NEET MOCK TEST - SET 353

Physics Section - A

1. Two lenses in contact form an achromatic lens, their focal lengths are in the ratio 2: 3. Their dispersive powers must be in the ratio of:
   (a) 1: 3
   (b) 2: 3
   (c) 3: 2
   (d) 3: 1

2. A compound lens is formed by combining one convex and one concave lens of the same focal length 20 cm. This compound lens is used to see a 5 cm high object situated at a distance of 20 cm. The image will be:

   (a) Enlarged and reverse

   (b) Small and erect

   (c) Erect and same size of object

   (d) Reverse and same size of object

3. Dispersive power of a prism depends upon:

   (a) Material of prism

   (b) Angle of prism

   (c) Shape of prism

   (d) Incidence angle

4. Ratio of rms velocities of O_2 and H_2 at equal temperature will be:
   (a) 1: 1
   (b) 1: 4
   (c) 2: 1
   (d) 4: 1

5. Relation between pressure (P) and energy (E) for a unit volume of gas:
   (a) $E = \frac{3}{2}p$
   (b) $E = \frac{2}{3}p$
   (c) $E = \frac{p}{3}p$
   (d) $E = 3p$

6. A charge is placed on the axis of a dipole at a distance r from centre then charge experiences a force F . If distance from the centre is doubled then new value of force will be:
   (a) 0

(b) $\frac{1}{2}$
(c) $\frac{F}{4}$
(d) $\frac{F}{8}$

7. At the centre of a cubical box $+Q$ charge is placed. The value of total flux that is coming out of each face is:
(a) $\frac{Q}{\epsilon_0}$
(b) $\frac{Q}{6\epsilon_0}$
(c) $\frac{Q}{4\epsilon_0}$
(d) $\epsilon_0 Q$

8. Relation between wavelength of photon and electron of same energy is:

(a) $\lambda_{\text{ph}} > \lambda_e$

(b) $\lambda_{\text{ph}} < \lambda_{\text{e}}$

(c) $\lambda_{\text{ph}} = \lambda_{\text{e}}$

(d) $\frac{\lambda_e}{\lambda_{ph}} = \text{constant}$

9. The minimum wavelength of X -rays produced from an electron accelerated from V volt is:
(a) $\frac{eV}{hc}$
(b) $\frac{hc}{eV}$
(c) $\frac{c^2h}{eV}$
(d) $\frac{h}{V}$

10. The velocity of sound in air is 333 m/s, if the fundamental frequency of an open pipe is 333 Hz Then length of the pipe required to produce second over tone is:
(a) 0.5 m
(b) 1.0 m
(c) 1.5 m
(d) 2 m

11. Extension in length of a spring is 12 cm, when 5 kg mass is suspended on it. If spring oscillate vertically, then its time period is:
(a) 0.7sec
(b) 0.9sec
(c) 1.1sec
(d) 1.4sec

12. Which of the following is a correct relation for a transistor?
(a) $\alpha = \frac{\beta}{1-\beta}$

(b) $\beta = \frac{\alpha}{1-\alpha}$

(c) $\beta = \frac{\alpha}{1+\alpha}$

(d) $\alpha = \frac{\beta}{1+\alpha}$

13. If **p − n** junction is unbiased then:

(a) Current is zero, because drifting of charge is same from both sides

(b) Current is zero, because there is no movement of charge

(c) Current is not zero

(d) None of these

14. Which of these relations is wrong?

(a) $1\text{cal} = 4.18\ \text{J}$

(b) $1\text{Å} = 10^{-10}\ \text{m}$

(c) $1\text{MeV} = 1.6 \times 10^{-13}\ \text{J}$

(d) $1\ \text{N} = 10^{-5}$ dyne

15. Dimensions of torque is:

(a) $[\text{M}^1\ \text{L}^2\ \text{T}^{-2}]$

(b) $[M^2L^2T^2]$

(c) $[\text{M}^{-1}\text{LT}^{-1}]$

(d) $[\text{M}^{-2}\ \text{L}^{-2}\ \text{T}^{-2}]$

16. Unit of magnetic flux is:

(a) Ampere/metre^2

(b) Weber

(c) Gauss

(d) Orested

17. Dimension of Planck's constant is similar to:

(a) Linear momentum

(b) Angular momentum

(c) Torque

(d) Velocity

18. Value of escape velocity from earth surface is:
    (a) 11.2 km/s
    (b) 112 m/s
    (c) 22.4 km/s
    (d) 11200 km/s

19. Two bodies A and B are revolving round a planet. Radius of A's orbit is $4R$ and that of B's orbit is R, if speed of A is $3v$ then speed b of B is:
    (a) 12v
    (b) 6v
    (c) $\frac{4}{3}$v
    (d) $\frac{3}{2}$v

20. The resistors whose ratio is 1: 2, are connected in parallel, the ratio of power dissipated is:
    (a) 1: 2
    (b) 1: 4
    (c) 4: 1
    (d) 2: 1

21. A glass slab of thickness 4 cm contains the same number of waves as 5 cm of the water column when both are transversed by the same monochromatic light. If the refractive index of water is $\frac{4}{3}$, what is that of glass:
    (a) $\frac{5}{3}$
    (b) $\frac{5}{4}$
    (c) $\frac{16}{15}$
    (d) $\frac{1}{5}$

22. Velocity of light in diamond, glass and water will be in following order:

    (a) Diamond < Glass < Water

    (b) Water < Glass < Diamond

    (c) Diamond > Water > Glass

    (d) Diamond > Glass > Water

23. On basis of which property light waves can be differentiated from sound waves:
    (a) Interference
    (b) Diffraction
    (c) Polarisaton
    (d) Reflection

24. Which of the following phenomena can explain quantum nature of light?

(a) Photoelectric effect

(b) Interference

(c) Diffraction

(d) Polarization

25. In H_2 molecule (atom) its total energy is proportional to:
(a) n^2
(b) n
(c) $\frac{1}{n}$
(d) $\frac{1}{n^2}$

26. Ratio of energies of two photons whose wavelengths are 600Å and 400Å is:
(a) 2: 3
(b) 3: 2
(c) 1: 5
(d) 5: 1

27. A current of 2amp is made to flow through a coil that has only one turn. The magnetic field produced at the centre is $4\pi \times 10^{-6}$ Wb/m^2. The radius of the coil is:
(a) 0.0001 m
(b) 0.01 m
(c) 0.1 m
(d) 0.001 m

28. When a coil moves towards a stationary magnet, the induced emf does not depend on:

(a) Speed with which the coil or magnet is moving

(b) Number of turns in the coil

(c) Strength of the magnet

(d) Resistance of the coil

29. The magnetic field at the centre of current carrying coil is B_0 If its radius is reduced to half keeping current the "same then magnetic field at its centre become:
(a) B_0
(b) 2 B_0
(c) 4 B_0
(d) $\frac{B_0}{2}$

30. What happens when a body is moving in a circular path with a constant speed?

(a) Force acting on it is zero

(b) Acceleration is not uniform

(c) Velocity is uniform

(d) Velocity is changing

31. Tyres are made circular because:

(a) Sliding friction is less than rolling friction

(b) It decreases the friction of the tyre

(c) It reduces wear & tear

(d) Rolling friction is less than sliding friction

32. For a series LCR circuit, the Root mean square (RMS) values of voltage across various components are $V_L = 90$ V, $V_C = 60$ V and $V_R = 40$ V.

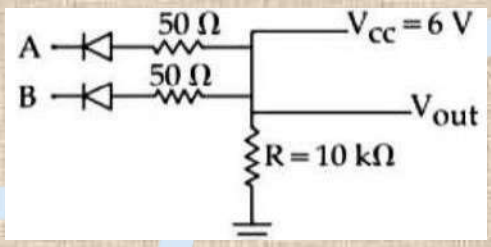
The RMS value of the voltage of the circuit is:
(a) 190 V
(b) 110 V
(c) 70 V
(d) 50 V

33. An arrow is projected into air. It's time of flight is 5 seconds and range 200 m. What is the maximum height reached by it? Take ($g = 10$ m/s^2)
(a) 31.25 m
(b) 46.75 m
(c) 24.50 m
(d) 18.25 m

34. Given: A and B are input terminals. Logic $1 \geq 5$ V

Logic $0 \leq 1$ V

Which logic gate operation, the following circuit does?



(a) AND Gate
(b) OR Gate
(c) XOR Gate
(d) NOR Gate

35. When a piece of aluminium wire of finite length is drawn through a series of dies to reduce its diameter to half its original value, its resistance will become:-

(a) Two times

(b) Four times

(c) Eight times

(d) Sixteen times

Physics Section - B

36. A block of mass 4 kg is kept on a rough horizontal surface. The coefficient of static friction is 0.8. If a force of 19 N is applied on the block parallel to the floor, then the force of friction between the block and floor is:
(a) 32 N
(b) 18 N
(c) 19 N
(d) 9.8 N

37. A gas is found to obey the law $P^2 V = \text{constant}$, The initial temperature and volume are T_0 and V_0. If the gas expands to a volume 3 V_0, its final temperature becomes:

(a) $\frac{T_0}{3}$

(b) $\frac{T_0}{\sqrt{3}}$

(c) $\sqrt{3}\, T_0$

(d) None of these

38. One litre of Helium gas at a pressure of 76 cm − Hg and temperature 27°C is heated till its pressure and volume are doubled. The final temperature attained by the gas is:
(a) 900°C
(b) 927°C
(c) 627°C
(d) 327°C

39. A body is moved along a straight line by a machine delivering a constant power. The distance moved by the body in time t proportional to:
(a) $\sqrt{t}$
(b) $t^{\frac{3}{4}}$
(c) $t^{\frac{3}{2}}$
(d) t^2

40. A uniform force of $(3\hat{\imath} + \hat{\jmath})N$ acts on a particle of mass 2 kg. Hence the particle is displaced from position $(2\hat{\imath} + \hat{k})m$ to position $(4\hat{\imath} + 3\hat{\jmath} - \hat{k})m$. The work done by the force on the particle is:
(a) 9 J
(b) 6 J

(c) 13 J
(d) 15 J

41. The angular speed of a motor wheel is increased from 1200rpm to 3120rpm in 16 seconds. What is its angular acceleration to be uniform?
(a) $4\pi \text{rad/s}^2$
(b) $28\pi \text{rad/s}^2$
(c) $120\pi \text{rad/s}^2$
(d) 1rad/s^2

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

43. A tube of length L is filled completely with an incompressible liquid of mass M and closed at both the ends. The tube is then rotated in horizontal plane about one of its ends with a uniform angular velocity ω. The force exerted by the liquid at the other end is:
(a) $\frac{1}{2}M\omega^2L^2$
(b) $M\omega^2L$
(c) $\frac{1}{4}M\omega^2L$
(d) $\frac{1}{2}M\omega^2L$

44. The flow rate from a tap of diameter 1.25 cm is 3lit/min. The coefficient of viscosity of water is 10^{-3} Pas. The nature of flow is:

(a) Unsteady

(b) Turbulent

(c) Laminar

(d) None of these

45. A simple pendulum hangs from the roof of a moving train. The string is inclined towards the rear of the train. What is the nature of the motion of the train?

(a) Accelerated

(b) Uniform

(c) Retarded

(d) None of these

46. The decay constant of a radio isotope is λ. If A_1 and A_2 are its activities at times t_1 and t_2 respectively, then the number of nuclei which have decayed during the time $(t_1^2 - t_2)$: -
(a) $A_1 - A_2$
(b) $\left(\frac{A_1 - A_2}{\lambda}\right)$
(c) $\lambda(A_1 - A_2)$
(d) $A_1 t_1 - A_2 t_2$

47. Two vessels separately contain two ideal gases A and B at the same temperature, the pressure of A being twice that of B. Under such conditions, the density of A is found to be **1. 5** times the density of B. The ratio of molecular weight of A and B is:
(a) $\frac{1}{2}$
(b) $\frac{2}{3}$
(c) $\frac{3}{4}$
(d) 2

48. Pure Si at 500 K has equal number of electron (n_e) and hole (n_h) concentrations of 1.5×10^{16} m^{-3}. Doping by indium increases n_h to 4.5×10^{22} m^{-3}. The doped semiconductor is of:

(a) p-type having electron concentrations $n_e = 5 \times 10^9$ m^{-3}

(b) n-type with electron concentrations $n_e = 5 \times 10^{22}$ m^{-3}

(c) p-type with electron concentrations $n_e = 2.5 \times 10^{10}$ m^{-3}

(d) n-type with electron concentrations $n_e = 2.5 \times 10^{23}$ m^{-3}

49. Two forces with equal magnitudes F act on a body and the magnitude of the resultant force is $\frac{F}{3}$. The angle between the two forces is:

(a) $\cos^{-1}\left(\frac{1}{2\sqrt{3}} - 1\right)$

(b) $\cos^{-1}\left(-\frac{1}{3}\right)$

(c) $\cos^{-1}\left(\frac{1}{2\sqrt{3}} + 1\right)$

(d) $\cos^{-1}\left(-\frac{8}{9}\right)$

50. Which two of the following five physical parameters have the same dimensions?

(A) Energy Density

(B) Refractive Index

(C) Dielectric constant

(D) Young's Modulus

(E) Magnetic field

(a) A and B

(b) B and D

(c) A and D

(d) All of the above

Chemistry Section - A

51. Atomic radii of fluorine and neon in Angstrom units are respectively given by:
(a) 0.72,1.60
(b) 1.60,1.60
(c) 0.72,0.72
(d) 0.72,0.78

52. Atomic radii from left to right across a row of the periodic table:

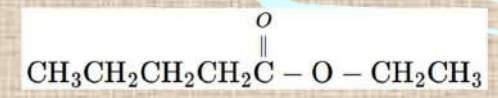
(a) Increases

(b) Decreases

(c) Remain constant

(d) None of these

53. The compound given below is named:



(a) Butyl acetate

(b) Ethyl pentanoate

(c) Ethyl butanoate

(d) Butyl ethanoate

54. If the carbonyl compound is hydrolyzed with H_2O^{18}, what would be observed?

(a) The extent of hydration will increase

(b) The extent of hydration will decrease

(c) The rate of hydration will increase

(d) Gradually all O^{16} of carbonyl compound will be replaced by O^{18} isotope

55. A mixture of benzaldehyde and formaldehyde on heating with aqueous NaOH solution gives:

(a) Benzyl alcohol and sodium formate

(b) Sodium benzoate and methyl alcohol

(c) Sodium benzoate and sodium formate

(d) Benzyl alcohol and methyl alcohol

56. ΔC_P for a reaction is given by $2.0 + 0.2$ Tcal/deg. Its enthalpy of reaction at 100 K in K cal will be, if $(\Delta H)_1$ at 10 K is -14.38 K cal:
(a) -13.21
(b) -15.37
(c) 16.02
(d) 7.08

57. Benzene carbaldehyde is reacted with concentrated NaOH solution to give the products A and B. Product A can be used food preservative and the product B is an aromatic hydroxyl compound where the OH group is linked to sp^3 hybridized carbon atom next to Benzene ring. The products A and B are respectively:

(a) Sodium benzoate and phenol

(b) Sodium benzoate and phenyl methanol

(c) Sodium benzoate and cresol

(d) Sodium benzoate and picric acid

58. In Haber process for the manufacture of ammonia, the catalyst used is:

(a) Platinized asbestos

(b) Iron

(c) Copper oxide

(d) Alumina

59. Negative deviation from Raoult's law is observed in which one of the following binary liquid mixtures?

(a) Ethanol and acetone

(b) Benzene and toluene

(c) Acetone and chloroform

(d) Chloroethane and bromoethane

60. If M is the element of the actinide series, the degree of complex formation decreases in the order:

(a) $M^{4+} > M^{3+} > MO_2^{2+} > MO_2^{+}$

(b) $MO_2^+ > MO_2^{2+} > M^{3+} > M^{4+}$

(c) $M^{4+} > MO_2^{2+} > M^{3+} > MO_2^+$

(d) $MO_2^{2+} > MO_2^+ > M^{4+} > M^{3+}$

61. Which of the following is paramagnetic?
(a) V(CO)6
(b) Fe(CO)5
(c) $Fe_2(CO)_9$
(d) Cr (CO)6

62. The glycosidic linkages and peptide linkages are present in:

(a) Carbohydrates, proteins

(b) Carbohydrates, fats

(c) Fats, proteins

(d) Fats, vitamins

63. In face-centred cubic (FCC) and body centred cubic (BCC), whose unit cell lengths are 3.5Å and 3.0 Å respectively, a metal crystallises into two cubic phases. What is the ratio of densities of FCC and BCC ?
(a) 1.259
(b) 3.0
(c) 12.5
(d) 0.59

64. 1 g silver salt of an organic dibasic acid on heating yields 0.5934 g Ag. If the weight percentage of C in acid is 8 times the weight percentage of hydrogen and one half the weight percentage of oxygen, then determine its molecular formula. $(M_{AgNO_3} = 108)$
(a) $C_4H_6O_6$
(b) $C_3H_4O_6$
(c) $C_4H_3O_3$
(d) $C_4H_6O_3$

65. Faraday's law of electrolysis is related to:

(a) Atomic number of cation

(b) Speed of cation

(c) Speed of anion

(d) Equivalent mass of electrolyte

66. Which of the following block of elements is called "Transition elements"?

(a) d-block elements

(b) f-block elements

(c) p-block elements

(d) s-block elements

67. A system is said to be in thermodynamic equilibrium if the system is in:

(a) Chemical equilibrium

(b) Thermal, chemical mechanical equilibrium

(c) Thermal equilibrium

(d) Mechanical equilibrium

68. The brown ring complex compound of iron is formulated as $[Fe(H_2O)_5(NO)]SO_4$. The oxidation state of iron is:
(a) 1
(b) 2
(c) 3
(d) 0

69. Nitrogen gas was injected into an equilibrium mixture of: $2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g)$ The pressure is increased from 1.0 atm to 10 atm. Which of the following statements is correct?

(a) The concentrations of the reactant and product are unchanged

(b) $[SO_3]$ increases

(c) $[SO_2]$ increases

(d) $[O_2]$ increases

70. C_3H_9N can have how many structural isomers?
(a) 2
(b) 3
(c) 4
(d) 5

71. Benzene forms Nitrobenzene on reaction with conc. HNO_3/H_2SO_4 , in the reaction HNO_3 acts as a:

(a) Catalyst

(b) Reducing agent

(c) Base

(d) Acid

72. Which of the molecules does not have a permanent dipole moment?
(a) H_2 S
(b) SO_2
(c) CS_2
(d) SO_3

73. Carbon tetrachloride has no net dipole moment because of: (a) Its planar structure

(b) Its regular tetrahedral structure

(c) Similar size of carbon and chlorine atoms

(d) Similar electron affinities of carbon and chlorine

74. In the presence of a catalyst, the heat evolved or absorbed during the reaction_____

(a) Increases

(b) Decreases

(c) Remains unchanged

(d) May increase or decrease

75. EDTA is used for the estimation of:

(a) $Na^+$and K^+ions

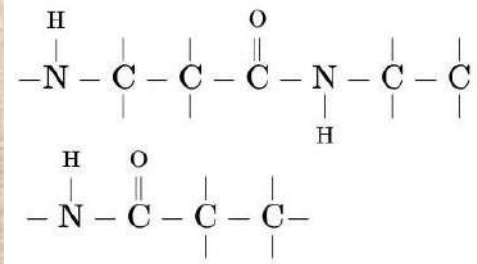
(b) $Cl^-$and Br^-ions

(c) Cu^{2+} and Cs^+ions

(d) Ca^{2+} and Mg^{2+} ions

76. Which one of the following structures represents the peptide chain:

(a)



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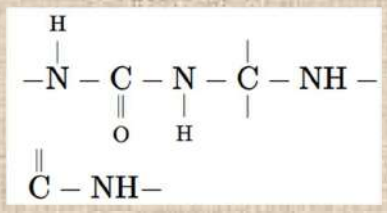

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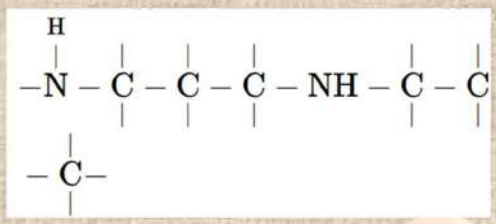
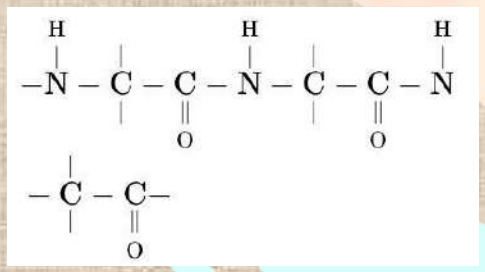


(d)



77. For the redox reaction, $MnO_4^- + C_2O_4^{2-} + H^+ \rightarrow Mn^{2+} + CO_2 + H_2O$, the correct coefficients of the reactants for the balanced reaction are:

(a) $MnO_4^- = 2, C_2O_4^{2-} = 5, H^+ = 16$

(b) $MnO_4^- = 16, C_2O_4^{2-} = 3, H^+ = 12$

(c) $MnO_4^- = 15, C_2O_4^{2-} = 16, H^+ = 12$

(d) $MnO_4^- = 2, C_2O_4^{2-} = 16, H^+ = 5$

78. Percentage of Se in peroxidase anhydrous enzyme is 0.5% by weight (at. wt. = 78.4) then minimum molecular weight of peroxide anhydrous enzyme is

(a) 1.568×10^4

(b) 1.568×10^3

(c) 15.68

(d) 2.136×10^4

79. Solution of $0.1N NH_4OH$ and $0.1N NH_4Cl$ has pH 9.25. Then find out pK_b of NH_4OH

(a) 9.25

(b) 4.75

(c) 3.75
(d) 8.25

80. Change in enthalpy for reaction, $2H_2O_{2(l)} \rightarrow 2H_2O_{(l)} + O_{2(g)}$ if heat of formation of $H_2O_{2(l)}$ and $H_2O_{(l)}$ are - 188 and - 286 kJ/mol respectively, is

(a) -196 kJ/mol

(b) $+196$ kJ/mol

(c) $+948$ kJ/mol

(d) -948 kJ/mol

81. The e.m.f. of a Daniell cell at 298 K is E_1.

$$Zn \begin{matrix} ZnSO_4 \\ (0.01M) \end{matrix} \begin{matrix} CuSO_4 \\ (1.0M) \end{matrix} Cu$$

When the concentration of $ZnSO_4$ is 1.0M and that of $CuSO_4$ is 0.01M, the e.m.f. changed to E_2. What is the relationship between E_1 and E_2

(a) $E_1 > E_2$
(b) $E_1 < E_2$
(c) $E_1 = E_2$
(d) $E_2 = 0 \neq E_1$

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

83. Which of the following statement is true?

(a) Silicon exhibits 4 coordination number in its compound.

(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 15^{th} group shows only $+3$ and $+5$ oxidation states.

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

85. Which complex compound will give four isomers?

(a) $[Fe(en)_3]Cl_3$

(b) $[Co(en)_2Cl_2]Cl$

(c) $[Fe(PPh_3)_3NH_3ClBr]Cl$

(d) $[Co(PPh_3)_3Cl]Cl_3$

Chemistry Section - B

86. Which of the following component will be used as the halide component for Friedel-Crafts reaction?

(a) Chlorobenzene

(b) Bromobenzene

(c) Chloroethene

(d) Isopropyl chloride

87. In which of the following coordination compounds is the central metal ion in zero oxidation state?

(a) $[Fe(H_2O)_6]Cl_3$

(b) $K_4[Fe(CN)_6]$

(c) $Fe(CO)_5$

(d) $[Fe(H_2O)_6]Cl_2$

88. Diethyl ether on heating with concentrated HI gives two moles of:

(a) Ethanol

(b) Iodoform

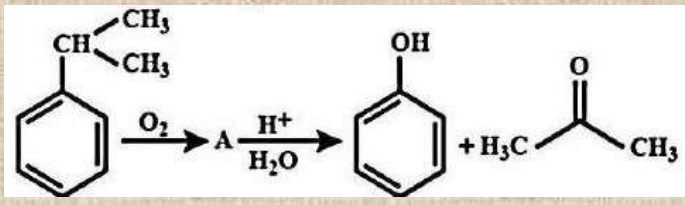
(c) Ethyl iodide

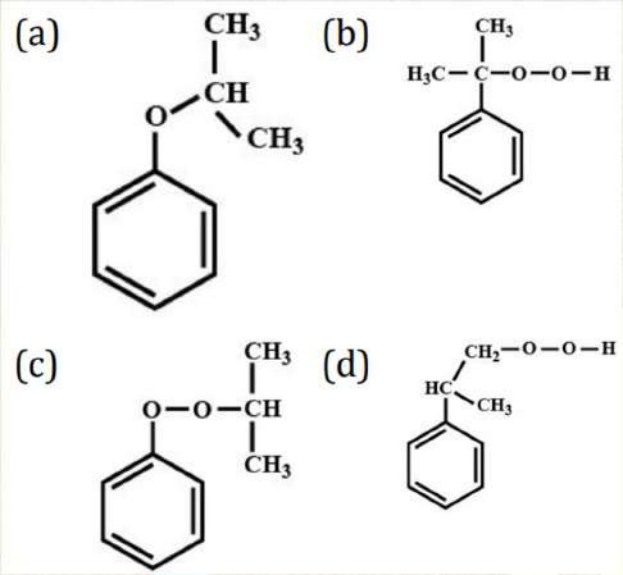
(d) Methyl iodide

89. A synthetic rubber which is resistant to the action of oils, gasoline and other solvents is:

(a) Buna-S
(b) Polyisoprene
(c) Neoprene
(d) Polystyrene

90. The structure of intermediate *A* in the following reaction is:





91. Chloroform is kept in dark-coloured bottles because _____.

(a) It reacts with clear glass

(b) It undergoes chlorination in transparent glass bottles

(c) It is oxidised to a poisonous gas, phosgene in sunlight

(d) It starts burning when exposed to sunlight

92. The change in oxidation number of chlorine when Cl_2 gas reacts with hot and concentrated sodium hydroxide solution is:

(a) Zero to -1 and zero to +3

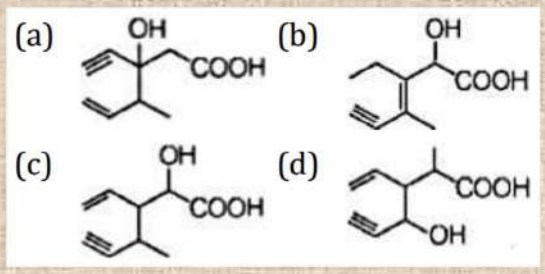
(b) Zero to +1 and zero to -3

(c) Zero to +1 and zero to -5

(d) Zero to -1 and zero to +5

93. Structure of the compound whose IUPAC name

3-Ethyl-2-hydroxy-4-methylhex-3-en-5-ynoic acid is:



94. Nitrobenzene on reaction with conc. HNO_3/H_2SO_4 at $80-100°C$ forms which one of the following products?

(a) 1,2 -Dinitrobenzene

(b) 1,3-Dinitrobenzene

(c) 1,4 -Dinitrobenzene

(d) 1,2,4-Trinitrobenzene

95. Which has maximum molecules?
(a) 7 g N_2
(b) $2gH_2$
(c) $16gNO_2$
(d) $16gO_2$

96. The frequency of radiation emitted when the electron falls from $n = 4$ to $n = 1$ in hydrogen atom will be (Given ionization energy of H $= 2.18 \times 10^{-18}$ J atom $^{-1}$ and h $= 6.625 \times 10^{-34}$ J s)

(a) $1.54 \times 10^{15}\ s^{-1}$

(b) $1.03 \times 10^{15}\ s^{-1}$

(c) $3.08 \times 10^{15}\ s^{-1}$

(d) $2.00 \times 10^{15}\ s^{-1}$

97. The equilibrium constants of the following are

$N_2 + 3H_2 \rightleftharpoons 2NH_3;\ K_1$

$N_2 + O_2 \rightleftharpoons 2NO;\ K_2$

$H_2 + \frac{1}{2}O_2 \rightleftharpoons H_2O;\ K_3$

The equilibrium constant (K) of the reaction :

$2NH_3 + \frac{5}{2}O_2 \rightleftharpoons 2NO + 3H_2O$ will be
(a) $K_2\ K_3{}^3/K_1$
(b) $K_2\ K_3/K_1$

(c) $K_2{}^3 K_3/K_1$
(d) $K_1 K_3{}^3/K_2$

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

99. The vapour pressure of two liquids *P* and *Q* are 80 and 60 torr, respectively. The total vapour pressure of solution obtained by mixing 3 mole of *P* and 2 mole of *Q* would be
(a) 72 torr
(b) 140 torr
(c) 68 torr
(d) 20 torr

100. Which compound has planar structure?
(a) XeF_4
(b) $XeOF_2$
(c) $XeO_2 F_2$
(d) XeO_4

Botany Section - A

101. In comparison with genus, which of the following is less general in characters?
(a) Family
(b) Division
(c) Species
(d) Class

102. Polytene chromosomes are found because of
(a) Endomixes
(b) Mitosis
(c) Meiosis
(d) Endomitosis

103. Hammerling's experiments on Acetabularia involved exchanging:

(a) Cytoplasm

(b) Nucleus

(c) Rhizoid and Stalk

(d) Gametes

104. The physical process involved in the release of molecular oxygen from leaves is:

(a) Diffusion

(b) Transpiration

(c) Osmosis

(d) Capillarity

105. Most abundant water pollutant is:

(a) Detergents

(b) Pesticides

(c) Industrial wastes

(d) Ammonia

106. The roots which develop from any portion of the plant except the radical are known as?

(a) Tap roots

(b) Stilt roots

(c) Fibrous roots

(d) Adventitious roots

107. The ovule of an angiosperm is technically equivalent to:

(a) Megasporangium

(b) Megasporophyll

(c) Megaspore mother cell

(d) Megaspore

108. Which one of the following may require pollinators, but is genetically similar to autogamy?

(a) Geitonogamy (b)

(b) Xenogamy

(c) Apogamy

(d) Cleistogamy

109. The tendency of population to remain in genetic equilibrium may be disturbed by:

(a) Random mating

(b) Lack of migration

(c) Lack of mutations

(d) Lack of random mating

110. What is meant by the term Darwin fitness?

(a) The ability to survive and reproduce

(b) High aggressiveness

(c) Healthy appearance

(d) Physical strength

111. Diversification in plant life appeared:

(a) Due to abrupt mutations

(b) Suddenly on earth

(c) By seed dispersal

(d) Due to long periods of evolutionary changes

112. Flowers, which have single ovule in the ovary and are packed into inflorescence are usually pollinated by:
(a) Bee
(b) Wind
(c) Bat
(d) Water

113. Which one of the following pairs of plant strucuture has a haploid number of chromosomes?

(a) Megaspore mother cell and antipodal cells

(b) Egg cell and antipodal cells

(c) Nucellus and antipodal cells

(d) Egg nucleus and secondary nucleus

114. Aerobic respiration produces more usable chemical energy than fermentation, because fermentation involves:

(a) Formation of lactic acid

(b) Complete oxidation of food

(c) Partial oxidation of food

(d) Evolution of CO_2 and alcohol

115. Cells regulate their activity through:

(a) Flow of substances

(b) Flow of hormones

(c) Flow of energy

(d) Flow of smoke

116. Phyllode is nothing but a leaf modification meant for photosynthesis adaptation in:
(a) Xerophytic
(b) Hydrophytic
(c) Mesophytic
(d) Thallophytic

117. Thick and woody climbers are called as:
(a) Suckers
(b) Climbers
(c) Lianas
(d) Creepers

118. The fundamental feature of Kranz anatomy of C_4 plants is:

(a) Presence of agranal chloroplasts in bundle sheath cells and granal chloroplasts in mesophyll cells

(b) Presence of granal chloroplasts in bundle sheath cells and agranal chloroplasts in mesophyll cells

(c) Presence of chloroplasts in epidermal and mesophyll cells

(d) Presence of agranal chloroplasts in both mesophyll and bundle sheath cells

119. Measuring Biochemical Oxygen Demand (BOD) is a method used for:

(a) Measuring the activity of Saccharomyces cerevisiae in producing curd on a commercial scale

(b) Working out the efficiency of R.B.Cs. about their capacity to carry oxygen

(c) Estimating the amount of organic matter in sewage water

(d) Working out the efficiency of oil driven automobile engines

120. Common indicator organism of water pollution is:

(a) Entamoeba histolytica

(b) Escherichia coli

(c) Eichhornia crassipes

(d) Lemna paucicostata

121. What is the name of the feature that allows organisms to survive in the conditions of its habitat?

(a) Adjustment

(b) Adaptation

(c) Acclimatisation

(d) Adaptive variation

122. An attribute found in plants but not animals is:

(a) Metabolism

(b) Sexual reproduction

(c) Autotrophy

(d) Asexual reproduction

123. Two plants can be conclusively said to belong to the same species if they:

(a) Can reproduce freely with each other and form viable seeds

(b) Have more than 90 percent similar genes

(c) Look similar and possess identical secondary metabolites

(d) Have same number of chromosomes

124. Which of the following is the correct scientific name of wheatderived by binominal nomenclature?

(a) Triticum vulgare

(b) Triticum aestivum

(c) Oryza sativa

(d) Zea mays

125. Which of the following 'Suffixes' used for units of classification in plants indicates a taxonomic category of 'family'?

(a) -Ales
(b) -Onae
(c) -Aceae
(d) —Ae

126. The main difference between human cheek cells and onion peel cells is:

(a) Presence of cell wall in onion peel cells

(b) Presence of mitochondria in onion peel cells

(c) Absence of endoplasmic reticulum in cheek cells

(d) Absence of the plasma membrane in cheek cells

127. This jellylike substance inside the plasma membrane in which all cell organelles are floating is:
(a) Cytoplasm
(b) Tonoplasm
(c) Karyoplasm
(d) Cell sap

128. What is the reason behind cell elongation in internodal regions of plants?

(a) Indole acetic acid

(b) Cytokinins

(c) Gibberellins

(d) Ethylene

129. The amount of water retained by soil after drainage is Known as:

(a) Soil water

(b) Field capacity

(c) Mineral water

(d) Gravitational capacity

130. Keystone species deserve protection because these:

(a) Are capable of surviving in harsh environmental conditions

(b) Indicate the presence of certain minerals in the soil

(c) Have become rare due to overexploitation

(d) Play an important role in supporting other species

131. Non-albuminous seed is produced in _____.
(a) Maize
(b) Castor
(c) Wheat
(d) Pea

132. Fruit color in squash is an example of:

(a) Recessive epistatis

(b) Dominant epistatis

(c) Complementary genes

(d) Inhibitory genes

133. Which of the following feature distinguish a monocot from a dicot plant?
(a) Phyllotaxy
(b) Venation
(c) Vernation
(d) Aestivation

134. The axillary buds arise:

(a) Endogenously from the pericycle

(b) Endogenously from the main growing point

(c) Exogenously from the inner cortical layers

(d) Exogenously from the epidermis

135. Which of the following is known as mitoplast?

(a) Mitochondria without outer membrane

(b) Another name for mitochondria

(c) Mitochondria without membranes

(d) Mitochondria without inner membrane

Botany Section - B

136. Which class is called amphibians of the plant kingdom?

(a) Thallophyta

(b) Bryophyta

(c) Gymnosperm

(d) Pteridophyta

137. The inner, darker and harder portion of the secondary xylem that can not conduct water, in an older dicot stem, is called_____
(a) Bast
(b) Alburnum
(c) Duramen
(d) Wood

138. Who concluded, based on his studies on plant tissues, that the presence of cell wall is a unique character of plant cells?

(a) Mathias Schleiden

(b) Theodore Schwann

(c) Rudolph Virchow

(d) Robert Hooke

139. What is the purpose of trichomes on leaves?

(a) Prevents guttation

(b) Aids in the rapid exchange of gas

(c) Increases transpiration

(d) Reduces transpiration

140. The amount of energy transferred from one trophic Level to next trophic level is:
(a) 1.5%
(b) 10%
(c) 20%
(d) 15%

141. The result of acid disposition is:

(a) Dying forests and lakes

(b) Acid indigestion in humans

(c) Greenhouse effect lessens

(d) All of the above

142. Wind pollinated flowers are:

(a) Small, brightly coloured, producing large number of pollen grains

(b) Small, producing large number of dry pollen grains

(c) Large, producing abundant nectar and pollen

(d) Small, producing nectar and dry pollen

143. Endosperm is consumed by developing embryo in the seed of:
(a) Coconut
(b) Castor
(c) Pea
(d) Maize

144. A tall true breeding garden pea plant is crossed with a dwarf true breeding garden pea plant. When the *F*1 plants were selfed, the resulting genotypes were in the ratio of _____.

(a) 3: 1-dwarf : tall

(b) 1: 2: 1 - tall homozygous : tall heterozygous : dwarf

(c) 1: 2: 1 - heterozygous : tall homozygous : dwarf

(d) 3: 1 - tall : dwarf

145. How many true-breeding pea plant varieties did Mendel select as pairs, which were similar except in one character with contrasting traits?
(a) 2
(b) 14
(c) 6
(d) 4

146. Nucellar polyembryony is reported in species of:
(a) Citrus
(b) Gossypium
(c) Triticum
(d) Brassica

147. Fruit colour in squash is an example of:

(a) Recessive epistasis

(b) Dominant epistasis

(c) Complementary genes

(d) Inhibitory genes

148. Kranz anatomy is usually associated with:

(a) C_3 plants

(b) C_4 plants

(c) CAM plants

(d) $C_3 - C_4$ intermediate plants

149. The Golgi complex plays a major role:

(a) In post translational modification of proteins and glycosidation of lipids

(b) In digesting proteins and carbohydrates

(c) As energy transferring orangelles

(d) All of the above

150. In ginger, vegetative propagation occurs through:
(a) Bulbils
(b) Runners

(c) Rhizome
(d) Offsets

Zoology Section - A

151. Large amoeboid cells, that are a part of our innate immune system, found in the areolar tissue are called as:

(a) Macrophages

(b) Mast cells

(c) Fibroblasts

(d) Adipocytes

152. The cells that release heparin and histamines in the blood are:
(a) Basophils
(b) Mast cells
(c) Eosinophils
(d) Neutrophils

153. Which of the following statements is not true?

(a) Life span is the period from birth to the natural death of an organism

(b) All small organisms have very short life span
(c) Life expectancy is the characteristic of a population

(d) Maximum life span is the characteristic of a species

154. Which of the following pheromones is involved in sexual reproduction in silk moth?
(a) Civetone
(b) Bombykol
(c) Ecdysone
(d) Villikinin

155. Infestation by tobacco budworm and armyworm is prevented by Bt toxin. These insects belong to order:

(a) Coleoptera

(b) Lepidoptera

(c) Diptera

(d) Hymenoptera

156. DNA or RNA segment tagged with a radioactive molecule is called:
(a) Vector
(b) Probes

(c) Clone
(d) Plasmid

157. Embryological support evolution was proposed by:

(a) Ernst Haeckel

(b) Karl Ernst Von Baer

(c) Charles Darwin

(d) Alfred Wallace

158. Flippers of Penguins and Dolphins are examples of:

(a) Convergent evolution

(b) Industrial melanism

(c) Natural selection

(d) Adaptive radiation

159. The Lipid Drugs' Detoxification including the other harmful compounds of various types in the ER is carried out by _____

(a) Cytochrome $a_1 - a_3$

(b) Cytochrome c

(c) Cytochrome bf

(d) Cytochrome P_{450}

160. Animal cells are interconnected by_____

(a) Desmosomes

(b) Cell wall

(c) Plasmodesmata

(d) Plasma membrane

161. Which of the following is put into anaerobic sludge digester for further sewage treatment?

(a) Floating debris

(b) Effluents of primary treatment

(c) Activated sludge

(d) Primary sludge

162. For the commercial and industrial production of citric acid, which of the following microbes is used?

(a) Aspergillus niger

(b) Lactobacillus sp

(c) Saccharomyces cerevisiae

(d) Clostridium bretylium

163. At the trophic level of consumers, the rate at which food energy is ascimilated is called:

(a) Secondary productivity

(b) Gross primary productivity

(c) Net primary productivity

(d) None of the above

164. Net Primary Productivity (NPP) is the gross primary productivity less:

(a) That which is consumed by herbivores

(b) That which is consumed by producer in metabolism

(c) Secondary productivity

(d) Loss due to mortality

165. Epithelial cells of the intestine involved in food absorption have on their surface:

(a) Pinocytic vesicles

(b) Phagocytic vesicles

(c) Zymogen granules

(d) Microvilli

166. A young infant may be feeding entirely on mother's milk, which is white in colour but the stools, which the infant passes out is quite yellowish. What is this yellow colour due to?

(a) Intestinal juice

(b) Bile pigments passed through bile juice

(c) Undigested milk protein casein

(d) Pancreatic Juice poured into duodenum

167. Which of the following mammalian tissues is associated with filtration and diffusion?

(a) Simple columnar

(b) Simple squamous

(c) Stratified squamous

(d) Stratified columnar

168. During an injury nasal septum gets damaged. Which cartilage is involved?

(a) Elastic cartilage

(b) Hyaline cartilage

(c) Calcified cartilage

(d) Fibrous cartilage

169. The cells having nuclear material without a nuclear membrane are termed _____cells.

(a) Prokaryotic
(b) Eukaryotic
(c) Unicellular
(d) Multicellular

170. Taxonomic hierarchy refers to:

(a) Classification of species based on the fossil record.

(b) Stepwise arrangement of all categories for classification of animals and plants.

(c) A group of senior taxonomists who decide the nomenclature of animals and plants.

(d) A list of botanists or zoologists who have worked on taxonomy of a species or group.

171. The rRNA is synthesized by _____

(a) Golgi body
(b) Nucleus
(c) Nucleolus
(d) Cytoplasm

172. The double membrane-bound, sausage-shaped cell organelle found in more numbers in activity dividing cells is:

(a) Chloroplast

(b) Mitochondria

(c) Ribosomes

(d) Nucleus

173. The mode of asexual reproduction is euglena is:

(a) Transverse binary

(b) Irregular binary fission

(c) Multiple fission

(d) Longitudinal binary fission

174. Forelimbs of cat, lizard used in walking, forelimbs of whale used in swimming and forelimbs of bats used in flying are an example of:

(a) Analogous organs

(b) Adaptive radiation

(c) Homologous organs

(d) Convergent evolution

175. Tasmanian wolf and placental wolf appear similar due to:

(a) Adaptive radiation

(b) Adaptive divergence

(c) Biochemical evolution

(d) Adaptive convergence

176. Flavr savr is genetically modified:

(a) Cotton
(b) Rice
(c) Tomato
(d) Potato

177. A genetically engineered microorganism used successfully in bioremediation of oil spills is a species of:

(a) Pseudomonas
(b) Trichoderma

(c) Xanthomonas

(d) Bacillus

178. A patient brought to a hospital with myocardial infarction is normally immediately given:

(a) Penicillin

(b) Streptokinase

(c) Cyclosporin-A

(d) Statins

179. A common biocontrol agent for the control of plant disease is:

(a) Baculovirus

(b) Bacillus thuringiensis

(c) Glomus

(d) Trichoderma

180. Two friends are eating together on a dining table. One of them suddenly starts coughing while swallowing some food. This coughing would have been due to improper movement of:
(a) Diaphragm
(b) Neck
(c) Tongue
(d) Epiglottis

181. In vertebrates lacteals are found in:

(a) Ileum

(b) Ischium

(c) Oesophagous

(d) Ear

182. The primary producers of the deep-sea hydrothermal vent ecosystem are:

(a) Green algae

(b) Chemosynthetic bacteria

(c) Blue-green algae

(d) Coral reefs

183. Which one of the following is a characteristic feature of cropland ecosystem?

(a) Least Genetic Diversity

(b) The absence of weeds

(c) Ecological successsion

(d) The absence of soil organisms

184. In human female, the fertilized egg gets implanted in uterus _____

(a) After about 7 days of fertilization

(b) After about 30 days of fertilization

(c) After about two months of fertilization

(d) After about 3 weeks of fertilization

185. Match column I with column II for housefly classification and select the correct option using the codes given below:

	Column I		Column II
(a)	Family	(i)	Diptera
(b)	Order	(ii)	Arthropoda
(c)	Class	(iii)	Muscidae
(d)	Phylum	(iv)	Insecta

(a) A- iii, B- i, C-iv, D-ii

(b) A- iii, B- ii, C- iv, D- i

(c) A-iv, B- iii, C- ii, D- i

(d) A- iv, B- ii, C- i, D- iii

Zoology Section - B

186. Stratum germinativum is an example of which kind of epithelium?
(a) Columnar
(b) Squamous
(c) Cuboidal
(d) Ciliated

187. Hermaphrodite animal is-
(a) Spider
(b) Honey Bee
(c) Ascaris
(d) Leech

188. Cellular organelles containing hydrolytic enzymes are called:
(a) Peroxisomes
(b) Lysosomes
(c) Ribosomes
(d) Mesosomes

189. Which of the following had the smallest brain capacity?

(a) Homo habilis

(b) Homo erectus

(c) Homo sapiens

(d) Homo neanderthalensis

190. Which kind of therapy was given in 1990 to a four-year-old girl with Adenosine Deaminase (ADA) deficiency?

(a) Gene therapy

(b) Chemotherapy

(c) Immunotherapy

(d) Radiation therapy

191. Probiotics are:

(a) Safe antibiotics

(b) Cancer inducing microbes

(c) New kind of food allergens

(d) Live microbial food supplement

192. Most animals that live in deep oceanic waters are:

(a) Tertiary consumers

(b) Detritivores

(c) Primary consumers

(d) Secondary consumers

193. Secretion of gastric juice is stopped by:

(a) Gastrin

(b) Pancreozymin

(c) Cholecystokinin

(d) Enterogastrone

194. Extrusion of second polar body from egg nucleus occurs:

(a) Simultaneously with first cleavage

(b) After entry of sperm but before fertilization

(c) After fertilization

(d) Before entry of sperm into ovum

195. The sum total of all the chemical reactions occurring in the body is known as:
(a) Metabolism
(b) Catabolism
(c) Anabolism
(d) Homeostasis

196. Cry endotoxins obtained from Bacillus thuringiensis are effective against:
(a) Flies
(b) Nematodes
(c) Boll worms
(d) Mosquitoes

197. Select the correct statement(s) with regard to brain.

A. Thalamus is the major coordinating centre for sensory and motor signaling.

B. Cerebral hemispheres are connected by corpus callosum.

C. Corpora quadrigemina are present in the midbrain.

D. The pneumotaxic centre controlling the respiration rate is located in the cerebellum.

(a) A and B only
(b) A, B and C
(c) A, B and D
(d) D only

198. The testes in humans are situated outside the abdominal cavity inside a pouch called scrotum. The purpose served is for?

(a) Escaping any possible compression by the visceral organs

(b) Providing more space for the growth of epididymis

(c) Providing a secondary sexual feature for exhibiting the male sex

(d) Maintaining the scrotal temperature lower than the internal body temperature

199. The process by which most of the cartilaginous tissue transformed into bones is:
(a) Endochondrial ossification

(b) Intermembranous ossification

(c) Calcification

(d) None of the above

200. Hugo de Vries gave his mutation theory on organic evolution while working on?

(a) Oenothera lamarckiana

(b) Drosophila melanogaster

(c) Pisum sativum

(d) Althea rosea

SOLUTIONS – SET 353

1(B). Given:

The ration of focal length, $f_1 : f_2 = 2 : 3$

Dispersive power (ω) : It is the ability of the prism materials to cause dispersion. It is defined as the ratio of the angular dispersion to the mean deviation.

$$\omega = \frac{\text{Angular dispersion}}{\text{Mean deviation}}$$

$$\omega = \frac{\delta_v - \delta_r}{\delta_y} = \frac{\mu_v - \mu_r}{u_y - 1}$$

Condition for achromatism is:

$$\Rightarrow \frac{\omega_1}{f_1} + \frac{\omega_2}{f_2} = 0$$

$$\Rightarrow \frac{\omega_1}{\omega_2} = -\frac{f_1}{f_2} = \frac{2}{3} \text{ (Leaving sign)}$$

2(C). Given:

Focal length of the concave lens, $f_1 = -20$ cm

Focal length of the convex lens, $f_2 = 20$ cm

The effective focal length f of a combination of two lenses having focal length f_1 and f_2

$$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$$

The lens maker's formula for thin lens is

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

Where f is the focal length of the lens, u is the object distance from the lens and v is the image distance from the lens.

The magnification produced by a lens or combination of the lens is given by $m = \frac{v}{u}$ Where u is the object distance from the lens and v is the image distance from the lens. Therefore, the effective focal length of the concavo-convex lens combination is:

$$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$$

$$\Rightarrow \frac{1}{f} = \frac{1}{-20} + \frac{1}{20}$$

$\Rightarrow \frac{1}{f} = 0$

$\Rightarrow f = \infty$

So, the effective focal length is infinite.

The object is kept at a distance of 20 cm from the lens combination.

So, $u = 20$ cm

So, the image distance is equal to the object distance, that is, $v = 20$ cm.

Therefore, magnification produced by the lens is given by,

$m = \frac{v}{u}$

$\Rightarrow m = \frac{20}{20} \Rightarrow m = 1$

Therefore, the image is of the same size as the object and is erect.

3(A). Dispersive power (ω) : It is the ability of the prism materials to cause dispersion. It is defined as the ratio of the angular dispersion to the mean deviation.

$\omega = \frac{\text{Angular dispersion}}{\text{Mean deviation}}$

$\omega = \frac{\delta_v - \delta_r}{\delta_y} = \frac{\mu_v - \mu_r}{u_y - 1}$

From above it is clear that dispersive power is independent of the angle of the prism and depends only on the material of the prism.

4(B). Molecular weight $\left(M_{O_2}\right)$ of $O_2 = 32$ Molecular weight $\left(M_{H_2}\right)$ of $H_2 = 2$

RMS velocity of O_2 gas is given by,

$V_{O_2} = \sqrt{\frac{3RT}{M_{O_2}}}$

$\Rightarrow V_{O_2} = \sqrt{\frac{3R}{32}}$ ....(i)

RMS velocity of H_2 gas is given by,

$V_{H_2} = \sqrt{\frac{3RT}{M_{H_2}}}$

$$\Rightarrow V_{H_2} = \sqrt{\frac{3RT}{2}} \ldots\ldots (ii)$$

On dividing equation (i) and (ii), we get,

$$\frac{V_{O_2}}{V_{H_2}} = \frac{\sqrt{\frac{3RT}{32}}}{\sqrt{\frac{3RT}{2}}}$$

$$\Rightarrow \frac{V_{O_2}}{V_{H_2}} = \sqrt{\frac{2}{32}}$$

$$\Rightarrow \frac{V_{O_2}}{V_{H_2}} = \frac{1}{4}$$

$$\Rightarrow V_{O_2} : V_{H_2} = 1:4$$

5(A). From kinetic theory of gases, the pressure P exerted by an ideal gas of density ρ and rms velocity of its gas molecules C is given by

$$P = \frac{1}{3}\rho v_{rms}^2 - (i)$$

Mean kinetic energy of translation per unit volume of the gas is

$$E = \frac{1}{2}\rho v_{rms}^2 \quad \ldots . (ii)$$

On dividing equations (i) and (ii), We get $P = \frac{2}{3}E$

The above equation can be written as

$$E = \frac{3}{2}P$$

6(D). Given:

Distance of a charge from the centre $= r$

Force exerted on a charge $= F$

Electric field intensity at a point on the axis of an electric dipole is given as,

$$E = \frac{2kP}{r^3} \quad \ldots . (i)$$

Force on a charge q in an electric field E is given as,

$F = Eq \cdots (ii)$

By equation (i) and equation (ii),

$$\Rightarrow \frac{F}{q} = \frac{2kP}{r^3}$$

$$\Rightarrow F = \frac{2kPq}{r^3}$$

When a charge is placed on the axis of a dipole at a distance r from the center,

$$\Rightarrow F = \frac{2kPq}{r^3}$$

When the distance is doubled,

$$\Rightarrow F' = \frac{2kPq}{(2r)^3}$$

$$\Rightarrow F' = \frac{2kPq}{8r^3}$$

$$\Rightarrow F' = \frac{F}{8}$$

7(B). Given:

Charge on cubical box $(q_{in}) = Q$

The Gaussian law is given as,

$$f = \frac{Q}{\epsilon_0}$$

Where f is the total electric flux, Q is the charge enclosed by the surface and ϵ_0 is the permittivity of the free space.

It is given that the charge of $+Q$ is placed at the centre of the box. The Gauss's law provides the information about the distribution of the electric charges for the closed surface. In the closed surface, the electric flux is directly proportional to the electric charges enclosed in the surface.

The cubical surface encloses the charge $+Q$

. Since the cube is the closed surface with the six faces, the gauss law can be applied to find the electric flux of it.

By using the formula of the Gaussian law,

$$f = \frac{Q}{\epsilon_0}$$

Since the cube contains the six faces, the permittivity of the free space is multiplied by six to find the flux from each face.

$$f = \frac{Q}{6 \in 0}$$

So, the electric flux that is coming out of each flux is obtained as $\frac{Q}{6\epsilon_0}$

8(A). The wavelength of the electron,

$$\lambda_e = \frac{h}{P_e} \cdots (i)$$

The wavelength of the photon,

$$\lambda_{Ph} = \frac{h}{P_{p_h}} \cdots (ii)$$

For the same energy, the momentum of the electron is more than that of the photon,

$P_e > P_{Ph} \cdots$ (iii)

From equation (i), equation (ii), and equation (iii), we get

$\Rightarrow \lambda_{Ph} > \lambda_e$

9(B). Let the potential difference between the accelerating plates of the tube $= V$

When the electron loses a whole of its energy in a single collision with the atom, an X-ray photon of maximum energy hv_{max} is emitted i.e., is

$$\Rightarrow \frac{1}{2}mv^2 = eV = hv_{max} = \frac{hc}{\lambda_{max}}$$

Where $v =$ velocity of the electron before the collision with a target atom, $V =$ potential difference through which electron is accelerated, $c =$ speed of light, $v_{max} =$ maximum frequency and $\lambda_{max} =$ maximum wavelength (here we have λ)

Since $eV = \frac{hc}{\lambda}$

$$\Rightarrow \lambda = \frac{hc}{eV}$$

10(C). The formula for the length of the pipe is $L = \frac{nv}{2v}$

Where $n = 1$ for fundamental frequency and $n = 3$ for second overtone.

In an open pipe, for fundamental frequency, to produce standing wave we require that the length of the pipe should be twice the wavelength of the fundamental mode or $\frac{\lambda}{2} = \text{L}$

The relation with frequency is $\text{L} = \frac{v}{2\nu}$

Where v is the velocity of sound in our case. This is so because frequency and wavelength are related as,

$v = \nu\lambda$

For the second overtone, the wavelength is thrice of fundamental wavelength. Therefore, we replace λ by $3 \times \lambda$

Putting this in the formula for length and putting the velocity of sound 333 m/s in place of v.

$$\text{L} = \frac{999 m/s}{2 \times 333}$$

$$\text{L} = \frac{3}{2}$$

$$\text{L} = 1.5$$

11(A). Given,

Displacement $x = 12$ cm $= 0.12$ m and mass $\text{m} = 5$ kg

We know that when the spring-mass system oscillates, there will be simple harmonic motion and the time period is given as,

$$T = 2\pi\sqrt{\frac{m}{k}} \quad \ldots (i)$$

Where k = spring constant

$$k = \frac{F}{x} \quad \cdots (ii)$$

Here,

$\text{F} = \text{mg}$

Where g = gravitational acceleration ≈ 10 m/s^2

$\Rightarrow \text{F} = 5 \times 10 = 50$ N

By equation (ii),

$$\Rightarrow k = \frac{50}{0.12}$$

By equation (i),

$$\Rightarrow T = 2\pi\sqrt{\frac{5}{\frac{50}{0.12}}}$$

$$\Rightarrow T = 2\pi\sqrt{\frac{5\times 0.12}{50}}$$

$$\Rightarrow T = 0.7\text{sec}$$

12(B). α of a transistor is defined as the current gain in the common base configuration which is in turn defined as the ratio of change in the collector current to change in the emitter current. It can possess a maximum value of one. Also, β is the current gain in the Common Emitter configuration. It can be defined as the ratio of the change in collector current to the change in base current. Δi_C is the collector current. It can possess any value.

Δi_E is the emitter current

Δi_B is the base current

Now, $\alpha = \left(\frac{\Delta i_C}{\Delta i_E}\right)$ and,

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

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

$$\Rightarrow \beta = \alpha\times\frac{\Delta i_E}{\Delta i_B} \quad \ldots.(1)$$

$$\Rightarrow \Delta i_B = \Delta i_E - \Delta i_C \quad .....(2)$$

Substituting the equation (2) in equation

(1) we get,

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

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

Now, we know $\alpha = \frac{\Delta i_C}{\Delta i_E}$ therefore we get,

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

13(A). If p-n junction is unbiased then the current is zero because the drifting of charge is the same from both sides. As the concentration of electrons is less in the P side compared to the n - side the electrons will diffusion n to the P-side of the junction. In the case of holes, it occurs in vice versa for holes, this diffusion of electrons from n to P constitutes diffusion current from P to n. As a consequence of this diffusion there creates a region that is depleted from charges known as the depletion region. The barrier potential set up across the junction produces a current from n to P which is known as drift current which is in opposite direction to the diffusion current.

14(D). Both Dyne and Newton are units of force in the CGS and S.I system.

Newton and dyne can also be written as,

$(1\ \text{N} = \text{kgm/s}^2)$ and $(1\ \text{dyne} = \text{gmcm/s}^2)$

$\Rightarrow 1\ \text{dyne} = 1\text{gmcm/s}^2$ and 1 newton

$= 1\text{kgm/s}^2$

$\Rightarrow 1\ \text{kg} = 1000\text{gm}$

$\Rightarrow 1\ \text{m} = 100\ \text{cm}$

$\Rightarrow 1\text{kgm/s}^2 = 1000\text{gm} \times 100\ \text{cm/s}^2$

$\Rightarrow 10^5\text{gmcm/s}^2 = 10^5$ dyne

$\Rightarrow 1\ \text{dyne} = 10^{-5}\text{kgm/s}^2$

$\Rightarrow 10^{-5}$ N

$\Rightarrow 1\ \text{N} = 10^5$ dyne

15(A). Torque is a physical computation with the dimension of force times distance. Its SI unit is a newton meter. It also has a unit as joule per radian.

We know that,

Torque (T) $= \text{rFsin}\ \theta$

As we know, that the dimension of force $(F) = [\text{MLT}^{-2}]$

The dimension of $\text{r} = [\text{L}]$

$\therefore$ The dimensions of torque (T) is

$\Rightarrow \text{T} = [\text{M}^1\ \text{L}^2\ \text{T}^{-2}]$

16(B). Unit of magnetic flux is weber.

Magnetic flux is a measurement of the total magnetic field which passes through a given area. It is a useful tool for helping describe the effects of the magnetic force on something occupying a given area.
Since magnetic flux $(\varphi) = \mathrm{BA}$

Where, $\mathrm{B} =$ megnatic field and $\mathrm{A} =$ area

The SI unit of magnetic flux = SI unit of magnetic field × SI unit of area = tesla meter $^2 = \mathrm{Tm}^2$

Since, 1 Weber $= 1\mathrm{Tm}^2$

Thus the SI unit of magnetic flux is Tm^2 and which is equal to weber (Wb).

17(B). The dimension of Planck's constant is similar to angular momentum.

It is a physical constant that is the quantum of electromagnetic action. It relates the energy carried by a photon to its frequency by, $\mathrm{E} = \mathrm{h}\nu$

$$\Rightarrow h = \frac{\mathrm{E}}{\nu}$$

Where, $\mathrm{E} =$ energy, $\nu =$ frequency and $\mathrm{h} =$ Planck's constant.

Now,

Dimensional formula of energy

$(\mathrm{E}) = [\mathrm{ML}^2\ \mathrm{T}^{-2}]$

Dimensional formula of frequency $(\nu) = [\mathrm{T}^{-1}]$

The dimension of the Planck's constant is (h)

$$\Rightarrow h = \frac{[ML^2T^{-2}]}{[T^{-1}]} = [ML^2T^{-1}]$$

Angular momentum:

It is the rotational equivalent of linear momentum.

$\Rightarrow \mathrm{L} = \mathrm{r} \times \mathrm{p}$

Where, $\mathrm{L} =$ angular momentum, $\mathrm{r} =$ distance and $\mathrm{p} =$ linear momentum.

Now,

Dimensional formula of $(\mathrm{r}) = [\mathrm{L}]$

Dimensional formula of $(\mathrm{p}) = [\mathrm{MLT}^{-1}]$

Therefore, the dimensional formula of L is

$\Rightarrow L = [L] \times [MLT^{-1}]$

$\Rightarrow L = [ML^2T^{-1}]$

18(A). We know,

For earth, g (gravitational acceleration) $= 9.8\ m/s^2$ and

R (radius of earth) $= 6.4 \times 10^6$ m

The escape velocity on earth is given by:

$$V_e = \sqrt{\frac{2GM}{R}}$$

As we know, $GM = gR^2$

$$\Rightarrow V_e = \sqrt{\frac{2gR^2}{R}} = \sqrt{2gR}$$

$$\Rightarrow V_e = \sqrt{2 \times 9.8 \times 6.4 \times 10^6}$$

$\Rightarrow V_e = 11.2 \times 10^3$ m/s

$\Rightarrow V_e = 11.2$ km/s

19(B). Given,

r_A(radius of orbit A) $= 4R, r_B$ (radius of orbit B) $=$ R and V_{OA}(speed of A) $= 3v$

We know that,

$$v_o = \sqrt{\frac{GM}{r}} \cdots (i)$$

Where $v_0 =$ orbital speed, $G =$ gravitational constant, $M =$ mass of the planet, and r = radius of the orbit

The orbital velocity for body A,

$$\Rightarrow v_{oA} = 3v = \sqrt{\frac{GM}{4R}}$$

$$3v = \frac{1}{2}\sqrt{\frac{GM}{R}} \ldots\ldots (ii)$$

The orbital velocity for body B,

$$v_{oB} = \sqrt{\frac{GM}{R}} \cdots (iii)$$

By dividing equation (ii) and equation (iii) , we get,

$$\Rightarrow v_{oB} = 6\text{v}$$

20(D). Given:

$$R_1 : R_2 = 1 : 2$$

Let the power in the first resistor be given as,

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

The power in the second resistor is given as, $P_2 = \frac{V^2}{R_2}$

By using equation (1) and equation (2), we get,

$$\frac{P_1}{P_2} = \frac{R_2}{R_1}$$

$$\Rightarrow \frac{P_1}{P_2} = \frac{2}{1}$$

The ratio of powers is given as 2: 1

21(A). Given:

Thickness of glass-slab $(t_g) = 4$ cm, Thickness of water $(t_w) = 5$ cm, and refractive index of water $(\mu_w) = \frac{4}{3}$

The optical path travelled by the wave must be the same in both mediums as it is given that the number of waves is the same in both the medium.

$$\text{t}_\text{w} \times \mu_\text{w} = \text{t}_\text{g} \times \mu_\text{g}$$

$$\Rightarrow \mu_g = \frac{t_w \mu_w}{t_g}$$

$$\Rightarrow \mu_g = \frac{5 \times \frac{4}{3}}{4}$$

$$\Rightarrow \mu_g = \frac{5}{3}$$

22(A). Refractive index:

The ratio of the speed of light in a vacuum to the speed of light in a medium is called the refractive index of that medium.

It is also called an absolute refractive index. Refractive

$$(\mu) = \frac{\text{Speed of light in vaccum } (C)}{\text{Speed of light in a medium } (v)}$$

Mathematically the refractive index can be written as

$$\text{Speed of light in a medium } (v) = \frac{\text{Speed of light in vaccum } (C)}{\text{Refractive index } (\mu)}$$

As the speed of light in a vacuum is constant, therefore we can say that speed of light in a medium is inversely proportional to the refractive index of the medium. The Refractive index of a different medium is given by:

Transparent medium	Refractive Index
Water	1.33
Crown glass	1.52
Dense flint glass	1.62
Diamond	2.42
Ice	1.31
Water	1.33
Alcohol	1.36
Kerosene oil	1.44
Sapphire	1.77
Ruby	1.71

From the above table, it is clear that the diamond has the maximum refractive index and water has the minimum refractive index, therefore the velocity of light in the diamond will be minimum and it will be maximum in water.

23(C). Sound waves are longitudinal waves and light waves are transverse waves.

As we know sound waves are longitudinal waves and travel through compression and rarefactions in the medium on the other hand light waves are transverse in nature and do not require a medium to travel.

As we know that, the sound wave and light wave travel with different velocities and have a different frequency, therefore the wavelength $\left(\lambda = \frac{v}{f}\right)$ is different for both.

Both sound and light waves follow the law of reflection, refraction, diffraction, and interference of waves.

Therefore, on the basis of polarization, sound waves can be differentiated from light waves as polarization is possible in light.

24(A). Photoelectric effect phenomena can explain the quantum nature of light.

The emission of free electrons from a metal surface when the light is shone on it, it is called the photoemission or the photoelectric effect.

This effect led to the conclusion that light is made up of packets or quantum of energy.

25(D). The atoms have protons and neutrons in the nucleus of the atom and electrons revolve around the nucleus in the orbits. For each orbit, there is a certain amount of energy for the electrons.

The energy of electrons in any orbit is given by:

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

Where n = principal quantum number and Z = atomic number

From the above, it is clear that the total energy in the H_2 molecule (atom) is written as,

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

Here for $Z = 1$, therefore the total energy is proportional to

$\Rightarrow E_n \propto \frac{1}{n^2}$

26(A). Given,

$\lambda_1 = 600\text{Å}$ and $\lambda_2 = 400\text{Å}$

The Photon energy formula is given by,

$E = \frac{hc}{\lambda} \ \ldots (i)$

Where E = energy, c = speed of light (3×10^8 m/s), λ = wavelength and h = planck's constant (6.6×10^{-34}Js)

By equation (i),

$$E_1 = \frac{hc}{\lambda_1}$$

$$\Rightarrow E_1 = \frac{hc}{600} \quad \ldots\ldots (ii)$$

$$\Rightarrow E_2 = \frac{hc}{\lambda_2}$$

$$\Rightarrow E_1 = \frac{hc}{400} \quad \ldots\ldots (iii)$$

By equation (ii) and equation (iii),

$$\frac{E_1}{E_2} = \frac{\frac{hc}{600}}{\frac{hc}{400}}$$

$$\Rightarrow \frac{E_1}{E_2} = \frac{400}{600}$$

$$\Rightarrow \frac{E_1}{E_2} = \frac{2}{3}$$

27(C). Given,

I = 2 amp, n = 1

and

B = $4\pi \times 10^{-6}$ Wb/m^2

The magnetic field produced at the center of the current carrying coil is given as,

$$B = \frac{\mu_0 nI}{2r} \quad \ldots\ldots (i)$$

Where, r = radius of the coil and $\mu_0 = 4\pi \times 10^{-7}$H/m

By equation (i),

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

$$\Rightarrow r = \frac{4\pi \times 10^{-7} \times 1 \times 2}{2 \times 4\pi \times 10^{-6}}$$

$\Rightarrow r = 0.1$ m

28(D). When a magnet is brought near a conducting loop along its axis, the distance between the loop and the magnet will reduce so the intensity of the magnetic field associated with the loop also increases. Because the magnetic field associated with the loop increases so the magnetic flux linked with the loop also increases.

So in this case the magnetic flux is changing, hence an electric current will generate.

From the above equation, it is cleared that the induced emf depends upon the magnetic field and number of turns and it is independent of the resistance of the coil.

29(B). Let B_0 be the initial magnetic field and $B =$ New magnetic field after changing the radius.

The magnetic field at the center of the circular loop before changing the radius is given by

$$B_0 = \frac{\mu_0 I}{2\pi R}$$

After changing the radius into half the new magnetic field can be written as,

$$B = \frac{\mu_0 I}{2\pi \frac{R}{2}}$$

$$\Rightarrow B = 2\frac{\mu_0 I}{2\pi R}$$

$$\Rightarrow B = 2B_0$$

30(D). Given that a body is moving in a circular path with constant speed. So it will have a centripetal force. The velocity of the body comes to the initial direction after one complete circle. So when a body is moving in a circular path with a constant speed, its direction changes. So the velocity of the

body is changing.

31(D). The tyres of the cars are made circular because it makes them roll on the road rather than slide. And Rolling friction is less than sliding friction.

Also, the circular shape maintains a uniform and smooth contact with the surface.

32(D). Given,

$V_R = 40$ V; $V_L = 90$ V; $V_C = 60$ V

We know that,

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

$$E = \sqrt{V_R^2 + (V_C - V_L)^2}$$

Where E is the emf, V_R is the potential drop across the resistor, V_L is the potential drop across the inductance, and V_R is the potential drop across the capacitance.

$$E = \sqrt{V_R^2 + (V_C - V_L)^2}$$

$$E = \sqrt{40^2 + (60 - 90)^2}$$

$$E = 50 \text{ V}$$

33(A). Range is there so the arrow was projected at some angle, let it is θ then time of flight and range

$$\text{T (time)} = \frac{2\text{uSin }\theta}{\text{g}} = 5 \ldots (i)$$

$$R \text{ (range)} = \frac{\text{u}^2 2\text{Sin }\theta\text{Cos }\theta}{\text{g}} = 200$$

By eq (i) and eq (ii), we get,

$$\frac{\text{R}}{\text{T}} = \frac{\frac{\text{u}^2 2\text{Sin }\theta\text{Cos }\theta}{\text{g}}}{\frac{2\text{uSin }\theta}{\text{g}}} = \frac{200}{5}$$

$$\Rightarrow \frac{\text{R}}{\text{T}} = \frac{\text{u}\cos\theta}{1} = \frac{200}{5} \text{ or,}$$

$$\Rightarrow \frac{\text{R}}{\text{T}} = \text{uCos }\theta = 40 \text{ m/s}$$

Putting it in the eq (ii), we get,

$$\text{R} = \frac{2\text{uSin }\theta \times 40}{\text{g}} = 200$$

$$\Rightarrow \text{R} = \frac{2\text{uSin }\theta}{\text{g}} = \frac{200}{40}$$

$$\Rightarrow \text{R} = \frac{2\text{uSin }\theta}{\text{g}} = 5$$

Here, we know that $\text{g} = 10 \text{ m/s}$

$$R = \frac{2 \times u\text{Sin}\ \theta}{10} = 5$$

$$\Rightarrow R = u\text{Sin}\ \theta = 25$$

So, maximum height will be,

$$H = \frac{(u\text{Sin}\theta)^2}{2\ g}$$

$$\Rightarrow H = \frac{625}{20}$$

$$\Rightarrow H = 31.25\ m$$

34(A). Since, when A and B both are logic 1 then no current will flow through the both 50Ω.

resistors, because both the diodes will not conduct. therefore, whole current will flow through $R = 10\ K$

and output is potential difference across the $R = 10\ K$ which will be 6 V in this case means high

Now, When either of the input is low current through terminal which is low will flow through it and most of the current will flow through the 50Ω resistance since it is very very less than $R = 10\ K$ therefore,
Potential across $R = 10\ K$ will be less than $1V$. So, when either of input is low output is also low.

When both the inputs are low same case as when either of input is low will be there hence output will also be low.

Therefore, above circuit acts as a AND Logic gate.

35(D). As Diameter is reduced to half, so radius is also reduced to half.

Let D and A are initial diameter and area. D' and A' are final diameter and area.

R' is final resistance.

Resistivity will be constant, As resistivity is a property of a material.

$$A = \pi r^2 = \frac{\pi D^2}{4}$$

$$D' = \frac{D}{2}$$

$$\Rightarrow A' = \pi r'^2 = \frac{\pi D'^2}{4}$$

$= \frac{\pi D^2}{16} = \frac{A}{4}$ ……(1)

From $R = \rho \frac{L}{A}$ (R is initial resistance)

$\Rightarrow R = \rho \frac{L \times A}{A^2}$

$\Rightarrow R = \rho \frac{V}{A^2}$

New resistance $R' = \rho \frac{V}{A'^2}$

From equation (1)-

$R' = 16\rho \frac{V}{A^2} = 16R$

36(C). Static friction is a self-adjusting force.

The limiting value of friction up to which the body stays at rest till it starts moving is given by, $F_s = \mu mg$

Where μ is the coefficient of static friction.

Below that limit, the frictional force is equal to the force applied.

Here,

$F_s = 0.8 \times 4 \times 10 = 32$ N; $g = 10$ m/s^2

Whereas force applied is 19 N less than the limiting value of friction.

So, Frictional force is 19 N.

37(C). Here, $P^2V =$ constant

As, $P = \frac{nRT}{V} =$ constant or $\frac{T^2}{V} =$ constant

$\therefore T^2 \propto V$ or $T \propto \sqrt{V}$

As, V is increased to 3 times, T would be increased to $\sqrt{3}$ times

i.e., $T = \sqrt{3}T_0$

38(B). Given,

Pressure at the first state $P_1 = 76$, Volume at the first state $V_1 = 1$, Temperature at the first state $T_1 = 27$

Here, we assume that the helium gas is behaving like an ideal gas. So, we can use the ideal gas relation. From the ideal gas relation, we can get by comparison of the two state, the equation

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

Where P_1 is the pressure at the first state, V_1 is the volume at the firststate, and T_1 is the temperature at the first state. Similarly, P_2 is the pressure at the second state, V_2 is the volume at the second state, and T_2 is the temperature at that state.

By inserting all given values, we have,

$$\frac{76(1)}{27+273} = \frac{(2\times 76)(2\times 1)}{T_2}$$

$(27 + 273$ Since temperature has to be in kelvin)

So,

$$T_2 = \frac{(2\times 76)(2\times 1)\times 300}{76}$$

Which by computation gives

$T_2 = 1200K$

Which by conversion to degree Celsius is

$T_C = 1200 - 273 \Rightarrow T_C = 927°\text{C}$

39(C). Power $= \frac{\text{K.E}}{\text{time}} = \frac{\frac{1}{2}mv^2}{t} =$

Constant

So, $\frac{v^2}{t} =$ Constant

$v = \sqrt{Ct}$

$\Rightarrow v = Kt^{\frac{1}{2}}$

$\Rightarrow \frac{dx}{dt} = Kt^{\frac{1}{2}}$

$\Rightarrow dx = Kt^{\frac{1}{2}}dt$

Integrating both side

$\mathbf{x} = \int \mathbf{K}\mathbf{t}^{\frac{1}{2}}\mathrm{dt}$

$\Rightarrow \mathrm{x} = \dfrac{\mathrm{K}\mathrm{t}^{\frac{3}{2}}}{\frac{3}{2}} + \mathrm{C}$

$\Rightarrow \mathrm{x} \propto \mathrm{t}^{\frac{3}{2}}$

40(A). Given that,

A uniform force, $\vec{F} = (3\hat{\imath} + \hat{\jmath}$

Mass, $\mathrm{m} = 2$ kg

Initial position of particle, $\overrightarrow{r_1} = (2\hat{\imath} + \hat{k})m$

Final position of particle,

$\overrightarrow{\mathrm{r}_2} = (4\hat{\imath} + 3\hat{\jmath} - \hat{\mathrm{k}})\mathrm{m}$

Net Displacement of particle,

$\vec{\Delta}\mathrm{r} = \overrightarrow{\mathrm{r}_2} - \vec{\mathrm{r}}_1 = (2\hat{\imath} + 3\hat{\jmath} - 2\hat{\mathrm{k}})\mathrm{m}$

Work done by the force on the particle,

$\mathrm{W} = \vec{\mathrm{F}} \cdot \overrightarrow{\Delta \mathrm{r}}$

$\Rightarrow \mathrm{W} = 6 + 3$

$\Rightarrow \mathrm{W} = 9$ J

41(A). We shall use $\omega = \omega_0 + \alpha t$ $\omega_0 =$ initial anugular speed in rad/s $= 2\pi \times$ angular speed in rev/s

$= 2\pi \times$ angular speed in rev /min

$= \dfrac{2\pi \times 1200}{60}$ rad/s

$= 40\pi$rad/s

Similarly, $\omega =$ final angular speed in rad/s

$= \dfrac{2\pi \times 3120}{60}$ rad/s

$= 2\pi \times 52$rad/s

$= 104\pi$rad/s

∴ Angular acceleration

$\alpha = \frac{\omega - \omega_0}{t}$

$\Rightarrow \alpha = 4\pi \text{rad/s}^2$

The angular acceleration of the engine $= 4\pi \text{rad/s}^2$

42(D). According to question, Initial angular velocity: $\omega_0 = 0$

Final angular velocity: $\omega = \frac{80}{\frac{20}{\pi}}$

$= 4\pi \text{rad/s} \left[\omega = \frac{\text{v}}{\text{r}}\right]$

Angular displacement: $\theta = 2(2\pi) = (4\pi)$

rad.

By $\omega^2 = \omega_0^2 + 2\text{a}\theta$

Now, The linear variables based equation

$\text{v}^2 = \text{u}^2 + 2as$

$(4\pi)^2 = 0^2 + 2\text{a}(4\pi)$

$\Rightarrow 16\pi^2 = 8\text{a}\pi$

$\therefore \text{a} = 2\pi \text{rad/s}^2$

Also, relation between angular and tangential acceleration : $(a_t = ar)$

$a_t = (2\pi)\left(\frac{20}{\pi}\right)$

$\therefore \text{a}_\text{t} = 40 \text{ m/s}^2$

43(D). The force exerted by liquid at the other end is the centripetal force due to rotation. The case can be treated as rotation of the center of mass of the liquid at distance $\frac{L}{2}$ from the axis of rotation.

So, Force exerted by liquid at the end $= \text{M}\omega^2 \left(\frac{\text{L}}{2}\right) = \frac{1}{2}\text{M}\omega^2 \text{ L}$

44(B). Here, diameter of the tap,

$\text{D} = 1.25 \text{ cm} = 1.25 \times 10^{-2} \text{ m}$

Density of water, $\rho = 10^3 \text{kgm}^{-3}$

Coefficient of viscosity, $\eta = 10^{-3}\text{Pas}$

Volume of water flowing out per second is

$Q = 3$ L per min

$$\Rightarrow Q = \frac{3 \times 10^{-3}\ \text{m}^3}{60\ \text{s}}$$

$$\Rightarrow Q = 5 \times 10^{-5}\ \text{m}^3\ \text{s}^{-1}$$

Reynolds number is given by:

$$R_e = \frac{4\rho Q}{\pi D \eta}$$

$$\Rightarrow R_e = \frac{4 \times 10^3 \text{kgm}^{-3} \times 5 \times 10^{-5}\ \text{m}^3\ \text{s}^{-1}}{3.14 \times 1.25 \times 10^{-2}\ \text{m} \times 10^{-3}\text{Pas}}$$

$$\Rightarrow R_e = 5095 > 2000$$

Thus, the flow will be turbulent.

45(A). The string of a simple pendulum is vertical in the neutral condition when no external force apart from the vertically downwards force of gravity acts on the bob of the pendulum.

According to the question, the string of the given simple pendulum is inclined. This means that a horizontal force must be acting on the bob of the simple pendulum. But there is no real source of horizontal force on the bob mentioned in the given question. So the horizontal force which acts on the bob must be a pseudo force.

We know that the pseudo force acts on a body kept inside an accelerating frame and is equal to the mass of the body times the acceleration of the frame. In this situation, the body is the bob of the pendulum, and the frame is the train.

This means that the train must be in nonuniform motion, or must be accelerated or retarded.

Now, we also know that the direction of the pseudo force is opposite to the acceleration of the frame. According to the question, the string is inclined towards the rear of the train. This implies that the direction of the pseudo force is towards the rear of the train. So we get the direction of the acceleration of the moving train towards the front. This means that the nature of the motion of the train is accelerated.

46(A). The decay constant of a ratio isotope is λ if a_1 and a_2 are

Its activates at times t_1 and t_2 respectively no of nuclei which have decayed during the time $(t_1 - t_2)$

So, $A_1 = \lambda N_1$ at time $t_1 = \lambda N_1$

$A_2 = \lambda N_2$ at time $t_2 = \lambda N_2$

Therefore, no of nuclei decayed during time interval $(t_1 - t_2)$

$\lambda N_1 - \lambda N_2 = A_1 - A_2$

λ taking common so

$\lambda(N_1 - N_2) = A_1 - A_2$

$\therefore N_1 - N_2 = A_1 - A_2$

47(C). For ideal gas, $PV = RT$ and $M = \rho V$

Thus, $\frac{PM}{\rho} = RT$

Here, $\frac{P_A M_A}{\rho_A} = RT$...(1)

And $\frac{P_B M_B}{\rho_B} = RT$....(2)

Dividing the equation (1) and (2)

$$\Rightarrow \frac{M_A}{M_B} = \frac{\rho_A}{\rho_B} \times \frac{P_B}{P_A} = \frac{3}{2} \times \frac{1}{2}$$

$$= \frac{3}{4}$$

48(A). Pure Silicon, $T = 500$ K

n_e concentration $= 1.5 \times 10^{16}$ m^{-3}

n_h concentration $= 1.5 \times 10^{16}$ m^{-3}

Doped with indium, increase n_h

So, Now

$n_h = 4.5 \times 10^{22}$ m^{-3}

To find n_c = elecron concentration after doping.

$n_i^2 = n_e n_h$

$$n_e = \frac{n_i^2}{n_h}$$

$$\Rightarrow n_e = \frac{(1.5 \times 10^{16})^2}{4.5 \times 10^{22}}$$

$\Rightarrow n_e = 5 \times 10^9\ m^{-3}$

so, $n_h \gg n_e$ semiconductor is p-type.

49(A). Given,

Both forces are of equal magnitude F

Resultant force is $F_R = \frac{F}{3}$

$$F_R = \sqrt{F_1^2 + F_2^2 + 2\,F_1\,F_2 \cos\,\theta}$$

$$\frac{F}{3} = \sqrt{F^2 + F^2 + 2FF\cos\,\theta}$$

$$\frac{F^2}{\sqrt{3}} = 2\,F^2(1 + \cos\,\theta)$$

$$\cos\,\theta = \left(\frac{1}{2\sqrt{3}} - 1\right)$$

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

Hence, angle between vectors is

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

50(C). Energy density can be said to be the energy per unit volume. The energy of a body can be said to be equivalent to the work done, which in turn is equivalent to the product of the force and the displacement. Force is a product of the mass and acceleration of a body. Representing the above analysis in equation form, we get,

$$\text{Energy density} = \frac{\text{Energy}}{\text{Volume}} = \frac{\text{Work done}}{\text{Volume}}$$

$$\Rightarrow \text{Energy density} = \frac{\text{Force} \times \text{Displacement}}{\text{Volume}}$$

$$\Rightarrow \text{Energy density} = \frac{\text{Mass} \times \text{acceleration} \times \text{Displacement}}{\text{Volume}}$$

The dimensions of Energy density can now be given as

$$\text{Energy density} = \frac{[M] \times [LT^{-2}] \times [L]}{[L^3]}$$

$$\Rightarrow \text{Energy density} = [ML^{-1}T^{-2}]$$

Since, the refractive index is a ratio, it is a dimensionless physical quantity. Similarly, the dielectric constant is also a ratio and is thus a dimensionless physical quantity. Both the Refractive index and Dielectric constant have a dimension of 1.

Young's Modulus of a substance is a ratio of the linear stress to the linear strain. Since strain is a ratio and hence dimensionless. Young's modulus has the same dimensions as linear stress, which is force per unit area. Force is equal to the product of mass and acceleration. Representing Young's modulus in equation form, we have,

$$\text{Young's Modulus} = \frac{\text{Linear Stress}}{\text{Linear Strain}}$$

Dimensions of Young's Modulus = Dimensions of linear stress ($\because$ Strain is dimensionless)

Linear Stress

$$= \frac{\text{Force}}{\text{Area}} = \frac{\text{Mass} \times \text{acceleration}}{\text{Area}}$$

The dimensions of Young's modulus can now be given as

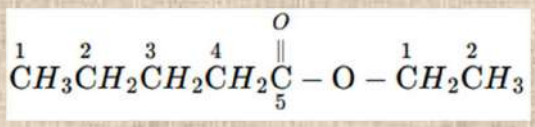
$$\text{Linear Stress} = \frac{[\text{M}] \times [LT^{-2}]}{[L^2]}$$
$$\text{Young's Modulus} = [ML^{-1}T^{-2}]$$

From the solution given above, we can say that Energy Density and Young's Modulus have the same dimensions.

51(A). Atomic radii of fluorine and neon in Angstrom units are respectively given by 0.72,1.60. Fluorine is a halogen atom and neon is a noble gas. So, the atomic radius of noble gases is greater than halogens of the same period. The radius of fluorine is measured using covalent radius whereas that of neon is measured using Vander Waal's radius. It is known that Vander Waal's radius is greater than the covalent radius. So, fluorine is smaller than neon.

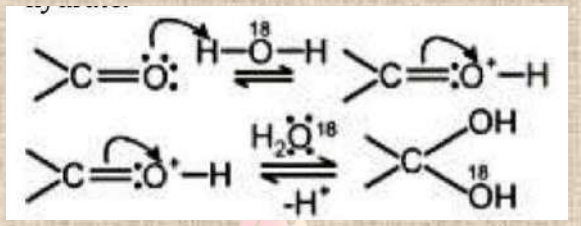
52(B). Atomic radii from left to right across a row of the periodic table decreases. This means that the nucleus attracts the electrons more strongly, pulling the atom's shell closer to the nucleus. The valence electrons are held closer towards the nucleus of the atom. And, in the periodic table, atomic radii increase as you move
down a group (due to the increasing number of electron shells).

53(B). The given compound is named as Ethyl pentanoate. By numbering the carbon which given in compound, we get maximum 5 carbon then it comes in pentane. Here pentane will convert in pentanoate due to $-\text{COOH}$ group.



54(A). If the carbonyl compound is hydrolyzed with H_2O^{18}, then the extent of hydration will increase. Hydration (hydrolysis) of carbonyl group involves protonation of the carbonyl

oxygen in a 1 , 3 -electron pair displacement operation. The next step is a nucleophilic attack by the water on the carbonyl carbon, and the last step is the loss of a proton to form the hydrate.



Heavier isotope forms stronger covalent bond, so extent of hydration increases.

55(A). A mixture of benzaldehyde and formaldehyde undergo cross Cannizzaro reaction and forms benzyl alcohol and sodium formate.

$C_6H_5CHO + HCHO \xrightarrow{NaOH} C_6H_5CH_2OH + HCOONa$

$C_6H_5CH_2OH$ - Benzyl alcohol

HCOONa - Sodium formate

56(A). Given,

$\Delta C_P = 2.0 + 0.2\ T cal/deg$

$(\Delta H)_1$ at $10\ K = -14.38\ K\ cal$

By Kirchoff's equation,

$$\frac{\Delta H_2 - \Delta H_1}{T_2 - T_1} = \Delta C_P$$

$$\Rightarrow \Delta H_2 - \Delta H_1 = \int_{T_1}^{T_2} \Delta C_P dT$$

$$\Rightarrow \Delta H_2 - \Delta H_1 = \int_{10\ K}^{100\ K} (2.0 + 0.2\ T) dT$$

$$\Rightarrow \Delta H_2 - \Delta H_1 = [2\ T + 0.1\ T^2]_{10}^{100}$$

$$\Rightarrow \Delta H_2 - \Delta H_1 = 2(100 - 10) + 0.1$$

$(100^2 - 10^2)$

$$\Rightarrow \Delta H_2 - \Delta H_1 = 180 + 0.1 \times 110 \times 90$$

$$\Rightarrow \Delta H_2 - \Delta H_1 = 180 + 990 = 1.170\ Kcal$$

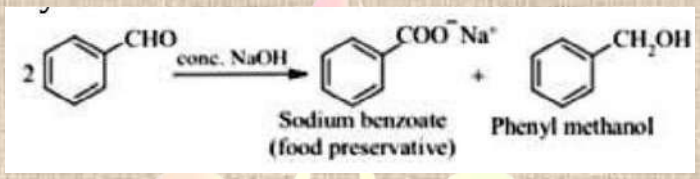
$$\Rightarrow \Delta H_2 = \Delta H_1 + 1 \cdot 170$$

$$= -14.38 + 1.17$$

$\Delta H_2 = -13.21$Kcal

$\therefore$ Enthalpy of reaction at 100 K in K cal will be -13.21 K cal.

57(B). Benzene carbaldehyde is reacted with concentrated NaOH solution to give the products A and B. Product A can be used food preservative and the product B is an aromatic hydroxyl compound where the OH group is linked to sp^3 hybridized carbon atom next to Benzene ring. The products A and B are respectively sodium benzoate and phenyl methanol. By Cannizzaro reaction:



58(B). In Haber process for the manufacture of ammonia, the catalyst used is iron. Finely divided iron is used as catalyst in the manufacture of ammonia by Haber process. The Haber process, also called the Haber-Bosch process, is an artificial nitrogen fixation process and is the main industrial procedure for the production of ammonia today. It is named after its inventors, the German chemists Fritz Haber and Carl Bosch, who developed it in the first decade of the 20th century.

59(C). A negative deviation from Raoult's law is observed in the binary liquid mixture of Acetone and chloroform.

This is due to the fact that chloroform molecule forms hydrogen bonds with acetone molecule.

60(C). The higher the charge on the metal ion, smaller is the ionic size and more is the complex forming ability. Thus, the degree of complex formation decreases in the order:

$M^{4+} > MO_2^{2+} > M^{3+} > MO_2^{+}$

The higher tendency of complex formation of MO_2^{2+} as compared to M^{3+} is due to high concentration of charge on metal atom M in MO_2^{2+}.

61(A). In carbonyl complexes, metal atoms are in zero oxidation state and CO ligand is very strong which can cause forcible pairing of 4 s electrons within the 3 d level.

Ground state,

$V_{23} = 3\,d^3 4\,s^2 = 3\,d^1\,d^1\,d^1\,d^0\,d^0 4\,s^2 4p_x^0 p_y^0\,p_z^0$

In presence of ligand,

$V_{23} = 3d^2 d^2 d^1 d^0 d^0 4s^0 4p_x^0 p_y^0 p_z^0$

In $V(CO)_6$, V undergoes d^2sp^3 hybridisation leaving one unpaired electron in the unhybridised d - orbital due to which it is paramagnetic.

62(A). The glycosidic linkages and peptide linkages are present in carbohydrates, proteins. The two monosaccharide units are joined together through an ether linkage formed by loss of a molecule of H_2O. Such a linkage between two monosaccharide units through oxygen atom is called glycosidic linkage. The carboxyl group of one amino acid and amino group of another amino acid gets condensed with the elimination of water molecule. The resulting $-CO-NH-$ linkage is called a peptide linkage.

63(A). Given,

In face-centred cubic (FCC) $(a_{FCC}) = 3.5Å$

In body centred cubic (BCC) $(a_{BCC}) = 3.5Å$

As we know,

Density of FCC, $d_{FCC} = Z_{FCC} \times \left(\frac{M}{N_A}\right) \times \frac{1}{(a_{FCC})^3}$ ... (i)

Density of BCC,

$d_{BCC} = Z_{BCC} \left(\frac{M}{N_A}\right) \frac{1}{a^3_{BCC}}$ ..... (ii)

By dividing equation (i) and (ii), we get

$$\frac{d_{FCC}}{d_{BCC}} = \frac{Z_{FCC}}{Z_{BCC}} \times \frac{a^3_{BCC}}{a^3_{FCC}}$$

$$= \frac{4}{2} \times \left(\frac{3 \cdot 0}{3 \cdot 5}\right)^3$$

$$= 2 \times 0 \cdot 6295$$

$$= 1.259$$

64(A). $RH_2 \longrightarrow RAg_2 \longrightarrow Ag$

The Principle of Atom Conservation (POAC) states that the total number of atoms of reactants must equal the number of atoms of products.

Apply principle of atom conservation to Ag,

$$\frac{1.00}{M_{(RA_2)}} \times 2 = \frac{0.534\ g}{108} \times 1$$

$$M_{(RAg_2)} = \frac{2 \times 108}{0.5934}$$

$$= 364\ g\ mol^{-1}$$

$$M_{RH_2} = 364 - 216 + 2 = 150\ g\ mol^{-1}$$

Element	% Composition	Atomic ratio
C	8	$\frac{8}{12} = 0.67$
H	1	$\frac{1}{1} = 1.00$
O	16	$\frac{16}{16} = 1.00$

Empirical formula $= C_2H_3O_3$

Empirical formula mass $= 75$ g per EFM

$\therefore n = \frac{\text{Molecular mass}}{\text{Empirical formula mass}}$

$= \frac{150}{75}$

$= 2$

The molecular formula is $C_4H_6O_6$.

65(D). Faraday's law of electrolysis states that 96500 coulombs of charge is needed to deposit one gm equivalent of an element at electrode. So, it is related to equivalent mass of electrolyte.

66(A). d-Block of elements are called "Transition elements" because the elements move from one place to another. Block division of Elements:

- The s-block elements having group 2 (alkaline earth metals) & group 1 (alkali metals).
- The p-block elements are groups 13-18 (basic metals, metalloids, nonmetals, halogens, and noble gases).
- The d and f Block elements in the groups of 3 to 11 are also called transition elements and inner transition elements respectively.
- 4f and 5f orbitals of f-block elements are steadily in the next two long periods.
- The position is highly thoughtful in the periodic table according to its nature & properties.

67(B). A system is said to be in thermodynamic equilibrium if the conditions for the following all three equilibrium is satisfied:

Mechanical equilibrium:

When there are no unbalanced forces within the system and between the system and the surrounding, the system is said to be under mechanical equilibrium.

Chemical equilibrium:

The system is said to be in chemical equilibrium when there are no chemical reactions going on within the system or there is no transfer of matter from one part of the system to another due to diffusion.

Thermal equilibrium:

When the temperature of the system is uniform and not changing throughout the system and also in the surroundings, the system is said to be in thermal equilibrium.

68(A). Given,

The brown ring complex compound of iron is formulated as $[Fe(H_2O)_5(NO)]SO_4$.

Applying formula,

Sum of total oxidation state of all atoms = Overall charge on the compound

Let oxidation state of iron is x.

$x + 0(5) + 1(1) + 1(-2) = 0$

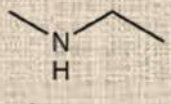
$\therefore x = +1$

Fe is in $+1$ oxidation state. H_2O is a neutral ligand. NO^+ is a positive charge ligand.

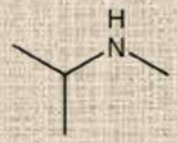
69(A). When an inert gas is added to the equilibrium mixture at constant volume, then the total pressure of the system will increase but there will be no change in the concentration of the reactant and product. In other words, the addition of inert gas will have no impact on the equilibrium at constant volume.

70(C). C_3H9N can have 4 structural isomers. And its isomers are:

propilamina



etilmetilamina



isopropilamina

trimetilamina

71(C). Benzene forms Nitrobenzene on reaction with conc. HNO_3/H_2SO_4, in the reaction HNO_3 acts as a base. Proton donor is acids and proton acceptor is bases. Conc. H_2SO_4 and conc. HNO_3 react in the following manner:

$$HNO_3 + H_2SO_4 \rightarrow H_2NO_3^+ + HSO_4^-$$

$$H_2NO_3^+ \rightarrow NO_2^+ + H_2O$$

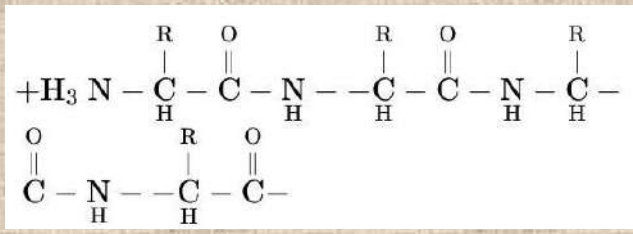
72(C). CS_2 is one of the molecules which does not possess dipole moment. It does not possess dipole moment as it is a linear molecule and therefore it does not have permanent dipole moment. It is represented as $S = C = S$.

73(B). Carbon tetrachloride has no net dipole moment because of its regular tetrahedral structure. Carbon tetrachloride is a non-polar molecule because the central carbon atom undergoes sp^3 hybridization which results in regular tetrahedral geometry in which all the four $C - Cl$ bond dipoles cancel each other. So, the molecule has no net dipole moment.

74(C). In the presence of a catalyst, the heat evolved or absorbed during the reaction remains unchanged. The enthalpy change value of the reaction will not be affected by a catalyst. A catalyst will only lower the required activation energy for the reactions. Since it will lower the activation energy for both the forward and reverse reactions to the same extent, the net change in enthalpy is zero.

75(D). EDTA is used for the estimation of Ca^{2+} and Mg^{2+} ions. The full form of EDTA is ethylene diamine tetraacetic acid which is a polycarboxylic acid of amine and its chemical formula is $[CH_2\ N(CH_2CO_2H)_2]_2$. It is a white solid which is soluble in water and is widely used to bind to iron, magnesium and calcium ions. In the conditions where the pH of the solution is greater than 9, it forms stable complexes with the alkaline earth metal ions like Ca^{2+} and Mg^{2+}. This acidic reagent is generally used to measure the total quantity of dissolved Ca^{2+} and Mg^{2+} ions in a sample of water. The hardness of a water sample is estimated by titrating it with a standard solution of EDTA.

76(D). A peptide chain must have alternate $C = O$ and NH groups from the peptide linkages.



77(A). The reaction in two half-reactions, oxidation half and reduction half as:

Reduction: $MnO_4^- \rightarrow Mn^{2+}$

Oxidation: $C_2O_4{}^{2-} \rightarrow CO_2$

Balance all atoms other than O and H.

$MnO_4^- \rightarrow Mn^{2+}$

$C_2O_4{}^{2-} \rightarrow 2CO_2$

Now balance the oxygen atoms by adding

H_2O molecules.

$MnO_4^- \rightarrow Mn^{2+} + 4H_2O$

$C_2O_4^{2-} \rightarrow 2CO_2$

Now balance hydrogen atoms by adding H^+ ions.

$MnO_4^- + 8H^+ \rightarrow Mn^{2+} + 4H_2O$

$C_2O_4{}^{2-} \rightarrow 2CO_2$

To balance the charge, add electrons to a more positive side to equal the less positive side of the half-reaction.

$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$

$C_2O_4^{2-} \rightarrow 2CO_2 + 2e^-$

Now multiply oxidation half-reaction by 5 and reduction half-reaction by 2 . Add both the reactions we will get

$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 10$

$CO_2 + 8H_2O$

78(A). $\frac{100}{0.5} \times 78.4 = 1.568 \times 10^4$

79(B). NH_4OH and NH_4Cl constitute to form a basic buffer.

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

We know, $pOH + pH = 14$ or

$pOH = 14 - pH$

$$\therefore 14 - pH - \log \frac{[\text{ Salt }]}{[\text{ Base }]} = pK_b$$

$$\Rightarrow 14 - 9.25 - \log \frac{0.1}{0.1} = pK_b$$

$\Rightarrow 14 - 9.25 - 0 = pK_b$

80(A).

$2H_2O_{2(l)} \rightarrow 2H_2O_{(l)} + O_{2(g)}, \Delta H_r = ?$

$H_{2(g)} + O_{2(g)} \rightarrow H_2O_{2(1)}, \Delta H = -188 \text{ kJ/mol}$ (1)

$H_{2(g)} + O_{2(g)} \rightarrow H_2O_{(l)}, \Delta H = -286 \text{ kJ/mol}$ (2)

(1) - (2)

$$H_2O_{2(1)} \rightarrow H_2O_{(1)} + \frac{1}{2}O_{2(g)}$$

81(A). Cell reaction is,

$Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$

$$E_{cell} = E^{\circ}_{cell} - \frac{RT}{nF} \ln \frac{[Zn^{2+}]}{[Cu^{2+}]}$$

Greater the factor $\frac{[Zn^{2+}]}{[Cu^{2+}]}$, less is the EMF.

Hence $E_1 > E_2$

82(A). As $r = k[A]^n$

if $n = 0$

$r = k[A]^0$

or r = k thus for zero order reactions rate is equal to the rate constant.

83(B). Fluorine is more reactive than chlorine. So, bond energy of chlorine is greater than fluorine.

Silicon exhibits 6 coordination numbers. In aqueous state Mn(II) is more stable.

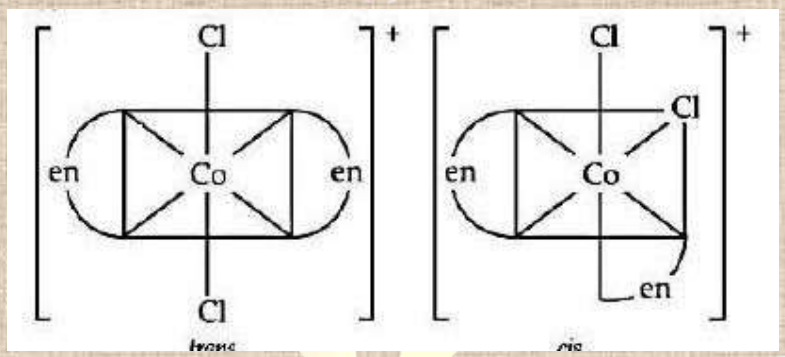
$Mn \rightleftharpoons Mn^{2+} + 2e^-$

84(C). $Mn: [Ar]3d^5 4s^2$

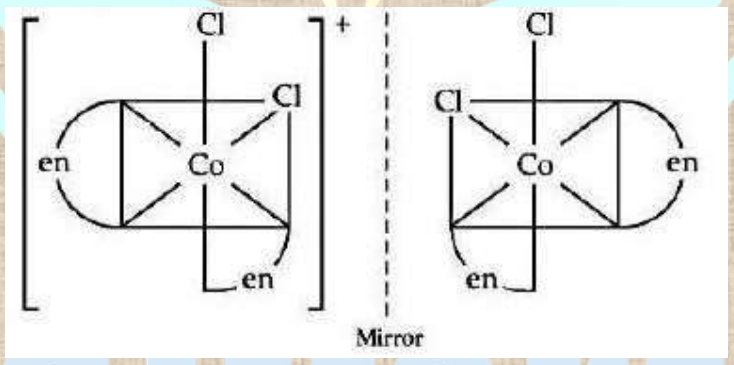
Shows $+2, +3, +4, +5, +6 \& +7$ oxidation states.

85(B). Complex $[Co(en)_2Cl_2]Cl$ show 4 different isomerism.

(i) Geometrical isomers

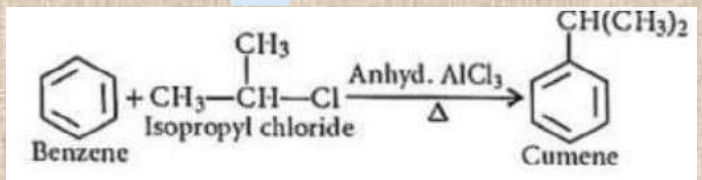


(ii) Optical isomers



86(D). Friedel craft reaction is carried out by the generation of a carbocation but in chlorobenzene, bromobenzene, chloroethene, lone pair of halogen are delocalized with π bonds to attain double bond character. So isopropyl chloride can be used as the halide component for Friedel-Crafts reaction.

Friedel-Crafts reaction:



87(C). By applying formula,

Sum of total oxidation state of all atoms = Overall charge on the compound

(C) For $Fe(CO)_5$

$x + 0 = 0$

$x = 0$

(A) For $[Fe(H_2O)_6]Cl_3$

$x + 6(0) + 3(-1) = 0$

$x = +3$

(B) For $K_4[Fe(CN)_6]$

$4 + 6(-1) + x = 0$

$x - 2 = 0$

$x = +2$

(D) For $[Fe(H_2O)_6]Cl_2$

$x + 6(0) - 2 = 0$

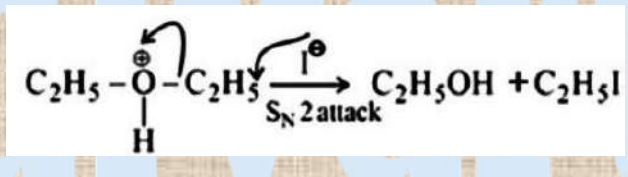
$x = +2$

88(C). Diethyl ether on heating with concentrated HI gives two moles of ethyl iodide.

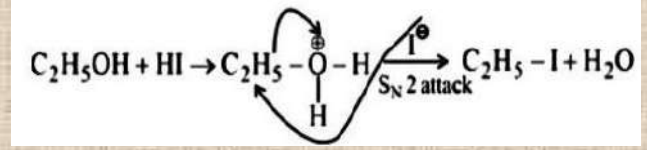
$C_2H_5 - O - C_2H_5 \xrightarrow[\Delta]{2HI} 2C_2H_5I + H_2O$

S_N2 reaction takes place through the formation of the oxonium ion.

First, HI dissociates into $H^{\oplus}$ and $I^{\ominus}$ and protonates ether to form ethanol and ethyl iodide.

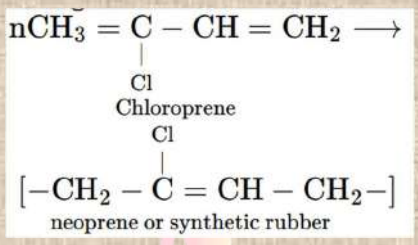


Now, 2nd molecule of HI will cause nucleophilic substitution in the ethanol molecule.

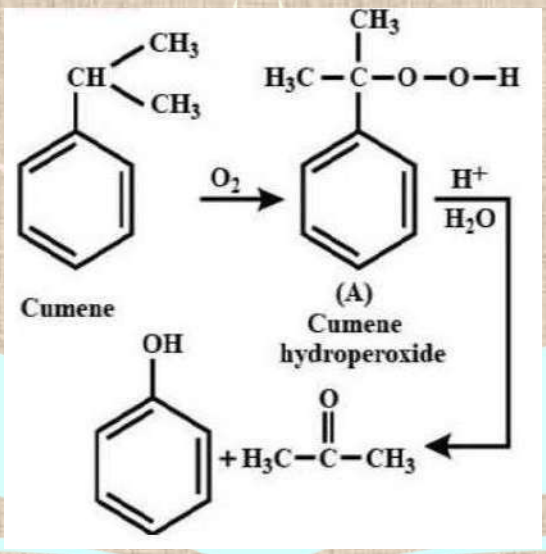


Nucleophilic substitution will be taking place as ethanol is a primary alcohol and $I^{\ominus}$ is a good nucleophile.

89(C). A synthetic rubber which is resistant to the action of oils, gasoline and other solvents is Neoprene. Neoprene is synthetic rubber. It is a polymer of chloroprene and is resistant to the action of oils, gasoline and other solvents.



90(B). The reaction is:



91(C). In presence of light, chloroform is oxidized by the air to form carbonyl chloride or phosgene and HCl. Phosgene is highly poisonous. That is why it is kept in a colored bottle as it undergoes oxidization in presence of light and air.

$CHCl_3 + [O] \rightarrow COCl_2 + HCl$

92(A). The oxidation state of chlorine atoms in chlorine molecules is zero.

When chlorine gas is reacted with hot and concentrated sodium hydroxide solution to give the product of sodium chloride and hypochlorite.

The chemical reaction for the above discussion is given below,

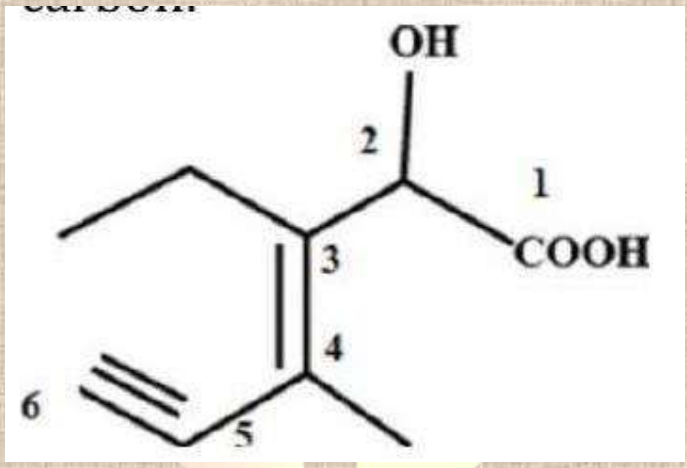
$Cl_2 + NaOH \rightarrow NaCl + HOCl$

The oxidation number of chlorine changes from chlorine molecule to sodium chloride is zero to-1and the oxidation number of chlorine changes from chlorine molecule to hypochlorite is zero to -3

According to the above discussion, we conclude when Cl_2 gas reacts with hot and concentrated sodium hydroxide solution, the oxidation number of chlorine changes from

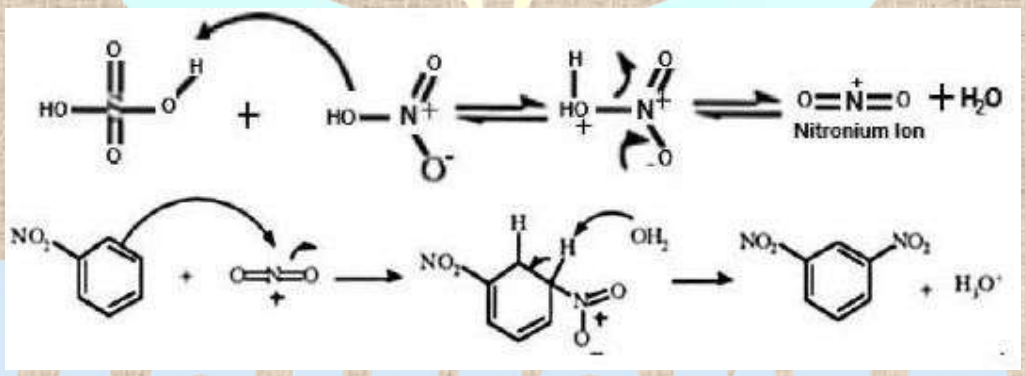
Zero to $-\mathbf{1}$ and zero to -3 .

93(B). Structure of the compound whose IUPAC name is 3 -Ethyl-2-hydroxy-4-methyl hex- 3 -en- 5 -ynoic acid is as given below. This structure contains on $C = C$ bond and one $C \equiv C$ bond. It also contains one $-OH$ group and one - COOH group. One methyl and on ethyl substituents are present. The parent hydrocarbon contains 6 carbon atoms. So numbering starts from $-COOH$ carbon.



94(B). When HNO_3 and H_2SO_4 react together it gives nitronium ion $(O = N^+ = O)$

This nitronium ion reacts on meta position of nitrobenzene, give 1,3 -dinitrobenzene.



95(B). 1 mole $= 6.023 \times 10^{23}$ number of molecules.

1 g mole of $O_2 = 32$ g of O_2

$\Rightarrow$ 16 g of $O_2 = 0.5$ g mole of O_2

1 g mole of $N_2 = 28$ g of N_2

$\Rightarrow$ 7 g of $N_2 = 0.25$ g mole of N_2

1 g mole of $H_2 = 2$ g of H_2

$\Rightarrow$ 2 g of $H_2 = 1$ g mole of H_2

96(C). $E = h\nu$ or $\nu = E/h$

For H atom, $E = \frac{-21.76\times10^{-1}}{n^2}$ Jatm^{-1}

$\Delta E = -21.76 \times 10^{-19}\left(\frac{1}{4^2} - \frac{1}{1^2}\right)$

$= 20.40 \times 10^{-19}$ J atm^{-1}

$v = \frac{20.40 \times 10^{-19}}{6.626 \times 10^{-34}} = 3.079 \times 10^{15}$ s^{-1}

97(A). $2NH_3 \rightleftharpoons N_2 + 3H_2;\ \frac{1}{K_1}$

$N_2 + O_2 \rightleftharpoons 2NO;\ K_2$

$3H_2 + \frac{3}{2}O_2 \rightleftharpoons 3H_2O;\ (K_3)^3$

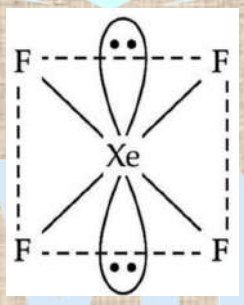
98(B). Na_2CO_3 is a salt of weak acid H_2CO_3 and strong base NaOH, therefore, its aqueous solution will be basic hence has pH more than 7.

99(A). Hence total vapour pressure = [(Mole fraction of P) × (Vapour pressure of P)] + [(Mole fraction of Q) × Vapour pressure of Q)]

$= \left(\frac{3}{5} \times 80 + \frac{2}{5} \times 60\right)$

$= 48 + 24 = 72$ torr

100(A). XeF_4 is $sp^3\ d^2$ hybridised and it is square planar:



101(C). In comparison with genus, species is less general in characters. The correct hierarchy of classification of various taxons in descending order is given by:

Kingdom → Phylum → Class → Order → Family → Genus → Species

The kingdom is the highest taxon with the least similar characters shared between its various members while species is the lowest level with almost similar morphological and behavioral similarities. Species are the smallest group of individuals which can be recognized by ordinary methods as groups and which are consistently and persistently different from other groups because their characters are less general.

102(D). Polytene chromosomes are found because of endomitosis.

They are produced when repeated rounds of DNA replication without cell division form a giant chromosome. Thus polytene chromosomes form when multiple rounds of replication produce many sister chromatids which stay fused together. Endomitosis is the replication or duplication of the chromosome in the absence of nuclear division or cell, resulting in numerous copies within each cell, which occurs in the Drosophila's salivary glands.

103(C). Hammerling's experiments on Acetabularia involved exchanging Rhizoid and Stalk.

Acetabularia used in Hammerling's nucleocytoplasmic experiment is unicellular uninucleate green algae. Hammerling's experiment of Acetabularia involved exchanging rhizoid and stalk. The presence of hereditary information in the nucleus was proved by the work of Hammerling on single-celled algae Acetabularia.

104(A). The physical process involved in the release of molecular oxygen from leaves is diffusion.

Diffusion is a slow process and is not dependent on a living system. Diffusion is very important to plants since it the only means for gaseous movement within the plant body. Intake of carbon dioxide and release of oxygen through stomata occurs through the process of diffusion. Diffusion rates are affected by the gradient of concentration, the permeability of the membrane separating them, temperature and pressure.

105(C). The most abundant water pollutant is industrial wastes.

Industrial wastes are the major water pollutants because of their ingredients. Heavy metal waste like mercury, cadmium, dirt and gravel, masonry and concrete, scrap metal, trash, oil, solvents, and chemicals, etc. are present in the industrial wastes. Their treatment is a long and expensive procedure as compared to domestic sewage treatment. Industrial waste is corrosive, reactive, and igniting. It poses dangerous effects on aquatic life primarily and human health thereafter. These have shown biomagnification capability as well.

106(D). The roots which develop from any portion of the plant except the radical are known as adventitious roots.

The roots that arise from any part of the plant other than the radicle or its branches are called adventitious roots. They generally reproduce from stem nodes, internodes, leaves, etc. During germination, the radicle from the seed grows downward and branches out. The branches jointly with the primary root are called the root system. Roots lack chlorophyll and hence they are not green in color. Roots are positively geotropic and hydrotropic, that is, they grow towards the ground and water and negatively phototropic, which is growing away from light.

107(A). The ovule of an angiosperm is technically equivalent to a megasporangium.

Ovules are immature seeds that are equivalent to the megasporangium. It consists of an integument, which is further divided into two parts, including the outer integument and the inner integument. Inside the integument, the part is referred to as nucellus, in which the

development of the female gametophyte or embryo sac occurs. Each ovule consists of a stalk-like structure called a funicle a part that helps with its attachment to the ovary.

108(A). Geitonogamy may require pollinators, but is genetically similar to autogamy.

Geitonogamy involves the transfer of the pollen from one flower of a plant to the stigma of another flower of the same plant. As the pollen has to move from one flower to another flower, it requires a pollinating agent. Yet it is genetically similar to autogamy, as both the flowers of the plant, share the same genotype of the plant.

109(D). The tendency of population to remain in genetic equilibrium may be disturbed by lack of random mating. According to Hardy-Weinberg principle, allele frequencies in a population are stable and is constant from generation to generation allele frequencies in a population will remain constant over generations only if the following condition are met:

i) There is no mutation no gene flow and all mating is random.

ii) All genotypes reproduce equally well (i.e., no natural selection,) but their conditions rarely met in nature.

110(A). The ability to survive and reproduce given by the term Darwin fitness. Darwin's fitness of an organism is focused on it's reproductive fitness. It stated that any species having better adaptability will leave progenies through reproduction and thus will ensure continuity on earth more than less adaptive ones. Reproductively fit individuals survive and are selected by nature.

111(D). Diversification in plant life appeared due to long periods of evolutionary changes.

Initially, plants were thalloid. There was no differentiation among root, stem, and leaves. By the evolutionary changes that occurred for a longer period, diversification in plants appeared.

112(B). Flowers, which have single ovule in the ovary and are packed into inflorescence are usually pollinated by wind.

Wind pollination or anemophily is favoured by flowers having a single ovule in each ovary, and numerous flowers packed in an inflorescence. Wind pollination is nondirectional pollination.

113(B). Egg cell and antipodal cells have a haploid number of chromosomes.

In angiosperms, a single diploid megaspore mother cell matures within an ovule. Through meiosis, it gives rise to four megaspores (haploid). In most plants, only one of these megaspores survive. This functional megaspore divides three times by mitosis and produces eight haploid nuclei enclosed within a 7-celled embryo sac. One nucleus is located near the opening of the embryo sac in the egg cell. Two nuclei are located in a single cell in the middle of the embryo sac and are called polar nuclei, two nuclei are contained in cells called synergids that flank the egg cell, and the other three nuclei reside in tire cells called antipodals, located at the end of embryo sac opposite the egg cell.

114(C). Aerobic respiration produces more usable chemical energy than fermentation because fermentation involves partial oxidation of food.

Aerobic respiration is the process that leads to the complete oxidation of organic substances in the presence of oxygen and releases CO_2 water, and a large amount of energy in the form of high-energy bonds of ATP.

In the cells of all living organisms, cellular respiration begins with glycolysis. In this process, glucose undergoes partial oxidation to form two molecules of pyruvic acid. In the absence of oxygen, pyruvic acid is converted to CO2 and ethanol by fermentation. In some organisms, lactic acid is formed from pyruvic acid e.g. muscles during exercise. In fermentation, less than 7% of the energy is released from glucose molecules because it is not completely oxidized.

115(C). Cells regulate their activity through the flow of energy.

Cells in your body get energy from the foods that are eaten, such as glucose (a sugar). Cellular respiration converts glucose and oxygen into water, carbon dioxide, and a usable form of energy called ATP (this stands for adenosine triphosphate).

116(A). Phyllode is nothing but a leaf modification meant for photosynthesis adaptation in xerophytic.

Phyllodes are leaf-like in appearance and function. They have the ability to perform photosynthesis and function as foliage. They are found on most species of Acacia trees and shrubs.

117(C). Thick and woody climbers are called lianas.

Lianas are the structures climb up to the canopy of the forest mainly seen in set tropical forests. A liana is a long-stemmed, woody vine that is rooted in the soil at ground level and uses trees, as well as other means of vertical support, to climb up to the canopy in search of direct sunlight.

118(A). The fundamental feature of Kranz Anatomy of C4 plants is presence of adrenal chloroplasts in bundle sheath cells and granular chloroplasts in mesophyll cells.

The C_4 plants have special anatomy called the kranz anatomy where the mesophyll cells cluster around the bundle sheath cells and form a ring. Due to this Carbon dioxide is first fixed into a 4-carbon compound in the mesophyll cells as the chloroplast is present in the bundle sheath cells.

119(C). Measuring Biochemical Oxygen Demand (BOD) is a method used for estimating the amount of organic matter in sewage water.

Biochemical oxygen demand (BOD) is the amount of oxygen, expressed in mg/L or parts per million (ppm), that bacteria take from water, when they oxidize organic matter. It is therefore used as a measure of the amount of certain types of organic pollutants in water.

120(B). A common indicator organism of water pollution is Escherichia coli. Escherichia coli is transmitted to water bodies through fecal matter. Detection of Escherichia coli in water bodies indicates that the water is contaminated with fecal matter and is not suitable for drinking. If this water is used for drinking, it can be serious for our health.

121(B). Adaptation is the feature that allows organisms to survive in the conditions of its habitat.

An adaptation is a feature that helps an organism, such as a plant or animal survive in its environment. It is common in a population because it provides some improved function. It enables a plant or an animal to live in a particular habitat.

122(C). An attribute found in plants but not in animals are known as Autotrophy.

It is the capability of an organism that synthesizes its own food from inorganic substances in nature by the use of light energy or chemical energy.

123(A). Two plants can be conclusively said to belong to the same species if they can reproduce freely with each other and form viable seeds.

A species is a group of closely related organisms that can interbreed freely to produce viable offspring. If the two plants belong to the same species then they can reproduce freely with each other and produce viable seeds.

124(B). Triticum aestivum is the correct scientific name of wheat-derived by binominal nomenclature.

Common wheat (Triticum aestivum), also known as bread wheat, is a cultivated wheat species. About 95% of the wheat produced worldwide is common wheat it is the most widely grown of all crops and the cereal with the highest monetary yield.

125(C). "Aceae" is the suffix used in the classification of plants to define the taxonomic division of "family". Families hold fifth place in the taxonomy classification.

The plant family name is a plural adjective and is formed by adding a suffix-Aceae. Some examples are Rosaceae, Linacae, and Cucurbitaceae.

126(A). The main difference between onion cells and human cheek cell is that the onion cell is a plant cell with a cell wall made up of cellulose whereas the human cheek cell is an animal cell without a cell wall. Furthermore, the onion cells are bricklike in shape while the human cheek cells are rounded.

127(A). The jelly-like substance inside the plasma membrane in which all cell organelles are floating is called cytoplasm. The cytoplasm is a thick solution that fills each cell. It is enclosed by the cell membrane. It is made up of water, salts and proteins. In eukaryotic cells, the cytoplasm includes all of the material inside the cell and outside of the nucleus.

128(C). The reason behind cell elongation in internodal regions of plants is gibberellins.

Gibberellin is the growth regulator that regulates the developmental cycle of higher plants. It stimulates the cell elongation in the internodal region by altering the rheological property of the cell wall and as a result, the cell gets lengthen.

129(B). The amount of water retained by soil after drainage is Known as field capacity.

Field Capacity is the amount of soil moisture or water content held in the soil after excess water has drained away and the rate of downward movement has decreased.

130(D). Keystone species deserve protection because they play an important role in supporting other species.

Keystone species are those which have a significant and disproportionately large influence on the community structure and characteristics. It has often considerably low abundance and biomass as compared to dominant species. Removal of such species causes serious disruption in the structure and function of the community.

131(D). Non-albuminous seed is produced in pea.

In the majority of dicot seeds, including pea, the endosperm is consumed during seed development and the food is stored in cotyledons and other regions. They are called non-endospermic or exalbuminous seeds.

132(B). Fruit color in squash is an example of dominant epistatis.

Dominant epistasis is a condition when a dominant gene masks the effect of the other non-allelic gene. In summer squash, the fruit color may be white, yellow or green. White fruits are produced by a domain epistatic allele ' W '. At another locus, Y for yellow fruits is dominant to its allele y for green fruits. Dominant white hides the effect of yellow or green. A consequence of this dominant epistasis is that the hybrid ratio is modified into 12 white: 3 yellow: 1 green. So, dominant epistasis suppresses the expression of a non-allelic gene (dominant or recessive).

133(B). Venation distinguishes a monocot from a dicot plant.

An arrangement or system of veins (as in the tissue of a leaf or the wing of an insect). Monocots and dicots are the parts of the angiosperm. Angiosperms are plants that have their seeds enclosed within the ovary. They have seeds that are covered by fruit walls outside. Based on the number of
cotyledons present in them they are categorized as monocotyledons and dicotyledons.

134(C). The axillary buds arise exogenously from the inner cortical layers. Axillary buds do not become actively growing shoots on plants with strong apical dominance (the tendency to grow just the terminal bud on the main stem). Apical dominance occurs because the shoot apical meristem produces auxin which prevents axillary buds from growing. The axillary buds begin developing when they are exposed to less auxin, for example if the plant naturally has weak apical dominance, if apical dominance is broken by removing the terminal bud, or if the terminal bud has grown far enough away for the auxin to have less of an effect.

135(A). Mitochondria without an outer membrane are known as mitoplast.

Mitoplast is a mitochondrion where the outer membrane stripped in it has been removed, by keeping the inner membrane unchanged or intact. The mitoplast term is used to denote the inner membrane and matrix of mitochondria as formed during subfractionation when the outer membrane is dissolved with the help of detergent digitonin.

136(B). Bryophyta class is called amphibians of the plant kingdom.

They include Mosses, liverworts, and hornworts. Bryophyta are known as amphibians of the plant kingdom because these plants live in soil but they need water for asexual reproduction. They were nonvascular plants. Asexual reproduction is the main method of reproduction in bryophytes. It occurs through the production of spores.

137(C). The inner, darker and harder portion of the secondary xylem that can not conduct water, in an older dicot stem, is called duramen.

Secondary xylem's central axis becomes inert, losing water and storing food content. It gets filled with complex metabolism by products. This area becomes hard in nature and dark in colour, and is named as duramen. This zone is losing nutrient conduction function.

138(B). Theodore Schwann concluded, based on his studies on plant tissues, that the presence of cell wall is a unique character of plant cells.

Theodore Schwann (1839), a British Zoologist, studied different types of animal cells and reported that cells had a thin outer layer which is today known as the 'plasma membrane'. He also concluded, based on his studies on plant tissues, that the presence of cell wall is a unique character of the plant cells.

139(D). Reduces transpiration is the purpose of trichomes on leaves.

Trichomes play a crucial role in the protection of plants from many insects. Trichomes interfere with herbivory and affect the infection of other arthropods on the plant surface, thus inhibiting their contact with leaf epidermis.

140(B). The amount of energy transferred from one trophic Level to next trophic level is 10%.

The amount of energy at each trophic level decreases as it moves through an ecosystem. As little as 10% of the energy at any trophic level is transferred to the next level, the rest is lost largely through metabolic processes as heat. The efficiency with which energy or biomass is transferred from one trophic level to the next is called as the ecological efficiency. Consumers at each level convert on average only about 10% of the chemical energy in their food to their own organic tissue (the ten-percent law).

141(A). The result of acid disposition is dying forests and lakes.

Acid deposition, commonly known as acid rain, occurs when emissions from the combustion of fossil fuels and other industrial processes undergo complex chemical reactions in the

atmosphere and fall to the earth as wet deposition (rain, snow, cloud, fog) or dry deposition (dry particles, gas).

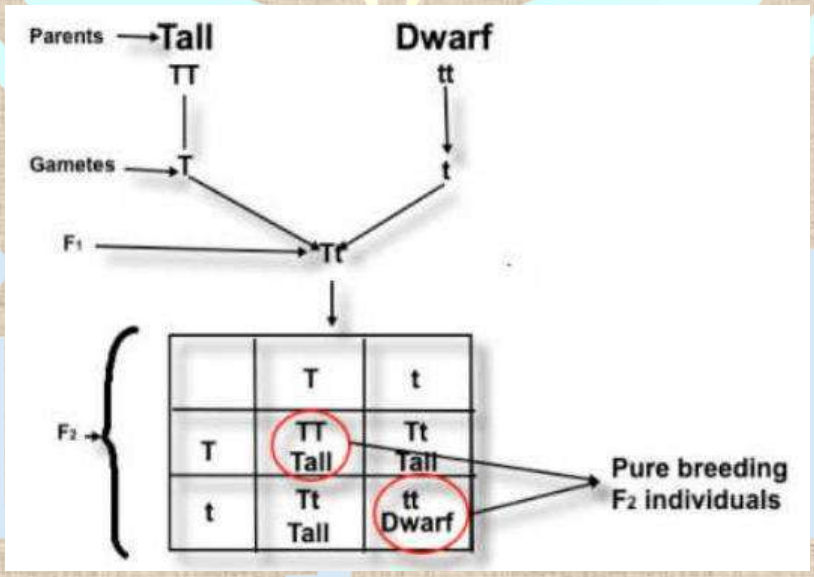
142(B). Wind pollinated flowers are small, producing large number of dry pollen grains.

Wind-pollinated flower shows large production of pollen grains, and their anther is well exposed. The flowers are not attractive and scent emitting and they are a feathery and sticky stigma. The pollens of wind-pollinated flowers are light and nonsticky so that they can be transported in wind currents. These flowers do not possess nectar.

143(C). The endosperm is consumed by developing an embryo in the seed of pea. In pea, the endosperm is consumed by developing embryo in the seed. The endosperm is completely absorbed by the growing embryo and the food reserve gets stored in the cotyledons. Such seeds are called non endospermic or exalbuminous.

144(B). A tall true breeding garden pea plant is crossed with a dwarf true breeding garden pea plant. When the F1 plants were selfed, the resulting genotypes were in the ratio of 1: 2: 1 - tall homozygous : tall heterozygous : dwarf.

Mendel crossed pure tall plant (TT) with a pure dwarf plant (tt). In the F_1 generation, tall plants are formed (Tt). When F_1 plant is subjected to self pollination, in the F_2 generation, 3 tall plants and 1 dwarf plants are formed. In the one homozygous tall plant (TT), 2 heterozygous tall plants (Tt), one homozygous dwarf plant (tt) are formed. Phenotypic ratio is 3: 1, genotypic ratio is 1: 2: 1.



145(B). 14 true-breeding pea plant varieties did Mendel select as pairs, which were similar except in one character with contrasting traits

A true breeding line refers to the plant that has undergone continuous self-pollination and showed stable trait inheritance and expression for several generations.

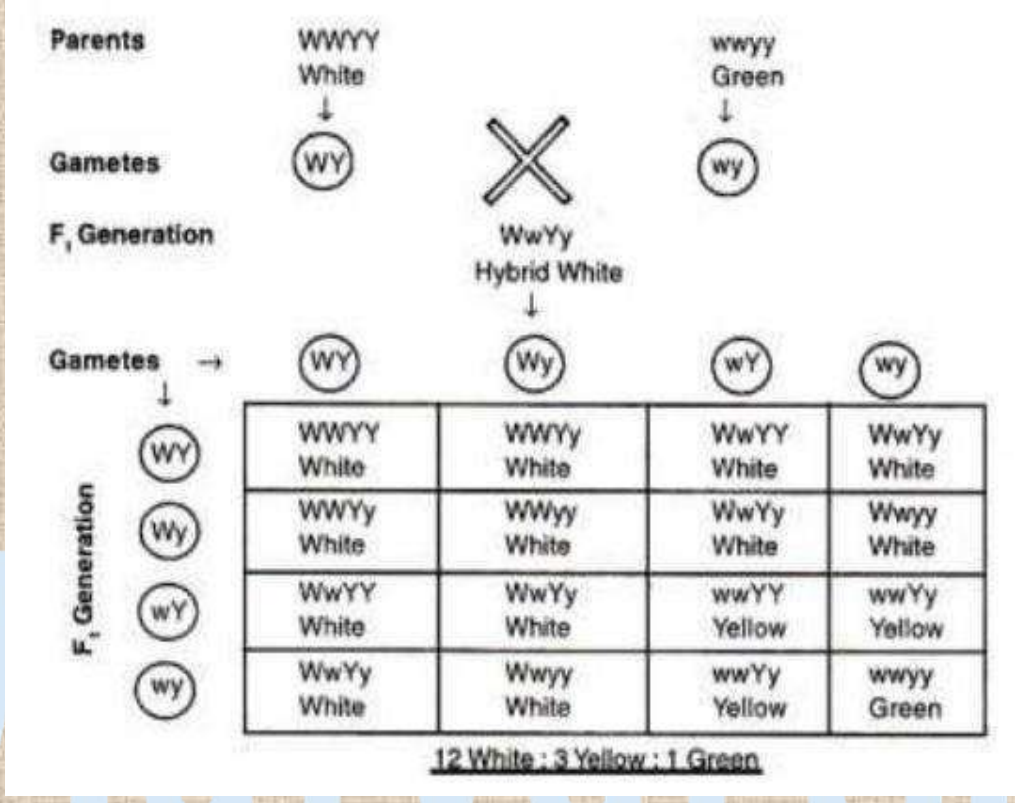
Mendel (father of genetics) selected 14 true-breeding pea plant varieties, as pairs, which were similar except for one character with contrasting traits.

146(A). Nucellar polyembryony is seen in the members of the citrus family.

It is a type of seed formation in which the nucellar cells that are present in the embryo divide and form many more embryos. These are the exact clones of the parents because these are formed from nucellar cells.

147(B). Fruit colour in squash is an example of dominant epistasis.

A dominant epistasis is a condition when a dominant gene masks the effect of the other non-allelic gene. In summer squash, the fruit color may be white, yellow, or green. White fruits are produced by a domain epistatic allele 'W'. At another locus, Y for yellow fruits is dominant to its allele y for green fruits. Dominant white hides the effect of yellow or green. A consequence of this dominant epistasis is that the hybrid ratio is modified into 12 white: 3 yellow: 1 green. So, dominant epistasis suppresses the expression of a non-allelic gene (dominant or recessive).



148(B). Kranz anatomy is usually associated with C_4 plants.

The C_4 plants plants are adapted to dry tropical regions and have greater productivity of biomass. They have special type of leaf anatomy known as Kranz anatomy. In this type of anatomy the bundle sheath cells form several layers around the vascular bundles; they are characterized by having a large number of chloroplasts, thick walls impervious to gaseous exchange and no intercellular spaces.

149(A). The Golgi complex plays a major role in post translational modification of proteins and glycosidation of lipids.

Golgi apparatus is the series of membranous stacks with two faces the cis face and the trans face. It plays an important role in processing proteins for secretion, containing a set of glycosylation enzymes that attach various sugar monomers to proteins as the proteins move through the apparatus. Glycosylation is a post-translational modification. Golgi also contains enzymes for glycosidation of lipids that is an addition of carbohydrates to lipids. Golgi does not involve in the digestion of proteins and carbohydrates or in energy transferring.

150(C). In ginger, vegetative propagation occurs through rhizome.

The rhizome is a thickened, underground, dorsiventral stem that grows horizontally at a particular depth within the soil. It is brown in colour and shows cymose branching. It can be distinguished from the modified root by the presence of nodes, internodes, terminal buds, axillary buds and scale leaves. The rhizome are perennial and propagate vegetatively. They store food materials and appear tuberous. e.g. f Zingiber officinale (ginger). Curcuma longa (turmeric).

151(B). Large amoeboid cells, that are a part of our innate immune system, found in the areolar tissue are called as mast cells.

Mast cells are a kind of white blood cells which are oval or round. These have granular cytoplasm. These cells are associated with allergic reactions.

Mast cells are important cells of the immune system and are of the hematopoietic lineage. Mast cells are originated from pluripotent progenitor cells of the bone marrow, and mature under the influence of the c-kit ligand and stem cell factor in the presence of other distinct growth factors provided by the microenvironment of the tissue where they are destined to reside. Under normal conditions, mature mast cells do not circulate in the bloodstream.

152(A). The cells that release heparin and histamines in the blood are Basophils. Histamine is an important neurotransmitter and is involved in various physiological processes, it acts during inflammatory responses. Heparin acts as an anticoagulant and prevents blood clotting. Serotonin has many physiological functions such as dilating capillaries, increasing vascular permeability, contraction of nonvascular smooth muscle. Histamine, serotonin, and heparin are secreted by the mast cells during inflammation and allergic reactions. A type of granular basophil cell consists of mast cells. Basophils are granulocytes that contain large cytoplasmic granules in the nucleus of the cell. Basophils store histamine which is a vasodilator also contains anticoagulant heparin and serotonin that induces the inflammation.

153(B). All small organisms have very short life span is not true statement.

The period from birth to the natural death of an organism is called its life span. Life span of an organism may be few minutes to several thousand years. Smaller organisms do not necessarily have the shorter life span.

154(B). Bombykol pheromones is involved in sexual reproduction in silk moth.

Bombykol is a pheromone released by the female silkworm moth to attract mates. It is also the sex pheromone in the wild silk moth (Bombyx mandarina).

Minute quantities of this pheromone can be used per acre of land to confuse male insects about the location of their female partners. It can thus serve as a lure in traps to remove insects effectively without spraying crops with large amounts of pesticides. Butenandt named the substance after the moth's Latin name Bombyx mori.

155(B). Infestation by tobacco budworm and armyworm is prevented by Bt toxin. These insects belong to order Lepidoptera. It is one of the most widespread and widely recognizable insect orders in the world. Lepidoptera show many variations of the basic body structure that have evolved to gain advantages in lifestyle and distribution.

Lepidopteran species are characterized by more than three derived features. The most apparent is the presence of scales that cover the bodies, wings, and a proboscis.

156(B). DNA or RNA segment tagged with a radioactive molecule is called probes. Probes are single stranded, radio labelled molecules of nucleic acids with known sequence. The probes having sequence complementary to the gene to be identified are supplied. They bind with the particular gene segment. Radiation imaging identifies the location of that particular segment which bind with probe. Probes are used as identification tool.

157(A). Embryological support for evolution was also proposed by Ernst Haeckel based upon the observation of certain features during embryonic stage common to all vertebrates that are absent in adult.

158(A). Flippers of penguins and dolphins are examples of analogous organs or convergent evolution.

In evolution the mentioned example of flippers of penguins and dolphins are convergent evolution. Convergent evolution refers to the similarity in function but superficial resemblance of structures in simple words, different morphological characteristics. Both the organ- flippers show the same function helping in swimming but the organisms are totally different in appearance from each other. This is known as convergent evolution.

159(D). The Lipid Drugs' Detoxification including the other harmful compounds of various types in the ER is carried out by cytochrome P_{450}.

Cytochrome P_{450} is a group of oxygenase enzymes present in ER of the liver cell responsible for detoxification of a number of xenobiotics (foreign compound), drugs, toxins, products of endogenous metabolism inside our body, etc.

160(A). Animal cells are interconnected by desmosomes.

Desmosomes are the structure by which adjacent cells are attached and formed from the protein plagues in cell membranes linked by the filaments.

These junctions are complex disc-shaped structures, usually a few hundred nanometers in diameter. The surface on one cell is matched with an identical structure on the surface of the adjacent cell. Within each cell, in close approximation to the junction is a circular plaque made of some 12 proteins called the attachment plaque, the plaques have numerous intermediate filaments (keratin) entering and leaving them.

161(C). Activated sludge is put into anaerobic sludge digester for further sewage treatment.

It contains biological flocs that contain bacteria and protozoa for further digestion of organic wastes under aerobic conditions.

162(A). For the commercial and industrial production of citric acid, aspergillus niger microbes is used.

Aspergillus niger is a filamentous fungus that causes the disease on vegetables and fruits called black mould. These organisms are used in fermentation processes to obtain citric acid and gluconic acid that are of commercial importance.

163(A). At the trophic level of consumers, the rate at which food energy is ascimilated is called secondary productivity.

The rate at which food energy is assimilated at the trophic level of consumers is called secondary productivity. In other words, the
rate of synthesis of organic matter by consumers is called as secondary productivity. The primary producers have produced the food for consumers, and secondary productivity reflects only the utilization of this food for the production of consumer biomass.

164(B). Net Primary Productivity (NPP) is the gross primary productivity less that which is consumed by producer in metabolism.

Net Primary Productivity (NPP) is given by Gross Primary Productivity (GPP) minus Respiration loses (R). A fraction of the Gross Primary Productivity (GPP) is used for respiration in plants. So, NPP < GPP. Only a part of incident energy is utilized by photosynthesis. However, it isn't a reason for lower Net Primary Productivity (NPP).

165(D). Epithelial cells of the intestine involved in food absorption have on their surface microvilli.

Microvilli are the tiny hair like structures which are present on the surface of epithelial cells.

These are present in the small intestine. The function of the microvilli is to increase the surface area for the absorption of water and nutrients directly into the bloodstream from the digested or partially digested food.

166(B). A young infant may be feeding entirely on mother's milk, which is white in colour but the stools, which the infant passes out is quite yellowish. This yellow colour due to bile pigments passed through bile juice.

The yellow colour of the stools is due to the presence of bile pigments. Bile pigments are the excretory products. Bile is a bittertasting greenish-yellow alkaline fluid produced by the liver and stored in the gall bladder and secreted into the duodenum. It assists the digestion and absorption of fats by the action of bile salts, which chemically reduce fatty substances and decrease the surface tension of fat droplets so that they are broken down and emulsified.

167(B). Simple squamous mammalian tissues is associated with filtration and diffusion.

Simple squamous epithelium, also known as simple squamous epithelial tissue are found in capillaries, alveoli, glomeruli, and other tissues where rapid diffusion is required. Cells are flat with flattened and oblong nuclei. It is also called pavement epithelium due to its tile-like appearance. This epithelium is associated with filtration and diffusion.

168(B). During an injury nasal septum gets damaged. Hyaline cartilage is involved. Hyaline cartilage is most abundant type of cartilage. Hyaline cartilage occurs in trachea, the larynx of nose and ends of long bone where they from joint.
169(A). The cells having nuclear material without a nuclear membrane are termed prokaryotic cells.

The nucleus of the bacterial cell is not wellorganized like the cells of multicellular organisms. The organisms with these kinds of cells are called prokaryotes (pro: primitive; karyon: nucleus). The cells, like onion cells and cheek cells having a wellorganized nucleus with a nuclear membrane, are designated as eukaryotic cells.

170(B). Taxonomic hierarchy refers to stepwise arrangement of all categories for classification of animals and plants.

The system by which various taxonomic categories are arranged in a proper stepwise manner for the classification of plants and animals is called taxonomic or systematic hierarchy.

171(C). The rRNA is synthesized by nucleolus.

A nucleolus is the small dense spherical structure in the cell nucleus. So, the r-RNA is synthesized by nucleolus. The nucleolus is a spherical structure present in the nuclear matrix or nucleoplasm. It is a site for active ribosomal RNA synthesis.

172(B). The double membrane-bound, sausage-shaped cell organelle found in more numbers in activity dividing cells is mitochondria.

Mitochondria are called as the powerhouses of the cell as they produce energy-rich molecules for the cell. The mitochondrial genome is inherited maternally in several organisms. It is a double membrane-bound, sausage-shaped organelle, found in almost all eukaryotic cells.

173(D). The mode of asexual reproduction is euglena is longitudinal binary fission.

Binary fission is an asexual mode of reproduction in which the bacteria divides into two equal halves. The process starts with the duplication of genetic contents of a parent cell by the process of replication.

When the binary fission takes place along the longitudinal plane it is known as longitudinal binary fission. For example, in euglena binary fission takes place by longitudinal fission.

Hence, the correct option (D).

174(C). Forelimbs of a cat, lizards used in walking, forelimbs of a whale used in swimming and forelimbs of bats used in flying are an example of homologous organs.

Homologous organs are those organs which have similar origin but perform different functions. Forelimbs of cat, lizard used in walking; forelimbs of whale used in swimming and forelimbs of bats used in flying are an example of homologous organs. Analogous organs are those organs which have similar functions but different origins.

175(D). Tasmanian wolf and placental wolf appear similar due to Adaptive convergence.

Adaptive convergence is the phenomenon which happens under adaptive convergence. The animals of unrelated groups occupying the same habitat exhibit common features. For example all the marsupials existing in Australia developed a pouch to carry their young ones during development. But marsupial have a different ancestry that is they develop or evolve from different ancestors. This type of evolution which has several adaptive radiations in a single isolated area is called as convergent evolution. The phenomenon which involves this convergent evolution is called as adaptive convergence.

176(C). Flavr savr is genetically modified tomato.

In 1994, Calgene, a California company, brought the first genetically engineered crop to market, the Flavr Savr tomato. The company's researchers were able to inhibit a gene that produces a protein that makes a tomato get squishy.

177(A). A genetically engineered microorganism used successfully in bioremediation of oil spills is a species of pseudomonas.

It is also known as 'Chakarborty's super bug. Bioremediation is the process of using living micro-organisms to clean up a contaminated site. Micro-organisms do this by removing toxins from materials. They decompose these compounds by using enzymes, specific proteins that control reactions in living cells. Organisms that produce enzymes capable of degrading petroleum are useful in cleaning up oil spills. Some common ones that break down oil are genetically engineered species of pseudomonas and azotobactera. Bioremediation accounts for 5 to 10 percent of all pollution treatment and has been used successfully in cleaning up leaking underground gasoline storage tanks. Bioremediation has many applications, from the ordinary garden compost to the removal of selenium and other toxic metals from waste. The best agents for bioremediation are the ones that can break down contaminants without becoming contaminated or harmful themselves.

178(B). A patient brought to a hospital with myocardial infarction is normally immediately given streptokinase.

Streptokinase is given to the patients with acute myocardial infarction in adults. It helps in the elysis of intracoronary thrombi, the improvement of ventricular function and thereby reduce the mortality caused by
infarction.

179(D). A common biocontrol agent for the control of plant disease is trichoderma. The natural method of pest and pathogen control involving use of viruses, bacteria and other insects (which are their natural predators and pests) is called biocontrol or biological control. For example, free living fungus Trichoderma exerts biocontrol over several plant pathogens for the control of plant diseases. Baculoviruses (mostly of genus Nucleo-polyhedrovirus) are also used as biocontrol agents but they are used for the control of

insects and arthropods. Bacillus thuringiensis is a soil bacterium which is used as biopesticide. Glomus, species are the most common fungal partners of mycorrhiza residing in the roots of higher plants.

180(D). Two friends are eating together on a dining table. One of them suddenly starts coughing while swallowing some food. This coughing would have been due to improper movement of epiglottis.

The epiglottis is a flap that is made of elastic cartilage tissue covered with a mucous membrane, attached to the entrance of the larynx. It prevents the entry of food into the larynx, and directs it to the oesophagus. Due to improper movement of epiglottis, one may suddenly start coughing while swallowing some food.

181(A). In vertebrates lacteals are found in ileum.

Ileum is the part of small intestine. Its mucosa is raised into numerous microscopic projections called the villi. The villi contain a minute blind ended lymph vessel lacteals. From the lacteals, the lipoprotein chylomicrons are carried into the blood stream directly via thoracic lymphatic duct.

182(B). The primary producers of the deep-sea hydrothermal vent ecosystem are chemosynthetic bacteria.

Primary producers of the deep sea hydrothermal vent ecosystem are chemosynthetic bacteria. Sulfide-oxidizing bacteria are chemolithotrophic in nature. They are found in the deep sea hydrothermal vent ecosystem. They provide the primary food for the invertebrates found in the immediate vicinity of the vent ecosystem.

183(A). Least Genetic Diversity is a characteristic feature of cropland ecosystem.

A cropland ecosystem will have a major crop cultivated in a given area. It shows that the diversity in that particular area will be least. Whereas it is the opposite when forest ecosystem is considered.

The cropland ecosystem:

This is manmade ecosystem. Man has been doing his best in modifying the croplands to get maximum benefit out of them. A cropland ecosystem may be illustrated by crops like wheat, maize, rice, sugarcane etc. It has following components.

1. Producers: A crop along with the weeds growing in the field are the producers of a cropland ecosystem. In the cropland ecosystem of maize, weeds like Cynodon dactylon, Euphorbia hirta, Alysicarpus, Launea nudicairlis are very common.

2. Consumers: Herbivores are the primary consumers of the cropland ecosystem. These include rats, rabbits, birds, man and insects. The second order and the third order consumers are represented by frogs, snakes, birds such as hawk etc.

3. Decomposers and transformers: Bacteria and fungi like Bacillus, Aspergillus, Clostridium, Agaricus, Mucor, Aspergillus and Fusarium are common decomposers and transformers of cropland ecosystem of maize.

184(A). In human female, the fertilized egg gets implanted in uterus after about 7 days of fertilization.

The fertilized egg or zygote undergoes several divisions to form the embryo. It moves into the uterus within a period of 4-5 days. In the uterus, the embryo implants itself into the endometrial lining 7-8 days after fertilizations. After implantation, it secretes a hormone called human chorionic gonadotrophin (hCG) which helps maintain the pregnancy.

185(A). The housefly (Musca domestica) is of phylum Arthropoda and is Classified under Class: Insecta.

Taxonomically it is as below:

	Column I		**Column II**
(a)	Family	(iii)	Muscidae
(b)	Order	(i)	Diptera
(c)	Class	(iv)	Insecta
(d)	Phylum	(ii)	Arthropoda

186(A). Stratum germinativum is an example of columnar of epithelium.

The innermost layer called stratum germinativum has columnar cells resting upon a common basement membrane. It is the deepest layer of the five layers of the epidermis and also the outer covering of skin in mammals.

187(D). Hermaphrodite animal is leech. The hermaphrodite animal is an animal that has both male and female reproductive gametes in the same individual. Leech is a hermaphrodite because it has both the reproductive gametes in the same individual. The sperms and ova mature at different times so the fertilization is reciprocal which means the leeches use a clitellum to hold their eggs and secrete the cocoon it is fertilized by sperms of another leech.

188(B). Cellular organelles containing hydrolytic enzymes are called lysosomes. Lysosomes are single membrane-bound organelles present in animal cells. These are heterogeneous structures and greatly vary in size as well as their shape. Lysosomes have acidic internal pH of 5 and are filled with hydrolytic enzymes. They contain about 40 different types of hydrolytic enzymes, including proteases, nucleases, glycosidases, lipases, sulfatases and phospholipases. These enzymes are responsible for controlling intracellular digestion of macromolecules.

189(A). Homo habilis had the smallest brain capacity.

Homo habilis lived around three million years ago. These species are considered to have evolved in the regions of East and South Africa. Through various studies, they are found to have the smallest brain capacity among the given species. Their brain capacity was about 800cc. They were the first species to have been involved in weapon making. They were the first species to have developed in the genus homo.

190(*A*). Gene therapy therapy was given in 1990 to a four-year-old girl with Adenosine Deaminase (ADA) deficiency.

First successful gene transfer in human was performed by F. Anderson. Ashi Disilva a 4-year girl was treated by replacing ADA gene in lymphocytes. The girl was suffering from Severe Combined Immunodeficiency (SCID). Gene therapy was used for the treatment of ADA deficiency.

191(D). Probiotics are live microbial food supplement

Probiotics are live microorganisms that are intended to have health benefits when consumed or applied to the body. They can be found in yogurt and other fermented foods, dietary supplements, and beauty products.

192(B). Most animals that live in deep oceanic waters are detritivores.

Deep oceanic creatures have to survive in harsh conditions like there are hundreds of bars of pressure, small amounts of oxygen are available to them, very little food, no sunlight, and constant, extreme cold. Most creatures have to depend on decomposing plant and animal parts as well as feces.

193(D). Secretion of gastric juice is stopped by enterogastrone.

An enterogastrone is any hormone secreted by the mucosa of the duodenum in the lower gastrointestinal tract in response to dietary lipids that inhibits the caudal (or forward, analward) motion of the contents of chyme.

194(B). Extrusion of second polar body from egg nucleus occurs after entry of sperm but before fertilization.

Extrusion of second polar body from egg
nucleus occurs after entry of sperm but before fertilization. The entry of sperm into the ovum induces completion of the meiotic division of the secondary oocyte. Entry of sperm causes breakdown of metaphase promoting factor (MPF) and turns on anaphase promoting complex (APC).

195(A). The sum total of all the chemical reactions occurring in the body is known as m etabolism.

All living organisms are continuously making or breaking biomolecules, such conversions are due to chemical reactions, and sum total of all such chemical reactions, occurring in the body is called metabolism. Each metabolic pathway in the cell is tightly regulated by enzymes.

196(C). Cry endotoxins obtained from Bacillus thuringiensis are effective against boll worms.

A bollworm is a common term for any larva of a moth that attacks the fruiting bodies of certain crops, especially cotton. B. thuringiensis (commonly known as Bt) is an insecticidal bacterium, marketed worldwide for control of many important plant pests - mainly caterpillars of the Lepidoptera (butterflies and moths) but also mosquito larvae. During sporulation, many Bt strains produce crystal proteins (proteinaceous inclusions), called as endotoxins or cry proteins, that have insecticidal action. This has led to their use as insecticides, and more recently to genetically modified crops using Bt genes.

197(B). Thalamus is mass of grey matter located at the base of cerebrum in the wall of third ventricle. It serves as relay station for sensory impulses as well as integration centre for recognition of pain, temperature and hard touch.

Corpus callosum is a bridge of white matter that connects two cerebral hemispheres. Corpora quadrigemina is present at the posterior surface of midbrain and consists of two superior and two inferior colliculi; hence the name quadrigemina.

Pneumotaxic centres are located bilaterally in upper pons and serve to shorten the inspiration and thereby causing shallow and more rapid respiratory patterns by inhibiting apneustic centre.

198(D). The sperms develop at a lower temperature than the internal body temperature which is 37 degree Celsius. To maintain a lower temperature during spermatogenesis the testis descends in the scrotal sac outside of the abdominal cavity. So, 'Maintaining the scrotal temperature lower than the internal body temperature'.
199(A). The process by which most of the cartilaginous tissue is transformed into bones is endochondrial ossification. Ossification is the formation of bone substance or conversion of other tissues to bone. It may be endochondrial ossification and intramembraneous ossification. Endochondrial ossification is the formation of bone in cartilage, as in formation of long bones. It involves the destruction and removal of cartilage and the formation of osseous tissue in space occupied by the cartilage. Intramembranous ossification is the formation of bone in or underneath a fibrous membrane.

200(A). Hugo de Vries gave his mutation theory on organic evolution while working on Oenothera lamarckiana.

De Vries gave his mutation theory on organic evolution while working on Oenothera lamarckiana. Oenothera lamarckiana is an annual plant commonly called as evening primose. De Vries in his experiment observed that original plant showed some offsprings with different phenotypes. These mutations were passed from offsprings to their progeny. However, late it was observed that the variations were due to chromosomal segregations and not due to mutations.