dfrac{u^2}{2g}$$

When $\quad h = \dfrac{H}{2}, u = 10 \text{ m/s}$

$$\dfrac{H}{2} = \dfrac{(10)^2}{2g}$$

or $\quad H = \dfrac{100}{10} = 10 \text{ m}$

4. Key Idea : *Equate the momenta of the system along two perpendicular axes.*

Let u be the velocity and θ the direction of the third piece as shown.
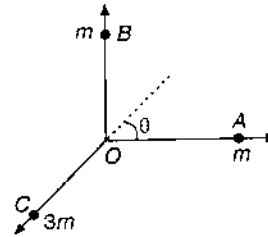
Equating the momenta of the system along OA and OB to zero, we get

$$m \times 30 - 3m \times v \cos \theta = 0 \quad ...(i)$$
and $\quad m \times 30 - 3m \times v \sin \theta = 0 \quad ...(ii)$

These give $3mv \cos \theta = 3mv \sin \theta$

or $\quad \cos \theta = \sin \theta$

$\therefore \quad \theta = 45°$

Thus, $\angle AOC = \angle BOC = 180° - 45° = 135°$

Putting the value of θ in Eq. (i), we get

$$30m = 3mv \cos 45° = \dfrac{3mv}{\sqrt{2}}$$

$\therefore \quad v = 10\sqrt{2} \text{ m/s}$

The third piece will go with a velocity of $10\sqrt{2}$ m/s in a direction making an angle of 135° with either piece.

Alternative : Key Idea : *The square of momentum of third piece is equal to sum of squares of momentum first and second pieces.*

As from key idea,

$$p_3^2 = p_1^2 + p_2^2$$

or $\quad p_3 = \sqrt{p_1^2 + p_2^2}$

or $\quad 3mv_3 = \sqrt{(m \times 30)^2 + (m \times 30)^2}$

or $\quad v_3 = \dfrac{30\sqrt{2}}{3} = 10\sqrt{2} \text{ m/s}$

5. Angular velocity of particle is,

$$\omega = \dfrac{2\pi}{T} \text{ or } \omega \propto \dfrac{1}{T}$$

It simply implies that ω does not depend on mass of the body and radius of the circle.

$$\therefore \qquad \frac{\omega_1}{\omega_2} = \frac{T_2}{T_1}$$

but time period is given same, i.e., $T_1 = T_2$

Hence, $\qquad \dfrac{\omega_1}{\omega_2} = \dfrac{1}{1}$

6. **Key Idea :** *For a body rolling without slipping, the velocity of any point P on the body is $\vec{v}_P = \vec{v}_{cm} + \vec{v}_{P, cm}$ where $\vec{v}_{P, cm} = R\omega$ in direction perpendicular to line joining centre and point P.*

Velocity of point A is,

$$\begin{aligned} v_A &= v_{cm} + R\omega \\ &= v_{cm} + v_{cm} \qquad (\because v_{cm} = R\omega) \\ &= 2v_{cm} \end{aligned}$$

Velocity of point B is,

$$\begin{aligned} v_B &= v_{cm} - R\omega \\ &= v_{cm} - v_{cm} = 0 \end{aligned}$$

Thus, the velocity of point A is $2\,v_{cm}$ and velocity of point B is zero.

7. **Key Idea :** *Maximum kinetic energy of swing should be equal to difference in potential energies to conserve energy.*

From energy conservation

$$\frac{1}{2} m v_{max}^2 = mg(H_2 - H_1)$$

Here, H_1 = minimum height of swing from earth's surface = 0.75 m

H_2 = maximum height of swing from earth's surface = 2m

$$\therefore \qquad \frac{1}{2} m v_{max}^2 = mg(2 - 0.75)$$

or $\qquad v_{max} = \sqrt{2 \times 10 \times 1.25}$

$\qquad\qquad\quad = \sqrt{25} = 5$ m/s

8. In SHM, the total energy = potential energy + kinetic energy

or $E = U + K$

$$\begin{aligned} &= \frac{1}{2} m\omega^2 x^2 + \frac{1}{2} m\omega^2 (A^2 - x^2) \\ &= \frac{1}{2} m\omega^2 A^2 \\ &= \frac{1}{2} kA^2 \end{aligned}$$

where k = force constant = $m\omega^2$

Thus, total energy depends on k and A.

9. **Key Idea :** *At highest point of projection, the vertical component of velocity is zero and there is only horizontal component of velocity.*

At the highest point

$$\begin{aligned} v_x &= u \cos\theta \\ v_y &= 0 \\ K_H &= \frac{1}{2} m v_x^2 \end{aligned}$$

or $\qquad K_H = \frac{1}{2} mu^2 \cos^2\theta \qquad$ ...(i)

Initial kinetic energy is

$$K = \frac{1}{2} mu^2 \qquad \text{...(ii)}$$

From Eq. (i) and (ii), we get

$$\begin{aligned} K_H &= K \cos^2\theta = K \cos^2 45° \\ &= K \times \left(\frac{1}{\sqrt{2}}\right)^2 = \frac{K}{2} \end{aligned}$$

10. **Key Idea :** *The force imparted (or impulse) by the ball to the hands of the player is equal to the rate of change of linear momentum.*

Force imparted = Rate of change of momentum

or $\qquad F = \dfrac{\Delta p}{\Delta t}$

or $\qquad F = \dfrac{p_1 - p_2}{\Delta t}$

or $\qquad F = \dfrac{m(v_1 - v_2)}{\Delta t}$

Here, $m = 150$ g = 0.150 kg, $v_1 = 20$ m/s, $v_2 = 0$

$\qquad \Delta t = 0.1$ s

$\therefore \qquad F = \dfrac{0.150 \times (20 - 0)}{0.1} = 30$ N

11. **Key Idea :** *According to the conservation of energy, total energy at the surface of earth must equal to the total energy at the maximum height.*

As from key idea,

energy at surface of earth = energy at maximum height

or $\qquad (K + U)$ at earth's surface = $(K + U)$ at maximum height

$$\therefore \qquad \frac{1}{2} mu^2 - \frac{GMm}{R} = \frac{1}{2} m \times (0)^2 - \frac{GMm}{R + h}$$

or $\qquad \dfrac{1}{2} mu^2 = \dfrac{GMm}{R} - \dfrac{GMm}{R + R} \qquad (\because h = R)$

or $\qquad u^2 = \dfrac{2GM}{R} - \dfrac{2GM}{2R}$

or $\qquad u^2 = \dfrac{GM}{R}$

$$\therefore \qquad u = \sqrt{\frac{GM}{R}}$$

Alternative : The expression for the speed with which a body should be projected so as to reach a height h is

$$u = \sqrt{\frac{2gh}{1 + (h/R)}}$$

Here, $h = R$ (given)

$$u = \sqrt{\frac{2gR}{1 + (R/R)}}$$

$$= \sqrt{\frac{2 \times \dfrac{GM}{R^2} \times R}{2}} = \sqrt{\frac{GM}{R}}$$

12. The given progressive waves are

$$y_1 = a \sin (\omega t + \phi_1)$$
$$y_2 = a \sin (\omega t + \phi_2)$$

The resultant of two waves is

$$y = y_1 + y_2$$
$$= a[\sin (\omega t + \phi_1) + \sin (\omega t + \phi_2)]$$

If A is the amplitude of resultant wave, then

$$A = a \qquad\qquad\text{(given)}$$
$$\therefore \qquad A^2 = a^2 + a^2 + 2a^2 \cos \phi$$
$$\text{or} \qquad a^2 = a^2 + a^2 + 2a^2 \cos \phi$$
$$\text{or} \qquad \cos \phi = -\frac{1}{2} = \cos 120°$$
$$\therefore \qquad \phi = 120° = \frac{2\pi}{3}$$

Thus, $\phi_1 - \phi_2 = \dfrac{2\pi}{3}$

13. The frictional force acting on the block
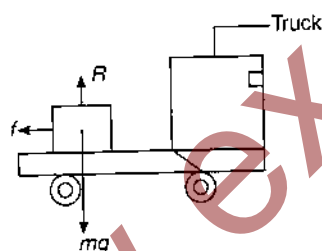
$$f = \mu R$$

but from figure, $R = mg$

$$\therefore \qquad f = \mu mg$$

Here, $\mu = 0.6$, $m = 1$ kg, $g = 10$ m/s^2

$$\therefore \qquad f = 0.6 \times 1 \times 10 = 6 \text{ N}$$

NOTE : Due to acceleration of truck, the block experiences a forward force

$$F = ma$$
$$= 1 \times 5 = 5\text{N}$$

Since $f > F$, so block is not displaced from its previous position.

14. When a wave enters from one medium to another, its frequency remains unchanged, *i.e.*, $n_1 = n_2$ but wavelength, intensity and velocity get changed.

15. Efficiency of the system is,

$$\eta = \frac{\text{output work}}{\text{input work}}$$

Input work $= Fs = 250 \times 12$
Output work $= mgh = 75 \times 10 \times 3$

So, $\qquad \eta = \dfrac{75 \times 10 \times 3}{250 \times 12} = 0.75 = 75\%$

16. **Key Idea :** *When a string is stretched, then work done in stretching it through a distance x is the potential energy stored in it.*

Potential energy stored = Workdone in stretching

or $\qquad U = \dfrac{1}{2} k x^2$

Also $\qquad F = kx$

or $\qquad x = \dfrac{F}{k}$

So, $\qquad U = \dfrac{1}{2} k \left(\dfrac{F}{k}\right)^2$

i.e., $\qquad U \propto \dfrac{1}{k} \qquad$ (for constant force)

$$\therefore \qquad \frac{U_B}{U_A} = \frac{k_A}{k_B}$$

but $k_B = 2k_A$

$$\therefore \qquad U_B = U_A \times \frac{k_A}{2k_A} = \frac{U_A}{2} = \frac{E}{2}$$

17. **Key Idea :** *The relation between the wavelength corresponding to maximum intensity of radiation at any temperature is given by Wien's displacement law.*

Wien's displacement law is given by

$$\lambda_m T = \text{constant}$$
$$\text{or} \qquad \lambda_1 T_1 = \lambda_2 T_2$$
$$\text{or} \qquad \lambda_2 = \lambda_1 \left(\frac{T_1}{T_2}\right)$$

Here, $T_1 = 2000$ K, $T_2 = 3000$ K, $\lambda_1 = \lambda$

$$\therefore \qquad \lambda_2 = \lambda \times \frac{2000}{3000} = \frac{2}{3} \lambda$$

18. Efficiency of heat engine is,

$$\eta = 1 - \frac{T_2}{T_1} \quad \text{or} \quad \eta = \frac{T_1 - T_2}{T_1}$$

Here, $T_1 = 273 + 127 = 400$ K

$$T_2 = 273 + 27 = 300 \text{ K}$$

$$\therefore \quad \eta = \frac{400 - 300}{400} = \frac{100}{400} = 0.25 = 25\%$$

Hence, 26% efficiency is impossible for a given heat engine.

19. Key Idea : *The standard wave equation is*

$$y = a \sin(\omega t - k x)$$

The given wave equation is

$$y = a \sin\left(100t - \frac{x}{10}\right)$$

Compare it with the standard wave equation, we obtain

$$\omega = 100, \ k = \frac{1}{10}$$

Velocity of the wave,

$$v = \frac{\omega}{k} = \frac{100}{\frac{1}{10}} = 100 \times 10 = 1000 \text{ m/s}$$

20. Key Idea : *The frequency of vibrating wire is*
$n = \frac{1}{2l}\sqrt{\frac{T}{m}}$, *where T is the tension in the wire.*

We have $n = \frac{1}{2l}\sqrt{\frac{T}{m}}$

Here, m = mass per unit length = $\pi r^2 d$

$$\therefore \quad n = \frac{1}{2l}\sqrt{\frac{T}{\pi r^2 d}}$$

or $\quad n \propto \left(\frac{T}{r^2 d}\right)^{1/2}$

or $\quad n \propto \frac{1}{r}\left(\frac{T}{d}\right)^{1/2}$

$$\therefore \quad \frac{n_1}{n_2} = \frac{r_2}{r_1}\left(\frac{T_1}{T_2} \times \frac{d_2}{d_1}\right)^{1/2}$$

We have given,

$$\frac{T_1}{T_2} = \frac{1}{2}, \ \frac{d_1}{d_2} = 2, \ \frac{r_1}{r_2} = \frac{1}{2}$$

$$\therefore \quad \frac{n_1}{n_2} = \frac{2}{1}\left(\frac{1}{2} \times \frac{1}{2}\right)^{1/2}$$

or $\quad \frac{n_1}{n_2} = \frac{2}{1} \times \frac{1}{2} = 1$

or $\quad n_2 = n_1 = n$

21. (a) Interference is a phenomenon in which two waves of same frequency superpose to give resultant intensity different from sum of their separate intensity. So, it cannot exhibit particles nature of light.

(b) Diffraction is a phenomenon in which light bends at sharp ends of an obstacle or a hole. So it also can't exhibit particle's nature of light.

(c) Polarisation of light is a property owing to which a light ray after emerging through a crystal (a special kind like tourmaline) have vibrations in a plane perpendicular to its direction of propagation. So, it also can't explain particle's nature of light.

(d) Photoelectric effect states that light travels in the form of bundles or packets of energy, called photons. This effect is explained on the basis of quantum nature of light. So, it clearly explain the particle's nature of light.

Hence, choice (d) is correct.

22. An optical fibre is a device based on total internal reflection by which a light signal can be transferred from one place to the other with a negligible loss of energy.

Quartz (μ=1.7)
Layer (μ=1.5)
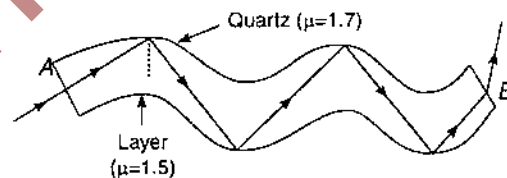
It consists of a very long and thin fibre of quartz glass.

When a light ray is incident at one end A of fibre making a small angle of incidence. It suffers multiple total internal reflections and finally it reaches the point B.

23. The main constituent of atmosphere called ozone lies in layer 'Ozone Sphere' extending from 30 km to nearly 50 km above the earth's surface. This layer absorbs the major part of the ultraviolet radiations and X-rays coming from the sun and does not allow them to reach the earth's surface. These radiations are harmful for men, animals and plants. It is for this reason that ozone layer is crucial for human survival.

24. Key Idea : *The light from the source will not emerge out of water if angle of incidence is greater than critical angle.*
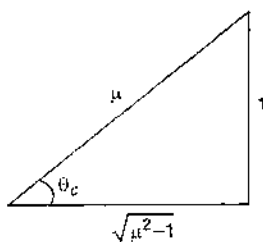
As shown in figure, $i > \theta_C$.
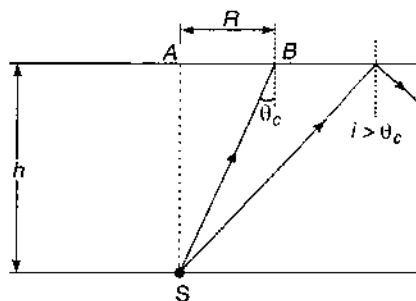
Therefore, minimum radius R corresponds to $i = \theta_C$.

In $\triangle SAB$

$$\frac{R}{h} = \tan \theta_C$$

$\therefore \qquad R = h \tan \theta_C$

or $\qquad R = \dfrac{h}{\sqrt{\mu^2 - 1}} = \dfrac{4}{\sqrt{\left(\dfrac{5}{3}\right)^2 - 1}}$

$\qquad = \dfrac{4 \times 3}{\sqrt{25 - 9}} = \dfrac{4 \times 3}{4} = 3$ m

25. Intensity of light source is given by

$$I \propto \frac{1}{d^2}$$

where d is the distance of light source from the cell.

or $\qquad \dfrac{I_1}{I_2} = \left(\dfrac{d_2}{d_1}\right)^2 = \left(\dfrac{1}{2}\right)^2 = \dfrac{1}{4}$

or $\qquad I_2 = 4I_1$

As number of photoelectrons emitted is directly proportional to intensity, so number of photoelectrons emitted will become 4 times, *i.e.*, $4\,n$.

26. When a current is passed through the galvanometer coil, then a magnetic field B is produced at right angles to the plane of the coil, *i.e.*, at right angles to the horizontal component of earth's magnetic field H. Under the influence of two crossed magnetic fields B and H, the magnetic needle of galvanometer undergoes a deflection θ which is given by the Tangent law. Using Tangent law, we can find a relation

$$I \propto \tan \theta$$

which clearly indicates that tangent galvanometer is an instrument used for detection of electric current in a circuit.

NOTE : A tangent galvanometer is most accurate when its deflection is 45°.

27. If a capacitor of capacitance C is connected with an AC signal, then reactance of that circuit is purely capacitive.

The capacitive reactance is

$$X = \frac{1}{\omega C} = \frac{1}{2\pi f C} \qquad (\omega = 2\pi f)$$

or $\qquad X \propto \dfrac{1}{fC}$

$\therefore \qquad \dfrac{X'}{X} = \dfrac{fC}{f'C'} = \dfrac{f \times C}{2f \times 2C}$

or $\qquad \dfrac{X'}{X} = \dfrac{1}{4}$

or $\qquad X' = \dfrac{X}{4}$

28. Out of the given choices, X-rays and γ-rays are electromagnetic waves, so have no charge. β-particles are negatively charged particles and are fast moving electrons. Alpha (α) particles have positive charge and is a nucleus of helium.

29. Key Idea : *Energy stored between the plates of a capacitor is equal to* $\dfrac{1}{2}\dfrac{Q^2}{C}$.

Energy stored, $U = \dfrac{1}{2}\dfrac{Q^2}{C}$

but $\sigma = \dfrac{Q}{A}$ and $C = \dfrac{\varepsilon_0 A}{d}$

$\therefore \qquad U = \dfrac{1}{2}\dfrac{(\sigma A)^2}{(\varepsilon_0 A/d)}$

or $\qquad U = \dfrac{A\sigma^2 d}{2\varepsilon_0}$

or $\qquad U = \dfrac{1}{2}\left(\dfrac{\sigma}{\varepsilon_0}\right)^2 \times \varepsilon_0 Ad$

or $\qquad U = \dfrac{1}{2}E^2\varepsilon_0 Ad$

Energy stored per unit volume *i.e.*, energy density is thus given by

$$u = \dfrac{U}{V} = \dfrac{U}{Ad} = \dfrac{1}{2}\varepsilon_0 E^2$$
$$= \dfrac{1}{2}\varepsilon_0\left(\dfrac{V}{d}\right)^2 = \dfrac{1}{2}\dfrac{\varepsilon_0 V^2}{d^2}$$

NOTE : $\dfrac{1}{2}\varepsilon_0 E^2$ is also a force on a conductor per unit area which is every where along the outward drawn normal to the surface.

30. **Key Idea :** *According to Gauss' law, total electric flux through a closed surface is equal to* $\dfrac{1}{\varepsilon_0}$ *times the total charge enclosed by the surface.*

From key idea, the electric flux emerging from the cube is

$$\phi = \dfrac{1}{\varepsilon_0} \times \text{charge enclosed}$$
$$= \dfrac{1}{\varepsilon_0} \times q \times 10^{-6}$$

Since, a cube has six faces, so electric flux through each face is,

$$\phi' = \dfrac{\phi}{6} = \dfrac{1}{6\varepsilon_0} \times q \times 10^{-6} = \dfrac{q \times 10^{-6}}{6\varepsilon_0}$$

31. The magnetic susceptibility of a material is a measure of the 'ease' with which a specimen of that material can be magnetised in a magnetising field. For a diamagnetic substance magnetic susceptibility (χ_m) is independent of temperature.

    NOTE : According to Curie's law χ_m for paramagnetic and ferromagnetic materials varies as $\chi_m \propto \dfrac{1}{T}$, *T* being Kelvin temperature.

32. If electric dipole is placed perpendicular to electric field, in this case net force on dipole will be zero but torque on dipole will not be zero.
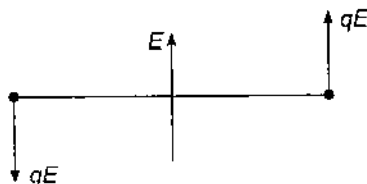
Torque $\qquad \tau = pE \sin\theta$

or $\qquad \vec{\tau} = \vec{\mathbf{p}} \times \vec{\mathbf{E}}$

33. If there are *N* turns in a coil, *i* is the current flowing and *A* is the area of the coil then magnetic dipole moment or simply magnetic moment of the coil is

$$M = NiA$$

34. **Key Idea :** *Resistivity of a metal is directly proportional to temperature and resistivity of semiconductor is inversely proportional to temperature.*

Resistivity of metal $\propto$ Temperature

Resistivity of semiconductor $\propto \dfrac{1}{\text{Temperature}}$

This implies that with decrease in temperature resistivity of metal decreases while that of semiconductor increases.

Here, Si is a semiconductor and Cu is a metal.

So, resistivity of Si increases but that of Cu decreases.

35. **Key Idea :** *In a Wheatstone's bridge, if* $\dfrac{P}{Q} = \dfrac{R}{S}$, *then resistance of galvanometer will be inaffective.*

The given circuit can be shown as,
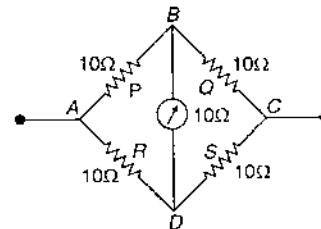
From figure, $\dfrac{P}{Q} = \dfrac{10}{10} = 1$

$\dfrac{R}{S} = \dfrac{10}{10} = 1$

$\therefore \qquad \dfrac{P}{Q} = \dfrac{R}{S}$

Therefore, the galvanometer will be ineffecitve.

The above Wheatstone's bridge can be redrawn as
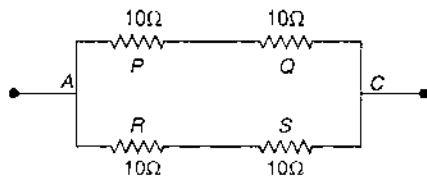
Resistances P and Q are in series, so
$$R' = 10 + 10 = 20\,\Omega$$
Resistances R and S are in series, so
$$R'' = 10 + 10 = 20\,\Omega$$
Now, R' and R'' are in parallel hence, net resistance of the circuit
$$= \frac{R' \times R''}{R' + R''} = \frac{20 \times 20}{20 + 20} = 10\,\Omega$$

36. Key Idea : *The emf is given by the relation* $e = -L\dfrac{di}{dt}$.

It is given that emf is zero *i.e.*,
$$e = -L\frac{di}{dt} = 0$$
or
$$L\frac{di}{dt} = 0$$
or
$$\frac{d}{dt}(t^2 e^{-t}) = 0$$
or
$$2t \times e^{-t} + t^2 \times (-1)e^{-t} = 0$$
or
$$te^{-t}(2 - t) = 0$$
or
$$t = 2\,s \qquad (\because te^{-t} \neq 0)$$

37. Key Idea : *Potential gradient of a wire is equal to potential fall per unit length.*

Potential gradient = Potential fall per unit length
$$= \text{Current} \times \text{Resistance per unit length}$$
$$= i \times \frac{R}{l}$$
but $R = \dfrac{\rho l}{A}$
$$\Rightarrow \frac{R}{l} = \frac{\rho}{A}$$
$\therefore$ Potential gradient $= i \times \dfrac{\rho}{A}$

Here, $\rho = 10^{-7}\,\Omega\text{-m}$, $i = 0.1\,A$, $A = 10^{-6}\,m^2$

Hence, potential gradient $= 0.1 \times \dfrac{10^{-7}}{10^{-6}} = \dfrac{0.1}{10}$
$$= 0.01 = 10^{-2}\,V/m$$

38. Key Idea : *From Bragg's law, the condition for the reflection of X-rays from series of atomic layers in a given plane is,*
$$2d\sin\theta = n\lambda.$$
From key idea,
wavelength $\lambda = \dfrac{2d\sin\theta}{n}$
$$\lambda_{max} = \frac{2d(\sin\theta)_{max}}{n}$$
$$= \frac{2d \times 1}{1} \qquad [\because (\sin\theta)_{max} = 1]$$
$$= 2d$$
$$= 2 \times 2.8 \times 10^{-10}\,m$$
$$= 5.6 \times 10^{-10}\,m$$

NOTE : Bragg's reflection can occur only for wavelength $\lambda \leq 2d$. Due to this fact, the visible light wavelength cannot be used in diffraction.

39. Key Idea : *Rate of heat flow is the ratio of heat transferred to the time interval.*

Rate of heat flow
$$H = \frac{Q}{t} = \frac{KA(\theta_1 - \theta_2)}{l}$$
or
$$H \propto \frac{A}{l}$$
Since, dimensions of area $(A) = [L^2]$
Dimensions of length $(l) = [L]$
$$\therefore \qquad H \propto l$$
or
$$\frac{H_2}{H_1} = \frac{l_2}{l_1} = \frac{2l_1}{l_1} \qquad (\because l_2 = 2l_1)$$
or
$$H_2 = 2H_1$$

40. For electron to pass undeflected,
electric force on electron
$$= \text{magnetic force on electron}$$
i.e.,
$$eE = evB$$
or
$$v = \frac{E}{B}$$
or
$$v = \frac{|\vec{E}|}{|\vec{B}|}$$

41. Key Idea : *For a charged particle to move in a circular path in a magnetic field, the magnetic force on charge particle provides the necessary centripetal force.*

Hence, magnetic force = centripetal force
i.e.,
$$qvB = \frac{mv^2}{r}$$
or
$$qvB = mr\omega^2 \qquad (v = r\omega)$$

or $\qquad \omega^2 = \dfrac{qvB}{mr} = \dfrac{q(r\omega)B}{mr}$

or $\qquad \omega = \dfrac{qB}{m}$

If ν is the frequency of rotation, then

$$\omega = 2\pi\nu \implies \nu = \dfrac{\omega}{2\pi}$$

$\therefore \qquad \nu = \dfrac{qB}{2\pi m}$

NOTE : In the resultant expression $\dfrac{q}{m}$ is known as specific charge. It is sometimes denoted by α. So, in terms of α, the above formula can be written as

$$\omega = B\alpha \quad \text{and} \quad \nu = \dfrac{B\alpha}{2\pi}$$

42. Key Idea : $\dfrac{\Delta i_C}{\Delta i_E}$ *is the current gain* (α) *in common-base configuration.*

$$\alpha = \dfrac{\Delta i_C}{\Delta i_E} = 0.98$$

The current gain in common-emitter configuration

$$\beta = \dfrac{\alpha}{1-\alpha} = \dfrac{0.98}{1-0.98}$$

$$= \dfrac{0.98}{0.02} = 49$$

43. In the circuit, diode D_1 is forward biased and diode D_2 is reverse biased. Therefore, no current flows in the arm containing D_2 and all of the current flows through arm containing D_1.

Thus, current flowing through the circuit

$$= \dfrac{5}{20+30} = \dfrac{5}{50}\,\text{A}$$

44. The given truth table follows a 'NAND' gate whose ouput is 1 only if at least one of its inputs is zero. Its Boolean expression is

$$Y = \overline{A \cdot B}$$

so that

$\overline{1 \cdot 1} = \overline{1} = 0$

$\overline{0 \cdot 1} = \overline{0} = 1$

$\overline{1 \cdot 0} = \overline{0} = 1$

$\overline{0 \cdot 0} = \overline{0} = 1$

NOTE : NAND gate is called as universal or digital building block because by the repeated use of NAND gates we can perform all the logic functions like OR, AND, etc.

45. When a nucleus is formed, then the mass of nucleus is slightly less than the sum of mass of Z protons and N neutrons.

i.e., $\qquad M < (Zm_p + Nm_n)$

46. In a nuclear process energy is released if binding energy per nucleon of the daughter products gets increased. In nuclear fission process, total binding energy of products formed due to nuclear fission is more than the parent fissionable material. Thus, energy is released.

47. The activity of a radioactive substance is

$$R = R_0\left(\dfrac{1}{2}\right)^n$$

Here, n = number of half-lives

$$= \dfrac{t}{T_{1/2}} = \dfrac{24}{6} = 4$$

$$R = 0.01\,\mu\text{C}$$

Hence,

$$0.01 = R_0\left(\dfrac{1}{2}\right)^4$$

or $\qquad R_0 = 0.01 \times (2)^4$

$$= 0.01 \times 16 = 0.16\,\mu\text{C}$$

48. The mass of radioactive substance remained is,

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

Here, $M = 1\,\text{g}, M_0 = 256\,\text{g}, t_{1/2} = 12.5\,\text{h}$

So, $\qquad 1 = 256\left(\dfrac{1}{2}\right)^n$

or $\qquad \dfrac{1}{256} = \left(\dfrac{1}{2}\right)^n$

or $\qquad \left(\dfrac{1}{2}\right)^8 = \left(\dfrac{1}{2}\right)^n$

Comparing the powers on both the sides, we get

$$n = 8 = \dfrac{t}{T_{1/2}}$$

$\therefore \qquad t = 8T_{1/2} = 8 \times 12.5 = 100\,\text{h}$

49. Key Idea : *In a nuclear reaction conservation of both the charge number and mass number must hold.*

The given nuclear reaction can be written as

$$_Z X^A + {_0}n^1 \rightarrow {_3}\text{Li}^7 + {_2}\text{He}^4$$
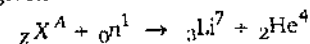
Conservation of mass number gives,

$$A + 1 = 7 + 4$$

$\implies \qquad A = 10$

Conservation of charge number gives,

$$Z + 0 = 2 + 3$$
$$\Rightarrow \qquad Z = 5$$

Hence, $Z = 5$, $A = 10$ correspond to Boron ($_5B^{10}$).

50. In a bcc structure, the position vectors of the nearest neighbours of the origin are $\left(\pm \dfrac{a}{2}\hat{\mathbf{i}}, \pm \dfrac{a}{2}\hat{\mathbf{j}}, \pm \dfrac{a}{2}\hat{\mathbf{k}} \right)$.

The distance between any two nearest neighbours is

$$\sqrt{\left(\dfrac{a}{2}\right)^2 + \left(\dfrac{a}{2}\right)^2 + \left(\dfrac{a}{2}\right)^2} = \sqrt{\dfrac{3a^2}{4}}$$
$$= \dfrac{\sqrt{3}}{2}\, a$$

Chemistry

51. The acidic behaviour of phenols may be explained due to two reasons—

    (a) Due to resonance (which is not possible in alcohols), the oxygen atom of the –OH group acquires a positive charge which helps in the release of a proton.
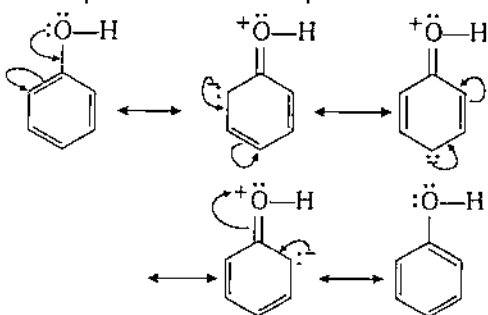
Resonance representation of phenol

    (b) In the dissociation of phenol to phenoxide ion and a proton the equilibrium lies mainly towards the right hand side as the resulting phenoxide ion is more stabilised by resonance as compared to phenol.

$$Ar\!-\!OH \rightleftharpoons ArO^- + H^+$$
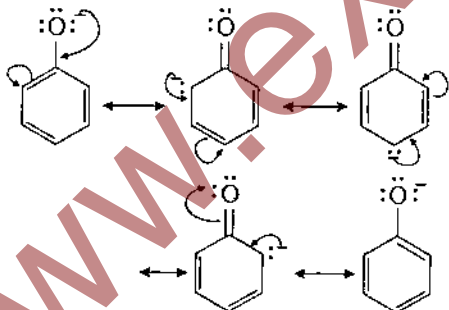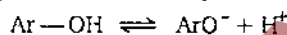
Resonance representation of phenoxide ion

The acidic strength of phenols depends on the nature of substituents present in the benzene nucleus.

Electron withdrawing groups like $-NO_2, -CN, -CHO, -COOH$ etc. when present in the *ortho* and *para* positions with respect to phenolic group increases the acidity of phenol due to greater stabilization of phenoxide ion. While the presence of electron releasing group like $-NH_2, -CH_3$ etc. decrease the acidity of phenols. This explains the following order of acidity,

p-nitrophenol > phenol > p-cresol.
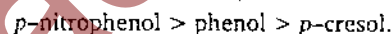
52. Chlorination of n-butane takes place by free radical mechanism as—

Step I : $Cl_2 \longrightarrow \overset{\bullet}{C}l + \overset{\bullet}{C}l$

Step II : $CH_3CH_2CH_2CH_3 + \overset{\bullet}{C}l \longrightarrow$
$$CH_3\overset{\bullet}{C}HCH_2CH_3 + HCl$$

Step III : $CH_3\overset{\bullet}{C}HCH_2CH_3 + Cl_2 \rightarrow$

Racemic mixture
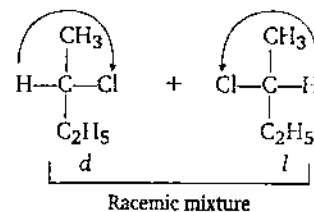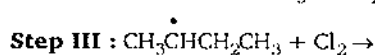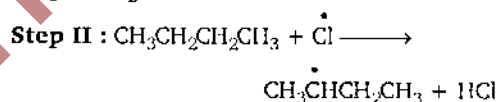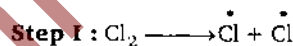
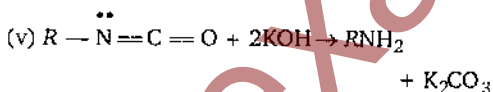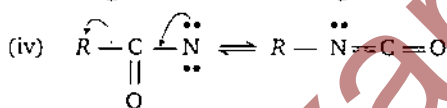53. When O_3 reacts with alkene, it forms ozonide, which on reaction with Zn and acid or H_2/Ni gives aldehydes and/or ketones. These

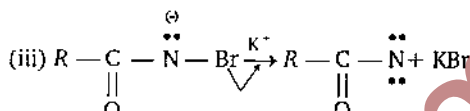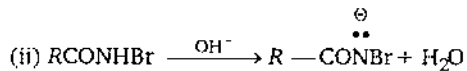products helps in locating the position of a double bond as—

$$CH_3-CH_2-CH=C\begin{array}{c}CH_3\\CH_3\end{array} + O_3 \longrightarrow$$

$$CH_3-CH_2-CHO + CH_3COCH_3 \xleftarrow{Zn/H^+/H_2O}$$

54. The reaction

$$RCONH_2 + Br_2 + KOH \longrightarrow RNH_2$$
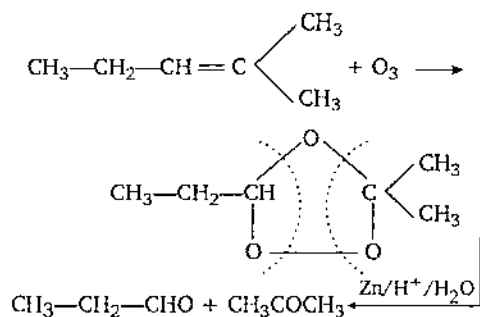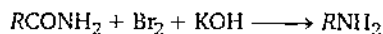
is known as Hofmann-bromamide reaction. The mechanism of this reaction is given as :

(i) $RCONH_2 + Br_2 \longrightarrow RCONHBr + HBr$

(ii) $RCONHBr \xrightarrow{OH^-} R-CONBr^{\ominus} + H_2O$

(iii) $R-\underset{O}{\underset{||}{C}}-\overset{\ominus}{\underset{..}{N}}-Br \xrightarrow{K^+} R-\underset{O}{\underset{||}{C}}-\overset{..}{\underset{..}{N}} + KBr$

(iv) $R-\underset{O}{\underset{||}{C}}-\overset{..}{\underset{..}{N}} \rightleftharpoons R-\overset{..}{\underset{..}{N}}=C=O$

(v) $R-N=C=O + 2KOH \rightarrow RNH_2 + K_2CO_3$

55. Alkyl halides reacts with Na in presence of dry ether to form alkanes is known as Wurtz reaction

$$R-X + 2Na + X-R \xrightarrow{Ether} R-R + 2NaX$$
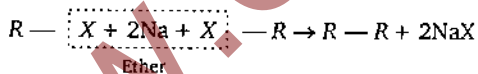
In the given question C_4H_9Cl is the *t*-butyl chloride (*A*). It reacts with Na in dry ether to form a hydrocarbon that on chlorination gives only one monochloro derivative.
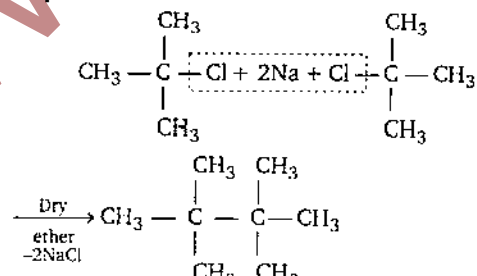
(It gives only one type of mono chloro derivative)

56. Tollen's reagent is ammoniacal silver nitrate solution and it is used for detection of aldehyde group not for unsaturation. Aldehydes reduces Tollen's reagent to give acids and silver powder is obtained which forms silver coloured mirror in the test tube.

$$R-CHO + [Ag(NH_3)_2]^+ \rightarrow RCOO^- + \underset{powder}{Ag}$$
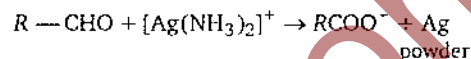
57. Glucose reduces Fehling solution to give red ppt. of Cu_2O.
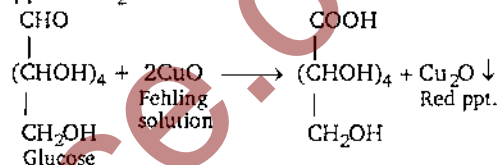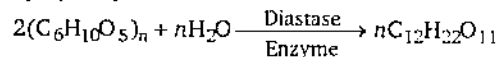

58. Terylene is formed by the condensation of methyl terephthalate and glycol. Its structure is

Terylene (Dacron)
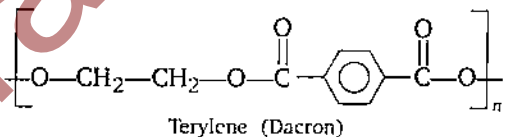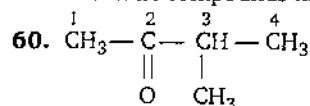
Hence, the structure of terylene is incorrect.

59. Diastase is an example of enzyme which is used for the conversion of starch into maltose by hydrolysis

$$2(C_6H_{10}O_5)_n + nH_2O \xrightarrow[\text{Enzyme}]{\text{Diastase}} nC_{12}H_{22}O_{11}$$

Acetophenone is , it is an aromatic ketone.

Cycloheptane is a cyclic compound because aromatic compounds have benzene.

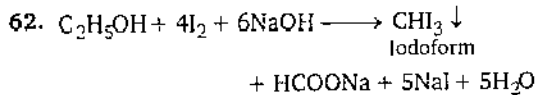**60.** $\overset{1}{CH_3}-\overset{2}{\underset{O}{\underset{||}{C}}}-\overset{3}{\underset{CH_3}{\underset{|}{CH}}}-\overset{4}{CH_3}$

Correct name is 3-methyl-2-butanone.

61. Temperature is the effective factor for dehydration of alcohol by Al_2O_3

$$R-CH_2-CH_2OH \xrightarrow[350°-380°C]{Al_2O_3}$$

$$R-CH=CH_2 + H_2O$$
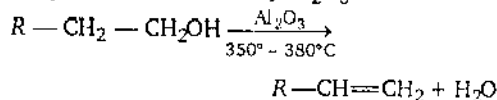
While at 220°-250°C it forms ether.

62. $C_2H_5OH + 4I_2 + 6NaOH \longrightarrow \underset{\text{Iodoform}}{CHI_3 \downarrow}$

$\qquad\qquad + HCOONa + 5NaI + 5H_2O$

Iodoform is a pale yellow solid.

63. The structure of DNA molecule is a double helicle structure. In this structure double helix are made up of polynucleotide chains which are held together by H-bonds. In these helixes the adenine (A) base is linked with thymine (T) by two H-bonds and guanine (G) is linked with cytocine (C) by three H-bonds as A=T, and G≡C.

64. Starch is also known as amylum which occurs in all green plants. A molecule of starch $(C_6H_{10}O_5)_n$ is built of a large number of α-glucose ring joined through oxygen-atom.

65. Peptide bond is formed by the reaction of —COOH group of one amino acid with the —NH_2 group of another amino acid and represented as
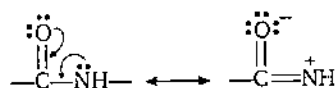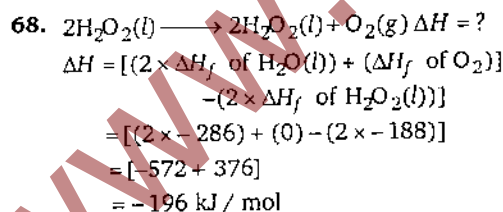

As partial double bond character found between C — N bond, the bond length of C—N in protein should be smaller than usual C—N bond.

66. In steam distillation of toluene, the pressure of toluene in vapour is less than pressure of barometer, because it is carried out when a solid or liquid is insoluble in water and is volatile with steam but the impurities are non-volatile.

67. 2, 3-dimethyl pentane
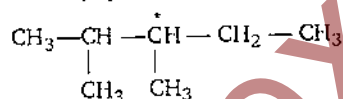
shows the property of optical isomerism due to presence of an asymmetric $\overset{*}{C}$ —atom.

68. $2H_2O_2(l) \longrightarrow 2H_2O_2(l) + O_2(g)\ \Delta H = ?$

$\Delta H = [(2 \times \Delta H_f \text{ of } H_2O(l)) + (\Delta H_f \text{ of } O_2)]$

$\qquad\quad -(2 \times \Delta H_f \text{ of } H_2O_2(l))]$

$= [(2 \times -286) + (0) - (2 \times -188)]$

$= [-572 + 376]$

$= -196 \text{ kJ / mol}$

69. As we know that $\Delta H = \Delta E + P\Delta V$

When $\Delta V = 0 \qquad \therefore \Delta H = \Delta E$

From first law of thermodynamics

$\qquad\qquad \Delta E = q - W$

In given problem $\Delta H = 500 \text{ J}$

$\qquad\qquad -W = -P\Delta V, \qquad \Delta V = 0$

So $\qquad\qquad \Delta E = q = 500 J$

70. $CH_4(g) + \dfrac{1}{2}O_2(g) \longrightarrow CH_3OH(l)$

$\therefore \Delta H = -[(\Delta H \text{ of combustion of } CH_3OH)$

$\qquad\qquad - (\Delta H \text{ of combustion of } CH_4)]$

$= -[(-y) - (-x)]$

$= -[-y + x] = y - x$

$\therefore \quad x > y$

71. $2N_2O_5 \longrightarrow 4NO_2 + O_2$

$\dfrac{-d[N_2O_5]}{dt} = k\,[N_2O_5]$

$1.02 \times 10^{-4} = 3.4 \times 10^{-5}\ s^{-1} \times [N_2O_5]$

$\therefore \qquad [N_2O_5] = \dfrac{1.02 \times 10^{-4}}{3.4 \times 10^{-5}} = 3$

72. Remaining activity = 0.01 M after 24 hrs

Remaining activity

$= \text{Initial activity} \times \left(\dfrac{1}{2}\right)^n$

Used half life time (n)

$= \dfrac{\text{Total time}}{T_{1/2}} = \dfrac{24}{6} = 4$

So $0.01 = \text{Initial activity} \times \left(\dfrac{1}{2}\right)^4$

Initial activity $= 0.01 \times 16 = 0.16$

73. When a biochemical reaction is carried out in laboratory from outside of human body in the absence of enzyme then rate of reaction obtained is 10^{-6} times than activation energy of reaction in the presence of enzyme. It is different from E_a obtained in laboratory because for a given chemical reaction

$K = Ae^{-Ea/RT}$ (Arrhenius equation)

74. Density = 1.17 g/cc

$= 1170 \text{ g/L}$

Molarity of solution $= \dfrac{\text{Strength in g / L}}{\text{mol. wt.}}$

$= \dfrac{1170}{36.5} M$

$= 32.05 M$

75. Suppose the mol. wt. of enzyme $= x$

0.5% by weight means in 100g of enzyme wt. of Se $= 0.5$ g

∴ In x g of enzyme wt. of Se $= \dfrac{0.5}{100} \times x$

Hence, $78.4 = \dfrac{0.5 \times x}{100}$

∴ $\qquad x = 15680 = 1.568 \times 10^4$

76. Specific volume (volume of 1 g) cylindrical virus particle $= 6.02 \times 10^{-2}$ cc / g

Radius of virus $(r) = 7 \times 10^{-8}$ cm

Length of virus $= 10 \times 10^{-8}$ cm

Volume of virus

$= \pi r^2 l = \dfrac{22}{7} \times (7 \times 10^{-8})^2 \times 10 \times 10^{-8}$

$= 154 \times 10^{-23}$ cc

Weight of one virus particle

$= \dfrac{\text{volume}}{\text{specific volume}} = \dfrac{154 \times 10^{-23}}{6.02 \times 10^{-2}}$

∴ Mol. wt. of virus $=$ Wt. of N_A particle

$= \dfrac{154 \times 10^{-23}}{6.02 \times 10^{-2}} \times 6.02 \times 10^{23}$

$= 15400$ g/mol $= 15.4$ kg/mol

77. Reverse osmosis : The minimum external pressure applied to a solution separated from a solvent by semipermeable membrane to prevent osmosis is called osmotic pressure. When the pressure applied to solution is more than osmotic pressure, solute will pass from the solution into solvent through the semipermeable membrane. This phenomenon is known as reverse osmosis.

The osmotic pressure of sea water is 25 atm at 15°C. When pressure greater than 26 atm is applied on sea water separated by a rigid semipermeable membrane, pure water is obtained. This is also called desalination of sea water.

78. The metals have higher negative values of their electrode potential can displace metals having lower values from their salt solution. So Fe^{3+} decreases.

79. Adsorption is the ability of substance to concentrate or hold gases, liquids or dissolved substances upon its surface.

Solids absorb greater amounts of substances at lower temperature. In general absorption decreases with increasing temperature.

80.
$$PbO_2 \longrightarrow PbO \qquad \Delta G_{298} < 0$$
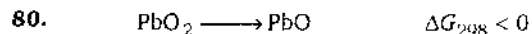
For this reaction ΔG is negative, hence Pb^{2+} is more stable than Pb^{4+}.

$$SnO_2 \longrightarrow SnO \qquad \Delta G_{298} > 0$$

For this reaction ΔG is positive, hence Sn^{4+} is more stable than Sn^{2+}.

because for spontaneous change ΔG must be negative.

81. Iso structural : Compounds having same structure and same hybridisation are known as isostructural species.

Ex. XeF_2 and IF_2^- are sp^3d hybridised and both have linear shape.

$$F—I^-—F \qquad F—Xe—F$$

**82.** In NH_4^+ bond angle is maximum (nearer 109°) due to its tetrahedral geometry.

33. $La(OH)_3$ is more basic than $Li(OH)_3$. In lanthanides the basic character of hydroxides decreases as the ionic radius decreases.

84. Ionisation potential : The amount of energy required to remove an electron from the outer-most orbit of a gaseous atom is known as ionisation potential. Elements having half filled or completely filled orbitals are more stable than partially filled orbitals.

In a period from left to right ionisation potential decreases as the atomic number increases. The given elements (Be, B, C, N, O) are present in II period as
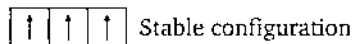
Be	B	C	N	O

Ionisation potential increases
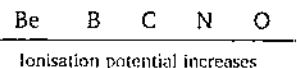
But in case of Be and B, 'Be' has higher ionisation potential due to stable configuration.

$_4Be = 1s^2, 2s^2$

$\boxed{\uparrow\downarrow}$ Stable configuration
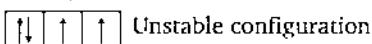
$_5B = 1s^2, 2s^2, 2p^1$

$\boxed{\uparrow \ \ \ }$ Unstable configuration
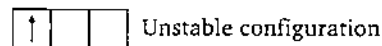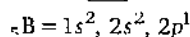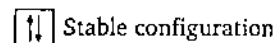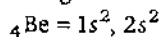
In the same way in case of 'N' and 'O', 'N' has higher I.P. than 'O' due to stable configuration

$_7N = 1s^2, 2s^2 2p^3$

 Stable configuration

$_8O = 1s^2, 2s^2 2p^4$

 Unstable configuration

So, the correct order of increasing IP will be :

$$B < Be < C < O < N.$$

**85.** $Cr(SCN)_2(NH_3)_4]^+$ shows linkage, geometrical and optical isomerism.

86. Co-ordination number of nickel in $[Ni(C_2O_4)_3]^{4-}$ is 6 because $C_2O_4^{2-}$ is bidentate ion and number of $C_2O_4^{2-}$ is 3.

87. $[Co(CO)_5 NH_3]^{2+}$. In this complex, Co-atom attached with NH_3 through σ bonding and with CO attached with dative π–bond.

88. In $Ni(CO)_4$, Ni has zero oxidation number

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

In excited state and during the formation of $Ni(CO)_4 \rightarrow$

sp^3-hybridisation
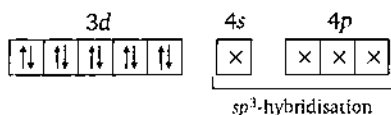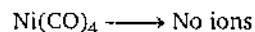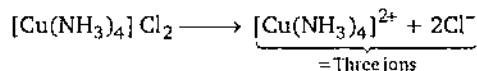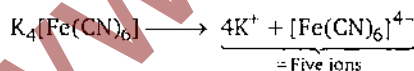
Hence in it, no unpaired electron is present.
So it shows the property of diamagnetism and tetrahedral structure.

89. In $X — H \text{-----} Y$, X and Y both are electronegative elements then electron density on X will increase and on H will decrease.

**90.** For π–overlap the lobes of the atomic orbitals are perpendicular to the line joining the nuclei.

π-overlapping
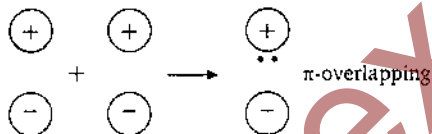
91. Compounds having larger number of ions after decomposition will show the maximum conductivity. $K_4[Fe(CN)_6]$ gives maximum number of ions. So, it shows maximum conductivity.

$$[Co(NH_3)_6]Cl_3 \longrightarrow \underbrace{[Co(NH_3)_6]^{3+} + 3Cl^-}_{= Four\ ions}$$

$$K_4[Fe(CN)_6] \longrightarrow \underbrace{4K^+ + [Fe(CN)_6]^{4-}}_{= Five\ ions}$$

$$[Cu(NH_3)_4]Cl_2 \longrightarrow \underbrace{[Cu(NH_3)_4]^{2+} + 2Cl^-}_{= Three\ ions}$$

$$Ni(CO)_4 \longrightarrow No\ ions$$

92. $n = 3$
$l = 2$
$m = +2$
$s = \pm 1/2$

These values of quantum numbers are possible for an orbital of $3d$ sub-shell as the possible value of m for $l = 2$ is

$m = $
+2	+1	0	−1	−2
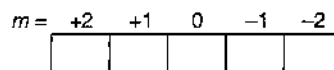
93. Basic strength $\propto$ rate of accepting of proton.

In $R — \overset{\bullet\bullet}{NH_2}$, N — has lone pair of electron which intensify due to electrons releasing R—group and increase the tendency to donate lone pair of electrons to H^+. Secondly as the size of the ion increases, there is less attraction for H^+ as form weaker bond with H—atom and less basic. The order of the given series :

$$RNH_2 > NH_3 > HS^- > I^-$$

94. The beans are cooked earlier in pressure cooker because boiling point increases with increasing pressure.

95. The most convenient method to protect the bottom of ship made of iron is white tin plating. Preventing the build up of barnacles.

96. hcp is a closed packed arrangement in which the unit cell is hexagonal and co-ordination number is 12.

97. Nitrogen form $N_2(i.e., N \equiv N)$ but phosphorus form P_2, it is at a time convert in P_4, because in P_2, $P_\pi — P_\pi$ bonding is present which is a weaker bonding due to larger size.

98. $CH_3COOH \rightleftharpoons CH_3COO^- + H^+$

$$K_a = \frac{[CH_3COO^-][H^+]}{[CH_3COOH]}$$

Given that

$$[CH_3COO^-] = [H^+] = 3.4 \times 10^{-4}\ M$$

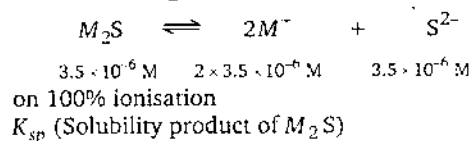K_a for $CH_3COOH = 1.7 \times 10^{-5}$

CH_3COOH is weak acid, so in it (CH_3COOH) is equal to initial concentration. Hence,

$$1.7 \times 10^{-5} = \frac{(3.4 \times 10^{-4})(3.4 \times 10^{-4})}{[CH_3COOH]}$$

$$[CH_3COOH] = \frac{3.4 \times 10^{-4} \times 3.4 \times 10^{-4}}{1.7 \times 10^{-5}}$$

$$= 6.8 \times 10^{-3} \text{ M}$$

99. Solubility of M_2S salt is 3.5×10^{-6} M

$$M_2S \rightleftharpoons 2M^- + S^{2-}$$

3.5×10^{-6} M $\quad 2 \times 3.5 \times 10^{-6}$ M $\quad 3.5 \times 10^{-6}$ M

on 100% ionisation
K_{sp} (Solubility product of M_2S)

$$= [M^+]^2[S]$$
$$= (7.0 \times 10^{-6})^2 (3.5 \times 10^{-6})$$
$$= 171.5 \times 10^{-18}$$
$$= 1.71 \times 10^{-16}$$

100. $_bX^a \longrightarrow _{+1}e^0 + _{b-1}A^a \xrightarrow{-2\alpha} _{b-5}B^{a-8}$

$_dY^c = _{b-5}D^{a-12} \xleftarrow{-\alpha} _{b-3}C^{a-8} \xleftarrow{-2\beta}$

Hence, $d = b - 5$, $c = a - 12$

or $a = c + 12$ $\quad b = d + 5$

$d = b - 5$

Biology

101. Suction pressure (also called DPD) is believed to suck water (cause movement of water molecule) from pure solvent/hypotonic solution.

B.S. Meyer (1938) coined the term suction pressure or DPD.

102. Phytochromes are plant chromatophores, containing protein pigment existing in two inter-convertible forms—P_r (absorbs red light, 660 nm) and P_{fr} (absorbs far red light-730 nm). It controls flowering, seed dormancy etc.

103. Light causes photosynthesis which lead to reduction in CO_2 concentration $\rightarrow$ synthesis of glycolate $\rightarrow$ oxidation of glycolate $\rightarrow$ ATP synthesis $\rightarrow$ activation of K^+ pump $\rightarrow$ movement of K^+ in guard cell $\rightarrow$ movement of water into guard cells $\rightarrow$ swelling of guard cell $\rightarrow$ opening of stomata.

104. In the process of biological nitrogen fixation, the dinitrogen molecule is reduced by the addition of pairs of hydrogen in the presence of enzyme nitrogenase. Nitrate reducatase and nitrite reductase come into picture at later stage (for nitrate assimiliation).

105. Metabolic inhibitors affect active absorption. Humidity does not affect abosorption of minerals as much as temperature.

The movement of mineral ions into the root cells by the process of simple diffusion is called as **passive absorption**. This is a spontaneous process and does not require energy.

106. Large circular plasmid of 1700 kilobase ha been reported in *Rhizobium meliloti*. As pe options available, however, 500 kilobase ma be considered correct.

107. C^{14} takes about 5,730 years for half th material to decay.

108. Thiamine, riboflavin, calciferol, tocopherol ar also known as vitamin B_1, vitamin B_2, vitamin D_2 and vitamin E respectively.

The main function of vitamin E are as follows :

(a) It is necessary for normal functioning o gonads. Continuation of pregnancy and normal child birth.

(b) It prevents oxidative destruction of othe vitamins e. g., vitamin-K.

(c) It prevents brown pigmantation.

(d) It removes scars and wrinkles.

109. In case of complementary genes, the ratio o 9 : 7 is obtained in F_2 generation. This was firs discovered by Bateson and Punnet.

Complementary genes are those genes whicl express themselves when present together None of these two express themselves whee present alone.

110. In co-dominance, both allelic genes of a genetic trait are equally expressive *i.e.*, there i complete lack of dominance.

Blood group system AB is a good example o co-dominance.

11. Linked genes occur on the same chromosome and do not separate during inheritance (complete linkage).

AB ab × ab ab

♀\♂	ab	ab
AB	AaBb	AaBb
ab	aabb	aabb

Genotype is AaBb and aabb.

12. The centres of origin of plants are more appropriately called the centres of diversity. These are the areas of maximum diversity of these species.

13. Probability of having a son in one delivery = 1/2
    ∴ probability of having four sons in four deliveries $= \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{16}$

14. Potato and tomato originated in the new world.

15. *Anabaena azollae* a cyanobacterium living in the cavities of *Azolla* leaves, fixes nitrogen from air and excretes nitrogenous compound. BGA (Blue-Green Algae-Cyanobacteria) are also nitrogen fixers.

16. In complementary genes, two separate pair of genes interact to produce the phenotype in such a way that neither of the dominant genes is expressive unless the other one is present.

17. About 100 types of restriction enzymes are available. Each restriction enzymes cleaves a molecule only at a particular nucleotide sequence. Some important restriction endonucleases are **Bam** H (*Bacillus amyloliquefaciens* H), EcoRI (*Escherichia coli*) HPaI (*Haemophilus parainfluenzae*)etc.

18. Tetradynamous condition is the characteristic feature of the family Cruciferae *e.g.*, mustard, radish etc. There are 6 stamens arranged in such a way that four stamens with longer filaments forms inner whorl while two stamens with shorter filament forms outer whorl.
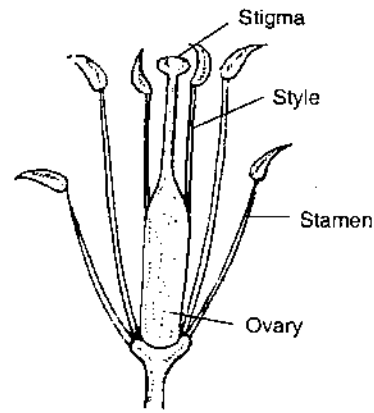
Androcium of *Brassica* showing tetradynamous condition

119. Each fruit of date palm (*Phoenix dactylifera*) is one seeded oblong berry.
    Fleshy pericarp of date palm is edible. We eat mesocarp of tomato, endosperm of maize and thalamus and pericarp of guava.

120. Fleshy mesocarp and rudimentary endocarp of banana are edible.
    Banana (*Musa sapientum*) is a perennial herb and belongs to family Musaceae.
    A fully ripened fruit of banana contains near about 75.6% moisture, 20.4% sugars (mainly glucose and fructose), 1.2% starch, 2% fats, 1.22% protein, 6% crude fibres and 0.8% ash.

121. Brinjal belongs to family Solanaceae. Obliquely placed bicarpellary ovary is characteristic of Solanaceae.
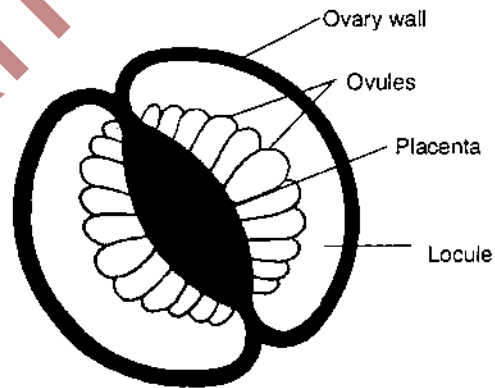
T.S. of ovary showing oblique septa

122. In *Hydra*, undigested residues are egested from coelentron through mouth, while nitrogenous excretory product (ammonia) is removed through general body surface.

Hydra are solitary sessile fresh water Coelentrates. They are found in lakes ponds stream. *Hydra* is an ammonotelic animal *i. e.*, it excretes waste material in the form of ammonia.

123. Most cultivated soils have a pH range between 4.5 and 8.5. However most plants grow best in soils with a neutral or slightly acidic pH.

124. *Gambusia affinis* eat mosquito larva. These are propagated and introduced into ponds and tanks for controlling malaria.

125. *Rauwolfia* and its preparations have gained importance in the treatment of hypertension as well as a sedative and tranquillising agent. Pharmacological activity is due to the presence of many alkaloids especially reserpine.

126. Biological Oxygen Demand (BOD) is the amount of O_2 required for biological oxidation by micro-organisms in any unit volume of water.

127. Pollen mother cell is a diploid structure which undergoes one meiotic division and produces four haploid pollen grains or microspores. Pollen grain is the first cell of male gametophyte.

128. The word noise is taken from the latin word nausea and is defined as unwanted or unpleasant sound that causes discomfort.

Intensity of some noise sources is as follows :

Source	Intensity (dB)
Breathing	10
Broadcasting studio	20
Trickling clock	30
Library	30-35
Normal conversation	35-60
Telephone	60
Office noise	60-80
Alarm clock	70-80
Traffic	50-90
Motor cycle	105
Jet fly (over 1000')	100-110
Train whistle (50')	110
Air craft (100')	110-120
Commercial jet air craft (100')	120-140
Space rocket (launching)	170-180

129. Polyembryony can be defined as formation of more than one embryos within a seed. Antony van Leeuwenhoek first time reported polyembryony in 1719. Nucellar embryony occurs in crassinucellate ovules *(e.g., Citrus, Opuntia)*. On the other hand, integumentary embryony occurs in tenuinucellate ovules *(e.g., Euonymus)*.

130. Lysergide (LSD) is also known as D-Lysergic acid diethylamide-15.

It is extracted from ergot a fruiting body of fungus *Claviceps purpurea*. It is a hallucinogens.

In very small amount it induces trachycardia and hypertension.

Addiction of LSD cause damage to central nervous system, chromosomal aberration and psychosis etc.

131. Corpus luteum is temporary endocrine tissue developing from ruptured Graafian follicle.

Sebum is an oily lipid containing secretion of mammalian sebaceous glands.

Sweat is a aquous secretion of mammalian sweat glands.

Bundle of His is a part of conducting system of heart and pacemaker is responsible for initiation of heart beat in right auricle SA node.

Vitamin B_5 is also known as niacin.

132. *Salmonella typhi* causes typhoid fever. The incubation period is about two weeks. The patient first suffers from high fever of 40°C and continual headache. Polio, TB and tetanus are caused by polio virus, *Mycobacterium tuberculosis* and *Clostridium tetani* respectively.

133. Gram's staining was discovered by C. Gram in 1884. This staining technique differentiates bacteria into two distinct group *i. e.*, Gram positive and Gram negative. This distinction is mainly based on the **composition of cell wall.**

Higher lipid content in the wall of Gram negative bacteria causes loss of crystal violet as lipid gets dissolved in acetone.

134. Huxley gave the fine structure of straited muscle fibre or myofibril. Each myofibril is made up of A-bands (dark band–anisotropic) and light bands (I-bands = isotropic). These two bands are made up of myosin and actin

filament respectively. Each I-band is divided into two equal halves by a thin, fibrous and transverse zig-zag partition, called Z-band or Z-disc or Krause's membrane.

The part of the myofibril between two successive Z lines functions as a contractile unit called sarcomere.

135. When Ca$^+$ ions combine with troponin contraction of muscle initiates.

During contraction, the Z lines come closer together and the sarcomere becomes shorter. The length of A band remains constant. I bands shortens and H zone narrows.

136. Genetic drift is most likely to occur in small, isolated populations. In these, even a chance change in gene frequency is perpetuated because the gene pool is small.

137. The streptomycin resistant strains, would grow only if all other requirements are provided and amounts of streptomycin is added sufficient enough to kill normal populations.

138. The word mutation is derived from **Latin** word **mutatus** means a change + **ion** means result of a process. Mutation is a heritable change in the kind structure, sequence or number of the component part of a DNA molecule. Mutation is the original source of genetic variation. It may be harmful or benefical for an individual. Due to harmful mutation the forthcoming generation are less adaptive than their parental generation.

As a result of natural selection, the frequency of genes of non-adaptive value is greatly reduced leading to diminished diversity and diminished adaptivity to further changes.

139. Epimorphosis is the replacement of a lost organ of the body by proliferating new cells from the surface of the wound or injured part. Morphogenesis (*Gr. Morphe* = form and *genesis* origin) is the growth shaping and arrangement of body parts according to genetically predefined patterns. The extent direction and rate of morphogenesis depend on genetic controls and environmental factors.

140. Seas separating the continents form barriers to free intercontinental movement causing evolution of organisms independently in these continents leading to endemism.

Endemic species are those species which are found in a restricted areas of the world.

141. According to both the views, 'something' is passed from parent to offspring which causes development of specific characters, *i.e.*, all that has been acquired by the organism during its life time is preserved by generation and transmitted to offsprings in form of pangenes or gemmules.

142. In snakes, post anal tail is found. Snakes belong to class reptilia. Jurrasic period (Mesozoic era) is known as golden age of reptiles. The study of snake is known as serpentology.

143. Chlorocruorin is a respiratory pigment (green, fluorescing red) dissolved in the plasma of some polychaete worms (annelid).

144. Pollination through air is known as anemophily *e. g.*, coconut.
In *Salvia*, the pollination is taken place by insects (entomophily).
In *Vallisneria*, the pollination occurs through water (hydrophily).
In Bottle brush (*Callistemon*) the pollination occurs through birds (ornithophily).

145. Each eye of potato represents a node. It has a scale leaf in the form of a ridge. The depression of eye contains buds.
Each of which on germination gives rise to a new plant.

Tuber of Potato
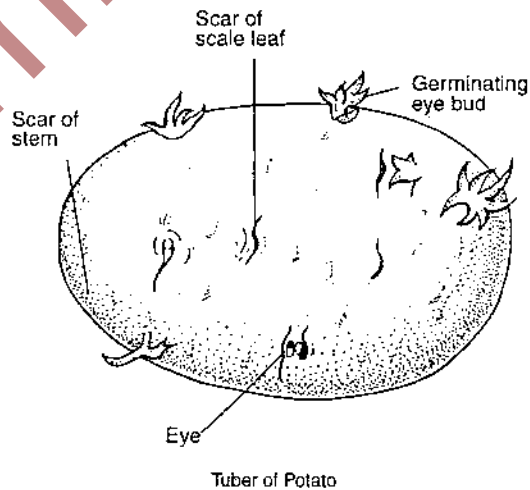
146. Ribozymes, catalytically active RNA molecule discovered in 1980's, are self-splicing introns indicating their possible role as intermediates in the evolution of biological systems from abiotic substances.
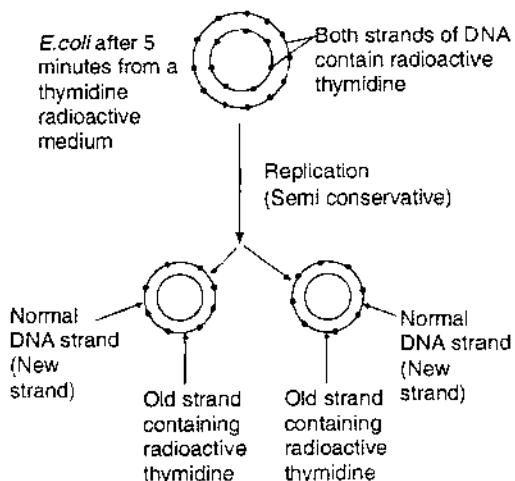
147. Maize is a C_4 plant. C_4 plants have Kranz type anatomy of leaves.
PGA (3-phosphoglyceric acid) is formed during Calvin cycle.
OAA (Oxalo Acetic Acid) a 4C compound is formed during Hatch and Slack cycle (C_4 cycle).

148. Gibberellins overcome the natural dormancy of buds, seeds, tubers etc. In this way, these are antagonistic to ABA.
IAA (Indole Acetic Acid) is the principal naturally occurring auxin, found in all plants including fungi. It helps in eradication of weeds, root initiation and production of parthenocarpic fruits.
ABA (Abscisic Acid) is the natural growth inhibitors.
Zeatin is a naturally occurring cytokinin that stimulates mature plant cells to divide when added to a culture medium along with an auxin.

149. Senescence is an active genetically controlled developmental process in which cellular structure and macro-molecules are broken down and translocated away from the senescing organ (typical leaves) to actively growing reason that serve as nutrient sinks. Senescence is initiated by environmental cues and is regulated by the hormones e.g., ABA (Abscisic Acid).
Higher amounts of ABA stops protein and RNA synthesis and accelerating the senescence.

150. NAA (Naphthalene Acetic Acid) is a synthetic auxin hormone which is useful for preventing pre harvest fruit drop of tomatoes.

151. Sugar synthesized in leaves (source) is 'loaded' in phloem through which it is transported to all other parts of plants where it is required (= sinks).

152. The fall in photosynthetic yield beyond red region of spectrum (680 nm) is called red drop. Reaction centre of PS-II is P_{680} while that of PS-I is 700.

153. Plants which require long day photoperiod for flowering and a small dark period for vegetation are known as long day plants, e.g., spinach.

154. Photolithotrophs use light energy and use inorganic electron donor (like H_2, H_2S) as hydrogen source. Purple and green sulphur bacteria are examples of this type.

155. Sunken stomata are found in *Nerium* to check the rate of transpiration.
Presence of sunken stomata is a characteristic feature of xerophytic plants.
Mango is a mesophytic plant.
Hydrilla is a hydrophytic plant.
Guava is a mesophytic plant.

156. Eye of a human is about 1 inch in diameter and is covered and protected by the **sclera**. Which is made up of tough connective tissue. The front of eye is transparent thus allows the light to enter the eye. This portion of the eye's outer layer is called **cornea**. It lacks a blood supply. It derives nutrients via aquous humor from cell body. Cornea not only allows light to enter the eye but also bend it as well.

157. Hepatitis may be transmitted via blood transfusions, contaminated equipment, unsterile needles (of drug addicts), or any body secretion like saliva, sweat, semen, breast milk, urine, faeces.

158. Cells infected by virus produce interferons which is antiviral. It spreads to neighbouring cells and makes them resistant to virus infections by inhibiting viral growth.

159. Caulimovirus (Cauliflower mosaic virus) contains double stranded (ds) DNA.
Influenza virus contains single stranded RNA (ss RNA).
Parvovirus contains single stranded DNA (ss DNA).

160. Cancer is an uncontrolled growth and division of certain body tissues. Lung cancer is a cancer of epithelial tissue. It is mainly 95% caused by smoking and can be found in both male and female. It may also occur in the people working in cement factory.

161. Since DNA replication is semiconservative, the newly synthesized strand of DNA would be

normal while the strand obtained from parent molecule would be radioactive.

E.coli after 5 minutes from a thymidine radioactive medium — Both strands of DNA contain radioactive thymidine

Replication (Semi conservative)

Normal DNA strand (New strand) — Old strand containing radioactive thymidine — Old strand containing radioactive thymidine — Normal DNA strand (New strand)

162. Cellulose, constituting the cell wall of plants, is most abundant organic molecule on earth.

163. Hormonal inbalance may lead to development of male characters in female or *vice versa*.
Deletion is the removal of one or few nitrogenous bases from a nucleotide chain.
Aneuploidy is a chromosomal aberration in which certain chromosomes are present in extra copies or are deficient in number.

164. Barr body is a condensed mass of chromatin found in the nuclei of placental mammals which conain two or more X-chromosomes, so named after its discoverer Murray Barr. The number of Barr bodies is one less than the number of X-chromosomes present.
So, the number of Barr bodies in XXXX female are -3.

165. In eukaryotes (nucleated organisms), three separate RNA polymerases catalyse the formation of ribosomal, messenger and transfer RNAs.
These are (a) RNA-polymerase-I found in nucleus and is responsible for r-RNA synthesis (b) RNA-polymerase-II, found in nucleoplasm and is responsible for m-RNA synthesis (c) RNA-polymerase-III, found in nucleoplasm and is responsible for t-RNA and 5-s RNA synthesis.

166. The archaebacteria are able to flourish in extreme conditions of environment that are believed to have existed on the primitive earth. It is believed that these represent the early forms of life. Hence, archaebacteria are called "oldest living fossils".

167. Extranuclear inheritance or cytoplasmic inheritance is the inheritance of the characters of only one parent (generally the female parent).
Some strains of *Paramecium* called killer strain, produce a poisonous substance called paramecin which kills sensitive strains.

168. The matrix of mitochondria and stroma of chloroplast contain a circular double-stranded molecule very similar to bacterial chromosome in shape.

169. Erusic acid occurs as glycerides in vegetable oils.

170. It takes some time for rhodopsin to split into scotopsin and retinal (bleaching) and release of transmitter passing nerve impulse *via* bipolar and ganglion cells to the optic nerves. This is a case of adaptation. It differs from accommodation which is a reflex mechanism by which the focus of the eye change to make the images of distant and near objects sharp on the retina.

171. Inulin a polymer of fructose, is used as a food store, particularly in roots and tubers of family Compositae. Pectin is a mucopolysaccharide which is found in cell wall of plants. During the time of food ripening, the pectin becomes hydrolyze and gives rise the constituents of sugar.

172. Gene (Greek : *genos*, birth, race) is the basic unit of heredity. It is a sequence of DNA nucleotides on a chromosome that encodes a polypeptide or RNA molecule and so determines the nature of individual's inherited traits. Cistron is a segment of DNA that codes for one polypeptide. Cistron is generally accepted as a synonym for gene.
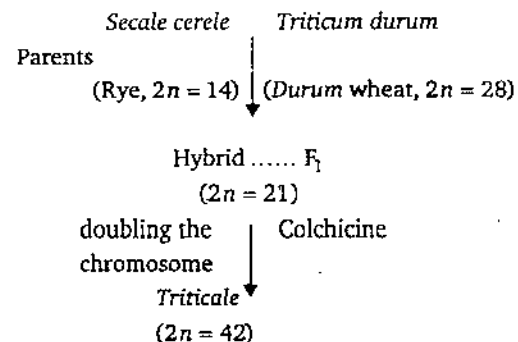
173. Presence of cell wall is the characteristic feature of all plant cells. Cell wall is consisted of three layers, middle lamella or middle layer, primary layer and secondary layer. The position of middle lamella is between two primary walls of different cells and thus functions as cementing layer between these two cells. Main constituents of middle lamella are calcium and megnesium pectate.

Primary cell wall is found on either sides of the middle lamella and composed of cellulose, hemicellulose, polysaccharides and many other pectic substances. Secondary cell wall is found on the inner surface of primary wall and composed of cellulose, hemicellulose and polysaccharides.

174. Gymnosperms (Greek—*gymnos* meaning naked and *sperma* meaning seed *i.e.,* naked seed plants) is a group of phanerogams which have the naked ovules *i.e.,* the structure (ovules) that is eventually become the seeds after fertilization are not completly enclosed by the tissues of the parent individual on which they are carried at the time of pollination.

175. Plant decomposers are saprophytic fungi and bacteria that absorb nutrients from non living organic material such as fallen plants material and the wastes of living organisms and convert them into organic forms. The bacteria belong to kingdom monera while fungi belong to fungi.

176. Cyanobacteria (Greek : *Kyanos*—dark blue and *bakterion*— a staff) is also known as blue green algae. It is a very important group of photosynthetic bacteria in the history of life on earth.
The cyanobacteria fix atmospheric nitrogen through the help of enzyme nitrogenase and are oxygenic photosynthetic also.

177. The synthesis of *m*-RNA is taken place in the nucleus (eukaryotes) or in the cytoplasm (prokaryotes). During this process, the RNA polymerase enzyme binds to a specific site, called promoter, in the DNA loated on the '5' side of the gene to be transcribed.

178. Cytochrome is the respiratory pigment. It is composed of protein, iron and porphyrin ring. It functions as an enzyme in the respiratory chain. Unlike in haemoglobin the metal atom in the porphyrin ring must change it's valency for the molecule to function. Cytochromes are basically located in inner mitochondrial membranes and thylakoids of chloroplasts.

179. A genus contains usually more than one species. Naturally species is more specific (less general as compared to genus). A species is a particular kind of organisms or member of a population that possess similar anatomical characteristics and that interbreed freely in their natural settings. Members of different species cannot interbreed in general.

180. Cell wall degrading enzymes (cellulolytic, pectolytic) as well as mechanical pressure of adhesive pad (appressorium) help the fungus in penetrating the host.

181. Microtubules are present only in eukaryotes; and are a component of their cilia and flagella as well as spindle (during cell division). They are straight, hollow rods measuring about 25 nm in diameter and form 200 nm to 25 μm in length. Microtubules give the shape and support to the cell.

182. The leaves of *Azolla* contain colonies of *Anabaena azollae* which have the capacity to fix atmospheric nitrogen.

183. Leghaemoglobin is present in roots of soyabean plants. It is an oxygen-binding haeme protein. Which is present in the cytoplasm of infected nodule cells at high concentrations and gives the nodules a pink colour. It's main function is to help in the transport of O_2 to the respiring symbiotic bacterial cells in a manner analogous to haemoglobin, which transports O_2 to respiring tissues in animals.

184. Triticale is a man-made cereal obtained by crossing a wheat plant with a rye plant and doubling the chromosome number using colchicine.

$$\underset{\text{(Rye, } 2n = 14)}{\textit{Secale cerele}} \qquad \underset{(\textit{Durum} \text{ wheat, } 2n = 28)}{\textit{Triticum durum}}$$

Parents

Hybrid ...... F_1
$(2n = 21)$

doubling the chromosome | Colchicine

Triticale
$(2n = 42)$

185. In eukaryotes, the regulation of gene expression involves splicing together of exonic portions of RNA to give rise to functional *m*-RNA.
Introns are DNA sequences lying within a coding sequence, but not usually encoding cell product.

Exon is a DNA sequence encoding and gives rise to a translated polypeptide sequence (protein).

186. The enzymes required for lysing *E. coli* could not be synthesized by the mutant strain. Two different strains had cistrons for synthesizing two different enzymes which acted together.

187. Though mutation provide the source of variation, the diversity in living beings is due to natural selection of variations and consequent evolutionary change over long periods of time.

188. The sixth amino acid from the amino terminal end of β chain of normal haemoglobin is glutamic acid while in sickle cell haemoglobin, it is valine.
    It results a change in confermation of the haemoglobin melecule and the RBC becomes sickle shaped.

189. Increase in resemblance over time of different evolutionary lineages (in one or more phenotypic characters) thereby increasing their phenetic similarities is called convergence (convergent evolution).

190. In blood of 'O' group, no antigens are present on red cells, but both anti-A and anti-B antibodies are present in plasma.
    Blood group A has antigen 'a' and antibody 'B'.
    Blood group B has antigen 'b' and antibody 'A'.
    Blood group AB has antigens 'a' and 'b' but no antibody.

191. Banding patterns of human chromosome number 3 and 6 are remarkably similar to that of chimpanzee indicating common origin for both.

192. Peking man → Hedelberg man → Neanderthal man → Cro-magnon man.

193. Only nerve cells do not form layers; these also remain structurally separate from each other (though communicate with each other through synapse).
    Nerve cells or neurons are the cells specialized to conduct an electrochemical current, Nerve tissue is made up of these cells and supporting cells.

194. Hyaline cartilage forms nasal cartilage, larynx, trachea and hyoid apparatus.

195. First living beings were formed in the environment of sea having abundant organic molecules. They absorbed the organic materials for the sake of nutrition and hence, were chemoheterotrophs.

196. A plasmid is a piece of DNA, mostly in bacteria (but also in yeast) not forming a part of normal chromosomal DNA of a cell, capable of replicating independently of it. These often act as vehicles for gene transfer.

197. Monoclonal antibodies are identical molecules specific for one type of antigen. These are obtained by injecting the target antigen into a rat or mouse. Sometimes later, the spleen cells producing antibodies are isolated and fused with myeloma cells to produce monoclonal antibodies.

198. Genes which are "linked" and are situated on same chromosome, cannot enter 'separate' during gametes and, hence, cannot assort independently.

199. In round seeds (RR/Rr) starch-branching enzyme (SBE-1) is found but is absent from wrinkled seeds. In rr seeds, a small DNA segment interferes with SBE-1 activity so that starch is not formed and free sugar gets accumulated. Resulting high osmotic pressure in rr seeds leads to shrinkage and wrinkling.

200. In case of a repressible operon, the free repressor cannot bind to the operator. Only repressor- corepressor complex binds with the operator. Since the product of the regulator (the repressor) acts by shutting off the transcription of structural genes, it is referred to as a negative control system.

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