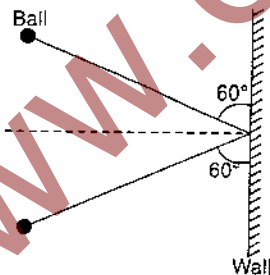# CBSE
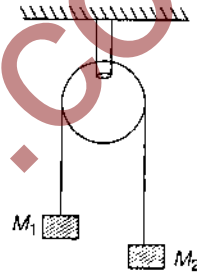
MEDICAL ENTRANCE

SOLVED PAPER / 2000

Physics

1. A pair of physical quantities having same dimensional formula is :
   (a) force and torque
   (b) work and energy
   (c) force and impulse
   (d) linear momentum and angular momentum

2. An engine exerts a force $\vec{F} = (20\hat{i} - 3\hat{j} + 5\hat{k})$ N and moves with velocity $\vec{v} = (6\hat{i} + 20\hat{j} - 3\hat{k})$ m/s. The power of the engine (in watt) is :
   (a) 45
   (b) 75
   (c) 20
   (d) 10

3. Two particles are projected with same initial velocities at an angle 30° and 60° with the horizontal. Then :
   (a) their heights will be equal
   (b) their ranges will be equal
   (c) their time of flights will be equal
   (d) their ranges will be different

4. A ball of mass 3 kg moving with a speed of 100m/s, strikes a wall at an angle 60° (as shown in figure). The ball rebounds at the same speed and remains in contact with the ball for 0.2 s, the force exerted by the ball on the wall is :


5. Two masses $M_1 = 5$ kg, $M_2 = 10$ kg are connected at the ends of an inextensible string passing over a frictionless pulley as shown. When masses are released, then acceleration of masses will be :

   (a) g
   (b) $\dfrac{g}{2}$
   (c) $\dfrac{g}{3}$
   (d) $\dfrac{g}{4}$

   (a) 1500 $\sqrt{3}$ N
   (b) 1500 N
   (c) 300 $\sqrt{3}$ N
   (d) 300 N

6. A particle moves along a straight line such that its displacement at any time t is given by $s = 3t^3 + 7t^2 + 14t + 5$. The acceleration of the particle at $t = 1$ s is :
   (a) 18 m/s^2
   (b) 32 m/s^2
   (c) 29 m/s^2
   (d) 24 m/s^2

7. A boat which has a speed of 5 km/h in still water crosses a river of width 1 km along the shortest possible path in 15 min. The velocity of the river water in km/h is :
   (a) 1
   (b) 3
   (c) 4
   (d) $\sqrt{41}$

8. A particle of mass 1 kg is thrown vertically upwards with speed 100 m/s. After 5 s it explodes into two parts. One part of mass 400 g comes back with speed 25 m/s, what is the speed of other part just after explosion ?
   (a) 100 m/s upward
   (b) 600 m/s upward
   (c) 100 m/s downward
   (d) 300 m/s upward

9. A stone is attached to one end of a string and rotated in a vertical circle. If string breaks at the position of maximum tension, it will break at :
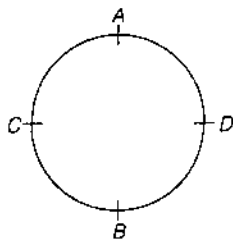
(a) A   (b) B
(c) C   (d) D

10. A solid sphere and a hollow sphere are thrown horizontally from a cliff with equal velocities, respectively. Then which sphere reaches first on earth ?
(a) Solid sphere
(b) Hollow sphere
(c) Both sphere simultaneously
(d) We cannot say because masses of spheres are not given

11. Escape velocity from earth is 11.2 km/s. Another planet of same mass has radius 1/4 times that of earth. What is the escape velocity from another planet ?
(a) 11.2 km/s   (b) 44.8 km/s
(c) 22.4 km/s   (d) 5.6 km/s

12. ABC is a right angled triangular plate of uniform thickness. The sides are such that $AB > BC$ as shown in figure. I_1, I_2, I_3 are moments of inertia about AB, BC and AC respectively. Then which of the following relations is correct ?
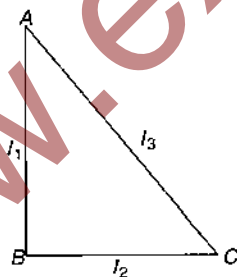
(a) $I_1 = I_2 = I_3$ (b) $I_2 > I_1 > I_3$
(c) $I_3 < I_2 < I_1$ (d) $I_3 > I_1 > I_2$

13. A gas is formed of molecules each molecule possessing f degrees of freedom, then the value of $\gamma = \dfrac{C_p}{C_v}$ is equal to :

(a) $\dfrac{2}{f}$ (b) $1 + \dfrac{2}{f}$
(c) $1 + \dfrac{f}{2}$ (d) $f + \dfrac{1}{2}$

14. A pendulum is displaced to an angle θ from its equilibrium position; then it will pass through its mean position with a velocity v equal to :
(a) $\sqrt{2gl}$ (b) $\sqrt{2gl \sin \theta}$
(c) $\sqrt{2gl \cos \theta}$ (d) $\sqrt{2gl (1 - \cos \theta)}$

15. An engine takes heat from a reservoir and converts its 1/6 part into work. By decreasing temperature of sink by 62°C, its efficiency becomes double. The temperatures of source and sink must be :
(a) 90 °C, 37 °C   (b) 99 °C, 37 °C
(c) 372 °C, 37 °C   (d) 206 °C, 37 °C

16. Two sources are at a finite distance apart. They emit sounds of wavelength λ. An observer situated between them on line joining approaches one source with speed u. Then the number of beats heard/s by observer will be :
(a) $\dfrac{2u}{\lambda}$ (b) $\dfrac{u}{\lambda}$ (c) $\dfrac{u}{2\lambda}$ (d) $\dfrac{\lambda}{u}$

17. Rainbows are formed by :
(a) reflection and diffraction
(b) refraction and scattering
(c) dispersion and total internal reflection
(d) interference only

18. A man is 6 feet tall. In order to see his entire image, he requires a plane mirror of minimum length equal to :
(a) 6 ft   (b) 12 ft
(c) 2 ft   (d) 3 ft

19. Two simple harmonic motions given by $x = A \sin (\omega t + \delta)$ and $y = A \sin \left(\omega t + \delta + \dfrac{\pi}{2} \right)$ act on a particle simultaneously; then the motion of particle will be :
(a) circular anti-clockwise
(b) circular clockwise
(c) elliptical anti-clockwise
(d) elliptical clockwise

20. A plano-convex lens is made of a material of refractive index $\mu = 1.5$. The radius of curvature of curved surface of the lens is 20 cm. If its plane surface is silvered, the focal length of the silvered lens will be :
(a) 10 cm   (b) 20 cm
(c) 40 cm   (d) 80 cm

21. Two wires are held perpendicular to the plane of paper at 5 m apart. They carry currents of 2.5 A and 5 A in same direction. Then the magnetic field strength (b) at a point midway between the wires will be :

(a) $\dfrac{\mu_0}{4\pi}$ T 　　　　(b) $\dfrac{\mu_0}{2\pi}$ T

(c) $\dfrac{3\mu_0}{2\pi}$ T 　　　　(d) $\dfrac{3\mu_0}{4\pi}$ T

22. A capacitor is charged by connecting a battery across its plates. It stores energy U. Now the battery is disconnected and another identical capacitor is connected across it, then the energy stored by both capacitors of the system will be :

(a) U 　　　　(b) $\dfrac{U}{2}$

(c) $2U$ 　　　　(d) $\dfrac{3}{2}U$

23. A bridge circuit is shown in figure The equivalent resistance between A and B will be :

(a) $21\,\Omega$ 　　　　(b) $7\,\Omega$

(c) $\dfrac{252}{85}\,\Omega$ 　　　　(d) $\dfrac{14}{3}\,\Omega$
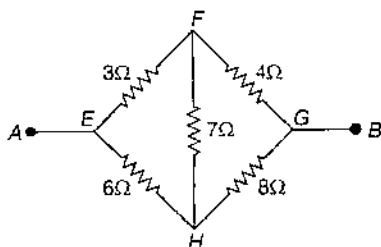
24. Two bulbs 25 W, 220 V and 100 W, 220 V are given. Which has higher resistance ?
    (a) 25 W bulb
    (b) 100 W bulb
    (c) Both bulbs will have equal resistance
    (d) Resistance of bulbs cannot be compared

25. An electron moves with a velocity 1×10^3 m/s in a magnetic field of induction 0.3 T at an angle 30°. If $\dfrac{e}{m}$ of electron is 1.76×10^{11} C/kg, the radius of the path is nearly :
    (a) 10^{-8} m 　　　(b) 2×10^{-8} m
    (c) 10^{-9} m 　　　(d) 10^{-10} m

26. A charged wire is bent in the form of a semi-circular arc of radius a. If charge per unit length is λ coulomb/metre, the electric field at the centre O is :

(a) $\dfrac{\lambda}{2\pi a^2 \varepsilon_0}$ 　　　　(b) $\dfrac{\lambda}{4\pi^2 \varepsilon_0 a}$

(c) $\dfrac{\lambda}{2\pi \varepsilon_0 a}$ 　　　　(d) zero

27. Potentiometer measures the potential difference more accurately than a voltmeter because :
    (a) it has a wire of high resistance
    (b) it has a wire of low resistance
    (c) it does not draw current from external circuit
    (d) it draws a heavy current from external circuit

28. In electrolysis the mass deposited on an electrode is directly proportional to :
    (a) current
    (b) square of current
    (c) concentration of solution
    (d) inverse of current

29. The frequency of γ-rays, X-rays and ultraviolet rays are a, b and c respectively. Then :
    (a) $a > b > c$ 　　(b) $a < b < c$
    (c) $a = b = c$ 　　(d) $a > c > b$

30. A wire of resistance R is connected in series with an inductor of reactance ωL. Then quality factor of RL circuit is :

(a) $\dfrac{R}{\omega L}$ 　　　　(b) $\dfrac{\omega L}{R}$

(c) $\dfrac{R}{\sqrt{R^2 + \omega^2 L^2}}$ 　　　(d) $\dfrac{\omega L}{\sqrt{R^2 + \omega^2 L^2}}$

31. Einstein's work on photoelectric effect gives support to :

(a) $E = mc^2$ 　　　　(b) $E = h\nu$

(c) $h\nu = \dfrac{1}{2}mv^2$ 　　　(d) $E = \dfrac{h}{\lambda}$

32. Nuclear fission can be explained by :
    (a) proton-proton cycle
    (b) liquid drop model of nucleus
    (c) independent of nuclear particle model
    (d) nuclear shell model

33. When electron jumps from $n = 4$ to $n = 2$ orbit, we get :
    (a) second line of Lyman series
    (b) second line of Balmer series
    (c) second line of Paschen series
    (d) an absorption line of Balmer series

34. Which of the following transitions gives photon of maximum energy ?
    (a) $n = 1$ to $n = 2$ (b) $n = 2$ to $n = 1$
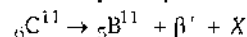   (c) $n = 2$ to $n = 6$ (d) $n = 6$ to $n = 2$

35. The relationship between disintegration constant (λ) and half-life (T) will be :
    (a) $\lambda = \dfrac{\log_{10} 2}{T}$ (b) $\lambda = \dfrac{\log_e 2}{T}$
    (c) $\lambda = \dfrac{T}{\log_e 2}$ (d) $\lambda = \dfrac{\log_2 e}{T}$

36. The half-life of a radioactive material is 3 h. If the initial amount is 300 g, then after 18 h, it will remain :
    (a) 4.68 g   (b) 46.8 g
    (c) 9.375 g   (d) 93.75 g

37. A nuclear decay is expressed as
    $$_6C^{11} \rightarrow {_5B^{11}} + \beta' + X$$
    Then the unknown particle X is :
    (a) neutron   (b) antineutrino
    (c) proton   (d) neutrino

38. If α and β are current gains in common-base and common-emitter configurations of a transistor, then β is equal to :
    (a) $\dfrac{1}{\alpha}$ (b) $\dfrac{\alpha}{1 + \alpha}$
    (c) $\dfrac{\alpha}{1 - \alpha}$ (d) $\alpha - \dfrac{1}{\alpha}$

39. The truth table given below :

Inputs		Output
A	B	Y
0	0	0
1	0	0
0	1	0
1	1	1

represents :
    (a) AND gate   (b) NOR gate
    (c) OR gate   (d) NAND gate

40. The gases carbon-monoxide (CO) and nitrogen at the same temperature have kinetic energies E_1 and E_2 respectively. Then :
    (a) $E_1 = E_2$
    (b) $E_1 > E_2$
    (c) $E_1 < E_2$
    (d) E_1 and E_2 cannot be compared

41. A sonometer wire when vibrated in full length has frequency n. Now it is divided by the help of bridges into a number of segments of lengths $l_1, l_2, l_3, \ldots$ When vibrated these segments have frequencies $n_1, n_2, n_3, \ldots$ then the correct relation is :
    (a) $n = n_1 + n_2 + n_3 + \ldots$
    (b) $n^2 = n_1^2 + n_2^2 + n_3^2 + \ldots$
    (c) $\dfrac{1}{n} = \dfrac{1}{n_1} + \dfrac{1}{n_2} + \dfrac{1}{n_3} + \ldots$
    (d) $\dfrac{1}{\sqrt{n}} = \dfrac{1}{\sqrt{n_1}} + \dfrac{1}{\sqrt{n_2}} + \dfrac{1}{\sqrt{n_3}} + \ldots$

42. In which of the following figures, junction diode is forward biased ?
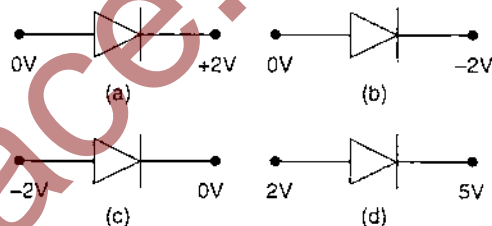
43. The energy of a photon of light is 3 eV. Then the wavelength of photon must be :
    (a) 4125 nm   (b) 412.5 nm
    (c) 41250 nm   (d) 4 nm

44. A body has a weight 72 N. When it is taken to a height $h = R$ (radius of earth), it would weigh :
    (a) 72 N   (b) 36 N   (c) 18 N   (d) zero

45. A cell has an emf 1.5 V. When connected across an external resistance of 2Ω, the terminal potential difference falls to 1.0 V. The internal resistance of the cell is :
    (a) 2Ω (b) $1.5\,\Omega$
    (c) $1.0\,\Omega$ (d) $0.5\,\Omega$

46. A charge q is placed at the corner of a cube of side a. The electric flux through the cube is :
    (a) $\dfrac{q}{\varepsilon_0}$ (b) $\dfrac{q}{3\varepsilon_0}$ (c) $\dfrac{q}{6\varepsilon_0}$ (d) $\dfrac{q}{8\varepsilon_0}$

47. A man goes at the top of a smooth inclined plane. He releases a bag to fall freely and he himself slides on inclined plane to reach the bottom. If v_1 and v_2 are the velocities of the man and bag respectively, then :
    (a) $v_1 > v_2$
    (b) $v_1 < v_2$
    (c) $v_1 = v_2$
    (d) v_1 and v_2 cannot be compared

48. A transparent cube contains a small air bubble. Its apparent distance is 2 cm when seen through one face and 5 cm when seen through other face. If the refractive index of the material of the cube is 1.5, the real length of the edge of cube must be :

(a) 7 cm   (b) 7.5 cm

(c) 10.5 cm   (d) $\dfrac{14}{3}$ cm

49. Which one of the following processes depends on gravity ?

(a) Conduction

(b) Convection

(c) Radiation

(d) None of the above

50. Two strings A and B have lengths l_A and l_B and carry masses M_A and M_B at their lower ends, the upper ends being supported by rigid supports. If n_A and n_B are their frequencies of their vibrations and $n_A = 2n_B$, then :

(a) $l_A = 4l_B$, regardless of masses

(b) $l_B = 4l_A$, regardless of masses

(c) $M_A = 2M_B$, $l_A = 2l_B$

(d) $M_B = 2M_A$, $l_B = 2l_A$

Chemistry

51. The energy of photon is given as : $\Delta e/\text{atom} = 3.03 \times 10^{-19}$ J atom^{-1} then, the wavelength (λ) of the photon is :

(a) 6.56 nm   (b) 65.6 nm

(c) 656 nm   (d) 0.656 nm

(Given, h(Planck's constant) $= 6.63 \times 10^{-34}$ J-s, c(velocity of light)$= 3.00 \times 10^8$ ms^{-1})

52. Which one of the following is planar ?

(a) XeF_4 (b) XeO_4

(c) XeO_3F (d) XeO_3F_2

53. The conjugate acid of NH_2^- is :

(a) N_2H_4 (b) NH_4^+

(c) NH_2OH (d) NH_3

54. The equivalent conductances of Ba^{2+} and Cl^- are 127 and 76 ohm^{-1} cm^{-1} eq^{-1} respectively at infinite dilution. The equivalent conductance of $BaCl_2$ at infinite dilution will be :

(a) 139.5   (b) 203

(c) 279   (d) 101.5

55. If ΔE is the heat of reaction for

$$C_2H_5OH(l) + 3O_2(g) \longrightarrow 2CO_2(g) + 3H_2O(l)$$

at constant volume, the ΔH (heat of reaction at constant pressure) at constant temperature is :

(a) $\Delta H = \Delta E + RT$

(b) $\Delta H = \Delta E - RT$

(c) $\Delta H = \Delta E - 2RT$

(d) $\Delta H = \Delta E + 2RT$

56. For a reversible reaction, if the concentrations of the reactants are doubled, the equilibrium constant will be :

(a) one-fourth   (b) halved

(c) doubled   (d) the same

57. The entropy change in the fusion of one mole of a solid melting at 27°C (Latent heat of fusion, 2930 J mol^{-1}) is :

(a) 9.77 J K^{-1} mol^{-1}

(b) 10.73 J K^{-1} mol^{-1}

(c) 2930 J K^{-1} mol^{-1}

(d) 108.5 J K^{-1} mol^{-1}

58. The half-life of a radioactive isotope is three hours. If the initial mass of the isotope was 300g, the mass which remained undecayed after 18 hours would be :

(a) 4.68g   (b) 2.34g

(c) 1.17g   (d) 9.36g

59. Cell reaction is spontaneous when :

(a) E°_{red} is negative   (b) E°_{red} is positive

(c) ΔG° is negative   (d) ΔG° is positive

60. $Cu^+(aq)$ is unstable in solution and undergoes simultaneous oxidation and reduction according to the reaction :

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

choose correct E° for above reaction if $E^\circ_{Cu^{2+}/Cu} = 0.34$ V and $E^\circ_{Cu^{2+}/Cu^+} = 0.15$ V

(a) -0.38 V   (b) $+0.49$ V

(c) $+0.38$ V   (d) -0.19 V

61. Which of the following expressions correctly represents the relationship between the average molar kinetic energy, $\overline{KE}$, of CO and N_2 molecules at the same temperature ?

(a) $\overline{KE}_{CO} < \overline{KE}_{N_2}$

(b) $\overline{KE}_{CO} > \overline{KE}_{N_2}$

(c) $\overline{KE}_{CO} = \overline{KE}_{N_2}$

(d) Cannot be predicted unless volumes of the gases are given

62. Which of the following statements about pH and H^+ ion concentration is incorrect ?

(a) Addition of one drop of concentrated HCl in NH_4OH solution decreases pH of the solution

(b) A solution of the mixture of one equivalent of each of CH_3COOH and NaOH has a pH of 7

(c) pH of pure neutral water is not zero

(d) A cold and conc. H_2SO_4 has lower H^+ ion concentration than a dilute solution of H_2SO_4

63. Which one of the following is true for any diprotic acid, H_2X ?

(a) $K_{a_2} = K_{a_1}$

(b) $K_{a_2} > K_{a_1}$

(c) $K_{a_2} < K_{a_1}$

(d) $K_{a_2} = \dfrac{1}{K_{a_1}}$

64. Which one of the following molecules will form a linear polymeric structure due to hydrogen bonding ?

(a) NH_3

(b) H_2O

(c) HCl

(d) HF

65. In the following reaction, how is the rate of appearance of the underlined product related to the rate of disappearance of the underlined reactant ?

$$BrO_3^-(aq) + \underline{5Br^-}(aq) + 6H^+(aq) \longrightarrow \underline{3Br_2}(l) + 3H_2O(l)$$
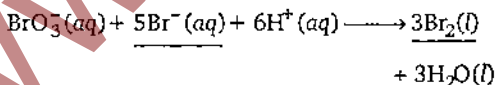
(a) $\dfrac{d[Br_2]}{dt} = -\dfrac{5}{3}\dfrac{d[Br^-]}{dt}$

(b) $\dfrac{d[Br_2]}{dt} = -\dfrac{d[Br^-]}{dt}$

(c) $\dfrac{d[Br_2]}{dt} = \dfrac{3}{5}\dfrac{d[Br^-]}{dt}$

(d) $\dfrac{d[Br_2]}{dt} = -\dfrac{3}{5}\dfrac{d[Br^-]}{dt}$

66. For the equilibrium

$$MgCO_3 \xrightleftharpoons{\Lambda} MgO(s) + CO_2(g)$$
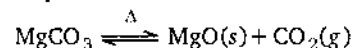
which of the following expressions is correct ?

(a) $K_p = P_{CO_2}$

(b) $K_P = \dfrac{[MgO][CO_2]}{[MgCO_3]}$

(c) $K_p = \dfrac{P_{MgO} + P_{CO_2}}{P_{MgCO_3}}$

(d) $K_p = \dfrac{P_{MgO} + P_{CO_2}}{P_{MgCO_3}}$

67. Among the following the electron deficient compound is :
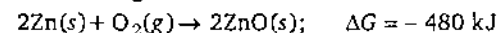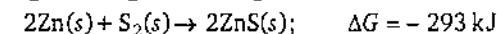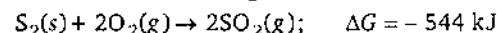
(a) BCl_3

(b) CCl_4

(c) PCl_5

(d) $BeCl_2$

68. The method usually employed for the precipitation of a colloidal solution is :

(a) dialysis

(b) addition of electrolytes

(c) diffusion through animal membrane

(d) condensation

69. The relationship between the dissociation energy of N_2 and N_2^+ is :

(a) dissociation energy of $N_2^+ >$ dissociation energy of N_2

(b) dissociation energy of $N_2 =$ dissociation energy of N_2^+

(c) dissociation energy of $N_2 >$ dissociation energy of N_2^+

(d) dissociation energy of N_2 can either be lower or higher than the dissociation energy of N_2^+

70. The factor of ΔG values is important in metallurgy. The ΔG values for the following reactions at 800°C are given as :

$$S_2(s) + 2O_2(g) \rightarrow 2SO_2(g); \quad \Delta G = -544 \text{ kJ}$$
$$2Zn(s) + S_2(s) \rightarrow 2ZnS(s); \quad \Delta G = -293 \text{ kJ}$$
$$2Zn(s) + O_2(g) \rightarrow 2ZnO(s); \quad \Delta G = -480 \text{ kJ}$$

The ΔG for the reaction

$$2ZnS(s) + 3O_2(g) \longrightarrow 2ZnO(s) + 2SO_2(g)$$
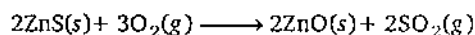
will be :

(a) −357 kJ

(b) −731 kJ

(c) −773 kJ

(d) −229 kJ

71. Which one of the following is not paramagnetic?
    - (a) NO
    - (b) N_2'
    - (c) CO
    - (d) O_2^-

72. Among the following ions the $p\pi - d\pi$ overlap could be present in :
    - (a) NO_2
    - (b) NO_3
    - (c) PO_4^{3-}
    - (d) CO_3^{2-}

73. A compound formed by elements A and B crystallises in the cubic structure where A atoms are at the corners of a cube and B atoms are at the face centres. The formula of the compound is :
    - (a) A_2B_2
    - (b) AB_3
    - (c) AB
    - (d) A_3B

74. Assuming fully decomposed, the volume of CO_2 released at STP on heating 9.85g of $BaCO_3$ (Atomic mass, Ba = 137) will be :
    - (a) 1.12 L
    - (b) 0.84 L
    - (c) 2.24 L
    - (d) 4.06 L

75. A compound contains atoms of three elements A, B and C. If the oxidation number of A is +2, B is +5, and that of C is –2, the possible formula of the compound is :
    - (a) $A_2(BC_3)_2$
    - (b) $A_3(BC_4)_2$
    - (c) $A_3(B_4C)_2$
    - (d) ABC_2

76. The correct structure of $Fe(CO)_5$ is :
    - (a) trigonal bipyramidal
    - (b) octahedral
    - (c) tetrahedral
    - (d) square pyramidal

77. Which one of the following complexes will have four different isomers ?
    - (a) $[Co(en)_2Cl_2]Cl$
    - (b) $[Co(en)(NH_3)_2Cl_2]Cl$
    - (c) $[Co(PPH_3)_2(NH_3)Cl_2]Cl$
    - (d) $[Co(en)_3]Cl_3$

78. Which one of the following forms a colourless solution in aqueous medium ?
    - (a) V^{3+}
    - (b) Cr^{3+}
    - (c) Ti^{3+}
    - (d) Sc^{3+}

    (Atomic number : Sc = 21, Ti = 22, V = 23, Cr = 24)

79. Among the following groupings which represents the collection of isoelectronic species ?
    - (a) NO, CN^-, N_2, O_2^-
    - (b) NO^+, C_2^{2-}, O_2^-, CO
    - (c) N_2, C_2^{2-}, CO, NO
    - (d) CO, NO^+, CN^-, C_2^{2-}

80. In the separation of Cu^{2+} and Cd^{2+} in 2nd group of qualitative analysis of cations, tetramine copper (II) sulphate and tetrammine cadmium (II) sulphate react with KCN to form the corresponding cyano complexes, which one of the following pairs of the complexes and their relative stability enables the separation of Cu^{2+} and Cd^{2+}?
    - (a) $K_3[Cu(CN)_4]$: less stable and $K_2[Cd(CN)_4]$: more stable
    - (b) $K_3[Cu(CN)_4]$: more stable and $K_2[Cd(CN)_4]$: less stable
    - (c) $K_2[Cu(CN)_4]$: less stable and $K_2[Cd(CN)_4]$: more stable
    - (d) $K_2[Cu(CN)_4]$: more stable and $K_2[Cd(CN)_4]$: less stable

81. Of the following transition metals, the maximum numbers of oxidation states are exhibited by :
    - (a) chromium ($Z = 24$)
    - (b) manganese ($Z = 25$)
    - (c) iron ($Z = 26$)
    - (d) titanium ($Z = 22$)

82. Which one of the following has magnesium ?
    - (a) Vitamin B_{12}
    - (b) Chlorophyll
    - (c) Haemocyanin
    - (d) Carbonic anhydrase

83. Propan-1-ol may be prepared by reaction of propene with :
    - (a) $CH_3—\overset{\overset{\displaystyle O}{\|}}{C}—O—O—H$
    - (b) H_3BO_3
    - (c) $B_2H_6 / NaOH-H_2O_2$
    - (d) H_2SO_4/H_2O

84. During reduction of aldehydes with hydrazine and potassium hydroxide, the first is the formation of :
    - (a) $R—CH = N—NH_2$
    - (b) $R—C \equiv N$
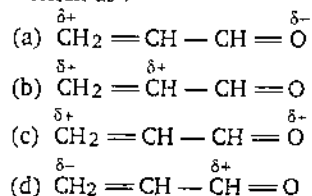   - (c) $R—\overset{\overset{\displaystyle }{\|}}{\underset{O}{C}}—NH_2$
    - (d) $R—CH = NH$

85. In Friedel-Craft's synthesis of toluene, the reactants in addition to anhydrous $AlCl_3$ are :
(a) $C_6H_5Cl + CH_4$ (b) $C_6H_5Cl + CH_3Cl$
(c) $C_6H_6 + CH_4$ (d) $C_6H_6 + CH_3Cl$

86. α-D(+)–glucose and β-D(+)–glucose are :
(a) anomers   (b) epimers
(c) enantiomers   (d) geometrical isomers

87. But-2-ene exhibits *cis-trans* isomerism due to :
(a) rotation around $C_2 - C_3$ double bond
(b) rotation around $C_3 - C_4$ sigma bond
(c) rotation around $C_1 - C_2$ bond
(d) restricted rotation around $>C = C<$ bond

88. Reduction by $LiAlH_4$ of hydrolysed product of an ester gives :
(a) two acids
(b) two aldehydes
(c) one molecule of alcohol and another of carboxylic acid
(d) two alcohols

89. Polarization of electrons in acrolein may be written as :
(a) $\overset{\delta+}{CH_2} = CH - CH = \overset{\delta-}{O}$
(b) $\overset{\delta+}{CH_2} = \overset{\delta+}{CH} - CH = O$
(c) $\overset{\delta+}{CH_2} = CH - CH = \overset{\delta+}{O}$
(d) $\overset{\delta-}{CH_2} = CH - \overset{\delta+}{CH} = O$

90. An organic compound A on reduction gives compound B which on reaction with chloroform and potassium hydroxide forms C. The compound C on catalytic reduction gives N-methylaniline. The compound A is :
(a) nitrobenzene   (b) nitromethane
(c) methylamine   (d) aniline

91. Among the following alkenes,
1-butene   *cis*-2-butene   *trans*-2-2butene
   I   II   III
the decreasing order of stability is :
(a) II > I > III   (b) III > II > I
(c) III > I > II   (d) I > II > III

92. The dihedral angle between two C—H bonds in the staggered conformation of ethane is :
(a) $60°$ (b) $180°$
(c) $0°$ (d) $120°$

93. The ionization constant of phenol is higher than that of ethanol because :
(a) phenoxide ion is bulkier than ethoxide
(b) phenoxide ion is stronger base than ethoxide
(c) phenoxide ion is stabilized through delocalization
(d) phenoxide ion is less stable than ethoxide

94. Which one of the following arrangements does not truly represent the property indicated against it ?
(a) $Br_2 < Cl_2 < F_2$: Oxidising power
(b) $Br_2 < Cl_2 < F_2$: Electronegativity
(c) $Br_2 < F_2 < Cl_2$: Electron affinity
(d) $Br_2 < Cl_2 < F_2$: Bond energy

95. Among the following compounds the decreasing order of reactivity towards electrophilic substitution is :

    CH_3 OCH_3 CF_3
    I   II   III   IV
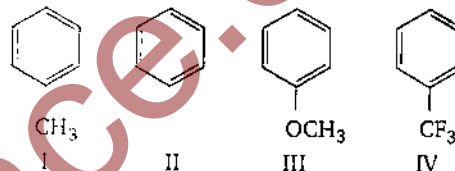
(a) II > I > III > IV   (b) III > I > II > IV
(c) IV > I > II > III   (d) I > II > III > IV

96. The (R)– and (S)– enantiomers of an optically active compound differ in :
(a) their solubility in a chiral solvents
(b) their reactivity with a chiral reagents
(c) their optical rotation of plane polarised light
(d) their melting points

97. Benzoic acid may be converted to ethyl benzoate by reaction with :
(a) sodium ethoxide
(b) ethyl chloride
(c) dry $HCl - C_2H_5OH$
(d) ethanol

98. $CF_2 = CF_2$ is a monomer of :
(a) buna-S   (b) teflon
(c) glyptal   (d) nylon-6

99. The hormone which controls the processes like burning of fats, proteins and carbohydrates to liberate energy in the body is :
(a) cortisone   (b) thyroxine
(c) adrenaline   (d) insulin

100. Which of the following colligative property can provide molar mass of proteins (or polymers or colloids) with greatest precision ?
(a) Osmotic pressure
(b) Elevation of boiling point
(c) Depression of freezing point

101. Darwin's finches provide an excellent evidence in favour of organic evolution. These are related to which of the following evidences ?
  (a) Embryology
  (b) Palaeontology (or fossils)
  (c) Anatomy
  (d) Biogeography (or geographic distribution)

102. Which one of the following is correctly matched pair of a certain plant family and its one example ?
  (a) Malvaceae—Cotton
  (b) Leguminosae—Mango (or Sunflower)
  (c) Cucurbitaceae—Orange
  (d) Brassicaceae—Wheat

103. Relative Biological Effectiveness (RBE) usually refers to the damages caused by :
  (a) low temperature
  (b) high temperature
  (c) radiation
  (d) pollution

104. The greatest biomass of autotrophs in the world's oceans is that of :
  (a) benthic brown algae, coastal red algae and daphnids
  (b) benthic diatoms and marine viruses
  (c) sea grasses and slime molds
  (d) free-floating micro-algae, cyanobacteria and nanoplankton

105. Enzymes are absent in :
  (a) algae
  (b) fungi
  (c) cyanobacteria
  (d) viruses

106. An institution where valuable plant material-likely to become irretrievably lost in the wild or in cultivation-is preserved in a viable condition is known as :
  (a) genome
  (b) gene library
  (c) gene bank
  (d) herbarium

107. For yielding one molecule of glucose, the Calvin cycle turns :
  (a) two times
  (b) four times
  (c) six times
  (d) eight times

108. Photochemical reactions in the chloroplast are directly involved in :
  (a) photolysis of water and phosphorylation of ADP to ATP
  (b) formation of phosphoglyceric acid
  (c) synthesis of glucose and starch
  (d) fixation of carbon dioxide

109. The first (initiating) step in photosynthesis is :
  (a) ionisation of water
  (b) attachment of CO_2 to 5-carbon sugar
  (c) excitation of chlorophyll by a photon of light
  (d) formation of ATP

110. In most fungi, the food material is stored in the form of :
  (a) starch
  (b) glucose
  (c) sucrose
  (d) glycogen

111. Feed back inhibition of an enzymatic reaction is caused by :
  (a) substrate
  (b) enzyme
  (c) end product
  (d) rise in temperature

112. Small proteins produced by vertebrate cells naturally in response to viral infections and which inhibit mutliplication of viruses are called :
  (a) immunoglobulins
  (b) interferons
  (c) antitoxins
  (d) lipoproteins

113. Which one of the following statements is correct with reference to honey bees ?
  (a) Bees wax is a waste (excretory) product of honey bees
  (b) Communication among honey bees was discovered by Von Frisch
  (c) *Apis indica* is largest wild bee in India
  (d) Honey is predominantly sucrose and arabinose

114. Lysosomes are the reservoirs (store houses) of :
  (a) hydrolytic enzymes
  (b) secretory glycoproteins
  (c) RNA and protein
  (d) fats (or sugars or ATP)

115. Black rust of wheat is caused by a member species of the genus :
  (a) *Mucor*
  (b) *Rhizopus*
  (c) *Aspergillus*
  (d) *Puccinia*

116. The first successfully cloned mammals (animal) that gained worldwide publicity was :
    (a) Molly (a sheep) (b) Polly (a sheep)
    (c) Chance (a bull) (d) Dolly (a sheep)

117. As per geological time scale, hominids evolved during :
    (a) Miocene   (b) Pliocene
    (c) Pleistocene   (d) Oligocene

118. Plasmids are suitable vectors for gene cloning because :
    (a) these are small circular DNA molecules which can integrate with host chromosomal DNA
    (b) these are small circular DNA molecules with their own replication origin site
    (c) these can shuttle between prokaryotic and eukaryotic cells
    (d) these often carry antibiotic resistance genes

119. A bacterium which has found extensive use in genetic engineering work in plants is :
    (a) *Bacillus coagulans*
    (b) *Clostridium septicum*
    (c) *Xanthomonas citric* (or *Pseudomonas*)
    (d) *Agrobacterium tumefaciens*

120. Enzymes enhance the rate of a reaction by :
    (a) lowering the activation energy of the reaction
    (b) combining with the product as soon as it is formed
    (c) forming a reactant-product complex
    (d) changing the equilibrium point of the reaction

121. One of the most important reasons why wild plants should thrive is that these are good sources of :
    (a) unsaturated edible oils
    (b) highly nutritive animals feed
    (c) genes for resistance to diseases and pests
    (d) rare and highly sought after fruits of medical importance

122. Producing a giant mouse in the laboratory was possible through :
    (a) gene mutation   (b) gene manipulation
    (c) gene synthesis   (d) gene duplication

123. Industrial production of ethanol from starch is brought about by a certain species of :
    (a) *Azotobacter*   (b) *Lactobacillus*
    (c) *Saccharomyces*   (d) *Penicillium*

124. A water fern which is used as a green manure in rice fields is :
    (a) *Salvinia*   (b) *Mucor*
    (c) *Aspergillus*   (d) *Azolla*

125. The endangered largest living lemur *Idri idri* is inhabitant of :
    (a) Madagascar   (b) Mauritius
    (c) Sri Lanka   (d) India

126. ATP is a :
    (a) nucleotide   (b) nucleosome
    (c) purine base   (d) nucleoside

127. The largest known ovules, largest male and female gametes, and largest plants are found among :
    (a) tree ferns and some monocots
    (b) angiosperms
    (c) gymnosperms
    (d) dicotyledonous plants

128. Which one of the following correctly matches a Sexually Transmitted Disease (STD) with its pathogen ?
    (a) AIDS—*Bacillus anthracis*
    (b) Syphilis—*Treponema pallidum*
    (c) Urethritis—*Entamoeba gingivalis*
    (d) Gonorrhoea—*Leishmania donovani*

129. Removal of apical (terminal) bud of a flowering plant (or pruning of a flowering plant) leads to :
    (a) formation of new apical buds
    (b) formation of adventitious roots on the cut side
    (c) early flowering (or stopping of floral growth)
    (d) promotion of lateral branches

130. The cell organelle involved in the glycosylation of proteins is :
    (a) ribosome
    (b) peroxisome
    (c) mitochondria
    (d) endoplasmic reticulum

131. Among mammals, a significant role is the digestion of milk is played by :
    (a) rennin   (b) invertase
    (c) amylase   (d) intestinal bacteria

132. Which one of the following is not a vestigial part in human ?
    (a) Coccyx
    (b) Finger nails
    (c) Third molar of each side in each jaw
    (d) Segmental muscles of abdomen

as prosthetic group are called :

(a) lipoproteins   (b) nucleoproteins

(c) glycoproteins   (d) chromoproteins

134. Which one of the following is correctly matched pair of the given secretion and its primary role in human physiology ?
    (a) Sebum—Sexual attraction
    (b) Sweat—Thermoregulation
    (c) Saliva—Tasting food
    (d) Tears—Excretion of salts

135. The function of copper T is to prevent :
    (a) fertilisation
    (b) egg maturation
    (c) ovulation
    (d) implantation of blastocyst

136. The replication of DNA is a pre-requisite for a eukaryotic cell to undergo division. During the cell cycle the DNA replicates in :
    (a) S phase   (b) G_1 phase
    (c) G_2 phase   (d) M phase

137. Which one of the following characters studied by Mendel in garden pea was found to be dominant ?
    (a) Green seed colour
    (b) Terminal flower position
    (c) Green pod colour
    (d) Wrinkled seed

138. Geocarpic fruits are produced by :
    (a) carrot   (b) onion
    (c) ground nut   (d) watermelon

139. Special kinds of roots called pneumatophores are characteristics of the plants growing in :
    (a) sandy soils
    (b) saline soils
    (c) marshy places and salt lakes
    (d) dryland regions

140. The plants growing in magnesium-deficient soil, but sprayed with urea would show :
    (a) deep green foliage
    (b) loss of pigments in petals
    (c) early flowering
    (d) yellowing of leaves

141. Coconut milk (coconut water) is widely used in tissue culture because it contains :
    (a) auxins
    (b) ethylene
    (c) cytokinin
    (d) gibberellins

and found that its cells contained chlorophyll a, chlorophyll d and phycoerythrin. The alga must belong to :
    (a) Chlorophyceae
    (b) Rhodopyceae
    (c) Bacillariophyceae
    (d) Cyanophyceae

143. Fixation of one molecule of CO_2 through Calvin cycle requires :
    (a) 3 ATP and 3 $NADPH_2$ molecules
    (b) 3 ATP and 2 $NADPH_2$ moelcules
    (c) 2 ATP and 1 $NADPH_2$ molecules
    (d) 1 ATP and 2 $NADPH_2$ molecules

144. In the life history of ferns, meiosis occurs at the time of :
    (a) formation of spores
    (b) formation of antheridia and archegonia
    (c) formation of gametes
    (d) germination of spores

145. In a given plant, red colour (R) of fruits is dominant over white fruit (r); and tallness (T) is dominant over dwarfness (t). If a plant with genotype RRTt is crossed with a plant of genotype rrtt, what will be the percentage of tall plants with red fruits in the next generation ?
    (a) 100%   (b) 25%
    (c) 50%   (d) 75%

146. Mutation generally produces :
    (a) recessive genes (b) lethal genes
    (c) polygenes   (d) dominant genes

147. The triplet codon in m-RNA which is usually the starting point for protein synthesis, is :
    (a) AUU   (b) AUG
    (c) AUA   (d) AUC

148. Zinc as a nutrient is used by the plants in the form of :
    (a) Zn   (b) Zn^{2+}
    (c) ZnO   (d) $ZnSO_4$

149. In an animal cell, protein synthesis takes place :
    (a) only on the ribosomes present in the cytosol
    (b) only on the ribosomes attached to nuclear envelope and endoplasmic reticulum
    (c) on ribosomes present in the nucleolus as well as in cytoplasm
    (d) on ribosomes present in the cytosol as well as in the mitochondria

150. The most important feature of all living systems from the point of view of their continuity is their capacity to :
(a) produce gametes
(b) utilise oxygen to generate energy
(c) use solar energy for metabolic activities
(d) replicate the genetic information

151. Many scientists consider viruses as living entities because these :
(a) respire
(b) can cause diseases
(c) reproduce (inside host)
(d) respond to tough environment

152. RNA and DNA are similar in :
(a) having similar sugars
(b) having similar pyrimidine bases
(c) being capable to replicate
(d) being polymers of nucleotides

153. In three-dimensional view, a transfer RNA (t-RNA) molecule appears :
(a) Y-shaped   (b) S-shaped
(c) E-shaped   (d) L-shaped

154. Anticodon is present on :
(a) r-RNA   (b) t-RNA
(c) mt-DNA   (d) m-RNA

155. Extranuclear DNA (genes) are located in :
(a) lysosomes and chloroplasts
(b) Golgi complex and ribosomes
(c) chloroplasts and mitochondria
(d) ribosomes and mitochondria

156. During replication of DNA, its two strands separate. Each of these serves as a template for the formation of new strands. Such type of replication is called :
(a) non-conservative (b) semi-conservative
(c) flexible   (d) conservative

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

158. During cell division, the spindle fibres get attached to the condensing chromosome at a highly differentiated region. This region is called :
(a) chromomere   (b) chromocentre
(c) centriole   (d) kinetochore

159. Mongoloid idiocy in human beings caused by the trisomy of chromosome 21 is also known as :

(a) Down's syndrome
(b) Turner's syndrome
(c) Klinefelter's syndrome
(d) Tay-Sachs disease

160. Drosophila flies with XXY genotype are females, but human beings with such genotype are abnormal males. It shows that :
(a) Y-chromosome is essential for sex determination in Drosophila
(b) Y-chromosome is female determinating in Drosophila
(c) Y-chromosome is male determining in human beings
(d) Y-chromosome has no role in sex determination either in Drosophila or in human beings

161. Which one pair of parents out of the following is most likely get a child who would suffer from hemolytic disease of the new-born :
(a) Rh^+ mother and Rh^- father
(b) Rh^- mother and Rh^- father
(c) Rh^+ mother and Rh^+ father
(d) Rh^- mother and Rh^+ father

162. During organ differentiation in Drosophila, an organ is modified to another organ (such as wings may be replaced by legs). Genes responsible for such metamorphosis are called :
(a) double dominant genes
(b) plastid genes
(c) complementary genes
(d) homeotic genes

163. One function of telomeres in a chromosome is to :
(a) 'seal' the ends of the chromosomes
(b) help two chromatids to move towards poles
(c) starts RNA synthesis
(d) identify the correct member of the homologous pair of chromosome

164. Melatonin is secreted by :
(a) skin   (b) thymus
(c) pituitary   (d) pineal gland

165. What is correct regarding leucocytes ?
(a) These can squeeze out through (can cross) the capillary walls
(b) These are enucleate
(c) Sudden fall in their number indicates cancer
(d) These are produced in thymus

166. Which one of the following is a skull bone?
    (a) Coracoid   (b) Arytaenoid
    (c) Atlas   (d) Pterygoid

167. The polysaccharide portion of a peptidoglycan present in the matrix of cartilage is called :
    (a) chondriotin   (b) ossein
    (c) cartilagin   (d) casein

168. In living beings, ammonia is converted into urea through :
    (a) Ornithine cycle   (b) citrulline cycle
    (c) fumarine cycle   (d) arginine cycle

169. Which one of the following hormones is involved in the ripening of fruits ?
    (a) Zeatin
    (b) Indole acetic acid
    (c) Ethylene
    (d) Naphthalene acetic acid

170. Which one of the following primates is believed to be the closest relative of human beings ?
    (a) Gorilla   (b) Rhesus monkey
    (c) Gibbon   (d) Orangutan

171. Which of the following is a correct statement with regard to a certain Mammal and its one feature ?
    (a) Bat bears feathers
    (b) Camel has biconcave red blood cells
    (c) Platypus lays eggs
    (d) Rat bears cloaca

172. Blastopore is the opening to the exterior of :
    (a) coelom   (b) coelenteron
    (c) archentron   (d) blastocoel

173. Movement of ions or molecules against the electrochemical gradient is called :
    (a) diffusion
    (b) pinocytosis
    (c) Brownian movement
    (d) active transport

174. The enteronephric nephridia of earthworms are mainly concerned with :
    (a) digestion
    (b) respiration
    (c) osmoregulation
    (d) excretion of nitrogenous wastes

175. The ability of the vertebrates to produce concentrated (hyperosmotic) urine usually depends upon the :
    (a) area of Bowman's capsule epithelium
    (b) length of Henle's loop
    (c) length of the proximal convoluted tubule
    (d) capillary network forming glomerulus

176. The enzyme which catalyses fixation of CO_2 in C_4 plants is :
    (a) RuBP carboxylase
    (b) hydrogenase
    (c) PEP carboxylase
    (d) reductase

177. Which of the following is not a characteristic feature of all the chordates ?
    (a) Presence of coelom
    (b) Pharyngeal gill clefts in the early embryonic stages
    (c) A diaphragm that separates thorax from abdomen
    (d) Dorsal nerve cord

178. Melanocyte Stimulating Hormone (MSH) is produced by :
    (a) anterior pituitary
    (b) posterior pituitary
    (c) pars intermedia of pituitary
    (d) parathyroid

179. The feature closely related with the evolution of humans is :
    (a) loss of tail   (b) flat nails
    (c) binocular vision   (d) shortening of jaws

180. An action potential in the nerve fibre is produced when positive and negative charges on the outside and the inside of the axon membrane are reversed, because :
    (a) more potassium ions enter the axon as compared to sodium ions leaving it
    (b) more sodium ions enter the axon as compared to potassium ions leaving it
    (c) all potassium ions leave the axon
    (d) all sodium ions enter the axon

181. Numerous filamentous hair-like structures protruding from the tip of a young cob of maize are :
    (a) anthers
    (b) hairs
    (c) hairy projections of the bracts
    (d) long styles of carpels

182. Which method out of the following renders the seed coat permeable to water so that embryo expansion is not physically retarded ?
    (a) Stratification
    (b) Denudation
    (c) Vernalisation
    (d) Scarification

183. Eight nucleate embryo sacs are :
    (a) always bisporic
    (b) always tetrasporic
    (c) always monosporic
    (d) sometimes monosporic, sometimes bisporic and sometimes tetrasporic

184. Double fertilisation (or triple fusion) leading to initiation of endosperm in angiosperms, requires :
    (a) fusion of 4 or more polar nuclei and the second male gamete only
    (b) fusion of 2 polar nuclei and second male gamete only
    (c) fusion of one polar nucleus and second male gamete only
    (d) all the above type of fusions in different types of angiosperms

185. Progestrone, which is the most important component of oral contraceptive pills, prevents pregnancy by :
    (a) preventing the formation of egg
    (b) preventing the clevage of the fertilized egg
    (c) creating unfavourable chemical environment for the sperms to survive in the female reproductive tract
    (d) blocking ovulation

186. Cleavage in mammalian egg is :
    (a) equal holoblastic
    (b) unequal holoblastic
    (c) superficial meroblastic
    (d) discoidal meroblastic

187. Bovine spongiform encephalopathy is a bovine disease. To which of the following human diseases it is related ?
    (a) Kala azar
    (b) Encephalitis
    (c) Cerebral spondylitis
    (d) Creutzfeldt Jacob disease

188. The type of joint between sternum and ribs in human beings is :
    (a) fibrous joint   (b) gliding joint
    (c) angular joint   (d) cartilaginous joint

189. What is common between *Ascaris lumbricoides* and *Anopheles stephensi* ?
    (a) Hibernation
    (b) Metamerism
    (c) Anaerobic respiration
    (d) Sexual dimorphism

190. A certain person eats boiled potato; one of the food component in it is :

(a) lactose which is indigestible
(b) starch which does not get digested
(c) cellulose which is digested by intestinal cellulase
(d) DNA which gets digested by pancreatic DNA ase

191. Pulmonary artery is different from pulmonary vein because it has :
    (a) larger lumen
    (b) thick muscular walls
    (c) no endothelium
    (d) valves

192. A common scent-producing gland among mammals is :
    (a) anal gland
    (b) prostate gland
    (c) adrenal gland
    (d) Bartholin's gland

193. What happens during vascularisation in plants ?
    (a) Differentiation of procambium followed by primary phloem and then primary xylem
    (b) Differentiation of procambium, xylem and phloem simultaneously
    (c) Differentaition of procambium followed immediately by the development of secondary xylem and phloem
    (d) Differentiation of procambium followed by the development of xylem and phloem

194. A person suffering from the deficiency of the visual pigment rhodopsin is advised to take more of :
    (a) radish and potato
    (b) apple and grapes
    (c) carrot and ripe papaya
    (d) guava and ripe banana

195. In a person of advanced age, the hair become thinner gradually. It happens because of decrease in :
    (a) synthesis of glucose
    (b) synthesis of proteins
    (c) energy availability
    (d) blood supply

196. In simple epithelium, the cells are :
    (a) continuously dividing to provide cells for forming an organ
    (b) hardened to provide support to the organs
    (c) loosely connected to one another to from an irregular layer
    (d) cemented directly to one another to form a single layer

197. Which one of the following amino acids is an essential part of human diet ?

   (a) Glycine   (b) Phenylalanine
   (c) Serine   (d) Aspartic acid

198. Patients suffering from cholera are given a saline drip because :

   (a) Na^+ ions help in stopping nerve impulses and hence sensation of pain
   (b) Na^+ ions help in the retention of water in the body tissues
   (c) NaCl is an important component of energy supply
   (d) NaCl furnishes most of the fuel required for cellular activity

199. A piece of bone such as femur of frog, if kept in dilute HCl, for about a week will :

   (a) shrink in size
   (b) assume black colour
   (c) crack into pieces
   (d) turn flexible

200. 'Signal hypothesis' for the biosynthesis of secretory type of proteins was proposed by :

   (a) Camillo Golgi
   (b) Blobel and Sabatini
   (c) Baltimore
   (d) Sheeler and Bianchi

ANSWERS

PHYSICS

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

CHEMISTRY

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

BIOLOGY

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

HINTS & SOLUTIONS

Physics

1. (a)   Force = Mass × acceleration

or $F = ma$

∴ $[F] = [m][a]$

         $= [M][LT^{-2}] = [MLT^{-2}]$

Torque = Moment of inertia × angular acceleration

or $\tau = I \times \alpha$

∴ $|\tau| = [I][\alpha]$

         $= [ML^2][T^{-2}]$

         $= [ML^2T^{-2}]$

(b) Work = Force × displacement

or $W = F \times d$

∴ $[W] = [F][d]$

         $= [MLT^{-2}][L]$

         $= [ML^2T^{-2}]$

Energy $= \frac{1}{2} \times$ Mass × (Velocity)^2

or $K = \frac{1}{2}mv^2$

∴ $[K] = [m][v^2]$

         $= [M][LT^{-1}]^2 = [ML^2T^{-2}]$

(c) Force as discussed above

     $[F] = [MLT^{-2}]$

Impulse = Force × time-interval

     $[I] = [F] \times [\Delta t]$

∴ $[I] = [MLT^{-2}][T]$

         $= [MLT^{-1}]$

(d) Linear momentum = Mass × velocity

or $[p] = [m][v]$

∴ $[p] = [M][LT^{-1}]$

         $= [MLT^{-1}]$

Angular momentum = Moment of inertia × angular velocity

or $[L] = [I] \times [\omega]$

∴ $[L] = [ML^2][T^{-1}]$

Hence, we observe that choice (b) is correct.

NOTE : In this problem, the momentum of inertia and impulse are given same symbol I.

2. **Key Idea :** *Power is equal to the scalar product of force with velocity.*

Power of the engine,

$$P = \vec{F} \cdot \vec{v} \qquad \qquad ...(i)$$

Given, $\vec{F} = (20\hat{i} - 3\hat{j} - 5\hat{k})\,N$

         $\vec{v} = (6\hat{i} + 20\hat{j} - 3\hat{k})\,m/s$

Thus, after substituting for $\vec{F}$ and $\vec{v}$ in Eq. (i), it becomes,

$P = (20\hat{i} - 3\hat{j} - 5\hat{k}) \cdot (6\hat{i} + 20\hat{j} - 3\hat{k})$

$= (20 \times 6)(\hat{i} \cdot \hat{i}) + (-3 \times 20)(\hat{j} \cdot \hat{j})$

$\qquad\qquad\qquad\qquad + (5 \times -3)(\hat{k} \cdot \hat{k})$

$= 120 - 60 - 15$

$= 45$

NOTE : In the simplification for power, the dot product of a unit vector with same unit vector gives 1.

The dot product of a unit vector with its orthogonal gives zero. Thus,

$$\hat{i} \cdot \hat{i} = \hat{j} \cdot \hat{j} = \hat{k} \cdot \hat{k} = 1$$

$$\hat{i} \cdot \hat{j} = \hat{i} \cdot \hat{k} = \hat{j} \cdot \hat{k} = 0$$

So, in above simplification second type of dot products are not shown.

3. (a) Maximum height

$$H = \frac{u^2 \sin^2\theta}{2g}$$

$$\Rightarrow \quad \frac{H_1}{H_2} = \frac{\sin^2\theta_1}{\sin^2\theta_2}$$

$$= \frac{\sin^2 30°}{\sin^2 60°}$$

$$= \frac{\left(\frac{1}{2}\right)^2}{\left(\frac{\sqrt{3}}{2}\right)^2} = \frac{1}{3}$$

(b) Range $R = \dfrac{u^2 \sin 2\theta}{g}$

$\Rightarrow \quad \dfrac{R_1}{R_2} = \dfrac{\sin (2 \times 30°)}{\sin (2 \times 60°)}$

$= \dfrac{\sin 60°}{\sin 120°} = \dfrac{\dfrac{\sqrt{3}}{2}}{\dfrac{\sqrt{3}}{2}} = 1$

$\Rightarrow \quad R_1 = R_2$

(c) Time of flight

$T = \dfrac{2u \sin \theta}{g}$

$\Rightarrow \quad \dfrac{T_1}{T_2} = \dfrac{\sin \theta_1}{\sin \theta_2}$

$= \dfrac{\sin 30°}{\sin 60°} = \dfrac{\dfrac{1}{2}}{\dfrac{\sqrt{3}}{2}} = \dfrac{1}{\sqrt{3}}$

Hence, their horizontal ranges will be equal.

Alternative : Key Idea : *For complementary angles of projection, horizontal range will be same.*

In this problem, it is given that two particles are projected at angles 30° and 60° which are complementary angles. We know that horizontal range will be same for complementary angles. Hence, their ranges will be equal.

4. **Key Idea :** *The force imparted by the ball is equal to rate of change of linear momentum.*

The vector $\overrightarrow{OA}$ represents the momentum of the ball before the collision and the vector $\overrightarrow{OB}$ that after the collision. The vector $\overrightarrow{AB}$ represents the change in momentum of the ball $\Delta\overrightarrow{p}$.
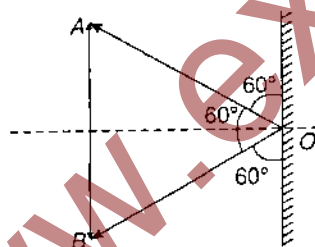
As the magnitude of $\overrightarrow{OA}$ and $\overrightarrow{OB}$ are equal the components of $\overrightarrow{OA}$ and $\overrightarrow{OB}$ along the wall are equal and in the same direction while those perpendicular to the wall are equal and opposite. Thus, the change in momentum is due only to the change in direction of the perpendicular components.

Hence $\quad \Delta\overrightarrow{p} = OA \sin 60° - (-OB \sin 60°)$

$= mv \sin 60° + mv \sin 60°$

$= 2mv \sin 60°$

$= 2 \times 3 \times 100 \times \dfrac{\sqrt{3}}{2}$

$= 300\sqrt{3} \text{ kg-m/s}$

The force exerted on the wall

$F = \dfrac{\Delta\overrightarrow{p}}{\Delta t} = \dfrac{300\sqrt{3}}{0.2} = 1500\sqrt{3} \text{ N}$

NOTE : $\Delta\mathbf{p}$ is directed perpendicular and away from the plate.

5. In the case of masses hanging from a pulley by a string, the tension in whole string is same, say equal to T.

As $M_2 > M_1$, so mass M_2 moves down and mass M_1 moves up with the same acceleration a (say). The arrangement of the motion is represented in the figure.
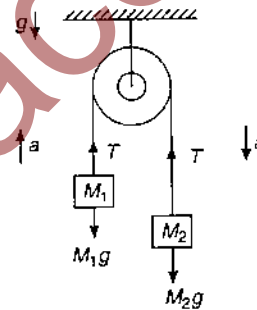
Equation of motion of mass M_2, is

$M_2 g - T = M_2 a \qquad ...(i)$

Equation of motion of mass M, is,

$T - M_1 g = M_1 a \qquad ...(ii)$

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

$(M_2 g - T) + (T - M_1 g) = (M_1 + M_2)a$

$(M_2 - M_1)g = (M_1 + M_2)a$

$\Rightarrow \qquad a = \left(\dfrac{M_2 - M_1}{M_1 + M_2}\right)g$

Given, $M_1 = 5 \text{ kg}, M_2 = 10 \text{ kg}$

Hence,

$a = \left(\dfrac{10 - 5}{5 + 10}\right)g = \dfrac{5}{15}g = \dfrac{g}{3}$

$$v = 3\frac{d}{dt}(t^3) + 7\frac{d}{dt}(t^2) + 14\frac{d}{dt}(t) + 0 \quad ...(ii)$$

(as differentiation of a constant is zero)

Now use $\dfrac{d}{dt}(x^n) = nx^{n-1}$

So, $\quad v = 3(3)t^{3-1} + 7(2)(t^{2-1}) + 14(t^{1-1})$

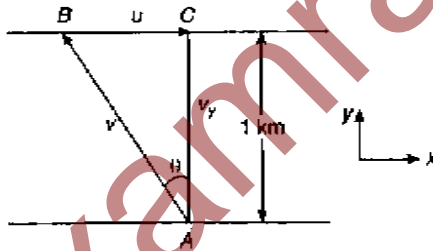$\Rightarrow \quad v = 9t^2 + 14t + 14 \quad\quad ....(iii)$

$(\because t^0 = 1)$

Again differentiating Eq. (iii) with respect to time, which gives the acceleration

$$a = \frac{dv}{dt} = \frac{d}{dt}(9t^2 + 14t + 14)$$

$$= 18t + 14 + 0$$

$$= 18t - 14$$

At $t = 1$ s,

$$a = 18(1) + 14$$

$$= 18 + 14 = 32 \text{ m/s}^2$$

7. The shortest possible path is straight line AC. Let u be the velocity of river water and v that of boat making an angle θ with line AC.

Magnitude of velocity of boat along AC

$$v_y = v\cos\theta$$

$$= 5 \times \sqrt{1 - \left(\frac{4}{5}\right)^2}$$

$$= 5 \times \frac{3}{5} = 3 \text{ km/h}$$

Alternative : From above figure

$$v^2 = u^2 + v_y^2$$

$$\Rightarrow \quad u = \sqrt{v^2 - v_y^2} = \sqrt{5^2 - 4^2}$$

$$= 3 \text{ km/h}$$

8. Velocity of particle after 5 s

$$v = u - gt$$

$$v = 100 - 10 \times 5$$

$$= 100 - 50 = 50 \text{ m/s} \quad \text{(upwards)}$$

Conservation of linear momentum gives

$$Mv = m_1v_1 + m_2v_2 \quad ...(i)$$

Taking upward direction positive, the velocity v_1 will be negative.

$\therefore \quad v_1 = -25$ m/s, $v = 50$ m/s

Also $M = 1$ kg, $m_1 = 400$ g $= 0.4$ kg

and $m_2 = (M - m_1) = 1 - 0.4 = 0.6$ kg

Thus, Eq. (i) becomes,

$$1 \times 50 = 0.4 \times (-25) + 0.6\,v_2$$

or $\quad\quad 50 = -10 + 0.6\,v_2$

or $\quad\quad 0.6\,v_2 = 60$

or $\quad\quad v_2 = \dfrac{60}{0.6} = 100$ m/s

As v_2 is positive, therefore the other part will move upwards with a velocity 100 m/s.

9. When string makes an angle θ with the vertical in a vertical circle, then

$$T - mg\cos\theta = \frac{mv^2}{l}$$
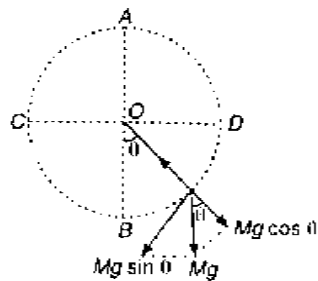
or $\quad T = mg\cos\theta + \dfrac{mv^2}{l}$

Tension is maximum when $\cos\theta = +1$ i.e., $\theta = 0$.

Thus, θ is zero at lowest point B. At this point tension is maximum. So, string will break at point B.

NOTE : The critical speed of a body on circular path $v_c = \sqrt{Rg}$, $R =$ radius of path.

If at the highest point the speed is less than this the string would become slack and the body would leave the circular path.

10. Both spheres reach the ground due to vertical component of velocity. As initial component of velocity of both spheres is zero, therefore both will reach the earth simultaneously. The time taken being given by

$$h = u_y t + \dfrac{1}{2}gt^2 = 0 + \dfrac{1}{2}gt^2$$

$$\Rightarrow \quad t = \sqrt{\dfrac{2h}{g}}$$

11. **Key Idea :** *The escape velocity from earth's surface is* $\sqrt{\dfrac{2GM_e}{R_e}}$.

Escape velocity is given by

$$v_{es} = \sqrt{\dfrac{2GM_e}{R_e}}$$

From a planet,

$$v'_{es} = \sqrt{\dfrac{2GM_p}{R_p}}$$

Therefore, $\dfrac{v'_{es}}{v_{es}} = \sqrt{\dfrac{2GM_p}{R_p}} \times \sqrt{\dfrac{R_e}{2GM_e}}$

It is given that,

mass of planet = Mass of earth

i.e., $\quad M_p = M_e$

So, $\quad \dfrac{v'_{es}}{v_{es}} = \sqrt{\dfrac{R_e}{R_p}}$ ...(i)

Given, $\quad R_p = \dfrac{R_e}{4} \Rightarrow \dfrac{R_p}{R_e} = \dfrac{1}{4}$

and $\quad v_{es} = 11.2\,\text{km/s}$

Substituting in Eq. (i), we have

$$\dfrac{v'_{es}}{11.2} = \sqrt{\dfrac{4}{1}} = 2$$

$$v'_{es} = 11.2 \times 2 = 22.4\,\text{km/s}$$

12. The moment of inertia of a body about an axis depends not only on the mass of the body, but also on the distribution of mass about the axis. For a given body mass is same, so it will depend only on the distribution of mass about the axis.

The mass is farthest from axis BC, so I_2 is maximum. Mass is nearest to axis AC, so I_3 is minimum.

Hence, the correct sequence will be

$$I_2 > I_1 > I_3$$

NOTE : In a rotational motion, moment of inertia is also known as rotational inertia.

13. According to law of equipartition of energy, the internal energy associated per degree of freedom is $\dfrac{1}{2}kT$, where k is the Boltzmann's constant.

Thus, internal energy associated per molecule

$$= f\dfrac{1}{2}kT$$

If N_A is Avagadro's number, then internal energy of one mole of an ideal gas is

$$U = N_A f \dfrac{1}{2}kT$$

$$= \dfrac{1}{2}f(N_A k)T$$

$$= \dfrac{1}{2}fRT$$

where $R = N_A k =$ gas constant

Molar heat capacity at constant volume

$$C_V = \dfrac{dU}{dT}$$

$$= \dfrac{d}{dT}\left(\dfrac{1}{2}fRT\right)$$

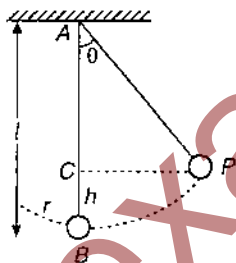$$= \dfrac{1}{2}fR$$

Molar heat capacity at constant pressure

$$C_p = C_V - R \quad \text{(Mayor's relation)}$$

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

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

Hence, $\gamma = \dfrac{C_P}{C_V}$

$$= \frac{\left(\frac{1}{2} f + 1\right) R}{\frac{1}{2} fR}$$

$$= \frac{\left(\frac{1}{2} f + 1\right)}{\frac{1}{2} f} = 1 + \frac{2}{f}$$

14. Key Idea : *The potential energy at an angular displacement* θ *will be converted to kinetic energy at mean position.*

If l be is the length of pendulum and θ the angular amplitude, then height

$$h = AB - AC$$
$$= l - l \cos \theta$$
$$= l(1 - \cos \theta) \qquad \ldots(i)$$

At point P (maximum displacement position i.e., extreme position), potential energy is maximum and kinetic energy is zero. At point B (mean or equilibrium position) potential energy is minimum and kinetic energy is maximum, so from principle of conservation of energy.

$$(PE + KE) \text{ at } P = (KE + PE) \text{ at } B$$

or $\qquad mgh + 0 = \dfrac{1}{2} mv^2 + 0$

or $\qquad v = \sqrt{2gh} \qquad \ldots(ii)$

Substituting the value of h from Eq. (i) into Eq. (ii), we get

$$v = \sqrt{2gl(1 - \cos \theta)}$$

15. Key Idea : *The efficiency of heat engine is the ratio of work done to the heat taken from the source.*

If T_1 is temperature of source and T_2 the temperature of sink, the efficiency of engine

$$\eta = \frac{\text{Work done } (W)}{\text{Heat taken } (Q_1)}$$

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

$\therefore \qquad 1 - \dfrac{T_2}{T_1} = \dfrac{1}{6} \qquad \ldots(i)$

When temperature of sink is reduced by 62°C then

$$T'_2 = T_2 - 62$$

$\therefore \qquad \eta' = 1 - \dfrac{T'_2}{T_1}$

Given : $\eta' = 2\eta = \dfrac{2}{6} = \dfrac{1}{3}$

$\therefore \qquad \dfrac{1}{3} = 1 - \dfrac{T_2 - 62}{T_1} \qquad \ldots(ii)$

From Eq. (i)

$$\frac{T_2}{T_1} = \frac{5}{6} \qquad \ldots(iii)$$

From Eq. (ii)

$$\frac{T_2 - 62}{T_1} = \frac{2}{3} \qquad \ldots(iv)$$

Dividing Eq. (iii) by Eq. (iv)

$$\frac{T_2}{T_2 - 62} = \frac{5}{4}$$

$\Rightarrow \qquad 4T_2 = 5T_2 - 310$

$\Rightarrow \qquad T_2 = 310 \text{ K}$

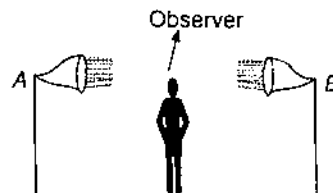and from Eq. (iii), we have

$$\frac{310}{T_1} = \frac{5}{6}$$

$\Rightarrow \qquad T_1 = 372 \text{ K}$

Hence, $T_1 = 372 \text{ K} = 372 - 273 = 99\,°\text{C}$

and $\quad T_2 = 310 \text{ K} = 310 - 273 = 37\,°\text{C}$

16. Let v be the speed of sound and n the original frequency of each source.

They emit sounds of wavelength λ.

When observer moves towards one source (say A), the apparent frequency of A as observed by the observer will be

$$n' = n\left(\frac{v+u}{v}\right)$$

The observes is now receding source B, so the apparent frequency of B observed will be

$$n'' = n\left(\frac{v-u}{v}\right)$$

Thus, number of beats

$$x = n' - n''$$

$$= n\left[\frac{v+u}{v} - \frac{v-u}{v}\right]$$

$$= \frac{n}{v}[v + u - v + u]$$

$$= \frac{2nu}{v}$$

but $\quad v = n\lambda$

Thus, $\quad x = \frac{2nu}{n\lambda} = \frac{2u}{\lambda}$

17. When white light from sun falls on rain drops, sometimes a band of different colours in form of a circular arc is seen in the sky opposite the sun. This is called the rainbow.

    The reason of origin of rainbow is that the small drops of water behave like a prism for the white sun light due to which refraction, dispersion and total internal reflection of white light occurs from the water drops.

    The rainbow is not seen after every rain, but is seen only when the light rays of particular colour suffer minimum deviation after one or two total internal reflections inside the small water drops.

18. The minimum size of plane mirror required for seeing full size image of man

    $$= \frac{\text{Height of man}}{2}$$

    Given, height of man = 6 ft
    Thus, minimum size of plane mirror

    $$= \frac{6}{2} = 3 \text{ ft}$$

19. Two simple harmonic motions be written as

    $$x = A \sin(\omega t + \delta) \qquad \text{...(i)}$$

    and $\quad y = A \sin\left(\omega t + \delta + \frac{\pi}{2}\right)$

    or $\quad y = A \cos(\omega t + \delta) \qquad \text{...(ii)}$

Squaring and adding Eqs. (i) and (ii), we obtain

$$x^2 + y^2 = A^2[\sin(\omega t + \delta) + \cos^2(\omega t + \delta)]$$

or $\quad x^2 + y^2 = A^2 \qquad (\because \sin^2\theta + \cos^2\theta = 1)$

This is the equation of a circle.
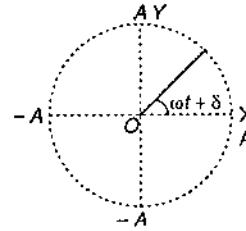At $\omega t + \delta = 0$; $\quad x = 0,\ y = A$
At $\omega t + \delta = \frac{\pi}{2}$; $\quad x = A,\ y = 0$
At $\omega t + \delta = \pi$; $\quad x = 0,\ y = -A$
At $\omega t + \delta = \frac{3\pi}{2}$; $\quad x = -A,\ y = 0$
At $\omega t + \delta = 2\pi$; $\quad x = 0,\ y = A$

Thus, it is obvious that motion of particle is traversed in clockwise direction.

20. When a ray falls on convex surface of a plano-convex lens, then it is first refracted and reflected from plane surface and then finally refracted from convex surface. Thus, two refractions and one reflection take place.
    So, focal length of plano-convex lens is

    $$\frac{1}{F} = \frac{2}{f_l} + \frac{1}{f_m} \qquad \text{...(i)}$$

    If plane surface is silvered, so

    $$f_m = \frac{R_2}{2} = \frac{\infty}{2} = \infty$$

    Now, $\quad \frac{1}{f_l} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

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

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

    $\therefore \quad \frac{1}{F} = \frac{2(\mu - 1)}{R} + \frac{1}{\infty}$

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

    or $\quad F = \frac{R}{2(\mu - 1)} \qquad \text{...(ii)}$

    Given, $\quad R = 20 \text{ cm}, \mu = 1.5$

Hence, $F = \dfrac{20}{2(1.5-1)}$

$= \dfrac{20}{2 \times 0.5} = 20$ cm

21. Key Idea : *At mid-point the directions of magnetic field due to both wires carrying current in same direction are opposite.*

According to Maxwell's right handed screw rule, the magnetic field at right hand of wire 1 is perpendicular to the paper going inwards shown by $\otimes$. Similarly, the magnetic field at left hand of wire 2 is perpendicular to paper coming out shown by $\odot$. Thus, the two fields are opposite to each other.
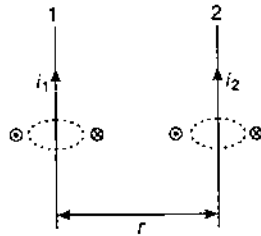
Therefore, net magnetic field

$B = B_1 - B_2$

$= \dfrac{\mu_0 i_1}{2\pi r_1} - \dfrac{\mu_0 i_2}{2\pi r_2}$

At mid point $r_1 = r_2 = r = \dfrac{5}{2} = 2.5$ cm

Hence, $B = \dfrac{\mu_0}{2\pi}\left(\dfrac{i_1}{r} - \dfrac{i_2}{r}\right)$

$= \dfrac{\mu_0}{2\pi}\left(\dfrac{5}{2.5} - \dfrac{2.5}{2.5}\right)$

$= \dfrac{\mu_0}{2\pi}(2-1)$

$= \dfrac{\mu_0}{2\pi}$ T

22. Key Idea : *On removing the battery after charging, the charge stored in the capacitor remains constant.*

When a capacitor is charged by connecting a battery across its plates, the initial energy stored,

$$U = \dfrac{q^2}{2C}$$

When the battery is disconnected, then the charge remains constant *i.e,.* q = constant.

Now another identical capacitor is connected across it *i.e.,* the capacitors are connected in parallel, so the equivalent capacitance

$C_{eq} = C_1 + C_2 = C + C = 2C$

Thus, final energy stored by the system of capacitors,

$U' = \dfrac{q^2}{2C_{eq}}$

$= \dfrac{q^2}{2(2C)} = \dfrac{1}{2}U$

$\therefore$ $U' = \dfrac{U}{2}$

23. Key Idea : *In the balanced condition of bridge circuit, no current will flow through 7Ω resistance.*
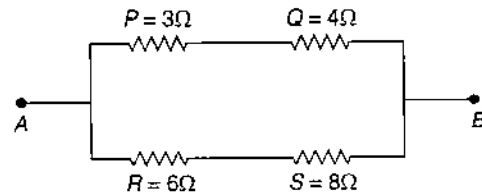
The bridge circuit can be shown as :
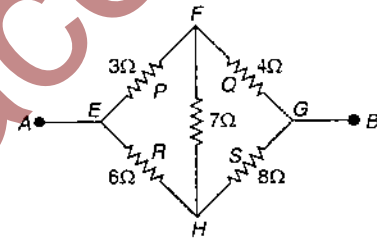
The balanced condition of bridge circuit is given by

$\dfrac{P}{Q} = \dfrac{3}{4}, \dfrac{R}{S} = \dfrac{6}{8} = \dfrac{3}{4}$

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

Thus, it is balanced Wheatstone's bridge, so potential at F is equal to potential at H. Therefore, no current will flow through 7Ω resistance. So, circuit can be redrawn as shown above.

P and Q are in series, so their equivalent resistance $= 3 + 4 = 7\,\Omega$

R and S are also in series, so their equivalent resistance $= 6 + 8 = 14\,\Omega$

Now $7\,\Omega$ and $14\,\Omega$ resistances are in parallel, so

$$R_{AB} = \frac{7 \times 14}{7 + 14} = \frac{7 \times 14}{21} = \frac{14}{3}\,\Omega$$

NOTE : Normally, in Wheatstone's bridge in middle arm galvanometer must be connected. In Wheatstone's bridge, cell and galvanometer arms are interchangeable.

In both the cases, condition of balanced bridge is

$$\frac{P}{Q} = \frac{R}{S}$$

24. Power of electric bulb

$$P = \frac{V^2}{R}$$

So, resistance of electric bulb

$$R = \frac{V^2}{P}$$

Given, $P_1 = 25\,W$, $P_2 = 100\,W$, $V_1 = V_2 = 220\,V$

Therefore, for same potential difference V,

$$R \propto \frac{1}{P}$$

Thus, we observe that for minimum power, resistance will be maximum and *vice-versa*.

Hence, resistance of 25 W bulb is maximum and 100 W bulb is minimum.

25. If electron moves in a magnetic field at an angle θ (other than $0°$, $180°$ or $90°$), its velocity can be resolved in two components one along $\vec{B}$ and another perpendicular to $\vec{B}$. Let the two components be $v_\parallel$ and $v_\perp$. Then
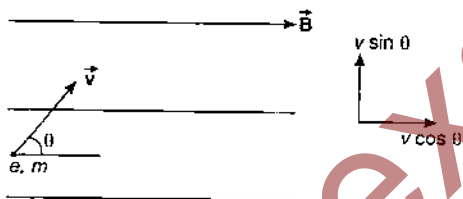
and
$$v_\parallel = v\cos\theta$$
$$v_\perp = v\sin\theta$$

The component perpendicular to field ($v_\perp$) gives a circular path and the component parallel to field ($v_\parallel$) gives a straight line path. The resultant path is, helix as shown in figure.
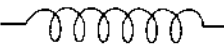
The radius of this helical path is

$$r = \frac{mv_\perp}{eB}$$

$$= \frac{mv\sin\theta}{eB}$$
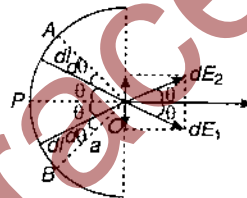
or
$$r = \frac{v\sin\theta}{\left(\dfrac{e}{m}\right)B}$$

Given, $v = 1 \times 10^3$ m/s, $B = 0.3\,T$, $\theta = 30°$,

$$\frac{e}{m} = 1.76 \times 10^{11}\,C/kg$$

$$\therefore \quad r = \frac{1 \times 10^3 \sin 30°}{1.76 \times 10^{11} \times 0.3}$$

$$= \frac{1 \times 10^3 \times \dfrac{1}{2}}{1.76 \times 10^{11} \times 0.3} = 10^{-8}\,m$$

26. Considering symmetric elements each of length dl at A and B, we note that electric fields perpendicular to PO are cancelled and those along PO are added. The electric field due to an element of length $dl(= ad\theta)$ along PO.

$$dE = \frac{1}{4\pi\varepsilon_0}\frac{dq}{a^2}\cos\theta \qquad (\because dl = ad\theta)$$

$$= \frac{1}{4\pi\varepsilon_0}\frac{\lambda dl}{a^2}\cos\theta$$

$$= \frac{1}{4\pi\varepsilon_0}\cdot\frac{\lambda(a\,d\theta)}{a^2}\cos\theta$$

Net electric field at O

$$E = \int_{-\pi/2}^{\pi/2} dE = 2\int_0^{\pi/2}\frac{1}{4\pi\varepsilon_0}\frac{\lambda\,a\cos\theta\,d\theta}{a^2}$$

$$= 2\cdot\frac{1}{4\pi\varepsilon_0}\frac{\lambda}{a}[\sin\theta]_0^{\pi/2}$$

$$= 2\cdot\frac{1}{4\pi\varepsilon_0}\cdot\frac{\lambda}{a}\cdot 1 = \frac{\lambda}{2\pi\varepsilon_0\,a}$$

27. When we measure the emf of a cell by the potentiometer then no current draws in the circuit in zero-deflection condition *i.e.*, cell is in open circuit. Thus, in this condition the

actual value of a cell is found. In this way potentiometer is equivalent to an ideal voltmeter of infinite resistance.

NOTE : The emf by the potentiometer is measured from null method in which zero deflection position is found on the wire.

28. In electrolysis, according to first law of Faraday, the mass of a substance deposited at an electrode is directly proportional to the charge passed through the electrolyte *i.e.*,

$$m \propto q$$

If a current i passes for a time t, then as we know,

$$q = it$$

Hence, $\qquad m \propto it$

or $\qquad m \propto i$

Thus, mass deposited at an electrode is directly proportional to current.

29. Frequency of radiations given are listed below :

	Waves	Frequency (in Hz)
1.	γ-rays	3×10^{21} to 3×10^{18} (a)
2.	X-rays	3×10^{18} to 3×10^{16} (b)
3.	Ultraviolet radiation	3×10^{16} to 7.5×10^{14} (c)

Thus, correct order is

$$a > b > c$$

30. We define the quality factor of the circuit as follows :

Quality factor Q

$$= 2\pi \times \frac{\text{Total energy stored in the circuit}}{\text{Loss in energy in each cycle}}$$

But the total energy stored in circuit $= L I_{rms}^2$

and the energy loss per second $= I_{rms}^2 R$

So, loss in energy per cycle $= \dfrac{I_{rms}^2 R}{f}$

Hence, quality factor $Q = 2\pi \times \dfrac{L I_{rms}^2}{I_{rms}^2 R / f}$

$$= \frac{2\pi f L}{R} = \frac{\omega L}{R}$$

NOTE : Evidently, Q is a dimensionless quantity.

31. In 1905, Einstein realized that the photoelectric effect could be understood if the energy in light is not spread out over wavefronts but is concentrated in small packets, or photons. Each photon of light of frequency v has the energy hv. Thus, Einstein's work on photoelectric effect gives support to $E = hv$.

32. Neil Bohr and J.A. Wheeler explained the nuclear fission on the basis of liquid drop model of the nucleus. The $_{92}U^{235}$ nucleus behaves like a liquid drop and owing to surface tension is perfectly spherical in shape. When the neutron strikes the nucleus, some energy called the excitation energy is imparted to the nucleus. The phenomenon of surface tension tries to keep the nucleus spherical in shape, whereas the excitation energy tries to deform it. Due to the struggle between the surface tension and the excitation energy, the oscillations are set up inside the compound nucleus. As a result the nucleus gets deformed from spherical shape to ellipsoidal and then to
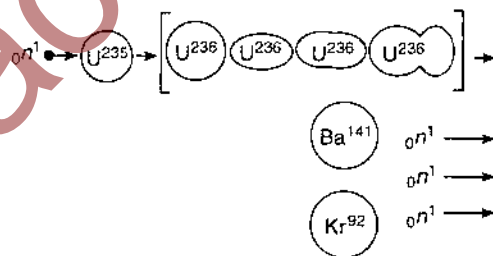
a dumb bell as shown, till the Coulomb's repulsive force between protons succeeds in tearing the two bells apart.

33. (a) Second line of Lyman series corresponds to the transition

$$n = 3 \rightarrow n = 1$$

(b) Second line of Balmer series corresponds to the transition

$$n = 4 \rightarrow n = 2$$

(c) Second line of Paschen series corresponds to the transition

$$n = 5 \text{ to } n = 3$$

(d) An absorption line of Balmer series arises when electron jumps from $n = 2$ to any other higher state.

Thus, choice (b) is correct.

34. Energy level of H-atom are given by

$$E_n = -\frac{13.6}{n^2} \text{ eV}$$

Photons are emitted only when electron jumps from higher energy level (higher n-value) to lower energy level (lower n-value). So, alternative (a) and (c) are wrong.

Energy difference from $n = 2$ to $n = 1$ level is

$$\Delta E_{2 \to 1} = 13.6 \left(\frac{1}{1^2} - \frac{1}{2^2} \right) \text{eV}$$

$$= 13.6 \times \frac{3}{4} = 10.2 \text{ eV}$$

Energy difference from $n = 6$ to $n = 2$ level is

$$\Delta E_{6 \to 2} = 13.6 \left(\frac{1}{2^2} - \frac{1}{6^2} \right) \text{eV}$$

$$= 13.6 \times \left(\frac{1}{4} - \frac{1}{36} \right) \text{eV}$$

$$= 13.6 \times \frac{2}{9} \text{ eV}$$

$$= 3.02 \text{ eV}$$

Thus, it is evident that difference is larger for $n = 2$ to $n = 1$ transition. Hence, maximum energy photon will be emitted during transition from $n = 2$ to $n = 1$.

35. The time required for the number of parent nuclei to fall to 50% is called half-life T and may be related to disintegration constant λ as follows. Since,

$$0.5 N_0 = N_0 \, e^{-\lambda T}$$

we have,

$$\lambda T = \log_e 2$$

$$\therefore \qquad \lambda = \frac{\log_e 2}{T}$$

36. Number of half-lives

$$n = \frac{t}{T} = \frac{18}{3} = 6$$

Amount remained after n half-lives

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

Given, $M_0 = 300$ g

$$\therefore \qquad M = 300 \left(\frac{1}{2} \right)^6$$

$$= 300 \times \frac{1}{64} = 4.68 \text{ g}$$

Alternative : Total time of decay given

$$t = \frac{2.303}{\lambda} \log_{10} \left(\frac{300}{M} \right)$$

but

$$\lambda = \frac{0.693}{T}$$

$$= \frac{0.693}{3} = 0.231/\text{h}$$

$$\therefore \qquad t = \frac{2.303}{0.231} \log_{10} \left(\frac{300}{M} \right)$$

Given, $t = 18$ h

So, $18 = \frac{2.303}{0.231} \log_{10} \left(\frac{300}{M} \right)$

or $\log_{10} \left(\frac{300}{M} \right) = \frac{0.231}{2.303} \times 18$

or $\frac{300}{M} = (10)^{1.8}$

or $M = \frac{300}{(10)^{1.8}} = 4.68$ g

37. Key Idea : *In a nuclear reaction conservation of charge number and mass number must hold good.*

Let Z be the charge number and A the mass number of particle X, then conservation of charge number gives.

$$6 = 5 + 1 + Z$$

$$\Rightarrow \qquad Z = 0$$

Conservation of mass number gives,

$$11 = 11 + 0 + A$$

$$\Rightarrow \qquad A = 0$$

X is a particle of zero charge and zero mass. This particle may be neutrino or antineutrino. With positive β-particle, neutrino is emitted and with negative β-particle, antineutrino is emitted.

Thus, in our case neutrino will be emitted.

38. Current gain in common-base configuration is,

$$\alpha = \left(\frac{\Delta i_C}{\Delta i_E} \right)_{V_{CB}}$$

Current gain in common-emitter configuration is,

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

Also $i_B = i_E - i_C$

or $\Delta i_B = \Delta i_E - \Delta i_C$

$\therefore \qquad \beta = \frac{\Delta i_C}{\Delta i_B} = \frac{\Delta i_C}{\Delta i_E} \times \frac{\Delta i_E}{\Delta i_B}$

or $\beta = \alpha \times \frac{\Delta i_E}{\Delta i_E - \Delta i_C}$

or $\beta = \alpha \times \frac{1}{1 - \frac{\Delta i_C}{\Delta i_E}}$

Here symbol (•) represents AND operation.

40. The gases carbon-monoxide (CO) and nitrogen (N_2) are diatomic, so both have equal kinetic energy $\frac{5}{2}kT$, i.e., $E_1 = E_2$.

41. From law of length, the frequency of vibrating string is inversely proportional to its length, i.e.,

$$n \propto \frac{1}{l}$$

or $\qquad nl = \text{constant (say } k)$

or $\qquad nl = k \quad \text{or } l = \frac{k}{n}$

The segments of string of length $l_1, l_2, l_3 \ldots$ have frequencies $n_1, n_2, n_3, \ldots$

Total length of string is l.

So, $\qquad l = l_1 + l_2 + l_3 + \ldots$

$\therefore \qquad \frac{k}{n} = \frac{k}{n_1} + \frac{k}{n_2} + \frac{k}{n_3} + \ldots$

or $\qquad \frac{1}{n} = \frac{1}{n_1} + \frac{1}{n_2} + \frac{1}{n_3} + \ldots$

42. Key Idea : *In forward biasing of p-n junction p-side is given more positive voltage than n-side.* For forward biasing of p-n junction, p-side should be at higher potential than n-side. Now we apply this rule to the four options.

(a) Here, p-side is at lower potential (0V) and n-side at higher potential (2V). So this diode is not forward biased.

(b) Here, p-side is at higher potential (0V) and n-side at lower potential (-2V). So, this diode is forward biased.

(c) Here, p-side is at lower potential (-2V) and n-side at higher potential (0V). So, this diode is not forward biased.

$\lambda(\text{A}) \qquad \lambda(\text{A})$

Here, $hc = 12375$ comes from the following procedure :

$hc = (\text{Planck's constant}) (\text{velocity of light})$

$$= \frac{(6.6 \times 10^{-34} \text{ J-s}) (3 \times 10^{8} \text{ m/s})}{(16 \times 10^{-19} \text{ J/eV})}$$

$= 12375 \times 10^{-7}$ eV-m $= 12375$ eV-Å

44. Key Idea : *At a height h from earth's surface, the value of acceleration due to gravity is*

$$g' = \frac{g}{\left(1 + \frac{h}{R}\right)^2}$$

The acceleration due to gravity at height h from earth's surface is

$$g' = \frac{g}{\left(1 + \frac{h}{R}\right)^2}$$

Weight of a body at height h

$$w' = mg'$$

$$= \frac{mg}{\left(1 + \frac{h}{R}\right)^2} = \frac{w}{\left(1 + \frac{h}{R}\right)^2}$$

Now at height h equal to radius (R) of earth i.e., $h = R$, we have

$$w' = \frac{w}{\left(1 + \frac{R}{R}\right)^2}$$

or $\qquad w' = \frac{w}{4}$

but $\qquad w = 72$ N $\qquad$ (given)

$\therefore \qquad w' = \frac{72}{4} = 18$ N

45. Internal resistance of the cell is given by

$$r = \left(\frac{E - V}{V}\right) R$$

Given, $E = 1.5$ V, $V = 1.0$ V, $R = 2\Omega$

$$\therefore \quad r = \left(\frac{1.5 - 1.0}{1.0}\right) \times 2 = \frac{0.5}{1.0} \times 2 = 1.0\,\Omega$$

46. According to Gauss's law, the electric flux through a closed surface is equal to $\frac{1}{\varepsilon_0}$ times the net charge enclosed by the surface.

Since, q is the charge enclosed by the surface, then electric flux $\phi = \frac{q}{\varepsilon_0}$

If charge q is placed at a corner of cube, it will be divided into 8 such cubes. Therefore, electric flux through the cube is

$$\phi' = \frac{1}{8}\left(\frac{q}{\varepsilon_0}\right)$$

47. The gravitational force is conservative, so the work done by it is independent of path, hence in both cases

$$\frac{1}{2}mv^2 = mgh$$

$$v = \sqrt{2gh};\ \text{independent of mass}$$

So, $v_1 = v_2$

48. Refractive index $(\mu) = \frac{\text{Real depth}}{\text{Apparent depth}}$

Refractive index $(\mu) = 1.5$
Apparent depth $= 2 + 5 = 7$ cm

So,

$$1.5 = \frac{\text{Real depth}}{7}$$

$\therefore$ Real depth $= 1.5 \times 7 = 10.5$ cm

49. (a) Conduction is the process of transmission of heat in a body from the hotter part to the colder part without any bodily movement of constituent atoms or molecules of the body.

(b) In convection, the heated lighter particles move upward and colder heavier particles move downward to their place. This depends on weight and hence, on gravity.

(c) Radiation is the process of transmission of heat from one body to another body through electromagnetic waves even through vacuum, irrespective of their temperatures.

Hence, choice (b) is correct.

50. The frequency of vibrations of string is

$$n = \frac{1}{2\pi}\sqrt{\frac{g}{l}} \qquad \ldots(i)$$

Given, $n_A = 2n_B$

$$\therefore \quad \frac{1}{2\pi}\sqrt{\frac{g}{l_A}} = 2 \cdot \frac{1}{2\pi}\sqrt{\frac{g}{l_B}}$$

or

$$\frac{1}{l_A} = \frac{4}{l_B}$$

or

$$l_B = 4l_A$$

It is obvious from Eq. (i), the frequency of vibrations of strings does not depend on their mass.

Chemistry

51. According to formula, $E = \frac{hc}{\lambda}$

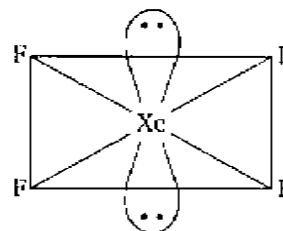$$3.03 \times 10^{-19} = \frac{hc}{\lambda}$$

$$\lambda = \frac{6.63 \times 10^{-34} \times 3.00 \times 10^8}{3.03 \times 10^{-19}}$$

$$= 6.56 \times 10^{-7}\ \text{m}$$

$$= 6.56 \times 10^{-7} \times 10^9\ \text{nm}$$

$$= 6.56 \times 10^2\ \text{nm} = 656\ \text{nm}$$
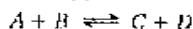
52. Structure of XeF_4 as follows :

It involves sp^3d^2 hybridisation in Xe atom. The molecule has square planar structure. Xe and four F atoms are coplanar. The lone pairs present on axial positions, minimise electron pair repulsion.

where Δn = number of moles of gaseous product – number of moles of gaseous reactant

$$= 2 - 3 = -1$$

So, $\Delta H = \Delta E - RT$

56. Consider a hypothetical change

$$A + B \rightleftharpoons C + D$$

For this reaction,

$$K_{eq.} = \frac{[C][D]}{[A][B]}$$

For the above reaction if concentration of reactants are doubled than the rate of forward reaction increases for a short time but after sometime equilibrium will established. So, concentration has no effect on equilibrium constant. It remains unchanged after increasing the concentration of reactants.

57. $\Delta S_f = \dfrac{\Delta H_f}{T_f}$

$$\Delta S_f = \frac{2930\,\text{J mol}^{-1}}{300\,\text{K}} = 9.77\ \text{J K}^{-1}\,\text{mol}^{-1}$$

58. Given

Half-life $(t_{1/2})$ = 3 h

Initial mass (N_0) = 300g

Total time (T) = 18 h

Mass left (N) = ?

We know that,

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

where n = number of half life

$$n = \frac{\text{Total time}}{\text{Half - life}} = \frac{18}{3} = 6$$

So, $\dfrac{N}{300} = \left(\dfrac{1}{2}\right)^6$
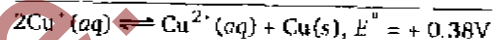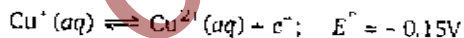
$$\Delta G_2^{\circ} = -1 \times (0.15)\,F$$

On addition

$$\text{Cu(s)} \longrightarrow \text{Cu}^{2+}(aq) + e^-,$$
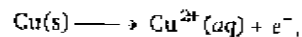
$$\Delta G_3'' = -1 \times E^{\circ} \times F$$

$$\Delta G_3'' = \Delta G_1^{\circ} - \Delta G_2^{\circ}$$

$$= (-2 \times 0.34 \times F) + (-1 \times 0.15 \times F)$$

$$= +0.68F - 0.15F = 0.53F$$

or $E^{\circ} = -0.53V$

Reaction $2\text{Cu}^+(aq) \rightleftharpoons \text{Cu}^{2+}(aq) + \text{Cu}(s)\ E^{\circ} = ?$

So, $\text{Cu}^+(aq) + e^- \rightleftharpoons \text{Cu}(s),\quad E'' = +0.53V$

$\text{Cu}^+(aq) \rightleftharpoons \text{Cu}^{2+}(aq) + e^-;\quad E^{\circ} = -0.15V$
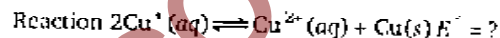
$$\overline{2\text{Cu}^+(aq) \rightleftharpoons \text{Cu}^{2+}(aq) + \text{Cu}(s),\ E'' = +0.38V}$$

61. $\text{KE} = \dfrac{3}{2}RT$ (for one mole of a gas)

The temperature is constant and kinetic energy is independent on molecular weights. So,

$$\overline{\text{KE}}_{\text{CO}} = \overline{\text{KE}}_{\text{N}_2}$$

62. CH_3COOH is weak acid while NaOH is strong base, so one equivalent of NaOH cannot be neutralized with one equivalent of CH_3COOH. Hence, one equivalent of each does not have pH value as 7.

As the NaOH is a strong base. The solution will be basic having a pH more than 7.

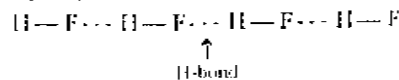**63.** $H_2X \rightleftharpoons H^+ + HX^- (K_{a_1})$

$HX^- \rightleftharpoons H^+ + X^{2-} (K_{a_2})$
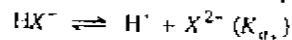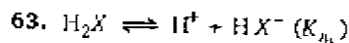
In the 1st equation hydrogen ion is formed from neutral molecule whereas in IInd equation it comes from negatively charged

species. Due to negative charge removal of proton is difficult.

So, $K_{a_1} > K_{a_2}$

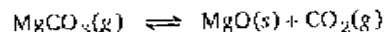**64.** HF molecules have linear polymeric structure due to hydrogen bond.

$$H—F\cdots H—F\cdots H—F\cdots H—F$$
$$\underset{\text{H-bond}}{\uparrow}$$

65. $-\dfrac{1}{5}\dfrac{d[Br^-]}{dt} = +\dfrac{1}{3}\dfrac{d[Br_2]}{dt}$

or $\dfrac{d[Br_2]}{dt} = -\dfrac{3}{5}\dfrac{d[Br^-]}{dt}$

66. In heterogeneous system K_c, K_p is not based upon concentration or pressure of solid substance. Hence, at equilibrium their concentration or pressure are assumed as one

$$MgCO_3(g) \rightleftharpoons MgO(s) + CO_2(g)$$
$$K_p = P_{CO_2}$$

67. Cl—B$\underset{Cl}{\overset{Cl}{<}}$ in BCl_3 boron contains six

electrons in its valence shell so, it is capable to accommodate one pair of electrons. Hence, it acts as Lewis acid or electron deficient compound. As we know that Lewis acids are the substances having a tendency to accept a pair of electron.

68. On addition of electrolyte charge of colloidal particles will neutralise and hence coagulation or precipitation of colloidal solution will occur.

69. The dissociation energy will be more when the bond order will be greater
or Bond order $\propto$ Dissociation energy
Molecular orbital configuration of $N_2(14) =$
$\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_y^2, \pi 2p_z^2, \sigma 2p_x^2$
So, bond order of $N_2 = \dfrac{N_b - N_a}{2} = \dfrac{10-4}{2} = 3$
and bond order of $N_2' = \dfrac{9-4}{2} = 2.5$

As the bond order of N_2 is greater than N_2'
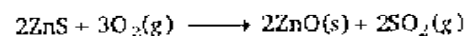
So, the dissociation energy of N_2 will be greater than N_2'.

70. ΔG of formation of different substances are as
$$2SO_2 = -544 \text{ kJ}$$
$$2ZnS = -293 \text{ kJ}$$
$$2ZnO = -480 \text{ kJ}$$

For the reaction

$$2ZnS + 3O_2(g) \longrightarrow 2ZnO(s) + 2SO_2(g)$$

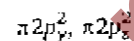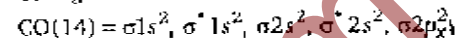$\Delta G = [(\Delta G_{(products)}) - \Delta G_{(reactants)}]$
$= [(-480) + (-544) - (-293)]$
$= -1024 + 293$
$= -731 \text{ kJ}$

71. Paramagnetic character is shown by those atoms or molecules which have unpaired electrons.

In the given compounds CO is not paramagnetic since it does not have unpaired electrons. The configuration of CO molecule is

$CO(14) = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_x^2,$
$\pi 2p_y^2, \pi 2p_z^2$

72. In P—O bond, π bond is formed by the sidewise overlapping of d-orbital of P and p-orbital of oxygen. Hence, it is formed by $p\pi$ and $d\pi$ overlapping.

In nitrogen and carbon no vacant d-orbital is present. So, they do not form $p\pi$ — $d\pi$ bond.

$$\underset{O^-}{\overset{\overset{O}{\sigma||\pi}}{\underset{|}{\overset{|}{P}}}}\quad O^-$$
$$O^-$$
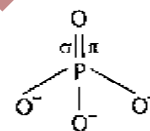
73. A atoms are at corners of a cube
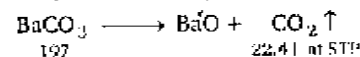So, the number of A atoms per unit cell
$= 8 \times \dfrac{1}{8} = 1$.

Similarly, B atoms are present at face centres of a cube.

So, the number of B atoms per unit cell
$= 6 \times \dfrac{1}{2} = 3$

Hence, the compound is AB_3

74. On decomposition $BaCO_3$ liberates CO_2 as
$$\underset{197}{BaCO_3} \longrightarrow BaO + \underset{22.4 L \text{ at STP}}{CO_2 \uparrow}$$

$\because$ 197g $BaCO_3$ gives = 22.4 L of CO_2 at STP

$\therefore$ 9.85g $BaCO_3$ will give $= \dfrac{22.4 \times 9.85}{197} = 1.12$ L

75. In $A_3(BC_4)_2$
$3 \times$ O.N. of $A + 2[$O.N. of $B + 4 \times$ O.N. of $C] = 0$
$3 \times (+2) + 2[+5 + 4 \times (-2)] = 0$
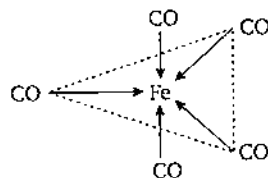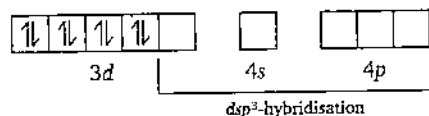$+6 + 2[-3] = 0$

Hence, in the compounds $A_3(BC_4)_2$, the oxidation number of A, B and C are +2, +5 and –2 respectively.
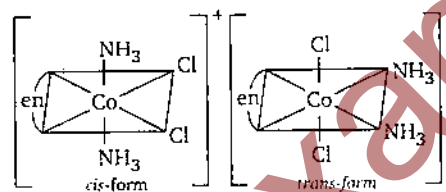
76. In $Fe(CO)_5$, the Fe atom is in dsp^3 hybridised state. Therefore, the shape of molecule is trigonal bipyramidal. The hybridisation is as
$$_{26}Fe = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3p^6, 4s^2 4p^0$$
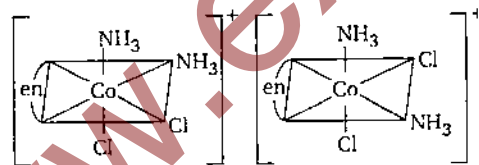
In $Fe(CO)_5$ the 'Fe' atom is—

dsp^3-hybridisation

77. Complex $Co(en)(NH_3)_2 Cl_2] Cl$ will have four different isomers.
(i) Geometrical isomers.

cis-form   trans-form

(ii) Optical isomers.

78. The electronic configuration of Sc is
$1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^1, 4s^2$
and configuration of Sc^{3+} is
$1s^2, 2s^2 2p^6, 3s^2 3p^6$
So, Sc^{3+} is colourless due to absence of unpaired electrons in d-orbital.
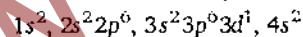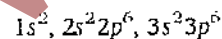
79. Species having equal number of electrons are known as isoelectronic species.

In CO number of electrons
$= 6 + 8 = 14$
In CN^- number of electrons
$= 6 + 7 + 1 = 14$

In NO^+ number of electrons
$= 7 + 8 - 1 = 14$
In C_2^{2-} number of electrons
$= 12 + 2 = 14$

Hence, all have 14 electrons so, they are isoelectronic species.

80. $K_3[Cu(CN)_4]$ is more stable while $K_2[Cd(CN)_4]$ is less stable.

81. Manganese shows maximum number of oxidation states because it has 5 unpaired electrons in 3d and also contains 2 electrons in 4s-subshell.
$$+ 2, + 3, + 4, + 5, + 6, + 7$$
Other metals show the following oxidation states
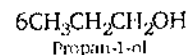$Cr = + 2, + 3, + 4, + 5, + 6$
$Fe = + 2, + 3$
$Ti = + 2, + 3, + 4$

82. Formula of chlorophyll is $C_{55}H_{72}MgN_4O_6$. So, Mg is present in chlorophyll. It is the green colouring matter of leaves and green stems.
Vitamin B_{12} contain cobalt. Haemocyanin contain copper and carbonic anhydrase H_2CO_3.

83. $6CH_3CH = CH_2 \xrightarrow{B_2H_6} 2(CH_3CH_2CH_2)_3 B$

Propene   Tri-n-propyl borane

$$\xrightarrow[\text{}]{H_2O_2 | OH^-}$$

$6CH_3CH_2CH_2OH$
Propan-1-ol

84.
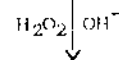
Aldehyde

Aldehyde hydrazone
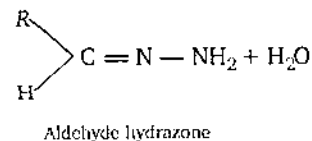
85. Friedel-Crafts alkylation of benzene (Ar—H)
Step (i)

$$CH_3Cl + AlCl_3 \longrightarrow \overset{+}{C}H_3 + AlCl_4^-$$

Electrophile
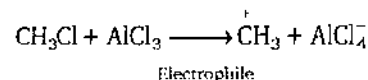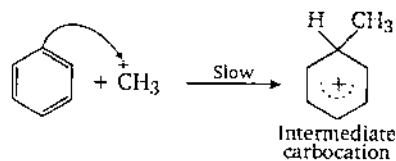
Step (ii)

Step (iii)

Thus, C_6H_6 and CH_3Cl are required in addition to $AlCl_3$

86. Those diastereomers which differ only in configuration at C-1 are known as anomers.

87. Due to presence of $> C = C <$ in butene-2, it shows restricted rotation. Hence, give two types of arrangements around the space of $> C = C <$ as *cis* and *trans* forms.

88. $R-COOR' \xrightarrow{H_2O} R-COOH + R'OH$

$$\downarrow \text{LiAlH}_4 / \text{ether}$$

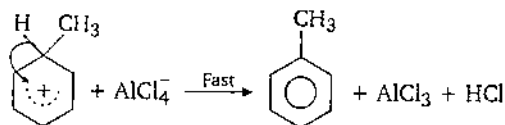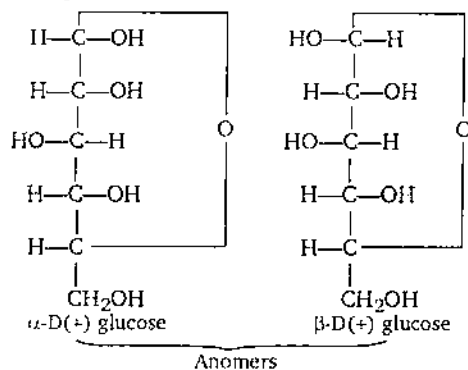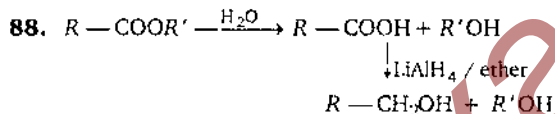$$R-CH_2OH + R'OH$$

According to above equation, it is clear that reduction of hydrolysed product of ester by $LiAlH_4$ gives two alcohols.

89. In $CH_2 = CH-CHO$ due to $-M$ effect of $-CHO$ group polarization of electron takes place as follows
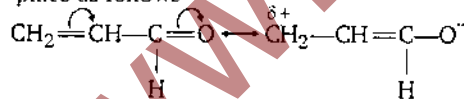
Hence, partial polarization is represented as

$$\overset{\delta+}{CH_2} = CH - CH = \overset{\delta-}{O}$$

90.
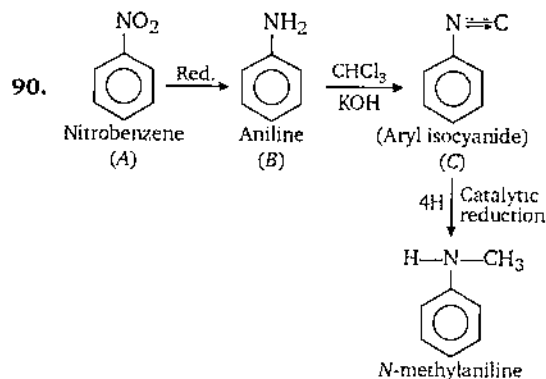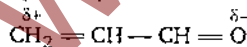
91. Stability of an alkene depends upon the heat of hydrogenation of an alkene. The lower the heat of hydrogenation of an alkene higher will be stability.

Order of stability

trans-2-butene > *cis*-2-butene > 1-butene.

Heat of hydrogenation (kJ/mol) are 115.5, 119.6 and 126.8 respectively.

92. Staggered form is produced when rear arrangement of $-CH_3$ groups is rotated as angle of $60°$ over front arrangement of $-CH_3$ group.
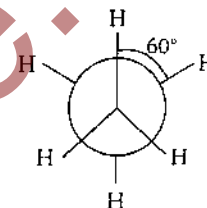
93. Resonance stabilization of phenoxide-ion.

$$C_2H_5-O-H \rightleftharpoons C_2H_5-O^- + H^+$$

stable   not stable (due to absence of resonance)
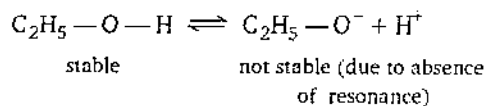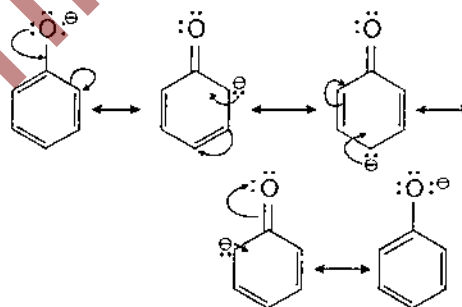
Phenoxide ion is more stable than ethoxide ion due to resonance. Therefore, the ionisation constant of phenol is higher than ethanol.

94. Bond energy of F_2, Cl_2 and Br_2 are 38, 57 and 45.5 kcal/mol respectively. So, the correct decreasing order of bond energy is—

$$Cl_2 > Br_2 > F_2$$
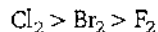
95. In $—CH_3$, $—OCH_3$ and CF_3, CH_3 and $—OCH_3$ are electron donating group. Hence, they activate the benzene nucleus. In these, order of activation is $—OCH_3 > —CH_3$ while $—CF_3$ group deactivates the benzene nucleus. So, it shows lower rate of electrophilic substitution on benzene ring. Thus, order of electrophilic substitution is–
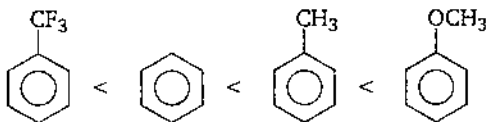
96. 'R' and 'S' forms of an optically active compounds differ in their behaviour towards plane polarised light. The species which rotate the plane of polarised towards right is called as 'R' form (*Rectus* form) or *d*-form (*dextro*-form) and the species which rotate the plane of polarised light towards left is known as *S*-form (*sinister* form) or *l*-form (*Laevo* form).

97. Ethyl benzoate is prepared by reacting benzoic acid and ethanol in presence of dry HCl. This reaction is known as esterification reaction.

$$\underset{\text{Benzoic acid}}{C_6H_5COOH} + \underset{\text{Ethanol}}{C_2H_5OH} \xrightarrow[\text{Dry}]{HCl}$$

$$\underset{\text{Ethyl benzoate}}{C_6H_5COOC_2H_5} + H_2O$$

98. $F_2C = CF_2$ is a monomer of well known plastic teflon, a material inert to almost all chemicals.

Teflon polymer

99. Thyroxine is a hormone secreted by thyroid gland. This hormone controls various biochemical reactions involving burning of proteins carbohydrates, fats to release energy.

100. Osmotic pressure is a colligative property which is used to find the molecular weight of polymer.
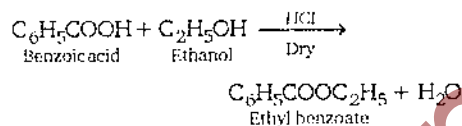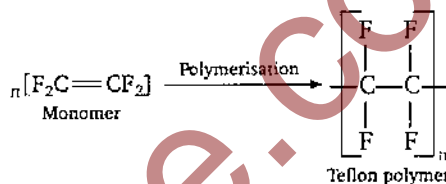
Biology

101. Biogeography is the study of the geographical distribution of life forms on earth. Darwin undertook a voyage on the ship HMS Beagle. The ship traversed the Southern Hemisphere where life is most abundant and varied. Along the way, Darwin found different forms of life very different from those in England. As he sailed southward along the South America, he found that similar species replaced each other. He thought that related species could have been modified according the environment. His views got confirmed on Galapagos islands (small group of volcanic islands off the Western coasts of South America). Darwin found different modified forms of finches which seemed to have descended from mainland finches as a result of the natural selection.

102. Mango belongs to family Anacardiacae,

orange to Rutaceae; wheat to Poaceae (= Graminae) while cotton (*Gossypium*) belongs to Malvaceae.

103. RBE (Relative Biological Effectiveness) is a comparison of the dose of the radiation being studied with the dose of standard radiation producing the same effect.

104. Phytoplanktons. diatoms and dinoflagellates are the dominant producers in the world's oceans. Diatoms tend to dominate in Northern waters while dinoflagellates are quite common in sub-tropical and tropical waters.

105. Viruses are made up of nucleic acid (DNA or RNA) + protein. Cellular organisation (cell membrane, protoplasm, ribosomes etc..) is not found. No metabolism occurs in viruses and hence, no enzymes are found (of course, some viruses have a few enzymes which help them penetrate the host). On the other hand, algae
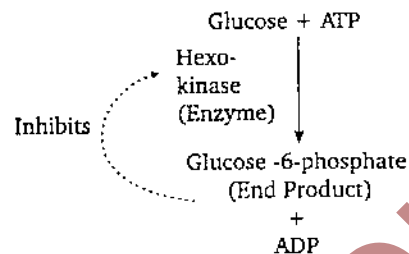
fungi and cyanobacteria have a variety of enzymes.

106. Herbarium is a collection of preserved plant material. Genome refers to total genetic material within a cell or individual. Gene library is the collection of DNA fragments. Gene banks (= world collections) are large collections of germ plasm representing materials from various parts of the world. In our country, NBPGR (National Bureau of Plant Genetic Resources), New Delhi is maintaining gene banks of different crops.

107. Conversion of CO_2 to simple (reduced) organic compounds is called **CO_2 assimilation** or **CO_2 fixation** or **carbon fixation**. This fixation pathway was elucidated in the early 1950s by **Melvin Calvin** and co-workers and is often called as **Calvin cycle**.

Since one molecule of carbon is fixed in one turn of the Calvin cycle. So, six turns of the cycle are required to fix the glucose molecule containing 6 carbon atoms.

108. CO_2 is fixed in the stroma of the chloroplast leading to the synthesis of PGA from which glyceraldehyde phosphate is formed. From glyceraldehyde phosphate, sugar and starch are formed. All these do not require light. However, photolysis of water and phosphorylation of ADP to ATP requires light energy.

109. The entire process of photosynthesis is driven by light energy comes from the Sun. This energy is first captured by chlorophyll molecules and later on utilized for the synthesis of ATP (chemical energy) molecules, which are later utilized in the dark reation i.e., Calvin cycle.

110. Glycogen, also known as "animal starch", is the chief polysaccharide store of animal cells and most of the fungi (though food is also stored as oil globules in some fungi).

Starch is a complex water insoluble polysaccharide carbohydrate chiefly found in green plants as their principal energy (food) source.

Glucose is the most widely distributed hexose sugar. It is an aldohexose reducing sugar. It is found in blood muscles and brain and works as energy fuel.

Sucrose is a non-reducing disaccharide consists of one glucose and one fructose molecules. It is one of the abundant transport sugar in plants.

111. In feedback inhibition, the product of an enzyme—catalysed reaction accumulates and acts as inhibitor of the reaction.

$$
\begin{array}{c}
\text{Glucose + ATP} \\
\downarrow \text{Hexo-} \\
\text{kinase} \\
\text{(Enzyme)} \\
\text{Glucose -6-phosphate} \\
\text{(End Product)} \\
+ \\
\text{ADP}
\end{array}
$$

Inhibits

112. Interferons (INFs) are a group of three vertebrate glyroproteins (α, β, γ). Out of these, two (α and β) are produced within virally infected cells. Interferon induces, among adjacent cells, as antiviral state by inducing synthesis of the enzymes which inhibit the viral production cycle.

113. **Karl von Frisch,** in 1940s, carried out many detailed experiments and determined that when a foraging bee returns to the hive, it performs a waggle dance. The number and pattern of waggles indicate the distance and direction of the food source. Honey is predominanty glucose and fructose (not arabinose). Bees wax is not excretory product. It is secreted by special wax glands to make compartments. *Apis indica* is a medium sized honey bee. A. *dorsata* is bigger while A. *florea* is smaller.

114. Lysosomes were discovered by **Christian de Duve** (1955) from rat liver. **Matile** (1964) discovered lysosomes in plants. Generally lysosomes are $0.2 - 0.8$ μ in size, irregular membranous vesicles filled with hydrolytic enzymes. They are polymorphic.

About 40 enzymes (all hydrolytic) are present in lysosomes. These include proteases, nucleases, glycosidases, lipases, phospholipases, phosphatases and sulfatases.

115. Black rust of wheat is caused by *Puccinia graminis tritici*.

This is the potential cause of enormous economic loss in all wheat growing regions of the world.

Puccinia graminis tritici usually passes its life cycle on two different hosts, wheat and barberry.

116. Dolly-the sheep was the first Mammal to be successfully cloned from an adults sheep cell at the Rosin Institute in Edinburgh, Scotland in February, 1997.

117. The family Hominids includes humans of today. These are the most intelligent of the hominoids. They are distinguished from the other families of hominoids in that they are **bipedal** *i. e.*, they walk upright on two legs. Hominids appeared during Pliocene but modern human *(Homo sapiens)* are believed to have arisen about 150,000 years back during Pleistocene.

118. Plasmids replicate autonomously. These carry a signal situated at their replication origin which determines how many copies are to be made and this number can be artificially increased for cloning a given gene.

119. *Agrobacterium tumefaciens* contains T_i (Tumour inducing) plasmid which can be transmitted between species of plants and is instrumental in genetic recombination naturally. It is called natural plant genetic engineer.

120. Enzymes enhance the rate of a reaction by just lowering the activation energy (the energy required for substances to react and get converted into product) of a reaction.
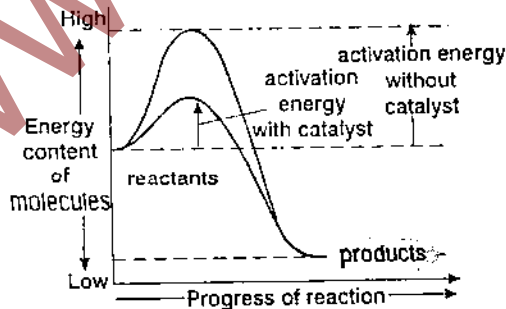
121. Wild plants have to survive without getting protection and for this, they evolve various strategies/characters which are exploited by plant breeders.

122. Transgenic mice (of much larger size than the normal) have been produced in the laboratory by transfer of genes to fertilized eggs as well as to stem cells.

123. Yeast *(Saccharomyces)* produces enzymes amylase, maltase and zymase. Amylase breaks down starch into maltose; Maltase converts maltose into glucose; glucose is converted by zymase to ethanol and CO_2.
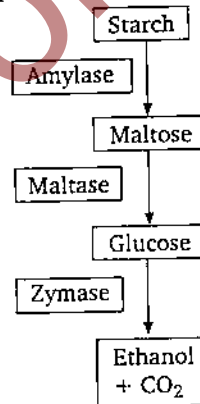
124. Singh (1977) has reported the use of *Azolla* as a precious green compost for rice cultivation.

The leaves of *Azolla* (water fern) contain upto 80,000 *Anabaena* which fix atmospheric nitrogen and make it available to *Azolla* which, in turn, makes it available to soil on decomposition.

125. The Lemurs are the inhabitants of Madagascar and the Comoro Islands.

Endangered species are those species whose population have been reduced to a critical level. So, they are near to extinction in near future.

126. A nucleotide contains (a) a 5-C sugar, (b) a phosphate molecule and (c) a nitrogenous base.

ATP is also a nucleotide. It also has a 5-C sugar (ribose), 3 phosphate molecules and a nitrogenous base (adenine).

The chemical structure of AMP, ADP and ATP

Adenine + sugar (ribose) ⟶ adenosine
Adenosine + 1 phosphate ⟶ adenosine monophosphate (AMP)
AMP + 1 phosphate ⟶ adenosine diphosphate (ADP)
ADP + 1 phosphate ⟶ adenosine triphosphate (ATP)
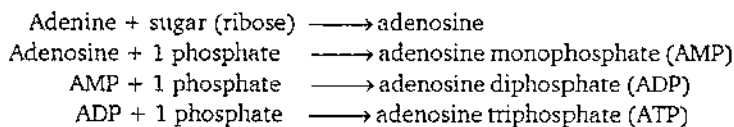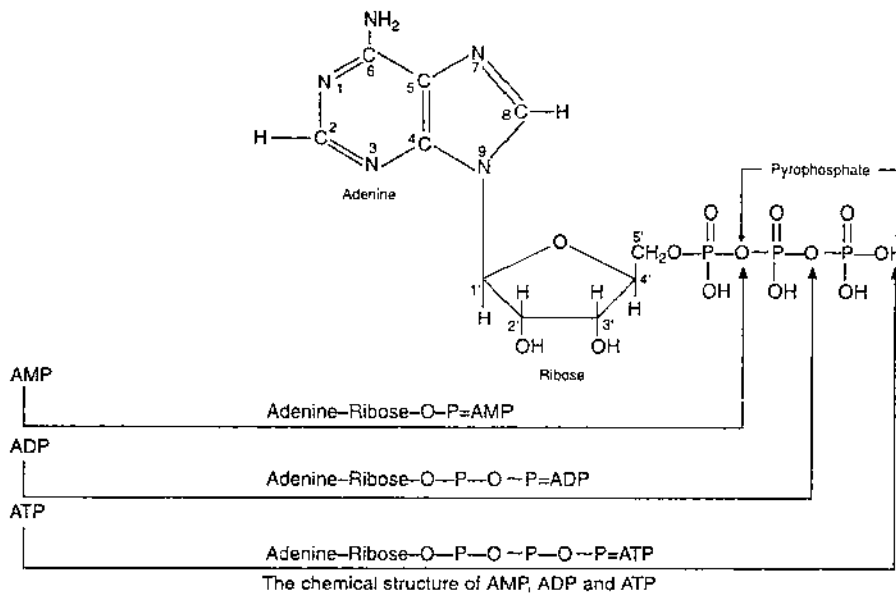
27. *Cycas* with largest antherozoids and ovule, and the largest plant *Sequoia* belong to gymnosperms.

Gymnosperm is a group of necked seeded plants *i.e.*, their ovules are not enclosed by ovary walls. Ovules of gymnosperms are directly borned on the megasporophyll.

28. Syphilis — *Treponema pallidum*
AIDS — HIV virus
Gonorrhoea — *Neisseria gonorrhoe*
Pyorrhoea — *Entamoeba gingivalis*
Anthrax — *Bacillus anthracis*
Urethritis — Inflammation of the urethra by bacteria

29. Removal of apical meristem leads to increase in cytokinin level of lateral buds. It stimulates cell division and completes vascular connection between axillary buds and transport stream. Now axillary buds get sufficient supply of IAA, cytokinin and other solutes so that these may develop into new shoots.

30. The proteins synthesized by the ribosomes bound to ER are passed into the lumen of ER where an oligosaccharide is added to them (*i.e.*, these are glycosylated).

131. The enzyme rennin coagulates casein, the soluble protein of the milk, into insoluble calcium salt of casein, which is then digested by the pepsin.

132. Structures or organs which are present in an organism in a diminished size but no longer useful are called **vestigial organ**.

About 90 vestigial organs have been reported from human body. These include coccyx (tail bone), third molar (wisdom teeth) and segmental muscles of abdomen.

133. Glycoproteins are proteins having at their *n*-terminal end a simple or complex sugar residue.

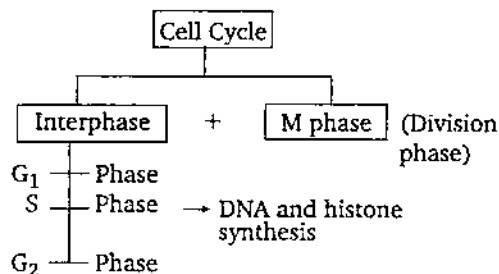Lipoproteins are proteins having lipid molecules.

Nucleic acid and proteins constitute nucleoprotein.

134. Sweat glands are coiled tubular glands situated in the dermis and connected to a sweat duct which open as pore on the surface of the skin. These secrete sweat which contains 0.1 to 0.4% of sodium chloride, sodium acetate and urea. Sweating occurs when the body temperature increases. As sweat evaporates

from the skin surface, energy is lost from the body as latent heat of evaporation; and this reduces body temperature.

135. Copper T is a small device made of copper, inserted into uterus by a doctor and left in place it prevents implantation. Of course, it may cause bleeding and discomfort.

136. A cell cycle is consisted of interphase and M phase or division phase. Interphase is consisted of 3 phases, G_1 phase, S phase and G_2 phase. In S phase syntheis of DNA and histone takes place.

```
                    Cell Cycle
                        |
          ┌─────────────┴─────────────┐
      Interphase    +    M phase   (Division
          |                           phase)
   G₁ ──┬── Phase
   S  ──┼── Phase  → DNA and histone
        │              synthesis
   G₂ ──┴── Phase
```

137. Mendel found that tallness, round shape of seed, yellow colour of seed, purple colour of flower, green colour of pod, inflated nature of pod and axial position of flower were dominant over dwarfness, wrinkled seed, green colour of seed, white colour of flower, yellow colour of pod, constricted nature of pod and terminal position of flower.

138. Geocarpy refers to ripening of fruits underground. In the case of groundnut, the young fruits are pushed into the soil as a result of post-fertilisation curvature of the stalk.

139. Pneumatophores are specialised roots which grow vertically upwards into the air from roots embedded in the mud. Since they are loosely constructed, these make gaseous exchange possible for submerged roots. These are found in plants growing in marshes or saline swamps.

140. Nitrogen is the constituent of amino acids, proteins, nucleic acids, nucleotides coenzymes, hexoamines etc. Deficiency of nitrogen repidly inhibits the plant growth and yellowing of the leaves (chlorosis) magnesium has the specific role in the activation of enzymes, taking part in photosynthesis, respiration. It also forms a part of the ring structure of the chlorophyll molecule. Deficiency of Mg causes chlorosis i.e., yellowing of leaves.

Deficiency of both Nitrogen and Magnesium causes chlorosis (yellowing of leaves).

Thus a plant growing in magnesium-deficient soil would show chlorosis inspite of being sprayed with urea (nitrogen).

141. Skoog (1954-1956) observed that coconut milk contained a substance which stimulated cell division. The substance was later on called cytokinin.

The most widely occurring cytokinin in plants is isopentanyladenine (IPA). IPA has been isolated from *Pseudomona tumefaciens*.

142. Members of Rhodophyceae (red algae) contain chlorophyll-a, d, r-phycoerythrin, r-phyco-cyanin α and β carotene pigments.

Members of Chlorophyceae (green algae) contain chlorophyll-a, b, β carotene pigments.

Members of Bacillariophyceae (diatoms) contain chlorophyll-a, c, β carotene, e-carotene pigments.

Members of Cyanophyceae (cyanobacteria, blue-green algae) contain chlorophyll-a, c-phycocyanin, c phycoerythrin, β carotene pigments.

143. 2 ATP are required during conversion of PGA to 1, 3 diphosphoglyceric acid and 1 ATP during conversion of glyceraldehyde phosphate to ribulose biphosphate. 2 $NADH_2$ molecules are utilized for converting 1, 3 diphosphoglyceric acid to glyceraldehyde phosphate.

144. In the ferns the sexual reproduction takes place through spores which are borned in sporangia. Sporangium is a diploid structure it bears diploid spore mother cells which undergo meiosis and produce haploid spores. Each spore contains an outer thick brown wall called exine and a thin innerwall called intine. Spore is the first cell of gametophyte. On germination, it gives rise to a haploid gametophytic stage.

145.

RRTt   rrtt   ..... (Parents)
(Red tall)   (White dwarf)

                    Fertilization
                         |
                         ↓

RT   Rt   rt   tt ..... Gametes

	rt	rt
RT	RrTt	RrTt
Rt	Rrtt	Rrtt
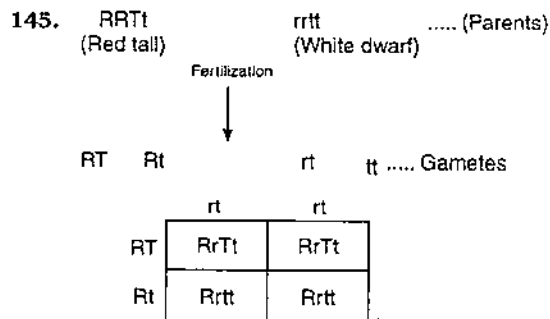
Phenotype of different plants is
(i) All plants contain red fruits.
(ii) 50% plants are tall with red fruits.
(iii) 50% plants are dwarf with red fruits.

146. Mutation is a sudden heritable change in the characteristics of an organisms. The individual shows these heritable changes is known as **mutant**.

Most mutations are recessive to wild-type alleles, normal gene product usually being produced in amounts sufficient for the function even though the allele is present in a single dose.

147. AUG acts as 'start' signal for intitiation of polypeptide chain synthesis. It codes for methionine.

148. Zinc is taken up by the plants in the form of Zn^{++}. It is required for biosynthesis of chlorophyll in some plants. Deficiency of Zn is shown by a reduction in internodal growth as a result plants display a rosette habit of growth in which the leaves form a circular cluster radiating at or close to the ground.

149. Though most of the protein synthesis occurs on the ribosomes in the cytoplasm, a number of proteins of the matrix and inner membrane of mitochondria are synthesised on the mitoribosomes (ribosomes present in the mitochondrion).

150. Reproduction is necessary for continuity of life. However, production of gametes is not only method for this. A number of organisms reproduce asexually. In any case, cell division is necessary which involves replication of DNA.

151. Viruses are non-cellular particulate entities. They cause various disease in living organisms. The only point favouring the virus as living entities is that they have the ability to reproduce (multiply) within the host by using host's machinery. The only point favouring the viruses as living entities is that they have the ability to reproduce (multiply)-though in the host using host's machinery.

152.

	DNA composition	RNA composition
(i)	Deoxyribose sugar	Ribose sugar
(ii)	Adenine, guanine (purine) and cytosine, thymine (pyrimidine), nitrogenous bases.	Adenine, guanine (purine) and uracil and cytosine (pyrimidine) nitrogenous bases.
(iii)	Phosphate molecules.	Phosphate molecules.
(iv)	It is polymer of nucleotides.	It is also polymer of nucleotides.
(v)	It is capable to replicate in all cases because it functions as heredity material.	It is formed from DNA by the process of transcription only in few cases (RNA viruses) it functions as heredity material as in viruses.

153. Kim *et. al.,* (1973) suggested L shape model of *t*-RNA by X-ray defraction while studying phenyl alanine *t*-RNA of yeast. L shape structure of *t*-RNA is a 3-dimentional (3D) structure of 20 Å thickness.

154. The basic structure (clover leaf, 2D) of *t*-RNA contains 3 loops and one lump.
The 'C$_3$' arm is called acceptor arm.
It has C—C—A at its one end that accepts amino acid and form aminoacyl *t*-RNA.
T Ψ C loop (or ribosomal binding site) binds with the ribosome.
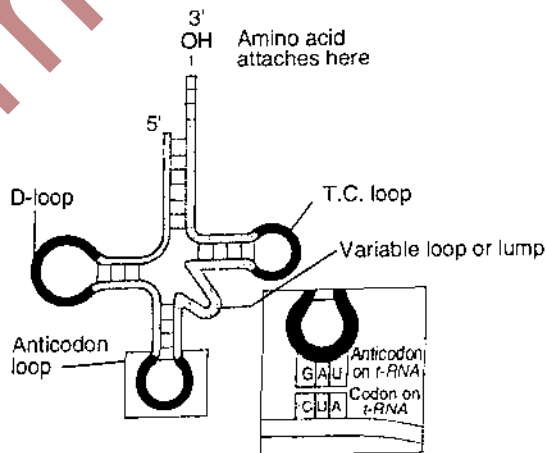
Position of anticodon on *t-RNA*

Anticodon loop has three specific base sequences making the code. This code pairs with the codon present on the m-RNA.

DHU loop binds amino acid synthetase. This is made up of 8-12 bases.

A lump is present between T Ψ C loop and anticodon loop.

155. Cytoplasmic genes plasmogens, cytogenes **extranuclear genes** or extrachromosomal genes are located in the cytoplasm or outside of the nucleus. The term **plasmon** is used to the sum total of genes present in the cytoplasm of a cell while the term **plastome** is used to the genes found in the plastids of a cell. Similarly the term **chondrione** is used to the some total of genes present in the mitochondria of a cell. All the available evidence indicate that extranuclear genes (DNA) are located in mitochondria and plastids of a cell.

156. Since each daughter DNA molecule contains one strand of the parent DNA double helix (only one strand synthesised afresh) the process of replication is called semiconservative.

Mathew Messelson and **Franklin Stahl** in 1958 proved experimentally that DNA replication is semi-conservative. To prove it they used N^{15} heavy DNA in a medium containing N^{14} isotope.

157. B-form of DNA shows right handed coiling which contains 10 base pairs in each turn. One complete turn of DNA occupies 34 Å distance so in nm it will 3.4 nm because

$$1\,nm = 10^{-9}\,m$$
$$1\text{Å} = 10^{-10}\,m$$
$$34\text{Å} = 34 \times 10^{-10}\,m$$
$$\text{or} \quad = 3.4 \times 10^{-9}\,m$$
$$\text{So,} \quad = 3.4\,nm.$$

158. During late prophase, specialised structures called kinetochores develop on either surface of the centromere. Chromosomal fibres get attached to kinetochore.

Chromomeres are beaded structures on the chromosomes which are found particularly at the prophase I (particularly at leptotene) of meiosis I.

Chromocentre is developed due to the fusion of centromeric regions of all the chromosomes of a cell.

Centrosome is found in animal cells (absent in plant cells). It is found near the nucleus. Each centrosome is made up of two centrioles and each centriole is a cylindrical structure with a diameter of 1500-1800 Å and is made up of nine fibrils.

The main function of centromere is at the time of cell division when the two centrioles separate and move to opposite poles. Aster and spindle are formed from it which help in the movement of chromatids.

159. Mongolism (Down's syndrome) is a congenital disorder of people; it is caused by trisomy of chromosome 21 (often by non-disjunction). The persons suffering from it are mentally retarded, have short body, swollen tongue and folded eyelids.

When sex chromosomes of male contain an extra copy of X-chromosome then this leads an abnormal condition i.e., syndrome called kilinefelter's syndrome.

Turner's syndrome is found due to absence of a sex chromosome (case of monosomy) which leaves only X-chromosome per cell (in human 44 + X).

160. In human beings, the presence of a Y-chromosome is required for the development of a male sex phenotype. X-chromosomes present in any number (XXX, XXXX) in the absence of a Y chromosome gives rise to female. Presence of even a single Y-chromosome confers maleness. In *Drosophila*, Y chromosome plays no significant role in sex determination. In *Drosophila* male determiners were localed on autosomes. One X and two autosomes produce male while two X (X, X) and two autosomes produce female.

161. Rhesus antibodies are formed in the plasma of Rh⁻ woman who have been pregnanted with Rh⁺ babies if the foetal blood leaks across the placenta during the birth of Rh⁺ baby. Later Rh⁺ foetuses would be at risk and may suffer from hemolysis.

162. Homeotic genes are control genes which either by getting expressed or by remaining silent during development, influence the differentiation of organs. These have been

found in insects, one nematode and some plants. A DNA sequence called homeobox, present in these genes, is involved in specification of organs. A mutation that causes a body part to develop in an appropriate position in an organism, is called homeotic mutation e.g., in *Drosophila*, such mutation may cause legs to develop on the head in place of antennae.

163. Ends of a chromosome are known as telomeres, these seal the ends of chromosomes and provide stability and individuality to a chromosome. The reason of telomere is made up of repeating sequence of 3′ TT AGGG 5′ in human.

164. The pineal gland (epiphysis) secretes the hormone melatonin which regulates the working of gonads by inhibiting gonadotrophins and their effects. Its production is inhibited by exposure of animal to light.

165. The great majority of T and B lymphocytes continuously circulate between the blood and lymph. These leave the blood stream, squeezing out between specialised endothelial cuts found in certain small vessels and enter various tissues including all the lymph nodes. After percolating through a tissue, these accumulate in small lymphatic vessels which connect to a series of lymph nodes, from where they ultimately enter the main lymphatic vessel (thoracic duct) which carries them back into the blood.

166. Pterygoid is a small bone articulated with the palatine.

167. The chief component of ground substance of cartiage is chondromucoprotein which is formed of chondriotin sulphate, karatan sulphate and hyaluronic acid.

168. Ornithine combines with one molecule of NH_3 and CO_2 to produce citrulline. Citrulline combines with another molecule of NH_3 to form arginine. Arginine is broken down into urea and Ornithine which repeats the cycle. This is called ornithine cycle or urea cycle or Kreb-Henseleit cycle.

169. Ethylene promotes ripening of fruits. It is also used to promote abscission of leaves, flowers and fruits in a variety of plants.

Zeatin is the first cytokinin hormone obtained from unripened maize grains or kernels by **Letham et. al.,**
Indole Acetic Acid (IAA) is a universal natural auxin hormone isolated by **Kogl et al.** (1934).
Naphthalene Acetic Acid (NAA) is the synthetic auxin.

170. Chimpanzees and gorillas are our closest relatives among the living primates.

171. Platypus *(Ornithorhynchus)* of Australia and Tasmania; and spiny ant eaters *(Tachyglossus, Zaglossus)* of Australia, Tasmania and New Guinea are members of the sub-class Prototheria of Mammalia which are oviparous (lay eggs).

172. Blastopore is the transitory opening on the surface of gastrula through which the internal cavity (archenteron) communicates with the exterior. It is formed by invagination of superficial cells during gastrulation.

173. Active transport is the energy-dependent transport of a substance across a cell membrane, accumulating it on the other side against the chemical or electrochemical gradient. It involves proton 'pumps' traversing the membrane and requires an appropriate energy supply.
Diffusion is the movement of molecules from their higher concentration to their lower concentration.
Pinocytosis is also known as cell drinking in which cell takes liquid material. It is a type of endocytosis.
Suspended particles in a colloidal system hit one another and are seen moving up and down, forward and backward. This movement is called **Brownian movement** or colloidal movement.

174. In annelids, the nephridia are the excererory organs. In earthworm, three types of nephridia are found—(i) septal, (ii) pharyngeal and (iii) integumentary. The septal nephridia do not discharge the excretory fluid to the exterior. Instead, these pour it into the intestine. Hence, these are also called enteronephric nephridia.

175. Urine is concentrated through counter current mechanism which involves (i) the loop of Henle, (ii) the vasa rectae, (iii) nearby collecting tubules and ducts, (iv) the interstitial fluid.

in the mesophyll cells. The primary acceptor of CO_2 is phosphoenol pyruvate (= PEP) which combines with CO_2 in the presence of PEP carboxylase to form oxaloacetic acid.

RuBP carboxylase is the primary CO_2 acceptor in C_3 **plants**.

Hydrogenase enzyme is common in micro organisms. It takes up or evolves gaseous O_2.

Reductase or dehydrogenase enzyme catalyzes the dehydrogenation or removal of hydrogen atoms (or electrons).

177. Main characteristics of phylum Chordata are as follows :
    1. Bilateral symmetry; segmented body; three germ layers; well developed coelom.
    2. **Notochord** (a skeletal rod) present at some stage in the life cycle.
    3. **Single, dorsal, tubular nerve cord;** anterior end of cord usually enlarged to form brain.
    4. **Pharyngeal pouches** present at some stage in the life cycle; in aquatic chordates these develop into gill slits.
    5. **Postanal tail,** usually projecting beyond the anus at some stage but may or may not persist.
    6. **Segmented muscles** in an unsegmented trunk.
    7. **Ventral heart,** with dorsal and ventral blood vessel; closed blood system.
    8. Complete digestive system.
    9. A cartilaginous or bony **endoskeleton** present in the majority of members (vertebrates).
    10. Presence of diaphragm is the characteristic feature of vertebrates e.g., Mammals.

178. The intermediate lobe (pars intermedium) of the pituitary gland secretes MSH which causes dispersal of pigment granules in the pigment cells (melanocytes) which give colour to the skin.
    In the frogs and tadpoles, MSH is responsible for the generalized blackening of the skin.

179. Evolution of modern man is accompanied by the reduction in length of jaw bones and teeth lines becoming semicircular instead of U-shaped.

180. When a nerve fibre is stimulated, its membrane becomes more permeable to sodium ions; hence, more sodium ions enter the axon than potassium ions leaving it. As a result, the positive and negative charges on the outside and inside of the membrane are reversed. The membrane with reversed polarity is called depolarised.
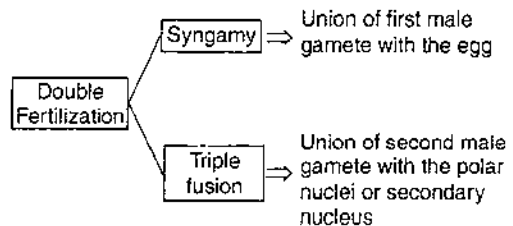
181. In maize, female inflorescence (cobs) are borne laterally at lower levels. The silk (style, stigma) of cobs protrude (project) beyond the protective leaves. The large and heavy pollen grains of maize fall down vertically from clusters of male inflorescences (tassels) to fertilize the cobs.

182. In many plants, the seed coats are quite tough and provide mechanical resistance to the growth of the embryos. Scarification by abrasion through machine, threshing, filing etc., is done to rupture or weaken the seed coat and promote germination.

183. Megapore is a haploid structure which divides and gives rise to embryo sac which is also called as female gametophyte.
    Eight-nucleate embryo sacs may be monosporic (e.g.. Polygonum); or bisporic (e.g., Allium); or tetrasporic (e.g., Adoxa).

184. **Nawaschin** (1898) was first to show that both the male gametes released by a pollen tube are involved in fertilization. Nucleus of one gamete fuses with egg nucleus (syngamy). Nucleus of the other gamete fuses with the polar nuclei or their fusion product (secondary nucleus). Most of the plants have two polar nuclei; hence second fertilization involves the fusion of three nuclei (triple fusion).

Double Fertilization → Syngamy ⇒ Union of first male gamete with the egg

Double Fertilization → Triple fusion ⇒ Union of second male gamete with the polar nuclei or secondary nucleus

185. Most contraceptive pills contain the hormones estrogen and progesterone. Progesterone, alongwith estrogen, disturbs the normal menstrual cycle to prevent ovulation. It inhibits the pituitary from secreting FSH and LH, which leads to blocking of ovulation.

186. The progressive division of cells during embryonic growth is called **cleavage**. it is not accompanied by any increase in the embryo's overall size.
The first cleavage occurs in human zygote about 30 hours after fertilization. It is holoblastic (complete) and gives rise to the blastomeres-one of which is slightly larger than the other.

187. Bovine Spongiform Encephalopathy (BSE) is a fatal brain disease known to exists in beef and other dairy cattle in UK. Also known as mad cow disease, it is believed to be caused by prions. Creutzfeldt-Jacob Disease (CJD) is a slow degenerative disease among human affecting central nervous system with dysfunction and degeneration of the brain. Some scientists have suggested that a few people in Britain might have contracted CJD by eating BSE-infected beef.

188. Cartilaginous joints are found between the centra of vertebrae; at pubic symphysis; and between ribs and sternum.
Fibrous joints are also called as sutures or immovable joints because in these joints the adjoining bones can not move upon each other e.g., Coronal suture between frontal and parietel bones of skull.
In gliding joints, two bones can slide upon each other. e.g., Joints between carpals in wrist.
In angular joints one bone is movable on another bone in two planes side to side and back and forth e.g., Wrist joints.

189. Both A. lumbricoides and A. stephensi; have different males and females; and it is possible to distinguish between them morphologically.

190. Anything which cannot be digested cannot serve as 'good'. Therefore, starch and lactose in the present case have been automatically deleted. Cellulose cannot be digested by human beings. thus option also stands rejected. Pancreatic juice can digest DNA which is the component of every cell.

191. Arteries have thick walls, narrow lumen but no valves. Endothelium is present in both arteries and veins.
Impure blood comes from different body organs, is first recieved by right auricle and from there it flows to right ventricle. Later flows impure blood through pulmonary artery and then to arteries to the lungs.

192. Scent or musk glands are located around the face, feet or anus of many mammals. These secrete pheromones which may be involved in defense, recognition and territorial behaviour.

193. From the procambium, (primary) xylem and phloem arise simultaneously.

194. Carrot and ripe papaya contain carotene from which vitamin A is yielded. Vitamin A is necessary for the formation of rhodopsin.
The visual pigments in vertebrate eyes are located in the tips of specialized sensory cells called **rod** and **cone cells**. Rod cells contain rhodopsin and are responsible for black and white vision.

195. In vertebrates, α-keratin (a protein) constitutes almost the entire dry weight of hair. Therefore, as the person ages, metabolism decreases, synthesis of protein decreases leading to thinning of hair.

196. An epithelium is a sheet or tube of firmly aderent cells with minimum (practically negligible) material and space between them.

197. For human beings, eight amino acids are essential : leucine, isoleucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine.

198. Severe diarrhoea, vomitting, watery stools are the chief symptoms of cholera. All these lead to dehydration. Actually, cholera toxin secreted by Vibrio cholerae causes, through a series of metabolic reactions, the continuous activation

of adenylate cyclase of intestinal epithelial cells. The resultant high concentration of cAMP triggers continual secretion of Cl^-, HCO_3^- and water into the lumen of the intestine. Administration of saline not only supports the sodium-potassium pump through which water in cell is restored, but glucose is also symported along with sodium.

199. When a bone is kept in dilute acid for a few days, the salts get dissolved, leaving only soft and flexible organic matrix (decalcification). If kept in KOH, it remains unaffected; only the surrounding mucles and connective tissue get dissolved so that the bone remains. If burnt, the organic matter burns off producing smoke and the ash (mineral matter) is left behind.

200. A variety of proteins are synthesized on ribosomes. However, these have different destinations. **David Sabatini** and **G. Blobel** proposed 'signal sequence' hypothesis according to which a short amino acid sequence at the amino terminus of a newly synthesized polypeptide directs a protein to its appropriate location sequence.

❏