CBSE

MEDICAL ENTRANCE

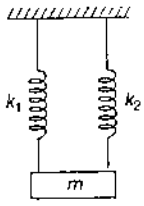
SOLVED PAPER 2002

Physics

1. The value of Planck's constant is :
(a) 6.63×10^{-34} J/s
(b) 6.63×10^{-34} kg-m/s
(c) 6.63×10^{-34} kg-m^2
(d) 6.63×10^{-34} J-s

2. A disc is rotating with angular velocity ω. If a child sits on it, what is conserved ?
(a) Linear momentum
(b) Angular momentum
(c) Kinetic energy
(d) Moment of inertia

3. A mass is suspended separately by two springs of spring constants k_1 and k_2 in successive order. The time periods of oscillations in the two cases are T_1 and T_2 respectively. If the same mass be suspended by connecting the two springs in parallel, (as shown in figure) then the time period of oscillations is T. The correct relation is :



(a) $T^{-2} = T_1^2 + T_2^2$ (b) $T^{-2} = T_1^{-2} + T_2^{-2}$
(c) $T^{-1} = T_1^{-1} + T_2^{-1}$ (d) $T = T_1 + T_2$

4. When a damped harmonic oscillator completes 100 oscillations, its amplitude is reduced to $\frac{1}{3}$ of its initial value. What will be its amplitude when it completes 200 oscillations ?
(a) $\frac{1}{5}$ (b) $\frac{2}{3}$ (c) $\frac{1}{6}$ (d) $\frac{1}{9}$

5. A circular disc is to be made using iron and aluminium. To keep its moment of inertia maximum about a geometrical axis, it should be so prepared that :
(a) aluminium at interior and iron surrounds it
(b) iron at interior and aluminium surrounds it
(c) aluminium and iron layers in alternate order
(d) sheet of iron is used at both external surfaces and aluminium sheet as inner material

6. The displacement of particle between maximum potential energy position and maximum kinetic energy position in simple harmonic motion is :
(a) $\pm\frac{a}{2}$ (b) $\pm a$ (c) $\pm 2a$ (d) ± 1

7. A solid sphere of radius R is placed on a smooth horizontal surface. A horizontal force F is applied at height h from the lowest point. For the maximum acceleration of the centre of mass :
(a) $h = R$
(b) $h = 2R$
(c) $h = 0$
(d) the acceleration will be same whatever h may be

8. P is the point of contact of a wheel and the ground. The radius of wheel is 1 m. The wheel rolls on the ground without slipping. The displacement of point P when wheel completes half rotation is :
(a) 2 m (b) $\sqrt{\pi^2 + 4}$ m
(c) π m (d) $\sqrt{\pi^2 + 2}$ m

9. A body of mass m is placed on earth's surface. It is then taken from earth's surface to a height $h = 3R$, then the change in gravitational potential energy is :
(a) $\frac{mgh}{R}$ (b) $\frac{2}{3}mgR$
(c) $\frac{3}{4}mgR$ (d) $\frac{mgR}{2}$

10. An object of mass 3 kg is at rest. If a force $\vec{F} = (6t^2\hat{i} + 4t\hat{j})$ N is applied on the object, then the velocity of the object at $t = 3$ s is :

(a) $18\hat{i} + 3\hat{j}$ (b) $18\hat{i} + 6\hat{j}$

(c) $3\hat{i} + 18\hat{j}$ (d) $18\hat{i} + 4\hat{j}$

11. If kinetic energy of a body is increased by 300% then percentage change in momentum will be :

(a) 100% (b) 150%

(c) 265% (d) 73.2%

12. A rod is of length 3 m and its mass acting per unit length is directly proportional to distance x from its one end. The centre of gravity of the rod from that end will be at :

(a) 1.5 m (b) 2.0 m

(c) 2.5 m (d) 3.0 m

13. A block of mass 10 kg is placed on a rough horizontal surface having coefficient of friction $\mu = 0.5$. If a horizontal force of 100 N is applied on it, then the acceleration of the block will be : ($g = 10\ m/s^2$)

(a) $15\ m/s^2$ (b) $10\ m/s^2$

(c) $5\ m/s^2$ (d) $0.5\ m/s^2$

14. A lift of mass 1000 kg is moving upwards with an acceleration of $1\ m/s^2$. The tension developed in the string, which is connected to lift is : ($g = 9.8\ m/s^2$)

(a) 9800 N (b) 10800 N

(c) 11000 N (d) 10000 N

15. A particle (A) is dropped from a height and another particle (B) is projected in horizontal direction with a speed of 5 m/s from the same height. Then the correct statement is :

(a) particle (A) will reach the ground earlier than particle (B)

(b) particle (B) will reach the ground earlier than particle (A)

(c) both the particles will reach the ground simultaneously

(d) both the particles will reach the ground with the same speed

16. What is the cause of "Green house effect"?

(a) Infrared rays (b) Ultraviolet rays

(c) X-rays (d) Radio-waves

17. Which of the following is close to an ideal black body :

(a) black lamp

(b) cavity maintained at constant temperature

(c) platinum black

(d) a lamp of charcoal heated to high temperature

18. Wien's displacement law expresses relation between :

(a) wavelength corresponding to maximum energy and absolute temperature

(b) radiated energy and wavelength

(c) emissive power and temperature

(d) colour of light and temperature

19. The unit of Stefan's constant is :

(a) $W \cdot m^2 \cdot K^4$ (b) $W \cdot m^2/K^4$

(c) $W/m^2 \cdot K$ (d) $W/m^2 \cdot K^4$

20. Consider two rods of same length and different specific heats (s_1, s_2), thermal conductivities (K_1, K_2) and areas of cross section (A_1, A_2) and both having temperatures (T_1, T_2) at their ends. If their rate of loss of heat due to conduction is equal, then :

(a) $K_1A_1 = K_2A_2$ (b) $\frac{K_1A_1}{s_1} = \frac{K_2A_2}{s_2}$

(c) $K_2A_1 = K_1A_2$ (d) $\frac{K_2A_1}{s_2} = \frac{K_1A_2}{s_1}$

21. The efficiency of Carnot engine is 50% and temperature of sink is 500 K. If the temperature of source is kept constant and its efficiency is to be raised to 60%, then the required temperature of the sink will be :

(a) 600 K (b) 500 K

(c) 400 K (d) 100 K

22. For a black body at temperature 727°C, its radiating power is 60 W and temperature of surrounding is 227°C. If the temperature of the black body is changed to 1227°C, then its radiating power will be :

(a) 120 W (b) 240 W

(c) 304 W (d) 320 W

23. The number of atoms per unit cell in bcc lattice is :

(a) 1 (b) 2 (c) 4 (d) 9

24. A wave of amplitude $A = 0.2$ m, velocity $v = 360\ m/s$ and wavelength 60 m is travelling along positive x-axis, then the correct expression for the wave is :

(a) $y = 0.2 \sin 2\pi\left(6t + \frac{x}{60}\right)$

(b) $y = 0.2 \sin \pi\left(6t + \frac{x}{60}\right)$

(c) $y = 0.2 \sin 2\pi\left(6t - \frac{x}{60}\right)$

(d) $y = 0.2 \sin \pi\left(6t - \frac{x}{60}\right)$

25. A whistle revolves in a circle with angular velocity $\omega = 20$ rad/s using a string of length 50 cm. If the actual frequency of sound from the whistle is 385 Hz, then the minimum frequency heard by the observer far away from the centre is : (velocity of sound $v = 340$ m/s)

(a) 385 Hz (b) 374 Hz
(c) 394 Hz (d) 333 Hz

26. The velocity of electromagnetic wave is along the direction of :

(a) $\vec{B} \times \vec{E}$ (b) $\vec{E} \times \vec{B}$
(c) $\vec{E}$ (d) $\vec{B}$

27. Diameter of human eye lens is 2mm. What will be the minimum distance between two points to resolve them, which are situated at a distance of 50 m from eye ? The wavelength of light is 5000 Å :

(a) 2.32 m (b) 4.28 mm
(c) 1.25 cm (d) 12.48 cm

28. A body is located on a wall. Its image of equal size is to be obtained on a parallel wall with the help of a convex lens. The lens is placed at a distance d ahead of second wall, then the required focal length will be :

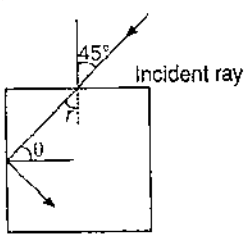
(a) only $\frac{d}{4}$

(b) only $\frac{d}{2}$

(c) more than $\frac{d}{4}$ but less than $\frac{d}{2}$

(d) less than $\frac{d}{4}$

29. For the given incident ray as shown in figure, the condition of total internal reflection of the ray will be satisfied if the refractive index of block will be :



(a) $\frac{\sqrt{3}+1}{2}$ (b) $\frac{\sqrt{2}+1}{2}$

(c) $\sqrt{\frac{3}{2}}$ (d) $\sqrt{\frac{7}{6}}$

30. Which of the following has minimum wavelength ?

(a) X-rays (b) Ultraviolet rays
(c) γ-rays (d) Cosmic rays

31. The following particles are moving with the same velocity, then maximum de-Broglie wavelength will be for :

(a) proton (b) α-particle
(c) neutron (d) β-particle

32. Which of the following is not the property of cathode rays ?

(a) It produces heating effect
(b) It does not deflect in electric field
(c) Its casts shadow
(d) It produces fluorescence

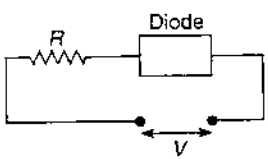
33. For a transistor $\frac{I_C}{I_E} = 0.96$, the current gain in common-emitter configuration is :

(a) 6 (b) 12 (c) 24 (d) 48

34. For conduction in a p-n junction, the biasing is :

(a) high potential on n-side and low potential on p-side
(b) high potential on p-side and low potential on n-side
(c) same potential on both p and n-sides
(d) undetermined

35. For a given circuit of ideal p-n junction diode, which of the following is correct ?



(a) In forward biasing the voltage across R is V
(b) In reverse biasing the voltage across R is V
(c) In forward biasing the voltage across R is $2V$
(d) In reverse biasing the voltage across R is $2V$

36. The specific resistance of a conductor increases with :

(a) increase in temperature
(b) increase in cross-sectional area
(c) decrease in length
(d) decrease in cross-sectional area

37. Some charge is being given to a conductor then its potential is :

(a) maximum at surface
(b) maximum at centre
(c) same throughout the conductor
(d) maximum somewhere between surface and centre

38. To convert a galvanometer into a voltmeter, one should connect a :
(a) high resistance in series with galvanometer
(b) low resistance in series with galvanometer
(c) high resistance in parallel with galvanometer
(d) low resistance in parallel with galvanometer

39. A capacitor of capacity C_1 is charged upto potential V volt and then connected in parallel to an uncharged capacitor of capacity C_2. The final potential difference across each capacitor will be :
(a) $\frac{C_2V}{C_1+C_2}$ (b) $\frac{C_1V}{C_1+C_2}$
(c) $\left(1+\frac{C_2}{C_1}\right)V$ (d) $\left(1-\frac{C_2}{C_1}\right)V$

40. For a cell the terminal potential difference is 2.2V when circuit is open and reduces to 1.8 V when cell is connected to a resistance $R = 5\Omega$, the internal resistance (r) of cell is :
(a) $\frac{10}{9}\Omega$ (b) $\frac{9}{10}\Omega$ (c) $\frac{11}{9}\Omega$ (d) $\frac{5}{9}\Omega$

41. Identical charges ($-q$) are placed at each corners of a cube of side b, then the electrostatic potential energy of charge ($+q$) placed at the centre of the cube will be :
(a) $-\frac{4\sqrt{2}q^2}{\pi\varepsilon_0}$ (b) $\frac{8\sqrt{2}q^2}{\pi\varepsilon_0 b}$
(c) $-\frac{4q^2}{\sqrt{3}\pi\varepsilon_0 b}$ (d) $\frac{8\sqrt{2}q^2}{4\pi\varepsilon_0 b}$

42. The magnetic field of a given length of wire carrying a current for a single turn circular coil at centre is B, then its value for two turns for the same wire when same current passing through it is :
(a) $\frac{B}{4}$ (b) $\frac{B}{2}$ (c) $2B$ (d) $4B$

43. A charge q moves in a region where electric field $\vec{\mathbf{E}}$ and magnetic field $\vec{\mathbf{B}}$ both exist, then the force on it is :
(a) $q\vec{\mathbf{v}}\times\vec{\mathbf{B}}$ (b) $q\vec{\mathbf{E}}+q\vec{\mathbf{v}}\times\vec{\mathbf{B}}$
(c) $q\vec{\mathbf{B}}+q\vec{\mathbf{B}}\times\vec{\mathbf{v}}$ (d) $q\vec{\mathbf{B}}+q(\vec{\mathbf{E}}\times\vec{\mathbf{v}})$

44. Two bar magnets having same geometry with magnetic moments M and $2M$, are firstly placed in such a way that their similar poles are on the same side; then its period of oscillation is T_1. Now the polarity of one of the magnets is reversed, then time period of oscillations will be :
(a) $T_1 < T_2$ (b) $T_1 > T_2$
(c) $T_1 = T_2$ (d) $T_2 = \infty$

45. For a series LCR circuit, the power loss at resonance is :
(a) $\frac{V^2}{\omega L-\frac{1}{\omega C}}$ (b) $I^2C\omega$
(c) I^2R (d) $\frac{V^2}{\omega C}$

46. A sample of radioactive elements contains 4×10^{10} active nuclei. If half life of element is 10 days, then the number of decayed nuclei after 30 days is :
(a) 0.5×10^{10} (b) 2×10^{10}
(c) 3.5×10^{10} (d) 1×10^{10}

47. Which of the following are suitable for the fusion process ?
(a) Light nuclei
(b) Heavy nuclei
(c) Elements lying in the middle of periodic table
(d) Elements lying in the middle of binding energy curve

48. When a deuterium is bombarded on ${}_8O^{16}$ nucleus, an α-particle is emitted then the product nucleus is :
(a) ${}_7N^{13}$ (b) ${}_5B^{10}$ (c) ${}_4Be^{9}$ (d) ${}_7N^{14}$

49. When ultraviolet rays are incident on metal plate, the photoelectric effect does not occur. It occurs by incidence of :
(a) infrared rays (b) X-rays
(c) radio waves (d) light waves

50. The truth table for a logic gate is :

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

The logic gate is :
(a) NAND gate (b) XOR gate
(c) NOR gate (d) OR gate

51. $_{92}U^{235}$ nucleus absorb a neutron and disintegrate in $_{54}Xe^{139}$, $_{38}Sr^{94}$ and X so, what will be product X :
(a) 3-neutrons (b) 2-neutrons
(c) α-particle (d) β-particle

52. In hydrogen atom, energy of first excited state is –3.4 eV. Then KE of same orbit of hydrogen atom :
(a) + 3.4 eV (b) + 6.8 eV
(c) – 13.6 eV (d) + 13.6 eV

53. Reaction $BaO_2(s) \rightleftharpoons BaO(s) + O_2(g)$; ΔH = +ve. In equilibrium condition, Pressure of O_2 depends on :
(a) increased mass of BaO_2
(b) increased mass of BaO
(c) increased temperature of equilibrium.
(d) increased mass of BaO_2 and BaO both

54. Solubility of MX_2-type electrolytes is 0.5×10^{-4} mol/L Then find out K_{sp} of electrolytes :
(a) 5×10^{-12} (b) 25×10^{-10}
(c) 1×10^{-13} (d) 5×10^{-13}

55. 1 M and 2.5 litre NaOH solution mixed with another 0.5 M and 3 L NaOH solution. Then find out molarity of resultant solution.
(a) 0.80 M (b) 1.0 M
(c) 0.73 M (d) 0.50 M

56. Which has highest pH ?
(a) CH_3COOK (b) Na_2CO_3
(c) NH_4Cl (d) $NaNO_3$

57. Solution of 0.1 N NH_4OH and 0.1 N NH_4Cl has pH 9.25, then find out pK_b of NH_4OH.
(a) 9.25 (b) 4.75
(c) 3.75 (d) 8.25

58. van der Waal's real gas, act as an ideal gas, at which condition ?
(a) High temperature, low pressure
(b) Low temperature, high pressure
(c) High temperature, hight pressure
(d) Low temperature, low pressure

59. Unit of entropy is :
(a) JK^{-1} mol^{-1} (b) J mol^{-1}
(c) J^{-1} K^{-1} mol^{-1} (d) JK mol^{-1}

60. In a closed insulated container a liquid is stirred with a paddle to increase the temperature, which of the following is true ?
(a) $\Delta E = \Delta W \neq 0, q = 0$
(b) $\Delta E = W = 0, q \neq 0$
(c) $\Delta E = 0, W = q \neq 0$
(d) $W = 0, \Delta E = q \neq 0$

61. 2 mole of ideal gas at 27°C temperature is expanded reversibly from 2 L to 20 L. Find entropy change (R = 2 cal/mol K) :
(a) 92.1 (b) 0 (c) 4 (d) 9.2

62. Heat of combustion $\Delta H°$ for $C(s)$, $H_2(g)$ and $CH_4(g)$ are –94, –68 and –213 kcal/mol. Then $\Delta H°$ for $C(s) + 2H_2(g) \rightarrow CH_4(g)$ is :
(a) – 17 kcal (b) – 111 kcal
(c) – 170 kcal (d) – 85 kcal

63. $3A \longrightarrow 2B$, rate of reaction $= -\frac{d[B]}{dt}$ is equal to :
(a) $-\frac{3}{2}\frac{d[A]}{dt}$ (b) $-\frac{2}{3}\frac{d[A]}{dt}$
(c) $-\frac{1}{3}\frac{d[A]}{dt}$ (d) $+2\frac{d[A]}{dt}$

64. $3A \longrightarrow B + C$
It would be a zero order reaction when :
(a) the rate of reaction is proportional to square of concentration of A
(b) the rate of reaction remains same at any concentration of A
(c) the rate remains unchanged at any concentration of B and C
(d) the rate of reaction doubles if concentration of B is increased to double

65. Which has maximum molecules ?
(a) 7 g N_2 (b) 2 g H_2
(c) 16 g NO_2 (d) 16 g O_2

66. A solution contains non-volatile solute of molecular mass M_2. Which of the following can be used to calculate the molecular mass of solute in terms of osmotic pressure :
(a) $M_2 = \left[\frac{m_2}{\pi}\right] VRT$ (b) $M_2 = \left[\frac{m_2}{V}\right] \frac{RT}{\pi}$
(c) $M_2 = \left[\frac{m_2}{V}\right] \pi RT$ (d) $M_2 = \left[\frac{m_2}{V}\right] \frac{\pi}{RT}$

67. A solution containing components A and B follows Raoult's law :
(a) $A - B$ attraction force is greater than $A - A$ and $B - B$
(b) $A - B$ attraction force is less than $A - A$ and $B - B$
(c) $A - B$ attraction force remains same as $A - A$ and $B - B$
(d) volume of solution is different from sum of volumes of solute and solvent

68. Which reaction is not feasible ?
(a) $2KI + Br_2 \rightarrow 3KBr + I_2$
(b) $2KBr + I_2 \rightarrow 2KI + Br_2$
(c) $2KBr + Cl_2 \rightarrow 2KCl + Br_2$
(d) $2H_2O + 2F_2 \rightarrow 4HF + O_2$

69. In electrolysis of NaCl when Pt electrode is taken then H_2 is liberated at cathode while with Hg cathode it forms sodium amalgam :
(a) Hg is more inert than Pt
(b) more voltage is required to reduce H^+ at Hg than at Pt
(c) Na is dissolved in Hg while it does not dissolved in Pt
(d) concentration of H^+ ions is larger when Pt electrode is taken

70. Which of the following statement is true ?
(a) Silicon exhibits 4 coordination number in its compounds
(b) Bond energy of F_2 is less than Cl_2
(c) Mn(III) oxidation state is more stable than Mn(II) in aqueous state
(d) Elements of 15th group shows only +3 and +5 oxidation states

71. Which of the following order is wrong ?
(a) $NH_3 < PH_3 < AsH_3$ – acidic
(b) $Li < Be < B < C$ – 1st IP
(c) $Al_2O_3 < MgO < Na_2O < K_2O$ – basic
(d) $Li^+ < Na^+ < K^+ < Cs^+$ – ionic radius

72. General electronic configuration of lanthanides are :
(a) $(n-2)\,f^{1-14}\,(n-1)\,s^2\,p^6d^{0-1}ns^2$
(b) $(n-2)\,f^{10-14}\,(n-1)d^{0-1}ns^2$
(c) $(n-2)\,f^{0-14}\,(n-1)\,d^{10}ns^2$
(d) $(n-2)\,d^{0-1}\,(n-1)\,f^{1-14}\,ns^2$

73. An atom has electronic configuration $1s^2\,2s^2 2p^6\,3s^2 3p^6 3d^3\,4s^2$, you will place it in :
(a) fifth group (b) fifteenth group
(c) second group (d) third group

74. Which of the following is iso-electronic ?
(a) CO_2, NO_2 (b) NO_2^-, CO_2
(c) CN^-, CO (d) SO_2, CO_2

75. Which of the following has $p_\pi - d_\pi$ bonding ?
(a) NO_3^- (b) SO_3^{2-}
(c) BO_3^{3-} (d) CO_3^{2-}

76. In NO_3^- ion number of bond pair and lone pair of electron on nitrogen atom are :
(a) 2, 2 (b) 3, 1
(c) 1, 3 (d) 4, 0

77. Which of the following shows maximum number of oxidation states ?
(a) Cr (b) Fe
(c) Mn (d) V

78. Atomic number of Cr and Fe are respectively 24 and 26, which of the following is paramagnetic with the spin of electron :
(a) $[Cr(CO)_6]$ (b) $[Fe(CO)_5]$
(c) $[Fe(CN)_6]^{4-}$ (d) $[Cr(NH_3)_6]^{3+}$

79. The hypothetical complex chloro diaquatriammine cobalt (III) chloride can be represented as :
(a) $[CoCl(NH_3)_3(H_2O)_2]Cl_2$
(b) $[Co(NH_3)_3(H_2O)Cl_3]$
(c) $[Co(NH_3)_3(H_2O)_2Cl]$
(d) $[Co(NH_3)_3(H_2O)_3]Cl_3$

80. In the silver plating of copper, $K[Ag(CN)_2]$ is used instead of $AgNO_3$. The reason is :
(a) a thin layer of Ag is formed on Cu
(b) more voltage is required
(c) Ag^+ ions are completely removed from solution
(d) less availability of Ag^+ ions, as Cu cannot displace Ag from $[Ag(CN)_2]^-$ ion

81. $CuSO_4$ when reacts with KCN forms CuCN. Which is insoluble in water. It is soluble in excess of KCN, due to formation of the following complex :
(a) $K_2[Cu(CN)_4]$ (b) $[K_3[CuCN)_4]$
(c) $CuCN_2$ (d) $Cu[K\,Cu(CN)_4]$

82. Position of non-polar and polar parts in Micelles:
(a) polar at outer surface but non-polar at inner surface
(b) polar at inner surface non-polar at outer surface
(c) distributed over all the surface
(d) are present in the surface only

83. In borax bead test which compound is formed ?

(a) *ortho* borate (b) *meta* borate
(c) double oxide (d) tetra borate

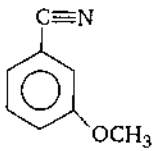
84. Zn gives H_2 gas with H_2SO_4 and HCl but not with HNO_3

(a) Zn act as oxidising agent when react with HNO_3
(b) HNO_3 is weaker acid then H_2SO_4 and HCl
(c) In electrochemical series Zn is above hydrogen
(d) NO_3^- is reduced in preference to hydronium ion

85. IUPAC name of the following is :

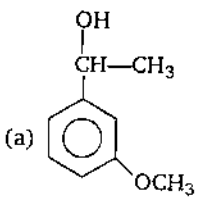
$CH_2 = CH - CH_2 - CH_2 - C \equiv CH$

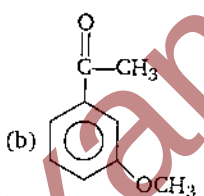
(a) 1, 5-hexenyne (b) 1-hexene-5-yne
(c) 1-hexyne-5-ene (d) 1, 5-hexynene

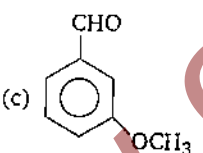
86. 

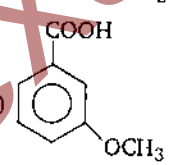
$+ CH_3MgBr \longrightarrow P$

Product '*P*' in the above reaction is :

(a) 

(b) 

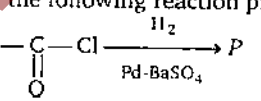
(c) 

(d) 

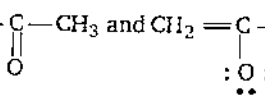
87. *n*-propyl alcohol and isopropyl alcohol can be chemically distinguished by which reagent :

(a) PCl_5
(b) reduction
(c) oxidation with potassium dichromate
(d) ozonolysis

88. In the following reaction product '*P*' is :



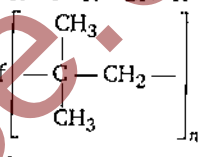
(a) RCH_2OH
(b) $RCOOH$
(c) $RCHO$
(d) RCH_3

89.  are :

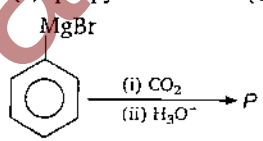
(a) resonating structures
(b) tautomers
(c) geometrical isomers
(d) opitical isomers

90. Reactivity order of halides for dehydrohalogenation is :

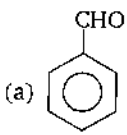
(a) $R - F > R - Cl > R - Br > R - I$
(b) $R - I > R - Br > R - Cl > R - F$
(c) $R - I > R - Cl > R - Br > R - F$
(d) $R - F > R - I > R - Br > R - Cl$

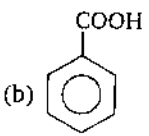
91. Monomer of  is :

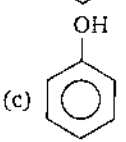
(a) 2-methyl propene (b) styrene
(c) propylene (d) ethene

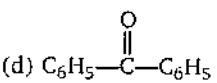
92. 

In the above reaction product 'P' is :

(a) 

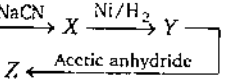
(b) 

(c) 

(d) 

93. Cellulose is polymer of :

(a) glucose (b) fructose
(c) ribose (d) sucrose

94. 

in above reaction sequence, *Z* is :

(a) $CH_3CH_2CH_2NHCOCH_3$
(b) $CH_3CH_2CH_2NH_2$
(c) $CH_3CH_2CH_2CONHCH_3$
(d) $CH_3CH_2CH_2CONHCOCH_3$

95. When phenol is treated with $CHCl_3$ and NaOH the product formed is :

(a) benzaldehyde (b) salicylaldehyde
(c) salicylic acid (d) benzoic acid

96. The percentage of C, H and N in an organic compound are 40%, 13.3% and 46.7% respectively then empirical formula is :
(a) $C_3H_{13}N_3$ (b) CH_2N
(c) CH_4N (d) CH_5N

97. Enzymes are made up of :
(a) edible proteins
(b) proteins with specific structure
(c) nitrogen containing carbohydrates
(d) carbohydrates

98. Geometrical isomers are differ in :
(a) position of functional group
(b) position of atoms
(c) spatial arrangement of atoms
(d) length of carbon chain

99. When $CH_3CH_2CHCl_2$ is treated with $NaNH_2$, the product formed is :
(a) $CH_3-CH=CH_2$
(b) $CH_3-C\equiv CH$
(c) $CH_3CH_2CH(NH_2)(NH_2)$
(d) $CH_3CH_2CH(Cl)(NH_2)$

100. Which is not true statement ?
(a) α-carbon of α-amino acid is asymmetric
(b) All proteins are found in *L*-form
(c) Human body can synthesize all proteins they need
(d) At pH = 7 both amino and carboxylic groups exist in ionised form

Biology

101. Which of the following is important for speciation ?
(a) Seasonal isolation
(b) Reproductive isolation
(c) Behavioural isolation
(d) Temporal isolation

102. In a population, unrestricted reproductive capacity is called :
(a) biotic potential (b) fertility
(c) carrying capacity (d) birth rate

103. Some bacteria are able to grow in streptomycin containing medium due to :
(a) natural selection
(b) induced mutation
(c) reproductive isolation
(d) genetic drift

104. Which of the following are homologous organs?
(a) Wings of birds and locust
(b) Wings of birds (sparrow) and pectoral fins of Fish
(c) Wings of bat and butterfly
(d) Legs of frog and cockroach

105. Which is a reducing sugar ?
(a) Galactose
(b) Gluconic acid
(c) β-methyl galactoside
(d) Sucrose

106. Reason of fast speciation in present day crop plants is :
(a) mutation (b) isolation
(c) polyploidy (d) sexual reproduction

107. Cause of mimicry is :
(a) attack (offence) (b) protection (defence)
(c) both (a) and (b) (d) isolation

108. Change in the sequence of nucleotide in DNA is called as :
(a) mutagen (b) mutation
(c) recombination (d) translation

109. Which of the following is a correct match ?
(a) Down syndrome – 21st chromosome
(b) Sickel cell anaemia –X-chromosome
(c) Haemophilia –Y-chromosome
(d) Parkinson disease – X and Y-chromosome

110. The semilog of per minute growing bacteria is ploted against time. What will be the shape of graph ?
(a) Sigmoid
(b) Hyperbola
(c) Ascending straight line
(d) Descending straight line

111. Hydrolytic enzymes which act at low pH are called as :
(a) proteases (b) α-amylases
(c) hydrolases (d) peroxidases

112. Acromegaly is caused by :
(a) excess of STH
(b) excess of thyroxin
(c) deficiency of thyroxin
(d) excess of adrenaline

113. Genetic drift operates in :
(a) small isolated population
(b) large isolated population
(c) fast reproductive population
(d) slow reproductive population

114. Mainly which type of hormones control the menstrual cycle in human beings ?
(a) FSH
(b) LH
(c) FSH, LH, estrogen
(d) Progesterone

115. There is no life on moon due to the absence of :
(a) O_2 (b) water
(c) light (d) temperature

116. When both ovaries are removed from rat which hormone is decreased in blood ?
(a) Oxytocin
(b) Prolactin
(c) Estrogen
(d) Gonadotrophic releasing factor

117. Which cartilage is present on the end of long bones ?
(a) Calcified cartilage
(b) Hyaline cartilage
(c) Elastic cartilage
(d) Fibrous cartilage

118. In fluid mosaic model of plasma membrane :
(a) upper layer is non-polar and hydrophilic
(b) polar layer is hydrophobic
(c) phospholipids form a bimolecular layer middle part
(d) proteins form a middle layer

119. According to fossils discovered upto present time, origin and evolution of man was started from which country ?
(a) France (b) Java
(c) Africa (d) China

120. Melanin protects from :
(a) UV rays (b) visible rays
(c) infra-red rays (d) X-rays

121. Choose the correct sequence of stages of growth curve for bacteria :
(a) lag, log, stationary, decline phase
(b) lag, log, stationary phase
(c) stationary, lag, log, decline phase
(d) decline, lag, log phase

122. Which of the following statements is true for lymph ?
(a) WBC and serum
(b) All components of blood except RBCs and some proetins
(c) RBCs, WBCs and plasma
(d) RBCs, proteins and platelets

123. Impulse of heart beat originates from :
(a) SA node (b) AV node
(c) vagus nerve (d) cardiac nerve

124. What will happen if ligaments are cut or broken ?
(a) Bones will move freely at joints
(b) No movement at joint
(c) Bone will become unfixed
(d) Bone will become fixed

125. Continuous bleeding from an injured part of body is due to deficiency of :
(a) vitamin-A (b) vitamin-B
(c) vitamin-K (d) vitamin-E

126. Which of the following statement is correct about node of ranvier ?
(a) Axolemma is discontinuous
(b) Myelin sheath is discontinuous
(c) Both neurilemma and myelin sheath are discontinuous
(d) Covered by myelin sheath

127. Stool of a person contains whitish grey colour due to malfunction of which type of organ ?
(a) Pancreas (b) Spleen
(c) Kidney (d) Liver

128. Adrenaline directly affects on :
(a) SA node
(b) β-cells of Langerhans
(c) dorsal root of spinal cord
(d) epithelial cells of stomach

129. Which of the following is used in the treatment of thyroid cancer ?
(a) I_{131} (b) U_{238}
(c) Ra_{224} (d) C_{14}

130. Number of wild life is continuously decreasing. What is the main reason of this ?
(a) Predation
(b) Cutting down of forests
(c) Destruction of habitats
(d) Hunting

131. In which era reptiles dominated ?
(a) Coenozoic era (b) Mesozoic era
(c) Paleozoic era (d) Archaeozoic era

132. What is true for individuals of same species ?
(a) Live in same niche
(b) Live in same habitat
(c) Interbreeding
(d) Live in different habitats

133. Which of the following is absent in polluted water ?
(a) *Hydrilla* (b) Water hyacinth
(c) Larva of stone fly (d) Blue-green algae

134. In Protozoa like *Amoeba* and *Paramecium*, an organelle is found for osmoregulation which is:
(a) contractile vacuole
(b) mitochondria
(c) nucleus
(d) food vacuole

135. During its formation bread, becomes porous due to release of CO_2 by the action of :
(a) yeast (b) bacteria
(c) virus (d) protozoans

136. Which bacteria are utilized in gober gas plant ?
(a) Methanogens
(b) Nitrifying bacteria
(c) Ammonifying bacteria
(d) Denitrifying bacteria

137. Which of the following is without exception in angiosperms ?
(a) Presence of vessels
(b) Double fertilisation
(c) Secondary growth
(d) Autotrophic nutrition

138. In the five kingdom system, the main basis of classification is :
(a) structure of nucleus
(b) nutrition
(c) structure of cell wall
(d) asexual reproduction

139. Cancerous cells can easily be destroyed by radiation due to :
(a) rapid cell division
(b) lack of nutrition
(c) fast mutation
(d) lack of oxygen

140. Which fungal disease spreads by seed and flowers ?
(a) Loose smut of wheat
(b) Corn smut
(c) Covered smut of barley
(d) Soft rot of potato

141. Sequence of which of the following is used to know the phylogeny ?
(a) *m*-RNA (b) *r*-RNA
(c) *t*-RNA (d) DNA

142. Which of the following does not secrete toxins during storage conditions of crop plants ?
(a) *Aspergillus* (b) *Penicillium*
(c) *Fusarium* (d) *Colletotrichum*

143. Which of the following plants produces seeds but not flowers ?
(a) Maize (b) Mint
(c) Peepal (d) *Pinus*

144. Best material for the study of mitosis in laboratory is :
(a) anther (b) root tip
(c) leaf tip (d) ovary

145. Mitotic spindle is mainly composed of which proteins ?
(a) Actin (b) Myosin
(c) Actomyosin (d) Myoglobin

146. Ribosomes are produced in :
(a) nucleolus (b) cytoplasm
(c) mitochondria (d) Golgi body

147. Which of the following occurs more than one and less than five in a chromosome ?
(a) Chromatid (b) Chromomere
(c) Centromere (d) Telomere

148. In which condition, the gene ratio remains constant for any species ?
(a) Sexual selection (b) Random mating
(c) Mutation (d) Gene flow

149. Organisms which obtain energy by the oxidation of reduced inorganic compound are called :
(a) photoautotrophs (b) chemoautotrophs
(c) saprozoic (d) coproheterotrophs

150. In which animal, dimorphic nucleus is found ?
(a) *Amoeba*
(b) *Trypanosoma gambiens*
(c) *Plasmodium vivax*
(d) *Paramecium caudatum*

151. In angiosperms, all the four microspores of tetrad are covered by a layer which is formed by :
(a) pectocellulose (b) callose
(c) cellulose (d) sporopollenin

152. In which of the following notochord is present in embryonic stage ?
(a) All chordates (b) Some chordates
(c) Vertebrates (d) Non-chordates

153. Which type of association is found in between entomophilous flower and pollinating agent ?
(a) Mutualism (b) Commensalism
(c) Co-operation (d) Co-evolution

154. What is the direction of micropyle in anatropous ovule ?
(a) Upward (b) Downward
(c) Right (d) Left

155. Maximum green house gas is released by which country ?
(a) India (b) France
(c) USA (d) Britain

156. In angiosperms, pollen tube liberates their male gametes into the :
(a) central cell (b) antipodal cell
(c) egg cell (d) synergids

157. Which of the following absorb light energy for photosynthesis ?
(a) Chlorophyll (b) Water molecule
(c) O_2 (d) RuBP

158. In photosynthesis energy from light reaction to dark reaction is transferred in the form of :
(a) ADP (b) ATP
(c) RuDP (d) chlorophyll

159. Choose the correct match
Bladderwort, sundew, venus fly trap :
(a) *Nepenthes, Dionea, Drosera*
(b) *Nepenthes, Utricularia, Vanda*
(c) *Utricularia, Drosera, Dionea*
(d) *Dionea, Trapa, Vanda*

160. How may ATP molecules are produced by aerobic oxidation of one molecule of glucose ?
(a) 2 (b) 4
(c) 38 (d) 34

161. Opening and closing of stomata is due to :
(a) hormonal change in guard cells
(b) change in turgor pressure of guard cells
(c) gaseous exchange
(d) respiration

162. Which pigment absorbs the red and far red light ?
(a) Cytochrome (b) Phytochrome
(c) Carotenoids (d) Chlorophyll

163. Seed dormancy is due to the :
(a) ethylene (b) abscisic acid
(c) IAA (d) starch

164. Edible part in mango is :
(a) mesocarp (b) epicarp
(c) endocarp (d) epidermis

165. What is true for cleavage ?
(a) Size of embryo increases
(b) Size of cells decreases
(c) Size of cells increases
(d) Size of embryo decreases

166. Geocarpic fruit is :
(a) potato
(b) peanut
(c) onion
(d) garlic

167. In which animal nerve cell is present but brain is absent ?
(a) Sponge (b) Earthworm
(c) Cockroach (d) *Hydra*

168. In bacteria, plasmid is :
(a) extrachromosomal material
(b) main DNA
(c) non-functional DNA
(d) repetetive gene

169. Bamboo plant is growing in a far forest then what will be the trophic level of it ?
(a) First trophic level (T_1)
(b) Second trophic level (T_2)
(c) Third trophic level (T_3)
(d) Fourth trophic level (T_4)

170. Which of the following is a correct pair ?
(a) *Cuscuta* - parasite
(b) *Dischidia* - insectivorous
(c) *Opuntia* - predator
(d) *Capsella* - hydrophyte

171. Two different species cannot live for long duration in the same niche or habitate. This law is :
(a) Allen's law
(b) Mendel's law
(c) Gause's competitive exclusion principal
(d) Weismann's theory

172. A gene is said to be dominant if :
(a) it expresses it's effect only in homozygous stage
(b) it expresses only in heterozygous condition
(c) it expresses in both homozygous and heterozygous conditions
(d) it is never expressed in any condition

173. Pleiotropic gene is :
(a) haemophilia
(b) thalassemia
(c) sickle cell anaemia
(d) colour blindness

174. Four radial vascular bundles are found in :
(a) dicot root (b) monocot root
(c) dicot stem (d) monocot stem

175. In *E. coli*, during lactose metabolism repressor binds to :
(a) regulator gene (b) operator gene
(c) structural gene (d) promoter gene

176. Vessels are found in :
(a) all angiosperms and some gymnosperms
(b) most of the angiosperms and few gymnosperms
(c) all angiosperms, all gymnosperms and some pteridopytes
(d) all pteridophytes

177. Jacob and Monod studied lactose metabolism in *E. coli* and proposed operon concept. Operon concept applicable for :
(a) all prokaryotes
(b) all prokaryotes and some eukaryotes
(c) all prokaryotes and all eukaryotes
(d) all prokaryotes and some protozoans

178. Out of 64 codons, 61 codons code for 20 type of amino acids; it is called :
(a) degeneracy of genetic code
(b) overlapping of gene
(c) wobbling of codon
(d) universality of codon

179. A diseased man marries a normal woman and they get three daughters and five sons. All the daughters were diseased and sons were normal. The gene of this disease is :
(a) sex-linked dominant
(b) sex-linked recessive
(c) sex-limited character
(d) autosomal dominant

180. In a DNA percentage of thymine is 20. What is the percentage of guanine ?
(a) 20% (b) 40%
(c) 30% (d) 60%

181. Which of the following is the example of sex-linked disease ?
(a) AIDS (b) Colour blindness
(c) Syphilis (d) Gonorrohoea

182. Main function of lenticel is :
(a) transpiration (b) guttation
(c) gaseous exchange
(d) bleeding

183. Which steroid is used for transformation ?
(a) Cortisol (b) Cholesterol
(c) Testosterone (d) Progesterone

184. Which statements is correct for bacterial transduction ?
(a) Transfer of some genes from one bacteria to another bacteria through virus
(b) Transfer of genes from one bacteria to another bacteria by conjugation
(c) Bacteria obtained its DNA directly
(d) Bacteria obtained DNA from other external source

185. Transformation experiment was first performed on which bacteria ?
(a) *E. coli*
(b) *Diplococcus pneumoniae*
(c) *Salmonella*
(d) *Pasteurella pestis*

186. A plant of F_1-generation has genotype "AABbCC". On selfing of this plant, the phenotypic ratio in F_2-generation will be :
(a) 3 : 1
(b) 1 : 1
(c) 9 : 3 : 3 : 1
(d) 27 : 9 : 9 : 9 : 3 : 3 : 3 : 1

187. What is the reason of formation of embryoid from pollen grain in tissue culture medium ?
(a) Cellular totipotency
(b) Organogenesis
(c) Double fertilization
(d) Test tube culture

188. If a diploid cell is treated with colchicine, it becomes :
(a) triploid (b) tetraploid
(c) diploid (d) monoploid

189. Axilliary bud and terminal bud are derived from the activity of :
(a) lateral meristem
(b) intercalary meristem
(c) apical meristem
(d) parenchyma

190. Which of the following crops have been brought to India from New world ?
(a) Cashewnut, potato, rubber
(b) Mango, tea
(c) Tea, rubber, mango
(d) Coffee

191. Nucleus of a donor embryonal cell/somatic cell is transferred to an enucleated egg cell. Then after the formation of organism, what shall be true ?
(a) Organism will have extra-nuclear genes of the donor cell

(b) Organism will have extra-nuclear genes of recipient cell
(c) Organism will have extra-nuclear genes of both donor and recipient cell
(d) Organism will have nuclear genes of recipient cell

192. Which of the following enzymes are used to join bits of DNA ?
(a) Ligase (b) Primase
(c) DNA polymerase (d) Endonuclease

193. Introduction of food plants developed by genetic engineering is not desirable because :
(a) economy of developing countries may suffer
(b) these products are less tasty as compared to the already existing products
(c) this method is costly
(d) there is danger of introduction viruses and toxins with introduced crop

194. Which of the following statement is true ?
(a) Vessels are multicellular and with wide lumen
(b) Tracheids are multicellular and with narrow lumen
(c) Vessels are unicellular and with narrow lumen
(d) Tracheids are unicellular and with wide lumen

195. Which of the following reunites the exon segments after RNA splicing ?
(a) RNA polymerase (b) RNA primase
(c) RNA ligase (d) RNA protease

196. Exon part of *m*-RNAs have code for :
(a) protein (b) lipid
(c) carbohydrate (d) phospholipid

197. There are three genes a, b, c, percentage of crossing over between a and b is 20%, b and c is 28% and a and c is 8%. What is the sequence of genes on chromosome ?
(a) b, a, c (b) a, b, c
(c) a, c, b (d) None of these

198. Manipulation of DNA in genetic engineering became possible due to the discovery of :
(a) restriction endonuclease
(b) DNA ligase
(c) transcriptase
(d) primase

199. Lipids are insoluble in water because lipids molecules are :
(a) hydrophilic (b) hydrophobic
(c) neutral (d) Zwitter ions

200. Collagen is :
(a) fibrous protein (b) globular protein
(c) lipid (d) carbohydrate

ANSWERS

PHYSICS

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

CHEMISTRY

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

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

HINTS & SOLUTIONS

Physics

1. The value of Planck's constant is 6.63×10^{-34} J-s.

2. If no external torque is applied on the system then angular momentum of the system remains constant. When a child sits on rotating disc, then no torque is applied (weight of child acts downward), so angular momentum will remain conserved.

3. **Key Idea :** *For a vertical spring-block system time period can be written as* $T = 2\pi\sqrt{\frac{l}{g}}$.

We can write time period for a vertical spring-block system as

$$T = 2\pi\sqrt{\frac{l}{g}}$$

Here, l is extension in the spring when the mass m is suspended from the spring.
This can be seen as under :

$$kl = mg \quad \text{(in equilibrium position)}$$

$$\Rightarrow \quad \frac{m}{k} = \frac{l}{g}$$

$$\therefore \quad T = 2\pi\sqrt{\frac{m}{k}}$$

$$\therefore \quad T_1 = 2\pi\sqrt{\frac{m}{k_1}} \Rightarrow k_1 = 4\pi^2\frac{m}{T_1^2} \qquad ...(i)$$

$$T_2 = 2\pi\sqrt{\frac{m}{k_2}} \Rightarrow k_2 = 4\pi^2\frac{m}{T_2^2} \qquad ...(ii)$$

Since springs are in parallel, effective force constant

$$k = k_1 + k_2$$

$$\therefore \quad T = 2\pi\sqrt{\frac{m}{k_1 + k_2}}$$

$$\Rightarrow \quad k_1 + k_2 = 4\pi^2\frac{m}{T^2} \qquad ...(iii)$$

Substituting value of k_1 and k_2 from Eqs. (i) and (ii) in Eq. (iii), we get

$$4\pi^2\frac{m}{T_1^2} + 4\pi^2\frac{m}{T_2^2} = 4\pi^2\frac{m}{T^2}$$

$$\Rightarrow \quad \frac{1}{T^2} = \frac{1}{T_1^2} + \frac{1}{T_2^2}$$

$$\Rightarrow \quad T^{-2} = T_1^{-2} + T_2^{-2}$$

4. In case of damped vibration, amplitude at any instant t is

$$a = a_0 e^{-bt}$$

where a_0 = initial amplitude
b = damping constant

Ist case : $t = 100T$ and $a = \frac{a_0}{3}$

$$\therefore \quad \frac{a_0}{3} = a_0 e^{-b(100T)}$$

$$\Rightarrow \quad e^{-100bT} = \frac{1}{3}$$

IInd case : $t = 200T$

$$a = a_0 e^{-bt} = a_0 e^{-b(200T)}$$

$$= a_0 (e^{-100bT})^2 = a_0 \times \left(\frac{1}{3}\right)^2 = \frac{a_0}{9}$$

Thus, after 200 oscillations, amplitude will become $\frac{1}{9}$ times.

5. Moment of inertia depends on distribution of mass about axis of rotation. Density of iron is more than that of aluminium, therefore for moment of inertia to be maximum, the iron should be far away from the axis. Thus, aluminium should be at interior and iron surrounds it.

6. **Key Idea :** *Potential energy is maximum at extreme positions and kinetic energy is maximum at mean position.*

Expression of kinetic energy is

$$K = \frac{1}{2} k (a^2 - y^2) \quad ...(i)$$

Expression of potential energy is

$$U = \frac{1}{2} k y^2 \quad ...(ii)$$

where $k = m\omega^2$

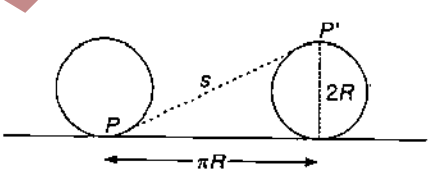
We observe that at mean position ($y = 0$), kinetic energy is maximum $\left(\frac{1}{2} ka^2\right)$ and potential energy is minimum (zero). Also at extreme positions ($y = \pm a$), kinetic energy is zero and potential energy is maximum $\left(\frac{1}{2} ka^2\right)$. Thus, displacement between positions of maximum potential energy and maximum kinetic energy is $\pm a$.

NOTE : Kinetic energy is zero at extreme positions but potential energy at mean position is need not be zero. It is minimum at mean position.

7. The linear acceleration of centre of mass will be $a = \frac{F}{m}$ wherever the force is applied. Hence, the acceleration will be same whatever the value of h may be.

8. When the wheel rolls on the ground without slipping and completes half rotation, point P takes new position as P' as shown in figure.

Horizontal displacement, $x = \pi R$



Vertical displacement, $y = 2R$

Thus, displacement of the point P when wheel completes half rotation,

$$s = \sqrt{x^2 + y^2}$$
$$= \sqrt{(\pi R)^2 + (2R)^2}$$
$$= \sqrt{\pi^2 R^2 + 4R^2}$$

but $R = 1\text{m}$ (given)

$$\therefore \quad s = \sqrt{\pi^2 (1)^2 + 4(1)^2}$$
$$= \sqrt{\pi^2 + 4}\ \text{m}$$

9. **Key Idea :** *The gravitational potential energy of mass m in the gravitational field of mass M at distance r from it is* $U = -\frac{GMm}{r}$.

From key idea, potential energy

$$U = -\frac{GMm}{r}$$

At earth's surface, $r = R$

$$\therefore \quad U_e = -\frac{GMm}{R}$$

Now, if a body is taken to height $h = 3R$, then the potential energy is given by

$$U_h = -\frac{GMm}{R + h} \quad (\because r = h + R)$$
$$= -\frac{GMm}{4R}$$

Thus, change in gravitational potential energy,

$$\Delta U = U_h - U_e$$
$$= -\frac{GMm}{4R} - \left(-\frac{GMm}{R}\right)$$
$$= -\frac{GMm}{4R} + \frac{GMm}{R}$$
$$= \frac{3}{4}\frac{GMm}{R}$$

$$\therefore \quad \Delta U = \frac{3}{4}\frac{gR^2 m}{R} \quad (\because GM = gR^2)$$
$$= \frac{3}{4} mgR$$

10. **Key Idea :** *Force applied on the object is rate of change of momentum.*

According to Newton's 2nd law, force applied on an object is equal to rate of change of momentum.

That is, $\vec{F} = \frac{d\vec{p}}{dt}$

or $\vec{F} = m\frac{d\vec{v}}{dt}$ ...(i)

Given, $m = 3$ kg, $t = 3$ s, $\vec{F} = (6t^2\hat{i} + 4\hat{j})$ N

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

$$(6t^2\hat{i} + 4t\,\hat{j}) = 3\frac{d\vec{v}}{dt}$$

or $$d\vec{v} = \frac{1}{3}(6t^2\hat{i} + 4t\hat{j})\,dt$$

Now, taking integration of both sides, we get

$$\int d\vec{v} = \int_0^t \frac{1}{3}(6t^2\hat{i} + 4t\hat{j})\,dt$$

$$\vec{v} = \frac{1}{3}\int_0^t (6t^2\hat{i} + 4t\hat{j})\,dt$$

but $t = 3$ s (given)

$$\therefore \quad \vec{v} = \frac{1}{3}\int_0^3 (6t^2\hat{i} + 4t\hat{j})\,dt$$

or $$\vec{v} = \frac{1}{3}\left[\frac{6t^3}{3}\hat{i} + \frac{4t^2}{2}\hat{j}\right]_0^3$$

or $$\mathbf{v} = \frac{1}{3}[2(3)^3\hat{i} + 2(3)^2\hat{j}]$$

or $$\vec{v} = \frac{1}{3}[54\hat{i} + 18\hat{j}] \quad \text{or } \vec{v} = 18\hat{i} + 6\hat{j}$$

11. Key Idea : *The relation between momentum p and kinetic energy K is* $K = \frac{1}{2m}(p^2)$

Kinetic energy

$$K = \frac{1}{2m}(p^2)$$

or $$p = \sqrt{2mK}$$

If kinetic energy of a body is increased by 300%, let its momentum becomes p'.

New kinetic energy

$$K' = K + \frac{300}{100}K = 4K$$

Therefore, momentum is given by

$$p' = \sqrt{2m \times 4K} = 2\sqrt{2mK} = 2p$$

Hence, % change (increase) in momentum

$$\frac{\Delta p}{p} \times 100 = \frac{p' - p}{p} \times 100\%$$

$$= \left(\frac{p'}{p} - 1\right) \times 100\%$$

$$= \left(\frac{2p}{p} - 1\right) \times 100\%$$

$$= 100\%$$

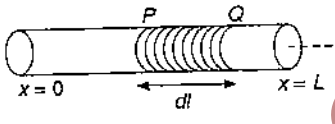
12. Key Idea : *Position of centre of gravity of a continuous body is given by* $r_{CG} = \frac{\int r\,dm}{M}$.

A rod lying along any of coordinate axes serves for us as continuous body.

Suppose a rod of mass M and length L is lying along the x-axis with its one end at $x = 0$ and the other at $x = L$.

Mass per unit length of the rod $= \frac{M}{L}$

Hence, the mass of the element PQ of length dx situated at $x = x$ is $dm = \frac{M}{L}\,dx$



The co-ordinates of the element PQ are $(x, 0, 0)$. Therefore, x-coordinate of centre of gravity of the rod will be

$$x_{CG} = \frac{\int_0^L x\,dm}{\int dm}$$

$$= \frac{\int_0^L (x)\left(\frac{M}{L}\right)dx}{M}$$

$$= \frac{1}{L}\int_0^L x\,dx = \frac{L}{2}$$

but as given, $L = 3$ m

$$\therefore \quad x_{CG} = \frac{3}{2} = 1.5 \text{ m}$$

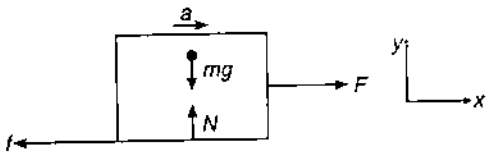
The y-co-ordinate of centre of gravity

$$y_{CG} = \frac{\int y\,dm}{\int dm} = 0 \qquad (\text{as } y = 0)$$

Similarly, $z_{CG} = 0$

i.e., the co-ordinates of centre of gravity of the rod are (1.5, 0, 0) or it lies at the distance 1.5 m from one end.

13. Key Idea : *Apply Newton's second law along x-axis.*



Free body diagram of block is :

From Newton's second law along x-axis

$$\Sigma F_x = ma$$

i.e., $$F - f = ma$$

or $$F - \mu mg = ma$$

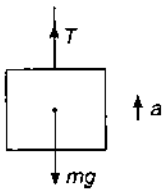
or $$a = \frac{F - \mu mg}{m}$$

Given, $F = 100$ N, $\mu = 0.5$, $m = 10$ kg, $g = 10\ m/s^2$

Substituting the values in the above relation for acceleration of block,

$$a = \frac{(100) - (0.5)(10)(10)}{(10)} = 5\ m/s^2$$

14. **Key Idea :** *The tension in the string during upward motion increases from weight of lift due to its upward acceleration.*



When lift moves upward with same acceleration then

$$T - mg = ma$$

or $$T = m(g + a)$$

Given, $m = 1000$ kg, $a = 1\ m/s^2$, $g = 9.8\ m/s^2$

Thus, $$T = 1000\ (9.8 + 1)$$
$$= 1000 \times 10.8$$
$$= 10800\ N$$

15. In both cases vertical component of velocity of particles is zero, therefore for both particles

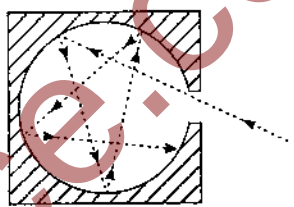
$$h = \frac{1}{2} gt^2$$

$$\Rightarrow \quad t = \sqrt{\frac{2h}{g}} \text{ is same.}$$

Hence, both the particles reach the ground simultaneously.

16. The green house is a room made of glass which is constructed to grow plants in open space. The glass transmits the infrared radiations of short wavelength and the visible light, but it absorbs the infrared radiations of long wavelength. During the day time the light and the infrared radiations of short wavelength enter inside the green house through the roof and the walls and they are absorbed by the plants. At night plants emit the infrared radiations through the glass wall and roof. As a result green house remains warm. This is called green house effect.

17. Materials like black velvet or lamp black come close to ideal black bodies, but the best practical realization of an ideal black body is a small hole leading into a cavity maintained at constant temperature as this absorbs 98% of the radiation incident on them. Cavity approximating an ideal black body is shown in the figure. Radiation entering the cavity has little chance of leaving before it is completely absorbed.



18. According to Wien's displacement law, the quantity of energy radiated out by a body is not uniformly distributed over all the wavelengths emitted by it. It is maximum for a particular wavelength (λ), which is at different temperatures. As the temperature is increased, the value of the wavelength which carries maximum energy is decreased.

The statement of this law is as follows :

"The wavelength corresponding to maximum energy is inversely proportional to the absolute temperature of the body."

i.e., $$\lambda_m \propto \frac{1}{T}$$

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

19. According to Stefan's law,

$$E \propto T^4$$

or $$E = \sigma T^4$$

Here, σ is proportionality constant called the Stefan's constant.

The unit of Stefan's constant is watt metre^{-2} kelvin^{-4} or W/m^2-K^4.

20. Rate of loss of heat by conduction is,

$$H = \frac{\Delta Q}{\Delta t} = K A \left(\frac{T_1 - T_2}{l} \right)$$

For first rod,

$$H_1 = K_1 A_1 \left(\frac{T_1 - T_2}{l_1} \right)$$

For second rod,

$$H_2 = K_2 A_2 \left(\frac{T_1 - T_2}{l_2}\right)$$

but $l_1 = l_2$ and $H_1 = H_2$

So, we have

$$K_1 A_1 (T_1 - T_2) = K_2 A_2 (T_1 - T_2)$$

or $K_1 A_1 = K_2 A_2$

NOTE : Heat transfer occurs only between regions that are at different temperatures, and the rate of heat flow is $\frac{dQ}{dt}$.

21. Efficiency of the Carnot engine is given by

$$\eta = 1 - \frac{T_2}{T_1} \quad ...(i)$$

where T_1 = temperature of source

T_2 = temperature of sink

Given, $\eta = 50\% = 0.5, T_2 = 500K$

Substituting in relation (i), we have

$$0.5 = 1 - \frac{500}{T_1}$$

or $$\frac{500}{T_1} = 0.5$$

$$\therefore \quad T_1 = \frac{500}{0.5} = 1000K$$

Now, the temperature of sink is changed to T_2' and the efficiency becomes 60% *i.e.*, 0.6.

Using relation (i), we get

$$0.6 = 1 - \frac{T_2'}{1000}$$

or $$\frac{T_2'}{1000} = 1 - 0.6 = 0.4$$

or $$T_2' = 0.4 \times 1000 = 400K$$

NOTE : Carnot engine is not a practical engine because many ideal situations have been assumed while designing this engine which can practically not be obtained.

22. Boltzmann corrected Stefan's law and stated that the amount of radiations emitted by the body, not only depend upon the temperature of the body but also on the temperature of the surrounding. The power by the body is given by

radiated $P = \sigma (T^4 - T_0^4)$ ...(i)

where T_0 is the absolute temperature of surrounding.

$$\therefore \quad \frac{P_2}{P_1} = \left(\frac{T_2^4 - T_0^4}{T_1^4 - T_0^4}\right) \quad ...(ii)$$

Here, $P_1 = 60$ W, $T_1 = 727°C = 1000$ K

$T_0 = 227°C = 500$ K, $T_2 = 1227°C = 1500$ K

Substituting in relation Eq. (ii), we get

$$P_2 = \frac{(1500)^4 - (500)^4}{(1000)^4 - (500)^4} \times 60$$

$$= \frac{(500)^4}{(500)^4} \times \left[\frac{3^4 - 1}{2^4 - 1}\right] \times 60$$

$$= \frac{80}{15} \times 60 = 320 \text{ W}$$

23. **Key Idea** : *In case of bcc lattice, there are eight atoms at the eight corners of the unit cell and one atom at the body centre.*

Number of atoms per unit cell is given by

$$N = N_b + \frac{N_f}{2} + \frac{N_c}{8}$$

where N_b = number of atoms centred in the body

N_f = number of atoms centred in the face

N_c = number of atoms centred at the corners

For bcc structure, $N_b = 1$, $N_f = 0$ and $N_c = 8$

$$\therefore \quad N = 1 + \frac{0}{2} + \frac{8}{8} = 2$$

24. **Key Idea** : *The expression of travelling wave is sine or cosine function of $\omega t \pm kx$.*

The general expression of travelling wave can be written as

$$y = A \sin (\omega t \pm kx) \quad ...(i)$$

For travelling wave along positive x-axis we should use minus (–) sign only.

$$\therefore \quad y = A \sin (\omega t - kx)$$

but $$\omega = \frac{2\pi v}{\lambda} \text{ and } k = \frac{2\pi}{\lambda}$$

So, $$y = A \sin \frac{2\pi}{\lambda} (vt - x) \quad ...(ii)$$

Given, $A = 0.2$ m, $v = 360$ m/s, $\lambda = 60$ m,

Substituting in Eq. (ii), we have

$$y = 0.2 \sin \frac{2\pi}{60} (360\, t - x)$$

or $$y = 0.2 \sin 2\pi \left(6\, t - \frac{x}{60}\right)$$

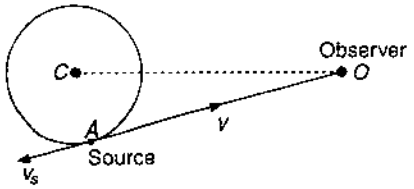
25. Velocity of source (whistle) is given by

$$v_s = r\omega$$

$$= (0.5 \text{ m}) (20 \text{ rad/s})$$

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

The frequency of sound observed by the observer will be minimum when he is at point A. Thus, at this point minimum frequency of source as observed by observer is



$$n_{min} = \left(\frac{v}{v + v_s}\right) n$$

$$n_{min} = \frac{340}{340 + 10} \times 385 = \frac{34}{35} \times 385$$

$$= 34 \times 11 = 374 \text{ Hz}$$

26. An electromagnetic wave is the wave composed of the oscillations of electric and magnetic fields in mutually perpendicular planes and these oscillations are perpendicular to the direction of propagation of wave.

The direction of propagation of electromagnetic wave is given by poynting vector

$$\vec{S} = \vec{E} \times \vec{H} = \frac{\vec{E} \times \vec{B}}{\mu_0}$$

This is parallel to $\vec{E} \times \vec{B}$.

27. **Key Idea :** *Angular limit of resolution of eye is the ratio of wavelength of light to diameter of eye lens.*

Angular limit of resolution of eye

$$= \frac{\text{Wavelength of light}}{\text{Diameter of eye lens}}$$

i.e., $$\theta = \frac{\lambda}{d} \quad ...(i)$$

If y is the minimum resolution between two objects at distance D from eye, then

$$\theta = \frac{y}{D} \quad ...(ii)$$

From Eqs. (i) and (ii), we have

$$\frac{y}{D} = \frac{\lambda}{d}$$

or $$y = \frac{\lambda D}{d} \quad ...(iii)$$

Given, $\lambda = 5000\text{Å} = 5 \times 10^{-7}$ m, $D = 50$ m,

$d = 2$ mm $= 2 \times 10^{-3}$ m

Substituting in Eq. (iii), we get

$$y = \frac{5 \times 10^{-7} \times 50}{2 \times 10^{-3}}$$

$$= 12.5 \times 10^{-3} \text{ m}$$

$$= 1.25 \text{ cm}$$

28. The lens formula can be written as

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \quad ...(i)$$

Given, $v = d$

For equal size image

$$|v| = |u| = d$$

By sign convention, $u = -d$

$$\therefore \quad \frac{1}{f} = \frac{1}{d} + \frac{1}{d}$$

or $$f = \frac{d}{2}$$

29. **Key Idea :** *For total internal reflection angle of incidence should be greater than critical angle.*

For total internal reflection to take place, angle of incidence > critical angle

i.e., $$i > C$$

or $$\theta > C$$

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

but $$\sin C = \frac{1}{\mu}$$

and from figure, $\theta = 90° - r$

So, $$\sin(90° - r) > \frac{1}{\mu}$$

i.e., $$\mu > \frac{1}{\cos r} \quad ...(i)$$

From Snell's law,

$$\frac{\sin 45°}{\sin r} = \mu$$

$$\Rightarrow \quad \sin r = \frac{1}{\sqrt{2}\mu}$$

$$\therefore \quad \cos r = \sqrt{1 - \sin^2 r} = \sqrt{1 - \frac{1}{2\mu^2}}$$

Thus, Eq. (i) becomes

$$\mu > \frac{1}{\sqrt{1 - \frac{1}{2\mu^2}}}$$

$$\therefore \quad \mu^2 = \frac{1}{1 - \frac{1}{2\mu^2}}$$

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

or $$\mu = \sqrt{\frac{3}{2}}$$

30. The wavelength order of waves are given below :

Waves	Wavelength (in Å)
(a) *X*-rays	1 Å to 100 Å
(b) Ultraviolet rays	100 Å to 4000 Å
(c) γ-rays	0.001 Å to 1 Å
(d) Cosmic rays	up to 4×10^{-3} Å

Thus, Cosmic rays have the minimum wavelength.

31. de-Broglie wavelength is given by

$$\lambda = \frac{h}{mv}$$

For same velocity,

$$\lambda \propto \frac{1}{m}$$

Out of the given particles, the mass of β-particle which is a fast moving electron, is minimum. Thus, de-Broglie wavelength is maximum for β-particle.

32. Cathode rays are negatively charged particles called as electrons :

(a) Cathode rays possess very high kinetic energy due to their high velocity. When these highly energetic rays fall on platinum (a metal), their kinetic energy is converted to heat energy.

(b) Outside the discharge tube, if an electric field is applied, the cathode rays bend towards the positive plate.

(c) Cathode rays travel in straight lines. This can be proved by an arrangement which shows that cathode rays cast shadow of the object placed in straight line path of cathode rays.

(d) In certain substances like barium platinocyanides, zinc sulphate, diamond etc., they produce fluorescence.

Thus, (b) is right option.

33. Given $\frac{I_C}{I_E}$ = Current gain $(\alpha) = 0.96$

So, current gain in common emitter configuration is

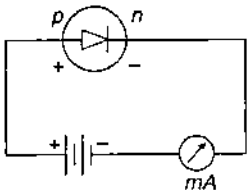
$$\beta = \frac{\alpha}{1-\alpha}$$

$$= \frac{0.96}{1-0.96} = \frac{0.96}{0.04}$$

$$= 24$$

NOTE : The current gain β in common emitter mode is very large as compared to the current gain α in common base mode. This is why a transistor is always used as an amplifier in the CE mode.

34. For conduction in a *p-n* junction, it should be forward biased. For this *p*-side must be connected to positive terminal (higher potential) and *n*-side must be connected to negative terminal (lower potential). Figure below shows the *p-n* junction in a conducting state (forward biased condition)

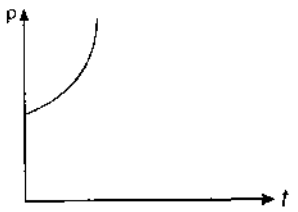


35. **Key Idea :** *In forward biasing, ideal junction diode has zero resistance and infinite resistance in reverse biasing.*

In forward biasing, the diode conducts. For ideal junction diode, the forward resistance is zero. Therefore, entire applied voltage occurs across resistance *R i.e.*, there occurs no voltage drop.

While in reverse biasing, the diode does not conduct, so it has infinite resistance. Thus, voltage across *R* is zero in reverse biasing.

36. The specific resistance (resistivity) of a metallic conductor nearly increases with increasing temperature as shown in figure. This is because, with the increase in temperature the ions of the conductor vibrate with greater amplitude, and the collision between electrons and ions become more frequent, over a small temperature range (up to 100°C). The resistivity of a metal can be represented approximately by the equation



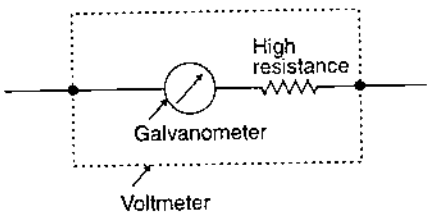
$$\rho_t = \rho_0 (1 + \alpha t)$$

The factor α is called the temperature coefficient of resistivity.

37. The surface and interior of a charged conductor is equipotential. Therefore, the potential is same throughout the charged conductor.

38. **Key Idea :** *A galvanometer has its own resistance low but a voltmeter must have high resistance.*

A voltmeter indeed is a modified form of a pivoted coil galvanometer. Since the resistance of coil of galvanometer of its own is low, its resistance is to be increased as is a necessary condition for a voltmeter. For this an appropriate high resistance should be connected in series with the galvanometer as shown.



NOTE : The resistance of an ideal voltmeter should be infinite.

39. The common potential difference across two capacitors connected in parallel

$$V' = \frac{C_1V_1 + C_2V_2}{C_1 + C_2}$$

Here, $V_1 = V, \quad V_2 = 0$

$$\therefore \quad V' = \frac{C_1V}{C_1 + C_2}$$

40. In an open circuit, emf of cell

$$E = 2.2\,\text{V}$$

In a closed circuit, terminal potential difference

$$V = 1.8\,\text{V}$$

External resistance, $R = 5\Omega$

Thus, internal resistance of cell is

$$r = \left(\frac{E}{V} - 1\right)R = \left(\frac{2.2}{1.8} - 1\right)5$$

$$= \left(\frac{11}{9} - 1\right)5 = \frac{2}{9} \times 5 = \frac{10}{9}\,\Omega$$

41. Electrostatic potential energy of charge $+q$ placed at the centre of cube is

$$U = 8 \times \frac{1}{4\pi\varepsilon_0} \times \frac{q(-q)}{\text{half-diagonal distance}}$$

$$= 8 \times \frac{1}{4\pi\varepsilon_0} \frac{-q^2}{b\frac{\sqrt{3}}{2}}$$

$$= \frac{-4q^2}{\sqrt{3}\pi\varepsilon_0 b}$$

42. Magnetic field at the centre of circular coil

$$B = \frac{\mu_0 Ni}{2r}$$

Ist case : $N = 1, L = 2\pi r \Rightarrow r = \frac{L}{2\pi}$

$$\therefore \quad B = \frac{\mu_0 \times 1 \times i}{2r} = \frac{\mu_0 i}{2r}$$

IInd Case : $N = 2, L = 2 \times 2\pi r'$

$$\Rightarrow \quad r' = \frac{L}{4\pi} = \frac{r}{2}$$

$$\therefore \quad B' = \frac{\mu_0 \times 2 \times i}{2r'}$$

$$= \frac{\mu_0 \times 2i}{2 \times (r/2)} = \frac{4\mu_0 i}{2r} = 4B$$

NOTE : Magnetic field at the centre of circular coil i maximum and decreases as we move away from th centre (on the axis of coil).

43. If $\vec{E}$ is the electric field strength and $\vec{B}$ th magnetic field strength and q the charge on particle, then electric force on the charge

$$\vec{F}_e = q\vec{E}$$

and magnetic force on the charge

$$\vec{F}_m = q\,\vec{v} \times \vec{B}$$

The net force on the charge

$$\vec{F} = \vec{F}_e + \vec{F}_m = q\vec{E} + q\,\vec{v} \times \vec{B}$$

44. The time period of bar magnet

$$T = 2\pi\sqrt{\frac{I}{MH}}$$

where M= magnetic moment of magnet
I = moment of inertia
and H = horizontal component of magneti field

When same poles of magnets are placed o same side, then net magnetic moment

$$M_1 = M + 2M = 3M$$

$$\therefore \quad T_1 = 2\pi\sqrt{\frac{I}{M_1 H}}$$

$$= 2\pi\sqrt{\frac{I}{3MH}} \qquad \ldots(i$$

When opposite poles of magnets are placed o same side, then net magnetic moment

$$M_2 = 2M - M = M$$

$$\therefore \quad T_2 = 2\pi\sqrt{\frac{I}{M_2 H}} = 2\pi\sqrt{\frac{I}{MH}} \qquad ...(ii)$$

From Eqs. (i) and (ii), we observe that

$$T_1 < T_2$$

15. **Key Idea :** *In a series L-C-R circuit, resonance occurs when capacitive reactance becomes equal to inductive reactance.*

In series *L-C-R* circuit at resonance,

capacitive reactance (X_C) = inductive reactance (X_L)

i.e., $$\frac{1}{\omega C} = \omega L$$

Total impedance of the circuit

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$= \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

i. e., $$Z = R$$

So, power factor

$$\cos\phi = \frac{R}{Z} = \frac{R}{R} = 1$$

Thus, power loss at resonance is given by

$$P = E_{rms}\, I_{rms} \cos\phi$$
$$= E_{rms}\, I_{rms} \times 1$$
$$= (I_{rms}\, R)\, I_{rms}$$
$$= (I_{rms})^2 R$$
$$= I^2 R$$

46. Number of half-lives

$$n = \frac{t}{T} = \frac{30 \text{ days}}{10 \text{ days}} = 3$$

So, number of undecayed radioactive nuclei

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

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

$$= 4 \times 10^{10}\left(\frac{1}{2}\right)^3$$

$$= 4 \times 10^{10} \times \frac{1}{8} = 0.5 \times 10^{10}$$

Thus, number of nuclei decayed after 30 days

$= N_0 - N = 4 \times 10^{10} - 0.5 \times 10^{10} = 3.5 \times 10^{10}$

47. Binding energy for light nuclei ($A < 20$) is much smaller than the binding energy for heavier nuclei. This suggests a process that is reverse of fission. When two light nuclei combine to form a heavier nucleus, the process is called nuclear fusion. The union of two light nuclei into heavier nuclei also lead to a transfer of mass and a consequent liberation of energy.

NOTE : Fusion reaction can take place at very high temperature ($\approx 10^8$ K) and very high pressure which can be provided at sun or by fission of atom bomb.

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

Let unknown product nucleus is ${}_ZX^A$.

The reaction can be written as

$${}_8O^{16} + {}_1H^2 \rightarrow {}_ZX^A + {}_2He^4$$

(Oxygen) (deuterium) (unknown nucleus) α–particle

Conservation of mass number gives,

$$16 + 2 = A + 4 \Rightarrow A = 14$$

Conservation of atomic number gives

$$8 + 1 = Z + 2 \Rightarrow Z = 7$$

Thus, the unknown product nucleus is nitrogen (${}_7N^{14}$).

49. **Key Idea :** *For photoemission to take place from metal, the wavelength of incident ray will be less than threshold value.*

For photoelectric emission from given metal plate, the incident wavelength must be less than that of ultraviolet rays assuming the wavelength of ultraviolet rays as the threshold value. Out of the given radiations, *X*-rays have wavelength less than that of ultraviolet rays. Thus, *X*-rays can cause photoelectric emission.

50. The given truth table is for NAND gate. The output for NAND gate is 1 only when one of its inputs is zero.

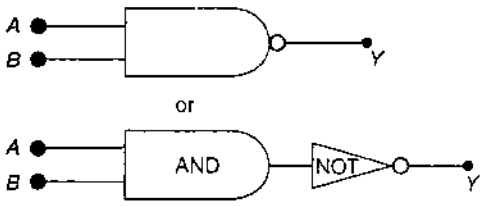
The Boolean expression for NAND gate is

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

That is

$$\overline{1 \,.\, 1} = \bar{1} = 0$$
$$\overline{0 \,.\, 1} = \bar{0} = 1$$
$$\overline{1 \,.\, 0} = \bar{0} = 1$$
$$\overline{0 \,.\, 0} = \bar{0} = 1$$

NOTE : The symbol for NAND gate can be shown as :



51. $_{92}U^{235}$ nucleus absorbs a neutron and then disintegrate in $_{54}Xe^{139}$, $_{38}Sr^{94}$ and X.

Thus

$$_{92}U^{235} + {}_0n^1 \longrightarrow {}_{54}Xe^{139} + {}_{38}Sr^{94} + 3\,{}_0n^1$$

52. $\because$ Total energy (E_n) = KE + PE

in first excited state $= \frac{1}{2}mv^2 + \left[-\frac{Ze^2}{r}\right]$

$$= +\frac{1}{2}\frac{Ze^2}{r} - \frac{Ze^2}{r}$$

$$-3.4 \text{ eV} = -\frac{1}{2}\frac{Ze^2}{r}$$

$$\therefore \quad \text{KE} = \frac{1}{2}\frac{Ze^2}{r} = +3.4 \text{ eV}$$

53. $BaO_2(s) \rightleftharpoons BaO(s) + O_2(g)$. $\Delta H = +$ ve

According to law of mass action.

The rate of forward reaction $= R_1$

$$R_1 \propto [BaO_2]$$

or $\quad R_1 = k_1[BaO_2]$

But concentration of solid = 1

then, $\quad R_1 = k_1$

Similarly the rate of backward reaction $= R_2$

$$R_2 \propto [BaO][O_2]$$

or $\quad R_2 = k_2[BaO][O_2]$

$\because$ Conc. of [BaO] = 1

or $\quad R_2 = k_2[O_2]$

At equilibrium

$$R_1 = R_2$$

$$k_1 = k_2[O_2] \text{ or } k_1 = k_2 \cdot p_{O_2}$$

where p_{O_2} = Partial pressure of O_2

or $\quad \frac{k_1}{k_2} = p_{O_2}$ (Equilibrium constant)

$\because \quad \frac{k_1}{k_2} = k \quad$ or $\quad k = p_{O_2}$

So, from the above it is clear that pressure of O_2 does not depend upon Conc. of reactants. The given equation is an endothermic reaction. If the temperature of such reaction is increased then dissociation of BaO_2 would increase; and more O_2 is produced.

54. $\underset{\text{Solubility } 0.5\times10^{-4}\text{ M}}{MX_2} \longrightarrow \underset{0.5\cdot10^{-4}\text{ M}}{M^{2+}} + \underset{2\cdot0.5\cdot10^{-4}\text{ M}}{2X^-}$

(on 100% ionisation)

$\therefore K_{sp}$ of $MX_2 = [M^{2+}][X^-]^2$

$$= (0.5\times10^{-4})(1.0\times10^{-4})^2$$

$$= 0.5\times10^{-12} = 5\times10^{-13}$$

55. Moles of 2.5 L of 1M NaOH $= 2.5\times1 = 2.5$

Moles of 3.0 L of 0.5 M NaOH $= 3.0\times0.5 = 1.5$

Total moles of NaOH in solution $= 2.5 + 1.5 = 4.0$

(Total volume of solution $= 2.5 + 3.0 = 5.5$ L.)

Thus $\quad M_1\times V_1 = M_2\times V_2$

$$4.0 = M_2\times5.5$$

$\therefore$ Molarity of resultant solution $= M_2 = \frac{4.0}{5.5}$ M

$$\approx 0.73\,M$$

56. $\text{pH} = \log\frac{1}{[H^+]}$

pH is inversely proportional to hydrogen ion concentration. As concentration of H^+ decreases pH increases and vice versa.

Ammonium chloride (NH_4Cl) is a salt of weak base and strong acid. So, its aqueous solution will be acidic as

$$NH_4Cl + H_2O \rightarrow \underset{\text{Weak base}}{NH_4OH} + \underset{\text{Strong acid}}{HCl}$$

So, pH of NH_4Cl is less than 7.

$NaNO_3$ (Sodium nitrate) is the salt of strong acid and strong base. So, its aqueous solution is neutral as

$$NaNO_3 + H_2O \rightarrow \underset{\text{Strong base}}{NaOH} + \underset{\text{Strong acid}}{HNO_3}$$

So, pH of $NaNO_3$ is 7.

CH_3COOK (Potassium acetate) is a salt of strong base and weak acid. Its aqueous solution will be basic and pH value will be $> 7 \approx 8.8$

$$CH_3COOK + H_2O \rightarrow \underset{\text{Weak acid}}{CH_3COOH} + \underset{\text{Strong base}}{KOH}$$

Na_2CO_3 (Sodium carbonate) is a salt of strong base and weak acid. Its aqueous solution is also basic and its pH value will be more than 10.

$$Na_2CO_3 + H_2O \rightarrow \underset{\text{Strong base}}{2NaOH} + \underset{\text{Weak acid}}{H_2CO_3}$$

57. Solution of NH_4OH and NH_4Cl acts as a basic buffer solution. For basic buffer solution

$$pOH = pK_b + \log \frac{[Salt]}{[Base]}$$

$$pOH = 14 - pH = 14 - 9.25 = 4.75$$

$$4.75 = pK_b + \log \frac{0.1}{0.1}$$

$$pK_b = 4.75$$

58. At higher temperature and low pressure real gas acts as an ideal gas and obey $PV = nRT$ relation.

59. $\Delta S = \frac{q}{T}$

q = required heat per mol
T = constant absolute temperature.
Unit of entropy is $JK^{-1}mol^{-1}$

60. In closed insulated container a liquid is stirred with a paddle to increase the temperature, therefore it behaves as adiabatic process, so, for it $q = 0$.
Hence, from first law of thermodynamics

$\Delta E = q + W$ if $q = 0$

$\therefore \Delta E = W$ but not equal to zero.

61. ΔS (Entropy change) $= 2.303\, nR \log_{10} \frac{V_2}{V_1}$

$$= 2.303 \times 2 \times 2 \times \log_{10} \frac{20}{2}$$

$$= 2.303 \times 2 \times 2 \times 1$$

$$= 9.212 \text{ cal}$$

62. For reaction,

$$C(s) + 2H_2(g) \longrightarrow CH_4(g),\ \Delta H° = ?$$

$\Delta H°$ = – [($\Delta H°$ of combustion of CH_4) – ($\Delta H°$ of combustion of C + 2 × ΔH of combustion of H_2)]

$C + O_2 \rightarrow CO_2$; $\Delta H = -94$ kcal ...(i)

$2H_2 + O_2 \rightarrow 2H_2O$; $\Delta H = -68 \times 2$ kcal ...(ii)

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$; $\Delta H = -213$ kcal ...(iii)

$= -[(-213) - (-94 + 2 \times -68)]$ kcal / mol

$= -[-213 + 230] = -17$ kcal/mol

63. For reaction,

$$3A \longrightarrow 2B$$

$$\text{Rate} = -\frac{1}{3}\frac{d[A]}{dt} = +\frac{1}{2}\frac{d[B]}{dt}$$

$$\therefore \quad +\frac{d[B]}{dt} = -\frac{2}{3}\frac{d[A]}{dt}$$

64. For reaction $3A \longrightarrow B + C$

If it is zero order reaction, therefore the rate remains same at any concentration of 'A' or $\frac{dx}{dt} = K[A^0]$. It means that rate is independent on concentration of reactants.

65. In 7g nitrogen, number of molecules

$$= \frac{7.0}{28} \text{ mol} = 0.25 \times N \text{ molecules}$$

where N = Avogadro number = 6.023×10^{23}

In 2 g $H_2 = \frac{2.0}{2}$ mol $= 1 \times N$ molecules

In 16 g $NO_2 = \frac{16.0}{46}$ mol $= 0.348 \times N$ molecules

In 16 g $O_2 = \frac{16}{32}$ mol $= 0.5 \times N$ molecules

Hence, maximum molecules are present in 2 g, H_2.

66. For dilute solution

$$PV = nRT$$

or $$\pi V = nRT$$

or $$\pi = \frac{n}{V}RT$$

$$\Rightarrow \quad \pi V = \frac{m_2}{M}RT$$

$$\Rightarrow \quad M = \frac{m_2 RT}{\pi V}$$

where, π = osmotic pressure
V = volume of solution
n = number of moles of solute
m_2 = mass of solute
M = molecular mass of solute

67. Raoult's law is valid for ideal solution only. These two components A and B follows the condition of Raoult's law if the force of attraction between A and B is equal to the force of attraction betwen $A - A$ and $B - B$.

68. $2KBr + I_2 \longrightarrow 2KI + Br_2$

reaction is not possible because Br^- ion is not oxidised in Br_2 with I_2 due to higher electrode potential of I_2 than bromine.
In halogens fluorine can displace chlorine bromine and iodine, chlorine can displace bromine and iodine and bromide can displace iodine from their salts.

69. Sodium chloride in water dissociates as

$$NaCl \rightleftharpoons Na^+ + Cl^-$$

$$H_2O \rightleftharpoons H^+ + OH^-$$

when electric current is passed through this solution using platinum electrode, Na^+ and H^+ move towards cathode. Whereas Cl^- and OH^- ions move towards anode.

At cathode :—

$$H^+ + e^- \longrightarrow H$$

$$H + H \longrightarrow H_2$$

At anode :—

$$Cl^- - e^- \longrightarrow Cl$$

$$Cl + Cl \longrightarrow Cl_2$$

If mercury is used as cathode, H^+ ions are not discharged at mercury cathode because mercury has a high hydrogen over voltage. Na^+ ions are discharged at cathode in preferance of H^+ ions yielding sodium, which dissolves in mercury to form sodium amalgam.

70. Bond energy of F_2 is less than Cl_2 because in F_2 molecule electron-electron repulsion of $2p$-orbital of two fluorine atom is maximum in comparision to this repulsion of $3p$-orbitals of two chlorine atom. So less amount of energy is required to break the bond of F_2 in comparison to Cl_2.

71. Li, Be, B and C are present in IInd period. In a period from left to right ionisation potential increases.

IP increases →

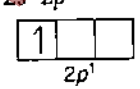
Li Be B C

* But in case of Be and B, Be has higher IP than B due to stable configuration of Be

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

$2s^2$

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

 unstable configuration

$2p^1$

So, the correct order of IP of given elements is—

$$Li < B < Be < C$$

72. In lanthanides (At. no. of elements 58 to 71) the electronic configuration of three outermost shell is $(n-2)f^{1-14}, (n-1)s^2p^6d^{0\text{ to }1}, ns^2$.

73. An atom has electronic configuration

$$1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^3, 4s^2$$

It is a member of d-block element because the last electron is filled in d-subshell as $3d^3$ and the following electronic configuration is possible for d-subshell as $(n-1)d$-subshell as $(n-1)d^{1\text{ to }10}$

Group No.	III B (13)	IVB (14)	VB (15)	VIB (16)	VIIB (17)	VIII (18)	VIII (19)	VIII (20)	IB (21)	IIB (22)
$ns^2(n-1)s^2p^6$	d^1	d^2	d^3	d^4	d^5	d^6	d^7	d^8	d^9	d^{10}

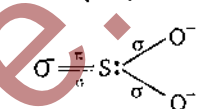
Hence, it is member of fifth group.

74. CN^- and CO are iso-electronic because they have equal number of electrons.

In CN^- the no. of electrons = 6 + 7 + 1 = 14

In CO the no. of electrons = 6 + 8 = 14

75. In SO_3^{2-} the S is sp^3 hybridised, so



$_{16}S = 1s^2, 2s^2 2p^6, \underbrace{3s^2 3p_x^1 3p_y^1 3p_z^1}_{sp^3 \text{ hybridisation}}\ \underbrace{3d_{xy}^1}_{\text{unhybridised}}$

(Sulphur atom in excited state)

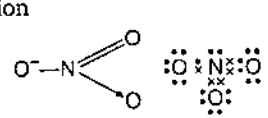
In 'S' the three p-orbitals forms σ bonds with three oxygen atoms and unhybridised d-orbital is involved in π bond formation

$$_{16}O = 1s^2, 2s^2 2p_x^2 2p_y^1 2p_z^1$$

In oxygen two unpaired p-orbitals are present, one is involved in σbond formation while other is used in π bond formation.

Thus in SO_3^{2-}, p_π and d_π orbitals are involved for $p_\pi - d_\pi$ bonding.

76. In NO_3^- ion



nitrogen has four bond pair and zero lone pair of electrons.

77. Each of the element in group IIIB to VIIB can show the maximum oxidation state equal to its group number. Mn shows maximum number of oxidation states on the basis of following electronic configuration

$$_{25}Mn = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^5, 4s^2 (+7)$$

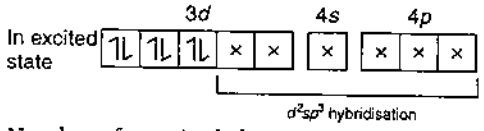
78. Atoms, ions or molecules having unpaired electrons are paramagnetic. In $[Cr(NH_3)_6^{3+}]$, Cr is present as Cr (III) or Cr^{3+}

So electronic configuration is

$$_{24}Cr = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^5, 4s^1$$

Ground state

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

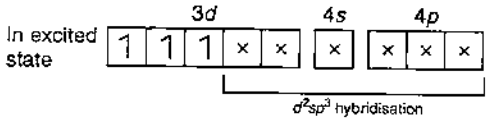


Number of unpaired electrons = 3

In $[Cr(CO)_6]$ (O. N. of Cr = 0)

$_{24}Cr = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^5, 4s^1$

(Ground state)

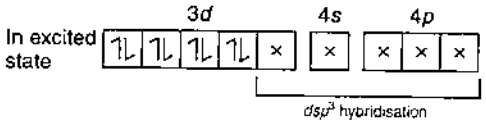


Number of unpaired electron = 0

In $[Fe(CO)_5]$ (ON of Fe = 0)

$_{26}Fe = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^6, 4s^2$

(Ground state)

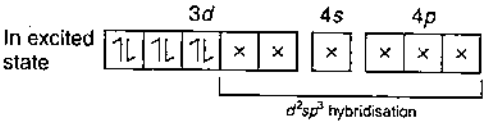


Number of unpaired electron = 0

In $[Fe(CN)_6]^{4-}$ (O No of Fe = +2)

$Fe^{2+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^6$

(Ground state)



Number of unpaired electron = 0

Hence, in above complex ion paramagnetic character is in $[Cr(NH_3)_6]^{3+}$ as it contains three unpaired electrons.

79. Chloro diaquatriammine cobalt (III) chloride is $[CoCl(NH_3)_3(H_2O)_2]Cl_2$

80. In the silver plating of copper, $K[Ag(CN)_2]$ is used instead of $AgNO_3$. The reason is less availability of Ag^+ ions, as Cu cannot displace Ag from $K[Ag(CN)_2]$ ion.

81. $CuSO_4$ reacts with KCN gives a white precipitate of cuprous cyanide and cyanogen gas. The cuprous cyanide dissolves in excess of KCN forming $K_3[Cu(CN)_4]$.

$$CuSO_4 + 2KCN \longrightarrow K_2SO_4 + Cu(CN)_2$$

$$2Cu(CN)_2 \longrightarrow \underset{\text{insoluble}}{2CuCN} + \underset{\text{cyanogen}}{CN-CN}$$

$$CuCN + 3KCN \longrightarrow \underset{\text{soluble}}{K_3[Cu(CN)_4]}$$

82. Micelles are the clusters formed by the association of colloids. They are formed by lyophillic and lyophobic groups. As the concentration is increased the lyophobic parts receding away from the solvent approach each other and form a cluster, the lyophobic ends are in the interior lyophilic groups projecting outward in contact with the solvent.

83. In borax bead test the coloured metaborates are formed by transition metal salts.

$$Na_2B_4O_7 \cdot 10H_2O \xrightarrow[-10H_2O]{\Delta} Na_2B_4O_7 \xrightarrow{\Delta} 2NaBO_2 + B_2O_3$$

$$B_2O_3 + CuO \longrightarrow \underset{\text{Cupric meta borate (Blue bead)}}{Cu(BO_2)_2}$$

84. Zn is present above H_2 in electrochemical series. So, it liberates hydrogen gas from dilute HCl/H_2SO_4. But HNO_3 is oxidising agent. The hydrogen obtained in this reaction is converted into H_2O. in HNO_3, NO_3^- ion is reduced and give NH_4NO_3, N_2O, NO and NO_2 (based upon the concentration of HNO_3)

$$[Zn + \underset{\text{(nearly 6\%)}}{2HNO_3} \longrightarrow Zn(NO_3)_2 + 2H] \times 4$$

$$HNO_3 + 8H \longrightarrow NH_3 + 3H_2O$$

$$NH_3 + HNO_3 \longrightarrow NH_4NO_3$$

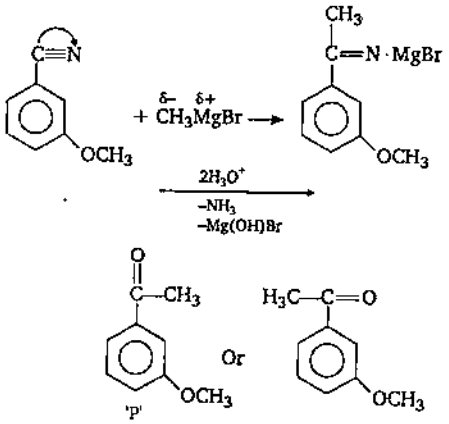
$$4Zn + 10HNO_3 \longrightarrow 4Zn(NO_3)_2 + NH_4NO_3 + 3H_2O$$

85. The double bond gets priority over triple bond. So, the IUPAC name of

$$\overset{1}{CH_2} = \overset{2}{CH} - \overset{3}{CH_2} - \overset{4}{CH_2} - \overset{5}{C} \equiv \overset{6}{CH}$$

is Hex-1-en-5-yne or 1-hexene-5-yne

86.



87. *n*-propyl alcohol and isopropyl alcohol gives different product on oxidation with $K_2Cr_2O_7$.

$$CH_3-CH_2-CH_2OH \xrightarrow[K_2Cr_2O_7/H_2SO_4]{[O]} CH_3-CH_2-CHO$$

n-Propyl alcohol — Propionaldehyde

$$CH_3-\underset{\underset{OH}{|}}{CH}-CH_3 \xrightarrow[K_2Cr_2O_7/H_2SO_4]{[O]} CH_3-\overset{\overset{O}{||}}{C}-CH_3$$

Isopropyl alcohol — Acetone

88. Rosenmunds reaction :

$$R-\overset{\overset{O}{||}}{C}-Cl \xrightarrow[Pd-BaSO_4]{H_2} R-\overset{\overset{O}{||}}{C}-H + HCl$$

'P'

89.

$$CH_2-\overset{\overset{O}{||}}{C}-CH_3 \longleftrightarrow CH_2=\underset{\underset{:\ddot{O}:}{|}}{C}-CH_3$$

(Structure I) (Structure II)

Structure I and structure II are the resonating forms because the position of atoms remains the same and only electron redistribution takes place.

90. F, Cl, Br and I are the elements of VII A group. In a group atomic, radii increases from top to bottom and the bond dissociation energy decreases as

$R-F > R-Cl > R-Br > R-I$

So, during dehydrohalogenation *R–I* bond breaks more easily than *R–F* bond. Hence, order of reactivity will be–

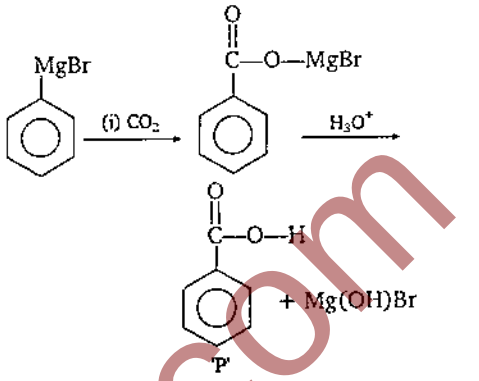
$R-I > R-Br > R-Cl > R-F$

91. Monomer of $\left[-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_2-\right]_n$ polymer is

2-methyl propene or isobutene

$$H_3C-\underset{\underset{CH_3}{|}}{C}=CH_2$$

92.

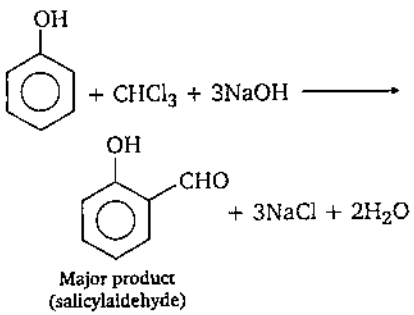


93. Cellulose is a polymer of glucose *i.e.*, $C_6H_{12}O_6$.

94.

$$CH_3CH_2Cl \xrightarrow{NaCN} \underset{'X'}{CH_3-CH_2-CN} \xrightarrow[Ni/H_2]{} \underset{Y}{CH_3-CH_2CH_2NH_2} \xrightarrow[anhydride]{Acetic} \underset{'Z'}{CH_3-CH_2-CH_2-NHCOCH_3}$$

95. Reimer-Tiemann reaction : When phenc is treated with chloroform and NaOH salicylaldehyde is obtained.



Major product (salicylaldehyde)

96. Table for Empirical formula

Element	%	At. wt.	Relative number	Ratio o elements
C	40.0	12	40/12 = 3.33	3.33/3.33 =
H	13.3	1	13.3/1 = 13.3	13.3/3.33 =
N	46.7	14	46.7/14 = 3.33	3.33/3.33 =

Hence, empirical formula of compound CH_4N.

97. Enzymes are made up of protein with specif structure and acts as a catalyst for biochemic reactions.

98. Geometrical Isomers :
The isomers having the same molecular formula but differ in the position of atoms or groups in space due to hindered rotation about a double bond are known as geometrical isomers.

99. $CH_3 - CH_2 - CHCl_2 \xrightarrow[\Delta]{NaNH_2}$

$CH_3 - CH = CHCl \xrightarrow[\Delta]{NaNH_2}$

$CH_3 - C \equiv CH$
Final product

100. All proteins are not found in *L*-form but they may be present in form of *D* or *L*.

Biology

101. Gene flow occurs between the populations of a given species (but not between populations of different species). For two species to remain separate, these have to be reproductively isolated, (gene flow must not occur between them). It may be (a) premating (habitat, temporal, behavioural) or (b) post mating (gamete, zygote, hybrid, sterility, F_2 fitness).

102. The biotic potential or innate capacity to increase of a population refers to the maximum rate of increase in the population that can possibly occur under ideal conditions (unlimited resources, no hinderances).

103. According to natural selection theory of Darwin "every organism has the potentiality to produce more offsprings but only those individuals which posses superior physical, behavioural or other attributes are more like to survive than those that are not so well endowed". Thus, natural selection in some bacteria helps them to survive in streptomycin containing medium.

104. Homologous organs are the organs which have the same origin and similar basic structure but may differ in external appearance and function; wings of birds and pectoral fins of fish are an example of the same. Analogous organs are those organs which are anatomically different but functionally same, e.g., Other three options.

105. Glucose, fructose, mannose, galactose are hexose monosaccharides. The monosaccharides have free aldehyde or ketone group which can reduce Cu^{2+} to Cu. Therefore, these are called reducing sugars.

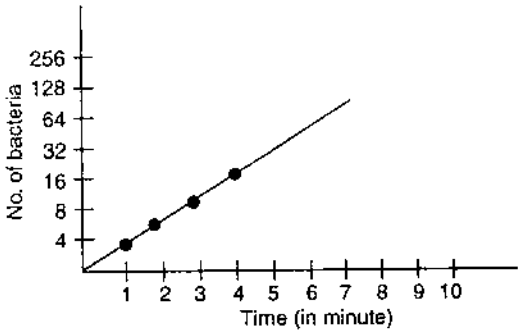
106. Presence of more than two sets of chromosomes is known as polyploidy. 'Polyploidy' causes fast speciation as it leads to complete reproductive isolation of an individual from other gene pools. Polyploidy is found in nature due to the failure of chromosomes to separate at the time of anaphase either due to disjunction or due to failure of spindle formation.

107. Mimicry occurs when a given species resembles another for its own benefit. It may help a predator in capturing food (offense) or it can help a prey in avoiding capturing. The concept of mimicry was first observed by **Henry Bates** (1862 AD). So, the phenomenon of mimicry is also known as Batesian mimicry. The individul which shows mimicry is called mimic while the animate (living) or inanimate (non living) object with which a mimic resembles is called model.

108. Alteration in the arrangement or amount of genetic material (DNA/genetic RNA) in a cell or virus is called mutation.
Point mutations involve minor changes in the genetic material, while macro mutations involve large segments of chromosomes. 'Frameshift mutations' are the addition or deletion of nucleotide (not involving 3 base pairs) so that the reading frame of the RNA is shifted to left or right during translation.

109. Down's syndrome also known as Mangolian idiocy is a trisomic condition resulting from non-disjunction of chromosome 21. The child is mentally retarded, has flat face and eyes like those found in Mangolian race (and hence the name). The chances of down syndrome in child increases with mother's age and become alarmingly high after the mother reaches the age of 40.

110. Semilog of per minute growing bacterium when plotted against time, would yield ascending straight line.



111. Lysosomes are the reservoirs of acid hydrolases showing optimum activity at pH 5.0 maintained within the lysosome. These include proteases, nucleases, glycosidases, lipase etc.

112. Hypersecretion of growth hormone (somatotrophic hormone) during adulthood causes acromegaly. It is characterised by bossing of frontal bone, prominent cheek, coarse hair, hirsutism and enlarged hands and feet.

Deficiency of thyroid hormone causes cretinism and goitre. Excess secretion of thyroid hormone responsibles for exophthalic goitre.

The principal hormone made by the adrenal medulla is adrenaline (also called epinephrine). It was the first hormone to be isolated in crystalline form in 1901 and was first synthesized in 1904. This hormone is also called as emergency hormone.

113. Genetic drift refers to changes in allele frequencies of a gene pool due to chance. Though it operates both in large and small populations, it is expected to be significant only in small populations, where alleles may become extinct or get fixed chance alone.

114. Follicle stimulating hormone (FSH), lutenising hormone (LH) and estrogen all play an important role in controlling the menstrual cycle in human females.

115. Water is an essential constituent of cytoplasm of all living organisms it helps in distribution of substances within the organism elimination of waste products, body temperature maintenance etc. It is absent on moon.

Anaerobic organisms can live in the absence of O_2. Light and temperatrue are already known to exist on moon.

116. If both the ovaries are removed then the blood plasma level of estrogen will be affected as it is produced by theca interna cells of Graafian follicles. Estrogen regulates growth and development of female accessary reproductive organs, secondary sexual characters and sexual behaviour.

117. Hyaline cartilage is present at the end of long articular bones. It provides a smooth articular surface to permit movement at joints. Elastic cartilage is found where support with flexibility is needed such as in external ears.

Fibro cartilage is a very tough substance and is used in places of the body where shock absorbers are needed.

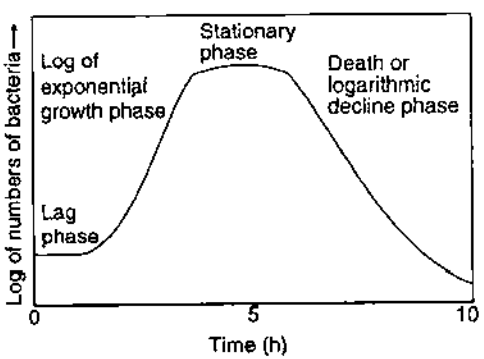
e.g., Discs between the vertebrae and in the knee joint.

118. According to the fluid mosaic model, the cell membrane consists of a highly viscous fluid matrix of two layers of phospholipid molecules. Protein molecules (or their complexes) occur in membrane but not in continuous layer.

119. The first hominid (ancestor from whom humans evolved) arose at a time when a change in weather led to the reduction in the size of the African forests favouring bipedalism.

120. Melanin is a protective pigment synthesized from tyrosine. Melanocytes under the influence of melanocyte secreting hormone secrete melanin which protects the body from harmful effects of UV rays.

121. When microbes are grown in a closed system or batch culture, the resulting growth curve has usually four phases : (a) lag phase (b) exponential (=log phase) (c) stationary phase (d) death phase.



Bacterial growth curve, showing the four typical phases of growth

122. Lymph can be defined as blood minus RBCs and some proteins. The main site of lymph formation is interstitial space and normally the rate of lymph formation is equal to the rate of its return to blood stream.

123. SA node (Sino Artial node) is a group of specialized cardiac muscle cells which have the property of generating rhythmic excitatory waves. It is also called pacemaker of the heart as it generates the wave for all the chambers of heart to contract.

124. Ligaments are specialized connective tissues which connect bones together; hence if they are cut or broken the bone will become unfixed.

125. Vitamin K is required for clotting process; it is required for the formation of prothrombin in liver, the deficiency of which leads to severe bleeding disorders. Deficiency of vitamin A causes night blindness, xerophthalmia, keratomalacia, retarded growth. Deficiency of vitaimin B causes beri-beri disease. Deficiency of vitamin E causes sterility.

126. Neurons are the chief functional units of the nervous system. An ordinary neuron has a soma or cyton and a long thread, called axon which is enclosed in a multilayered myelin sheath, made by Schwann cells. The myelin sheath is interrupted at the spaces between Schwann cells to form gaps. These gaps are called **nodes of Ranvier**. These nodes and the myelin sheath create condition that speed up the nerve impulses.

127. Bilirubin is broken down to urobilinogen and stercobilinogen. Yellowish brown colour of stool is due to **stercobilinogen.** Due to malfunctioning of liver, insufficient production of stercobilinogen leads to white stool.

128. The hormone adrenaline (epinephrine) is secreted by adrenal medula. This was the first hormone to be isolated in crystalline form. This hormone is primarily responsible for the alarming reactions. It increases the **heart rate,** breathing blood glucose level.

129. Radioactive iodine administered to patients suffering from thyroid cancer.

130. Destruction of habitats due to any reason (including cutting down of forests) exposes wild life to a variety of risk factors including predation and hunting.

131. Mesozoic era began about 24.8 crore years ago and lasted for about 18.3 crore years. It is also known as the "Age of Reptiles".

Main events in different era are as follows—

Era	Events
a. Precambrian	(i) Approximate origin of Earth. (ii) Oldest definite fossils known (prokaryotes). (iii) Oxygen begins accumulating in atmosphere. (iv) Oldest eukaryotic fossils. (v) Origin of first animals.
b. Paleozoic	(i) Origin of most invertebrate phyla; diverse algae. (ii) First vertebrates (jawless fishes); marine algae abundant. (iii) Diversity of jawless vertebrates; colonization of land by plants and arthropods; origin of vascular plants. (iv) Diversification of bony fishes; first amphibians and insects. (v) Extensive forests of vascular plants; first seed plants; origin of reptiles; amphibians dominant. (vi) Radiation of reptiles; origin of mammal like reptiles and most modern order of insect; extinction of many marine inverte-braters.
c. Mesozoic	(i) Gymnosperms dominate landscape; first dinosaurs and mammals. (ii) Gymnosperms continue as dominant plants; dinosaurs dominant; first birds. (iii) Flowering plants (angiosperms) appear, dinosaurs and many groups of organisms become extinct at end of period.

d. Cenozoic	(i)	Major radiation of mammals, birds and pollinating insects.
	(ii)	Angiosperm dominance increases; further increase in mammalian diversity.
	(iii)	Origins of most modern mammalian orders, including Apes.
	(iv)	Continued radiation of mammals and angiosperms.
	(v)	Ape like ancestors of humans appear.
	(vi)	Ice ages; humans appear.

132. According to the biological concept of species, a species is a group of organisms which can interbreed freely in nature and produce fertile offsprings.

133. Stone flies are exopterygote insects with aquatic nymphs; long antennae, biting mouth parts and weak flight. Adults have the tendency to feed on lichens and unicellular algae. These are good pollution indicators.

134. Unicellular organisms such as *Amoeba, Paramecium* use organelles called contractile vacuole for excretion. These are fresh water living animals *i. e.*, they are lived in hypotonic solution. Therefore, water flows from outside to inside of the body of the organism. The contractile vacuoles in these organisms collect this excess water and gradually increase in size. When the vacuoles reach a critical size they contract, squeezing out their contents through the process of simple diffusion.

135. Strains of *Saccharomyces cerevisiae* are extensively used for leavening of bread. During fermentation, the yeasts produce alcohol and CO_2 which leaves the leavened bread making it porous.

Bacteria—Unicellular prokaryotic micro-organism.

Virus—Particulate obligate parasite.

Protozoa—Unicellular eukaryotic micro-organisms.

136. Biogas production involves three steps :

(a) breakdown of polymers (b) conversion of monomers into organic acids by microbial fermentation (c) generation of methane by methanogenic bacteria (conversion of organic acids into CH_4 and CO_2).

137. A few plants *(e.g., Rafflesia)* are parasitic. Some angiosperm genera are vesselless. Secondary growth does not take place in a large variety of angiosperms. However, double fertilization is met with amongst all angiosperms. In this one male gamete fuses first with egg nucleus (n). This is known as syngamy and the second male gamete fuses with the secondary nucleus ($2n$). This is known as triple fusion. Together both these two syngamy and triple fusion is known as double fertilization.

138. All organisms which do not contain true nucleus (nucleus with nuclear membrane and nucleolus) and cytoplasmic organelles such as mitochondria, Golgi bodies, endoplasmic reticulum etc., are grouped under **prokaryotes**. While the organisms which contain the true nucleus and cytoplasmic organelles are grouped under **eukaryotes**.

139. The ability of radiations to kill cells is highest in the tissue with the highest number of dividing cells. Tumour cells proliferate rapidly. Hence, tumours are killed more rapidly by radiations.

140. The causal organism of loose smut disease is *Ustilago* fungus. It is an internal parasite. It has a dikaryotic mycelium which remains within the intercellular spaces of the host tissues. This fungus infects the ovary of the host flower as a result of which the masses of **teliospores** or **brand spores** are formed in place of grains. Teliospores are not surrounded by any wall hence called loose smut. These spores are dispersed by wind to the healthy plants.

141. The genes for *r*-RNAs tend to be highly conserved and, are, therefore, often employed for phylogenetic studies.

142. *Aspergillus, Penicillium* and *Fusarium* are quite common fungi infesting food and food stuffs and secrete toxins.

Claviceps purpurea → ergot

Aspergillus flavus → aflatoxin.

143. *Pinus* is a gymnospermic plant. Ovules of *Pinus* are uncovered which lie on the megasporophyll, hence these plants do not have flowers. How ever it produces seeds (from ovule after fertilization) like other three plants mentioned, all of which are angiosperms.

144. Root tips have active meristematic zone where cells divide mitotically leading to increase in the length of the roots. This is the best site for the study of mitosis.

145. Spindles formed during mitosis and meiosis are nothing but micro-tubule complex. Micro-tubules are made up of small units of tubulin which has an amino acid composition similar to actin.

Myosin : A protein that makes up the thick myofilaments in muscle fibre.

Actomyosin : Complex formed when the pure proteins actin and myocin are mixed.

Myoglobin : Conjugated protein of vertebrate's striated and cardiac muscle fibres.

146. The proteins required for the formation of ribosome are synthesized within the cytoplasm through the process of translation. These proteins are later shifted to nucleus and then to nucleolus where the RNA and proteins are assembled into ribosomal subunits.

147. A chromosome has one centromere, may have many chromomeres, two chromatids; but four telomeres (two each at the opposite ends of each chromatid).

148. According to Hardy–Weinberg theorem, the mixing of alleles at meiosis and their subsequent recombination will not alter the frequencies of alleles in the future generations provided the mating within the population is random.

149. The organisms obtaining energy by chemical reactions independent of light are called chemotrophs. The reductants obtained from the environment may be inorganic (in case of chemoautotrophs) or organic (in case of chemoheterotrophs).

Photoautotrophs—Organisms that make their own food by photosynthesis, using the energy of sun.

Saprozoic— Organisms which obtain food from dead and decaying matter.

150. *Paramecium* is heterokaryotic—it possesses a dimorphic nuclear apparatus (a single large macronucleus which controls metabolism; and one or more small micronuclei concerned with reproduction).

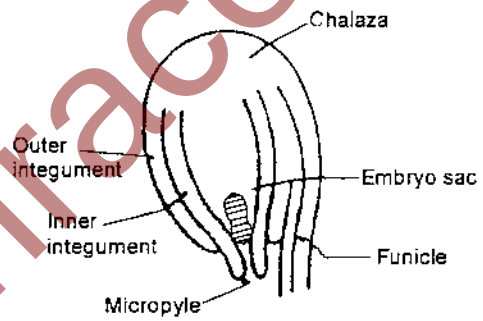
151. The deposition of callose starts in pollen mother cell as it enters meiosis and is complete by the end of first meiotic division. By the time tetrad are formed, the common callose wall dissolves; even then all the four micro-spores lie within a common callose wall.

152. Notochord is the primary axial supportive structure present in all chordate embryos—as well as in many adults. In a vast majority, it is replaced by vertebral column in adults. Vertebrates come under the category of chordate. Non chordates do not contain notochord.

153. A plant and its pollinator have a mutualistic relationship. The plant uses its pollinator to ensure cross-pollination while pollinator uses the plant as food.

Commensalism—One organism is benefited while the other living vicinity with the first neither benefited nor harmed.

154. In anatropous ovules, the micropyle comes to lie close to the funiculus due to unilateral growth of the ovule.



An anatropous ovule

155. USA is the largest consumer of fuel energy.

156. The contents of the pollen tube are discharged in the synergid from where the first sperm is transferred to the egg cell, while the other sperm moves to the central cell through cytoplasmic current.

157. Obviously, it is chlorophyll which absorbs light for photosynthesis. H_2O molecules provide H^+ ions and electrons during photosynthesis. O_2 is liberated during photosynthesis. RuDP (Ribulose 1, 5-diphosphate) reacts with CO_2 during dark reaction of photosynthesis. This process takes place in the presence of enzyme rubisco.

158. As a result of light reaction, oxygen, NADPH and ATP are formed. Oxygen is released into the atmosphere while NADPH and ATP are utilised for reduction of CO_2 to carbohydrate in dark reaction.

159. *Utricularia, Drosera* and *Dionaea* are also known as Bladderwort, Sundew and Venus fly trap, respectively. They all are insectivorous plants.

160. A total of 38 molecules of ATP are produced during aerobic respiration of one molecule of glucose :

Summary of ATP synthesis :

8 ATP from glycolysis.
6 ATP from acetyl Co-A.
24 ATP from Krebs cycle.
Total = 38 ATP from aerobic oxidation of one molecule of glucose.

161. When the guard cells become turgid, the stomata open. On the other hand, if the guard cells lost water, these become flaccid, the inner walls sag and the pore closes.

162. Phytochrome is a regulatory pigment which regulates many light-dependent developmental processes. It exists in two interconvertible forms — P_{FR} or P_{730} (absorbs far-red light) and P_R or P_{660} (absorbs red light).

163. Abscisic Acid (ABA) was isolated by Liu and Crans (1961) from mature cotton fruits. The other name **dormin** is also given to ABA because it induces seed dormancy as well as bud dormancy.

Main physiological effects of ABA are :

(a) It promotes abscission of leaves, flowers and fruits.
(b) It accelerates senescence.
(c) It promotes bud dormancy.
(d) It is a natural growth inhibitors.

164. Mango is a drupe fruit which develops from a monocarpillary, syncarpous, unilocular and superior ovary. Epicarp of mango fruit forms skin while mesocarp is fleshy and fibrous which is edible part of this fruit. Endocarp is hard and stony.

165. Cleavage is a succession of rapid cell division during which the cells undergo the S (DNA synthesis) and M (mitosis) phases of the cell cyle but often virtually skip the G_1 and G_2 phases. Cleavage simply divides the cytoplasm of larger cells into smaller cells, called blastomeres.

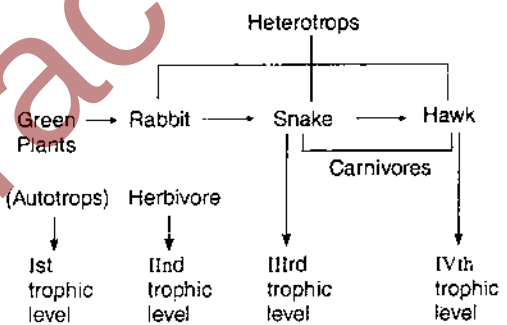
166. The groundnut fruits ripen underground—the young fruits being pushed into the soil by a post-fertilization curvature of the stalk.

167. The neurons of *Hydra* synapse with each other and other body cells. As a result, it responds to external stimuli. However, there is no brain in *Hydra* to co-ordinate the responses.

168. Plasmid is a piece of circular DNA molecule (mostly in bacteria but in yeast also) which is not part of the normal chomosomal DNA of a cell, and is capable of replicating independently of it.

169. Plants, being photosynthetic, occupy first trophic level (T_1) in the food chain.

A trophic level is a step in the flow of energy through an ecosystem, such as the step at which plants manufacture food or the step at



which carnivores feed on other animals.

170. *Cuscuta*, commonly known as dodder or amarbel, is a parasitic plant.

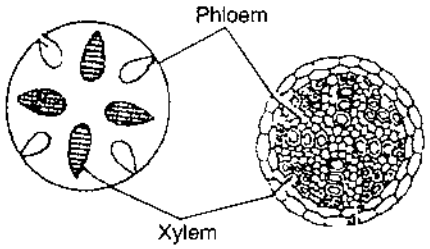
171. **The Principle of competitive exclusion** was postulated by Soviet ecologist **G.F. Gause**. It states that if two species are competiting with each other for the same limited resource, then one of the species will be able to use that resource more efficiently than the other and the former will, therefore, eventually eliminate the latter locally.

172. A dominant gene would lead to the expression of its phenotype irrespective of the fact whether its allelic gene is dominant or recessive.

e.g., R gene which is responsible for red colour, is dominant over r gene which is responsible for white colour. Then R will express itself in homozygous *i. e.*, RR as well as in heterozygous *i. e.*, Rr conditions.

173. The ability of a gene to affect an organism in many ways is called **Pleiotropy** (Greek : *Pleion* - more) and that gene is called as **pleiotropic gene**.
e.g., Individuals heterozygous for the sickle cell anaemia (Hb^A Hb^S) are resistant to malaria.

174. Roots have radial vascular bundles while stems have conjoint vascular bundles. Dicot roots have 3-6 vascular bundles while monocot roots have more than 6 vascular bundles.



Radial vascular bundle

175. In lac operon, the repressor protein combines with the operator gene controls its functioning.

176. Most angiosperms have vessels except a few *(e.g., Drimys, Tetracentron, Trochodendron).* The gymnosperms, as a rule, lack vessels but these are found in the order Gnetales. Vessels are the constituent of xylem complex tissue. They are composed of row of cells placed one above to other. Transverse wall of these cells is absent due to dissolution.

177. Jacob and Monod's operon concept is basically a theory of gene expression in prokaryotes—though it is of some value in the explanation of eukaryotic gene expression.

178. For a particular amino acid, more than one codon can be used.

179. Since the father is diseased and daughters also—the disease is not sex-limited of course, it is sex-linked. Sex linked inheritance may be X-linked as given in the question, Y-linked and XY-linked.
In X-linked inheritance the characters are controlled by genes located on non homologous part of X-chromosome. These X-linked genes do not have their corresponding alleles on Y-chromosome. In daughter it is express even when present in heterozygous condition.

180. Total DNA (100) = A + T + C + G
A = 20% (Given)
A = T (Base pairing rule)
100 = 20 + 20 + C + G
C + G = 100 – 40 = 60
C/G = 30 (C = G).

181. Colourblindness and haemophilia are well known examples of sex-linked diseases.

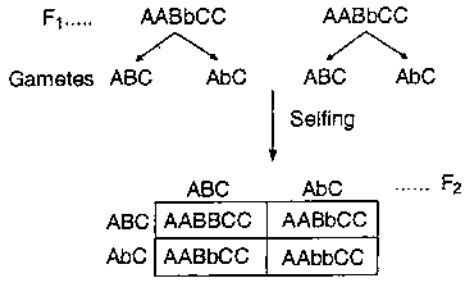
182. The primary function of lenticels is gaseous exchange. Of course, transpiration occurs automatically. Transpiration takes place through stomata. Guttation and bleeding takes place through hydathods.

183. Cholesterol forms a major component of animal cell membranes liposomes (artificially created spheres surrounded by a phospholipid bilayer like a membrane) are used for transformation (transgenics).

184. Transduction involves the picking up of DNA by bacteriophage from one bacterial cell and carrying it to another where the DNA fragment may get incorporated into the bacterial host's genome.

185. Griffith (1928) discovered the phenomenon of transformation while working on *Diplococcus pneumoniae* for developing a vaccine against it. In transformation the naked DNA is taken up by a competent bacterial cell from their surrounding medium.

186. Since AABbCC contains only one heterozygous allelic pair 'Bb', the cross would behave as monohybrid cross leading to 3 : 1 phenotypic ratio in F_2.



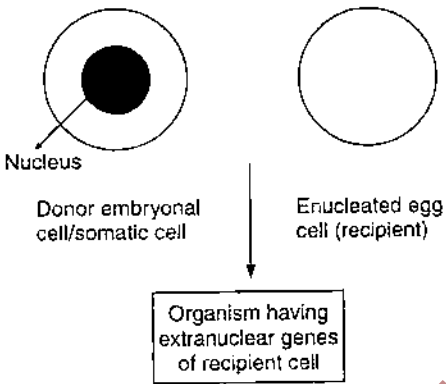
Phenotypic ratio is 3 : 1.

187. Totipotency is the inherent capability of a single cell to provide the genetic programme required to direct the development of complete individual. Pollen grains also contain one set of such programme. Differentiation of organs from the embryo is known as organogenesis.

188. *Cholchicum autumnale* provides an alkaloid called colchicine which is used in plant breeding for doubling the chromosome number. Treatment with 0.1% colchicine inhibits spindle formation so that chromatids fail to separate during anaphase.

189. It is the shoot apical meristem which gives rise to lateral buds. The lateral buds-however remain suppressed due to apical dominance.

190. Cashew nut, potato and rubber are new world crops. Mango, tea and coffee are old world crops.



191. The organism will have extranuclear genes of recipient cell. Since the recipient cell has already been enucleated (its nucleus is removed), the organism developing from it would have the nuclear genes of donor cell.

192. Ligase enzymes catalyse condensation of two molecules involving hydrolysis of ATP or any other such triphosphate. DNA ligase is used to join bits of DNA.

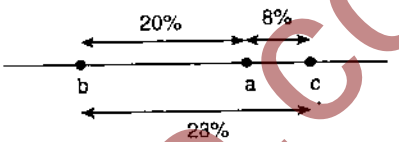
193. It is difficult for developing countries to keep up and maintain such crops.

194. Each vessel is made up of a number of components called 'vessel members' arranged end-to-end running parallel to the long axis of the organ in which it lies.

195. *m*-RNA processing involves precise excision of the intron and ligation of the exons.

196. *m*-RNA consists of codons for protein synthesis. Exon is the stretch of bases which codes for amino acids while the non-coding stretches of bases is called intron.

197.



198. Isolation of restriction endonucleases by Nathans and Smith (1970) made it possible to cut DNA at specific sites. Restriction enzyme can cut both strands of DNA when foreign nucleotides are introduced in the cell. They cleave DNA to generate a nick with a 5′ phosphoryl and 3′ hydroxyl terminus.

199. Bloor (1943) first time used the term 'lipid'. These are the compounds of C, H, O but the ratio of H and O is more than 2 : 1 that is the ratio of oxygen is lesser as compared to carbohydrates. Lipids are insoluble in water but soluble in non polar solvents such as benzene, chloroform etc. Commonest lipids occur in a cell is phospholipid. It contains a hydrophilic (polar) head and a hydrophobic (non-polar) tail.

200. Collagen is a major fibrous protein of connective tissue, occurring as white fibres produced by fibroblast.

❑