CBSE

MEDICAL ENTRANCE

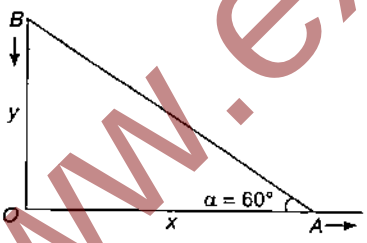
SOLVED PAPER 1998

Physics

1. The speed of a boat is 5 km/h in still water. It crosses a river of width 1.0 km along the shortest possible path in 15 min. The velocity of the river water is : (in km/h)

(a) 5 (b) 1
(c) 3 (d) 4

2. Two particles A and B are connected by a rigid rod AB. The rod slides along perpendicular rails as shown here. The velocity of A to the right is 10 m/s. What is the velocity of B when angle $\alpha = 60°$?



(a) 9.8 m/s (b) 10 m/s
(c) 5.8 m/s (d) 17.3 m/s

3. A mass of 1 kg is suspended by a thread. It is (i) lifted up with an acceleration 4.9 m/s^2, (ii) lowered with an acceleration 4.9 m/s^2. The ratio of the tensions is :

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

4. A car moving with a speed of 40 km/h can be stopped by applying brakes after atleast 2 m. If the same car is moving with a speed of 80 km/h, what is the minimum stopping distance ?

(a) 8 m (b) 2 m
(c) 4 m (d) 6 m

5. A force acts on a 3.0 g particle in such a way that the position of the particle as a function of time is given by $x = 3t - 4t^2 + t^3$, where x is in metre and t in second. The work done during the first 4 s is :

(a) 570 mJ (b) 450 mJ
(c) 490 mJ (d) 528 mJ

6. A bullet is fired from a gun. The force on the bullet is given by :

$$F = 600 - 2 \times 10^5 t$$

where F is in newton and t in second. The force on the bullet becomes zero as soon as it leaves the barrel. What is the average impulse imparted to the bullet ?

(a) 8 Ns (b) Zero
(c) 0.9 Ns (d) 1.8 Ns

7. Two equal masses m_1 and m_2 moving along the same straight line with velocities + 3 m/s and − 5 m/s respectively collide elastically. Their velocities after the collision will be respectively :

(a) + 4 m/s for both
(b) − 3 m/s and + 5 m/s
(c) − 4 m/s and + 4 m/s
(d) − 5 m/s and + 3 m/s

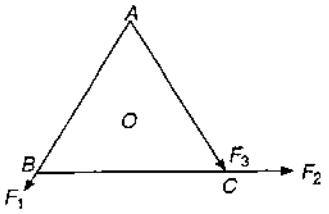
8. A 5000 kg rocket is set for vertical firing. The exhaust speed is 800 ms^{-1}. To give an initial upward acceleration of 20 m/s^2, the amount of gas ejected per second to supply the needed thrust will be : ($g = 10\ ms^{-2}$)

(a) 127.5 kg s^{-1} (b) 187.5 kg s^{-1}
(c) 185.5 kg s^{-1} (d) 137.5 kg s^{-1}

9. A ball of mass 0.25 kg attached to the end of a string of length 1.96 m is moving in a horizontal circle. The string will break if the tension is more than 25 N. What is the maximum speed with which the ball can be moved ?

(a) 14 m/s (b) 3 m/s
(c) 3.92 m/s (d) 5 m/s

10. O is the centre of an equilateral triangle ABC. F_1, F_2 and F_3 are three forces acting along the sides AB, BC and AC as shown in figure. What should be the magnitude of F_3 so that the total torque about O is zero ?



(a) $(F_1 + F_2)/2$ (b) $(F_1 - F_2)$
(c) $(F_1 + F_2)$ (d) $2(F_1 + F_2)$

11. A weightless ladder 20 ft long rests against a frictionless wall at an angle of 60° from the horizontal. A 150 pound man is 4 ft from the top of the ladder. A horizontal force is needed to keep it from slipping. Choose the correct magnitude of force from the following :
(a) 17.3 pound (b) 100 pound
(c) 120 pound (d) 150 pound

12. A thin circular ring of mass M and radius r is rotating about its axis with a constant angular velocity ω. Two objects each of mass m are attached gently to the opposite ends of diameter of the ring. The ring will now rotate with an angular velocity :
(a) $\frac{\omega(M - 2m)}{(M + 2m)}$ (b) $\frac{\omega M}{(M + 2m)}$
(c) $\frac{\omega M}{(M + m)}$ (d) $\frac{\omega(M + 2m)}{M}$

13. A rubber ball is dropped from a height of 5 m on a planet where the acceleration due to gravity is not known. On bouncing it rises to 1.8 m. The ball loses its velocity on bouncing by a factor of :
(a) $\frac{16}{25}$ (b) $\frac{2}{5}$
(c) $\frac{3}{5}$ (d) $\frac{9}{25}$

14. Two simple pendulums of length 0.5 m and 2.0 m respectively are given small linear displacement in one direction at the same time. They will again be in the same phase when the pendulum of shorter length has completed oscillations :
(a) 5 (b) 1
(c) 2 (d) 3

15. A mass m is vertically suspended from a spring of negligible mass; the system oscillates with a frequency n. What will be the frequency of the system, if a mass 4 m is suspended from the same spring ?
(a) $\frac{n}{4}$ (b) $4n$
(c) $\frac{n}{2}$ (d) $2n$

16. A particle, with restoring force proportional to displacement and resisting force proportional to velocity is subjected to a force $F \sin \omega t$. If the amplitude of the particle is maximum for $\omega = \omega_1$ and the energy of the particle is maximum for $\omega = \omega_2$, then :
(a) $\omega_1 = \omega_0$ and $\omega_2 \neq \omega_0$
(b) $\omega_1 = \omega_0$ and $\omega_2 = \omega_0$
(c) $\omega_1 \neq \omega_0$ and $\omega_2 = \omega_0$
(d) $\omega_1 \neq \omega_0$ and $\omega_2 \neq \omega_0$
where $\omega_0 \rightarrow$ natural angular frequency of oscillations of particle.

17. If the ratio of specific heat of a gas at constant pressure to that at constant volume is γ, the change in internal energy of a mass of gas, when the volume changes from V to $2V$ at constant pressure P is :
(a) $\frac{R}{(\gamma - 1)}$ (b) PV
(c) $\frac{PV}{(\gamma - 1)}$ (d) $\frac{\gamma PV}{(\gamma - 1)}$

18. We consider a thermodynamic system. If ΔU represents the increase in its internal energy and W the work done by the system, which of the following statements is true ?
(a) $\Delta U = -W$ in an adiabatic process
(b) $\Delta U = W$ in an isothermal process
(c) $\Delta U = -W$ in an isothermal process
(d) $\Delta U = W$ in an adiabatic process

19. The radiant energy from the sun, incident normally at the surface of earth is 20 kcal/m^2 min. What would have been the radiant energy, incident normally on the earth, if the sun had a temperature, twice of the present one ?
(a) 160 kcal/m^2 min
(b) 40 kcal/m^2 min
(c) 320 kcal/m^2 min
(d) 80 kcal/m^2 min

20. A transverse wave is represented by the equation

$$y = y_0 \sin \frac{2\pi}{\lambda}(vt - x)$$

For what value of λ is the maximum particle velocity equal to two times the wave velocity ?

(a) $\lambda = 2\pi y_0$ (b) $\lambda = \frac{\pi y_0}{3}$

(c) $\lambda = \frac{\pi y_0}{2}$ (d) $\lambda = \pi y_0$

21. A vehicle, with a horn of frequency n is moving with a velocity of 30 m/s in a direction perpendicular to the straight line joining the observer and the vehicle. The observer perceives the sound to have a frequency $n + n_1$. Then : (if the sound velocity in air is 300 m/s)

(a) $n_1 = 10\,n$ (b) $n_1 = 0$

(c) $n_1 = 0.1\,n$ (d) $n_1 = -0.1\,n$

22. In a sinusoidal wave, the time required for a particular point, to move from maximum displacement to zero displacement is 0.170 s. The frequency of the wave is :

(a) 1.47 Hz (b) 0.36 Hz

(c) 0.73 Hz (d) 2.94 Hz

23. A standing wave having 3 nodes and 2 antinodes is formed between two atoms having a distance 1.21 Å between them. The wavelength of the standing wave is :

(a) 1.21 Å (b) 1.42 Å

(c) 6.05 Å (d) 3.63 Å

24. A luminous object is placed at a distance of 30 cm from the convex lens of focal length 20 cm. On the other side of the lens, at what distance from the lens, a convex mirror of radius of curvature 10 cm, be placed in order to have an upright image of the object coincident with it ?

(a) 12 cm (b) 30 cm

(c) 50 cm (d) 60 cm

25. Light enters at an angle of incidence in a transparent rod of refractive index n. For what value of the refractive index of the material of the rod the light once entered into it will not leave it through its lateral face whatsoever be the value of angle of incidence ?

(a) $n > \sqrt{2}$ (b) $n = 1$

(c) $n = 1.1$ (d) $n = 1.3$

26. A point Q lies on the perpendicular bisector of an electrical dipole of dipole moment p. If the distance of Q from the dipole is r (much larger than the size of the dipole) then electric field at Q is proportional to :

(a) p^{-1} and r^{-2} (b) p and r^{-2}

(c) p^2 and r^{-3} (d) p and r^{-3}

27. A particle of mass m and charge q is placed at rest in a uniform electric field E and then released. The kinetic energy attained by the particle after moving a distance y is :

(a) qEy^2 (b) qE^2y

(c) qEy (d) q^2Ey

28. A hollow insulated conducting sphere is given a positive charge of 10 μC. What will be the electric field at the centre of the sphere if its radius is 2 m ?

(a) Zero (b) 5 μCm^{-2}

(c) 20 μCm^{-2} (d) 8 μCm^{-2}

29. Three equal resistors connected in series across a source of emf together dissipate 10 watt of power. What will be the power dissipated in watt if the same resistors are connected in parallel across the same source of emf ?

(a) 10/3 (b) 10

(c) 30 (d) 90

30. A 5°C rise in temperature is observed in a conductor by passing a current. When the current is doubled the rise in temperature will be approximately :

(a) 16°C (b) 10°C

(c) 20°C (d) 12°C

31. If nearly 10^5 C liberate 1 g equivalent of aluminium, then the amount of aluminium (equivalent weight 9) deposited through electrolysis in 20 min by a current of 50 amp will be :

(a) 0.6 g (b) 0.09 g

(c) 5.4 g (d) 10.8 g

32. A galvanometer having a resistance of 8 ohm is shunted by a wire of resistance 2 ohm. If the total current is 1 A, the part of it passing through the shunt will be :

(a) 0.25 A (b) 0.8 A

(c) 0.2 A (d) 0.5 A

33. A coil of one turn is made of a wire of certain length and then from the same length a coil of two turns is made. If the same current is passed in both the cases, then the ratio of the magnetic induction at their centres will be :

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

34. Two long parallel wires are at a distance of 1 m. Both of them carry one ampere of current. The force of attraction per unit length between the two wires is :
(a) 2×10^{-7} N/m (b) 2×10^{-8} N/m
(c) 5×10^{-8} N/m (d) 10^{-7} N/m

35. For protecting a sensitive equipment from the external magnetic field, it should be :
(a) placed inside an aluminium can
(b) placed inside an iron can
(c) wrapped with insulation around it when passing current through it
(d) surrounded with fine copper sheet

36. Two coils have a mutual inductance of 0.005 H. The current changes in the first coil according to equation $I = I_0 \sin \omega t$, where $I_0 = 10$A and $\omega = 100\ \pi$ rad/s. The maximum value of emf in the second coil is :
(a) 2π (b) 5π
(c) π (d) 4π

37. A step-up transformer operates on a 230 V line and supplies current of 2A to a load. The ratio of the primary and secondary windings is 1 : 25. The current in the primary coil is :
(a) 15 A (b) 50 A
(c) 25 A (d) 12.5 A

38. The 21 cm radio wave emitted by hydrogen in interstellar space is due to the interaction called the hyperfine interaction in atomic hydrogen. The energy of the emitted wave is nearly :
(a) 10^{-17} J (b) 1 J
(c) 7×10^{-6} J (d) 10^{-24} J

39. In the Bohr's model of a hydrogen atom, the centripetal force is furnished by the Coulomb attraction between the proton and the electron. If a_0 is the radius of the ground state orbit, m is the mass and e is the charge on the electron, ε_0 is the vacuum permittivity, the speed of the electron is :
(a) zero (b) $\dfrac{e}{\sqrt{\varepsilon_0 a_0 m}}$
(c) $\dfrac{e}{\sqrt{4\pi\varepsilon_0 a_0 m}}$ (d) $\dfrac{\sqrt{4\pi\varepsilon_0 a_0 m}}{e}$

40. Light of wavelength 5000 Å falls on a sensitive plate with photoelectric work function of 1.9 eV. The kinetic energy of the photoelectron emitted will be :
(a) 0.58 eV (b) 2.48 eV
(c) 1.24 eV (d) 1.16 eV

41. In a photo-emissive cell, with exciting wavelength λ, the fastest electron has speed v. If the exciting wavelength is changed to $3\lambda/4$, the speed of the fastest emitted electron will be :
(a) $v\,(3/4)^{1/2}$
(b) $v\,(4/3)^{1/2}$
(c) less than $v\,(4/3)^{1/2}$
(d) greater than $v\,(4/3)^{1/2}$

42. Half-lives of two radioactive substances A and B are respectively 20 min and 40 min. Initially the samples of A and B have equal number of nuclei. After 80 min the ratio of remaining number of A and B nuclei is :
(a) 1 : 16 (b) 4 : 1
(c) 1 : 4 (d) 1 : 1

43. Atomic weight of boron is 10.81 and it has two isotopes $^{10}_{5}B$ and $^{11}_{5}B$. Then, the ratio of atoms of $^{10}_{5}B$ and $^{11}_{5}B$ in nature would be :
(a) 19 : 81 (b) 10 : 11
(c) 15 : 16 (d) 81 : 19

44. A nucleus ${}_nX^m$ emits one α and two β particles. The resulting nucleus is :
(a) ${}_nX^{m-4}$ (b) ${}_{n-2}Y^{m-4}$
(c) ${}_{n-4}Z^{m-4}$ (d) none of these

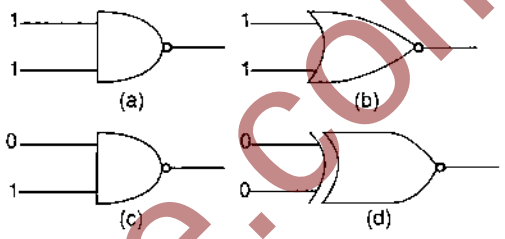
45. Complete the equation for the following fission process :
${}_{92}U^{235} + {}_0n^1 \longrightarrow {}_{38}Sr^{90} + \ldots\ldots$
(a) ${}_{54}Xe^{143} + 3\,{}_0n^1$
(b) ${}_{54}Xe^{145}$
(c) ${}_{57}Xe^{142}$
(d) ${}_{54}Xe^{142} + {}_0n^1$

46. The cause of the potential barrier in a p n diode is :
(a) depletion of positive charges near the junction
(b) concentration of positive charges near the junction
(c) depletion of negative charges near the junction
(d) concentration of positive and negative charges near the junction

47. A semi-conducting device is connected in a series in circuit with a battery and a resistance. A current is allowed to pass through the circuit. If the polarity of the battery is reversed, the current drops to almost zero. The device may be :
(a) a *p-n* junction
(b) an intrinsic semiconductor
(c) a *p*-type semiconductor
(d) an *n*-type semiconductor

48. The transfer ratio β of a transistor is 50. The input resistance of the transistor when used in the common emitter configuration is 1 kΩ. The peak value of the collector AC current for an AC input voltage of 0.01 V peak is :
(a) 100 μA (b) 0.01 mA
(c) 0.25 mA (d) 500 μA

49. Which one of the following gates will have an output of 1 ?



(a) A (b) B (c) C (d) D

50. The truth table given below is for which gate ?

Input		Output
A	B	C
0	0	1
0	1	1
1	0	1
1	1	0

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

Chemistry

51. Given the number, 161 cm, 0.161 cm. 0.0161 cm. The number of significant figures for the three numbers is :
(a) 3, 4 and 5, respectively
(b) 3, 4 and 4, respectively
(c) 3, 3 and 4, respectively
(d) 3, 3 and 3, respectively

52. Haemoglobin contains 0.33% of iron by weight. The molecular weight of haemoglobin is approximately 67200. The number of iron atoms (at. wt. of Fe is 56) present in one molecule of haemoglobin are :
(a) 1 (b) 6
(c) 4 (d) 2

53. Bohr radius for the hydrogen atom ($n = 1$) is approximately 0.530Å. The radius for the first excited state ($n = 2$) orbit is (in Å) :
(a) 0.13 (b) 1.06
(c) 4.77 (d) 2.12

54. The position of both, an electron and a helium atom is known within 1.0 nm. Further the momentum of the electron is known within 5.0×10^{-26} kg ms^{-1}. The minimum uncertainty in the measurement of the momentum of the helium atom is :
(a) 50 kg ms^{-1}
(b) 80 kg ms^{-1}
(c) 80×10^{-26} kg ms^{-1}
(d) 5.0×10^{-26} kg ms^{-1}

55. Which one is not paramagnetic among the following ?
[Atomic number : Be = 4, Ne = 10, As = 33, Cl = 17]
(a) Cl^- (b) Be
(c) Ne^{2+} (d) As^-

56. Number of neutrons in a parent nucleus X, which gives $_7N^{14}$ nucleus after two successive β-emmissions would be :
(a) 9 (b) 6
(c) 7 (d) 8

57. In PO_4^{3-} ion, the formal charge on each oxygen atom and P—O bond order respectively are :
(a) – 0.75, 0.6
(b) – 0.75, 1.0
(c) – 0.75, 1.25
(d) – 3, 1.25

58. The number of anti-bonding electrons in O_2^{2-} molecular ion on the basis of molecular orbital theory is (Atomic no. of O is 8) :
(a) 5 (b) 2
(c) 4 (d) 6

59. Schottky defect in crystals is observed when :
(a) an ion leaves its normal site and occupies an interstitial site
(b) unequal number of cations and anions are missing from the lattice
(c) density of the crystal is increased
(d) equal number of cations and anions are missing from the lattice

60. The edge length of face centred unit cubic cell is 508 pm. If the radius of the cation is 110 pm, the radius of the anion is :
(a) 288 pm (b) 398 pm
(c) 144 pm (d) 618 pm

61. The second order Bragg diffraction of X-rays with $\lambda = 1.0$Å from a set of parallel planes in a metal occurs at an angle 60°. The distance between the scattering planes in the crystals is :
(a) 0.575 Å (b) 1.00 Å
(c) 2.00 Å (d) 1.17 Å

62. In crystals of which of the following ionic compounds would you expect maximum distance between centres of cations and anions ?
(a) LiF (b) CsF
(c) CsI (d) LiI

63. An organic compound containing C, H and N gave the following results on analysis C = 40%, H = 13.33%, N = 46.67%. Its empirical formula would be :
(a) $C_2H_7N_2$ (b) CH_5N
(c) CH_4N (d) C_2H_7N

64. A 5% solution of cane sugar (mol. wt. = 342) is isotonic with 1% solution of a substance X. The molecular weight of X is :
(a) 34.2 (b) 171.2
(c) 68.4 (d) 136.8

65. The vapour pressure of a solvent decreased by 10 mm in two columns of mercury when a non-volatile solute was added to the solvent. The mole fraction of the solute in the solution is 0.2. What should be the mole fraction of the solvent if the decrease in the vapour pressure is to be 20 mm of mercury ?
(a) 0.8 (b) 0.6
(c) 0.4 (d) 0.2

66. If K_1 and K_2 are the respective equilibrium constants for the two reactions :
$XeF_6(g) + H_2O(g) \rightleftharpoons XeOF_4(g) + 2HF(g)$
$XeO_4(g) + XeF_6(g) \rightleftharpoons XeOF_4(g) + XeO_3F_2(g)$
the equilibrium constant of the reaction
$XeO_4(g) + 2HF(g) \rightleftharpoons XeO_3F_2(g) + H_2O(g)$
will be :
(a) $K_2/(K_2)^2$
(b) $K_1 \cdot K_2$
(c) K_1/K_2
(d) K_2/K_1

67. In the reaction
$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(l)$
when 1 mole of ammonia and 1 mole of O_2 are made to react to completion then :
(a) 1.0 mole of H_2O is produced
(b) 1.0 mole of NO will be produced
(c) all the oxygen will be consumed
(d) all the ammonia will be consumed

68. Identify the correct statement regarding entropy :
(a) At absolute zero temperature, entropy of a perfectly crystalline substance is taken to be zero
(b) At absolute zero of temperature the entropy of a perfectly crystalline substance is +ve
(c) At absolute zero of temperature the entropy of all crystalline substance is to be zero
(d) At 0°C, the entropy of a perfectly crystalline substance is taken to be zero

69. Activation energy of a chemical reaction can be determined by :
(a) evaluating rate constant at standard temperature
(b) evaluating velocities of reaction at two different temperatures
(c) evaluating rate constants at two different temperatures
(d) changing concentration of reactants

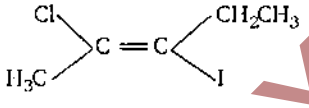
70. One mole of an ideal gas at 300K is expanded isothermally from an initial volume of 1 L to 10L. The ΔE for this process is (R = 2 cal $mol^{-1}K^{-1}$) :
(a) 163.7 cal
(b) zero
(c) 1381.1 cal
(d) 9 L atm

71. For the cell reaction,
$Cu^{2+}(C_1\ aq) + Zn(s) \rightleftharpoons Zn^{2+}(C_2\ aq) + Cu(s)$
of an electrochemical cell. The change in free energy (ΔG) at a given temperature is a function of :
(a) ln (C_1) (b) ln (C_2 / C_1)
(c) ln (C_2) (d) ln ($C_1 + C_2$)

72. Without losing its concentration $ZnCl_2$ solution cannot be kept in contact with :
(a) Au (b) Al
(c) Pb (d) Ag

73. At the critical micelle concentration (cmc) the surfactant molecules :
(a) decompose
(b) dissociate
(c) associate
(d) become completely soluble

74. IUPAC name of the compound



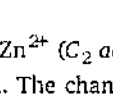
(a) *trans*-3 iodo- 4 chloro-3-pentene
(b) *cis*-2-chloro-3-iodo-2-pentene
(c) *trans*-2-chloro-3-iodo-2-pentene
(d) *cis*-3-iodo-4-chloro-3-pentene

75. Which of the following compounds is not chiral ?
(a) $DCH_2CH_2CH_2Cl$ (b) CH_3CH_2CHDCl
(c) CH_3CHDCH_2Cl (d) $CH_3CHClCH_2D$

76. Which one of the following orders is correct regarding the –I effect of the substituents ?
(a) $-NR_2 < -OR > -F$
(b) $-NR_2 > -OR > -F$
(c) $-NR_2 < -OR < -F$
(d) $-NR_2 > -OR < -F$

77. Which one of the following compounds is resistant to nucleophilic attack by hydroxyl ions ?
(a) Methyl acetate (b) Acetonitrile
(c) Dimethyl ether (d) Acetamide

78. 2-bromopentane is heated with potassium ethoxide in ethanol. The major product obtained is :
(a) 2-ethoxypentane
(b) pentene-1
(c) *trans*-pentene-2
(d) *cis*-pentene-2

79. Reaction of  with *R*MgX leads to formation of :
(a) *R*CHOH*R* (b) *R*CHOHCH$_3$
(c) RCH_2CH_2OH (d) $CHCH_2OH$

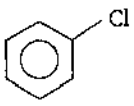
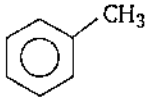
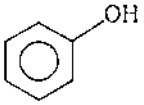
80. Glucose molecule reacts with '*X*' number of molecules of phenylhydrazine to yield osazone. The value of '*X*' is :
(a) four (b) one
(c) two (d) three

81. Iodoform test is not given by :
(a) 2-pentanone
(b) ethanol
(c) ethanal
(d) 3-pentanone

82. An ester (*A*) with molecular formula $C_9H_{10}O_2$ was treated with excess of CH_3MgBr and the complex so formed was treated with H_2SO_4 to give an olefin (*B*). Ozonolysis of (*B*) gave a ketone with molecular formula C_8H_8O which shows +ve iodoform test. The structure of (*A*) is :
(a) $C_6H_5COOC_2H_5$
(b) $C_6H_5COOC_6H_5$
(c) $H_3COCH_2COC_6H_5$
(d) $p-H_3CO-C_6H_4-COCH_3$

83. Which one of the following esters cannot undergo Claisen self-condensation ?
(a) $CH_3CH_2CH_2CH_2COOC_2H_5$
(b) $C_6H_5COOC_2H_5$
(c) $C_6H_5CH_2COOC_2H_5$
(d) $C_6H_{11}CH_2COOC_2H_5$

84. Which one of these, is not compatible with arenes ?
(a) Greater stability
(b) Delocalisation of π-electrons
(c) Electrophilic additions
(d) Resonance

85. Which one of the following compounds will be most easily attacked by an electrophile ?
(a) 
(b) 
(c) 
(d) 

86. Aniline is reacted with bromine water and the resulting product is treated with an aqueous solution of sodium nitrite in presence of dilute hydrochloric acid. The compound so formed is converted to a tetrafluoroborate which is subsequently heated. The final product is :
(a) 1, 3, 5-tribromobenzene
(b) *p*-bromofluorobenzene
(c) *p*-bromoaniline
(d) 2, 4, 6-tribromofluorobenzene

87. Aspirin is an acetylation product of :
(a) *o*-hydroxybenzoic acid
(b) *o*-hydroxybenzene
(c) *m*-hydroxybenzoic acid
(d) *p*-dihydroxybenzene

88. The number of molecules of ATP produced in the lipid metabolism of a molecule of palmitic acid is :
(a) 130 (b) 36
(c) 56 (d) 86

89. In DNA the complementary bases are :
(a) adenine and thymine, guanine and cytosine
(b) uracil and adenine, cytosine and guanine
(c) adenine and guanine, thymine and cytosine
(d) adenine and thymine, guanine and uracil

90. The first ionization potential (in eV) of Be and B, respectively are :
(a) 8.29, 9.32 (b) 9.32, 9.32
(c) 8.29, 8.29 (d) 9.32, 8.29

91. The total number of possible isomers for the complex compound $[Cu^{II}(NH_3)_4][Pt^{II}Cl_4]$
(a) 3 (b) 6
(c) 5 (d) 4

92. IUPAC name of $[Pt(NH_3)_3(Br)(NO_2)Cl]Cl$ is :
(a) Triammine chlorobromonitro platinum (IV) chloride
(b) Triammine bromonitrochloro platinum (IV) chloride
(c) Triammine bromochloronitro platinum (IV) chloride
(d) Triammine nitrochlorobromo platinum (IV) chloride

93. A co-ordination complex compound of cobalt has the molecular formula containing five ammonia molecules, one nitro group and two chlorine atoms for one cobalt atom. One mole of this compound produces three mole ions in an aqueous solution. On reacting this solution with excess of $AgNO_3$ solution, we get two moles of AgCl precipitate. The ionic formula for this complex would be :
(a) $[Co(NH_3)_4(NO_2)Cl][(NH_3Cl]$
(b) $[Co(NH_3)Cl][Cl(NO_2)]$
(c) $[Co(NH_3)_5(NO_2)]Cl_2$
(d) $[Co(NH_3)_5][(NO_2)_2Cl_2]$

94. Which one of the following elements shows maximum number of different oxidation states in its compounds ?
(a) Eu (b) La
(c) Gd (d) Am

95. Which one of the following elements constitutes a major impurity in pig iron ?
(a) Silicon
(b) Oxygen
(c) Sulphur
(d) Graphite

96. When a substance *A* reacts with water it produces a combustible gas *B* and a solution of substance *C* in water. When another substance *D* reacts with this solution of *C*, it also produces the same gas *B* on warming but *D* can produce gas *B* on reaction with dilute sulphuric acid at room temperature. '*A*' imparts a deep golden yellow colour to a smokeless flame of bunsen burner *A*, *B*, *C*, and *D*, respectively are :
(a) Na, H_2, NaOH, Zn
(b) K, H_2, KOH, Al
(c) CaH_2, $Ca(OH)_2$, Sn
(d) CaC_2, C_2H_2, $Ca(OH)_2$, Fe

97. Which one of the following pairs of substances on reaction will not evolve H_2 gas ?
(a) Iron and H_2SO_4 (aqueous)
(b) Iron and steam
(c) Copper and HCl (aqueous)
(d) Sodium and ethyl alcohol

98. A one litre flask is full of brown bromine vapour. The intensity of brown colour of vapour will not decrease appreciably on adding to the flask some :
(a) pieces of marble
(b) animal charcoal powder
(c) carbon tetrachloride
(d) carbon disulphide

99. Repeated use of which one of the following fertilizers would increase the acidity of the soil ?
(a) Urea
(b) Superphosphate of lime
(c) Ammonium sulphate
(d) Potassium nitrate

100. Which one of the following ionic species w impart colour to an aqueous solution ?
(a) Ti^{4+} (b) Cu^{+}
(c) Zn^{2+} (d) Cr^{3+}

Biology

101. The reason why vagetatively reproducing crop plants are best suited for maintaining hybrid vigour is that :
(a) they can be easily propagated
(b) they have a longer life span
(c) they are more resistant to dieases
(d) once a desired hybrid is produced, there are no chances of losing it

102. An adult human with average health has systolic and diastolic pressures as :
(a) 80 mm Hg and 80 mm Hg
(b) 70 mm Hg and 120 mm Hg
(c) 120 mm Hg and 80 mm Hg
(d) 50 mm Hg and 80 mm Hg

103. The formation of multivalents at meiosis in diploid organism is due to :
(a) monosomy
(b) inversion
(c) deletion
(d) reciprocal translocation

104. In the developmental history of mammalian heart, it is observed that it passes through a two-chambered fish-like heart, three chambered frog-like heart and finally four-chambered stage. To which hypothesis can this above cited statement be approximated ?
(a) Biogenetic law
(b) Hardy-Weinberg law
(c) Lamarck's principle
(d) Mendelian principles

105. Which of the following is the contractile protein of a muscle ?
(a) Tubulin (b) Myosin
(c) Tropomyosin (d) All of these

106. Which of the micro-organisms is used f production of citric acid in industries ?
(a) *Lactobacillus bulgaris*
(b) *Pencillium citrinum*
(c) *Aspergillus niger*
(d) *Rhizopus nigricans*

107. Which of the following is not main function lymph glands ?
(a) Forming WBC (b) Forming antibodi
(c) Forming RBC (d) Destroying bacter

108. In mammals, histamine is secreted by :
(a) fibroblasts (b) histocytes
(c) lymphocytes (d) mast cells

109. Which one of the following organisms is us as indicator of water quality ?
(a) *Beggiatoa* (b) *Chlorella*
(c) *Azospirillum* (d) *Escherichia*

110. Transfusion tissue is present in the leaves o
(a) *Dryopteris* (b) *Cycas*
(c) *Pinus* (d) Both (b) and (c)

111. The hormone that stimulates the stomach secrete gastric juice is :
(a) gastrin (b) renin
(c) enterokinase (d) enterogastrone

112. Phytochrome becomes active in :
(a) green light (b) blue light
(c) red light (d) none of these

113. Which one of the following statements ab *Cycas* is incorrect ?
(a) It roots contain some blue-green algae
(b) It does not have a well organized fen flower
(c) It has circinate vernation
(d) Its xylem is mainly composed of xy vessel

14. Plants such as *Prosopis, Acacia* and *Capparis* represent examples of tropical :
(a) grass lands
(b) thorn forests
(c) deciduous forests
(d) evergreen forests

15. The rate at which light energy is converted into chemical energy of organic molecules is the ecosystem's :
(a) net primary productivity
(b) gross secondary productivity
(c) net secondary productivity
(d) gross primary productivity

16. The layer of cells that secrete enamel of tooth is :
(a) dentoblast (b) ameloblast
(c) osteoblast (d) odontoblast

17. Which one among the following chemicals is used for causing defoliation of forest trees ?
(a) Amo-1618 (b) Phosphon-D
(c) Malic hydrazide (d) 2, 4-D

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

19. One of the factors required for the maturation of erythrocytes is :
(a) vitamin D (b) vitamin A
(c) vitamin B_{12} (d) vitamin C

20. The hormone which regulates the basal metabolism in our body is secreted from :
(a) pituitary (b) thyroid
(c) adrenal cortex (d) pancreas

21. Loss of an X-chromosome in a particular cell, during its development, results into :
(a) diploid individual
(b) triploid individual
(c) gynandromorphs
(d) both 'a' and 'b'

22. Yeast *(Saccharomyces cerevisiae)* is used the industrial production of :
(a) butanal
(b) citric acid
(c) tetracycline
(d) ethanol

123. Which important green-house gas, other than CO_2, is being produced from the agricultural fields ?
(a) Arsine (b) Sulphur dioxide
(c) Ammonia (d) Nitrous oxide

124. Carbon mono-oxide is a pollutant because :
(a) it reacts with O_2
(b) it inhibits glycolysis
(c) reacts with haemoglobin
(d) makes nervous system inactive

125. A plant hormone used for inducing morphogenesis in plant tissue culture is :
(a) abscisic acid (b) gibberellins
(c) cytokinins (d) ethylene

126. The exchange of gases in the alveoli of the lungs takes place by :
(a) osmosis (b) simple diffusion
(c) passive transport (d) active transport

127. If there was no CO_2 in the earth's atmosphere the temperature of earth's surface would be :
(a) same as present
(b) less than the present
(c) higher than the present
(d) dependent on the amount of oxygen in the atmosphere

128. When a single gene influences more than one traits it is called :
(a) pleiotropy
(b) epistasis
(c) pseudodominance
(d) none of these

129. The role of double fertilization in angiosperms is to produce :
(a) endosperm (b) integuments
(c) cotyledons (d) endocarp

130. Total number of bones in the hind limb of a man is :
(a) 14 (b) 21
(c) 24 (d) 30

131. If Mendel had studied the seven traits using a plant with 12 chromosomes instead of 14, in what way would his interpretation have been different ?
(a) He would have mapped the chromosome
(b) He would have discovered blending or incomplete dominance
(c) He would not have discovered the law of independent assortment
(d) He would have discovered sex linkage

132. The lower jaw in mammals is made up of :
(a) angulars (b) mandible
(c) dentary (d) maxills

133. Botulism caused by *Clostridium botulinum* affects the :
(a) spleen
(b) intestine
(c) lymph glands
(d) neuromuscular junction

134. Which of the following is non-symbiotic biofertilizer ?
(a) VAM (b) *Azotobacter*
(c) *Anabaena* (d) *Rhizobium*

135. The most important component of the oral contraceptive pills is :
(a) progesterone
(b) growth hormone
(c) thyroxine
(d) luteinizing hormone

136. The contraction of gall bladder is due to :
(a) gastrin (b) secretin
(c) cholecystokinin (d) enterogastrone

137. Microtubule is involved in the :
(a) cell division
(b) DNA recognition
(c) muscle contraction
(d) membrane architecture

138. Which base is responsible for hot spots for spontaneous point mutations ?
(a) Guanine (b) Adenine
(c) 5-bromouracil (d) 5-methylcytosine

139. The age of the fossil of *Dryopithecus* on the geological time scale is :
(a) 75×10^6 years back
(b) 25×10^6 years back
(c) 2.5×10^6 years back
(d) 50×10^6 years back

140. A sewage treatment process in which a portion of the decomposer bacteria present in the waste is recycled into the beginning of the process, is called :
(a) cyclic treatment
(b) primary treatment
(c) activated sludge treatment
(d) tertiary treatment

141. Floral features are chiefly used in angiosperms identification because :
(a) flowers are nice to work with
(b) flowers are of various colours
(c) flowers can be safely pressed
(d) reproductive parts are more stable and conservative than vegetative parts

142. Calcitonin is a thyroid hormone which :
(a) elevates potassium level in blood
(b) lowers calcium level in blood
(c) elevates calcium level in blood
(d) has no effect on calcium

143. A bacterium divides every 35 minutes. If a culture containing 10^5 cells per ml is grown for 175 minutes, what will be the cell concentration per ml after 175 minutes ?
(a) 175×10^5 cells (b) 85×10^5 cells
(c) 35×10^5 cells (d) 32×10^5 cells

144. Mental retardation in man, associated with sex chromosomal abnormality is usually due to :
(a) reduction in X complement
(b) increase in X complement
(c) moderate increase in Y complement
(d) large increase in Y complement

145. Which of the following meristems is responsible for extrastelar secondary growth in dicotyledonous stem ?
(a) Phellogen
(b) Intra-fascicular cambium
(c) Inter-fascicular cambium
(d) Inter-calary meristem

146. Lactose is composed of :
(a) glucose + fructose
(b) glucose + glucose
(c) glucose + galactose
(d) fructose + galactose

147. *Puccinia* forms :
(a) uredia and pycnia on barberry leaves
(b) uredia and aecia on wheat leaves
(c) uredia and telia on wheat leaves
(d) uredia and aecia on barberry leves

148. Radioactive thymidine when added to the medium surrounding living mammalian cells gets incorporated into the newly synthesised DNA. Which of the following types of chromatin is expected to become radioactive if cells are exposed to radioactive thymidine as soon as they enter the S phase ?
(a) Neither heterochromatin nor euchromatin but only the nucleolus
(b) Heterochromatin
(c) Euchromatin
(d) Both (b) and (c)

149. Cellulose, the most important constituent of plant cell wall is made up of :
(a) branched chain of glucose molecules linked by α, 1, 6 glycosidic bond at the site of branching
(b) unbranched chain of glucose molecules linked by α, 1, 4 glycosidic bond
(c) branched chain of glucose molecules linked by β, 1, 4 glycosidic bond in straight chain and α, 1, 6 glycosidic bond at the site of branching
(d) unbranched chain of glucose molecules linked by β, 1, 4 glycosidic bond

150. Which of the following pesticides is an acetylcholinesterase inhibitor ?
(a) Aldrin (b) Y-BHC
(c) Endosulfan (d) Malathion

151. In desert grasslands, which type of animals are relatively more abundant ?
(a) Diurnal (b) Arboreal
(c) Aquatic (d) Fossorial

152. The long bones are hollow and connected by air passage. They are the characteristics of :
(a) aves (b) mammals
(c) reptilia (d) land vertebrates

153. *Ulothrix* can be described as a :
(a) filamentous alga with flagellated reproductive stages
(b) non-motile colonial alga lacking zoospores
(c) filamentous alga lacking flagellated reproductive stages
(d) membranous alga producing zoospores

154. How many different types of genetically different gametes will be produced by a heterozygous plant having genotype AABbCc ?
(a) Two (b) Four (c) Six (d) Nine

155. In vertebrates lacteals are found in :
(a) ileum (b) ischium
(c) oesophagous (d) ear

156. Which combination of gases is suitable for fruit ripening ?
(a) 80% C_2H_4 and 20% CO_2
(b) 80% CO_2 and 20% CH_2
(c) 80% CH_4 and 20% CO_2
(d) 80% CO_2 and 20% O_2

157. The DNA of *E. coli* is :
(a) single stranded and linear
(b) single stranded and circular
(c) double stranded and linear
(d) double stranded and circular

158. What is the major cause of diminishing wild life number ?
(a) Cannibalism
(b) Habitat destruction
(c) Felling of trees
(d) Paucity of drinking water

159. Biological control compenent is central to advanced agricultural production. Which of the following is used as a third generation pesticide ?
(a) Pathogens
(b) Pheromones
(c) Insect repellants
(d) Insect hormone analogues

160. The embryo in sunflower has :
(a) no cotyledon
(b) one cotyledon
(c) two cotyledons
(d) many cotyledons

161. Crossing over in diploid organism is responsible for :
(a) dominance of genes
(b) linkage between genes
(c) segregation of alleles
(d) recombination of linked alleles

162. The main role of bacteria in the carbon cycle involves :
(a) photosynthesis
(b) assimilation of nitrogenous compounds
(c) chemosynthesis
(d) digestion or breakdown of organic compounds

163. A condition of failure of kidney to form urine is called :
(a) deamination (b) entropy
(c) anuria (d) none of these

164. Human immuno deficiency virus (HIV) has a protein coat and a genetic material which is :
(a) single stranded DNA
(b) single stranded RNA
(c) double stranded RNA
(d) double stranded DNA

165. Which one of the following is a protein deficiency disease ?
(a) Eczema (b) Cirrhosis
(c) Kwashiorkor (d) Night blindness

166. Largest sperms in the plants world are found in :
(a) *Thuja* (b) *Pinus*
(c) Banyan (d) *Cycas*

167. Recombinant DNA is obtained by cleaving the pro-DNAs by :
(a) primase
(b) exonucleases
(c) ligase
(d) restriction endonuclease

168. The water potential and osmotic potential of pure water are :
(a) 100 and zero (b) zero and zero
(c) 100 and 200 (d) zero and 100

169. The chemical knives of DNA are :
(a) ligases (b) polymerases
(c) endonucleases (d) transcriptases

170. Which of the following cells, found in testes of rabbit, secrete male hormone ?
(a) Leydig's cell (b) Sertoli cells
(c) Epithelial cells (d) Spermatocytes

171. What is agent orange ?
(a) A biodegradable insecticide
(b) A weedicide containing dioxin
(c) Colour used in fluorescent lamp
(d) A hazardous chemical used in luminous paints

172. Genes that are involved in turning on or off the transcription of a set structural genes are called :
(a) polymorphic genes
(b) operator genes
(c) redundant genes
(d) regulatory genes

173. Farmers have reported over 50% higher yields of rice by using which of the following biofertilizer ?
(a) Mycorrhiza
(b) *Azolla pinnata*
(c) Cyanobacteria
(d) Legume-*Rhizobium* symbiosis

174. The supersonic jets cause pollution by the thinning of :
(a) CO_2 layer (b) SO_2 layer
(c) O_2 layer (d) O_3 layer

175. Albinism is known to be due to an autosomal recessive mutation. The first child of a couple with normal skin pigmentation was an albino. What is the probability that their second child will also be an albino ?
(a) 100% (b) 25% (c) 50% (d) 75%

176. Transfer of genetic information from one bacterium to another in the transduction process is through :
(a) physical contact between donor and recipient strains
(b) conjugation between opposite strain bacterium
(c) bacteriophages released from the donor bacterial strain
(d) another bacterium having special organ for conjugation

177. The periderm includes :
(a) cork
(b) cambium
(c) secondary phloem
(d) all of these

178. Typhoid fever is caused by :
(a) *Giardia* (b) *Salmonella*
(c) *Shigella* (d) *Escherichia*

179. Most appropriate term to describe the life cycle of *Obelia* is :
(a) neoteny (b) metagenesis
(c) metamorphosis (d) all of these

180. The walking fern is so named because :
(a) its spores are able to walk
(b) it is dispersed through the agency of walking animals
(c) it propagates vegetatively by its leaf tips
(d) it knows how to walk by itself

181. The functional unit of contractile system in striated muscle is :
(a) cross bridge (b) myofibril
(c) sarcomere (d) Z-band

182. Bryophytes are dependent on water because :
(a) archegonium has to remain filled with water for fertilization
(b) water is essential for fertilization for their homosporous nature
(c) water is essential for their vegetative propagation
(d) the sperms can easily reach upto egg in the archegonium

183. How many genome types are present in a typical green plant's cell ?
(a) Two (b) Three
(c) More than five (d) More than ten

184. Restriction endonucleases are :
(a) synthesized by dog
(b) present in mammalian cells for degradation of DNA
(c) used for *in vitro* DNA synthesis
(d) used in genetic engineering

185. The diversity in the type of beaks of finches adapted to different feeding habits on the Galapagos islands, as observed by Darwin, provides evidence for :
(a) origin of species by natural selection
(b) intraspecific variations
(c) intraspecific competition
(d) interspecific competition

186. DNA elements, which can switch their position, are called :
(a) exons (b) introns
(c) cistrons (d) transposons

187. Which one of the following statements about cytochrome P_{450} is wrong ?
(a) It has an important role in metabolism
(b) It contains iron
(c) It is a coloured cell
(d) It is an enzyme involved in oxidation reactions

188. Genetic drift operates only in :
(a) island populations
(b) smaller populations
(c) larger populations
(d) Mendelian populations

189. An interesting modification of flower shape for insect pollination occurs in some orchids in which a male insect mistakes the pattern on the orchid flower for the female species and tries to copulate with it, thereby pollinating the flower. This phenomenon is called :
(a) mimicry
(b) pseudocopulation
(c) pseudopollination
(d) pseudoparthenocarpy

190. The response of different organisms to the environmental rhythms of light and darkness is called :
(a) phototaxis (b) phototropism
(c) vernalization (d) photoperiodism

191. Warm ocean surge of the peru current recurring every 5 to 8 years or so in the East Pacific of South America is widely known as :
(a) Magnox (b) Gull stream
(c) El Nino (d) Aye Aye

192. In the five kingdom system of classification, which single kingdom out of the following can include blue-green algae, nitrogen fixing bacteria and methanogenic archaebacteria ?
(a) Monera (b) Fungi
(c) Plantae (d) Protista

193. Genetic engineering is possible, because :
(a) the phenomenon of transduction in bacteria is well understood
(b) we can see DNA by electron microscope
(c) we can cut DNA at specific sites by endonucleases like DNAse I
(d) restriction endonucleases purified from bacteria can be used *in vitro*

194. Two bacteria found to be very useful in genetic engineering experiments are :
(a) *Nitrosomonas* and *Klebsiella*
(b) *Escherichia* and *Agrobacterium*
(c) *Nitrobacter* and *Azotobacter*
(d) *Rhizobium* and *Diplococcus*

195. Species restricted to a given area are called :
(a) sibling (b) endemic
(c) sympatric (d) allopatric

196. Which one of the following statements is correct ?
(a) *Homo erectus* is the ancestor of man
(b) Cro-magnon man's fossil has been found in Ethiopia
(c) *Australopithecus* is the real ancestor of modern man
(d) Neanderthal man is the direct ancestor of *Homo sapiens*

197. In a terrestial ecosystem such as forest, maximum energy is in which trophic level ?
(a) T_1 (b) T_2 (c) T_3 (d) T_4

198. A woman with two genes (one on each 'X' chromosome) for haemophilia and one gene for colour blindness on the 'X' chromosomes marries a normal man. How will the progeny be ?
(a) All sons and daughters haemophilic and colourblind
(b) Haemophilic and colourblind daughters
(c) 50% haemophilic colourblind sons and 50% haemophilic sons
(d) 50% haemophilic daughters and 50% colourblind daughters

199. Solenocytes are the main excretory structures in :
(a) annelids (b) molluscs
(c) echinodermates (d) platyhelminthes

200. A few organisms are known to grow and multiply at temperatures of 100-105°C. They belong to :
(a) thermophilic subaerial fungi
(b) marine archaebacteria
(c) thermophilic sulphur bacteria
(d) hot spring blue-green algae

ANSWERS

PHYSICS

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

CHEMISTRY

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

BIOLOGY

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

HINTS & SOLUTIONS

Physics

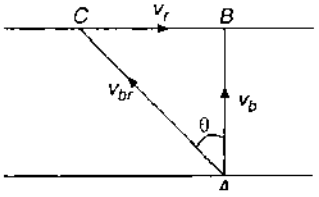
1. Let v_r = velocity of river

v_{br} = velocity of boat in still water and

w = width of river

Time taken to cross the river = 15 min

$$= \frac{15}{60}\text{ h} = \frac{1}{4}\text{ h}$$



Shortest path is taken when v_b is along AB. I this case

$$v_{br}^2 = v_r^2 + v_b^2$$

Now, $$t = \frac{w}{v_b} = \frac{w}{\sqrt{v_{br}^2 - v_r^2}}$$

$$\therefore \quad \frac{1}{4} = \frac{1}{\sqrt{5^2 - v_r^2}}$$

$$\Rightarrow \quad 5^2 - v_r^2 = 16$$

$$\Rightarrow \quad v_r^2 = 25 - 16 = 9$$

$$\therefore \quad v_r = \sqrt{9} = 3\,\text{km/h}$$

NOTE : If $v_r \geq v_{br}$, the boatman can never reach at point *B*.

2. Let the velocity along x and y axes be v_x and v_y respectively.

$$\therefore \quad v_x = \frac{dx}{dt} \text{ and } v_y = \frac{dy}{dy}$$

From figure.

$$\tan \alpha = \frac{y}{x}$$

$$\Rightarrow \quad y = x \tan \alpha$$

Differentiating Eq. (i) w.r.t. t, we get

$$\frac{dy}{dt} = \frac{dx}{dt} \tan \alpha$$

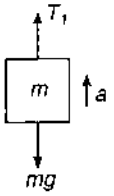
$$\Rightarrow \quad v_y = v_x \tan \alpha$$

Here, $v_x = 10$ m/s, $\alpha = 60°$

$$\therefore \quad v_y = 10 \tan 60° = 10\sqrt{3} = 17.3 \text{ m/s}$$

3. Key Idea : *In a lift weight is the net force acting on the mass while going upwards or downwards.*

(i) When mass is lifted upwards with an acceleration a, then apparent weight



$$T_1 - mg = ma$$

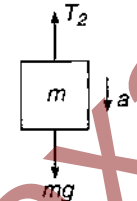
$$\Rightarrow \quad T_1 = mg + ma$$

$$T_1 = m(g + a)$$

Substituting the values, we obtain

$$\therefore \quad T_1 = (1)(9.8 + 4.9) = 14.7 \text{ N}$$

(ii) When mass is lowered downwards with an acceleration a, then



$$mg - T_2 = ma$$

$$\Rightarrow \quad T_2 = mg - ma = m(g - a)$$

Substituting the values, we have

$$T_2 = (1)(9.8 - 4.9) = 4.9 \text{ N}$$

Then, ratio of tensions

$$\frac{T_1}{T_2} = \frac{14.7}{4.9} = \frac{3}{1}$$

$$\Rightarrow \quad T_1 : T_2 = 3 : 1$$

4. According to conservation of energy, the kinetic energy of car = work done in stopping the car

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

where F is the retarding force and s the stopping distance.

For same retarding force, $s \propto v^2$

$$\therefore \quad \frac{s_2}{s_1} = \left(\frac{v_2}{v_1}\right)^2 = \left(\frac{80}{40}\right)^2 = 4$$

$$\therefore \quad s_2 = 4s_1 = 4 \times 2 = 8 \text{ m}$$

Alternative : Initial speed of car

$$u = 40 \text{ km/h} = 40 \times \frac{5}{18} \text{ m/s} = \frac{100}{9} \text{ m/s}$$

From 3rd equation of motion,

$$v^2 = u^2 - 2as$$

$$\Rightarrow \quad 0 = \left(\frac{100}{9}\right)^2 - 2 \times a \times 2$$

$$\Rightarrow \quad a = \frac{2500}{81} \text{ m/s}^2$$

Final speed of car = 80 km/h

$$= 80 \times \frac{5}{18} = \frac{200}{9} \text{ m/s}$$

Suppose car stops for a distance s'. Then

$$v^2 = u^2 - 2as'$$

$$0 = \left(\frac{200}{9}\right)^2 - 2 \times \frac{2500}{81} s'$$

$$\Rightarrow \quad s' = \frac{200 \times 200 \times 81}{9 \times 9 \times 2 \times 2500} = 8 \text{ m}$$

5. Key Idea : *Work done during the first 4s is equal to gain in kinetic energy.*

We have given,

$$x = 3t - 4t^2 + t^3$$

So, velocity

$$v = \frac{dx}{dt} = 3 - 8t + 3t^2$$

At $t = 0$, $v_1 = 3 - 0 + 0 = 3$ m/s

At $t = 4$ s, $v_2 = 3 - 8 \times 4 + 3 \times 4^2$

$$= 3 - 32 + 48 = 19 \text{ m/s}$$

Now work done during $t = 0$ to $t = 4$s

= gain in kinetic energy

$$= \frac{1}{2} mv_2^2 - \frac{1}{2} mv_1^2 = \frac{1}{2} m (v_2^2 - v_1^2)$$

$$= \frac{1}{2} \times 3 \times 10^{-3} [(19)^2 - (3)^2]$$

[Using $a^2 - b^2 = (a + b)(a - b)$]

$$= 1.5 \times 10^{-3} \times [(19 + 3)(19 - 3)]$$

$$= 1.5 \times 10^{-3} \times 22 \times 16$$

$$= 528 \times 10^{-3} \text{ J}$$

$$= 528 \text{ mJ}$$

6. We have given

$$F = 600 - 2\times10^5 t$$

At the bullet leaves the barrel, the force on the bullet becomes zero.

So, $600 - 2\times10^5 t = 0$

$$\Rightarrow \quad t = \frac{600}{2\times10^5} = 3\times10^{-3}\ s$$

Then, average impulse imparted to the bullet

$$I = \int_0^t F dt$$

$$= \int_0^{3\times10^{-3}} (600 - 2\times10^5 t)\, dt$$

$$= \left[600t - \frac{2\times10^5 t^2}{2}\right]_0^{3\times10^{-3}}$$

$$= 600\times3\times10^{-3} - 10^5\times(3\times10^{-3})^2$$

$$= 1.8 - 0.9 = 0.9\ \text{Ns}$$

Alternative : As obtained in previous method, the time taken by bullet when it leaves the barrel

$$t = 3\times10^{-3}\ s$$

Let F_1 an F_2 denote the forces at the time of firing of bullets *i.e.*, at $t = 0$ and at the time of leaving the bullet *i.e.*, at $t = 3\times10^{-3}$ s.

$F_1 = 600 - 2\times10^5\times0 = 600$ N

$F_2 = 600 - 2\times10^5\times3\times10^{-3} = 0$

Mean value of force

$$F = \frac{1}{2}(F_1 + F_2) = \frac{600+0}{2} = 300\ \text{N}$$

Thus, impulse $= F\times t$

$$= 300\times3\times10^{-3}$$

$$= 0.9\ \text{Ns}$$

7. Key Idea : *In an elastic collision, linear momentum remains conserved.*

Given : $u_1 = 3$ m/s, $u_2 = -5$m/s, $m_1 = m_2 = m$

According to principle of conservation of linear momentum

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$

$$m\times3 - m\times5 = mv_1 + mv_2$$

or $$v_1 + v_2 = -2 \qquad ...(i)$$

In an elastic collision,

$$e = \frac{v_2 - v_1}{u_1 - u_2}$$

$$\Rightarrow \quad v_2 - v_1 = e(u_1 - u_2)$$

$$\Rightarrow \quad v_2 - v_1 = (1)(3+5) \qquad (\because e = 1)$$

$$\Rightarrow \quad v_1 - v_2 = -8 \qquad ...(ii)$$

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

$$2v_1 = -10$$

$$\Rightarrow \quad v_1 = -5\ \text{m/s}$$

From Eq. (i),

$$v_2 = -2 - v_1 = -2 + 5 = 3\ \text{m/s}$$

Thus, $v_1 = -5$m/s, $v_2 = +3$ m/s

Alternative : If two bodies collide elastically, then their velocities are interchanged. Since, it is an elastic collision hence, velocities after collision will be –5 m/s and 3 m/s.

8. Key Idea : *Thrust force on the rocket balances the weight of the rocket.*

Thrust force on the rocket

$$F_t = v_r\left(-\frac{dm}{dt}\right) \qquad \text{(upwards)}$$

Weight of the rocket

$$w = mg \qquad \text{(downwards)}$$

Net force on the rocket

$$F_{net} = F_t - w$$

$$\Rightarrow \quad ma = v_r\left(\frac{-dm}{dt}\right) - mg$$

$$\Rightarrow \quad \left(\frac{-dm}{dt}\right) = \frac{m(g+a)}{v_r}$$

∴Rate of gas ejected per second

$$= \frac{5000(10+20)}{800} = \frac{5000\times30}{800}$$

$$= 187.5\ \text{kg s}^{-1}$$

NOTE : Problems related to variable mass can be solved in following three steps :

1. Make a list of all the forces acting on the main mass and apply them on it.
2. Apply an additional thrust force $\vec{\mathbf{F}}_t$ on the mass, the magnitude of which is $\left|\vec{\mathbf{v}}_r\left(\pm\frac{dm}{dt}\right)\right|$ and direction is given by the direction of $\vec{\mathbf{v}}_r$ in case the mass is increasing and otherwise the direction of $-\vec{\mathbf{v}}_r$ if it is decreasing.
3. Find net force on the mass and apply

$\vec{\mathbf{F}}_{net} = m\frac{d\vec{\mathbf{v}}}{dt}$ (m = mass at that particular instant)

9. Key Idea : *In a horizontal circle, tension in the string provides the necessary centripetal force.* For a ball to move in horizontal circle, the ball should satisfied the condition :

Tension in the string = Centripetal force

$$\Rightarrow \quad T_{max} = \frac{Mv_{max}^2}{R}$$

$$\Rightarrow \quad v_{max} = \sqrt{\frac{T_{max} \cdot R}{M}} \qquad ...(i)$$

Making substitution, we obtain

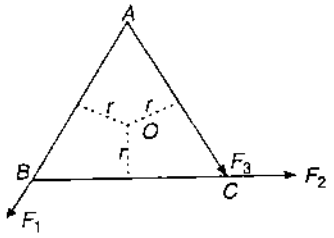
$$v_{max} = \sqrt{\frac{25 \times 1.96}{0.25}}$$

$$= \sqrt{196}$$

$$= 14 \text{ m/s}$$

NOTE : In a vertical circle, the tension at the highest point is zero and at lowest point is maximum.

10. Let r be the perpendicular distance of F_1, F_2 and F_3 from O as shown in figure



The torque of force F_3 about O is clockwise, while torque due to F_1 and F_2 are anticlockwise.

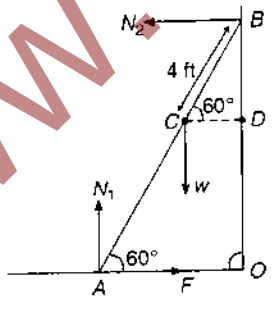
For total torque to be zero about O, we must have

$$F_1 r + F_2 r - F_3 r = 0$$

$$\Rightarrow \quad F_3 = F_1 + F_2$$

11. Key Idea : *The net moment about point of contact between ground and ladder should be zero.*

Let (as shown in figure) AB be a ladder and F be the horizontal force to keep it from slipping.



w is the weight of man. Suppose N_1 and N_2 be normal reactions of ground and wall respectively.

In horizontal equilibrium,

$$N_2 = F$$

In vertical equilibrium,

$$N_1 = w$$

Taking moments about A;

Clockwise torque = Anticlockwise torque

$$N_1 \times CD = N_2 \times OB \qquad ...(i)$$

but in ΔAOB, $\sin 60^\circ = \frac{OB}{AB}$

$$\Rightarrow \quad OB = AB \sin 60^\circ$$

In ΔBCD,

$$\cos 60^\circ = \frac{CD}{BC}$$

$$\Rightarrow \quad CD = BC \cos 60^\circ$$

Substituting in Eq. (i), we have

$$N_1 \times BC \cos 60^\circ = N_2 \times AB \sin 60^\circ$$

$$\Rightarrow \quad w \times BC \times \frac{1}{2} = F \times AB \times \frac{\sqrt{3}}{2}$$

Given : $w = 150$ pound, $AB = 20$ ft., $BC = 4$ ft.

$$\therefore \quad 150 \times 4 \times \frac{1}{2} = F \times 20 \times \frac{\sqrt{3}}{2}$$

$$\Rightarrow \quad F = \frac{150 \times 4}{20\sqrt{3}}$$

$$= \frac{150 \times 4 \times \sqrt{3}}{20 \times 3}$$

$$= 17.3 \text{ pound}$$

12. Key Idea : *Angular momentum remains conserved in the universe.*

According to conservation of angular momentum

$$L = \text{constant}$$

or $$I\omega = \text{constant}$$

$$\therefore \quad I_1\omega_1 = I_2\omega_2 \qquad ...(i)$$

Initial moment of inertia

$$I_1 = MR^2$$

and angular velocity

$$\omega_1 = \omega$$

Hence, $$I_1\omega_1 = MR^2\omega \qquad ...(ii)$$

When two objects of mass m are attached to opposite ends of a diameter, the final readings are

$$I_2 = MR^2 + mR^2 + mR^2$$
$$= (M + 2m)R^2$$

So, $I_2\omega_2 = (M + 2m)R^2\omega_2$ ...(iii)

∴ From Eqs. (i), (ii) and (iii)

$$MR^2\omega = (M + 2m)R^2\omega_2$$

$$\Rightarrow \quad \omega_2 = \frac{\omega M}{M + 2m}$$

13. Key Idea : *According to conservation of energy, potential energy at height h = kinetic energy at ground*

Potential energy = Kinetic energy

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

$$\Rightarrow \quad v = \sqrt{2gh}$$

If h_1 and h_2 are initial and final heights, then

$$v_1 = \sqrt{2gh_1}\ ,\ v_2 = \sqrt{2gh_2}$$

Loss in velocity

$$\Delta v = v_1 - v_2 = \sqrt{2gh_1} - \sqrt{2gh_2}$$

∴ Fractional loss in velocity $= \frac{\Delta v}{v_1}$

$$= \frac{\sqrt{2gh_1} - \sqrt{2gh_2}}{\sqrt{2gh_1}}$$

$$= 1 - \sqrt{\frac{h_2}{h_1}}$$

Substituting the values, we have

$$\therefore \quad \frac{\Delta v}{v_1} = 1 - \sqrt{\frac{1.8}{5}}$$
$$= 1 - \sqrt{0.36} = 1 - 0.6$$
$$= 0.4 = \frac{2}{5}$$

14. Key Idea : *For the pendulum to be again in the same phase, there should be difference of 1 complete oscillation.*

If smaller pendulum completes n oscillations the larger pendulum will complete $(n-1)$ oscillations, so

Time period of n oscillations of first = Time period of $(n-1)$ oscillations of second

i.e., $nT_1 = (n-1)T_2$

or $n\,2\pi\sqrt{\frac{L_1}{g}} = (n-1)2\pi\sqrt{\frac{L_2}{g}}$

or $n\sqrt{L_1} = (n-1)\sqrt{L_2}$

or $\frac{n}{n-1} = \sqrt{\frac{L_2}{L_1}} = \sqrt{\frac{2.0}{0.5}}$

or $\frac{n}{n-1} = 2$

or $n = 2n - 2$

∴ $n = 2$

15. Key Idea : *Time period of oscillating system whether it is a simple pendulum or spring-mass system, is given by*

$$T = 2\pi\sqrt{\left(\frac{\text{displacement}}{\text{acceleration}}\right)}.$$

Time period of spring-mass system is

$$n = \frac{1}{T} = \frac{1}{2\pi}\sqrt{\frac{\text{acceleration}}{\text{displacement}}}$$

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

In case of vertical spring mass system, in equilibrium position

$$kl = mg \Rightarrow \frac{g}{l} = \frac{k}{m}$$

where l = extension in the spring and

k = spring constant or force constant of spring

∴ From Eq. (i), we have

$$n = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$$

or $n \propto \frac{1}{\sqrt{m}}$

or $\frac{n_1}{n_2} = \sqrt{\frac{m_2}{m_1}}$

but $m_1 = m$, $m_2 = 4m$; $n_1 = n$ (given)

$$\therefore \quad \frac{n}{n_2} = \sqrt{\frac{4m}{m}} = 2$$

or $n_2 = \frac{n}{2}$

16. In driven harmonic oscillator, the energy is maximum at $\omega_2 = \omega_0$ and amplitude is maximum at frequency $\omega_1 < \omega_0$ in the presence of damping. So, $\omega_1 \neq \omega_0$ and $\omega_2 = \omega_0$.

17. Change in internal energy is

$$\Delta U = \frac{1}{(\gamma - 1)}(P_2V_2 - P_1V_1)$$

Here, $V_1 = V$, $V_2 = 2V$

$$\therefore \quad \Delta U = \frac{1}{\gamma - 1}[P \times 2V - P \times V]$$

$$= \frac{1}{\gamma - 1} \times PV$$

$$= \frac{PV}{\gamma - 1}$$

NOTE : The internal energy of an ideal gas depends only on its absolute temperature (T) and is directly proportional to T.

18. An isothermal process is a constant temperature process. In this process, T = constant or $\Delta T = 0$.

$\therefore$ $\Delta U = nC_v \Delta T = 0$

An adiabatic process is defined as one with no heat transfer into or out of a system. Therefore, $Q = 0$. From the first law of thermodynamics.

$$W = -\Delta U$$

or $\Delta U = -W$.

19. According to Stefan's law, the rate at which an object radiates energy is proportional to the fourth power of its absolute temperature *i.e.*,

$$E = \sigma T^4 \text{ or } E \propto T^4$$

or $$\frac{E_1}{E_2} = \left(\frac{T_1}{T_2}\right)^4$$

Here, $T_1 = T, T_2 = 2T, E_1 = 20$ kcal/ m^2 min

$\therefore$ $$\frac{20}{E_2} = \left(\frac{T}{2T}\right)^2$$

or $$\frac{20}{E_2} = \frac{1}{16}$$

$\therefore$ $E_2 = 20 \times 16$

$= 320$ kcal/m^2 min

20. The given wave equation is

$$y = y_0 \sin \frac{2\pi}{\lambda}(vt - x) \quad ...(i)$$

In the wave equation v is the particle velocity. Differentiating Eq. (i) with respect to time,

$$u = \frac{dy}{dt} = y_0 \frac{2\pi v}{\lambda} \cos \frac{2\pi}{\lambda}(vt - x)$$

Maximum particle velocity, $u_{max} = y_0 \frac{2\pi v}{\lambda}$

Now it is given that,

maximum particle velocity = 2 × wave velocity

or $$y_0 \frac{2\pi v}{\lambda} = 2v$$

or $$\lambda = \pi y_0$$

21. When velocity of source (vehicle) is perpendicular to the line joining the observer and source, then there is no Doppler's effect of sound or, there is no change in apparent frequency. Therefore, $n_1 = 0$.

22. If T is the time period, then time required for a point to move from maximum displacement to zero displacement is $\frac{T}{4}$.

$\therefore$ $$\frac{T}{4} = 0.170$$

or $T = 0.170 \times 4 = 0.680$ s

Therefore, the frequency of wave is

$$n = \frac{1}{T} = \frac{1}{0.680} = 1.47 \text{ Hz}$$

23. **Key Idea :** *The given standing wave has 2 segments.*

The given standing wave has shown in the figure.

As length of one loop or segment is $\frac{\lambda}{2}$, so length of 2 segments is $2\left(\frac{\lambda}{2}\right)$.

$\therefore$ $$2\frac{\lambda}{2} = 1.21 \text{ Å}$$

$\Rightarrow$ $\lambda = 1.21$ Å

24. The lens formula is $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

we have

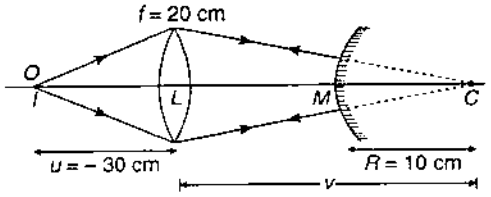
$u = -30$ cm, $f = 20$ cm

$\therefore$ $$\frac{1}{20} = \frac{1}{v} - \frac{1}{-30}$$

or $$\frac{1}{v} = \frac{1}{20} - \frac{1}{30} = \frac{3-2}{60} = \frac{1}{60}$$

$\therefore$ $v = 60$ cm

The ray diagram for the problem is shown as follows :



For the image (I) coincident with object (O), the rays after refraction from the lens must fall on the convex mirror normally or the rays refracted from lens must meet at C.

$\therefore \quad LC = v = 60$ cm

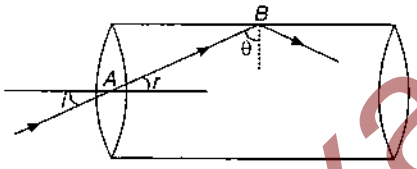
Thus, distance between lens and mirror

$LM = 60 - 10 = 50$ cm

25. **Key Idea :** *The first idea is that for no refraction at its lateral face, angle of incidence should be greater than critical angle.*

Let a light ray enters at A and refracted beam is AB. At the lateral face, the angle of incidence is θ. For no refraction at this face, $\theta > C$

$$\sin\theta > \sin C$$



but $\theta + r = 90°$

$\Rightarrow \quad \theta = (90° - r)$

$\therefore \quad \sin(90° - r) > \sin C$

or $\quad \cos r > \sin C \quad ...(i)$

Key Idea : *The second idea is that in Eq. (i), the substitution for cos r can be found from Snell's law.*

Now from Snell's law,

$$n = \frac{\sin i}{\sin r} \Rightarrow \sin r = \frac{\sin i}{n}$$

$$\therefore \quad \cos r = \sqrt{1 - \sin^2 r} = \sqrt{\left(1 - \frac{\sin^2 i}{n^2}\right)}$$

$\therefore$ Eq. (i) gives,

$$\sqrt{1 - \frac{\sin^2 i}{n^2}} > \sin C$$

$$\Rightarrow \quad 1 - \frac{\sin^2 i}{n^2} > \sin^2 C$$

Also $\sin C = \frac{1}{n}$

$$\therefore \quad 1 - \frac{\sin^2 i}{n^2} > \frac{1}{n^2}$$

or $\quad 1 > \frac{1}{n^2} + \frac{\sin^2 i}{n^2}$

or $\quad \frac{1}{n^2}(\sin^2 i + 1) < 1$

or $\quad n^2 > \sin^2 i + 1$

The maximum value of $\sin i$ is 1. So,

$\therefore \quad n^2 > 2$

or $\quad n > \sqrt{2}$

26. Electric field due to a dipole at bisector or at a point on its broad side on position is given by

$$E = \frac{1}{4\pi\varepsilon_0} \cdot \frac{p}{r^3}$$

or $\quad E \propto \frac{p}{r^3} \quad ...(i)$

where r is the distance of that point from centre of dipole.

So, from Eq. (i)

$$E \propto p$$

and $\quad E \propto r^{-3}$

NOTE : The electric field due to a dipole at its end on position is twice the value at its broad side on position *i.e.*,

$$E_{\text{end-on}} = \frac{1}{4\pi\varepsilon_0} \cdot \frac{2p}{r^3}$$

27. **Key Idea :** *Kinetic energy obtained by the particle is equal to the work done in moving a distance y.*

Electric force on charged particle

$$F = qE$$

Kinetic energy attained by particle

= work done

= force × displacement

$= qE \times y$

Alternative :

Force on charged particle in a uniform electric field is

$$F = ma = Eq$$

or $\quad a = \frac{Eq}{m} \quad ...(i)$

From the equation of motion, we have

$$v^2 = u^2 + 2ay$$

$$= 0 + 2 \times \frac{Eq}{m} \times y$$

$$= \frac{2Eqy}{m}$$

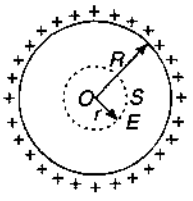
Now kinetic energy of the particle

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

$$= \frac{m}{2} \times \frac{2Eqy}{m} = qEy$$

28. Key Idea : *No charge is enclosed by the hollow insulated conducting sphere.*

Charge resides on the outer surface of a conducting hollow sphere of radius R (say). We consider a spherical surface of radius $r < R$.



By Gauss theorem

$$\int_s \vec{\mathbf{E}} \cdot \vec{\mathbf{ds}} = \frac{1}{\varepsilon_0} \times \text{charge enclosed}$$

or $$E \cdot 4\pi r^2 = \frac{1}{\varepsilon_0} \times 0$$

$$\Rightarrow \quad E = 0$$

i.e., electric field inside a hollow sphere is zero.

29. Key Idea : *Power is the rate at which energy is transferred.*

Power $$= \frac{\Delta U}{\Delta t} = V\frac{\Delta q}{\Delta t} = Vi$$

or $$P = Vi = \frac{V^2}{R} \qquad (\because V = iR)$$

When resistors are in series, then

$$R_1 = R + R + R = 3R$$

$\therefore$ Power dissipated

$$P_1 = \frac{V^2}{R_1} = \frac{V^2}{3R}$$

When resistors are in parallel, then

$$\frac{1}{R_2} = \frac{1}{R} + \frac{1}{R} + \frac{1}{R} = \frac{3}{R}$$

$$\Rightarrow \quad R_2 = \frac{R}{3}$$

$$\therefore \quad P_2 = \frac{V^2}{R_2} = \frac{V^2}{R/3} = \frac{3V^2}{R}$$

Therefore, $$\frac{P_2}{P_1} = \frac{3V^2}{R} \Big/ \frac{V^2}{3R} = 9$$

$$P_2 = 9P_1 = 9 \times 10$$

$$= 90 \text{ watt}$$

30. Key Idea : *When current is passed through a conductor, electric energy is absorbed by the conductor through collisions between its atomic lattice and the charge carriers causing its temperature to rise.*

Energy loss in conductor $Q = i^2RT$

Heat developed $= ms\,\Delta\theta$

$\therefore \quad ms\,\Delta\theta = i^2\,Rt$

or $$\Delta\theta \propto i^2$$

$$\frac{\Delta\theta_2}{\Delta\theta_1} = \frac{i_2^2}{i_1^2}$$

or $$\Delta\theta_2 = \left(\frac{i_2}{i_1}\right)^2 \Delta\theta_1 \qquad \ldots (i)$$

Here : $i_2 = 2i_1$, $\Delta\theta_1 = 5°C$

From Eq. (i)

$\therefore \quad \Delta\theta_2 = \left(\frac{2i_1}{i_1}\right)^2 \times 5$

$$= 4 \times 5 = 20° C$$

31. Total charge flowing through electrolyte

$$Q = it$$

$$= 50 \times 20 \times 60$$

$$= 6 \times 10^4 \text{ C}$$

10^5 C release $= 9$ g of Al

$\therefore 6 \times 10^4$ C would release

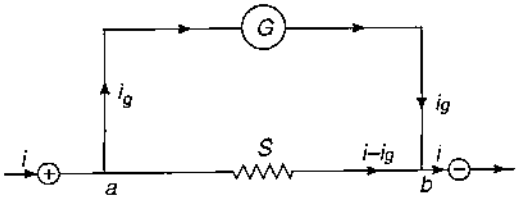
$$= \frac{9 \times 6 \times 10^4}{10^5} \text{ g}$$

$$= 5.4 \text{ g of Al}$$

32. Key Idea : *Potential difference across galvanometer should be equal to potential difference across shunt.*

The shunt and galvanometer are connected as shown in figure.

Let the total current through the parallel combination is i, the current through the galvanometer is i_g and the current through the shunt is $i - i_g$.



The potential difference V_{ab} $(= V_a - V_b)$ is the same for both paths, so

$$i_g G = (i - i_g) S$$

or $$i_g (G + S) = i S$$

or $$\frac{i_g}{i} = \frac{S}{S + G}$$

The fraction of current passing through shunt

$$= \frac{i - i_g}{i} = 1 - \frac{i_g}{i}$$

$$= 1 - \frac{S}{S + G}$$

$$= \frac{G}{S + G}$$

$$= \frac{8}{2 + 8}$$

$$= \frac{8}{10} = 0.8 \text{ A}$$

33. Magnetic induction at the centre of current carrying coil

$$B = \frac{\mu_0 ni}{2r} \quad ...(i)$$

Suppose the length of the wire be L.

Ist case : For coil of one turn, let radius be r_1.

$\therefore$ $$L = 2\pi r_1 \times n$$

or $$r_1 = \frac{L}{2\pi \times n} = \frac{L}{2\pi} \quad (\because n = 1)$$

2nd case : For coil of two turns, let radius be r_2.

$\therefore$ $$L = 2\pi r_2 \times n$$

or $$r_2 = \frac{L}{2\pi \times n} = \frac{L}{2\pi \times 2} \quad (\because n = 2)$$

or $$r_2 = \frac{r_1}{2}$$

From Eq. (i), we have

$$\frac{B_1}{B_2} = \frac{n_1}{r_1} \times \frac{r_2}{n_2}$$

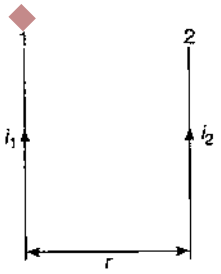
or $$\frac{B_1}{B_2} = \frac{1 \times \frac{r_1}{2}}{r_1 \times 2}$$

$\therefore$ $$\frac{B_1}{B_2} = \frac{1}{4}$$

34. Magnetic force between parallel wires per unit length is

$$\frac{F}{l} = \frac{\mu_0}{2\pi} \times \frac{i_1 i_2}{r}$$

where i_1 and i_2 are the currents in wires 1 and 2 respectively and r is the distance between them. Since, it is given that between two wires, there is a force of attraction, so the direction of currents in both will be the same.



Here,

$i_1 = i_2 = 1$ A, $r = 1$ m,

$\mu_0 = 4\pi \times 10^{-7}$ T-m/A

$\therefore$ $$\frac{F}{l} = \frac{4\pi \times 10^{-7}}{2\pi} \times \frac{1 \times 1}{1}$$

$$= 2 \times 10^{-7} \text{ N/m}$$

35. Iron is a ferromagnetic substance. There are no magnetic lines of force inside a ferromagnetic substance. So, equipment may be protected by placing it inside the can made of a ferromagnetic substance. Hence, it is placed inside an iron can.

36. **Key Idea :** *For maximum value of emf in the second coil, the rate of change of current* $\left(\frac{dI}{dt}\right)$ *should be maximum.*

The given equation of current changing in the first coil is

$$I = I_0 \sin \omega t \quad ...(i)$$

Differentiating Eq. (i) with respect to time, we have

$$\frac{dI}{dt} = \frac{d}{dt} (I_0 \sin \omega t)$$

or $$\frac{dI}{dt} = I_0 \frac{d}{dt} (\sin \omega t)$$

or $$\frac{dI}{dt} = I_0 \omega \cos \omega t$$

For maximum $\frac{dI}{dt}$, the value of cos ωt should be equal to 1.

So, $\left(\frac{dI}{dt}\right)_{max} = I_0\,\omega$

The maximum value of emf is given by

$\therefore \quad e_{max} = M\left(\frac{dI}{dt}\right)_{max} = MI_0\omega$

Here, $M = 0.005$ H, $I_0 = 10$ A, $\omega = 100\pi$ rad/s

$\therefore \quad e_{max} = 0.005 \times 10 \times 100\pi = 5\pi$

37. Key Idea : *The flux per turn of primary coil must be equal to flux per turn of the secondary coil.*

As per key idea, $\frac{\phi_p}{n_p} = \frac{\phi_s}{n_s}$

or $\frac{1}{n_p}\cdot\frac{d\phi_p}{dt} = \frac{1}{n_s}\frac{d\phi_s}{dt}$

$\therefore \quad \frac{e_s}{e_p} = \frac{n_s}{n_p} \qquad \left(\text{as } e \propto \frac{d\phi}{dt}\right)$

For no loss of power,

$ei = \text{constant}$

$\therefore \quad i = \frac{1}{e} \times \text{constant}$

or $\frac{i_p}{i_s} = \frac{e_s}{e_p}$

or $\frac{i_p}{i_s} = \frac{n_s}{n_p}$

Here, $\frac{n_p}{n_s} = \frac{1}{25}$, $i_s = 2$A

$\therefore \quad \frac{i_p}{2} = \frac{25}{1}$

or $i_p = 25 \times 2 = 50$ A

NOTE : In step-up transformer $n_s > n_p$. It increases voltage and reduces current.

In step-down transformer, $n_p > n_s$. It increases current and reduces voltage.

38. The energy of emitted photon

$$E = \frac{hc}{\lambda}$$

Given : $\lambda = 21$ cm $= 0.21$ m

$\therefore \quad E = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{0.21} = 10^{-24}$ J

39. Key Idea : *According to the Newton's second law, a radially inward centripetal force is needed to the electron which is being provided by the Coulomb's attraction between the proton and electron.*

Coulomb's attraction between the positive proton and negative electron $= \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r^2}$

Centripetal force has magnitude

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

As per key idea,

$$\frac{mv^2}{r} = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r^2}$$

$\Rightarrow \quad v^2 = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{mr}$

$\Rightarrow \quad v = \frac{e}{\sqrt{4\pi\varepsilon_0 mr}}$

For ground state of H-atom, $r = a_0$

$\therefore \quad v = \frac{e}{\sqrt{4\pi\varepsilon_0 m a_0}}$

40. Energy of photon is given by

$$E = \frac{hc}{\lambda} = \frac{12375}{\lambda(\text{Å})}\text{ eV}$$

$\therefore \quad E = \frac{12375}{5000} = 2.48$ eV

Einstein's photoelectric equation is

$E_k = E - W$

$= 2.48$ eV $- 1.9$ eV

$= 0.58$ eV

41. Einstein's photoelectric equation is given by

$E_k = E - W$

but $E_k = \frac{1}{2}mv^2$ and $E = \frac{hc}{\lambda}$

$\therefore \quad \frac{1}{2}mv^2 = \frac{hc}{\lambda} - W$ ...(i)

Suppose v' be the new speed, when λ is changed to $\frac{3\lambda}{4}$,

$\therefore \quad \frac{1}{2}mv'^2 = \frac{hc}{(3\lambda/4)} - W$

or $\frac{1}{2}mv'^2 = \frac{4}{3}\frac{hc}{\lambda} - W$ ...(ii)

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

$$\frac{v'^2}{v^2} = \frac{\frac{4}{3}\frac{hc}{\lambda} - W}{\frac{hc}{\lambda} - W}$$

$$= \frac{\frac{4}{3}\frac{hc}{\lambda} - \frac{4}{3}W + \frac{1}{3}W}{\frac{hc}{\lambda} - W}$$

$$= \frac{4}{3} + \frac{W}{3\left(\frac{hc}{\lambda} - W\right)} > \frac{4}{3}$$

$\therefore \quad \frac{\nu'}{\nu} > \sqrt{\frac{4}{3}} \quad$ or $\quad \nu' > \sqrt{\frac{4}{3}}\,\nu$

42. Key Idea : *Total no. of nuclei remained after n half-lives is* $N = N_0\left(\frac{1}{2}\right)^n$.

Total time given = 80 min

Number of half-lives of A, $n_A = \frac{80 \text{ min}}{20 \text{ min}} = 4$

Number of half-lives of B, $n_B = \frac{80 \text{ min}}{40 \text{ min}} = 2$

Number of nuclei remained undecayed $N = N_0\left(\frac{1}{2}\right)^n$

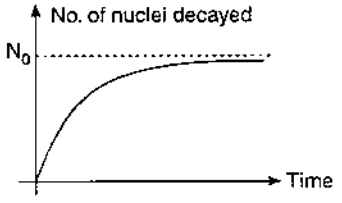
where N_0 is initial number of nuclei

$$\therefore \quad \frac{N_A}{N_B} = \frac{\left(\frac{1}{2}\right)^{n_A}}{\left(\frac{1}{2}\right)^{n_B}}$$

$$\text{or} \quad \frac{N_A}{N_B} = \frac{\left(\frac{1}{2}\right)^4}{\left(\frac{1}{2}\right)^2} = \frac{\left(\frac{1}{16}\right)}{\left(\frac{1}{4}\right)}$$

$$\text{or} \quad \frac{N_A}{N_B} = \frac{1}{4}$$

NOTE : The graph between number of nuclei decayed with time is shown along side.



43. Let n_1 and n_2 be the number of atoms in $^{10}_{5}B$ and $^{11}_{5}B$ isotopes.

Atomic weight

$$= \frac{n_1 \times (\text{At. wt. of } {}^{10}_{5}B) + n_2 \times (\text{At. wt. of } {}^{11}_{5}B)}{n_1 + n_2}$$

$$\text{or} \quad 10.81 = \frac{n_1 \times 10 + n_2 \times 11}{n_1 + n_2}$$

$$\text{or} \quad 10.81\, n_1 + 10.81\, n_2 = 10\, n_1 + 11\, n_2$$

$$\text{or} \quad 0.81\, n_1 = 0.19\, n_2$$

$$\text{or} \quad \frac{n_1}{n_2} = \frac{0.19}{0.81} = \frac{19}{81}$$

44. Key Idea : *In α-particle emission, atomic mass decreases by 4 unit and atomic number decreases by 2 unit. In β-particle emission, atomic mass remains unchanged and atomic number increases by 1 unit.*

The reaction can be shown as

$$_nX^m \xrightarrow{\alpha} {}_{n-2}Y^{m-4}$$

$$_{n-2}Y^{m-4} \xrightarrow{2\beta} {}_nX^{m-4}$$

Thus, the resulting nucleus is the isotope of parent nucleus and is $_nX^{m-4}$.

45. Key Idea : *In a nuclear reaction, atomic mass and charge number remain conserved.*

For a nuclear reaction to be completed, the mass number and charge number on both sides should be same.

If we complete the equation by choice (a), then the complete reaction is

Total atomic number on LHS = 92 + 0 = 92

$$_{92}U^{235} + {}_0n^1 \rightarrow {}_{38}Sr^{90} + {}_{54}Xe^{143} + 3\,{}_0n^1$$

Total atomic number on RHS

= 38 + 54 + 0 = 92

Total mass number on LHS = 235 + 1 = 236

Total mass number on RHS

= 90 + 143 + 3 × 1 = 236

Thus, choice (a) is correct.

46. In a *p-n* junction diode, majority carriers are holes on *p*-side and electrons on *n*-side. Holes thus diffuse to *n*-side and electrons to *p*-side This diffusion causes an excess positive charge in the *n*-region and an excess negative charge in the *p*-region near the junction. This double layer of charge creates an electric field which exerts a force on the electrons and holes, against their diffusion. This electric field becomes strong enough as diffusion proceeds to stop it. In the equilibrium position, there is a barrier, for charge motion with the *n*-side at a higher potential than the *p*-side.

The junction region has a very low density of either *p* or *n*-type carriers, because of inter diffusion. It is called depletion region. There is a barrier V_B associated with it. This is the potential barrier.

47. When the connection of battery is reversed, then a semiconducting device is reverse biased. We know that in forward biasing of *p-n* junction the current is of the order of milliampere while in reverse biasing the current is of the order of microampere (negligible). Thus, device is a *p-n* junction.

48. **Key Idea :** *In common emitter configuration of a transistor, the input current is a base current..*

Input current

$$i_B = \frac{\Delta V_B}{R_B}$$

$$= \frac{0.01}{1000} = 10^{-5}\ \text{A}$$

Also current gain

$$\beta = \frac{i_C}{i_B}$$

$$\therefore \quad i_C = \beta i_B = 50 \times 10^{-5}\ \text{A}$$

$$= 500 \times 10^{-6}\ \text{A} = 500\ \mu\text{A}$$

49. (a) Gate *A* is NAND gate, is ouput will be

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

(b) Gate *B* is NOR gate, its output will be

$$Y_B = \overline{1 + 1} = \bar{1} = 0$$

(c) Gate *C* is NAND gate, its output will be

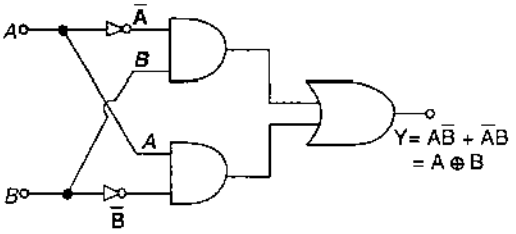
$$Y_C = \overline{0 \cdot 1} = \bar{0} = 1$$

(d) Gate *D* is XOR gate, its ouput wil be

$$Y_D = 0 \oplus 0 = 0 \cdot \bar{0} + \bar{0} \cdot 0 = 0$$

Thus, gate (c) will give an output of 1.

NOTE : Option (d) represents a logic symbol of exclusive OR gate or XOR gate. Its descriptive form showng its Boolean expression may be represented as :



50. The given truth table gives

$0^*0 = 1$

$0^*1 = 1$

$1^*0 = 1$

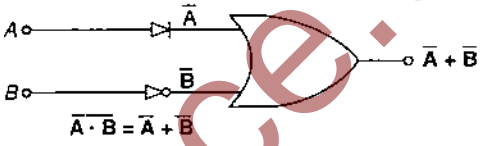
$1^*1 = 0$

The above data represents the expression

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

This expression is the Boolean expression of NAND gate.

NOTE : NAND gate used as OR function



Thus $\overline{A \cdot B} = \bar{A} + \bar{B}$

This is according to De Morgan's theorem which states that complements of products equals the sum or *vice-versa*.

Chemistry

51. (i) All non zero digits are significant.

(ii) Non zero digits to the right of the decimal point are significant.

(iii) Zeroes to the left of the first non-zero digits in a number are not significant

So, the number of significant figures for the numbers 161 cm, 0.161 cm and 0.0161 cm are same *i. e.*, 3

52. ∵ 0.33% of iron by weight means 100 g haemoglobin has 0.33 g iron.

100 g of haemoglobin contains iron = 0.33 g

∴ 67200 g of haemoglobin contains iron

$$= \frac{0.33 \times 67200}{100}\ \text{g} = 221.768\ \text{g of iron}$$

$$\text{Number of Fe atoms} = \frac{221.768}{56} = 3.96 \approx 4$$

53. $r \propto n^2 Z^2$

where n = number of orbit

Z = Atomic number

$$\because \quad r_1 \propto n_1^2$$

$$r_2 \propto n_2^2 \ (Z = 1 \text{ for H-atom})$$

$$\text{So,} \quad \frac{r_1}{r_2} = \frac{n_1^2}{n_2^2}$$

$$\frac{0.530}{r_2} = \frac{1^2}{2^2}$$

$$\therefore \quad r_2 = 0.530 \times 4 = 2.120 \text{ Å}$$

54. By Heisenberg uncertainty principle

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

when the position of electron and helium atoms is known and momentum of electron is also known within a range, therefore the momentum of helium atom is equal to the momentum of electron

i.e., 5×10^{-26} kg ms^{-1}

55. Paramagnetic character is based upon presence of unpaired electron

$_{17}Cl^- = 1s^2, 2s^2 2p^6, 3s^2 3p_x^2 3p_y^2 3p_z^2$

Unpaired electron about Diamagnetic

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

$1s^2\ 2s^2$

$_{10}Ne^{2+} = 1s^2, 2s^2 2p_x^2 2p_y^1 2p_z^1$

$_{33}As^+ = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^{10}, 4s^2\ 4p_x^1 4p_y^1 4p_z^0$

All have unpaired electrons. So, these are paramagnetic in nature.

56. After emiting a β particle, atomic number is increased by one unit and atomic weight has no change. So the atomic number of parent nucleus will be 5.

$$_5X^{14} \xrightarrow{-\beta} {}_6Y^{14} \xrightarrow{-\beta} {}_7N^{14}$$

Number of neutrons = Mass number − Number of proton

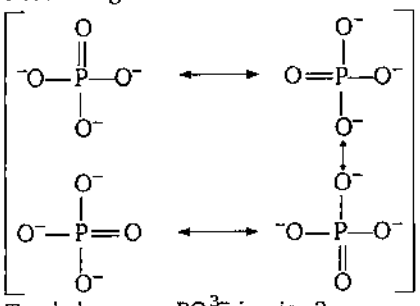
$= 14 - 5 = 9$

57. Bond order between P—O

$$= \frac{\text{no. of bonds in all possible direction}}{\text{Total no. of resonating structures}}$$

$$= \frac{5}{4} = 1.25$$

Resonating structures are :



Total charge on PO_4^{3-} ion is −3

So, the average formal charge on each 'O' atom is $= -\frac{3}{4} = -0.75$

58. Total no. of electrons in $O_2^{2-} = 16 + 2 = 18$

According to MOT, the configuration of O_2^{2-} is

$\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_x^2, \pi 2p_y^2$

$\pi 2p_z^2, \pi^* 2p_y^1, \pi^* 2p_z^1$

Orbitals with represent anti bonding M.O. so, the number of antibonding electrons = 6

59. Schottky defect in crystals is observed when equal number of cations and anions are missing from the lattice.

So, the crystal remains neutral *e.g.*, NaCl and the density of the crystal decreases.

60. Edge length $= 2r^+ + 2r^-$

$$\frac{508}{2} = r^+ + r^-$$

$$254 = 110 + r^-$$

$$r^- = 254 - 110 = 144 \text{ pm}$$

61. According to Bragg's equation $n\lambda = 2d \sin\theta$

$n = 2\ \lambda = 1\ \theta = 60°\ d = ?$

$$2 \times 1 = 2 \times d \times \sin 60°$$

$$2 \times 1 = 2 \times d \times \frac{\sqrt{3}}{2}$$

$$d = \frac{2}{\sqrt{3}} = \frac{2}{1.7} = 1.17 \text{ Å}$$

62. On moving from top to bottom in a group of periodic table distance between ions in ionic compounds increases. Hence, it is maximum in CsI.

63. Table for empirical formula

Element	%	At. wt.	Relative Number	Ratio
C	40.00	12	$\frac{40}{12} = 3.66$	$\frac{3.66}{3.33} = 1.09 \sim 1$
H	13.33	1	$\frac{13.33}{1} = 13.33$	$\frac{13.33}{3.33} = 4$
N	46.67	14	$\frac{46.67}{14} = 3.33$	$\frac{3.33}{3.33} = 1$

Hence, empirical formula CH_4N

64. Isotonic solutions are the solutions having same osmotic pressure.

Applying Van'tHoff equation

$$\pi V = nST$$

$$\pi = cST$$

Osmotic pressure of 5% cane sugar solution

$$(\pi_1) = C \times S \times T = \frac{50 g/L}{342} \times 0.0821 \times T$$

Osmotic pressure of 1% solution of substance x (π_2)

$$= \frac{10 g/L}{M} \times 0.0821 \times T$$

Both are isotonic

So, $\pi_1 = \pi_2$

or $\frac{50}{342} \times 0.0821 \times T = \frac{10}{M} \times 0.0821 \times T$

$\therefore$ M (mol. wt. of X) $= \frac{342}{5} = 68.4$

65. According to Raoult's law. The relative lowering of vapour pressure is equal to the mole fraction of solute i.e.,

$$\frac{p - p_s}{p} = \frac{n}{n + N}$$

or $$\frac{\Delta p}{p} = \frac{n}{n + N}$$

$$\frac{10}{p} = 0.2 \quad \therefore p = 50 \text{ mm}$$

For other solution of same solvent

$$\frac{20}{p} = \frac{n}{n + N}$$

or $$\frac{20}{50} = \frac{n}{n + N}$$

$$0.4 = \frac{n}{n + N}$$

(mole fraction of solute)

So, mole fraction of solvent = 1 – 0.4 = 0.6

66. $XeF_6(g) + H_2O(g) \rightleftharpoons XeOF_4(g) + 2HF(g)$

$$K_1 = \frac{[XeOF_4][HF]^2}{[XeF_6][H_2O]} \quad ...(i)$$

$XeO_4(g) + XeF_6(g) \rightleftharpoons XeOF_4(g) + XeO_3F_2(g)$

$$K_2 = \frac{[XeOF_4][XeO_3F_2]}{[XeO_4][XeF_6]} \quad ...(ii)$$

For reaction,

$XeO_4(g) + 2HF(g) \rightleftharpoons XeO_3F_2(g) + H_2O(g)$

$$K = \frac{[XeO_3F_2][H_2O]}{[XeO_4][HF]^2}$$

$\therefore$ From Eqs. (i) and (ii)

$$K = \frac{K_2}{K_1}$$

67. $4NH_3(g) + 5O_2(g) \longrightarrow 4NO(g) + 6H_2O(l)$

4 mol + 5 mol $\longrightarrow$ 4 mol + 6 mol

According to equation

1 mole of O_2 requires $= \frac{4}{5} = 0.8$ mole of NH_3

While 1 mole of NH_3 requires

$$= \frac{5}{4} = 1.25 \text{ mole of } O_2$$

As there is 1 mole of NH_3 and 1 mole of O_2. So, all oxygen will be consumed.

68. At absolute zero temperature, entropy of a perfectly crystalline substance is taken to be zero.

It is called third law of thermodynamics.

69. Activation energy can be calculated by using Arrhenius equation. The Arrhenius equation is-

$$\log \frac{k_2}{k_1} = \frac{E_a}{2.303R}\left[\frac{T_2 - T_1}{T_1 T_2}\right]$$

where k_1 and k_2 = rate constant at two different temperatures

E_a = Activation energy

R = Gas constant

So, activation energy of a chemical reaction can be determined by evaluating rate constants at two different temperatures.

70. Isothermal means temperature is constant.

At constant temperature, change in internal energy (ΔE) remains constant.

So, $\Delta E = 0$

71. $\Delta G = -nE^\circ F$

For concentration cell

$$E = \frac{RT}{nF} \ln \frac{C_2}{C_1}$$

In it R, T, n and F are constant.

So E is based upon $\ln C_2 / C_1$

$\Delta G = -nEF$

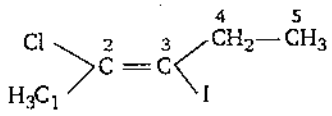
$$= -nF \times \frac{RT}{nF} \ln \frac{C_2}{C_1} = -RT \ln \frac{C_2}{C_1}$$

So, at constant temperature ΔG depends upon $\ln C_2 / C_1$

72. In electrochemical series Al is placed above Zn and all others are present below Zn. So, aluminium displaces zinc from $ZnCl_2$ solution. Hence, it cannot keep in contact with Al

$2Al + 3ZnCl_2 \longrightarrow 2AlCl_3 + 3Zn$

73. The soap concentration at which micelles first appear is called as critical micelle concentration (CMC). At this condition the surfactant molecules associate with each other.

74. 

In these groups preferential order is
$-Cl > -CH_3$ and $-I > -CH_2-CH_3$

Hence, more preferential order containing groups are attached in opposite sides. So it is *E (trans)* isomer.

Thus its name is *trans*-2-chloro-3-iodo-2-pentene

75. Chiral carbon is that carbon whose all the four valencies are satisfied by four different groups. Due to absence of asymmetric (Chiral) C-atom

$$D-CH_2-CH_2-CH_2Cl$$

molecule is not a chiral molecule

76. The electronegativity follows the order N < O < F. So due to electronegative character the order of $-I$ effect is :

$$-NR_2 < -OR < -F$$

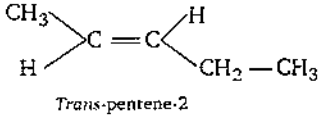
77. Dimethyl ether does not show nucleophilic attack due to absence of multiple bond.

Other compounds have multiple bond C-atom and bears partial positive charges therefore they undergo nucleophilic attack by OH^- ions.

78. $CH_3-\underset{\underset{Br}{|}}{CH}-CH_2-CH_2-CH_3 \xrightarrow{C_2H_5O^-K^+}$

2-bromopentane

$$CH_3-\overset{+}{C}H-CH_2-CH_2-CH_3 \xrightarrow[-H^+]{(-Br^-)}$$



Trans-pentene-2

79. $CH_2-CH_2 + \overset{\delta-}{R}-\overset{\delta+}{Mg}X \longrightarrow$

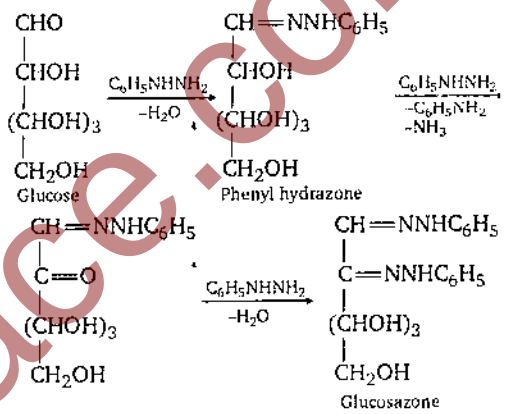
Ethylene oxide

$$R-CH_2-CH_2-O-MgX$$

$$R-CH_2-CH_2-OH \xleftarrow{H_3O/H^+}$$

$+ Mg(OH)X$

80.



Glucose → Phenyl hydrazone → Glucosazone

Thus only three phenyl hydrazine molecules and one molecule of glucose is required to form osazone.

81. Iodoform test is given by compounds which have

CH_3-CO-group or $CH_3-\underset{\underset{OH}{|}}{\overset{\overset{H}{|}}{C}}-$ group.

Hence, 2-pentanone, C_2H_5CHO and C_2H_5OH give this test $CH_3CH_2CH_2COCH_3$

2-pentanone

and 3-pentanone $CH_3CH_2COCH_2CH_3$ does not give idoform test.

$$CH_3-COCH_2-CH_2-CH_3 + 3I_2 + 4NaOH$$
$$\rightarrow \underset{\text{Iodoform (yellow ppt.)}}{CHI_3\downarrow} + CH_3CH_2CH_2COONa$$

$$+ 3NaI + 3H_2O$$

$$CH_3-CHO + 3I_2 + 4NaOH \longrightarrow$$
$$\underset{\text{Iodoform (yellow ppt.)}}{CHI_3\downarrow} + HCOONa$$

$$+ 3NaI + 3H_2O$$

$$C_2H_5OH + 4I_2 + 6NaOH \longrightarrow \underset{\text{Iodoform (yellow ppt.)}}{CHI_3\downarrow}$$

$$+ HCOONa + 5NaI + 5H_2O$$

In it following reaction is possess

$$(C_2H_5OH \xrightarrow{I_2} CH_3-CHO \xrightarrow{I_2+NaOH} CHI_3)$$

$$CH_3-CH_2-CO-CH_2-CH_3 + I_2$$
$$+ NaOH \longrightarrow \text{No reaction}$$

82. $C_6H_5COOC_2H_5$ (A) $\xrightarrow{CH_3MgBr}$ $C_6H_5-\underset{CH_3}{\overset{OMgBr}{\underset{|}{\overset{|}{C}}}}-OC_2H_5$

$\xrightarrow{-(C_2H_5-O)MgBr}$ $C_6H_5-\underset{CH_3}{\overset{OMgBr}{\underset{|}{\overset{|}{C}}}}-CH_3$ $\xleftarrow{CH_3MgBr}$ $C_6H_5-\overset{O}{\overset{\|}{C}}-CH_3$

$\xrightarrow{H_2O}$ $C_6H_5-\underset{CH_3}{\overset{OH}{\underset{|}{\overset{|}{C}}}}-CH_3$ $\xrightarrow[-H_2O]{\text{Conc. } H_2SO_4}$ $C_6H_5-\underset{CH_3}{\overset{}{\underset{|}{\overset{|}{C}}}}=CH_2$ (B)

$C_6H_5-\underset{CH_3}{\overset{}{\underset{|}{\overset{|}{C}}}}=CH_2 \xrightarrow{O_3/H_2O} C_6H_5-\overset{O}{\overset{\|}{C}}-CH_3$ (C_8H_8O)

$C_6H_5-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow[NaOH]{I_2} CHI_3 + C_6H_5COONa$

Iodoform

83. It is due to presence of α-hydrogen atom in ester

(a) $CH_3-CH_2-CH_2-CH_2-$

$C(=O)-O-C_2H_5 + H-CH(CH_2-CH_2CH_3)-COOC_2H_5$

$\xrightarrow[\text{condensation}]{\text{Claisen}}$

$CH_3-CH_2-CH_2-CH_2-\underset{O}{\overset{}{C}}-\underset{CH_2-CH_2-CH_3}{CH}-COOC_2H_5 + C_2H_5OH$

(b) $C_6H_5COOC_2H_5 + C_6H_5COOC_2H_5$

⟶ No reaction because for Claisen condensation an ester with two α-hydrogens atoms are required

(c) $C_6H_5-CH_2CO-OC_2H_5 + H-CH(C_6H_5)-COOC_2H_5$

$\xrightarrow[\text{condensation}]{\text{Claisen}}$ $C_6H_5CH_2COCHCOOC_2H_5$ (C_6H_5)

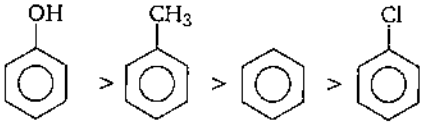
(d) $C_6H_{11}CH_2CO-OC_2H_5 + H-CH(C_6H_{11})-COOC_2H_5$

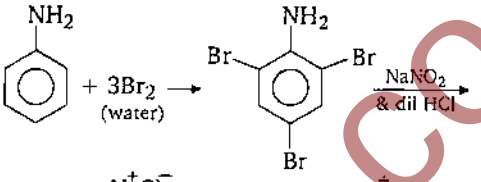
$\xrightarrow[\text{condensation}]{\text{Claisen}}$ $C_6H_{11}CH_2COCH(C_6H_{11})-COOC_2H_5 + C_2H_5OH$

84. Arenes undergoes electrophilic substitution reactions. Arenes do not give electrophilic addition reaction in normal state.

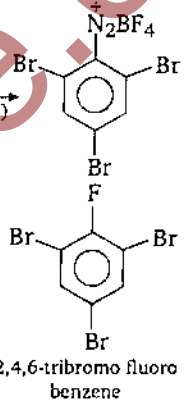
85. —Cl atom shows *o/p*-directive influence but deactivate the benzene ring, while —OH and —CH_3 groups show *o/p* influence but activates the benzene ring but in these —OH group activate the benzene ring more than —CH_3.

Hence, order of electrophilic substitution is

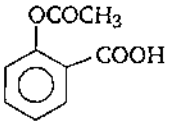


86. 

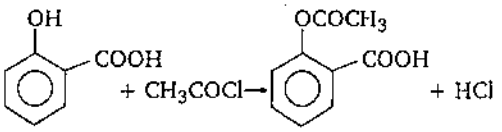
2,4,6-tribromo benzenediazonium chloride



2,4,6-tribromo fluoro benzene

87. Aspirin is 

which is acetylated product of salicylic acid (*o*-hydroxy benzoic acid).



Salicylic acid — Acetyl salicylic acid (Aspirin)

88. The number of molecules of ATP (Adenosine tri phosphate) produced in lipid metabolism of a molecule of palmitic acid is 130.

89. DNA has a double helical structure. These helix contains polynucleotide chains and these chains are held together by hydrogen bonds. In these polynucleotide chain of DNA, adenine has thymine opposite to it and guanine has cytosine opposite to it.

90. First ionisation potential of Be (completely filled orbital) is greater than boron due to stable configuration

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

$_5B = 1s^2, 2s^2 2p^1$

Order of attraction of electrons towards nucleus $2s > 2p$, so more amount of energy is required to remove the electron with $2s$-orbital in comparison to $2p$ orbital. So ionisation potential of Be is 9.32 eV and B is 8.29 eV.

91. Total isomers of the given complex are four. These are—

(i) $[Cu(NH_3)_4][PtCl_4]$

(ii) $[Cu(NH_3)_3Cl][Pt(NH_3)Cl_3]$

(iii) $[Pt(NH_3)_2Cl_2][Cu(NH_3)_2Cl_2]$

(iv) $[Pt(NH_3)_4][CuCl_4]$

92. Oxidation number of central ion (Pt) = +4 and ligands are arranged in alphabetical order. So, triammine bromo chloro nitro platinum (IV) chloride.

93. $[Co(NH_3)_5NO_2]Cl_2 \rightarrow [Co(NH_3)_5NO_2]^{2+} + 2Cl^-$

$2Cl^- + 2AgNO_3 \longrightarrow 2AgCl + 2NO_3^-$

94. Oxidation state shown by elements are as—

La = + 3

Europium (Eu) and gadolium (Gd) = + 2 and +3

Americum (Am) = + 2, + 3, + 4, + 5 and + 6

Am shows maximum number of differer oxidation state due to its larger size and lo ionisation energy.

95. Graphite produces impurity in pig iron. Pig iro contains 2.5 to 5.0% of carbon.

96. Only Na gives golden colour to bunsen flame. S *A* is Na.

$$\underset{'A'}{2Na} + 2H_2O \longrightarrow \underset{'C'}{2NaOH} + \underset{'B'}{H_2}\uparrow$$

$$\underset{'D'}{Zn} + \underset{'C'}{2NaOH} \longrightarrow Na_2ZnO_2 + \underset{'B'}{H_2}\uparrow$$

$$\underset{'D'}{Zn} + \text{dil. } H_2SO_4 \longrightarrow ZnSO_4 + \underset{'B'}{H_2}\uparrow$$

Na, produces golden yellow colour wit smokeless flame of bunsen burner.

97. $Fe + \text{dil. } H_2SO_4 \longrightarrow FeSO_4 + H_2\uparrow$

$3Fe + 4H_2O \xrightarrow{\text{Steam}} Fe_3O_4 + 4H_2\uparrow$

Cu is below H in electrochemical series.

$Cu + \text{dil. } HCl \longrightarrow$ No reaction

$2Na + C_2H_5OH \longrightarrow 2C_2H_5ONa + H_2\uparrow$

98. Bromine is soluble in CCl_4 and CS_2. Anim charcoal also adsorbs on bromine water. B marble has no action with Br_2. So, after addi $(CaCO_3)$ marble piece to the flask, there will no decreament in the intensity of brown colour

99. Ammonium sulphate is a salt of weak base ar strong acid. The aqueous solution of ammoniu sulphate is acidic, so, it produces acidity.

100. $Cr^{3+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^3$ (coloured)

$Zn^{2+} = 1s^2, 2s^2, 2p^6, 3s^2 3p^6 3d^{10}$ (colourless)

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

$Ti^{4+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6$ (colourless)

(Colour is produced due to presence of unpair electron.)

Biology

101. Vegetative reproduction is the process of multiplication in a small part or portion of the plant body which functions as a propagule and develops into a new individual. Thus, vegetative reproduction does not involve meiosis; hence, recombination and no loss of heterozygosity.

102. In a normal human being, the systolic and diastolic pressure are 120 mm Hg and 80 mm

103. In case a translocation is present in one of t two sets of chromosomes, this will translocation heterozygote. In such organism, normal pairing into bivalents wou not be possible. Instead, pairing betwe homologous segments of chromosome wou result in an 'X' shaped arrangement involvi four chromosomes (multivalent).

104. Biogenetic law as propounded by **Ernst Haeckel** in 1860. According to it, during its development an animal passes through ancestral adult stages.

105. Myosin-II, a two-headed tailed variety of myosin is involved in muscle contraction.

106. At one time, citric acid was commercially prepared from concentrated lemon juice. But now its main source is the fermentation of sugar with *A. niger*.
Citric acid has an extraordinary range of uses. It gives tartness and flavor to the foods. It is an antioxidant and pH adjuster in many foods and dairy products, it often serves as an emulsifier.

107. Cells of lymph nodes (i) produce lymphocytes (ii) synthesize antibodies (iii) destroy bacteria by phagocytosis.

108. Histamine is a potent vasodilator formed by decarboxylation of the amino acid histidine and released by mast cells in response to appropriate antigens.
Mast cells are especially prevalent in the connective tissue of the skin and respiratory tract and in surrounding blood vessels.

109. A variety of the enteric group of bacteria (facultative, aerobic) reside in the human large intestine (*e.g.*, *E. coli*). Therefore, their presence in water supply indicates that water supply has been contaminated by sewage.

10. In *Cycas*, transfusion tissue consists of a few layers of transversely elongated cell present in both wings just in between the palisade and spongy parenchyma. In *Pinus*, many transfusion cells are present interspersed with albuminous cells and parenchymatous cells.

11. The stomach controls the production of gastric juice by means of a digestive hormone called **gastrin**. It is produced by endocrine (hormone secreting) cells that are scattered throughout the epithelium of the stomach.

12. Phytochrome has two forms - P_R and P_{FR} which absorb red light and far-red light respectively. Phytochromes are pigment molecules that absorb light energy and undergo changes in their chemical structure as a result of this energy absorption.

13. Vessels are absent from the xylem of all gymnosperms (except Gnetales). *Cycas* belongs to Cycadales (not Gnetales).

114. Flora of thorn forests include *Prosopis cineraria, Acacia senagal, Capparis decidua, Salvadora oleoides, Asparagus racemosus, Ephedra foliata.*

115. Plants, found in an ecosystem are known as producers, because they can prepare food for theirself by the process of photosynthesis.The energy fixed by the autotrophs during photosynthesis gets incorporated into organic compounds. The rate at which organic molecules are formed in a green plant (or a population of green plants) is called gross primary productivity.

116. The pulp cavity contains a mass of dense but soft connective tissue which is called **pulp**. A single layer of **odontoblast cells** is lined the pulp cavity. These cells secrete **enamel** which is a bluish white shiny translucent and the hardest substance of the body.

117. 2, 4-D (2, 4 dichlorophenoxy acetic acid) is an auxin hormone. It overstimulate the growth activities of the cells of the root due to which roots get destroyed and thus plants finally destroy. 2, 4-D is used as a defoliant for broad leaved dicots (mainly weeds).

118. Environmental resistance is against biotic potential. A population tends to decrease by mortality (death) and emigration. Mortality is opposite to reproduction.

119. Vitamin B_{12} (cyanocobalamin) promotes DNA synthesis, maturation of erythrocytes and myelin formation. Vitamin D is also known as calciferol. It is necessary for the formation of healthy bones and teeth. Vitamin A is also knwon as retinol. It is necessary for proper body growth and night vision. Vitamin C is also known as ascorbic acid. It helps in wound healing, blood formation and absorption of iron.

120. Thyroxine (T_4) and triiodo-thyroxin (T_3) hormones are secreted by the thyroid follicular cells. These hormones maintain the basal metabolic rate (BMR) of the body.

121. Gynandromorphs are those individuals in which one part of the body is female while another part is male. It occurs due to irregularity in mitosis at the first clevage of the zygote. One of the X-chromosomes of an XX (female) zygote lags in the spindle, one daughter nucleus receives only one X-chromosomes while the other receives

X-chromosomes. A mosaic body pattern is thus established.

122. When yeast is added to sugar solution, it causes fermentation leading to the formation of alcohol.

123. In addition to CO_2, some other gases also contribute to green-house effect. These include ozone, CFCs, nitrous oxide and even methane. Nitrous oxide is produced by denitrifying bacteria acting on artificial fertilizers applied to poorly aerated soils.

124. Carbon monoxide, when inhaled, combines with blood haemoglobin to form carboxyhaemoglobin at a rate 210 times faster than the rate oxygen forms oxyhaemoglobin. Thus, respiration is impaired.

125. Ratio of cytokinin to auxin controls cell differentiation. If there is more cytokinin than auxin, shoot buds develop. Relatively more auxin than cytokinins leads to the development of roots. Abscisic acid (ABA) is known as natural plant growth inhibitor. Gibberellin stimulates stem elongation, leaf expension, bolting flowering etc. Ethylene is a fruit ripening hormone.

126. Oxygen diffuses from alveoli to deoxygenated blood, and CO_2 diffuses from deoxygenated blood to alveoli by simple diffusion. Diffusion is defined as, the flow of the substance (gases) from a region of their higher concentration to a region of lower concentration.

127. CO_2 layer around earth surface acts as insulator and does not allow heat of the earth to escape into space thus keeping the earth warm.

128. Pleiotropy is the condition in which a single gene influences more than one traits, *e.g.*, gene for single cell produces anaemia as well as resistance to malaria.

129. Usually, fertilization of female egg by male gamete results in the formation of zygote. In angiosperms, however, a second fertilization of secondary polar nucleus by another male gamete leads to the formation of triploid primary endosperm nucleus. This nucleus is divided by successive or simulataneous type of division and forms a multicellular structure called as endosperm which provides nutrition to developing embryo.

130. 1 Femur + 1 fibula + 1 tibia + 1 patella + 7 tarsals + 5 meta tarsals + 14 phalanges make one hind limb of man.

131. It is possible that at least two traits might have been linked, and had not assorted independently.

132. Dentary is tooth bearing membrane bone of lower jaw of the vertebrates-one on each side.

133. *Clostridium botulinum* bacterium causes food poisoning (botulism). *Clostridium* is an obligate anaerobic endospore-forming gram positive rod shaped bacterium.
This bacterium produces an exotoxin which is highly toxic for the synaptic ends of the nerves where it blocks the release of **acetylcholine**. Later is a chemical necessary for the transmission of nerve impulse across the synapses.

134. Free-living (non-symbiotic) bacteria like *Azotobacter* and *Bacillus polymyxa* fix atmospheric nitrogen and make it available to crop plants. **VAM (Vascular Arbuscular Mycorrhizae)** is an endosymbiosis between fungi and roots of higher plants.

Anabaena is a cyanobacterium (blue-green algae) which live solitary or in association with other plant and can fix atmospheric N_2.
Rhizobium bacterium makes symbiotic association with leguminous plants.

135. Use of contraceptive pills is a wide spread form of birth control. Contraceptive pills contain estrogen and progesterone. The production of the pituitary hormones FSH and LH in the normal sexual cycle of a female is shut down by these hormones. In the absence of FSH, the ovarian follicles do not ripen and ovulation does not occur in the absence of LH.

136. Cholecystokinin (also called pancreozymin) is a hormone of mucosa of small intestine. It is released in the response to chyme. it causes pancreas to release pancreatic enzymes and gall bladder to eject bile.

137. Microtubules are one of the essential protein filaments of the cytoskeletons of probably all eukaryotic cells and of their cilia, flagella, basal bodies, centrioles and mitotic and meiosis spindles. Each microtubule is made up of a

hollow cylinder of 13 protofilaments of the tubulin protein. The diameter of each microfibril is 25 nm. The function of microtubule is to guide organelle and chromosome movement in the cell, cause cell elongation and help in movements of cilia/flagella.

138. The term "hot spots" was used by Benzer for the sites which are more mutable than other sites.Studies in 1978 revealed that 5-methyl cytosine residues occur at the position of each hot spot.

139. *Dryopithecus* lived about 20-25 million years ago. *Dryopithecus* had the combined characters of great apes, old world monkeys and man. The main structural characteristics of *Dryopithecus* are broaded jaws, large canines, semierect walking, 5 cusped molars and absence of brow ridges.

140. The word activated sludge system is derived from the practice of adding to the incoming sewage some of the sludge from a previous batch. This sludge inoculum contains large numbers of metabolizing bacteria, together with yeasts, molds and Protozoa. An especially important ingredient of the sludge are species of *Zoogloea* bacteria, which form flocculant masses (floc) in the aereation tanks. The activity of these aerobic micro-organisms oxidizes much of the effluent's organic matter into carbon dioxide and water. When the aeration phase is completed, the floc (secondary sludge) is allowed to settle to the bottom, just as the primary sludge settles in primary treatment.

141. Vegetative parts are relatively less stable and exhibit changes due to environmental factors quite readily. On the other hand, floral features are more conservative and can be relied upon. On the basis of reproductive parts of different flowers Linnaeus classified plants into different groups.

142. Calcitonin is a polypeptide hormone which lowers calcium and phosphate levels of plasma by inhibiting bone degradation and stimulating their uptake by bone. Parathyroid hormone elevates calcium level in blood.

143. $1\times10^5 \xrightarrow{35\text{min}} 2\times10^5 \xrightarrow{70\text{min}} 4\times10^5 \xrightarrow{105\text{min}} 8\times10^5 \xrightarrow{140\text{min}} 16\times10^5 \xrightarrow{175\text{min}} 32\times10^5$

144. Klinefelter's syndrome is formed by union of an XX egg and a normal Y sperm or normal X egg and abnormal XY sperm. The individual thus has 47 chromosomes (44 + XXY). Such persons are sterile males with undeveloped testes, mental retardation etc.

145. Phellogen or cork cambium is a part of periderm. It presents between phellem or cork towards outerside and phelloderm or secondary cortex towards inner side. Phellogen appearing in the cortical regions cuts off new cells for extrastelar secondary growth—cork on the outer side and secondary cortex on the inner side.

146. Lactose ($C_{12}H_{22}O_{11}$) is a disaccharide found in mammalian milk. It comprises galactose and glucose units which are linked together by β, 1-4 glycosidic bonds. It is a reducing sugar.

147. *Puccinia graminis tritici* (fungus) causes black rust of wheat. It is a heteroecious parasite *i. e.*, it's life cycle completes within two hosts. It's dikaryotic phase completes on wheat plant *(Triticum aestivum)* which is also known as primary host while its haplophase completes on leaves of barbery plant *(Barberis vulgaris)* which is also known as secondary host. Urediospores (uredia) and teleutospores (telia) are formed on wheat leaves.

148. In the beginning of S phase, DNA replication occurs. DNA replication can occur in diffuse/less tightly coiled euchromatin.

149. Cellulose $(C_6H_{10}O_5)_n$ is the most abundant organic polymer. It is a polysaccharide and consists of long unbranched chains of glucose residues linked by β, 1-4 glycosidic bonds. In plants, cellulose is formed from sugar. It serves as building material in the formation of cell wall.

150. Malathion is one of the most widely used organophosphate. It combine with the phosphorus molecule of enzyme cholinesterase and inhibiting its normal functioning.

151. Fossorial animals are adapted to digging, burrowing to live under-ground inside burrows.

152. The bones of birds are pneumatic (*i. e.*, they have air cavities) to reduce weight which help them in flying.

153. *Ulothrix* is a fresh water, filamentous green algae, found in rather cold flowing water. Sexual reproduction in *Ulothrix* is **isogamous** type *i.e.*, it takes place between two morphological similar motile, flagellated male and female gametes which come from different filaments.

154. First pair AA is homozygous, hence it will contribute only one type of genes to gametes, Bb will yield two types of gametes—B and b similarly, Cc will yield two types of gametes—C and c. Hence, $1 \times 2 \times 2 = 4$ types of gametes would be produced having the genotypes

ABC, ABc, AbC and Abc

155. Lacteals are lymph vessels draining villi of vertebrate small intestine. After digestion, reconstituted fats are released into lacteals as chylomicrons.

156. Ethylene is a gaseous hormone which promotes ripening of fruits. **Methionine amino acid** is precursor molecule for ethylene synthesis. Ethylene synthesis takes place in all parts of a plant such as roots, stem, leaves fruits, seeds etc.

157. In prokaryotes (bacteria) most of the genetic material is included in a closed circular molecule of DNA that resides in the **nucleoid region**. Later is a portion of a prokaryotic cell which is not bounded by membranes.

158. Destruction of habitat (including felling of trees) exposes wildlife to a number of adverse factors leading to diminishing of their numbers.

159. Inorganic substances, oils, plant extracts used as insecticides are called first generation pesticides; synthetic organic compounds as second generation pesticides; whereas insect hormones as third generation pesticides. **Pheromones** are the chemical substances which when released into an animal's surroundings, influence the behaviour or development of other individuals of the same species.

160. Sunflower is a dicotyledonous plant; so the number of cotyledons in sunflower is two. Monocotyledons contains only one cotyledon in their embryo.

161. The genes present on the same chromosome do not always remain together. These usually get separated and recombine with genes present on homologous chromosomes to form new combinations (recombinants).

162. Huge amount of plants, animals and human wastes are decomposed by bacteria and fungi present in environment and Large quantity of CO_2 necessary for photosynthesis is released into the atmosphere.

163. The terms anuria, oligonuria, polynuria and dysuria are used for absence of urine, scanty urine, large amounts of urine, and painful urination respectively. Deamination is the removal of an amino ($-NH_2$) group frequently from an amino acid by transaminase enzymes.

164. AIDS (Acquired Immunodeficiency Syndrome) was first reported in U.S.A in 1981. It is caused by **HIV (Human Immunodeficiency Virus)**. HIV is the member of retroviruses. Later are so named because they contain enzyme revers transcriptase, which mediates the formation of DNA from RNA. The genetic material of HIV is single stranded RNA.

165. Kwashiorkor is a protein deficiency disease (no calorie deficiency but structural). Its common symptoms are wasting of muscles, thinning of limbs, failure of growth and brain development; and diarrhoea.

166. *Cycas* is a gymnospermic plant. It has the biggest sperms (antherozoids) and ovules in the plant world.

167. Restriction endonuclease is a class of endonucleases which cleaves double stranded DNA at specific base sequences, called restriction sites. **W. Arber** postulated the presence of restriction enzymes, while first true restriction endonuclease was isolated in 1970 by **Smith *et. al.,*** for which they were awarded Nobel Prize in 1978.

168. The term water potential indicates the net tendency of any system to donate water to its surroundings. The water potential of pure water at atmospheric pressure is zero. Any addition of solute to this water reduces it's water potential and makes it's value negative. The osmotic potential of pure water also would be zero.

169. Restriction endonucleases work as knives, and are used to chop out required segments of DNA.

170. Leydig cells (= interstitial cells) are group of relatively scanty cells in the interstices between seminiferous tubules of the vertebrate testes and are responsible for production of steroids specially testosterone.

171. Agent orange, so called because of distinctive orange stripe on its packaging, combines equal parts of 2, 4-D and 2, 4, 5-T; was later on found to contain a highly poisonous chemical dioxin as impurity.

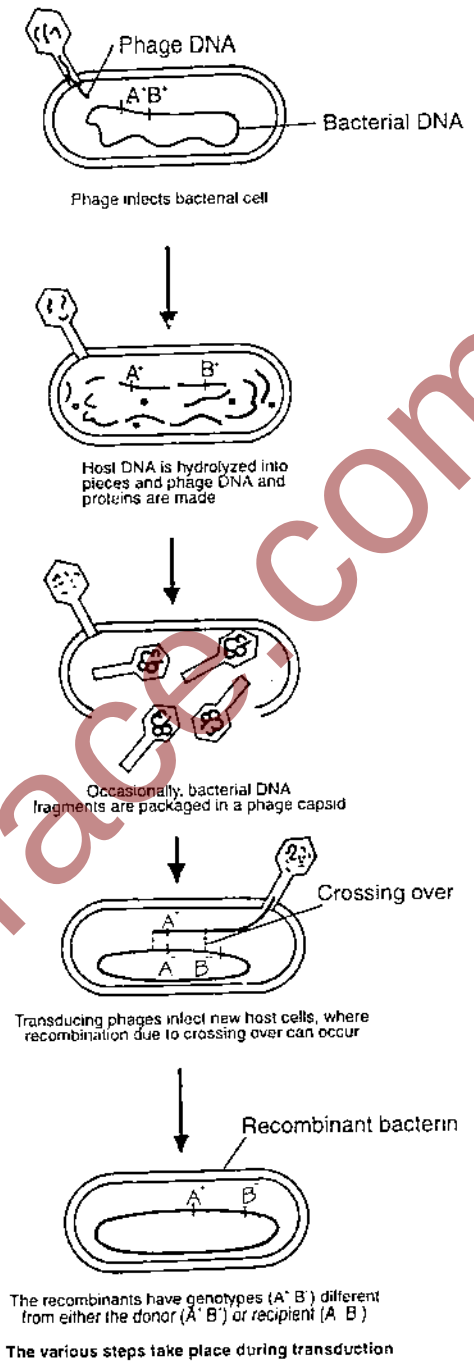
172. The switching on and off of an operator is controlled by respressor protein which is coded by the regulator gene *R*.

173. *Anabaena azollae*, a cyanobacterium living in the cavities of fern *Azolla* fixes atmospheric nitrogen and releases it into the leaf cavity of the fern. Farmers have reported over 50% higher yields by using *Azolla*.

174. Ozone layer is found in the stratosphere. It protects us from the harmful UV radiations come from sun. The supersonic aircrafts flying at stratospheric heights cause major disturbances in ozone level due to releasing of CFCs.

175. Since albinism is a recessive character, a child will be albino only if it is homozygous for albinism genes. Since parents have normal skin, it means they are heterozygous. As a result of cross between two heterozygous parents, 25% of the children will be homozygous recessive. The nature of the second child is not affected in any way by the nature of the first child because both are independent events.

176. During transduction, a small double-stranded piece of DNA is transferred from donor to recipient by a bacteriophage. Transduction does not involve physical contact between donor and recipient strains.



The various steps take place during transduction

177. Dicot stem produces a cork cambium or **phellogen** in the region of outer cortical cells. Phellogen produces phellem or cork towards outerside. Phellem is consisted of dead and compactly arranged cells which contains suberized cell walls while towards innerside phellogen produces secondary cortex or **phelloderm** which contains collenchymatous or parenchymatous cells. The phellem, phellogen and phelloderm are collectively called as **Periderm**. It protects internal tissues and prevents water loss.

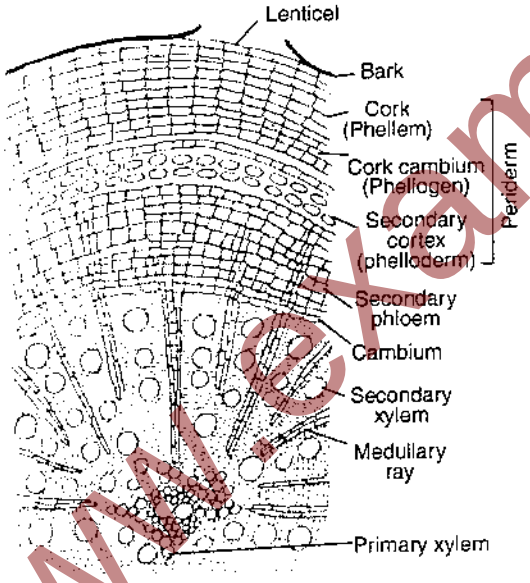


Fig : TS. of a Dicot stem

178. *Salmonella typhi* causes typhoid fever in human beings. It is characterized by constant fever due to infection of intestine. *Giardia* is a flagellate protozoan, *lamblia* species of this protozoan causes disease giardiasis, a prolonged diarrheal disease of humans.
Bacterial genus *Shigella* causes shigellosis or **bacillary dysentery**.
Escherichia coli is a facultative anaerobes, found in the intestine of human beings.

179. True alternation of generations is alternation between haploid gametophyte and diploid sporophyte phase. In *Obelia*, both polyploid and medusoid bodies are diploid, and this type of life cycle is called metagenesis.

180. *Adiantum* is called walking fern. The tips of its leaves, on coming in contact with the soil, gives out adventitious roots which in turn produce new leaves and develop into new plants.

181. A skeletal muscle consists of a bundle of long fibers running the length of the muscle. Each fiber is a single cell with many nuclei.
Skeletal muscle is also called striated muscle because the regular arrangement of the myofilaments creates as repeating pattern of light and dark bands. Each repeating unit is a **sarcomere**, the basic functional unit of the muscle. The borders of the sarcomere, the **Z lines**, are lined up in adjacent myofibrils and contribute to the striations visible with a light microscope. The thin filaments are attached to the Z lines and project toward the center of the sarcomere while the thick filaments are centered in the sarcomere. At rest the thick and thin filaments do not overlap completely, and the area near the edge of the sarcomere where there are only thin filaments is called the **I band**. The **A band** is the broad region that corresponds to the length of the thick filaments. The thin filaments do not extend completely across the sarcomere, so the **H zone** in the center of the **A band** contains only thick filaments. This arrangement of thick and thin filaments is the key to how the sarcomere and hence the whole muscle contracts.

182. Bryophyta is a group of cryptogams. Main plant body of bryophytes is gametophytic (haploid). It bears male and female sex organs. The antherozoids (sperms) of bryophytes are flagellated (motile) and need a film of water to swim through for reaching the archegonium.

183. Three types of genomes found in green plant cell are (i) nuclear genome, (ii) mitochondrial genome and (iii) chloroplast genome.

184. Genetic engineering was made possible by the discovery and development of a number of tools and techniques. Perhaps most important was the discovery of **restriction endonucleases** which are produced by bacterial cells. These enzymes can be used to cut DNA from different sources into pieces that are easy to recombine *in vitro* means in glass *i. e.*, in test tube

185. Birds of Galapagos islands (Darwin's finches) are believed to have evolved from ancestors on the South American mainland as a result of natural selection due to different feeding niches available to them.

186. Transposons are genetic elements varying from 750 base pairs to 40 kilobase pairs in length and can move from a site in one genome to another site in the same or in a different genome.

187. Cytochrome is not a coloured cell, instead this is a respiratory pigment-mixture of iron and protein-which are electron acceptors.

188. Genetic drift may be of significance in small populations only, where alleles may easily get extinct by chance alone.

189. For its pollination the orchid *Ophrys speculum* has picked on the most selective attraction in the entire animal kingdom. It is pollinated by a hairy wasp, *Colpa aurea*. The wasp has a fixed habit whereby its males leave the burrows for above-ground existence about four weeks before the females emerge for the open-air mating. The orchid opens its flowers about the same time the males appear and they possess an appearance and odour similar to those possessed by the female wasps. The inexperienced males mistake the *Ophrys* fowers for their female counterparts and land to perform the act of pseudo-copulation. The insect repeats the act with a number of orchid flowers and carries pollinia from one flower to another. This insect-plant relationship is beneficial only to the plant.

190. Photoperiodism is the term to denote a biological response to changes in the ratio of light and darkness in a 24 hour cycle.

191. El Nino is a warm ocean surge of Peru current (flowing north from Antarctic along the west coast of South America to S. Ecuador, the west). It recurs every 5-8 years or so in the E. Pacific off South America.

192. For the classification of living organisms **R.H. Whittaker** (1969) proposed a five kingdom system of classification. He designated these five kingdoms as :

(a) **Monera**—It includes all prokaryotic organisms including bacteria and blue-green algae.

(b) **Protista**—It includes eukaryotic unicellular organisms *e. g.*, *Amoeba*.

(c) **Plantae**—It includes algae, bryophytes, pteridophytes, gymnosperms and argiosperms.

(d) **Fungi**—It includes fungi.

(e) **Animalia**—It includes multicellular animals.

193. Genetic engineering is the manipulation of genetic material of an organism using enzyme restriction endonuclease. **Nathans** and **Smith** (1970) isolated the first restriction endonuclease. **Jackson, Symons** and **Paul Berg** (1972) successfully generated recombinant DNA molecules *in vitro*.

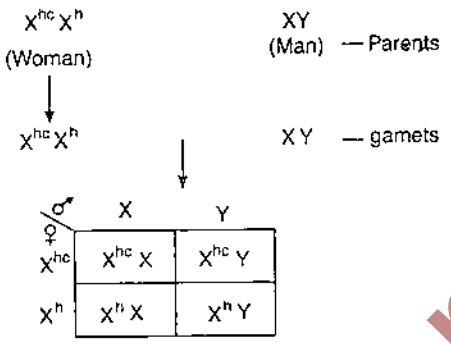
194. Till today, the most important tool in genetic engineering of plants has been the Ti plasmid of soil bacterium, *Agrobacterium tumefaciens*. *E. coli* has been extensively used for genetic engineering in animals *e.g.*, Production of humulin, somatotropin.

195. Species restricted to small areas are called endemic; approximately 29% of dicots in the Himalayas are endemic.

196. *Homo erectus* was replaced by *Homo sapiens*.

197. There is 90% loss at every trophic level. There is maximum energy, therefore, at T_1 level.

198. Haemophilia and colour blindness both are **recessive X-linked traits**. They express in males when present in single copy (heterozygous) but in females they express only when present in homozygous condition.



Results : (a) 50% sons are colourblinds and haemophilic.

(b) 50% sons are haemophilic only.

(c) 50% daughter are carrier for colour blindness and haemophilia.

(d) 50% daughter are carrier for haemophilia only.

199. Solenocytes (also called **flame cells)** are meant for excretion and osmoregulation in platyhelminthes.

Annelids have **metanephridia** for excretion

Molluscs have **kidneys** (although different from vertebrate kidneys) for excretion.

In echinodermates no especial excretory organs are found for excretion. In them excretion takes place through diffusion or osmosis or through active transport.

200. The lipids of archaebacteria are branched chain lipids, long chain branched alcohols, phytanals, ether linked to glycerol, This helps them withstand extreme conditions and temperature.

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