# CBSE

MEDICAL ENTRANCE

SOLVED PAPER / 2003

Physics

1. A man weighs 80 kg. He stands on a weighing scale in a lift which is moving upwards with a uniform acceleration of 5 m/s². What would be the reading on the scale ? ($g = 10$ m/s²)
   - (a) 800 N
   - (b) 1200 N
   - (c) Zero
   - (d) 400 N

2. A monkey of mass 20 kg is holding a vertical rope. The rope will not break when a mass of 25 kg is suspended from it but will break if the mass exceeds 25 kg. What is the maximum acceleration with which the monkey can climb up along the rope ? ($g = 10$m/s²)
   - (a) 25 m/s²
   - (b) 2.5 m/s²
   - (c) 5 m/s²
   - (d) 10 m/s²

3. J.J. Thomson's cathode-ray tube experiment demonstrated that :
   - (a) the e/m of electrons is greater than the e/m of protons
   - (b) the e/m ratio of the cathode-ray particles changes when a different gas is placed in the discharge tube
   - (c) cathode rays are streams of negatively charged ions
   - (d) all the mass of an atom is essentially in the nucleus

4. Reverse bias applied to a junction diode :
   - (a) increases the majority carrier current
   - (b) increases the minority carrier current
   - (c) lowers the potential barrier
   - (d) raises the potential barrier

5. In which of the following systems will the radius of the first orbit ($n = 1$) be minimum?
   - (a) Deuterium atom
   - (b) Hydrogen atom
   - (c) Doubly ionized lithium
   - (d) Singly ionized helium

6. A bar magnet is oscillating in the earth's magnetic field with a period T. What happens to its period and motion if its mass is quadrupled?
   - (a) Motion remains SH with time period $= 4T$
   - (b) Motion remains SH and period remains nearly constant
   - (c) Motion remains SH with time period $= \dfrac{T}{2}$
   - (d) Motion remains SH with time period $= 2T$

7. A charged particle moves through a magnetic field in a direction perpendicular to it. Then the :
   - (a) acceleration remains unchanged
   - (b) velocity remains unchanged
   - (c) speed of the particle remains unchanged
   - (d) direction of the particle remains unchanged

8. A thin circular ring of mass M and radius r is rotating about its axis with a constant angular velocity ω. Four objects each of mass m, are kept gently to the opposite ends of two perendicular diameters of the ring. The angular velocity of the ring will be :
   - (a) $\dfrac{(M + 4m)\,\omega}{M}$
   - (b) $\dfrac{(M - 4m)\,\omega}{M + 4m}$
   - (c) $\dfrac{M\,\omega}{4m}$
   - (d) $\dfrac{M\,\omega}{M + 4m}$

9. A long solenoid carrying a current produces a magnetic field B along its axis. If the current is doubled and the number of turns per cm is halved, the new value of the magnetic field is :
   - (a) $2B$
   - (b) $4B$
   - (c) $B/2$
   - (d) B

10. Following diagram performs the logic function of :

    - (a) OR gate
    - (b) AND gate
    - (c) XOR gate
    - (d) NAND gate

11. The volume occupied by an atom is greater than the volume of the nucleus by factor of about :
    (a) 10^{10} (b) 10^{15}
    (c) 10^1 (d) 10^5

12. The mass number of a nucleus is :
    (a) sometimes equal to its atomic number
    (b) sometimes less than and sometimes more than its atomic number
    (c) always less than its atomic number
    (d) always more than its atomic number

13. The mass of proton is 1.0073 u and that of neutron is 1.0087 u (u = atomic mass unit) The binding energy of $_2\text{He}^4$ is :
    (a) 28.4 MeV   (b) 0.061 u
    (c) 0.0305 J   (d) 0.0305 erg
    Given, mass of helium nucleus $\approx$ 4.0015 u

14. Barrier potential of a *p-n* junction diode does not depend on :
    (a) forward bias   (b) doping density
    (c) diode design   (d) temperature

15. A particle moves along a circle of radius $\left(\dfrac{20}{\pi}\right)$ m with constant tangential acceleration. If the velocity of the particle is 80 m/s at the end of the second revolution after motion has begun, the tangential acceleration is :
    (a) $160\,\pi$ m/s^2 (b) 40 m/s^2
    (c) $40\,\pi$ m/s^2 (d) $640\,\pi$ m/s^2

16. An electric kettle has two heating coils. When one of the coils is connected to an AC source, the water in the kettle boils in 10 min. When the other coil is used the water boils in 40 min. If both the coils are connected in parallel, the time taken by the same quantity of water to boil will be :
    (a) 25 min   (b) 15 min
    (c) 8 min   (d) 4 min

17. If a ball is thrown vertically upwards with speed *u*, the distance covered during the last *t* seconds of its ascent is :
    (a) $ut - \dfrac{1}{2}gt^2$ (b) $(u + gt)t$
    (c) ut (d) $\dfrac{1}{2}gt^2$

18. Two 220 V, 100 W bulbs are connected first in series and then in parallel. Each time the combination is connected to a 220 V AC supply line. The power drawn by the combination in each case respectively will be :
    (a) 200 W, 150 W
    (b) 50 W, 200 W
    (c) 50 W, 100 W
    (d) 100 W, 50 W

19. Fuse wire is a wire of :
    (a) low resistance and low melting point
    (b) low resistance and high melting point
    (c) high resistance and high melting point
    (d) high resistance and low melting point

20. Solar energy is mainly caused due to :
    (a) fusion of protons during synthesis of heavier elements
    (b) gravitational contraction
    (c) burning of hydrogen in the oxygen
    (d) fission of uranium present in the sun

21. An equiconvex lens is cut into two halves along (i) *XOX'* and (ii) *YOY'* as shown in the figure. Let f, f', f'' be the focal lengths of the complete lens, of each half in case (i), and of each half in case (ii), respectively.
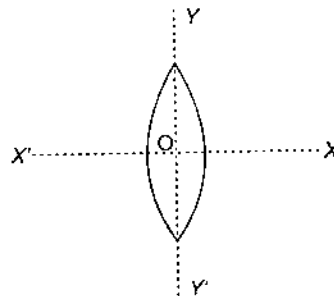
Choose the correct statement from the following :
(a) $f' = f$, $f'' = f$ (b) $f' = 2f$, $f'' = 2f$
(c) $f' = f$, $f'' = 2f$ (d) $f' = 2f$, $f'' = f$

22. A nuclear reaction given by :
    $$_z X^A \to _{z+1} Y^A + _{-1}e^0 + \bar{\nu}$$
    represents :
    (a) fusion   (b) fission
    (c) β-decay   (d) γ-decay

23. A sample of radioactive element has a mass of 10 g at an instant $t = 0$. The approximate mass of this element in the sample after two mean lives is :
    (a) 3.70 g   (b) 6.30 g
    (c) 1.35 g   (d) 2.50 g

24. A photoelectric cell is illuminated by a point source of light 1 m away. When the source is shifted to 2 m then :
(a) each emitted electron carries half the initial energy
(b) number of electrons emitted is a quarter of the initial number
(c) each emitted electron carries one quarter of the initial energy
(d) number of electrons emitted is half the initial number

25. The vector sum of two forces is perpendicular to their vector differences. In that case, the forces :
(a) are not equal to each other in magnitude
(b) cannot be predicted
(c) are equal to each other
(d) are equal to each other in magnitude

26. A ball rolls without slipping. The radius of gyration of the ball about an axis passing through its centre of mass is K. If radius of the ball be R, then the fraction of total energy associated with its rotational energy will be :
(a) $\dfrac{K^2}{K^2 + R^2}$
(b) $\dfrac{R^2}{K^2 + R^2}$
(c) $\dfrac{K^2 + R^2}{R^2}$
(d) $\dfrac{K^2}{R^2}$

27. The acceleration due to gravity on the planet A is 9 times the acceleration due to gravity on planet B. A man jumps to a height of 2m on the surface of A. What is the height of jump by the same person on the planet B?
(a) 6 m (b) $\dfrac{2}{3}$ m (c) $\dfrac{2}{9}$ m (d) 18 m

28. When a long spring is stretched by 2 cm, its potential energy is U. If the spring is stretched by 10 cm, the potential energy in it will be :
(a) $10U$
(b) $25U$
(c) $U/5$
(d) $5U$

29. A particle of mass m oscillates with simple harmonic motion between points x_1 and x_2, the equilibrium position being O. Its potential energy is plotted. It will be as given below in the graph :

(a)   (b)

(c)   (d)
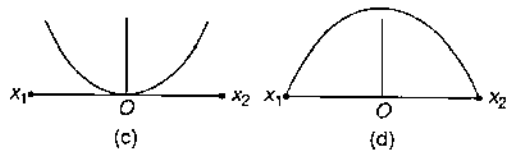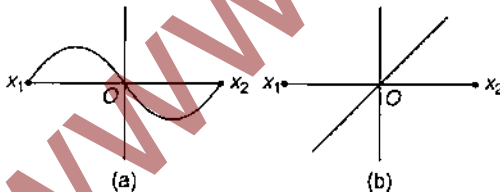
30. An electron is moving round the nucleus of a hydrogen atom in a circular orbit of radius r. The coulomb force $\overrightarrow{F}$ between the two is :
(a) $k\dfrac{e^2}{r^3}\overrightarrow{\mathbf{r}}$
(b) $-k\dfrac{e^2}{r^3}\overrightarrow{\mathbf{r}}$
(c) $k\dfrac{e^2}{r^2}\hat{\mathbf{r}}$
(d) $-k\dfrac{e^2}{r^3}\hat{\mathbf{r}}$
(where $k = \dfrac{1}{4\pi\varepsilon_0}$)

31. A charge q is located at the centre of a cube. The electric flux through any face is :
(a) $\dfrac{\pi q}{6(4\pi\varepsilon_0)}$
(b) $\dfrac{q}{6(4\pi\varepsilon_0)}$
(c) $\dfrac{2\pi q}{6(4\pi\varepsilon_0)}$
(d) $\dfrac{4\pi q}{6(4\pi\varepsilon_0)}$

32. An observer moves towards a stationary source of sound with a speed 1/5th of the speed of sound. The wavelength and frequency of the source emitted are λ and f respectively. The apparent frequency and wavelength recorded by the observer are respectively :
(a) f, 1.2λ
(b) $0.8f$, 0.8λ
(c) $1.2f$, 1.2λ
(d) $1.2f$, λ

33. Consider a compound slab consisting of two different materials having equal thicknesses and thermal conductivities K and $2K$, respectively. The equivalent thermal conductivity of the slab is :
(a) $3K$ (b) $\dfrac{4}{3}K$ (c) $\dfrac{2}{3}K$ (d) $\sqrt{2}K$

34. If a full wave rectifier circuit is operating from 50 Hz mains, the fundamental frequency in the ripple will be :
(a) 70.7 Hz
(b) 100 Hz
(c) 25 Hz
(d) 59 Hz

35. A diamagnetic material in a magnetic field moves :
(a) perpendicular to the field
(b) from weaker to the stronger parts of the field
(c) from stronger to the weaker parts of the field
(d) in none of the above directions

36. A convex lens is dipped in a liquid whose refractive index is equal to the refractive index of the lens. Then its focal length will :
    (a) become small, but non-zero
    (b) remain unchanged
    (c) become zero
    (d) become infinite

37. A *n-p-n* transistor conducts when :
    (a) collector is positive and emitter is at same potential as the base
    (b) both collector and emitter are negative with respect to the base
    (c) both collector and emitter are positive with respect to the base
    (d) collector is positive and emitter is negative with respect to the base

38. Which of the following rays are not electromagnetic waves ?
    (a) β-rays   (b) Heat rays
    (c) X-rays   (d) γ-rays

39. A man throws balls with the same speed vertically upwards one after the other at an interval of 2 seconds. What should be the speed of the throw so that more than two balls are in the sky at any time?
    (Given $g = 9.8$ m/s^2)
    (a) Any speed less than 19.6 m/s
    (b) Only with speed 19.6 m/s
    (c) More than 19.6 m/s
    (d) At least 9.8 m/s

40. Two spheres of masses *m* and *M* are situated in air and the gravitational force between them is *F*. The space around the masses is now filled with a liquid of specific gravity 3. The gravitational force will now be :
    (a) $\frac{F}{3}$ (b) $\frac{F}{9}$ (c) $3F$ (d) F

41. The potential energy of a simple harmonic oscillator when the particle is half way to its end point is :
    (a) $\frac{1}{4}E$ (b) $\frac{1}{2}E$ (c) $\frac{2}{3}E$ (d) $\frac{1}{8}E$
    (where E is the total energy)

42. According to Curie's law, the magnetic susceptibility of a paramagnetic substance at an absolute temperature T is proportional to :
    (a) $\frac{1}{T^2}$ (b) T^2
    (c) $\frac{1}{T}$ (d) T

43. The time period of a mass suspended from a spring is T. If the spring is cut into four equal parts and the same mass is suspended from one of the parts, then the new time period will be :
    (a) $\frac{T}{2}$ (b) $2T$
    (c) $\frac{T}{4}$ (d) T

44. In case of a forced vibration, the resonance wave becomes very sharp when the :
    (a) applied periodic force is small
    (b) quality factor is small
    (c) damping force is small
    (d) restoring force is small

45. A solid cylinder of mass M and radius R rolls without slipping down an inclined plane of length L and height h. What is the speed of its centre of mass when the cylinder reaches its bottom ?
    (a) $\sqrt{\frac{4}{3}gh}$ (b) $\sqrt{4gh}$
    (c) $\sqrt{2gh}$ (d) $\sqrt{\frac{3}{4}gh}$

46. A stationary particle explodes into two particles of masses m_1 and m_2 which move in opposite directions with velocities v_1 and v_2. The ratio of their kinetic energies E_1/E_2 is :
    (a) 1   (b) $m_1 v_2/m_2 v_1$
    (c) m_2/m_1 (d) m_1/m_2

47. An ideal gas heat engine operates in a Carnot cycle between 227°C and 127°C. It absorbs 6 kcal at the higher temperature. The amount of heat (in kcal) converted into work is equal to :
    (a) 1.6   (b) 1.2
    (c) 4.8   (d) 3.5

48. We consider the radiation emitted by the human body. Which of the following statements is true?
    (a) The radiation is emitted during the summers and absorbed during the winters
    (b) The radiation emitted lies in the ultraviolet region and hence is not visible
    (c) The radiation emitted is in the infra-red region
    (d) The radiation is emitted only during the day

49. Three capacitors each of capacity $4\,\mu F$ are to be connected in such a way that the effective capacitance is $6\,\mu F$. This can be done by :

(a) connecting two in series and one in parallel

(b) connecting two in parallel and one in series

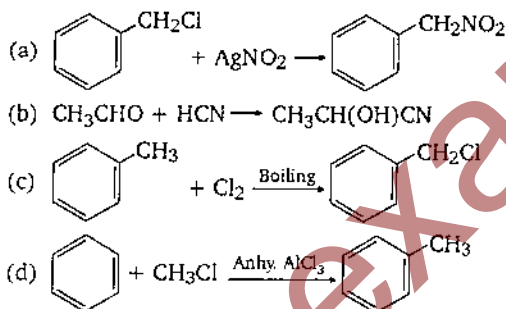(c) connecting all of them in series

(d) connecting all of them in parallel

50. In a Wheatstone's bridge all the four arms have equal resistance R. If the resistance of the galvanometer arm is also R, the equivalent resistance of the combination as seen by the battery is :

(a) R

(b) $2R$

(c) $\dfrac{R}{4}$

(d) $\dfrac{R}{2}$

Chemistry

51. The correct order of reactivity towards the electrophilic substitution of the compounds aniline (I), benzene (II) and nitrobenzene (III) is :

(a) $II < III > I$

(b) $I > II > III$

(c) $III > II > I$

(d) $II > III > I$

52. The densities of graphite and diamond at 298 K are 2.25 and 3.31 $g\,cm^{-3}$, respectively. If the standard free energy difference (ΔG°) is equal to 1895 $J\,mol^{-1}$, the pressure at which graphite will be transformed into diamond at 298 K is :

(a) 9.92×10^6 Pa

(b) 9.92×10^5 Pa

(c) 9.92×10^8 Pa

(d) 9.92×10^7 Pa

53. Which one of the following is a free radical substitution reaction ?

(a) + $AgNO_2 \longrightarrow$

(b) $CH_3CHO + HCN \longrightarrow CH_3CH(OH)CN$

(c) + $Cl_2 \xrightarrow{\text{Boiling}}$

(d) + $CH_3Cl \xrightarrow{\text{Anhy. AlCl}_3}$

54. The radioisotope, tritium ($_1^3H$) has a half-life of 12.3 years. If the initial amount of tritium is 32 mg, how many milligrams of it would remain after 49.2 years ?
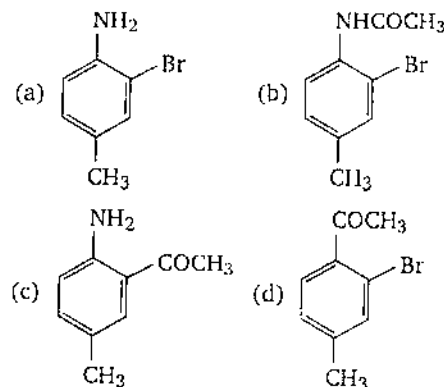
(a) 4 mg

(b) 8 mg

(c) 1 mg

(d) 2 mg

55. The reaction $A \to B$ follows first order kinetics. The time taken for 0.8 mole of A to produce 0.6 mole of B is 1 hour. What is the time taken for conversion of 0.9 mole of A to produce 0.675 mole of B ?

(a) 0.25 h (b) 2 h (c) 1 h (d) 0.5 h

56. On the basis of the information available from the reaction

$\dfrac{4}{3} Al + O_2 \to \dfrac{2}{3} Al_2O_3, \; \Delta G = -827 \text{ kJ mol}^{-1}$ of O_2, the minimum emf required to carry out an electrolysis of Al_2O_3 is ($F = 96500 \text{ C mol}^{-1}$)
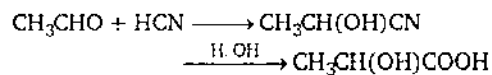
(a) 6.42 V

(b) 8.56 V

(c) 2.14 V

(d) 4.28 V

57. The final product C, obtained in this reaction

 $\xrightarrow{Ac_2O} A \xrightarrow[\text{CH}_3\text{COOH}]{Br_2} B \xrightarrow[\text{H}^+]{H_2O} C$

would be :

(a)

(b)

(c)

(d)

58. In this reaction :

$$CH_3CHO + HCN \longrightarrow CH_3CH(OH)CN$$
$$\xrightarrow{\text{H. OH}} CH_3CH(OH)COOH$$
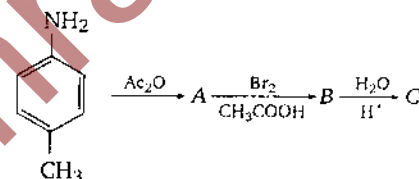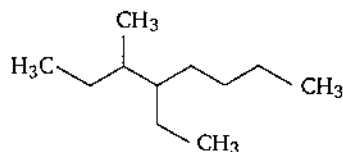
an asymmetric centre is generated. The acid obtained would be :
(a) 50% D + 50% L-isomer
(b) 20% D + 80% L-isomer
(c) D-isomer
(d) L-isomer

59. Name of the compound given below is :

(a) 2, 3-diethylheptane
(b) 5-ethyl-6-methyloctane
(c) 4-ethyl-3-methyloctane
(d) 3-methyl-4-ethyloctane

60. According to the adsorption theory of catalysis, the speed of the reaction increase because :
(a) absorption produces heat which increases the speed of the reaction
(b) adsorption lowers the activation energy of the reaction
(c) the concentration of reactant molecules at the active centres of the catalyst becomes high due to adsorption
(d) in the process of adsorption, the activation energy of the molecules becomes large

61. The emf of a Daniell cell at 298 K is E_1

$$Zn \left| \begin{array}{c} ZnSO_4 \\ (0.01\,M) \end{array} \right| \left| \begin{array}{c} CuSO_4 \\ (1.0\,M) \end{array} \right| Cu$$

When the concentration of $ZnSO_4$ is 1.0 M and that of $CuSO_4$ is 0.01 M, the emf changed to E_2. What is the relationship between E_1 and E_2 ?
(a) $E_1 = E_2$
(b) $E_2 = 0 \neq E_1$
(c) $E_1 > E_2$
(d) $E_1 < E_2$

62. Vitamin B_{12} contains :
(a) Zn (II)
(b) Ca (II)
(c) Fe (II)
(d) Co (III)

63. Which one of the following octahedral complexes will not show geometrical isomerism? (A and B are monodentate ligands)
(a) $[MA_4B_2]$
(b) $[MA_5B]$
(c) $[MA_2B_4]$
(d) $[MA_3B_3]$

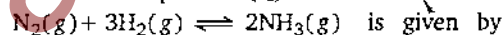64. Acrilan is a hard, horny and a high melting material. Which of the following represents its structure?

(a) $\left(\begin{array}{c} -CH_2-CH- \\ | \\ COOC_2H_5 \end{array} \right)_n$

(b) $\left(\begin{array}{c} -CH_2-CH- \\ | \\ Cl \end{array} \right)_n$

(c) $\left(\begin{array}{c} CH_2-CH- \\ | \\ CN \end{array} \right)_n$

(d) $\left(\begin{array}{c} CH_3 \\ | \\ -CH_2-C- \\ | \\ COOCH_3 \end{array} \right)_n$

65. The molar heat capacity of water at constant pressure, C, is 75 $JK^{-1} mol^{-1}$, When 1.0 kJ of heat is supplied to 100 g of water which is free to expand, the increase in temperature of water is :
(a) 4.8 K
(b) 6.6 K
(c) 1.2 K
(d) 2.4 K

66. The reaction quotient (Q) for the reaction $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ is given by $Q = \dfrac{[NH_3]^2}{[N_2][H_2]^3}$. The reaction will proceed towards right side if :
(a) $Q > K_c$
(b) $Q = 0$
(c) $Q = K_c$
(d) $Q < K_c$
where K_c is the equilibrium constant.

67. What is the entropy change (in $JK^{-1} mol^{-1}$) when one mole of ice is converted into water at 0°C ? (The enthalpy change for the conversion of ice to liquid water is 6.0 kJ mol^{-1} at 0°C.)
(a) 2.198
(b) 21.98
(c) 20.13
(d) 2.013

68. The method of zone refining of metals is based on the principle of :
(a) greater noble character of the solid metal than that of the impurity
(b) greater solubility of the impurity in the molten state than in the solid
(c) greater mobility of the pure metal than that of impurity
(d) higher melting point of the impurity than that of the pure metal

69. According to IUPAC nomenclature sodium nitroprusside is named as :
(a) sodium pentacyanonitrosyl ferrate (II)
(b) sodium pentacyanonitrosyl ferrate (III)
(c) sodium nitroferricyanide
(d) sodium nitroferrocyanide

70. Phospholipids are esters of glycerol with :
    (a) one carboxylic acid residue and two phosphate groups
    (b) three phosphate groups
    (c) three carboxylic acid residues
    (d) two carboxylic acid residues and one phosphate groups

71. The oxidation states of sulphur in the anions SO_3^{2-}, $S_2O_4^{2-}$ and $S_2O_6^{2-}$ follow the order :
    (a) $S_2O_4^{2-} < S_2O_6^{2-} < SO_3^{2-}$
    (b) $S_2O_6^{2-} < S_2O_4^{2-} < SO_3^{2-}$
    (c) $S_2O_4^{2-} < SO_3^{2-} < S_2O_6^{2-}$
    (d) $SO_3^{2-} < S_2O_4^{2-} < S_2O_6^{2-}$

72. The value of Planck's constant is 6.63×10^{-34} Js. The velocity of light is 3.0×10^8 ms^{-1}. Which value is closest to the wavelength in nanometers of a quantum of light with frequency of 8×10^{15} s^{-1} ?
    (a) 4×10^1 (b) 3×10^7
    (c) $2 \times 10^{.25}$ (d) 5×10^{-18}

73. The ions O^{2-}, F^-, Na^+, Mg^{2+} and Al^{3+} are isoelectronic. Their ionic radii show :
    (a) an increase from O^{2-} to F^- and then decrease from Na^+ to Al^{3+}
    (b) a decrease from O^{2-} to F^- and then increase from Na^+ to Al^{3+}
    (c) a significant increase from O^{2-} to Al^{3+}
    (d) a significant decrease from O^{2-} to Al^{3+}

74. The temperature dependence of rate constant (k) of a chemical reaction is written in terms of Arrhenius equation, $k = Ae^{-E*/RT}$. Activation energy (E^*) of the reaction can be calculated by ploting :
    (a) $\log k$ vs $\frac{1}{T}$ (b) $\log k$ vs $\frac{1}{\log T}$
    (c) k vs T (d) k vs $\frac{1}{\log T}$

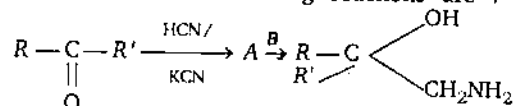75. If the rate of the reaction is equal to the rate constant, the order of the reaction is :
    (a) 2   (b) 3
    (c) 0   (d) 1

76. Which one of the following monomers gives the polymer neoprene on polymerization ?
    (a) $CH_2 = \overset{\overset{Cl}{|}}{C} - CH = CH_2$
    (b) $CF_2 = CF_2$
    (c) $CH_2 = CHCl$
    (d) $CCl_2 = CCl_2$

77. A and B in the following reactions are :

    $R - \overset{\overset{}{||}}{\underset{O}{C}} - R' \xrightarrow[KCN]{HCN/} A \xrightarrow{B} R - \overset{R'}{\underset{}{C}} \diagdown \begin{matrix} OH \\ CH_2NH_2 \end{matrix}$

    (a) $A = RR'CH_2CN$, $B = NaOH$
    (b) $A = RR'C \diagdown \begin{matrix} OH \\ COOH \end{matrix}$, $B = CH_3$
    (c) $A = RR'C \diagdown \begin{matrix} CN \\ COOH \end{matrix}$, $B = CH_3$
    (d) $A = RR'C \diagdown \begin{matrix} CN \\ OH \end{matrix}$, $B = LiAlH_4$

78. Glycolysis is :
    (a) oxidation of glucose to pyruvate
    (b) conversion of glucose to haem
    (c) oxidation of glucose to glutamate
    (d) conversion of pyruvate to citrate

79. The basic character of the transition metal monoxides follows the order :
    (a) $TiO > FeO > VO > CrO$
    (b) $TiO > VO > CrO > FeO$
    (c) $VO > CrO > TiO > FeO$
    (d) $CrO > VO > FeO > TiO$
    (Atomic number Ti = 22, V = 23, Cr = 24, Fe = 26)

80. Which of the following statements is not true ?
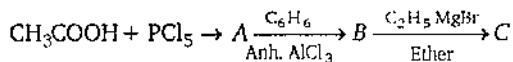   (a) HOCl is a stronger acid than HOBr
    (b) HF is a stronger acid than HCl
    (c) Among halide ions, iodide is the most powerful reducing agent
    (d) Fluorine is the only halogen that does not show a variable oxidation state

81. The compound $CH_3 - \overset{\overset{CH_3}{|}}{C} = CH - CH_3$ on reaction with $NaIO_4$ in the presence of $KMnO_4$ gives :
    (a) $CH_3COCH_3 + CH_3CHO$
    (b) $CH_3CHO + CO_2$
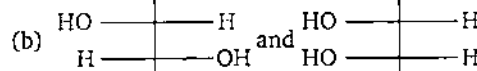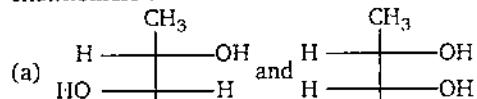   (c) CH_3COCH_3
    (d) $CH_3COCH_3 + CH_3COOH$

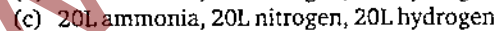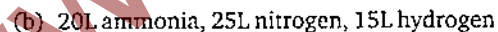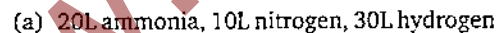**82.** In a set of the given reactions, acetic acid yielded a product C.

$$CH_3COOH + PCl_5 \rightarrow A \xrightarrow[\text{Anh. AlCl}_3]{C_6H_6} B \xrightarrow[\text{Ether}]{C_2H_5 MgBr} C$$

product C would be :

(a) $CH_3CH(OH)C_6H_5$

(b) $CH_3 - \underset{\overset{|}{C_2H_5}}{C}(OH)C_6H_5$
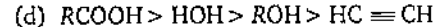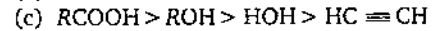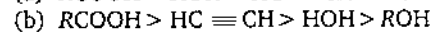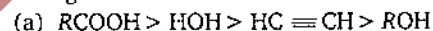
(c) $CH_3CH(OH)C_2H_5$

(d) $CH_3COC_6H_5$
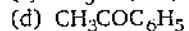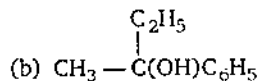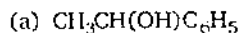
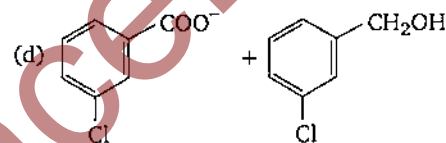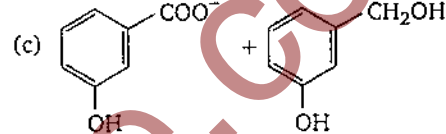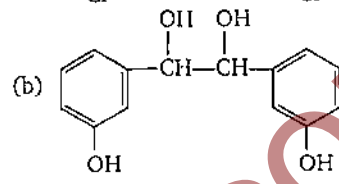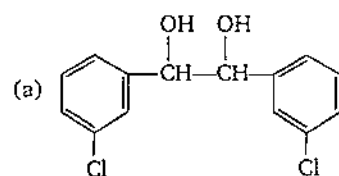**83.** Which of the following pairs of compounds are enantiomers ?

84. In Haber process 30 L of dihydrogen and 30 L of dinitrogen were taken for reaction which yielded only 50% of the expected product. What will be the composition of gaseous mixture under the aforesaid condition in the end ?
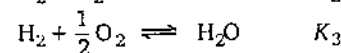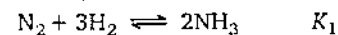
(a) 20L ammonia, 10L nitrogen, 30L hydrogen

(b) 20L ammonia, 25L nitrogen, 15L hydrogen

(c) 20L ammonia, 20L nitrogen, 20L hydrogen

(d) 10L ammonia, 25L nitrogen, 15L hydrogen
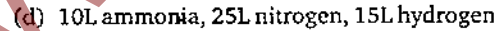
85. Which one of the following orders of acid strength is correct ?

(a) $RCOOH > HOH > HC \equiv CH > ROH$

(b) $RCOOH > HC \equiv CH > HOH > ROH$

(c) $RCOOH > ROH > HOH > HC \equiv CH$
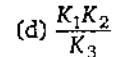
(d) $RCOOH > HOH > ROH > HC \equiv CH$

86. When m-chlorobenzaldehyde is treated with 50% KOH solution, the product(s) obtained is (are) :

87. The following equilibria are given :

$$N_2 + 3H_2 \rightleftharpoons 2NH_3 \qquad K_1$$
$$N_2 + O_2 \rightleftharpoons 2NO \qquad K_2$$
$$H_2 + \frac{1}{2}O_2 \rightleftharpoons H_2O \qquad K_3$$

The equilibrium constant of the reaction $2NH_3 + \frac{5}{2}O_2 \rightleftharpoons 2NO + 3H_2O$ in terms of K_1, K_2 and K_3 is :

(a) $\dfrac{K_1 K_3^2}{K_2}$

(b) $\dfrac{K_2 K_3^3}{K_1}$

(c) $K_1 K_2 K_3$

(d) $\dfrac{K_1 K_2}{K_3}$
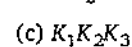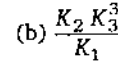
88. For which one of the following equations $\Delta H°_{react}$ equal to $\Delta H°_f$ for the product ?

(a) $Xe(g) + 2F_2(g) \longrightarrow XeF_4(g)$

(b) $2CO(g) + O_2(g) \longrightarrow 2CO_2(g)$

(c) $N_2(g) + O_3(g) \longrightarrow 2CO_2(g)$

(d) $CH_4(g) + 2Cl_2(g) \longrightarrow$
$$CH_2Cl_2(l) + 2HCl(g)$$
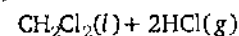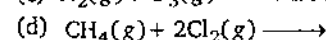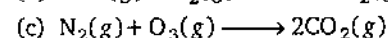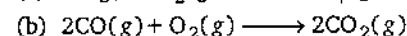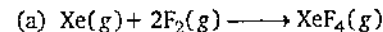
89. Which of the following statements is not correct for sigma- and pi-bonds formed between two carbon atoms ?

(a) Free rotation of atoms about a sigma-bond is allowed but not in case of a pi-bond

(b) Sigma-bond determines the direction between carbon atoms but a pi-bond has no primary effect in this regard

(c) Sigma-bond is stronger than a pi-bond

(d) Bond energies of sigma- and pi-bonds are of the order of 264 kJ/mol and 347 kJ/mol, respectively

90. Which one of the following compounds is not a protonic acid ?

(a) $SO(OH)_2$ (b) $SO_2(OH)_2$

(c) $B(OH)_3$ (d) $PO(OH)_3$

91. Among the following, which is not the π-bonded organometallic compound ?

(a) $Cr(\eta^6-C_6H_6)_2$

(b) $(CH_3)_4\,Sn$

(c) $K\,[PtCl_3\,(\eta^2-C_2H_4)]$

(d) $Fe(\eta^5-C_5H_5)_2$

92. The correct order of ionic radii of Y^{3-}, La^{3+}, Eu^{3+} and Lu^{3+} is :

(a) $Lu^{3+} < Eu^{3+} < La^{3+} < Y^{3+}$

(b) $La^{3+} < Eu^{3+} < Lu^{3+} < Y^{3+}$

(c) $Y^{3+} < La^{3+} < Eu^{3+} < Lu^{3+}$

(d) $Y^{3+} < Lu^{3+} < Eu^{3+} < La^{3+}$

(Atomic no. Y = 39, La = 57, Eu = 63, Lu = 71)

93. Which one of the following characteristics of the transition metals is associated with their catalytic activity ?

(a) Colour of hydrated ions

(b) Variable oxidation states

(c) High enthalpy of atomization

(d) Paramagnetic behaviour

94. The number of unpaired electrons in the complex ion $[CoF_6]^{3-}$ is :

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

(Atomic number Co = 27)

95. Chargaff's rule states that in an organism :

(a) amount of adenine (A) is equal to that of cytosine (C) and the amount of thymine (T) is equal to that of guanine (G)

(b) amounts of all bases are equal

(c) amount of adenine (A) is equal to that of thymine (T) and the amount of guanine (G) is equal to that of cytosine (C)

(d) amount of adenine (A) is equal to that of guanine (G) and the amount of thymine (T) is equal to that of cytosine (C)

96. The activation energy for a simple chemical reaction $A \to B$ is E_a in forward direction. The activation energy for reverse reaction :

(a) can be less than or more than E_a

(b) is always double of E_a

(c) is negative of E_a

(d) is always less than E_a

97. Formation of a solution from two components can be considered as :

(1) pure solvent $\to$ separated solvent molecules, ΔH_1

(2) pure solute $\to$ separated solute molecules, ΔH_2

(3) separated solvent and solute molecules $\to$ solution, ΔH_3

Solution so formed will be ideal if :

(a) $\Delta H_{soln} = \Delta H_1 - \Delta H_2 - \Delta H_3$

(b) $\Delta H_{soln} = \Delta H_3 - \Delta H_1 - \Delta H_2$

(c) $\Delta H_{soln} = \Delta H_1 + \Delta H_2 + \Delta H_3$

(d) $\Delta H_{soln} = \Delta H_1 + \Delta H_2 - \Delta H_3$

98. The solubility product of AgI at 25°C is 1.0×10^{-16} $mol^2\,L^{-2}$. The solubility of AgI in 10^{-4} N solution of KI at 25°C is approximately (in mol L^{-1}) :

(a) 1.0×10^{-10} (b) 1.0×10^{-8}

(c) 1.0×10^{-16} (d) 1.0×10^{-12}

99. For the reaction,

$$C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(l)$$

at constant temperature, $\Delta H - \Delta E$ is :

(a) $+3RT$ (b) $-RT$

(c) $+RT$ (d) $-3RT$

100. The pyknometric density of sodium chloride crystal is 2.165×10^3 kg m^{-3} while its X-ray density is 2.178×10^3 kg m^{-3}. The fraction of unoccupied sites in sodium chloride crystal is :

(a) 5.96×10^{-1}

(b) 5.96×10^{-3}

(c) 5.96

(d) 5.96×10^{-2}

101. Genetic map is one that :
(a) shows the stages during the cell division
(b) shows the distribution of various species in a region
(c) establishes sites of the genes on a chromosome
(d) establishes the various stages in gene evolution

102. Coconut milk factor is :
(a) abscisic acid   (b) cytokinin
(c) an auxin   (d) a gibberellin

103. Which one of the following triplet codes, is correctly matched with its specificity for an amino acid in protein synthesis or as 'start' or 'stop' codon ?
(a) UGU—Leucine
(b) UAC—Tyrosine
(c) UCG—Start
(d) UUU—Stop

104. Tobacco mosaic virus is a tubular filament of size :
(a) 300×20 nm
(b) 700×30 nm
(c) 300×10 nm
(d) 300×5 nm

105. ELISA is used to detect viruses where the key reagent is :
(a) DNA probe
(b) RNAase
(c) alkaline phosphatase
(d) catalase

106. Convergent evolution is illustrated by :
(a) starfish and cuttle fish
(b) dogfish and whale
(c) rat and dog
(d) bacterium and protozoan

107. During translation initiation in prokaryotes, a GTP molecule is needed in :
(a) association of 30S, *m*-RNA with formyl-met-*t*-RNA
(b) association of 50S subunit of ribosome with initiation complex
(c) formation of formyl-met-*t*-RNA
(d) binding of 30S subunit of ribosome with *m*-RNA

108. *Sycon* belongs to a group of animals, which are best described as :
(a) multicellular with a gastrovascular system
(b) multicellular having tissue organization, but no body cavity
(c) unicellular or acellular
(d) multicellular without any tissue organization

109. Viruses are no more "alive" than isolated chromosomes because :
(a) they both require oxygen for respiration
(b) both require the environment of a cell to replicate
(c) they require both RNA and DNA
(d) they both need food molecules

110. Cellular totipotency is demonstrated by :
(a) all eukaryotic cells
(b) only bacterial cells
(c) only gymnosperm cells
(d) all plant cells

111. Which one of the following concerns photophosphorylation ?
(a) ADP + Inorganic $PO_4 \rightarrow$ ATP
(b) AMP + Inorganic $PO_4 \xrightarrow{\text{Light energy}}$ ATP
(c) ADP + AMP $\xrightarrow{\text{Light energy}}$ ATP
(d) ADP + Inorganic $PO_4 \xrightarrow{\text{Light energy}}$ ATP

112. What is true about T-lymphocytes in mammals ?
(a) They scavenge damaged cells and cellular debris
(b) These are produced in thyroid
(c) There are three main types—cytotoxic T-cells, helper T-cells and suppressor T-cells
(d) These originate in lymphoid tissues

113. In recent years, DNA sequences (nucleotide sequence) of *mt*-DNA and Y-chromosomes were considered for the study of human evolution, because :
(a) their structure is known in greater detail
(b) they can be studied from the samples of fossil remains
(c) they are small and therefore, easy to study
(d) they are uniparental in origin and do not take part in recombination

114. Which one of the following is a matching pair of an animal and a certain phenomenon it exhibits ?
    (a) *Chameleon* — Mimicry
    (b) *Taenia* — Polymorphism
    (c) *Pheretima* — Sexual dimorphism
    (d) *Musca* — Complete metamorphosis

115. Which fractions of the visible spectrum of solar radiations are primarily absorbed by carotenoids of the higher plants ?
    (a) Red and violet   (b) Violet and blue
    (c) Blue and green   (d) Green and red

116. Species are considered as :
    (a) artificial concept of human mind which cannot be defined in absolute terms
    (b) real units of classification devised by taxonomists
    (c) real basic units of classification
    (d) the lowest units of classification

117. Random genetic drift in a population probably results from :
    (a) constant low mutation rate
    (b) large population size
    (c) highly genetically variable individuals
    (d) interbreeding within this population

118. If Henle's loop were absent from mammalian nephron, which of the following is to be expected ?
    (a) The urine will be more concentrated
    (b) The urine will be more dilute
    (c) There will be no urine formation
    (d) There will be hardly any change in the quality and quantity of urine formed

119. During prolonged fasting, in what sequence are the following organic compounds used up by the body ?
    (a) First carbohydrates, next proteins and lastly lipids
    (b) First proteins, next lipids and lastly carbohydrate
    (c) First carbohydrates, next fats and lastly proteins
    (d) First fats, next carbohydrates and lastly proteins

120. What used to be described as Nissl granules in a nerve cell are now identified as ?
    (a) Ribosomes   (b) Mitochondria
    (c) Cell metabolites (d) Fat granules

121. Genes for cytoplasmic male sterility in plants are generally located in :
    (a) nuclear genome
    (b) cytosol
    (c) chloroplast genome
    (d) mitochondrial genome

122. The apical meristem of the root is present :
    (a) only in adventitious roots
    (b) in all the roots
    (c) only in radicals
    (d) only in tap roots

123. Diffuse porous woods are characteristic of plants growing in :
    (a) temperate climate
    (b) tropics
    (c) alpine region
    (d) cold winter regions

124. In which one of the following nitrogen is not a constituent ?
    (a) Invertase   (b) Pepsin
    (c) Idioblast   (d) Bacteriochlorophyll

125. Which one of the following is wrong in relation to photorespiration ?
    (a) It is a characteristics of C_4 plants
    (b) It is a characteristics of C_3 plants
    (c) It occurs in chloroplasts
    (d) It occurs in daytime only

126. Stomata of a plant open due to :
    (a) influx of hydrogen ions
    (b) influx of calcium ions
    (c) influx of potassium ions
    (d) efflux of potassium ions

127. Stomata of CAM plants :
    (a) open during the night and close during the day
    (b) never open
    (c) are always open
    (d) open during the day and close at night

128. The major portion of the dry weight of plants comprises of :
    (a) carbon, nitrogen and hydrogen
    (b) carbon, hydrogen and oxygen
    (c) nitrogen, phosphorus and potassium
    (d) calcium, magnesium and sulphur

129. In *Drosophila*, the sex is determined by :
    (a) the ratio of pairs of X-chromosomes to the pairs of autosomes
    (b) whether the egg is fertilized or develops parthenogenetically
    (c) the ratio of number of X-chromosomes to the set of autosomes
    (d) X and Y-chromosomes

130. Christmas disease in another name for :
    (a) Down's syndrome
    (b) sleeping sickness
    (c) haemophilia B
    (d) hepatitis B

131. When a cluster of genes show linkage behaviour they :
    (a) do not show independent assortment
    (b) induce cell division
    (c) do not show a chromosome map
    (d) show recombination during meiosis

132. Degeneration of a genetic code is attributed to the :
    (a) entire codon
    (b) third member of a codon
    (c) first member of a codon
    (d) second member of a codon

133. Two opposite forces operate in the growth and development of every population. One of them relates to the ability to reproduce at a given rate. The force opposing it is called :
    (a) biotic potential
    (b) environmental resistance
    (c) morbidity
    (d) fecundity

134. Fluoride pollution mainly affects :
    (a) teeth   (b) kidney
    (c) brain   (d) heart

135. Which one of the following statements about viruses is correct ?
    (a) Viruses are obligate parasites
    (b) Nucleic acid of viruses is known as capsid
    (c) Viruses possess their own metabolic system
    (d) All viruses contain both RNA and DNA

136. Sexual reproduction in *Spirogyra* is an advanced feature because it shows :
    (a) morphologically different sex organs
    (b) physiologically differentiated sex organs
    (c) different sizes of motile sex organs
    (d) same size of motile sex organs

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

138. In alcohol fermentation :
    (a) there is no electron donor
    (b) oxygen is the electron acceptor

(c) triose phosphate is the electron donor while acetaldehyde is the electron acceptor
(d) triose phosphate is the electron donor while pyruvic acid is the electron acceptor

139. During anaerobic digestion of organic waste, such as in producing biogas, which one of the following is left undegraded ?
    (a) Hemicellulose   (b) Cellulose
    (c) Lipids   (d) Lignin

140. Industrial melanism is an example of :
    (a) protective resemblance with the surroundings
    (b) defensive adaptation of skin against ultraviolet radiations
    (c) drug resistance
    (d) darkening of skin due to smoke from industries

141. The cells of the quiescent centre are characterised by :
    (a) dividing regularly to add to the corpus
    (b) dividing regularly to add to tunica
    (c) having dense cytoplasm and prominent nuclei
    (d) having light cytoplasm and small nuclei

142. Differentiation of shoot is controlled by :
    (a) high gibberellin : auxin ratio
    (b) high gibberellin : cytokinin ratio
    (c) high auxin : cytokinin ratio
    (d) high cytokinin : auxin ratio

143. In a flowering plant, archesporium gives rise to :
    (a) wall and the tapetum
    (b) only tapetum and sporogenous cells
    (c) only the wall of the sporangium
    (d) both wall and the sporogenous cells

144. Which one of the following mineral elements plays an important role in biological nitrogen fixation ?
    (a) Zinc   (b) Molybdenum
    (c) Copper   (d) Manganese

145. Plants deficient of element zinc, show its effect on the biosynthesis of plant growth hormone :
    (a) ethylene   (b) abscisic acid
    (c) auxin   (d) cytokinin

146. In sugarcane plant $^{14}CO_2$ is fixed in a malic acid, in which the enzyme that fixes CO_2 is :
    (a) ribulose phosphate kinase
    (b) fructose phosphatase
    (c) ribulose biphosphate carboxylase
    (d) phosphoenol pyruvic acid carboxylase

147. Mycorrhiza is an example of :
(a) endoparasitism
(b) decomposers
(c) symbiotic relationship
(d) ectoparasitism

148. Which one of the following is categorised under living fossils ?
(a) *Selaginella*   (b) *Metasequoia*
(c) *Pinus*   (d) *Cycas*

149. Boron in green plants assists in :
(a) photosynthesis
(b) sugar transport
(c) activation of enzymes
(d) acting as enzyme cofactor

150. Chlorenchyma is known to develop in the :
(a) spore capsule of a moss
(b) pollen tube of *Pinus*
(c) cytoplasm of *Chlorella*
(d) mycelium of a green mould such as *Aspergillus*

151. The term "antibiotic" was coined by :
(a) Selman Waksman
(b) Alexander Flemming
(c) Edward Jenner
(d) Louis Pasteur

152. The aleurone layer in maize grain is specially rich in :
(a) lipids   (b) auxins
(c) proteins   (d) starch

153. Which one of the following sequences was proposed by Darwin and Wallace for organic evolution ?
(a) Overproduction, constancy of population size, variations, natural selection
(b) Variations, natural selection, overproduction, constancy of population size
(c) Overproduction, variations, constancy of population size, natural selection
(d) Variations, constancy of population size, overproduction, natural selection

154. Given below are four matchings of an animal and its kind of respiratory organ :
(A) silver fish— trachea
(B) scorpion — book lung
(C) sea squirt — pharyngeal gills
(D) dolphin — skin
The correct matchings are :
(a) B and D   (b) C and D
(c) A and D   (d) A, B and C

155. Grey spots of oat are caused by deficiency of :
(a) Mn   (b) Fe
(c) Cu   (d) Zn

156. Which of the following discoveries resulted in a Nobel Prize ?
(a) Recombination of linked genes
(b) Genetic engineering
(c) X-rays induce sex-linked recessive lethal mutations
(d) Cytoplasmic inheritance

157. The chief advantage of encystment of an *Amoeba* is :
(a) protection from parasites and predators
(b) the chance to get rid of accumulated waste products
(c) the ability to survive during adverse physical conditions
(d) the ability to live for some time without ingesting food

158. Which of the following plants are used as green manure in crop fields and in sandy soils?
(a) *Saccharum munja* and *Lantana camara*
(b) *Dichanthium annulatum* and *Azolla nilotica*
(c) *Crotolaria juncea* and *Alhagi comelorum*
(d) *Calotropis procera* and *Phyllanthus niruri*

159. In which kingdom would you classify the archaea and nitrogen-fixing organisms. If the five- kingdom system of classification is used :
(a) Protista   (b) Monera
(c) Plantae   (d) Fungi

160. Which one of the following traits of garden pea studied by Mendel was a recessive feature ?
(a) Green pod colour
(b) Round seed shape
(c) Axial flower position
(d) Green seed colour

161. The genes controlling the seven pea characters studied by Mendel are now known to be located on how many different chromosomes ?
(a) Five   (b) Four
(c) Seven   (d) Six

162. Juicy hair-like structures observed in the lemon fruit develop from :
(a) endocarp
(b) mesocarp and endocarp
(c) exocarp
(d) mesocarp

163. Which one of the following describes correctly the homologous structures ?
    (a) Organs that have no function now, but had an important function in ancestors
    (b) Organs appearing only in embryonic stage and disappearing later in the adult
    (c) Organs with anatomical similarities, but performing different functions
    (d) Organs with anatomical dissimilarities, but performing same functions

164. Darwin in his 'Natural Selection Theory', did not believe in any role of which one of the following in organic evolution ?
    (a) Struggle for existence
    (b) Discontinuous variations
    (c) Parasites and predators as natural enemies
    (d) Survival of the fittest

165. During its life-cycle, *Fasciola hepatica* (liver fluke) infects its intermediate host and primary host at the following larval stages respectively :
    (a) metacercaria and cercaria
    (b) miracidium and metacercaria
    (c) redia and miracidium
    (d) cercaria and redia

166. *Escherichia coli* is used as an indicator organism to determine pollution of water with:
    (a) industrial effluents
    (b) pollen of aquatic plants
    (c) heavy metals
    (d) faecal matter

167. Down's syndrome is caused by extra copy of chromosome number 21. What percentage of offspring produced by an affected mother and a normal father would be affected by this disorder ?
    (a) 50% (b) 25% (c) 100% (d) 75%

168. What would happen if in a gene encoding a polypeptide of 50 amino acids, 25th codon (UAU) is mutated to UAA ?
    (a) A polypeptide of 49 amino acids will be formed
    (b) A polypeptide of 25 amino acids will be formed
    (c) A polypeptide of 24 amino acids will be formed
    (d) Two polypeptides of 24 and 25 amino acids will be formed

169. Which one of the following pairs is not correctly matched ?
    (a) Vitamin B_{12}—Pernicious anaemia
    (b) Vitamin B_1—Beri-beri
    (c) Vitamin C —Scurvy
    (d) Vitamin B_2—Pellagra

170. Which elements is located at the centre of the porphyrin ring in chlorophyll ?
    (a) Potassium   (b) Manganese
    (c) Calcium   (d) Magnesium

171. The major role of minor elements inside living organisms is to act as :
    (a) constituents of hormones
    (b) binder of cell structure
    (c) co-factors of enzymes
    (d) building blocks of important amino acids

172. In the genetic code dictionary, how many codons are used to code for all the 20 essential amino acids ?
    (a) 61   (b) 60   (c) 20   (d) 64

173. Which one of the following pairs of plants are not seed producers ?
    (a) *Ficus* and *Chlamydomonas*
    (b) *Punica* and *Pinus*
    (c) Fern and *Funaria*
    (d) *Funaria* and *Ficus*

174. Systemic heart refers to :
    (a) entire heart in lower vertebrates
    (b) the two ventricles together in humans
    (c) the heart that contracts under stimulation from nervous system
    (d) left auricle and left ventricle in higher vertebrates

175. The linkage map of X-chromosome of fruit-fly has 66 units, with yellow body gene (y) at one end and bobbed hair (b) gene at the other end. The recombination frequency between these two genes (y and b) should be :
    (a) ≤ 50%   (b) 100%
    (c) 66%   (d) > 50%

176. Choromosomes in a bacterial cell can be 1-3 in number and :
    (a) can be either circular or linear, but never both within the same cell
    (b) can be circular as well as linear within the same cell
    (c) are always circular
    (d) are always linear

177. Which one of the following contains the largest quantity of extracellular material ?
    (a) Stratified epithelium
    (b) Myelinated nerve fibres
    (c) Striated muscle
    (d) Areolar tissue

178. Bundle of His is a network of :
    (a) nerve fibres distributed in ventricles
    (b) nerve fibres found throughout the heart
    (c) muscle fibres distributed throughout the heart walls
    (d) muscle fibres found only in the ventricle wall

179. Which endangered animal is the source of the world's finest, lightest, warmest and most expensive wool—the shahtoosh ?
    (a) Kashmiri goat   (b) Chiru
    (c) Nilgai   (d) Cheetal

180. Carcinoma refers to :
    (a) malignant tumours of the colon
    (b) benign tumours of the connective tissue
    (c) malignant tumours of the connective tissue
    (d) malignant tumours of the skin or mucous membrane

181. Which one of the following pairs correctly mathces a hormone with a disease resulting from its deficiency ?
    (a) Parathyroid hormone — Tetani
    (b) Insulin — Diabetes insipidus
    (c) Relaxin — Gigantism
    (d) Prolactin — Cretinism

182. Maximum application of animals cell culture technology today is in the production of :
    (a) vaccines   (b) edible proteins
    (c) insulin   (d) interferons

183. Ommatidia serve the purpose of photoreception in :
    (a) humans   (b) sunflower
    (c) cockroach   (d) frog

184. In a random mating population in equilibrium, which of the following brings about a change in gene frequency in non-directional manner ?
    (a) Selection   (b) Migration
    (c) Mutations   (d) Random drift

185. In which one of the following options the two names refer to one and the same thing ?
    (a) Citric acid cycle and Calvin cycle
    (b) Tricarboxylic acid cycle and urea cycle
    (c) Krebs cycle and Calvin cycle
    (d) Tricarboxylic acid cycle and citric acid cycle

186. Test tube baby means a baby born when :
    (a) the ovum is fertilized externally and thereafter implanted in the uterus
    (b) it develops from a non-fertilized egg
    (c) it is developed in a test tube
    (d) it is developed through tissue culture method

187. Which one of the following bacteria has found extensive use in genetic engineering work in plants ?
    (a) Bacillus coagulens
    (b) Agrobacterium tumefaciens
    (c) Clostridium septicum
    (d) Xanthomonas citri

188. Which group of vertebrates comprises the highest number of endangered species ?
    (a) Reptiles   (b) Birds
    (c) Mammals   (d) Fishes

189. During transcription, the DNA site at which RNA polymerase binds is called :
    (a) receptor   (b) enhancer
    (c) promoter   (d) regulator

190. During embryonic development, the establishment of polarity along anterior/posterior, dorsal/ventral or medial/lateral axis is called :
    (a) anamorphosis
    (b) pattern formation
    (c) organizer phenomena
    (d) axis formation

191. What does "lac" refer to in what we call the lac operon ?
    (a) Lac insect
    (b) The number, 1,00,000
    (c) Lactose
    (d) Lactase

192. Two crosses between the same pair of genotypes or phenotypes in which the sources of the gametes are reversed in one cross, is known as :
    (a) dihybrid cross
    (b) reverse cross
    (c) test cross
    (d) reciprocal cross

193. Pattern baldness, moustaches and beard in human males are examples of :
    (a) sex differentiating traits
    (b) sex determining traits
    (c) sex linked traits
    (d) sex limited traits

194. Which one of the following conditions though harmful in itself, is also a potential saviour from a mosquito borne infectious disease ?
   (a) Pernicious anaemia
   (b) Leukemia
   (c) Thalassaemia
   (d) Sickle cell anaemia

195. Plants reproducing by spores such as mosses and ferns are grouped under the general term :
   (a) sporophytes   (b) thallophytes
   (c) cryptogams   (d) bryophytes

196. Which one pair of examples will correctly represent the grouping spermatophyta according to one of the schemes of classifying plants ?
   (a) *Rhizopus, Triticum*
   (b) *Ginkgo, Pisum*
   (c) *Acacia*, sugarcane
   (d) *Pinus, Cycas*

197. *Nicotiana sylvestris* flowers only during long days and *N. tabacum* flowers only during short days, If raised in the laboratory under different photoperiods, they can be induced to flower at the same time and can be crossfertilized to produce s elf-fertile offspring. What is the best reason for considering *N. sylvestris* and *N. tabacum* to be separate species ?
   (a) They are physiologically distinct
   (b) They are morphologically distinct

(c) They cannot interbreed in nature
(d) They are reproductively distinct

198. Biosystematics aims at :
   (a) the classification of organisms based on their evolutionary history and establishing their phylogeny on the totality of various parameters from all fields of studies
   (b) identification and arrangement of organisms on the basis of their cytological characterisites
   (c) the classification of organisms based on broad morphological characters
   (d) delimiting various taxa of organisms and establishing their relationships

199. Bartholin's glands are situated :
   (a) on either side of vagina in humans
   (b) on either side of vas deference in humans
   (c) on the sides of the head of some amphibians
   (d) at the reduced tail end of birds

200. Short-lived immunity acquired from mother to foetus across placenta or through mother's milk to the infant is categorised as :
   (a) cellular immunity
   (b) innate non-specific immunity
   (c) active immunity
   (d) passive immunity

ⒶNSWERS

➡ **PHYSICS**

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

➡ **CHEMISTRY**

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

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

HINTS & SOLUTIONS

Physics

1. **Key Idea :** *When lift is moving upwards, it weighs more than actual weight of man by a factor of ma.*

   Mass of man $M = 80$ kg
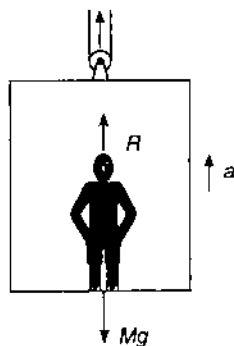
   Acceleration of lift, $a = 5$ m/s^2

   When lift is moving upwards, the reading of weighing scale will be equal to R.
   The equation of motion gives
   $$R - Mg = Ma$$
   or $\quad R = Mg + Ma = M(g + a)$
   $\therefore \quad R = 80(10 + 5) = 80 \times 15 = 1200$ N

2. Maximum bearable tension in the rope
   $$T = 25 \times 10 = 250 \text{ N}$$

From the figure,
$$T - mg = ma$$
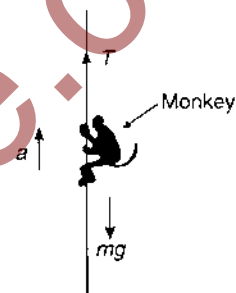or $\quad a = \dfrac{T - mg}{m}$

Given,
$m = 20$ kg,
$g = 10$ m/s^2,
$T = 250$ N

Hence,
$$a = \dfrac{250 - 20 \times 10}{20}$$
$$= \dfrac{50}{20} = 2.5 \text{ m/s}^2$$

3. J.J. Thomson's cathode-ray tube experiment demonstrated the relation for e/m of charged particles. The relation is
 $$\frac{e}{m} = \frac{E^2}{2B^2V}$$

   Thus, knowing E, B and V, the value of e/m for electrons and protons can be calculated. It is found the e/m of electrons is much greater than the e/m of protons.

4. In reverse biasing of a *p-n* junction, *p*-side is connected to the negative terminal of the battery and *n*-side is connected to positive terminal of battery. In this situation battery increases the restraining force and current through the junction is exceedingly small. The

Holes p n Electrons

Low current
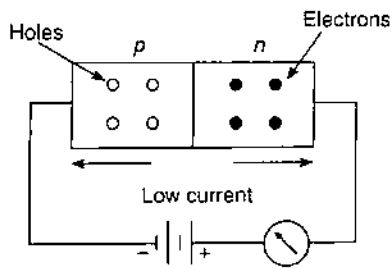
cause of this small, current is the conduction by the minority electrons and holes obtained due to light and thermal agitation. Such circuit lowers the fermi level on n-side by an amount eV raising the barrier height to $e(V_B + V)$ and increasing the depletion width too.

(i) No bias

(ii) Reverse bias
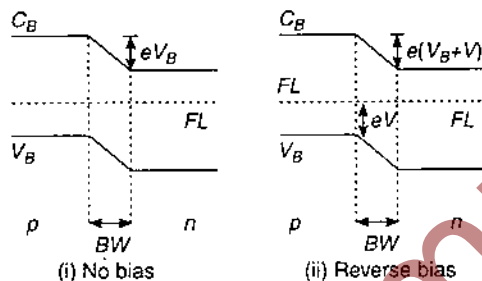
5. Radius of nth Bohr's orbit of hydrogen like atom,

$$r_n \propto \frac{n^2}{Z}$$

where, Z is atomic number.

For first orbit, $n = 1$

$\therefore$ $\qquad r_n \propto \frac{1}{Z}$

Now, for radius of first orbit to be minimum, its atomic number must be greater. Here in the problem, atomic number Z is greater for doubly ionized lithium and is $Z = 3$. Hence, for this system the radius of first orbit will be minimum.

6. If the magnet is displaced through an angle θ, the restoring torque in displaced position is

$$\tau = -MH \sin\theta \qquad \qquad ...(i)$$

Here, M = Magnetic moment of the magnet

H = Horizontal component of earth's magnetic field

but $\tau = I\alpha$ and $\sin\theta \approx 0$ for small angular displacement.

Thus, Eq. (i) becames

$$I\alpha = -MH\theta \qquad \qquad ...(ii)$$

or $\qquad \alpha = -\frac{MH}{I}\theta$

$$= -\frac{MH}{(ml^2/12)}\theta \qquad \left(\because I = \frac{ml^2}{12}\right)$$

$$= -k\theta$$

where $\quad k = \frac{MH}{ml^2/12}$ = a constant

If the mass of bar magnet is quadrupled, then k is again a constant. Hence,

$$\alpha \propto -\theta$$

Thus, the motion is again simple harmonic.

Now, from Eq. (ii)

$$\left|\frac{\theta}{\alpha}\right| = \frac{I}{MH}$$

The time period will be

$$T = 2\pi\sqrt{\left|\frac{\theta}{\alpha}\right|} = 2\pi\sqrt{\frac{I}{MH}}$$

or $\qquad T \propto \sqrt{I}$

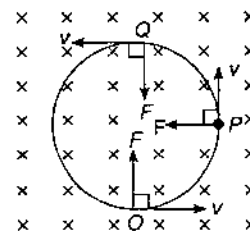or $\qquad T \propto \sqrt{m} \qquad \left(\because I = \frac{ml^2}{12}\right)$

$\therefore \qquad \frac{T_1}{T_2} = \sqrt{\frac{m_1}{m_2}}$

or $\qquad \frac{T}{T_2} = \sqrt{\frac{m}{4m}} = \frac{1}{2}$

$\therefore \qquad T_2 = 2T$

7. When a charged particle moves through a perpendicular magnetic field, then a magnetic

force acts on it which changes the direction of particle but does not alter the magnitude of its velocity (i.e. speed).

NOTE : If a charged particle moves at 45° to magnetic field then path of the particle will be a helix whose circular part has radius according to relation $r = \frac{mv \sin\theta}{qB}$.

8. **Key Idea :** *If external torque acting on the system is zero, hence angular momentum remains conserved.*

$$\tau_{ext} = 0$$
or $$\frac{dL}{dt} = 0$$
or $$L = \text{constant}$$
or $$I\omega = \text{constant}$$
∴ $$I_1\,\omega_1 = I_2\,\omega_2 \qquad ...(i)$$

Here, $I_1 = Mr^2$, $\omega_1 = \omega$, $I_2 = Mr^2 + 4mr^2$

Hence, Eq. (i) can be written as

$$Mr^2\omega = (Mr^2 + 4mr^2)\,\omega_2$$

∴ $$\omega_2 = \frac{M\omega}{M + 4m}$$

9. **Key Idea :** *According to Ampere's law, the line integral $\oint \vec{B}.\,d\,\vec{l}$ of the resultant magnetic field along a closed, plane curve is equal to μ_0 times the total current crossing the area bounded by the closed curve.*

Using Ampere's law,

$$\oint \vec{B}.\,d\,\vec{l} = \mu_0\,(i_{net}) \qquad ...(i)$$

In our case,

i_{net} = (number of turns inside the area) × (current through each turn)

$$= (nl)\,i$$

(n = number of turns per unit length)

Then, Eq. (i) can be written as,

$$Bl = (\mu_0)\,(nli)$$
or $$B = \mu_0\,ni$$
or $$B \propto ni$$
∴ $$\frac{B_1}{B_2} = \frac{n_1\,i_1}{n_2\,i_2}$$

Here, $n_1 = n_1$, $n_2 = \dfrac{n}{2}$, $i_1 = i$, $i_2 = 2i$, $B_1 = B$

Hence, $$\frac{B}{B_2} = \frac{n}{n/2} \times \frac{i}{2i} = 1$$

or $$B_2 = B$$

10. For our convenience, the output of first NAND gate is chosen as X as shown
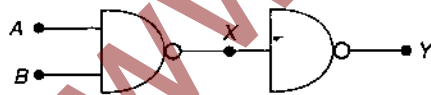
Output of first NAND gate,

$$X = \overline{A.\,B}$$

Using De-Morgain's theorem

$$\overline{A.\,B} = \overline{A} + \overline{B}$$

So, $$X = \overline{A} + \overline{B}$$

Now, output of 2nd NAND gate,

$$Y = \overline{X} = \overline{\overline{A} + \overline{B}}$$

Again $\overline{\overline{A} + \overline{B}} = \overline{\overline{A}}.\,\overline{\overline{B}} = A.\,B \;(\because \overline{\overline{A}} = A)$

Hence, $$Y = A.\,B$$

This is the logic function of AND gate.

11. Radius of atom $\approx 10^{-10}$ m

Radius of nucleus $\approx 10^{-15}$ m

Ratio of volume of atom to volume of nucleus

$$= \frac{\text{volume of atom}}{\text{volume of nucleus}}$$

$$= \frac{\frac{4}{3}\,\pi r_1^3}{\frac{4}{3}\,\pi r_2^3}$$

$$= \left(\frac{10^{-10}}{10^{-15}}\right)^3 = 10^{15}$$

12. Mass number = Atomic number + Number of neutrons

For example, in case of hydrogen
Number of neutrons = 0
Thus, mass number = atomic number
Hence, sometimes the atomic number is equal to the mass number.

13. **Key Idea :** *The binding energy of a nucleus,*

$$\Delta E = (mass\ defect) \times 931$$

$_2\text{He}^4$ contains 2 neutrons and 2 protons

Mases of 2 protons = 2×1.0073
$$= 2.0146\ u$$

Mass of 2 neutrons = 2×1.0087
$$= 2.0174\ u$$

Total mass of 2 protons and 2 neutrons
$$= (2.0146 + 2.0174)\ u = 4.032\ u$$

Mass of helium nucleus = $4.0015\ u$

Thus, mass defect is lacking of mass in forming the helium nucleus from 2 protons and 2 neutrons.

∴ $$\Delta m = \text{mass defect}$$
$$= (4.032 - 4.0015)\ u$$
$$= 0.0305\ u$$

$$= 0.0305 \text{ amu}$$

but 1 amu = 931 MeV

Hence, binding energy

$$\Delta E = (\Delta m) \times 931$$
$$= 0.0305 \times 931 = 28.4 \text{ MeV}$$

14. Barrier potential does not depend on diode design while it depends on temperature, doping density and forward biasing.

15. Key Idea : *The tangential acceleration in a circular path is the product of radius of circular path and angular acceleration.*

The tangential acceleration

$$a_T = r\alpha \qquad \ldots(i)$$

From 2nd equation of motion in rotational motion,

$$\omega^2 = \omega_0^2 + 2\alpha\theta$$

Here, $\omega_0 = 0$, $\omega = \dfrac{v}{r} = \dfrac{80}{20/\pi} = 4\pi$ rad/s,

$$\theta = 2 \times 2\pi \text{ rad}$$

So, $\alpha = \dfrac{\omega^2}{2\theta} = \dfrac{(4\pi)^2}{2 \times (2 \times 2\pi)}$

$$= \dfrac{16\pi^2}{8\pi} = 2\pi$$

Hence, from Eq. (i), we have

$$a_T = r\alpha = \dfrac{20}{\pi} \times 2\pi = 40 \text{ m/s}^2$$

16. Let R_1 and R_2 be the resistances of the coils, V the supply voltage, H the heat required to boil the water.

For first coil, $H = \dfrac{V^2 t_1}{R_1}$ ...(i)

For second coil, $H = \dfrac{V^2 t_2}{R_2}$ ...(ii)

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

$$\dfrac{t_1}{R_1} = \dfrac{t_2}{R_2}$$

i.e., $\dfrac{R_2}{R_1} = \dfrac{t_2}{t_1} = \dfrac{40}{10} = 4$

$\Rightarrow \qquad R_2 = 4R_1$ ...(iii)

When the two heating coils are in parallel,

$$R = \dfrac{R_1 R_2}{R_1 + R_2} = \dfrac{R_1 \times 4R_1}{R_1 + 4R_1} = \dfrac{4R_1}{5}$$

and $H = \dfrac{V^2 t}{R}$ ...(iv)

Comparing Eqs. (i) and (iv), we get

$$\dfrac{V^2 t_1}{R_1} = \dfrac{V^2 t}{R}$$

$\Rightarrow \qquad t = \dfrac{R}{R_1} \times t_1 = \dfrac{4}{5} \times 10 = 8 \text{ min}$
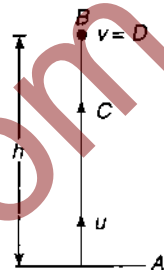
17. Let the ball takes T sec to reach maximum height H.

$$v = u - gT$$

put $v = 0$ (at height H)

$\therefore \quad u = gT$ or $T = u/g$ ...(i)

Velocity attained by the ball in $(T - t)$ sec is,

$$v' = u - g(T - t)$$
$$= u - gT + gt$$
$$= u - g\dfrac{u}{g} + gt$$
$$= u - u + gt$$
$$v = gt \qquad \ldots(ii)$$

Hence, distance travelled in last t sec of its ascent

$$CB = v't - \dfrac{1}{2}gt^2$$
$$= (gt)t - \dfrac{1}{2}gt^2$$
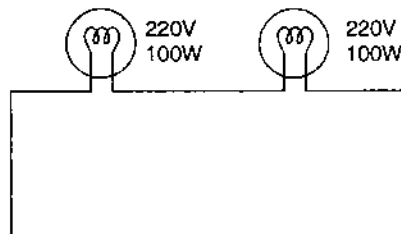$$= gt^2 - \dfrac{1}{2}gt^2 \quad \text{[From Eq. (ii)]}$$
$$= \dfrac{1}{2}gt^2$$

18. Let, $P_1 = 100\text{W}$, $P_2 = 100\text{W}$, $V = 220$ volt

$$P_1 = \dfrac{V^2}{R_1} \text{ and } P_2 = \dfrac{V^2}{R_2}$$

$\therefore \quad R_1 = \dfrac{V^2}{P_1} = \dfrac{(220)^2}{100} = \dfrac{220 \times 220}{100}\,\Omega$

and $R_2 = \dfrac{V^2}{P_2} = \dfrac{(220)^2}{100} = \dfrac{220 \times 220}{100}\,\Omega$
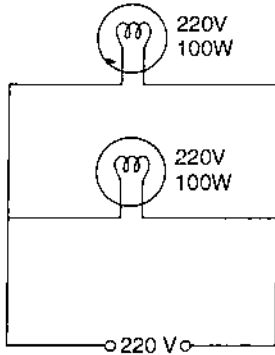
Case I : When two bulbs are connected in series.

In series, $R_{eq} = R_1 + R_2$

$$= \left(\frac{220 \times 220}{100}\right) \times 2$$

Hence, $P_{eq} = \frac{V^2}{R_{eq}} = \frac{220 \times 220}{\left(\frac{220 \times 220}{100} \times 2\right)}$

$$= \frac{100}{2} = 50W$$

Case II : When two bulbs are connected in parallel.

In parallel,

$$R_{eq} = \frac{R_1 R_2}{R_1 + R_2}$$

$$= \frac{\left(\frac{220 \times 220}{100}\right)^2}{\frac{220 \times 220}{100} \times 2}$$

$$R_{eq} = \frac{220 \times 220}{100} \times \frac{1}{2}$$

Hence, $P_{eq} = \frac{V^2}{R_{eq}} = \frac{220 \times 220}{\frac{220 \times 220}{100} \times \frac{1}{2}}$

$$= 200 \text{ W}$$

Alternative :

For series $P_{eq} = \frac{P_1 P_2}{P_1 + P_2} = \frac{100 \times 100}{200} = 50W$

For parallel $P_{eq} = P_1 + P_2$
$$= 100 + 100 = 200W$$

19. The electric fuse is a device which is used to limit the current in an electric circuit. Thus, the use of fuse safeguards the circuit and the appliances connected in the circuit from being damaged. It is always connected with the live (or phase) wire. The fuse wire is a short piece of wire made of a material of high resistance and low melting point so that it may easily melt due to overheating when excessive current passes through it.

NOTE : A fuse wire is an alloy made of tin and lead.

20. In sun energy in huge amount is produced due to fusion of 4 protons (hydrogen nucleus) into a helium nucleus according to the reaction

$$_1H^1 + {}_1H^1 + {}_1H^1 + {}_1H^1 \rightarrow {}_2He^4 + 2\,_{-1}\beta^0$$
$$+ \gamma \text{ (energy)} + 2v$$

NOTE : It is estimated that sun will radiate energy at its present rate for next one thousand crore (10^{11}) years.

21. Initially, the focal length of equiconvex lens is

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

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R} - \frac{1}{-R}\right) = \frac{2(\mu - 1)}{R}$$

Case I : When lens is cut along *XOX'*, then each half is again equiconvex with

$$R_1 = + R, R_2 = - R$$

Thus, $\frac{1}{f} = (\mu - 1)\left[\frac{1}{R} - \frac{1}{(-R)}\right]$

$$= (\mu - 1)\left[\frac{1}{R} + \frac{1}{R}\right]$$

$$= (\mu - 1)\frac{2}{R} = \frac{1}{f'}$$

$$\Rightarrow \qquad f' = f$$

Case II : When lens is cut along *YOY'*, then each half becomes plano-convex with

$$R_1 = + R, R_2 = \infty$$

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

$$= (\mu - 1)\left(\frac{1}{R} - \frac{1}{\infty}\right)$$

$$= \frac{(\mu - 1)}{R} = \frac{1}{2f}$$

Hence, $f' = f, f'' = 2f$

22. Since, $_{-1}e^0$ is emitted which is a β-particle, so it is a β-decay process.

23. Mean life

$$\tau = \frac{1}{\lambda}, \lambda \text{ beings decay constant.}$$

Also time given

$$t = 2\tau = 2 \times \frac{1}{\lambda} = \frac{2}{\lambda}$$

Thus, mass remained after time t is

$$M = M_0 \, e^{-\lambda t}$$

$$= 10e^{-\lambda \cdot \frac{2}{\lambda}} \qquad (\because M_0 = 10 \text{g})$$

$$= 10e^{-2} = \frac{10}{e^2} = 1.35 \, g$$

24. Key Idea : *Number of photoelectrons emitted per second is directly proportional to intensity of light.*

Intensity of light source is

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

When distance is doubled, intensity becomes one fourth.

As number of photoelectrons $\propto$ intensity, so number of photoelectrons is quarter of the initial number.

25. Key Idea : *The two vectors must be perpendicular if their dot product must be zero.*

Let $\vec{A}$ and $\vec{B}$ are two forces. The sum of the two forces.

$$\vec{F}_1 = \vec{A} + \vec{B} \qquad \ldots(i)$$

The difference of the two forces,

$$\vec{F}_2 = \vec{A} - \vec{B} \qquad \ldots(ii)$$

Since, sum of the two forces is perpendicular to their differences as given, so

$$\vec{F}_1 \cdot \vec{F}_2 = 0$$

or $\qquad (\vec{A} + \vec{B}) \cdot (\vec{A} - \vec{B}) = 0$

or $\qquad A^2 - \vec{A} \cdot \vec{B} + \vec{B} \cdot \vec{A} - B^2 = 0$

or $\qquad A^2 = B^2$

or $\qquad |\vec{A}| = |\vec{B}|$

Thus, the forces are equal to each other in magnitude.

26. Key Idea : *In rolling without slipping, total energy of ball is the sum of its translational and rotational energy.*

Kinetic energy of rotation is

$$K_{rot} = \frac{1}{2} I \, \omega^2 = \frac{1}{2} MK^2 \frac{v^2}{R^2}$$

where K is radius of gyration

Kinetic energy of translation is

$$K_{trans.} = \frac{1}{2} Mv^2$$

Thus, total energy

$$E = K_{rot.} + K_{trans.}$$

$$= \frac{1}{2} MK^2 \frac{v^2}{R^2} + \frac{1}{2} Mv^2$$

$$= \frac{1}{2} Mv^2 \left(\frac{K^2}{R^2} + 1 \right)$$

$$= \frac{1}{2} \frac{Mv^2}{R^2} (K^2 + R^2)$$

Hence,

$$\frac{K_{rot.}}{K_{trans.}} = \frac{\frac{1}{2} MK^2 \frac{v^2}{R^2}}{\frac{1}{2} \frac{Mv^2}{R^2} (K^2 + R^2)} = \frac{K^2}{K^2 + R^2}$$

27. It is given that, acceleration due to gravity planet A is 9 times the acceleration due to grav. on planet B i.e.,

$$g_A = 9g_B \qquad \ldots$$

From third equation of motion

$$v^2 = 2gh$$

At planet A, $h_A = \dfrac{v^2}{2g_A}$ (

At planet B, $h_B = \dfrac{v^2}{2g_B}$ (i

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

$$\frac{h_A}{h_B} = \frac{g_B}{g_A}$$

From Eq. (i), $g_A = 9g_B$

$\therefore \qquad \dfrac{h_A}{h_B} = \dfrac{g_B}{9g_B} = \dfrac{1}{9}$

or $\qquad h_B = 9h_A = 9 \times 2 = 18 \text{m} \qquad (\because h_A = 2$

28. Potential energy in a stretched spring is giv by

$$U = \frac{1}{2} k x^2$$

$\therefore \qquad \dfrac{U_1}{U_2} = \left(\dfrac{x_1}{x_2} \right)^2$

Given, $x_1 = 2 \text{ cm} = 0.02 \text{ m}$, $x_2 = 10 \text{ cm} = 0.1$
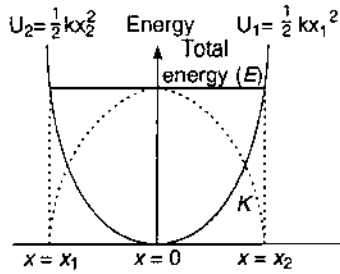
Substituting the values, we have

$$\frac{U_1}{U_2} = \left(\frac{0.02}{0.1} \right)^2 = \left(\frac{1}{5} \right)^2 = \frac{1}{25}$$

$\Rightarrow \qquad U_2 = 25U_1 = 25U$

29. Potential energy is given by

$$U = \frac{1}{2} kx^2$$

The corresponding graph is shown in figure.

At equilibrium position $(x = 0)$, potential energy is minimum. At extreme positions x_1 and x_2, its potential energies are

$$U_1 = \frac{1}{2} kx_1^2 \text{ and } U_2 = \frac{1}{2} kx_2^2$$

NOTE : In the above graph, the dotted line (curve) is shown for kinetic energy. This graph shows that kinetic energy is maximum at mean position and zero at extreme positions x_1 and x_2.

30. Let charges on an electron and hydrogen nucleus are q_1 and q_2. The Coulomb's force between them at a distance r is,

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

putting, $\frac{1}{4\pi\varepsilon_0} = k$ (given)

$$\vec{F} = - k \frac{q_1 q_2}{r^2} \hat{r}$$

Since, the nucleus of hydrogen atom has one proton, so charge on nucleus is e i.e., $q_2 = e$

also $q_1 = e$ for electron

So, $\vec{F} = - k \frac{e \cdot e}{r^2} \hat{r} = - k \frac{e^2}{r^2} \hat{r}$

but $\hat{r} = \frac{\vec{r}}{|\vec{r}|} = \frac{\vec{r}}{r}$

Hence, $\vec{F} = - k \frac{e^2}{r^2} \cdot \frac{\vec{r}}{r} = - k \frac{e^2}{r^3} \cdot \vec{r}$

NOTE : Negative sign in the expression for Coulomb's force shows that force between electron and hydrogen nucleus is of attraction.

31. Key Idea : *Gauss's law states that, "the net electric flux through any closed surface is equal to the net charge inside the closed surface divided by* ε_0.

Thus, from Gauss's law

$$\phi = \frac{q}{\varepsilon_0}$$

This is the net flux coming out from cube.

Since, a cube has 6 sides so electric flux through any face is

$$\phi' = \frac{\phi}{6} = \frac{q}{6\varepsilon_0}$$

32. When an observer moves towards an stationary source of round, then apparent frequency heard by the observer increases. The apparent frequency heard in this situation

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

As source is stationary hence, $v_s = 0$

$\therefore$ $f' = \left(\frac{v + v_o}{v} \right) f$

Given, $v_o = \frac{v}{5}$

Substituting in the relation for f', we have

$$f' = \left(\frac{v + v/5}{v} \right) f$$

$$= \frac{6}{5} f = 1.2 f$$

Motion of observer does not affect the wavelength reaching the observer, hence, wavelength remains λ.

NOTE : When the speed of source and observer are much lesser than that of sound, the change in frequency becomes independent of the fact whether the source is moving or the observer.

33. The quantity of heat flowing across a slab in time t,

$$Q = \frac{KA\Delta\theta}{l}$$

For same heat flow through each slab and composite slab, we have

$$\frac{K_1 A (\Delta\theta_1)}{l} = \frac{K_2 A (\Delta\theta_2)}{l} = \frac{K' A (\Delta\theta_1 + \Delta\theta_2)}{2l}$$

or $K_1 \Delta\theta_1 = K_2 \Delta\theta_2 = \frac{K'}{2} (\Delta\theta_1 + \Delta\theta_2) = C$ (say)

So, $\Delta\theta_1 = \frac{C}{K_1}, \ \Delta\theta_2 = \frac{C}{K_2}$

and $(\Delta\theta_1 + \Delta\theta_2) = \dfrac{2C}{K'}$

or $\dfrac{C}{K_1} + \dfrac{C}{K_2} = \dfrac{2C}{K'}$

or $C\left(\dfrac{K_1 + K_2}{K_1 K_2}\right) = \dfrac{2C}{K'}$

$\therefore \qquad K' = \dfrac{2K_1 K_2}{K_1 + K_2}$

Given, $\qquad K_1 = K, K_2 = 2K$

So, $\qquad K' = \dfrac{2K \times 2K}{K + 2K} = \dfrac{4}{3}$

34. For full wave rectifier, ripple frequency

$= 2 \times$ input frequency

$= 2 \times 50$

$= 100$ Hz

NOTE : A full wave rectifier consists of two junction diodes, so, its efficiency is twice that of half wave rectifier.

35. When a diamagnetic material is placed in an external magnetic field, the spin motion of electrons is so modified that the electrons which produce the magnetic moments in the direction of external field slow down while the electrons which produce magnetic moments in opposite direction get accelerated. Thus, a net magnetic moment is induced in the opposite direction of applied magnetic field. Hence, the substance is magnetised opposite to the external field. Thus, it moves from stronger to weaker parts of the magnetic field.

36. From lens maker's formula

$$\dfrac{1}{f} = (\mu_g - 1)\left(\dfrac{1}{R_1} - \dfrac{1}{R_2}\right) \qquad ...(i)$$

When convex lens is dipped in a liquid of refractive index (μ_l) then its focal length

$$\dfrac{1}{f_l} = \left(\dfrac{\mu_g}{\mu_l} - 1\right)\left(\dfrac{1}{R_1} - \dfrac{1}{R_2}\right)$$

or $\dfrac{1}{f_l} = \dfrac{(\mu_g - \mu_l)}{\mu_l}\left(\dfrac{1}{R_1} - \dfrac{1}{R_2}\right) \qquad ...(ii)$

Dividing Eq. (i) by Eq. (ii), we get

$$\dfrac{f_l}{f} = \dfrac{(\mu_g - 1)\mu_l}{(\mu_g - \mu_l)} \qquad ...(iii)$$

But it is given that refractive index of lens is equal to refractive index of liquid i.e., $\mu_g = \mu_l$.

Hence, Eq. (iii) gives,

$$\dfrac{f_l}{f} = \dfrac{(\mu_g - 1)\mu_l}{0} = \infty \qquad \text{(infinity)}$$

37. For amplifying action of a transistor, emittor-base junction is forward biased while base-collector junction is reverse biased. For forward biasing of emittor-base junction in n-p-n transistor, left n-side i.e. emittor should be connected to negative terminal and p-side (base) should be connected to positive terminal of the battery. On the other hand in right side, n-side (collector) should be connected to positive terminal of the battery to make base-collector junction reverse biased. The whole situation is shown in the figure for n-p-n transistor
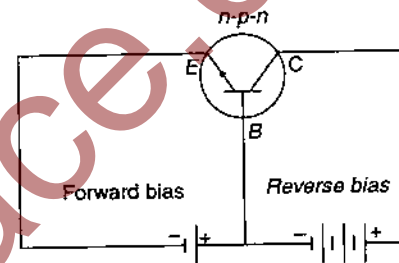
$E \rightarrow$ Emitter

$B \rightarrow$ Base

$C \rightarrow$ Collector

38. (a) β-rays are fast moving electrons. So, they are not electromagnetic waves.

(b) Heat rays can travel through vacuum via radiation process. They are electromagnetic waves.

(c) X-rays are electromagnetic waves having wavelengths from about 10^{-8} m to 10^{-12} m.

(d) γ-rays are electromagnetic waves having wavelengths ranging from about 10^{-16} m to 10^{-14} m.

Hence, choice (a) is correct.

39. Time taken by ball to reach maximum height

$$v = u - gT$$

at maximum height, final speed is zero i.e., $v = 0$

So, $\quad u = gT$

or $\quad T = u/g$

In 2 s, $u = 2 \times 9.8 = 19.6$ m/s

If man throws the ball with velocity of 19.6 m/s then after 2 sec it will reach the maximum height. When he throws 2nd ball, 1st is at top. When he throws third ball, 1st will come to ground and 2nd will at the top.

Therefore, only 2 balls are in air. If he wants to keep more than 2 balls in air he should throw the ball with a speed greater than 19.6 m/s.

40. According to Newton's law of gravitation, the force between two spheres is given by

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

From the relation, we can say the gravitational force does not depend on the medium between two spheres hence, it remains same *i.e.*, *F*.

41. Potential energy of a simple harmonic oscillator

$$U = \frac{1}{2} m\omega^2 y^2$$

Kinetic energy of a simple harmonic oscillator

$$K = \frac{1}{2} m\omega^2 (A^2 - y^2)$$

Here, y = displacement from mean position
A = maximum displacement (or amplitude) from mean position

Total energy is

$$E = U + K$$
$$= \frac{1}{2} m\omega^2 y^2 + \frac{1}{2} m\omega^2 (A^2 - y^2)$$
$$= \frac{1}{2} m\omega^2 A^2$$

When the particle is half way to its end point *i.e.*, at half of its amplitude then

$$y = \frac{A}{2}$$

Hence, potential energy

$$U = \frac{1}{2} m\omega^2 \left(\frac{A}{2}\right)^2$$
$$= \frac{1}{4}\left(\frac{1}{2} m\omega^2 A^2\right)$$
$$U = \frac{E}{4}$$

42. According to Curie's law magnetic susceptibility of a paramagnetic substance is inversely proportional to absolute temperature T *i.e.*,

$$\chi_m \propto \frac{1}{T}$$

43. **Key Idea :** *Force constant of spring is inversely proportional to length of spring.*
Time period of mass suspended from spring,

$$T = 2\pi \sqrt{\frac{m}{k}} \qquad ...(i)$$

Now we know that,

spring constant $\propto \dfrac{1}{\text{length}}$

or $\qquad k \propto \dfrac{1}{x} \qquad ...(ii)$

Since, spring is cut into four equal parts, hence force constant of each part becomes four times the previous. So,

$$k' = 4k$$

So, new time period of same mass suspended from one of the parts,

$$T' = 2\pi \sqrt{\frac{m}{4k}} = \frac{1}{2} \cdot 2\pi \sqrt{\frac{m}{k}} = \frac{T}{2}$$

44. In resonant vibrations of a body, the frequency of external force applied on the body is equal to its natural frequency. If on increasing and decreasing the frequency of external force from the natural frequency by a factor, the amplitude of vibrations reduces very much. In this case sharp resonance will take place. But if it reduces by a small factor then flat resonance will take place.

The sharp and flat resonance will depend on damping present in the body executing resonant vibrations. Less the damping, greater will be the sharpness.

45. The situation is shown in the figure.
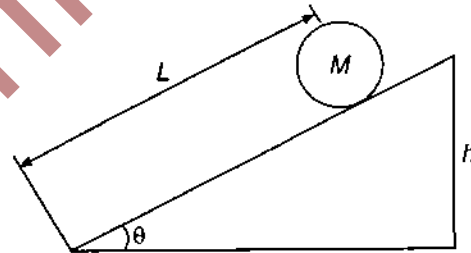
Potential energy of cylinder at the top will be converted into rotational kinetic energy and translational kinetic energy. So, energy conservation gives,

$$Mgh = \frac{1}{2} Mv^2 + \frac{1}{2} I\omega^2$$
$$= \frac{1}{2} Mv^2 + \frac{1}{2} \frac{MR^2}{2} \frac{v^2}{R^2} \left(\because I_{\text{cylinder}} = \frac{MR^2}{2}\right)$$

So, $\quad Mgh = \frac{1}{2} Mv^2 + \frac{1}{4} Mv^2$

or $Mgh = \frac{3}{4} Mv^2$

or $v^2 = \frac{4}{3} gh$

or $v = \sqrt{\frac{4}{3} gh}$

46. Key Idea : *For a exploding body, linear momentum is conserved.*

From conservation of linear momentum,

$$P_{initial} = P_{final}$$
$$0 = m_1 v_1 - m_2 v_2$$

or $m_1 v_1 = m_2 v_2$

or $\dfrac{v_1}{v_2} = \dfrac{m_2}{m_1}$ ...(i)

Thus, ratio of kinetic energies,

$$\frac{E_1}{E_2} = \frac{\frac{1}{2} m_1 v_1^2}{\frac{1}{2} m_2 v_2^2} = \frac{m_1}{m_2} \times \left(\frac{m_2}{m_1}\right)^2$$

$$= \frac{m_2}{m_1}$$

NOTE : In a collision of two bodies whether it is perfectly elastic or inelastic, linear momentum is always conserved but kinetic energy need not to be conserved.

47. The efficiency of heat engine is $\eta = 1 - \dfrac{T_2}{T_1}$

or $\dfrac{W}{Q_1} = 1 - \dfrac{T_2}{T_1}$

Here, Q_1 = heat absorbed from the source of heat
= 6 kcal

T_1 = temperature of source
= 227 + 273 = 500 K

and T_2 = temperature of sink
= 127 + 273 = 400 K

Hence, $\dfrac{W}{6} = 1 - \dfrac{400}{500}$

or $\dfrac{W}{6} = \dfrac{100}{500}$

or $W = 1.2$ kcal

Thus, amount of heat converted into work is 1.2 kcal.

48. The heat radiation emitted by the human body is the infrared radiation. Their wavelength is of the order of 7.9×10^{-7} m to 10^{-3} m which is of cource the range of infrared region. Hence, human body emits radiation in infrared region.

49. Key Idea : *In series order, the net capacitance is,*

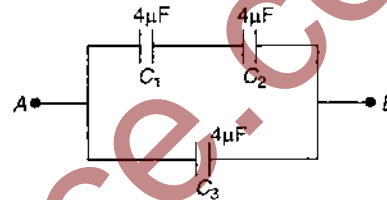$$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \cdots\cdots$$

In parallel order, the net capacitance is,

$$C = C_1 + C_2 + C_3 + \cdots\cdots$$

We have given,

$$C_1 = C_2 = C_3 = 4\,\mu F$$
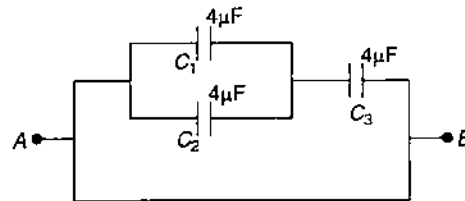
(a) The network of three capacitors can be shown as

Here, C_1 and C_2 are in series and the combination of two is in parallel with C_3.

$$C_{net} = \frac{C_1 C_2}{C_1 + C_2} + C_3$$

$$= \left(\frac{4 \times 4}{4 + 4}\right) + 4$$

$$= 2 + 4 = 6\,\mu F$$

(b) The corresponding network is shown

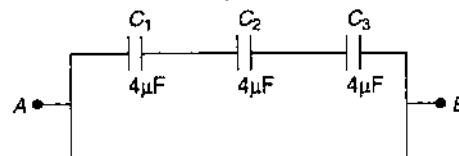Here, C_1 and C_2 are in parallel and this combination is in series with C_3.

So, $C_{net} = \dfrac{(C_1 + C_2) \times C_3}{(C_1 + C_2) + C_3}$

$$= \frac{(4 + 4) \times 4}{(4 + 4) + 4} = \frac{32}{12} = \frac{8}{3}\,\mu F$$

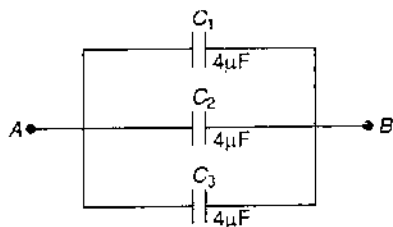(c) The corresponding network is shown

All of three are in series.

So, $\dfrac{1}{C_{net}} = \dfrac{1}{C_1} + \dfrac{1}{C_2} + \dfrac{1}{C_3}$

$= \dfrac{1}{4} + \dfrac{1}{4} + \dfrac{1}{4} = \dfrac{3}{4}$

$\therefore \quad C = \dfrac{4}{3} \mu F$

(d) The corresponding network is shown

All of them are in parallel.

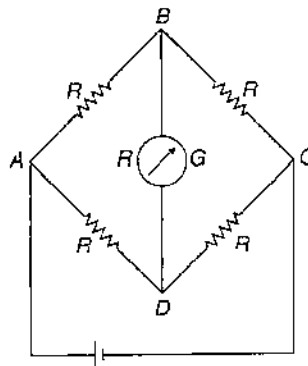So, $C_{net} = C_1 + C_2 + C_3$

$= 4 + 4 + 4$

$= 12 \mu F$

Hence, only choice (a) is correct.

50. Key Idea : *The balanced condition of Wheat-stone's bridge is,*

$$\dfrac{R_{AB}}{R_{BC}} = \dfrac{R_{AD}}{R_{DC}}$$

As bridge is in balanced condition, no current will flow through BD.

$R_1 = R_{AB} + R_{BC}$

$= R + R = 2R$

$R_2 = R_{AD} + R_{CD} = R + R = 2R$

R_1 and R_2 are in parallel combination.

Hence, equivalent resistance between A and C will be.

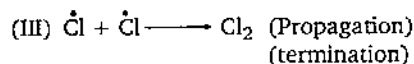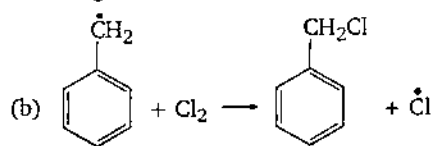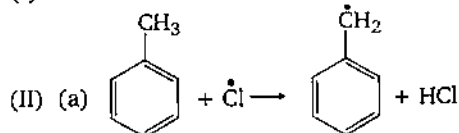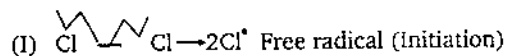$\therefore \quad R_{eq} = \dfrac{R_1 R_2}{R_1 + R_2} = \dfrac{4R^2}{4R} = R$

Chemistry

51. In aniline —NH_2 group is attached with benzene ring. —NH_2 group shows +M effect. So it activates the benzene ring. Hence, rate of electrophilic substitution is increased due to increase in the electron density at o/p position. In case of nitrobenzene, —NO_2 deactivates the benzene ring, so in nitrobenzene rate of electrophilic substitution is lower than benzene. Hence, order of S_E reaction :
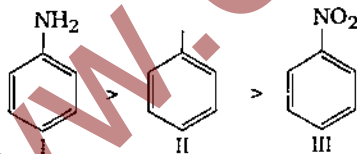
52. The pressure at which graphite will be transformed into diamond at 298K is 9.92×10^8 Pa.

53. At higher temperature the reaction of toluene with chlorine is an example of free radical substitution.

(I) $Cl \diagdown \diagup Cl \longrightarrow 2Cl^\bullet$ Free radical (Initiation)

(II) (a)

$+ \dot{C}l \longrightarrow$ $\dot{C}H_2$ $+ HCl$

(b)

$+ Cl_2 \longrightarrow$ CH_2Cl $+ \dot{C}l$

(III) $\dot{C}l + \dot{C}l \longrightarrow Cl_2$ (Propagation) (termination)

54. $t_{1/2} = 12.3$ y.

Initial amount $(N_0) = 32$ mg

Amount left $(N) = ?$

Total time $(T) = 49.2$ y

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

where n = total number of half-life

$$n = \frac{\text{Total time}}{\text{Half - life}}$$

$$\frac{49.2}{12.3} = 4$$

So,

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

$$\frac{N}{32} = \left(\frac{1}{2}\right)^4$$

$$\frac{N}{32} = \frac{1}{16}$$

$$N = \frac{32}{16} = 2 \text{ mg}$$

55. Rate constant of first order reaction

$$(k) = \frac{2.303}{t} \log_{10} \frac{(A)_0}{(A)_t}$$

or

$$k = \frac{2.303}{1} \times \log_{10} \frac{0.8}{0.2} \quad ...(i)$$

(because 0.6 moles of B is formed)

Suppose t_1 hour are required for the change of concentration of A from 0.9 mole to 0.675 mole of B.
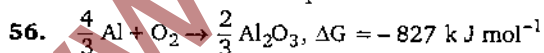
Remaining mole of $A = 0.9 - 0.675 = 0.225$

$$\therefore \quad k = \frac{2.303}{t_1} \log_{10} \frac{0.9}{0.225} \quad ...(ii)$$

From Eqs. (i) and (ii)

$$\frac{2.303}{1} \log_{10} \frac{0.8}{0.2} = \frac{2.303}{t_1} \log_{10} \frac{0.9}{0.225}$$

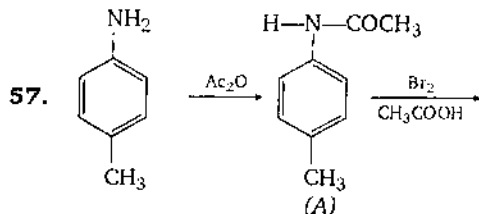$$2.303 \log_{10} 4 = \frac{2.303}{t} \log_{10} 4$$

$$t_1 = 1 \text{ h.}$$

56. $\frac{4}{3}Al + O_2 \rightarrow \frac{2}{3} Al_2O_3$, $\Delta G = -827$ kJ mol^{-1}

As we know that

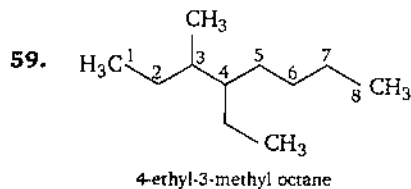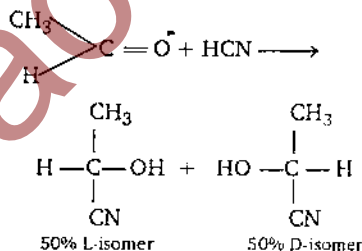$\because \Delta G = -nEF$ (value of $n = 4$)

$$-827 \times 10^3 \text{ J} = -4 \times E \times 96500$$

$$E = \frac{827 \times 10^3}{4 \times 96500}$$

$$E = 2.14\text{V}$$

57.

58. Lactic acid obtained in the given reaction is an optically active compound due to the presence of chiral C-atom. It exits as d and l forms whose ratio is 1:1.
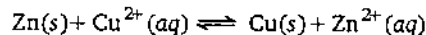

59.

4-ethyl-3-methyl octane

60. According to adsorption theory of catalysis, the speed (rate) of the reaction increase because adsorption lowers the activation energy of the reaction

$$\left(\because \text{ Rate of reaction} \propto \frac{1}{\text{activation energy}}\right)$$

61. For Daniell cell

$$Zn \begin{vmatrix} ZnSO_4 \\ 0.01 \text{ M} \end{vmatrix} \quad \begin{vmatrix} CuSO_4 \\ 1.0\text{M} \end{vmatrix} Cu$$

Cell reaction is

$$Zn(s) + Cu^{2+}(aq) \rightleftharpoons Cu(s) + Zn^{2+}(aq)$$

For above cell

$$E_1 = E^\circ_{cell} - \frac{0.0591}{n} \log_{10} \frac{[Zn^{2+}]}{[Cu]}$$

$E_1 = E^\circ_{cell} - \dfrac{0.0591}{2} \log_{10} \dfrac{0.01}{1.0}$

$E_1 = E^\circ_{cell} - \dfrac{0.0591}{2} \log_{10} \dfrac{1}{100}$

$\quad = E^\circ_{cell} + 0.0591 \log_{10} 10$

$\quad = E^\circ_{cell} + 0.0591 \qquad \qquad ...(i)$

When the concentration of Zn^{2+} is 1.0 M and concentration of Cu^{2+} is 0.01 M

$E_2 = E^\circ_{cell} - \dfrac{0.0591}{2} \log_{10} \dfrac{1}{0.01}$

$\quad = E^\circ_{cell} - \dfrac{0.0591}{2} \log_{10} 10^2$

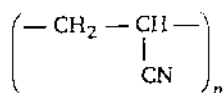$\quad = E^\circ_{cell} - 0.0591 \qquad \qquad ...(ii)$

From Eqs. (i) and (ii) $E_1 > E_2$

62. The molecular formula of vitamin B_{12} is $C_{63}H_{84}N_{14}O_{14}PCo$ and the chemical name is cyanocobalamine. So, cobalt is present in vitamin B_{12}.

63. $[MA_5B]$ due to absence of symmetry of 'B' ligand cannot exist in the form of *cis-trans* isomer.

64. Acrilan means polyacrylonitrile (PAN)

$$\left(\begin{array}{c} -CH_2 - CH - \\ | \\ CN \end{array} \right)_n$$

(It is an addition polymer of acrylonitrile)

65. $C = \dfrac{q}{m(T_2 - T_1)}$

(Given that $C = 75 \ JK^{-1} \ mol^{-1}$,

$q = 1.0 \ kJ = 1000 \ J$)

$75 = \dfrac{1000}{5.55 \, (\Delta T)} \quad \left(m = \dfrac{100}{18} = 5.55 \right)$

$\therefore \qquad \Delta T = \dfrac{1000}{5.55 \times 75} = 2.4 \ K$

66. For reaction,

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

$Q \ (\text{Quotient}) = \dfrac{[NH_3]^2}{[N_2][H_2]^3}, \Delta n = 2 - 4 = -2$

At equilibrium Q is equal to K_c but for the progress of reaction towards right side $Q > K_c$

67. $\Delta S = \dfrac{\Delta H_f}{T} = \dfrac{6.0}{273} = 0.02198 \ kJ \ K^{-1} \ mol^{-1}$

$(T = 0^\circ C + 273 = 273 \ K)$

$\quad = 0.02198 \times 1000 \ JK^{-1} \ mol^{-1}$

$\quad = 21.98 \ JK^{-1} \ mol^{-1}$

68. The method of zone refining of metals is based on the principle of greater solubility of the impurity in the molten state than in the solid. Elements which are used as semiconductors like Si, Ge, Ga etc. are refined by this method.

69. IUPAC name of sodium nitroprusside $Na_2[Fe(CN)_5NO]$ is sodium pentacyanonitrosoyl ferrate (III) because in it NO is neutral ligand and the O.N. of Fe is III. Which is calculated as—

$2 \times O.N.$ of $Na + O.N.$ of $Fe + 5 \times O.N.$ of $CN + 1 \times O.N.$ of $NO = 0$

$2 \times (+1) + O.N.$ of $Fe + 5 \times (-1) + 1 \times 0 = 0$

O.N. of $Fe = 5 - 2 = +3$

70. Phospholipids are esters of glycerol with two carboxylic acid residue and one phosphate group.

Hence, phospholipids may be regarded as derivative of glycerol in which two hydroxyl groups are esterified with fatty acid, while third is esterified with phosphoric acid.

71. Oxidation state of 'S' in

$SO_3^{2-}, \ x + (-2 \times 3) = -2, \ x = +6 - 2 = +4$

Oxidation state of 'S' in

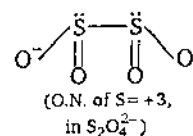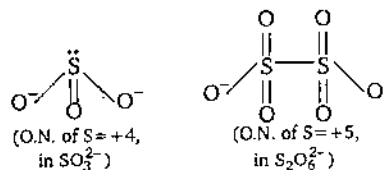$S_2O_4^{2-} \ 2x + (-2 \times 4) = -2$

$2x = +8 - 2 = +6$

$x = \dfrac{+6}{2} = +3$

Oxidation state of 'S' in

$S_2O_6^{2-} \ 2x + (-2 \times 6) = -2$

$2x = +12 - 2 = 10$
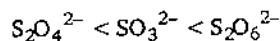
$x = \dfrac{10}{2} = +5$

On the basis of structures

(O.N. of S = +4, in SO_3^{2-})   (O.N. of S = +5, in $S_2O_6^{2-}$)

(O.N. of S = +3, in $S_2O_4^{2-}$)

Hence, increasing order of oxidation state of S is

$$S_2O_4^{2-} < SO_3^{2-} < S_2O_6^{2-}$$

72. $\therefore$ Frequency $= \dfrac{c}{\lambda} = \dfrac{3 \times 10^8 \text{ m s}^{-1}}{8 \times 10^{15} \text{ s}^{-1}}$
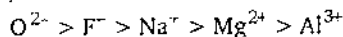
$= 0.375 \times 10^{-7}$ m

$= 3.75 \times 10^1 \text{ nm} \approx 4 \times 10^1 \text{ nm}$

73. On increasing atomic number of isoelectronic species ionic radii decreases due to increasing the effective nuclear charge (Z_{eff})

$$\text{Radius} \propto \dfrac{1}{Z_{eff}}$$

So, by increasing the –ve charge ionic radii increases and by increasing the +ve charge ionic radii decreases.
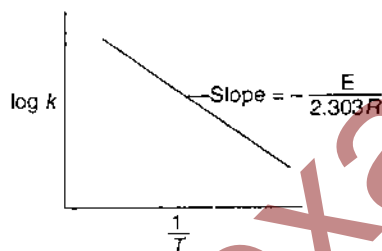
Hence, order of radii

$$O^{2-} > F^- > Na^+ > Mg^{2+} > Al^{3+}$$

74. Arrhenius equation $k = Ae^{-E/RT}$

$$\ln k = \ln A - \dfrac{E}{RT}$$

or $\quad \log k = \log A - \dfrac{E}{2.303 \, RT}$

Hence, E is calculated with the help of slope of following

75. Rate of reaction is equal to the rate constant for zero order reaction
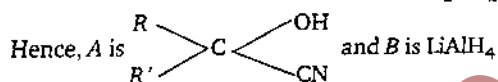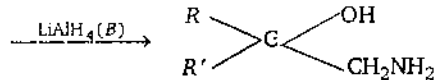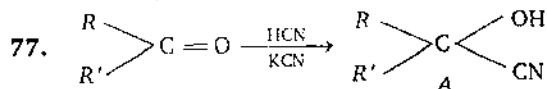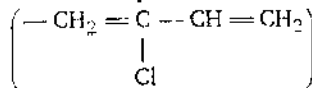
Let us consider the following hypothetic change.

$$A \rightarrow B + C$$

Suppose this reaction is zero order then

Rate $\propto [A]^0$

$\therefore \quad$ rate $= k[A]^0 = k$

76. Neoprene is an addition polymer of chloroprene or chloro 1,3-butadiene (monomer) and the structure of chloroprene is

$$\left(-CH_2 = C - CH = CH_2 \right)$$
$$\qquad\qquad\; |$$
$$\qquad\qquad\; Cl$$

77.

78. Glycolysis is the first stage in the oxidation of glucose. It is an anaerobic process and involves the degradation of glucose into two molecules of pyruvate with the generation of two molecules of ATP.

79. The order of basic character of the transition metal monoxide is TiO > VO > CrO > FeO because basic character of oxides decrease with increase in atomic number. Hence, oxides of transitional metals in low oxidation state i.e., +2 and +3 are generally basic except Cr_2O_3.

80. Due to strong H—F bond proton is not easily removed. So, HF is not a stronger acid than HCl. Order of halogen acids is HI > HBr > HCl > HF

81.

82. $CH_3COOH + PCl_5 \longrightarrow CH_3COCl$
$\qquad\qquad\qquad\qquad\qquad\qquad\qquad (A)$
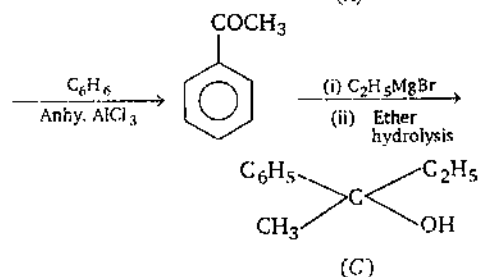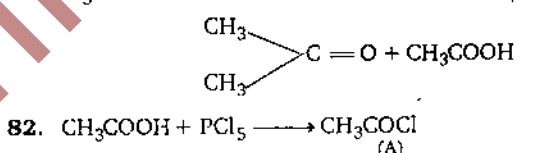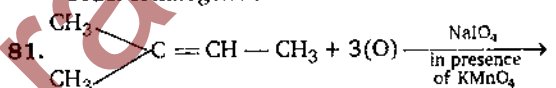
83. Enantiomers are mirror image to each other but they do not superimposable to each other.

84.
N_2	+	$3H_2$	$\longrightarrow$	$2NH_3$
1 mole		3 mole		2 mole
or $\frac{1}{2}$ mole		$\frac{3}{2}$ mole		1 mole
or $10 \times \frac{1}{2} = 5$		$10 \times \frac{3}{2} = 15$		$10 \times 1 = 10$
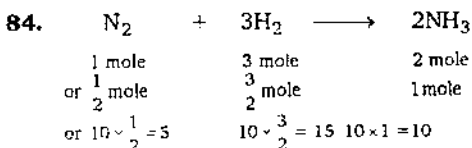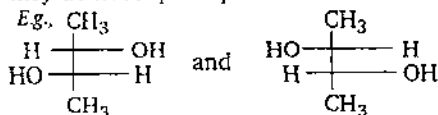
Composition of gaseous mixture under the aforesaid condition in the end

$$H_2 = 30 - 15 = 15\,L$$
$$N_2 = 30 - 5 = 25\,L$$
$$NH_3 = 10\,L$$

85. Carboxylic acid is stronger than alcohol and water because after removal of proton, carboxylate ion is stabilized by resonance. Hence, correct order of acid strength is

$$RCOOH > HOH > ROH > HC \equiv CH$$

which is based upon rate of donation of proton or strength of base, order of basic strength

$$\bar{C} = CH > R - \bar{O} > OH^- > RCOO^-$$

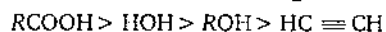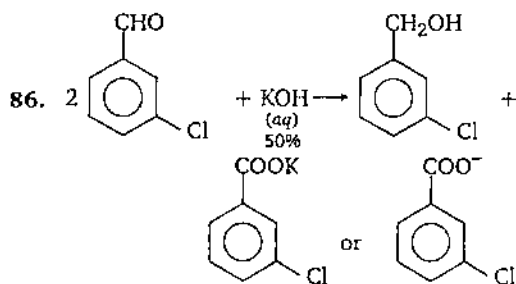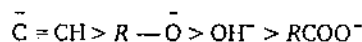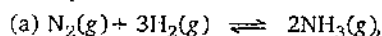**86.** 2 [CHO benzene ring with Cl] + KOH (aq) 50% ⟶ [CH₂OH benzene ring with Cl] + [COOK benzene ring with Cl] or [COO⁻ benzene ring with Cl]

(It is a Cannizaro's reaction)

87. For equilibrium

(a) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$,
$$K_1 = \frac{[NH_3]^2}{[N_2][H_2]^3} \qquad ...(i)$$

(b) $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$,
$$K_2 = \frac{[NO]^2}{[N_2][O_2]} \qquad ...(ii)$$
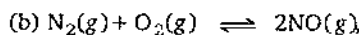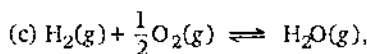
(c) $H_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons H_2O(g)$,
$$K_3 = \frac{[H_2O]}{[H_2][O_2]^{1/2}} \qquad ...(iii)$$

For reaction,
$$2NH_3(g) + \frac{5}{2}O_2(g) \rightleftharpoons 2NO(g) + 3H_2O(g)$$
$$K = \frac{[NO]^2 \times [H_2O]^3}{[NH_3]^2[O_2]^{5/2}} \qquad ...(iv)$$

From equations number (i), (ii) and (iii)
$$K = \frac{K_2 \times K_3^3}{K_1}$$

88. $\Delta H^\circ_{react} = \Delta H^\circ_f$ for the reaction
$$Xe(g) + 2F_2(g) = XeF_4(g)$$

Because in this reaction one mole of XeF_4 is formed from its constituent elements.

89. Bond energy of sigma and pi bonds are not of the order of 264 kJ/mol and 347 kJ/mol respectivley. The bond energy of C—C is 347 k J/mol and for C=C is 619 kJ/mol.

90. $B(OH)_3$ is not protonic acid because it does not give proton on ionisation directly while it acts as Lewis acid due to acceptance of OH^- from water and forms a hydrated species.

$$B(OH)_3 + H_2O \longrightarrow [B(OH)_4]^- + H^+$$
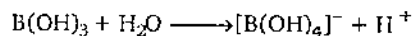
91. In $(CH_3)_4$ Sn (organometallic compounds of tin) single bonds are present in form of sigma bond. π bonded organometallic compound includes organometallic compounds of alkenes, alkynes and some other carbon containing compounds having π electrons in their molecular orbitals.

[Structure of Sn with four CH₃ groups]
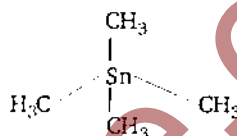
92. The correct order of ionic radii of Y^{3+}, La^{3+} Eu^{3+} and Lu^{3+}, is $Y^{3+} < Lu^{3+} < Eu^{3+} < La^{3+}$ because Eu and Lu are the members of lanthanide series (so they show lanthanide contraction) and La is the representative element of all elements of such series and Y^{3+} ion has lower radii as comparison to La^{3+} because it lies immediately above it in periodic table.

93. The catalytic activity of transitional metals is due to their variable oxidation state.

94. In complex ion $[CoF_6]^{3-}$, Co is present as $+3$ oxidation state
$$_{27}Co = 1s^2, 2s^2\,2p^6, 3s^2\,3p^6\,3d^7, 4s^2$$
$$Co^{3+} = 1s^2, 2s^2\,2p^6, 3s^2\,3p^6\,3d^6$$

$3d^6$

⇅	↑	↑	↑	↑

unpaired electrons
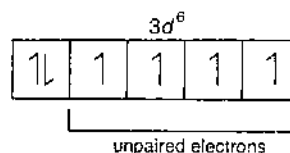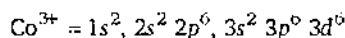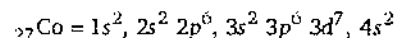
Thus, the number of unpaired electrons in $3d$ sub-shell of $[CoF_6]^{3-}$ is 4.

95. Chargaff's rule states that – amount of adenine is equal to that the amount of thymine and the amount of guanine is equal to that of the amount of cytosine.

96. The energy of activation of reverse reaction is less than or more than E_a.

Energy of activation of forward reaction.

$$\therefore \quad \Delta H = (E_a)_F - (E_a)_R$$

Because it depends upon the nature of reaction.

If $(E_a)_F > (E_a)_R$ $\therefore$ reaction is endothermic

or $(E_a)_F < (E_a)_R$ $\therefore$ reaction is exothermic

97. For ideal solution,
$$\Delta H_{solution} = \Delta H_1 + \Delta H_2 + \Delta H_3$$

98. $AgI \longrightarrow Ag^+ + I^-$

For binary electrolyte
$$K_{sp} = s^2$$

where s = solubility in mol/L

$$1.0 \times 10^{-16} = s^2$$

or $\quad s = 1 \times 10^{-8}$ mol/L

solubility of AgI in KI solution
$$= 1 \times 10^{-8} \times 10^{-4}$$
$$= 1 \times 10^{-12} \, mol / L$$

99. For the reaction,

$$C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(l)$$

Δn = number of gaseous moles of products – number of gaseous moles of reactants

$$= 3 - 6 = -3$$

$$\therefore \quad \Delta H = \Delta E + \Delta nRT$$

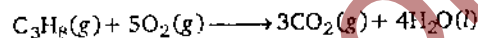or $\quad \Delta H - \Delta E = \Delta nRT$

$$\therefore \quad \Delta H - \Delta E = -3RT$$

100. The fraction of unoccupied site in sodium chloride crystal is 5.96×10^{-3}.

Biology

101. Genetic map is a diagram which shows the relative position of genes on a chromosome. Strurtevant in 1911 prepared the first genetic map of two chromosomes of fruit fly.

102. Skoog (1954-56) found that coconut milk contains a substance cytokinin which stimulated cell division in tobacco pith culture. Abscisic acid is known as natural plant growth inhibitor. It produces senescence, abscission in leaves and dormancy in buds and seeds.

Auxin is a plant growth hormone. Gibberellin is also a plant growth hormone which is originally isolated from the fungus *Gibberella fujikuroi*.

103. UGU → cistine

UAC → tyrosine

UCG → serine

UUU → phenylalanine

UAG, UGA, UAA → are stop codons

UAG → start codon.

104. TMV is Elongated rod-like, 3000Å (300nm) long and 180Å (18nm) in diameter.

105. The enzyme-linked immunosorbent assay (ELISA), also known as the Enzyme immunoassay (EIA) has become a widely used serological technique for, detection of AIDS. The enzymes used for labelling in ELISA include horse radish peroxidase, alkaline phosphatase, β-galactosidase, lactoperoxidase etc.

106. Convergent evolution is the acquisition of same or similar characters by distantly related lines of descent. Dogfish (pisces) and whale (mammals) have acquired aquatic character though distantly related.

107. During the process of translation an initial complex is formed between m-RNA, 30S ribosomal subunit and methionyl t-RNA. This complex is formed due to association of IF_1, IF_2, IF_3 initiation factors and GTP molecule.

108. *Sycon* belongs to phylum Porifera. The porifers are most primitive group of multicellular animals. They have no tissue grade of organisation, and represent cell aggregated body plan; hence, included in the subkingdom Parazoa.

109. Viruses are noncellular obligate parasite. In the free state they are just like the particles. They do not have their own metabolic

machinery. They use host's machinery for multiplication.

110. Professor **F.C. Steward** of Cornell University (USA) demonstrated that mature cells removed from a carrot and placed in a suitable culture solution could be stimulated to start dividing again and to provide new carrot plants (totipotency). Totipotency is the inherent capability of a single cell which provides the genetic programme required to direct the development of an entire individual.

111. Phosphorylation refers to the process in which ATP is made when energy is used to bond another phosphate to ADP. In photosynthesis, the energy is supplied by light; and the process is therefore, called photophosphorylation.

112. The function of T-cells is to provide immunity (cellular type) and not to scavenge damaged cells and cell debris. These are produced in bone marrow and mature in thyroid. Hence, the only true statement is that there are three types of T-cells-cytotoxic, helper and suppressor.

113. **Wilson** and **Sarich** choose mitochondrial DNA (mt-DNA) for the study of maternal line inheritance. While Y-chromosomes were considered for the study of human evolution particularly male domain. It is possible because they are uniparental in origin and do not take part in recombination.

114. The young forms of housefly (maggot, pupas) are entirely different from the adult, the metamorphosis being complete (holometabolic metamorphosis). Metamorphosis is a process during which an animal undergoes a comparatively rapid changes from their larval stages to adult form.

115. Carotenoids are a group of yellow, red and orange pigments which function as acessary pigments and protect chlorophyll molecules from destruction by intensive light rays. Carotenoids have three absorption peaks in the blue-violet range of the spectrum.

116. A species is a group of organisms that interbreed freely in their natural setting and do not interbreed with other population. In simple words, members of one species are reproductively isolated from members of other species. Species is the basic unit for understanding taxonomy as well as evolution.

117. Genetic drift or Sewall Wright effect is statically significant change in population gene frequencies resulting from by chance and not from natural selection, emigration or immigration. In simple words, random loss of alleles is known as genetic drift.

118. The main function of the Henle's loop is to absorb water from the tubular lumen, thus making the urine concentrated. If loop of Henle becomes absent then the urine becomes more dilute.

119. During prolonged fasting, first of all carboydrates are utilised which includes glycogen stored in liver. This is followed by the breakdown of adipose tissue—thus providing lipids and lastly the body utilises proteins.

120. Main cell body of neuron is called as cyton or soma. It contains a large and centrally located nucleus, mitochondria, Golgi bodies, rough endoplasmic reticulum, lysosomes, fat globules. Besides these soma also contains Nissl's granules or neurofibrils. These are masses of ribosomes and rough endoplasmic reticulum and are engaged in the process of protein synthesis.

121. Mitochondria are originated from pre-existing mitochondria. These are semi-autonomous, living, organells present in all eukaryotic cells. These contain DNA (mt-DNA). The available evidences show that the genes located in mt-DNA control the cytoplasmic male starility.

122. Apical meristems are primary meristems which are located in the growing points (roots and shoot apices), as well as buds in the axils of leaves. The various organs increase in length due to activity of apical meristem.

123. In tropics, there is no sharp distinction between the seasons; hence, there is not much difference in the activity of cambium. In a diffused porous wood, the large sized vessels are distributed through spring wood and autumn wood. e.g., *Syzygium cumini*.

124. Idioblast seems to be most appropriate (not correct) choice. Invertase and pepsin are enzymes proteins (contain nitrogen), bacteriochlorophyll also contains nitrogen. Idioblasts are cells having crystals of calcium oxalate, called raphides.
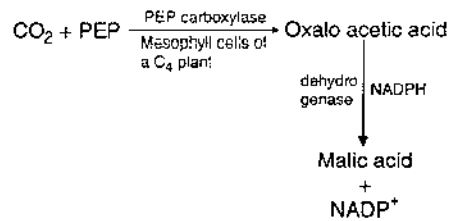
125. **Dicker** and **Tio** (1959) discovered photorespiration in tobacco plant. It is a light dependent process of oxygenation of ribulose bis phosphate (RuBP). During this process CO_2 is liberated and O_2 is consumed. C_4 plants avoid photorespiration by following Hatch Slack Pathway.

126. Accumulation of K^+ ions in the guard cells during the day time is responsible for migration of water molecules from subsidiary cells to guard cells. This increases turgidity of guard cells and thus stomata become open.

127. CAM (Crassulacean Acid Metabolism) plants open stomata only at night (when temperature is low and humidity is high) to cause lesser loss of water, (e.g., *Agave, Opuntia* etc.).

128. The four most common elements in living organisms are H, C, O, N. These are also called as framework element.

129. Calvin Bridges demonstrated that in *Drosophila*, the sex is determined by ratio of the number of X-chromosomes to the sets of autosomes. According to balance theory of sex determination, Y-chromosome of *Drosophila* is not important for the determination of sex.

130. Christmas disease is another name for haemophilia B characterised by the deficiency of factor IX. Down's syndrome is the disorder results when one chromosome (21st chromosomes in human beings) is present in 3 copies. *Trypanosoma,* is a protozoan, which causes sleeping sickness (African trypnosomiasis). Hepatitis B is caused by the hepatitis virus (HBV).

131. According to law of independent assortment of Mendel, alleles segregate randomly from each other i.e., all alleles separate from each other during gamete formation and are inherited independently from one another. But genes which are located on the same chromosomes (called linked genes) do not assort independently. Such type of genes are called linked genes and this phenomenon is called as linkage.

132. It has seen variously that one *t*-RNA molecule codes more than one amino acid molecules. This is possible due to improper pairing of third codon with the first anticodon of *t*-RNA. This is called degeneracy of genetic code. This pairing is not very stable and is allowed due to wobbling in base pairing at third position. **Wobble hypothesis** was proposed by Crick (1965) to explain this phenomenon.

133. The environmental check on biotic potential is called environmental resistance.
Biotic potential — overall reproductive output.
Fecundity — reproductive output, usually of an individual.

134. Prolonged intake of fluoride polluted water causes stiffing of bone and joints particularly spinal cord. Due to affinity with calcium, fluoride stores in bones which causes mottling of teeth, bone pains and outward bending of legs from the knees. This is known as **Knock Knee Syndrome**.

135. Viruses are **non cellular, obligate parasites**. They have DNA or RNA as genetic material **(never both)**. Genetic material of virus is covered in an envelope, known as **Capsid**. Viruses do not contain their own metabolic system instead they occupy host's metabolic system after entrance in them.

136. In *Spirogyra,* the sexual reproduction involves the fusion of two morphologically identical isogametes, and physiologically dissimilar anisogametes. This is a case of primitive anisogameter. In this the active gamete is known as the male and the passive as the female.

137. Phenetics (Greek *Phain*–to appear, the term phenotype is derived from this same root) dedicates taxonomic affinities entirely on the basis of measurable similarities and differences.

138. In alcoholic fermentation, (a) NADH (formed during conversion of triose-3 phosphate to 3 phosphoglycerate) is oxidized to NAD^- (b) electrons are accepted by acetaldehyde formed by decarboxylation of pyruvate.

139. During bio-gas formation, digestion of cellulose is slow (rate-limiting) and most of the lignin is not decomposed. After cellulose lignin is the most abundant plant polymer. It forms 20 to 30% of the wood of the tree. Lignin is a complex polymeric molecule, made up of phenyl propanoid units. Cellulose is a large chained polymer of glucose molecules which are linked with each other by glycosidic

bonds. Hemicellulose are branched polymers of glucose, xylose, galactose, mannose and arabinose.

140. Industrial melanism is an example of directional selection-changing environment leading to change in the phenotypic/genotypic constitution of a population.

141. The cells of queiscent centre have lower concentration of DNA, RNA and protein as compared to other cells in the root apex. These cells also have fewer mitochondria, little endoplasmic reticulum and very small nuclei and nucleoli. The region of queiscent centre was discovered by **Clower** (1958).

142. Ratio of cytokinins to auxins controls differentiation. If both of these are present in equal quantities, the cells divide but fail to differentiate. If there is more cytokinin than auxin, shoot buds develop. If there is more auxin than cytokinin, roots develop.

143. The archesporial cells divide periclinally, cutting off primary parietal layer (forming wall later on) towards the outer side and primary sporogenous cells towards the inner side.

```
              Archesporial cells

                          Periclinally
        ↙              ↘
    Primary              Primary
    parietal             sporangenous cell
    layer
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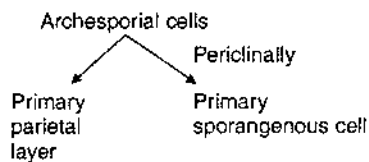
144. Molybdenum ions are components of several enzymes such as nitrate reductase and nitrogenase which are involved in biological nitrogen fixation. Nitrate reductase catalyses the reduction of nitrate to nitrite during its assimilation by the plant cell while nitrogen as enzyme converts nitrogen into ammonia in nitrogen fixing organism.

145. Deficiency of zinc is characterized by a reduction in internodal growth due to which plant develops rosette habit of growth. The leaves may also be small and distorted. These results are due to loss of capacity to produce auxin indoleacitic acid.

146. In C_4 plants, CO_2 is picked up by phosphoenolpyruvate (PEP) and the reaction being catalyzed by PEP carboxylase.

$$CO_2 + PEP \xrightarrow[\text{Mesophyll cells of a } C_4 \text{ plant}]{\text{PEP carboxylase}} \text{Oxalo acetic acid}$$

$$\downarrow \text{dehydrogenase} \quad NADPH$$

$$\text{Malic acid} + NADP^+$$

147. Mycorrhiza is a result of symbiosis between the roots of higher plants and fungi.

In this association, plants provide space and prepared food material to fungi in exchange of this, fungi help in absorption of minerals and water to plants.

148. Order Cycadales includes both living and fossil members which are originated in the upper triassic period of the early Mesozoic era.

The family Cycadaceae of this order has 10 living and one fossil genera. *Cycas* comes under living genera. It has a long writing history. So, is also known as fossil.

149. Boron is required by plants for (i) uptake and utilization of Ca^{++}, (ii) pollen germination and cell differentiation (iii) **carbohydrate translocation**.

150. The apophysis of moss capsule contains chloroplast bearing parenchymatous cells, called as chlorenchyma. Due to presence of chloroplasts, chlorenchyma cells have the ability to prepare food by the process of photosynthesis.

151. The term "antibiotics" was first time used by S.A. Waksman in 1945. Antibiotics are the substances which are produced by micro-organisms such as fungi or bacteria. These substances are harmful to the growth of other micro-organisms.

e.g., Penicillin, streptomycin, chloramphenicol etc.

152. Outer most layer of endosperm in cereals such as maize is known as aleurone layer. This layer is consisted of aleurone grains. Each grain is surrounded by a single unit membrane layer. Aleuron grains contain protein, phytin phospholipids and carbohydrate.

153. Though living organisms tend to multiply geometrically, the number of individuals of a species tend to remain constant over a long period of time. Out of heterogenous population (due to variation) best adapted individuals are selected by nature.

154. Dolphins are mammals which respire by lungs, which are situated next to the heart in the thorax cavity.

155. Grey spots of oat are caused by deficiency of manganese (Mn). It is a trace element, required in very small amount. Manganese exists in the soil in the form of bivalents, trivalents.

156. H.J. Muller was awarded Nobel Prize in 1946 for his discovery of the production of mutations by X-ray irradiation.

157. Encystment of *Amoeba* is occurred regularly to tide over unfavourable - conditions like drought and extreme temperature etc. During these conditions, the *Amoeba* forms a covering or cyst wall around itself.

158. *Crotolaria juncea* (Sunnhemp) and *Alhagi cameiorum* are among the plants which are used as green manures in India. These green manures help the soil through increasement of area and water holding capacities and fertility.

159. N_2—fixing organisms (eubacteria/cyanobacteria) as well as Archea are prokaryotes—hence, classified among Monera under five kingdom concept proposed by Whittaker.

160. When a pair of contrasting characters are crossed with each together then F_1 generation has only one type of character. This expressed character is known as dominant character while the character which could not express in F_1 generation is known as recessive character. In pea plants, tallness, round seed, yellow seed, purple flower, green pod, inflated pod and axial flower are dominant over dwarfness, wrinkled seed, green seed, white flower, yellow pod, constricted pod and terminal flower respectively.

161. As a result of studies by **S. Blixt**, it is now known that Mendel's seven selected characters are located on four chromosomes. Of these, two characters are located on chromosome number 1 three of chromosome number 4. One each on chromosome number 5 and 7.

162. Lemon is a hespridium type of fruit. Epicarp of this fruit contains many oil glands. Below epicarp is present a fibrous part which fuses with epicarp, this is known as mesocarp. While endocarp projects inwards and forms distinct chambers. Many unicellular juicy hairs are present on the inner side of endocarp which are edible parts of this fruit.

163. The term homologous was introduced by **Richard Owen** (1834). Homologous organs are those organs which are similar in origin and basic structure but are adapted differently to perform different functions. *e.g.*, Fore limb of human and wing of bat.
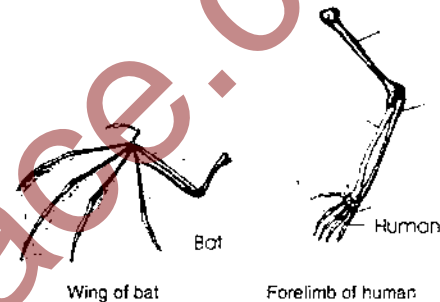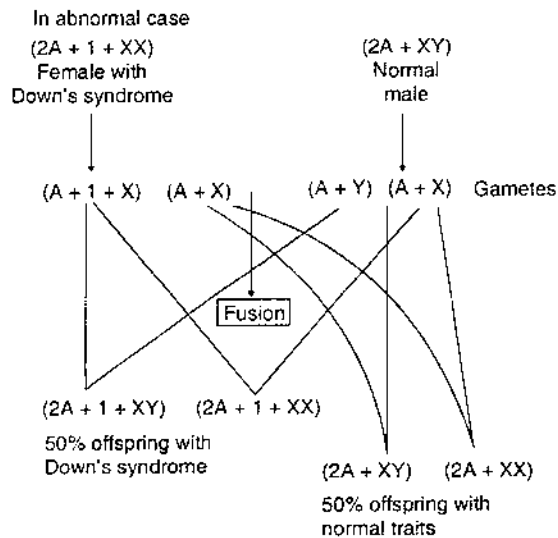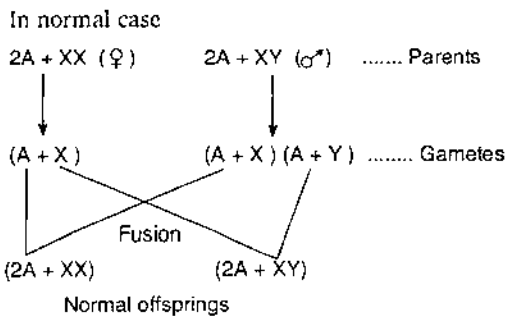

Wing of bat   Forelimb of human
Fig . Homologous organs of human and Bat

164. Natural theory of Darwin did not believe in any role of discontinuous variations. Darwin called these variations as 'sports'. While Hugo de Vries used the term mutation to these variations. These variations are sudden heritable changes which can occur in any stage of development.

165. Liver fluke (*Fasciola hepatica*) is a 'digenetic' endoparasite *i.e.*, it's life cycle completes within two hosts. The primary host is sheep and the secondary or intermediate host is fresh water gastropod, snail. *Fasciola hepatica* infects it's intermediate host at miracidium stage and it's primary host at metacercaria stage.

166. *E. coli* resides in the large intestine of human. Therefore, if these are present in water supply, it can be guessed that water supply has been contaminated by sewage.

167. Down's syndrome is the result of trisomy in which chromosome number 21^{st} contains an extra copy of chromosome (2A + 1). Affected mother will produce 50% normal egg cells and rest 50% eggs are of abnormal type.

In normal case

2A + XX (♀)   2A + XY (♂) .... Parents

(A + X)   (A + X) (A + Y) .... Gametes

Fusion

(2A + XX)   (2A + XY)

Normal offsprings

In abnormal case

(2A + 1 + XX)   (2A + XY)
Female with   Normal
Down's syndrome   male

(A + 1 + X) (A + X)   (A + Y) (A + X) Gametes

Fusion

(2A + 1 + XY)   (2A + 1 + XX)

50% offspring with
Down's syndrome

(2A + XY) (2A + XX)

50% offspring with
normal traits

(n + 1) — abnormal egg

n — normal egg

Fusion of normal egg with a normal sperm (comes from father) produces a normal offspring while fusion of abnormal egg with a normal sperm will produce an abnormal offspring.

168. UAA is the 'stop' codon; hence, polypeptide chain will not grow after 24th amino acid. In t he absence of new initiating codon rest of codons will not be able to translate.

169. Pellagra (Italian *Pelle* - skin *agra* - rough) is a skin disease which is caused due to deficiency of vitamin B_5 or niacin. Pellagra is especially frequent among the people eating food with low tryptophan (an-essential amino acid).

170. Magnesium is at the centre of the porphyrin ring in chlorophyll.

Structure of chlorophyll-a molecule
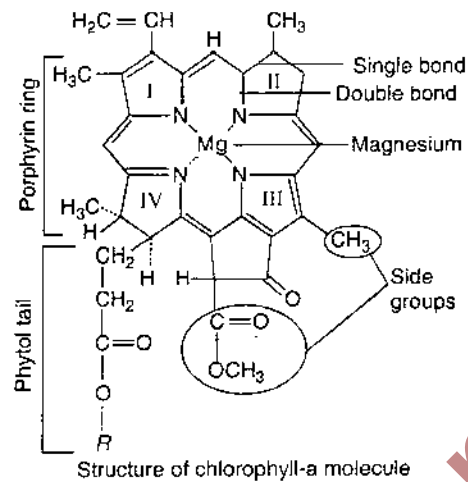
171. Though trace elements are required for various uses, most of these have a significant role in enzyme activities (*e.g.*, Zinc activates carboxylases, carbonic anhydrase and various dehydrogenases).

172. Out of 64 codons three (UAA, UAG, UGA) are chain terminating codons-the translating mechanism is not able to read these codons.
(a) 61 codons are used to code all the 20 essential amino acids.
(b) Out of 64, 3 codons, UAA, UAG, UGA does not code any amino acid molecule.

173. Phanerogams is a group of plants which produce seeds and flowers. It includes gymnospermic and angiospermic plants. While cryptogams is an other group of plants which do not produce seeds and flowers. *e.g.*, Algae, fungi, bryophytes and pteridophytes.

Fern is a pteridophyte and *Funaria* is a bryophyte both these produce spores but not seeds.

174. Systemic heart refers to enteric heart in lower vertebrates. It pumps the blood to different body parts and not to lungs.

175. The actual distance between two genes is said to be equivalent to the percentage of crossing over between these two genes. Since the two genes lie at the ends of the chromosome, there are 100% chances of their segregation during crossing over.

176. Bacterial chromosomes are circular DNA molecules.

177. Loose connective tissue, also called areolar connective tissue, is the "packing material" of the body that anchors blood vessels, nerves and body organs. It contains fibroblasts that synthesize the fibres and ground substance of connective tissue and wandering macrophages that phagocytize pathogens or damaged cells. The different fiber types include strong collagen fibres and thin elastic fibers formed of the protein elastin. Adipose (fat) tissue is considered a type of loose connective tissue.

178. Bundle of His is a network of specialised conducting muscle fibres (Purkinje fibres) which transmit the impulse from AV node to all parts of both the ventricles.

179. Chiru, is the source of shahtoosh.

180. **Carcinoma** is a malignant or metastatic tumour. It can extend to the neighbouring cells, this process is called as metastasis. These tumours are generally located in epithelial tissue and glands.
    e.g., Breast cancer, skin cancer, stomach cancer, lungs cancer, pancreas cancer etc.

181. Hyposecretion of parathormone from parathyroid gland leads to tetany disorder. It causes the lowering of blood calcium level. Insulin deficiency leads to disease diabetes mellitus (hypoglycemia). Hypersecretion of thyroid hormone results of gigantism in children.
    Relaxin deficiency prevents the process of parturition. Low secretion of thyroid hormone results of cretinism in infants and children. Deficiency of prolactin hinders the development of mammary glands and secretion of lactin.

182. Production of vaccines is the most important example of the use of large scale cell culture e.g., Polio vaccine, BLV vaccine, rabies vaccines etc. A vaccine is a suspension of micro-organisms that will induce immunity in a host, long before the attack of pathogenic microbe.

183. Ommatidium is the basic unit of arthropod compound eye; it comprises a cornea lens, crystalline cone, a group of usually 7-8 retinal cells redially arranged around a central rhabdome.

184. Given certain conditions, the allele frequencies remain constant from generation to generation. Under these conditions, a population would be in equilibrium and there will be no evolutionary change. However, many evolutionary changes usually occur following the appearance of new alleles and source of this is mutation.

185. Tricarboxylic acid cycle is also known as citric acid cycle or Krebs cycle. This is an aerobic process, takes place in the matrix of mitochondria. Krebs discovered this cycle in 1937. So this is also known as Hens Krebs' cycle.

186. In certain cases, where normal fertilization is not possible, ovum from the female and the sperm from the male are mated *in vitro*. The zygote, later on, is implanted in the uterus where further development into baby takes place. Patrick Steptoe and Robert Edwards first time developed 'test tube baby' technique in 1978.

187. *Agrobacterium tumefaciens* is a plant pathogen that causes a disease of plants called crown gall. The tumour like gall grows when *A. tumefaciens* inserts a plasmid (Ti plasmid), containing bacterial genetic information, into the plant's chromosomal DNA. So, for this reason, this bacterium has been extensively used as vector for gene transfer to plant cells.

188. Approximately 69 mammalian species, 40 bird species are threatened in India alone.

189. Formation of a single stranded linear chain of complementary genes (*m*-RNA) on the template strand of DNA in nucleus (eukaryote) or in cytoplasm (prokaryotes) is known as transcription. Promoter is the nucleotide sequence to which RNA polymerase binds and initiates transcription.

190. Embryonic axis are formed very early in development and sometimes by the polarity of the egg.

191. Lac operon refers to the DNA sequence in the genome of the bacterium *E. coli* encoding enzymes involved in lactose uptake and metabolism.

192. Since genotypes/phenotypes of both parents are same—only sources of gametes are reversed, these crosses are called reciprocal crosses.

193. Sex limited traits are those which are expressed in one sex only. Moustaches, beard are found in human males only. It was suggested on the basis of statistical analysis that premature baldness is controlled by a dominant gene, which expresses only in the presence of a certain level of male hormone (androgen).

194. Sickle cell anaemia is a genetic disorder in which abnormal haemoglobin is formed because valine replaces glutamic acid at the sixth position on β chain. But the persons having this disease do not suffer from malaria as the parasite fails to thrive in such RBCs.

195. The word cryptogam came from the greek word *cryptos* - hidden : *gamos* - marriage.
Sporophyte is a stage in the life cycle of a plant. In ordinary conditions it always diploid. Thallophytes are the group of lower plants which do not have vascular supply, *e.g.,* Bacteria, algae, fungi etc.
Bryophyta is a group of cryptogams which has the amphibious type of adaptation.

196. *Ginkgo* is a gymnospermic plant so it comes before angiospermic plant, *Pisum* (pea).

Rhizopus is a fungus and *Triticum* (wheat) is an angiospermic plant.
Option 'c' has both angiospermic plants and option 'd' has both gymnospermic plants.

197. Biological concept of species says that only the members of a species can breed freely in nature to produce fertile offsprings. The plant tobacco *(Nicotiana)* has two different species, *Nicotiana tobaccum* and *Nicotiana sylvestris.* These two species cannot reproduce freely.

198. Biosystematics aims at morphological delimitation of taxa but incorporates evidences from genetics, cytology, anatomy, palynology, chemistry, physiology etc.

199. **Bartholin's glands** (Bulbovestibular glands) are one pair, small sized glands find just behind the labia minora one on either sides of vaginal orifice. These lubricate the vagina during mating and parturition by secretion of mucus.

200. Passive immunity is the one in which the individual acquires pre-formed antibodies from outside and so is the case of the immunity that foetus/infant/acquires from mother *via* placenta/mother's milk.

❏