

**PART A: CLASS XII**

**PHYSICS**

**Q1**

The velocity of an electromagnetic wave is along the direction of:

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

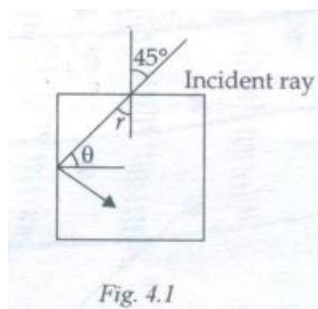
**Q2**

The diameter of the human eye lens is 2 mm. What will be the minimum distance between two points for resolving them that are situated at a distance of 50 m from an eye? The wavelength of light is  $5000 \text{ \AA}$ .

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

**Q3**

For the given incident ray as shown in Fig. 4.1, the condition of total internal reflection of the ray will be satisfied if the refractive index of block is:



- (a)  $\frac{\sqrt{3}+1}{2}$
- (b)  $\frac{\sqrt{2}+1}{2}$
- (c)  $\sqrt{\frac{3}{2}}$
- (d)  $\sqrt{\frac{7}{6}}$

**Q4**

Which one of the following is not a property of cathode rays?

- (a) They produce a heating effect
- (b) They are not deflected by electric fields
- (c) They cast shadows
- (d) They produce fluorescence

**Q5**

For a transistor,  $\frac{I_C}{I_E} = 0.96$ . Thus, the current gain in the Common Emitter (CE) configuration is:

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

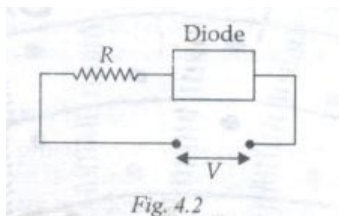
**Q6**

For conduction in a p – n junction, the biasing is done through:

- (a) High potential on n – side and low potential on p – side
- (b) High potential on p – side and low potential on n – side
- (c) Same potential on both p and n sides
- (d) None of these

**Q7**

Refer Fig. 4.2. For a given a circuit of an ideal P – n junction diode, which one of the following is correct?



- (a) In forward bias, the voltage across R is V
- (b) In reverse bias, the voltage across R is V
- (c) In forward bias, the voltage across R is 2V
- (d) In reverse bias, the voltage across R is 2V

**Q8**

Two resistances of unequal resistance values have been connected in parallel. If voltage is applied to them:

- (a) More heat will be produced in the smaller resistance
- (b) More heat will be produced in the larger resistance
- (c) Equal heat will be produced in both resistances
- (d) None of these

**Q9**

Some charge is being given to a conductor, So, its potential is:

- (a) Maximum at the surface
- (b) Maximum at the centre
- (c) The same throughout the conductor
- (d) Maximum between its surface and centre

**Q10**

In order to convert a galvanometer into a voltmeter, we should connect a:

- (a) High resistance in series with the galvanometer
- (b) Low resistance in series with the galvanometer
- (c) High resistance in parallel with the galvanometer
- (d) Low resistance in parallel with the galvanometer

**Q11**

A capacitor of capacitance  $C_1$  has been charged up to a potential  $V$  volt and connected in parallel with an uncharged capacitor of capacitance  $C_2$ . The final potential difference across each capacitor will be:

- (a)  $\frac{C_2 V}{C_1 + C_2}$
- (b)  $\frac{C_1 V}{C_1 + C_2}$
- (c)  $\left(1 + \frac{C_2}{C_1}\right) V$
- (d)  $\left(1 - \frac{C_2}{C_1}\right) V$

**Q12**

For a cell, the terminal potential difference is 2.2 V when the circuit is open and reduces to 1.8 V. If the cell is connected to a resistance of  $5\ \Omega$ , the internal resistance ( $r$ ) of the cell is:

- (a)  $\frac{10}{9}\Omega$
- (b)  $\frac{9}{10}\Omega$
- (c)  $\frac{11}{9}\Omega$
- (d)  $\frac{5}{9}\Omega$

**Q13**

Identical charges ( $-q$ ) are placed at each corner of a cube of side  $b$ . So, the electrostatic potential energy of the charge ( $+q$ ) placed at the centre of the cube is:

- (a)  $-\frac{4\sqrt{2}q^2}{\pi\epsilon_0}$
- (b)  $\frac{8\sqrt{2}q^2}{\pi\epsilon_0 b}$
- (c)  $-\frac{4q^2}{\sqrt{3}\pi\epsilon_0 b}$
- (d)  $\frac{8\sqrt{2}q^2}{4\pi\epsilon_0 b}$

**Q14**

A charge  $q$  moves in a region where an electric field  $\vec{E}$  and a magnetic field  $\vec{B}$  exist. Hence, the force on it is equal to:

- (a)  $q\vec{v} \times \vec{B}$
- (b)  $q\vec{E} + q\vec{v} \times \vec{B}$
- (c)  $q\vec{B} + q\vec{B} \times \vec{v}$
- (d)  $q\vec{B} + q(\vec{E} \times \vec{v})$

**Q15**

For a series LCR circuit, the power loss at resonance is:

- (a)  $\frac{V^2}{\omega L - \frac{1}{\omega C}}$
- (b)  $I^2 C \omega$
- (c)  $I^2 R$
- (d)  $\frac{V^2}{\omega C}$

**Q16**

A sample of radioactive elements contains  $4 \times 10^{10}$  active nuclei. If the half – life of this element is 10 days, the number of decayed nuclei after 30 days is:

- (a)  $0.5 \times 10^{10}$
- (b)  $2 \times 10^{10}$
- (c)  $3.5 \times 10^{10}$
- (d)  $1 \times 10^{10}$

**Q17**

Which one of the following are suitable for the fusion process?

- (a) Light nuclei
- (b) Heavy nuclei
- (c) Elements lying in the middle of the periodic table
- (d) Elements lying in the middle of the binding energy curve

**Q18**

When a deuterium particle is bombarded on  ${}_8\text{O}^{16}$  nucleus, an  $\alpha$  – particle is emitted. The product so obtained is:

- (a)  ${}_7\text{N}^{13}$
- (b)  ${}_5\text{B}^{10}$
- (c)  ${}_4\text{Be}^9$
- (d)  ${}_7\text{N}^{14}$

**Q19**

When ultraviolet rays are incident upon a metal plate, the photoelectric effect does not occur. It occurs by the incidence of:

- (a) Infrared rays
- (b) X – rays
- (c) Radio waves
- (d) Light waves

**Q20**

Which one of the following proves the particle nature of light?

- (a) Interference
- (b) Diffraction
- (c) Polarization
- (d) Photoelectric effect

**Q21**

The refractive index of water is  $\frac{5}{3}$ . A light source has been placed in water at a depth of 4 meters. What is the minimum radius of a disc put on the water surface so that the light of source can be stopped?

- (a) 3 m
- (b) 4 m
- (c) 5 m
- (d) 6 m

**Q22**

A light source is at a distance  $d$  from a photoelectric cell. The number of photoelectrons emitted from the cell is  $n$ . If the distance of light source and cell is reduced to one half, the number of photoelectrons emitted is:

- (a)  $\frac{n}{4}$
- (b)  $6n$
- (c)  $6n$
- (d)  $4n$

**Q23**

A tangent galvanometer measures:

- (a) Capacitance
- (b) Current
- (c) Resistance
- (d) Potential difference

**Q24**

The reactance of a capacitor of capacitance  $C$  is  $X$ . If the frequency and capacitance are doubled, the new reactance will be:

- (a)  $X$
- (b)  $2X$
- (c)  $4X$
- (d)  $\frac{X}{4}$

**Q25**

In a parallel – plate capacitor, the distance between the plates is  $d$  and potential difference across the plates  $V$ . The energy stored per unit volume between the plates of this capacitor is:

- (a)  $\frac{Q^2}{2V^2}$
- (b)  $\frac{1}{2} \epsilon_0 \frac{V^2}{d^2}$
- (c)  $\frac{1}{2} \frac{V^2}{\epsilon_0 d^2}$
- (d)  $\frac{1}{2} \epsilon_0 \frac{V^2}{d^2}$

**Q26**

A charge  $q$  of micro – coulombs is at the centre of a cube of side 0.1 m. So, the electric flux emanating from each face of this cube is:

- (a)  $\frac{q \times 10^{-6}}{24 \epsilon_0}$
- (b)  $\frac{q \times 10^{-4}}{\epsilon_0}$
- (c)  $\frac{q \times 10^{-6}}{6 \epsilon_0}$
- (d)  $\frac{q \times 10^{-4}}{12 \epsilon_0}$

**Q27**

In which type of material does magnetic susceptibility not depend upon temperature?

- (a) Diamagnetic
- (b) Paramagnetic
- (c) Ferromagnetic
- (d) Ferrite

**Q28**

The torque acting on an electric dipole of dipole moment  $\vec{P}$  placed in a uniform electric field  $\vec{E}$  is:

- (a)  $\vec{P} \times \vec{E}$
- (b)  $\vec{P} \cdot \vec{E}$
- (c)  $\vec{P} \times \vec{E} \times \vec{P}$
- (d)  $\frac{\vec{E} \cdot \vec{p}}{p^2}$

**Q29**

The current is flowing in a coil of area  $A$  and number of turns  $N$ . So, the magnetic moment of the coil ( $M$ ) is equal to:

- (a)  $NiA$
- (b)  $\frac{Ni}{A}$
- (c)  $\frac{Ni}{\sqrt{A}}$
- (d)  $N^2 Ai$

**Q30**

In a Wheatstone's bridge, the resistance of each side is  $10\Omega$ . If the resistance of the galvanometer is  $10\Omega$ , the effective resistance of the bridge is:

- (a)  $6\Omega$
- (b)  $10\Omega$
- (c)  $18\Omega$
- (d)  $12\Omega$

**Q31**

In an inductor of self – inductance  $L = \text{mH}$ , current changes with time according to equation  $I = t^2 e^{-t}$ . At what time will the emf be zero?

- (a) 1 second
- (b) 5 seconds
- (c) 3 seconds
- (d) 2 seconds

**Q32**

The resistivity of a potentiometer wire is  $10^{-7} \text{ ohm – meter}$  and its area of cross – section is  $10^{-6} \text{ m}^2$ . When a current of  $0.1 \text{ A}$  flows through the wire, its potential gradient is:

- (a)  $10^{-4} \text{ V – m}^{-1}$
- (b)  $10^{-3} \text{ V – m}^{-1}$
- (c)  $10^{-2} \text{ V – m}^{-1}$
- (d) Zero



**Q33**

In a Common Base (CB) configuration of a transistor,  $\frac{\Delta i_C}{\Delta i_E} = 0.98$ . The current gain in the transistor is:

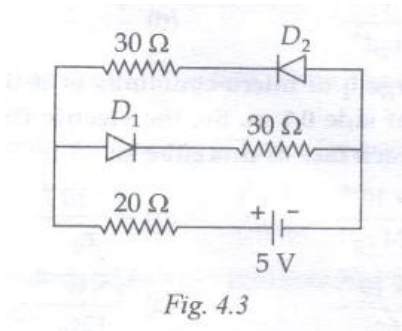


Fig. 4.3

- (a) 51
- (b) 50
- (c) 52
- (d) 49

**Q34**

If the internal resistance of a cell is negligible, the current flowing through the circuit of Fig. 4.3.is:

- (a) 2.1 A
- (b) 0.1 A
- (c) 1.1 A
- (d) 2 A

**Q35**

The truth table given in Table 4 – I represents a/an:

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

- (a) Not gate
- (b) OR gate
- (c) XOR gate
- (d) NAND gate

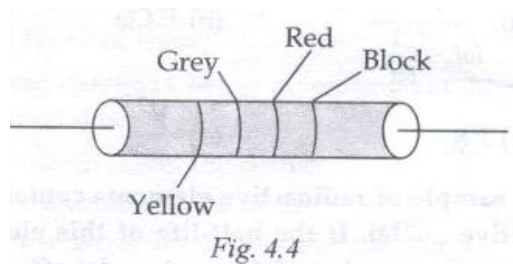
**Q36**

The half – life period of a radioactive substance is 6 hours. After 24 hours, the activity is  $0.01 \mu\text{C}$ , what was the initial activity?

- (a)  $0.04 \mu\text{C}$
- (b)  $0.08 \mu\text{C}$
- (c)  $0.24 \mu\text{C}$
- (d)  $0.16 \mu\text{C}$

**Q37**

Calculate the resistance of the resistive element shown in **Fig. 4.4**.



- (a)  $84 \times 10^3 \Omega \pm 10\%$
- (b)  $36 \times 10^3 \Omega \pm 10\%$
- (c)  $48 \times 10^2 \Omega \pm 20\%$
- (d)  $84 \times 10^2 \Omega \pm 5\%$

**Q38**

The magnetic dipole moment of a revolving electron is given by the following relationship:

- (a)  $\mu = \frac{eVr}{8}$
- (b)  $\mu_1 = \frac{el}{2} m_e$
- (c)  $\mu_1 = n \left( \frac{eh}{4\pi m_e} \right)$
- (d)  $\mu = \frac{2m_e}{el}$

**Q39**

The direction of a current loop, acting as a magnetic dipole, is given by the:

- (a) right hand thumb rule
- (b) left hand thumb rule
- (c) either of these two rules
- (d) Fleming's left hand rule

**Q40**

The wavelength range of microwaves varies from:

- (a) 600 m to 0.1 m
- (b) 0.3 m to  $10^{-3}$  m
- (c) 300 m to 600 m
- (d) None of these

**Q41**

The wavelength range of visible light is:

- (a) 1 mm to 700 nm
- (b) 0.1 m to 1.0 mm
- (c) 700 nm to 400 nm
- (d) 1 nm to  $10^{-3}$  nm

**Q42**

Two identical circular coils of radius 0.6 m each have 30 turns each. They have been mounted coaxially and are at a distance of 0.8 m from each other. A value of magnetic field (a) when the current flows through both of them. The values of magnetic field (a) when the current flows through them in the same direction and (b) when the current flows through them in the opposite direction are as follows:

- (a)  $4.3 \times 10^{-6}$  tesla,  $4.0 \times 10^{-6}$  tesla
- (b)  $4.3 \times 10^{-4}$  tesla,  $3.96 \times 10^{-4}$  tesla
- (c)  $4.3 \times 10^{-7}$  tesla,  $3.96 \times 10^{-7}$  tesla
- (d) None of these

**Q43**

If the potential difference applied across a conductor is tripled, what would be the impact on the drift velocity of electrons present in it?

- (a) It would be doubled
- (b) It would be halved
- (c) It would be tripled
- (d) It would be reduced to one fourth of its initial value

**Q44**

A potentiometer wire should not receive current for a long period because of:

- a. The poor material of the wire
- b. Bad circuit design of most potentiometer
- c. The back of resistance of the wire
- d. None of these

**Q45**

In a circuit L, C and R have been connected in series. The power source is AC and its frequency is f(HZ). The current leads the voltage by an angle of  $45^\circ$ . The value of C is:

- (a)  $C = \frac{1}{2\pi f (2\pi fL - R)}$
- (b)  $C = \frac{2\pi f}{(L+R)}$
- (c)  $C = \frac{2\pi fL}{R}$
- (d)  $C = \frac{1}{2\pi f (L+R)}$

**PART B: CLASS XII****CHEMISTRY****Q46**

1 M and 2.5 – liter NaOH solution is mixed with another 0.5 M and 3 – liter NaOH solution. What is the molarity of the resultant solution?

- (a) 0.80 M
- (b) 1.0 M
- (c) 0.73 M
- (d) 0.50 M

**Q47** Which has the highest pH value?

- (a)  $\text{CH}_3\text{COOK}$
- (b)  $\text{Na}_2\text{CO}_3$
- (c)  $\text{NH}_4\text{Cl}$
- (d)  $\text{NaNO}_3$

**Q48**

The solution of 0.1 N  $\text{NH}_4\text{OH}$  and 0.1 N  $\text{NH}_4\text{Cl}$  has a pH value of 9.25. What is the value of  $\text{pK}_b$  of  $\text{NH}_4\text{OH}$ ?

- (a) 9.28
- (b) 4.75
- (c) 3.75
- (d) 8.25

**Q49**

Read the reaction:  $3A \rightarrow B + C$

If would be a zero – order reaction when the rate of reaction:

- (a) Is proportional to the square of concentration of A
- (b) Remains the same at any concentration of A
- (c) Remains unchanged at any concentration of B and C
- (d) Doubles if the concentration of B doubled

**Q50**

Which one of the following has the maximum number of molecules?

- (a) 7 grams of  $N_2$
- (b) 2 grams of  $H_2$
- (c) 16 grams of  $NO_2$
- (d) 16 grams of  $O_2$

**Q51**

A solution contains a nonvolatile solute of molecular mass  $M_2$ . Which one of the following can be used for calculating the molecular mass of the solute in terms of osmotic pressure?

- (a)  $M_2 = \left[ \frac{m_2}{\pi} \right] V R T$
- (b)  $M_2 = \left[ \frac{m_2}{V} \right] \frac{RT}{\pi}$
- (c)  $M_2 = \left[ \frac{m_2}{V} \right] \pi R T$
- (d)  $M_2 = \left[ \frac{m_2}{V} \right] \frac{\pi}{RT}$

**Q52**

A solution containing components A and B follow Raoult's law. Which one of the following statements is correct?

- (a) A – B attraction force is greater than that of A – A and B – B
- (b) A – B attraction force is less than that of A – A and B – B
- (c) A – B attraction force remains the same as that between A – A and B – B
- (d) The volume of solution is different from the sum of volumes of solute and solvent

**Q53**

In the electrolysis of NaCl, when a Platinum electrode is taken,  $H_2$  is liberated at cathode. But with the Hg cathode, it forms a sodium amalgam. The reason behind this is as that:

- (a) Hg is more inert than Pt
- (b) More voltage is required for reducing  $H^+$  at Hg than at Pt
- (c) Na is dissolved in Hg while it is not dissolved in Pt
- (d) The concentration of  $H^+$  ions is larger when the Pt electrode is taken

**Q54**

Which one of the following statements is true?

- a. Silicon exhibits coordination number in its compounds
- b. Bond energy of  $F_2$  is less than that of  $Cl_2$
- c. Mn (III) oxidation state is more stable than Mn(II) aqueous state
- d. The elements of 15<sup>th</sup> group show only + 3 and + 5 oxidation states

**Q55**

Which one of the following orders is wrong?

- (a)  $NH_3 < PH_3 < AsH_3$  – acidic
- (b)  $Li < Be < B < C$  1stIP
- (c)  $Al_2O_3 < MgO < Na_2O < K_2O$  – basic
- (d)  $Li^+ < Na^+ < K^+ < Cs^+$  - ionic radius

**Q56**

The general electronic configuration of lanthanides

- (a)  $(n-2) f^{1-14} (n-1) s^2 p^6 d^{0-1} ns^2$
- (b)  $(n-2) f^{10-14} (n-1) d^{0-1} ns^2$
- (c)  $(n-2) f^{0-14} (n-1) d^{10} ns^2$
- (d)  $(n-2) d^{0-1} (n-1) f^{1-14} ns^2$

**Q57**

An atom has an electronic configuration  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3 4s^2$ . Hence, we will place it in the:

- (a) Fifth group
- (b) Fifteenth group
- (c) Second group
- (d) Third group

**Q58**

Which one of the is iso – electronic?

- (a)  $\text{CO}_2$ ,  $\text{NO}_2$
- (b)  $\text{CO}_2^{+}$ ,  $\text{CO}_2$
- (c)  $\text{CN}^{-}$ ,  $\text{CO}$
- (d)  $\text{SO}_2$ ,  $\text{CO}_2$

**Q59**

In  $\text{NO}_3^{-}$ , the ion number of bond pair and lone pair of electron on the nitrogen atom are (respectively):

- (a) 2, 2
- (b) 3, 1
- (c) 1, 3
- (d) 4, 0

**Q60**

In the process of silver plating of copper,  $\text{K} [\text{Ag} (\text{CN})_2]$  has been used in place of  $\text{AgNO}_3$ . The reason behind this is that:

- (a) A thin layer of Ag is formed on Cu
- (b) More voltage is required
- (c)  $\text{Ag}^{+}$  ions are completely removed from solution
- (d) There is less availability of  $\text{Ag}^{+}$  ions, for Cu cannot displace Ag from the  $[\text{Ag} (\text{CN})_2]^{-}$  ion

**Q61**

Zn gives  $\text{H}_2$  gas with  $\text{H}_2\text{SO}_4$  and  $\text{HCl}$  but not with  $\text{HNO}_3$ . The reason behind this is that:

- (a) Zn acts as an oxidizing agent when it reacts with  $\text{HNO}_3$
- (b)  $\text{HNO}_3$  is a weaker acid than  $\text{H}_2\text{SO}_4$  and  $\text{HCl}$
- (c) In the electrochemical series, Zn is above  $\text{H}_2$
- (d)  $\text{NO}_3^{-}$  is reduced in preference to the hydronium ion

**Q62**

n – propyl alcohol and isopropyl alcohol can be chemically distinguished through this chemical or process:

- (a)  $\text{PCl}_5$
- (b) Reduction
- (c) Oxidation with potassium dichromate
- (d) Ozonolysis

**Q63**

When phenol is treated with  $\text{CHCl}_3$  and  $\text{NaOH}$ , the product is:

- (a) Benz aldehyde
- (b) Salicylaldehyde
- (c) Salicylic acid
- (d) Benzoic acid

**Q64**

In the following reaction, the product T is:



- (a)  $\text{RCH}_2\text{OH}$
- (b)  $\text{RCOOH}$
- (c)  $\text{RCHO}$
- (d)  $\text{RCH}_3$

**Q65**

The percentages of C, H and N in an organic compound are 40%, 13.3% and 46.7%, respectively. So, the empirical formula is:

- (a)  $\text{C}_3 \text{H}_{13} \text{N}_3$
- (b)  $\text{CH}_2 \text{N}$
- (c)  $\text{CH}_4 \text{N}$
- (d)  $\text{CH}_6 \text{N}$

**Q66**

Enzymes are made up of:

- (a) Edible proteins
- (b) Proteins with specific structures
- (c) Nitrogen – containing carbohydrates
- (d) Carbohydrates



**Q67**

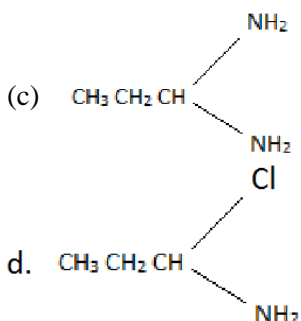
Geometrical isomers are differ in terms of the:

- (a) Position of functional group
- (b) Position of atoms
- (c) Spatial arrangement of atoms
- (d) Length of carbon chain

**Q68**

When  $\text{CH}_3\text{CH}_2\text{CHCl}_2$  is treated with  $\text{NaNH}_2$ , the product formed is:

- (a)  $\text{CH}_3 - \text{CH} = \text{CH}_2$
- (b)  $\text{CH}_3 - \text{C} \equiv \text{CH}$

**Q69**

Which one of the following is not true?

- (a)  $\alpha$  – carbon of  $\alpha$  – amino acid is asymmetric
- (b) All proteins are found in the L – form
- (c) The humans body can synthesize all proteins it needs
- (d) At  $\text{pH} = 7$ , both amino and carboxylic groups exist in an ionized form

**Q70**

During the course of preparation of alkane from alcohol using  $\text{Al}_2\text{O}_3$  which one of the following is an effective factor?

- (a) Porosity of  $\text{Al}_2\text{O}_3$
- (b) Temperature
- (c) Concentration
- (d) Surface area of  $\text{Al}_2\text{O}_3$

**Q71**

Which one of the following is correct about hydrogen – bonding in nucleotides?

- (a) A – T, G – C
- (b) A – G, T – C
- (c) G – T, A – C
- (d) A – A, T – T

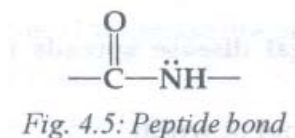
**Q72**

Which one of the following is a correct statement?

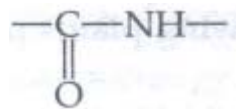
- a. Starch is a polymer of  $\alpha$  – glucose
- b. Amylose is a component of cellulose
- c. Proteins comprise only one type of amino acid
- d. In the cyclic structure of fructose, there are four carbon atoms but only one oxygen atom

**Q73**

Refer Fig. Which statement is not true about the peptide bond?



- (a) C – N bond length in proteins is longer than usual bond length of the Nitrogen bond



- (b) Spectroscopic analysis shows a planar structure of the group
- (c) C – N bond length in proteins is less than the usual bond length of the C – N bond
- (d) None of these

**Q74**

A compound of molecular formula  $C_2H_{16}$  shows optical isomerism. Hence, the compound is:

- (a) 2, 3 – dimethyl pentane
- (b) 2, 2 – dimethyl butane
- (c) 2 – methyl hexane
- (d) None of these

**Q75**

When a biochemical reaction is carried out in laboratory from outside the human body in the absence of an enzyme, the rate of reaction is  $10^{-6}$  times. Hence, the activation energy of the reaction in the presence of that enzyme is follows:

- (a)  $\frac{6}{RT}$
- (b)  $K = e^{-E_a}$
- (c) It is different from  $E_a$  obtained in laboratory
- (d) None of these

**Q76**

The density of HCl solution is  $1.17 \text{ g - cc}^{-1}$ . The molarity of liquid HCl is:

- (a) 36.5
- (b) 18.25
- (c) 32.05
- (d) 42.10

**Q77**

Pure water can be obtained from seawater through:

- (a) Centrifugation
- (b) Plasmolysis
- (c) Reverse osmosis
- (d) Sedimentation

**Q78**

Which one of the following is not correct regarding the adsorption of a gas on the surface of a solid?

- (a) Upon increasing temperature, adsorption increases continuously
- (b) Enthalpy change and entropy change are negative
- (c) Adsorption is more for a few substances
- (d) It is reversible

**Q79**

Which ones of the following are is structural?

- (a)  $\text{XeF}_2$ ,  $\text{IF}_2^-$
- (b)  $\text{NH}_3$ ,  $\text{BF}_3$
- (c)  $\text{CO}_3^{2-}$ ,  $\text{SO}_3^{2-}$
- (d)  $\text{PCl}_5$ ,  $\text{ICl}_5$

**Q80**

Which one of the following statements is not correct?

- (a)  $\text{La}(\text{OH})_3$  is less basic than  $\text{Li}(\text{OH})_3$
- (b) In the lanthanide series, ionic radius of the  $\text{Ln}^{3+}$  ion decreases
- (c) La is actually an element of transition series and not a lanthanide
- (d) The atomic radii of Zn and Hf are the same because of lanthanide contraction

**Q81**

The correct order of the first ionization potential among the following elements is:

- (a)  $\text{B} < \text{Be} < \text{C} < \text{O} < \text{N}$
- (b)  $\text{Be} < \text{B} < \text{C} < \text{O} < \text{N}$
- (c)  $\text{Be} < \text{B} < \text{C} < \text{N} < \text{O}$
- (d)  $\text{Be} < \text{B} < \text{C} < \text{O} < \text{N}$

**Q82**

What are complete proteins?

- (a) The molecules that give all essential nutrients through the process of digestion
- (b) The proteins that provide all essential amino acids in the right proportion for human nutrition
- (c) The proteins that have long chains and thus are difficult to break
- (d) The proteins that are deficient in essential amino acids.

**Q83**

Adsorption is a \_\_\_\_\_ phenomenon whereas absorption is a \_\_\_\_\_ phenomenon.

- (a) Bulk, surface
- (b) Surface, molecular
- (c) Molecular, bulk
- (d) Surface, bulk

**Q84**

Which one of the following statements is incorrect?

- (a)  $\text{Ni}(\text{CO})_4$ : Tetrahedral, paramagnetic
- (b)  $\text{Ni}(\text{CN})_4^{2-}$ : Square planar, diamagnetic
- (c)  $\text{Ni}(\text{CO})_4$ : Tetrahedral, diamagnetic
- (d)  $[\text{Ni}(\text{CO})_4]^{2-}$ : Tetrahedral, paramagnetic

**Q85**

In  $X - H - Y$ , X and Y both are electronegative elements. Therefore:

- (a) The electron density on X will increase and on H, it will decrease
- (b) In both, electron density will increase
- (c) In both, electron density will decrease
- (d) On X, electron density will decrease and on H, it will increase

**Q86**

The main axis of a diatomic molecule is z. So, the molecular orbitals  $p_x$  and  $p_y$  overlap to form the following orbital:

- (a)  $\pi$  – molecular orbital
- (b)  $\sigma$  – molecular orbital
- (c)  $\delta$  – molecular orbital
- (d) none of these

**Q87**

In  $HS^-$ ,  $I^-$ ,  $RNH_2$  and  $NH_3$ , the order of proton acceptance tendency is:

- (a)  $I^- > NH_3 > RNH_2 > HS^-$
- (b)  $NH_3 > RNH_2 > HS^- > I^-$
- (c)  $RNH_2 > NH_3 > HS^- > I^-$
- (d)  $HS^- > RNH_2 > NH_3 > I^-$

**Q88**

Ferrocene is a:

- (a) Sigma – bonded organometallic compound
- (b) Pie – bonded organometallic compound
- (c) Hydrogen – bonded organometallic compound
- (d) None of these

**Q89**

The ionization constant of  $CH_3COOH$  is  $1.7 \times 10^{-5}$  and concentration of  $H^+$  ions is  $3.4 \times 10^{-4}$ . Calculate the initial concentration of  $CH_3COOH$  molecules.

- (a)  $3.4 \times 10^{-4}$
- (b)  $3.4 \times 10^{-3}$
- (c)  $6.8 \times 10^{-4}$
- (d)  $6.8 \times 10^{-3}$

**Q90**

The solubility of a  $M_2S$  salt is  $3.5 \times 10^{-6}$ . Calculate the solubility product:

- (a)  $1.7 \times 10^{-6}$
- (b)  $1.71 \times 10^{-16}$
- (c)  $1.7 \times 10^{-18}$
- (d)  $1.7 \times 10^{-12}$

**PART C: CLASS XII  
BOTANY**

**Q91**

The factor behind the fast speciation in the present day crop plants is:

- (a) Mutation
- (b) Isolation
- (c) Polyploidy
- (d) Sexual reproduction

**Q92**

When parthenogenesis occurs in larva, it is called:

- (a) Obligatory Parthenogenesis
- (b) Complete Parthenogenesis
- (c) Incomplete Parthenogenesis
- (d) Paedogenetic Parthenogenesis

**Q93**

Which one of the following is absent in polluted water?

- (a) Hydrilla
- (b) Water hyacinth
- (c) Larva of stone fly
- (d) Blue – green algae

**Q94**

During its formation, bread becomes porous due to release of  $CO_2$  by the action of:

- (a) Yeast
- (b) Bacteria
- (c) Virus
- (d) Protozoa

**Q95**

Which bacteria are utilized in a gober gas plant?

- (a) Methanogens
- (b) Nitrifying bacteria
- (c) Ammonifying bacteria
- (d) Denitrifying bacteria

**Q96**

Trench layering is observed in:

- (a) Clematis
- (b) Mulberry
- (c) China Rose
- (d) Jasmine

**Q97**

Which fungal disease spreads through seed and flowers?

- (a) Loose smut of wheat
- (b) Corn smut
- (c) Covered smut of barley
- (d) Soft rot of potato

**Q98**

Which one of the following plants produces seeds but not flowers?

- (a) Maize
- (b) Mint
- (c) Peepal
- (d) Pinus

**Q99**

Which type of association is found in between entomophilous flower and pollinating agent?

- (a) Mutualism
- (b) Commensalism
- (c) Co – operation
- (d) Co – evolution

**Q100**

What is the direction of micro Pyle in anatropous ovule?

- (a) Upwards
- (b) Downwards
- (c) Right
- (d) Left

**Q101**

The maximum amounts of Green House Gases (GHGs) are being released by:

- (a) India
- (b) France
- (c) The USA
- (d) Berlin

**Q102**

In angiosperms, pollen tubes liberate their male gametes into the:

- (a) Central cell
- (b) Antipodal cell
- (c) Egg cell
- (d) Synergids

**Q103**

In composite fish farming:

- (a) Rohu and Tuna are bred separately
- (b) Selected species of fish are kept together in a proper proportion in a pond
- (c) The number of fish per pond is less
- (d) The number of reptiles is restricted in a fish pond

**Q104**

Which one of the following is an incorrect match?

- (a) Catlacatla: surfaces feeder
- (b) Labeo – rohita: column feeder
- (c) Cirrhinamrigala: bottom feeder
- (d) Options (a), (b) and (c) are correct matches



**Q105**

Choose the correct match:

- (a) Nepenthes, Dionea, Drosera
- (b) Nepenthes, Utricularia, Vanda
- (c) Utricularia, Drosera, Dionea
- (d) Dionea, Trapa, Vanda

**Q106**

The development of disease in a plant depends upon:

- (a) Host genotype
- (b) Pathogen's genotype
- (c) Environment
- (d) All of these

**Q107**

Which one of the following statements is incorrect in the parlance of ecosystems?

- (a) The flow of energy is uni9directional
- (b) There is no dissipation of nutrients at any level
- (c) All nutrients belong to the earth
- (d) Microorganisms play a major role in the flow of energy

**Q108**

What is Pyrolysis?

- (a) Generation of electric power by burning sludge
- (b) Aerobic combustion of waste matter at 900-1300degrees C
- (c) Combustion in chambers in the absence of oxygen at 1650 degree C
- (d) Dumping of waste matter in low lying areas

**Q109**

Bamboo plant is growing in a forest. So, what will be the trophic level for level for the same?

- (a) First trophic level ( $T_1$ )
- (b) Second trophic ( $T_2$ )
- (c) Third trophic ( $T_3$ )
- (d) Fourth trophic level ( $T_4$ )

**Q110**

Which one of the following is a correct pair?

- (a) Cuscuta – parasite
- (b) Dischidia – insectivorous
- (c) Opuntia – predator
- (d) Capsella – hydrophyte

**Q111**

High- level radiations of nuclear power plants and reactors can produce:

- (a) Genertic deformation
- (b) Cancer of vaious types
- (c) Subcutaneous bleeding
- (d) All of these

**Q112**

A mining quarry is an example of a/an:

- (a) Fixed source pollution
- (b) Line source pollution
- (c) Area source pollution
- (d) Mobile source pollution

**Q113**

A plant of  $F_1$  generation has genotype AABbCC. On selfing of the thisplant, phenotypic ratio in  $F_2$ -generation is:

- (a) 3:1
- (b) 1:1
- (c) 9:3:3:1
- (d) 27:9:9:9:3:3:1

**Q114**

What is the reason behind the formation of embryoid from pollen grain in a tissue culture medium?

- (a) Cellular totipotency
- (b) Organogenesis
- (c) Double fertilization
- (d) Test tube culture

**Q115**

If you are using a motor car, what type of pollution type are you?

- (a) Point source
- (b) Mobile source
- (c) Lines source
- (d) Diffuse source

**Q116**

Which ones of the following crops have been brought to india from the New World?

- (a) Cashewnut, potato, rubber
- (b) Mango, tea
- (c) Tea, rubber, mango
- (d) Coffee

**Q117**

The introduction of food plants developed by genetic engineering is not describable because the:

- (a) Economy of developing countries may suffer
- (b) These products are less tasty as compared to the existing products
- (c) This method is costly
- (d) There is the danger of introduction of viruses and toxins through the introduced crop

**Q118**

Which one of the following leads to organ formation?

- (a) Gametogenesis
- (b) Embryogenesis
- (c) Parthenogenesis
- (d) Any one of these

**Q119**

Which one of the following is not exalbuminous?

- (a) Pea
- (b) Sunflower
- (c) Castor
- (d) Bean

**Q120**

The difference between in – breeding and out – breeding is that:

- (a) Inbreeding is done between the animals of different breeds whereas outbreeding is done between the animals of the same breed
- (b) Inbreeding involves outcrossing whereas outbreeding involves the superior male
- (c) Inbreeding is done between the animals of the same breed for 4 – 6 generations whereas outbreeding is done between the unrelated animals which may be between individuals of the same breed (or between different breeds)
- (d) Inbreeding is controlled but outbreeding is not.

**Q121**

Which one of the following is not a Broadly Utilarian reason behind man's resolve of conserving biodiversity?

- (a) Pollination
- (b) Nutrient cycling
- (c) Flood and erosion control
- (d) Bio prospecting

**Q122**

Where would you find xerophytes?

- (a) In lakes
- (b) In dry land areas
- (c) In oceans
- (d) In lush green gardens

**Q123**

The number of trophic levels in a food chain varies from:

- (a) 8 to 10
- (b) 11 to 12
- (c) 1 to 4
- (d) 3 to 6

**Q124**

The residual nucleus does not persist in this seed:

- (a) Coffee
- (b) Castor
- (c) Nymphaea
- (d) Groundnut

**Q125**

Which one of the following is not an application of the Polymerase Chain Reaction (PCR)?

- (a) DNA finger print
- (b) Cutting of DNA at particular spots
- (c) Prenatal diagnosis
- (d) Detection of particular micro – organisms

**Q126**

The first animal that was genetically modified and had the honor of becoming the first transgenic animal for food production was the:

- (a) Transgenic sheep
- (b) Transgenic cow
- (c) Transgenic chicken
- (d) Transgenic Salmon fish

**Q127**

What is Germ line Gene Therapy?

- (a) It is a process of introducing genes in somatic cells
- (b) It is a process of modifying sperms or eggs by introducing functional genes
- (c) It is the process of isolating a healthy gene
- (d) All of these

**Q128**

The first step in the process of producing human insulin is as follows:

- (a) Production of multiple copies of rDNA
- (b) Screening of transformed cells
- (c) Isolation of DNA segment
- (d) Formation of rDNA

**Q129**

The process of exploiting and/or patenting biological resources of other countries without proper authorization is called:

- (a) Bio deformation
- (b) Bio piracy
- (c) Bio – war
- (d) Bio – transfer

**Q130**

What is the limitation of time under the Indian patents act?

- (a) 5 years
- (b) 6 – 18 years
- (c) 7 or 14 years
- (d) 20 years (maximum)

**Q131**

The ozone layer is being formed and photo dissociated in the following layer of atmosphere:

- (a) Stratosphere
- (b) Ionosphere
- (c) Exosphere
- (d) Troposphere

**Q132**

What is greenhouse flux?

- (a) The release of CFCs from refrigerators and air conditioners
- (b) The fall in global temperature at two polls
- (c) The transformation of any Green House Gas (GHG) into a being component
- (d) The reflection of a part of energy received by GHGs back to the earth

**Q133**

Who was closely associated with the Chipko Movement?

- (a) MedhaPatker
- (b) SunderlalBahuguna
- (c) Maneka Gandhi
- (d) Dr. VergheseKurien

**Q134**

What is the difference between binary fission and multiple fission?

- (a) In binary fission, the nucleus of the parents body divides repeatedly. In multiple fission, this occurs only once
- (b) In binary fission, the nucleus of the parents body divides once. In multiple fission, this happens many times over
- (c) There is no difference between these two processes
- (d) In multiple fission, immortality is guaranteed. This is not the case in binary fission

**Q135**

According to the Red Data Book, a critically endangered species is the one that:

- (a) Has been totally eliminated
- (b) Is likely to become extinct if it is not allowed to realize its full biotic potential
- (c) Faces a high risk of extinction
- (d) None of these

**PART D: CLASS XII  
ZOOLOGY**

**Q136**

If the bleeding from a wound is not stopping, the patient lacks:

- (a) Vitamin A
- (b) Vitamin C
- (c) Vitamin E
- (d) None of these

**Q137**

The Change in the sequence of nucleotide in DNA is called:

- (a) Mutagen
- (b) Mutation
- (c) Recombination
- (d) Translation

**Q138**

Which one of the following is a correct match?

- (a) Down syndrome: 21<sup>st</sup> chromosome
- (b) Sickel cell anaemia: X-chromosome
- (c) Haemophilia: Y-chromosome
- (d) Parkinson's disease X- and Y-chromosomes

**Q139**

Genetic drift operates a:

- (a) Small isolated population
- (b) Large isolated population
- (c) Fast reproductive population
- (d) Slow reproductive population

**Q140**

Which hormones control the menstrual cycle in human beings?

- (a) FSH
- (b) LH
- (c) FSH, LH, estrogen
- (d) Progesterone

**Q141**

When both ovaries are removed from the rat, which hormone is decreased in blood?

- (a) Oxytocin
- (b) Prolactin
- (c) Estrogen
- (d) Gonadotrophic Releasing Factor

**Q142**

The middle part of the epididymis is called:

- (a) Corpus Epididymis
- (b) Cauda Epididymis
- (c) Caput Epididymis
- (d) Central Epididymis

**Q143**

Choose the correct sequence of stages of growth curve for bacteria:

- (a) Lag, log, stationary, decline phase
- (b) Lag, log, stationary phase
- (c) Stationary, lag, log, decline phase
- (d) Decline, lag, log phase

**Q144**

In the parlance of human reproduction, what is orgasm?

- (a) Ejaculation of semen at the end of copulation
- (b) Emission of alkaline liquid from penis
- (c) Pleasure sensation in male and female at the peak of sexual stimulation during copulation
- (d) The period before the erection of penis



**Q145**

The initiation factors in procaryotes are:

- (a) IF3
- (b) IF2
- (c) IF1
- (d) All of these

**Q146**

Ribosomes are produced in:

- (a) Nucleolus
- (b) Cytoplasm
- (c) Mitochondria
- (d) Golgi body

**Q147**

DNA replication occurs during the:

- (a) T-phase of cell cycle
- (b) R-phase of cell cycle
- (c) Beginning of the cell cycle
- (d) S-phase of cell cycle

**Q148**

Organisms that get obtain energy by the oxidation of reduced inorganic compound are called:

- (a) Photoautotrophs
- (b) Chemoautotrophs
- (c) Saprozoic
- (d) Coproheterotrophs

**Q149**

In which animal is dimorphic nucleus found?

- (a) Amoeba
- (b) Trypanosomagambiens
- (c) Plasmodium vivax
- (d) Paramecium caudatum

**Q150**

Which one of the following is not a major feature of a species?

- (a) Anatomical similarity
- (b) Molecular similarity
- (c) Same karyotype
- (d) Different ancestors

**Q151**

Two different species cannot live for a long period in the same niche or habitat. This law is called:

- (a) Allen's Law
- (b) Mendel's Law
- (c) Cause's Competitive Exclusion Principle
- (d) Weismann's Theory

**Q152**

A gene is said to be dominant if:

- (a) It expresses its effect only in homozygous stage
- (b) It expresses only in heterozygous condition
- (c) It expresses in both homozygous and heterozygous conditions
- (d) It is never expressed in any condition

**Q153**

The pleiotropic gene is the following:

- (a) Haemophilia
- (b) Thalassemia
- (c) Sickle cell anaemia
- (d) Colour blindness

**Q154**

Jacob and Monod studied lactose metabolism in *E. coli* and proposed operon concept. The Operon concept is applicable to all:

- (a) Prokaryotes
- (b) Prokaryotes and some eukaryotes
- (c) Prokaryotes and all eukaryotes
- (d) Prokaryotes and some protozoans

**Q155**

Out of 64 codons, 61 codons code for 20 types of amino acids. It is called:

- (a) Degeneracy of genetic code
- (b) Overlapping of gene
- (c) Wobbling of codon
- (d) University of codon

**Q156**

In a DNA percentage of thymine is 20. What is the percentage of guanine?

- (a) 20%
- (b) 40%
- (c) 30%
- (d) 60%

**Q157**

Which one of the following statements is incorrect?

- (a) Transcription is the synthesis of RNA from DNA
- (b) In replication, RNA primer is essential for initiation
- (c) In Prokaryotic transcription, the processing of released RNA cannot occur in cytoplasm
- (d) In Eukaryotic transcription, mRNA is generally monocistronic

**Q158**

Which steroid is used for transformation?

- (a) Cortisol
- (b) Cholesterol
- (c) Testosterone
- (d) Progesterone

**Q159**

Choose the correct statement for bacterial transduction?

- (a) Transfer of some genes from one bacteria to another bacteria through virus
- (b) Transfer of genes from one bacteria to another bacteria through conjugation
- (c) Bacteria obtained its DNA directly
- (d) Bacteria obtained DNA from other external

**Q160**

If a diploid cell is treated with colchicine, it becomes a:

- (a) Triploid
- (b) Tetraploid
- (c) Diploid
- (d) Monoploid

**Q161**

The nucleus of a donor embryonal cell/somatic cell is transferred to an enucleated egg cell. After, the formation of organism, what shall be true?

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

**Q162**

Which one of the following enzymes are used for joining the bits of DNA?

- (a) Ligase
- (b) Primase
- (c) DNA polymerase
- (d) Endonuclease

**Q163**

The codon is found in\_\_\_\_and\_\_\_\_but anticodon is found in\_\_\_\_?

- (a) DNA; mRNA; tRNA
- (b) mRNA; tRNA; cell
- (c) DNA; RNA; mRNA
- (d) None of these

**Q164**

The exon part of m-RNAs has the codons for:

- (a) Protein synthesis
- (b) Lipid synthesis
- (c) Carbohydrate synthesis
- (d) Phospholipid synthesis

**Q165**

There are three genes a, b, c. The percentage of crossing over between a and b is 20%, between b and c is 28% and between a and c is 80%. What is the sequence of genes on the chromosome?

- (a) B, a, c
- (b) A, b, c
- (c) A, c, b
- (d) None of these

**Q166**

The manipulation of DNA in genetic engineering became possible due to the discovery of:

- (a) Restriction endonuclease
- (b) DNA ligase
- (c) Transcriptase
- (d) Primase

**Q167**

Sympatric species are the ones that have been developed:

- (a) Due to crossbreeding
- (b) Reproductive isolation
- (c) In adjoining geographical areas
- (d) None of these

**Q168**

The IFN-g interferons are produced by:

- (a) T-lymphocytes
- (b) Epithelial cells
- (c) Leucocytes
- (d) Macrophytes

**Q169**

The ratio of complementary genes is:

- (a) 9 : 3 : 4
- (b) 12 : 3 : 1
- (c) 9 : 3 : 3 : 4
- (d) 9 : 7

**Q170**

A and B genes are linked. What shall be the genotype of progeny in the cross between AB/ab and ab/ab?

- (a) AAbb and aabb
- (b) AaBb and aabb
- (c) AABB and aabb
- (d) None of these

**Q171**

The probability for a couple of having four sons is:

- (a)  $\frac{1}{4}$
- (b)  $\frac{1}{8}$
- (c)  $\frac{1}{16}$
- (d)  $\frac{1}{32}$

**Q172**

Which one of the following is a pair of biofertilizers?

- (a) Azolla and BGA
- (b) Nostoc and legume
- (c) Rhizobium and grasses
- (d) Salmonella and E. coil

**Q173**

Two non-allelic genes produce the new phenotype when present together but fail to do so independently, it is called:

- (a) Epistasis
- (b) Polygene
- (c) Non-complementary gene
- (d) Complementary gene

**Q174**

Salmonella is related to:

- (a) Typhoid
- (b) Polio
- (c) TB
- (d) Tetanus

**Q175**

Molasses can be processed with help of the following:

- (a) Methanobacterium
- (b) Coli
- (c) *Saccharomyces cerevisiae*
- (d) *Candida lipolytica*

**Q176**

The following is a sex chromosomal abnormality:

- (a) Down's Syndrome
- (b) 18-Trisomy
- (c) Myelogenous Leukemia
- (d) Turner's Syndrome

**Q177**

Forthcoming generations are less adaptive than their parental generations due to:

- (a) Natural selection
- (b) Mutation
- (c) Genetic drift
- (d) Adaptation

**Q178**

During regeneration, modification of an organ into another is called:

- (a) Morphogenesis
- (b) Epimorphosis
- (c) Morphallaxis
- (d) Accretionary growth

**Q179**

In the parlance of molecular Basis of Inheritance, an inducer:

- (a) Is a chemical that acts as a regulator protein
- (b) Is a substrate, hormone or metabolite that , after coming in contact with a repressor, changes the repressor into a non-DNA binding state
- (c) Is a catabolic activator protein
- (d) None of these

**Q180**

In the model of B-DNA, the base pairs lie:

- (a) At nearly 180 degrees to the axis of helix
- (b) At nearly 90 degrees to the axis of helix
- (c) Nearly parallel to the axis of helix
- (d) None of these



## ANSWERS AND EXPLANATIONS

### PART A: PHYSICS

#### Sol. 1 (b)

An electromagnetic wave is the wave that has the oscillations of electric and magnetic fields in mutually perpendicular planes. Also, the oscillations are perpendicular to the direction of propagation of wave.

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

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

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

**The right choice is (b).**

#### Sol.2 (c)

Angular limit of resolution of eye is the ratio of wavelength of light to diameter of eye lens.

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

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

if y is the minimum resolution between two objects at distance D from eye, we have:

$$\theta = \frac{y}{D} \dots \dots \dots \text{ (ii)}$$

From eqns. (i) and (ii), we get:

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

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

Given,  $\lambda = 5000 \text{ \AA} = 5 \times 10^{-7} \text{ m}$ ,  $D = 50$ ,  $d = 2 \text{ mm} = 2 \times 10^{-3} \text{ m}$

Substituting in Eqn. (iii), we get:

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

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

$$= 1.25 \text{ cm}$$

**The right choice is (c).**

**Sol. 3 (c)**

For total internal reflection, the angle of incidence, the angle of incidence should be greater than the critical angle.

$$\text{i.e., } i > C$$

$$\text{or, } \theta > C$$

$$\text{or, } \sin \theta > \sin C$$

$$\text{and } \sin C = \frac{1}{\mu}$$

$$\text{and } \theta = 90^\circ - r$$

$$\text{so, } \sin (90^\circ - r) > \frac{1}{\mu}$$

$$\text{i.e., } \mu > \frac{1}{\cos r}$$

according to shell's law, we have:

$$\frac{\sin 45^\circ}{\sin r} = \mu$$

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

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

Thus, eqn. (i) becomes

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

$$\Rightarrow \mu^2 - \frac{1}{2} = 1 \text{ or, } \mu = \frac{\sqrt{3}}{2}$$

The right choice is (c).

**Sol.4 (b)**

Cathode rays are negatively charged particles, called **Electron**. Cathode rays possess very high kinetic energy due to their high velocity. When these highly energetic rays fall on platinum (a metal), their kinetic energy is converted into heat energy. Outside the discharge tube, if an electric field is applied, the cathode rays bend towards the positive plate. Cathode rays travel in straight lines. They cast shadow of the object placed in their straight line path. In certain substances like barium platinocyanides, zinc sulphate, diamond etc, they produce fluorescence. **The right choice is (b).**

**Sol. 5 (c)**

Give  $\frac{I_c}{I_E}$  = Current gain  $= \alpha = 0.96$

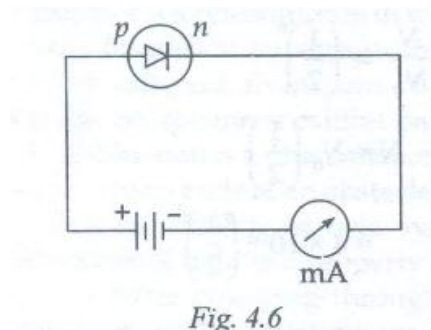
So, current gain in common emitter configuration is  $\beta = \frac{\alpha}{1-\alpha}$

$$= \frac{0.96}{1-0.96} = \frac{0.96}{0.04} = 24$$

**Sol. 6 (b)**

For conduction in a p-n junction, it should be forward biased. For the p- side must be connected to positive terminal (higher potential) and n- side must be connected to negative terminal (lower – potential).

**Fig 4.6** below shows the p-n junction in a conducting state (forward biased conducting).



**The right choice is (b).**

**Sol. 7 (a)**

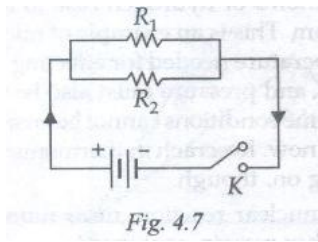
In forward biasing, ideal junction diode has zero resistance and infinite resistance in reverse biasing. In forward biasing, the diode conducts. For ideal junction diode, the forward resistance is zero. Therefore, entire applied voltage occurs across resistance R i.e., there is no voltage drop.

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

**The right choice is (a).**

**Sol.8 (a)**

**Refer Fig. 4.7.**



We have:

$$P = VI \dots (i)$$

$$\text{But } V = IR$$

$$\Rightarrow I = \frac{V}{R}$$

Put Eqn. (ii) in eqn. (i)

$$P = V \cdot I$$

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

Voltage V is same across each resistor.

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

$$\text{Also } V = IR$$

$$\Rightarrow I = \frac{V}{R}$$

Voltage V is same across each resistor.

$$\Rightarrow I \propto \frac{1}{R} \dots (iv)$$

From Eqn. (iii) and Eqn. (iv), we conclude that in a parallel set of resistors, the current, power consumed and heat generated would be more in the resistance with small resistance values.

**The right choice is (a).**

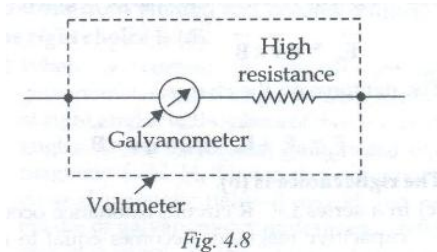
**Sol. 9 (c)**

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

**The right choice is (c).**

**Sol. 10 (a)**

A galvanometer has its low own resistance but a voltmeter must have high resistance. A Voltmeter is a modified form of a pivoted-coil galvanometer. Since the resistance of the coil of a galvanometer is low, its resistance is to be increased. It is a necessary condition for making a voltmeter. So, a high resistance should be connected in series with the galvanometer. **Refer Fig. 4.8.**



It is obvious that the resistance of an ideal voltmeter has to be infinite.

**The right choice is (a).**

**Sol. 11 (b)**

The common potential difference across two capacitors connected in parallel:

$$V' = \frac{C_1 V_1 + C_2 V_2}{C_1 + C_2}$$

Here,  $V_1 = V, V_2 = 0$

$$\Rightarrow V' = \frac{C_1 V}{C_1 + C_2}$$

**The right choice is (b).**

**Sol. 12(a)**

In an open circuit, the emf of the cell:

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

In a closed circuit, terminal potential difference:

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

External resistance,  $R = 5\Omega$

Thus, internal resistance of cell is

$$\begin{aligned} r &= \left( \frac{E}{V} - 1 \right) R = \left( \frac{2.2}{1.8} - 1 \right) 5 \\ &= \left( \frac{11}{9} - 1 \right) 5 = \frac{2}{9} \times 5 = \frac{10}{9} \Omega \end{aligned}$$

**The right choice is (a).**

**Sol. 13 (c)**

Electrostatic potential energy of charge +q placed at the centre of cube is:

$$\begin{aligned} u &= 8 \times \frac{1}{4\pi\epsilon_0} \times \frac{q(-q)}{\text{half-diagonal distance}} \\ &= 8 \times \frac{1}{4\pi\epsilon_0} \times -\frac{q^2}{b \frac{\sqrt{3}}{2}} \\ &= -\frac{4q^2}{\sqrt{3}\pi\epsilon_0 b} \end{aligned}$$

**The right choice is (c).**

**Sol. 14 (b)**

If  $\vec{E}$  is the electric field strength and  $\vec{B}$  is the magnetic field strength and q is the charge on the particle, the electric force on the charge is given by:

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

The magnetic force on the charge is given by:

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

The net force on the charge:

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

**The right answer choice is (b).**

**Sol. 15 (c)**

In a series L-C-R circuit, resonance occurs when capacitive reaction becomes equal to inductive reactance.

In a series L-C-R circuit at resonance, capacitive reactance is equal to inductive reactance.

$$\Rightarrow X_c = X_L$$

$$\Rightarrow \frac{1}{\omega C} = \omega L$$

Total impedance of the circuit

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

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

$$\Rightarrow Z = R$$

So, power factor

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

Thus, power LOSS AT RESONANCE IS GIVEN BY:

$$P = E_{rms} I_{rms} \cos \Phi$$

$$= E_{rms} I_{rms} \times 1$$

$$= (I_{rms} R) I_{rms}$$

$$= (I_{rms})^2 R$$

$$= I^2 R$$

**The right choice is (c).**

**Sol.16 (c)**

Number of half-lives

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

So, number of undecayed radioactive nuclei is given by:

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

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

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

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

The number of nuclei decayed after 30days

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

The right choice is (c).

**Sol. 17 (a)**

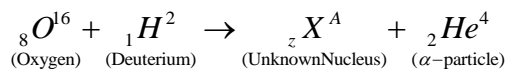
The binding energy for light nuclei ( $A < 20$ ) is much less than the binding energy heavier ones. This suggests a process that is the reverse of nuclear fission. When two light nuclei combine to form a heavier nucleus, the process is called **Nuclear Fusion**. The union of two light nuclei for creating a heavy nucleus also leads to the transfer of mass and a consequent liberation of energy. In the sun, two atoms of hydrogen fuse to form an atom of helium. This is an example of nuclear fusion. The temperature needed for effecting nuclear fusion is  $10^6$  K and pressure must also be very high. Such extreme conditions cannot be created on the earth, as of now. Research in thermonuclear reactions is going on, though.

**Sol.18 (d)**

In a nuclear reaction, mass number and atomic number remain conserved.

Let an unknown product nucleus be  ${}_Z X^A$

The reaction can be written as



As per the law of conservation of mass number:

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



As per the law of conservation of atomic number:

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

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

**The right choice is (d).**

**Sol.19 (b)**

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

**The right choice is (b).**

**Sol.20 (a)**

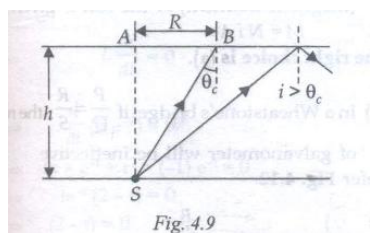
Interference is a phenomenon in which two waves of same frequency superpose to give resultant intensity different from sum of their separate intensity. So, it cannot exhibit particle nature of light. Diffraction is a phenomenon in which light bends at sharp ends of an obstacle or a hole. So, it also cannot exhibit particle nature of light. Polarization of light is a property due to which a light ray (after emerging through a crystal like tourmaline) will have vibrations in a plane that is perpendicular to its direction of propagation. So, it also cannot explain the particle nature of light. Photoelectric effect states that light travels in the form of bundles or packets of energy, called **Photons**. This effect can be explained on the basis of quantum nature of light. So, it explains the particle nature of light.

**The right choice is (d).**

**Sol. 21(a)**

The light from the source will not emerge out of water if angle of incidence is greater than critical angle.

Refer Fig. 4.9. We can observe that  $i > \theta_c$



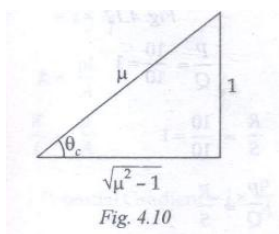
The, minimum radius R corresponds to  $i = \theta_c$ .

In  $\triangle SAB$ , we have:

$$\frac{R}{h} = \tan \theta_c$$

$$\Rightarrow R = h \tan \theta_c$$

**Refer Fig.4.10**



$$\begin{aligned} \Rightarrow R &= \frac{h}{\sqrt{\mu^2 - 1}} = \frac{4}{\sqrt{\left(\frac{5}{3}\right)^2 - 1}} \\ &= \frac{4 \times 3}{\sqrt{25 - 9}} = \frac{4 \times 3}{4} = 3m \end{aligned}$$

**The right option is (a).**

**Sol.22 (d)**

The intensity of light source is given by:

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

Where d is the distance of light source from the cell.

$$\text{Or,} \quad \frac{I_1}{I_2} = \left(\frac{d_2}{d_1}\right)^2 = \left(\frac{1}{2}\right)^2 = \frac{1}{4}$$

$$\text{Or,} \quad I_2 = 4I_1$$

As the number of photoelectrons emitted is directly proportional to intensity, the number of photoelectrons emitted will become 4 times, i.e., 4 n.

**The right choice is (d).**

**Sol. 23 (b)**

When a current is passed through the galvanometer coil, a magnetic field B is produced at right angles to the plane of the coil, i.e, at right angles to the horizontal component of earth's magnetic field H. under the influence of two crossed magnetic fields B and H, the magnetic needle of galvanometer undergoes a deflection  $\theta$  which is given by the Tangent Law. Using the Tangent Law, we can find a relationship:

$$I \propto \tan \theta$$

It indicates that the tangent galvanometer is an instrument used for detecting electric current in circuits.

**The right choice is (b).**

**Sol. 24 (d)**

If a capacitor of capacitance  $C$  is connected with an AC signal, the reactance of that circuit is purely capacitive.

The capacitive reactance is

$$X = \frac{1}{\omega C} = \frac{1}{2\pi f C} \quad (\omega = 2\pi f)$$

$$\Rightarrow X \propto \frac{1}{fC}$$

$$\therefore \frac{X'}{X} = \frac{fC}{f'C'} = \frac{f \times C}{2f \times 2C}$$

$$\Rightarrow \frac{X'}{X} = \frac{1}{4}$$

$$\Rightarrow X' = \frac{X}{4}$$

**The right choice is (d).**

**Sol. 25 (b)**

The energy stored between the plates of a capacitor

$$= \frac{1}{2} \frac{Q^2}{C} \quad \text{Hence, } U = \frac{1}{2} \frac{Q^2}{C}$$

$$\text{Now, } \sigma = \frac{Q}{A} \text{ and } C = \frac{\epsilon_0 A}{d}$$

$$\therefore U = \frac{1}{2} \frac{(\sigma A)^2}{(\epsilon_0 A/d)}$$

$$\text{Or, } U = \frac{A\sigma^2 d}{2\epsilon_0}$$

$$\text{Or, } U = \frac{1}{2} \left( \frac{\sigma}{\epsilon_0} \right)^2 \times \epsilon_0 A d$$

$$\text{Or, } U = \frac{1}{2} E^2 \epsilon_0 A d \quad \text{Energy density or energy stored per unit volume given by:}$$

$$u = \frac{U}{V} = \frac{U}{Ad} = \frac{1}{2} \epsilon_0 E^2$$

$$= \frac{1}{2} \epsilon_0 \left( \frac{V}{d} \right)^2 = \frac{1}{2} \frac{\epsilon_0 V^2}{d^2}$$

The force on a conductor per unit area which is everywhere along the normal to the surface is  $\frac{1}{2} \epsilon_0 E^2$

**The right choice is (b).**

**Sol.26 (c)**

According to Gauss' law, the total electric flux through a closed surface is equal to  $\frac{1}{\epsilon_0}$  times the total charge enclosed by that surface.

The electronic flux coming out of the cube is given by:

$$\Phi = \frac{1}{\epsilon_0} \times \text{charge enclosed}$$

$$= \frac{1}{\epsilon_0} \times q \times 10^{-6}$$

A cube has six faces. Hence, the electric flux through each face is:

$$\Phi = \frac{\Phi}{6} = \frac{1}{6\epsilon_0} \times q \times 10^{-6} = \frac{q \times 10^{-6}}{6\epsilon_0}$$

**The right choice is (c).**

**Sol.27 (a)**

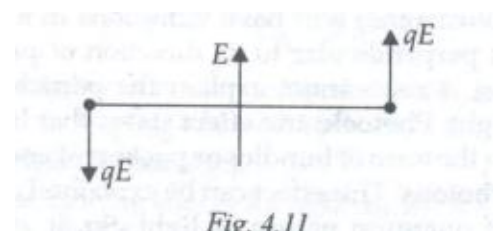
The magnetic susceptibility of a material a measure of the 'case' with which a specimen of that material can be magnetized in a magnetising field. For a diamagnetic substance, magnetic susceptibility ( $\chi_m$ ) is independent of temperature.

As per Curie's law, ( $\chi_m$ ) for paramagnetic and ferromagnetic materials varies as  $\chi_m \propto \frac{1}{T}$ . T is the Kelvin temperature.

**The right choice is (a).**

**Sol.28 (a)**

Refer Fig. 4.11. If an electric dipole is placed perpendicular to an electric field, the net force on this dipole will be zero but torque on it will not be zero.



Torque  $\tau = pE \sin \theta$

$$\Rightarrow \quad \vec{\tau} = \vec{P} \times \vec{E}$$

**The right choice is (a).**

**Sol. 29 (a)**

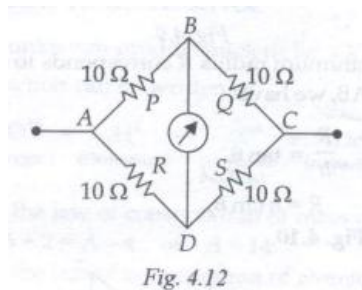
If there are  $N$  turns in a coil,  $I$  is the current and  $A$  is the area of the coil, the magnetic dipole moment (magnetic moment) of the coil is given by:

$$M = N i A$$

**Sol.30 (b)**

In a Wheatstone's bridge, if  $\frac{P}{Q} = \frac{R}{S}$ , the resistance of galvanometer will be ineffective.

Refer **Fig. 4.12**.



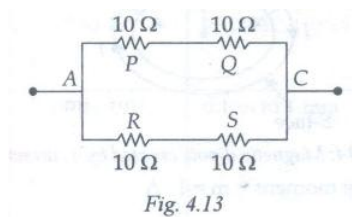
$$\frac{P}{Q} = \frac{10}{10} = 1$$

$$\frac{R}{S} = \frac{10}{10} = 1$$

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

So, the galvanometer will be ineffective.

This Wheatstone bridge can be re-drawn. Refer **Fig. 4.13**.



Resistance  $P$  and  $Q$  in series:

$$R' = 10 + 10 = 20\Omega$$

Resistance  $R$  and  $S$  are in series:

$$R'' = 10 + 10 = 20\Omega$$

Now,  $R'$  and  $R''$  are in parallel. Thus, the net resistance of the circuit is:

$$= \frac{R' \times R''}{R' + R''} = \frac{20 \times 20}{20 + 20} = 10\Omega$$

**The right choice is (b).**

**Sol.31 (d)**

The emf is given by the equation:

$$e = -L \frac{di}{dt}$$

It is given that emf is zero. Thus, we have:

$$e = -L \frac{di}{dt} = 0$$

$$\Rightarrow L \frac{di}{dt} = 0$$

$$\Rightarrow \frac{d}{dt}(t^2 e^{-t}) = 0$$

$$\Rightarrow 2t \times e^{-t} + t^2 \times (-1)e^{-t} = 0$$

$$\Rightarrow t e^{-t}(2 - t) = 0$$

$$\Rightarrow (2 - t) = 0 \quad (\because t e^{-t} \neq 0)$$

$$\Rightarrow t = 2s$$

**The right choice is (d).**

**Sol. 32 (c)**

The potential gradient of a wire is equal to the fall in potential per unit length.

Potential Gradient = Potential fall per unit length = Current  $\times$  Resistance per unit length

$$i \times \frac{R}{l}$$

$$\text{Now, } R = \frac{\rho l}{A}$$

$$\Rightarrow \frac{R}{l} = \frac{\rho}{A}$$

$$\therefore \text{potential Gradient} = i \times \frac{\rho}{A}$$

$$\rho = 10^{-7} \Omega - m, i = 0.1A, A = 10^{-6} m^2$$

$$\Rightarrow \text{potential Gradient} = 0.1 \times \frac{10^{-7}}{10^{-6}} = \frac{0.1}{10} = 0.01 = 10^{-2} V - m^{-1} \quad \text{The right choice is (c).}$$

**Sol.33 (d)**

$\frac{\Delta i_c}{\Delta i_E}$  is the current gain ( $\alpha$ ) in the Common Base or CB configuration.

$$\alpha = \frac{\Delta i_c}{\Delta i_E} = 0.98$$

The current gain in the Common Emitter or CE configuration:

$$\begin{aligned}\beta &= \frac{\alpha}{1 - \alpha} = \frac{0.98}{1 - 0.98} \\ &= \frac{0.98}{0.02} = 49\end{aligned}$$

**The right choice is (d).**

**Sol.34 (b)**

In the circuit, diode  $D_1$  is forward-biased and diode  $D_2$  is reverse-biased. Therefore, no current flows in the arm containing  $D_2$ . Thus, the entire current flows through the circuit is given by:

$$= \frac{5}{20 + 30} = \frac{5}{50} = 0.1 \text{ A}$$

**The right choice is (b).**

**Sol.35 (d)**

The given truth table follows a NAND gate whose output is 1 only if at least one of its inputs is zero. Its Boolean expression is as follows:

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

$$\Rightarrow \overline{1 \cdot 1} = \overline{1} = 0$$

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

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

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

The NAND gate is the universal or digital building block. That is because due to the repeated use of the NAND gate, we can perform all logic function, viz. OR, AND, etc.

**The right choice is (d).**

**Sol. 36 (d)**

The activity of a radioactive substance is given by:

$$R = R_0 \left(\frac{1}{2}\right)^n$$

Here, n = number of half-lives

$$= \frac{t}{T_{\frac{1}{2}}} = \frac{24}{6} = 4$$

$$R = 0.01\mu C$$

$$\text{Hence, } 0.01 = R_0 \left(\frac{1}{2}\right)^4$$

$$\text{Or } R_0 = 0.01 \times (2)^4$$

$$= 0.01 \times 16 = 0.16\mu C$$

**The right choice is (d).**

**Sol.37 (d)**

Follow the magic formula which was extracted from the phrase – BB Roy Great Britain Very Good Wife.

<b>B</b>	<b>B</b>	<b>R</b>	<b>O</b>	<b>Y</b>	<b>G</b>	<b>B</b>	<b>V</b>	<b>G</b>	<b>W</b>
0	1	2	3	4	5	6	7	8	9

First band is yellow ↔ 4

Second band is Gray ↔ 8

Third band is Red ↔ 2

Fourth band is Black ↔ 5

So, the resistance value is

$$= 48 \times 10^2 \Omega \pm 5\%$$

**The right answer choice is (d).**



**Sol. 38 (c)**

The magnetic dipole moment of a revolving electron is given by:

$$h_e = \frac{evr}{2}$$

$$= \frac{el}{2m_e}$$

$$= n \left[ \frac{eh}{4\pi m_e} \right]$$

Where, I = magnitude of angular momentum of the electron

n = number of revolution orbit of the electron,

e = charge on the electron

m<sub>e</sub> = mass of the electron

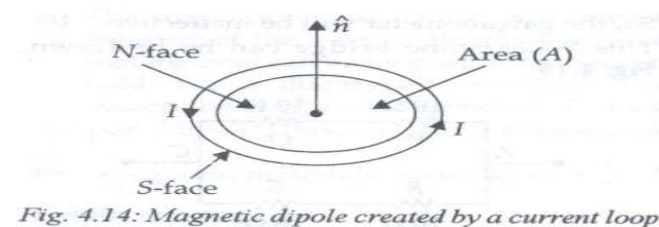
r = radius of the orbit

V = speed of the electron and

h = Planck's constant

**Sol. 39 (a)**

A current loop can get as a magnetic dipole. A current loop of area A has been shown in **Fig. 4.14**. The current I flows through it. It behaves as a magnetic dipole.



Dipole moment  $\vec{m} = I \cdot \vec{A}$

Also,  $\vec{m} = I \cdot \vec{A}$  (Vector form)

The direction of  $\vec{m}$  is given by the Right Hand Thumb Rule. If we are the fingers of our right hand along the directions of current in the loop, we find that the extended thumb gives us the direction of the the magnetic moment associated with the loop.

**The right choice is (a).**

**Sol. 40 (b)**

The wavelength range of microwaves varies from 0.3 m to  $10^{-3}$  m. their frequency band is  $10^9$  -  $10^{12}$  Hz. They are generated in klystrons, magnetrons and gun diodes. They are also used in microwave ovens for cooking and baking purposes. They impart very high energy to food particles in a microwave oven the food particles start vibrating at very high frequencies. These movements generate heat in food. Thus, it gets heated up in a jiffy. Due to their short wavelength, microwaves can also travel as beams in a signal.

**The right choice is (b).**

**Sol. 41 (c)**

The visible light has the wavelength band ranging from, 700nm to 400nm. **Table 4-1** shows the entire electro-magnetic spectrum in nut shell.

**The right choice is (c).**

**Sol.42 (b)**

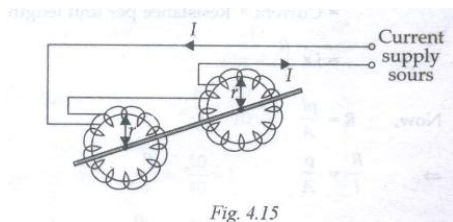
**Refer Fig. 4.15.**

$$\alpha = 0.8 \text{ m}$$

$$r = 0.6 \text{ m}$$

$$N = 30$$

$$I = 2.5 \text{ A}$$



**Table:**

Table 4-1: Electromagnetic Spectrum

Name	Frequency range (Hz)	Wavelength range	Production	Detection	Main properties and uses
Radio waves	$10^6$ to $10^9$	$> 0.1$ m	Rapid acceleration and decelerations of electrons in aerials.	Receivers aerials.	Different wavelengths find specialised uses in radio communication.
Micro waves	$10^9$ to $10^{12}$	0.1 m to 1 mm	Klystron, valve or magnetron tubes.	Point contact diodes.	(a) Radar communication. (b) Analysis of fine details of molecular and atomic structure. (c) Since $1 \times 3 \times 10^{-2}$ m, useful for demonstration of all wave properties on macroscopic scale.
Infrared	$10^{11}$ to $5 \times 10^{14}$	1 mm to 700 nm Vibration of	atoms and molecules. Thermopiles Bolometers	Infrared photographic film.	(a) Useful for elucidating molecular structures. (b) Less scattered than visible light by atmospheric particles-useful for haze photography.
Visible light	$4 \times 10^{14}$ to $7 \times 10^{14}$	700 nm to 400 nm	electrons in atoms emit light when they move from one energy level to a lower energy level.	Human eye Photocells Photographic film.	(a) Detected by stimulating nerve endings of human retina. (b) Can cause chemical reaction.
Ultraviolet	$10^{15}$ to $10^{17}$	400 nm to 1 nm	Inner shell electrons in atoms moving from one energy level to a lower level.	Photocells Photographic film.	(a) Absorbed by glass. (b) Can cause many chemical reactions, e.g., the tanning of the human skin. (c) Ionize atoms in atmosphere, resulting in the ionosphere.
X-ray	$10^{16}$ to $10^{18}$	1 nm to $10^{-4}$ nm	X-ray tubes or inner shell electrons.	Photographic film, Geiger tubes, ionization chamber.	(a) Penetrate matter (e.g., radiography) (b) Ionize gases (c) Cause fluorescence (d) Cause photoelectric emission from metals. (e) Reflected and diffracted by crystals enabling ionic lattice spacing and $N_A$ (or wave-length) to be measured.
Gamma rays	$10^{18}$ to $10^{21}$	$< 10^{-3}$ nm	Radioactive decay of the nucleus.	Photographic film, Geiger tubes, ionization chamber.	Similar to X-rays.

Magnetic field at the centre of each coil =  $B_1$

$$\begin{aligned}
 &= \frac{\mu_0 NI}{a} \\
 &= \frac{4\pi \times 10^{-7} \times 30 \times 2.5}{2 \times 0.8} \\
 &= \frac{4\pi \times 10^{-7} \times 30}{2 \times 8} \times \frac{25}{10} \times 10
 \end{aligned}$$

$$\begin{aligned}
 &= \frac{4 \times 22 \times 30 \times 25 \times 10^{-7}}{7 \times 8} \\
 &= 4125 \times 10^{-7} \\
 &= 4.125 \times 10^{-4} \\
 &4.13 \times 10^{-4}
 \end{aligned}$$

Magnetic field at the centre of one coil due to the current in the other coil =  $B_2$

$$\begin{aligned}
 &= \frac{\mu_0 N I r^2}{2(a^2 + r^2)^{1.5}} \\
 &= \frac{4\pi \times 10^{-7} \times 30 \times 2.5 \times (0.6)^2}{2[(0.8)^2 + (0.6)^2]^{1.5}} \\
 &= 4 \times \frac{22}{7} \times \frac{10^{-7} \times 30 \times 2.5 \times 0.36}{2[0.64 + 0.36]^{1.5}} \\
 &= 4 \times \frac{22}{7} \times \frac{10^{-7} \times 30 \times 2.5 \times 0.36}{2[1.0]^{3/2}} \\
 &= 4 \times \frac{22}{7} \times \frac{30 \times 2.5 \times 0.36}{2[1^2]^{3/2}} 10^{-7} \\
 &= 4 \times \frac{22}{7} \times \frac{30 \times 2.5 \times 0.36}{2[1]^3} 10^{-7} \\
 &= 4 \times \frac{22}{7} \times \frac{30 \times 2.5 \times 0.36 \times 10^{-7}}{2 \times 1} \\
 &= 169.71 \times 10^{-7} \\
 &= 0.16971 \times 10^{-4} \text{tesla} \\
 &= 0.17 \times 10^{-4} \text{tesla}
 \end{aligned}$$

(a) when currents are in the same directions, the magnetic fields are added. The resultant field at the center of each coil is:

$$\begin{aligned}
 B &= B_1 + B_2 = 4.13 \times 10^{-4} + 0.17 \times 10^{-4} \\
 &(4.13 + 0.17) \times 10^{-4} \\
 &= 4.30 \times 10^{-4} \text{tesla}
 \end{aligned}$$

(b) when the currents are in the opposite directions, the magnetic fields are subtracted. The resultant field at the centre of each coil is:

$$\begin{aligned} B^1 &= B_1 - B_2 \\ &= 4.13 \times 10^{-4} - 0.17 \times 10^{-4} \\ &= (4.13 - 0.17) \times 10^{-4} \\ &= 3.96 \times 10^{-4} \text{ tesla} \end{aligned}$$

**The right choice is (b).**

**Sol. 43 (a)**

$$\begin{aligned} \text{Drift velocity} &= \frac{eE\tau}{m} \\ &= \frac{eV\tau}{ml} \end{aligned}$$

If V becomes 3 times, the drift velocity would also be trebled (because it is directly proportional to V).

**The right choice is (c).**

**Sol. 44 (d)**

If current is allowed to pass through the wire of a potentiometer for a long period, it would get heated up. High heat would increase its resistance. So, the potentiometer would not give correct readings in the circuit it is in.

**The right choice is (d).**

**Sol. 45 (a)**

If  $\Phi$  is the phase difference between current and voltage, we have:

$$\begin{aligned} \tan \Phi &= \frac{X_L - X_C}{R} \\ \Rightarrow \frac{X_L - X_C}{R} &= \tan 45^\circ = 1 \\ \Rightarrow X_L - X_C &= 1 \cdot R = R \\ \Rightarrow -X_C &= R - X_L \\ \Rightarrow X_C &= -R + X_L \\ &= X_L - R \\ \Rightarrow \frac{1}{2\pi fC} &= 2\pi fL - R \end{aligned}$$

$$\Rightarrow 2\pi fC = \frac{1}{(2\pi fL - R)}$$

$$\Rightarrow C = \frac{1}{2\pi f(2\pi fL - R)}$$

The right choice is (a).

## PART B: CHEMISTRY

### Sol. 46 (c)

Moles of 2.5 L of 1 M NaOH =  $2.5 \times 1 = 2.5$ , Moles of 3.0 L of 5.0 M NaOH =  $3.0 \times 0.5 = 1.5$  Total moles of NaOH in solution =  $2.5 + 1.5 = 4.0$  Total volume of the solution =  $2.5 + 3.0 = 4.0$  L

Hence,  $M_1 \times V_1 = M_2 \times V_2$

$$4.0 = M_2 \times 5.5$$

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

$$= 0.73 \text{ M}$$

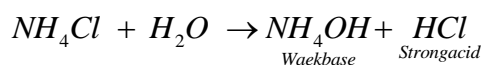
The right choice is (c).

### Sol. 47 (b)

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

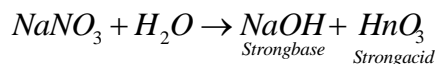
pH is inversely proportional to hydrogen ion concentration. As concentration of  $H^+$  decreases, the value of pH increases and vice-versa.

Ammonium chloride ( $NH_4Cl$ ) is a salt of weak base and strong acid so, its aqueous solution will be acidic:



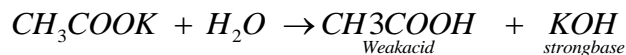
So, the pH value of  $NH_4Cl$  is less than 7.

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



So, the pH value of  $NaNO_3$  is 7.

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



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

**The right choice is (b).**

**Sol.48 (b)**

The solution of  $NH_4Cl$  acts as a basic buffer solution. For a basic buffer solution:

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

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

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

$$pK_b = 4.75$$

**The right choice is (b).**

**Sol. 49 (b)**

For the reaction  $3A \rightarrow B + C$

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

**The right choice is (b).**

**Sol. 50 (b)**

In 7 grams of nitrogen, the number of molecules is given by:

$$= \frac{7.0}{28} \text{mol} = 2.5 \times N \text{ molecules}$$

$$N = \text{Avogadro number} = 6.023 \times 10^{23}$$

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

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

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

Hence, maximum number of molecules is present in 2 grams of hydrogen gas.

**The right choice is (b).**

**Sol. 51 (b)**

For a dilute solution, we have:

$$PV = nRT$$

$$\text{Or } \pi V = nRT$$

$$\text{Or } \pi = \frac{n}{V} RT$$

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

$$\Rightarrow M = \frac{m_2 RT}{\pi V} = \left[ \frac{m_2}{V} \right] \frac{RT}{\pi}$$

Where,  $\pi$  = osmotic pressure

$V$  = volume of solution

$N$  = number of moles of solute

$m_2$  = mass of solute

$M$  = molecular mass of solute

**The right choice is (b).**

**Sol. 52 (c)**

Raoult's law is valid for ideal solutions only. These two components A and B follow the condition of Raoult's law if the force of attraction between A and B is equal to the force of attraction between A – A and B – B.

**The right choice is (c).**

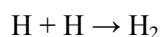
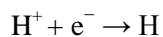
**Sol. 53 (b)**

Sodium chloride dissociates in water.



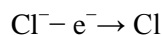
When electric current is passed through this solution using platinum electrode,  $\text{Na}^+$  and  $\text{H}^+$  move towards anode.

At cathode:





At anode:



If mercury is used as a cathode,  $\text{H}^+$  ions are not discharged at mercury cathode because mercury has a high hydrogen over-voltage.  $\text{Na}^+$  ions are discharged at cathode in preference of  $\text{H}^+$  ions, yielding sodium which dissolves in mercury to form the sodium amalgam.

**The right choice is (b).**

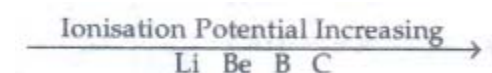
**Sol. 54 (b)**

Bond energy of  $\text{F}_2$  is less than for  $\text{Cl}_2$  because in  $\text{F}_2$  molecules, electron-electron repulsion of 2p-orbital of two fluorine atoms is maximum in comparison to chlorine atoms. So, less amount of energy is needed for breaking the bond of  $\text{F}_2$  in comparison to that of  $\text{Cl}_2$ .

**The right choice is (b).**

**Sol. 55 (b)**

Li, Be, B and C are present in the second period of the Periodic Table. In a period, if we move from left to right, ionization potential increases.



But in case of Be and B, Be has a higher ionization potential than B due to its stable configuration.

Refer **Fig. 4.16**.

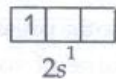
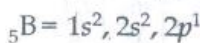
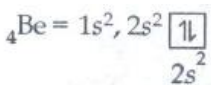


Fig. 4.16

So, the correct order of ionization potentials of the given elements is as follows:

$\text{Li} < \text{B} < \text{Be} < \text{C}$  In choice (b), the order is incorrect.

**The right choice is (b).**

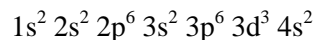
**Sol. 56 (a)**

In lanthanides (Atomic numbers 58 to 71) the electronic configuration of three outermost shell is  $(n-2)f^{1-14}, (n-1)s^2 p^6 d^{0 \text{ to } 1}, ns^2$

**The right option is (a).**

**Sol. 57 (a)**

An atom has the electronic configuration:



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

Group III	B	IVB	VB	VIB	VIIB	VIII	VIII	VIII	IB	IIB
	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
$ns^2(n-1)s^2p^6$	$d^1$	$d^2$	$d^3$	$d^4$	$d^5$	$d^6$	$d^7$	$d^8$	$d^9$	$d^{10}$

Hence, it is a member of the fifth Group.

**The right option is (a).**

**Sol. 58 (c)**

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

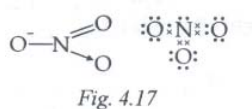
In  $CN^-$ , the number of electrons =  $6 + 7 + 1 = 14$

In CO, the number of electrons =  $6 + 8 = 14$

**The right choice is (c).**

**Sol. 59 (d)**

Refer Fig. 4.17. in  $NO_3^-$  ion, we have



Nitrogen has four bond pairs and zero lone pair of electrons.

**The right choice is (d).**

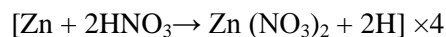
**Sol. 60 (d)**

In the silver plating of copper,  $\text{K}[\text{Ag}(\text{CN})_2]$  is used instead of  $\text{AgNO}_3$ . The reason is less availability of  $\text{Ag}^+$  ions. Note that Cu cannot displace Ag from  $\text{K}[\text{Ag}(\text{CN})_2]$  ion.

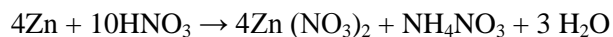
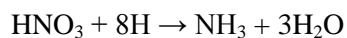
**The right option is (d).**

**Sol. 61 (d)**

Zn is present above  $\text{H}_2$  in the electrochemical series. So, it liberates hydrogen gas from dilute  $\text{HCl}/\text{H}_2\text{SO}_4$ . But  $\text{HNO}_3$  is an oxidising agent. The hydrogen obtained in this reaction is converted into  $\text{H}_2\text{O}$ . In  $\text{HNO}_3$ ,  $\text{NO}_3^-$  ion is reduced and gives  $\text{NH}_4\text{NO}_3$ ,  $\text{N}_2\text{O}$ ,  $\text{NO}$  and  $\text{NO}_2$  (depending upon the concentration of  $\text{HNO}_3$ ).



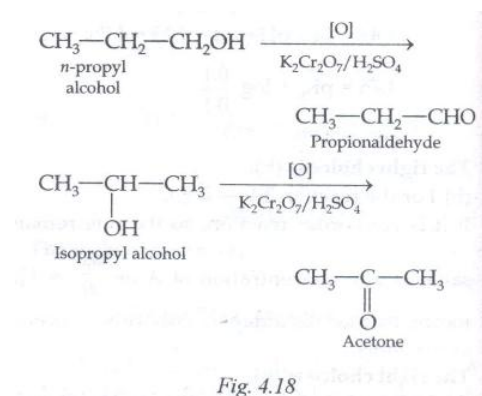
(nearly 6%)



**The right choice is (d).**

**Sol. 62 (c)**

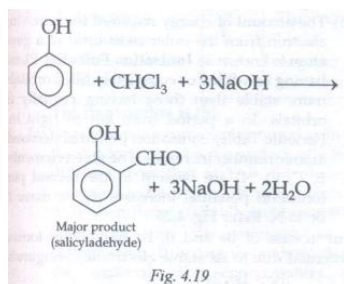
Refer Fig. 4.18. n-propyl alcohol and isopropyl alcohol give different product on oxidation with  $\text{K}_2\text{Cr}_2\text{O}_7$



**The right choice is (c).**

**Sol. 63 (b)**

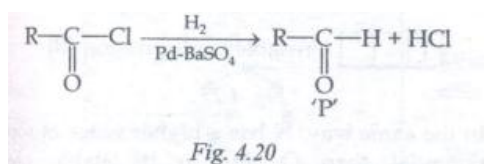
**Reamer – Tiemann reaction:** when phenol is treated with chloroform and NaOH, Salicylaldehyde is obtained. Refer **Fig. 4.19**.



**The right choice is (b).**

**Sol. 64 (c)**

**Rosenmund's Reaction.** Refer **Fig. 4.20**



**The right choice is (c).**

**Sol. 65 (c)**

**Refer Table 4-III.**

**Table 4-III.**

Element	%	Atomic Weight	Relative Number	Ratio Of Elements
C	40.0	12	40/12=3.33	3.33/3.33=1
H	13.3	1	13.3/1=13.3	13.3/3.33=4
N	46.7	14	46.7/14=3.33	3.33/3.33=1

Hence, the empirical formula of compound is CH<sub>4</sub>N.

**The right choice is (c).**

**Sol. 66 (b)**

Enzymes are made up of proteins with specific structures. They act as catalysts in a host of biochemical reactions.

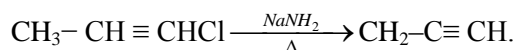
**The right option is (b).**

**Sol. 67 (c)**

**Refer Fig. 4.21.** The isomers having the same molecular formula but differ in terms of the position of atoms or groups in space due to hindered rotation about a double bond are known as **Geometrical Isomers**.

**The right option is (c).**

**Sol. 68 (b)**



Final product

**Fig.4.21**

**The right option is (b).**

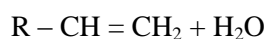
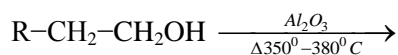
**Sol. 69 (b)**

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

**The right choice is (b).**

**Sol. 70 (b)**

**Refer Fig.4.22** Temperature is the effective factor for the dehydration of alcohol by  $\text{Al}_2\text{O}_3$ .



**Fig.4.22**

At  $220^\circ\text{C}$  to  $250^\circ\text{C}$ , it forms ether.

**Sol.71 (a)**

The structure of DNA molecules is double helical. In this structure, the double helixes are made up of polynucleotide chains which are held together with the help of H-bonds. In these helixes, the Adenine (A) base is linked with Thymine (T) through two H-bonds and Guanine (G) is linked with Cytosine (C) through three H-bonds. Thus, the bonds are  $A=T$ , and  $G \equiv C$ . In the question statements, we have shown only one line for bonds of all types. In fact, they can be more than one bond in many cases.

**The right choice is (a).**

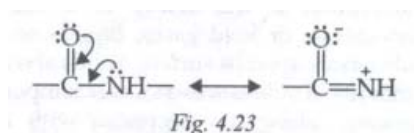
**Sol.72 (a)**

Starch is also known as **Amylum** which occurs in all green plants. A molecule of starch  $(C_6H_{10}O_5)_n$  is made up of a large number of  $\alpha$ - glucose rings that are joined through through an oxygen atom.

**The right choice is (a).**

**Sol. 73 (c)**

A peptide bond is formed by the reaction of the COOH group of one amino acid with the  $NH_2$  group of another amino acid. It is represented as follows. Refer **Fig. 4.23**

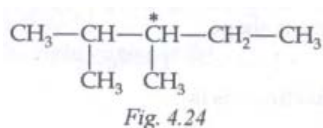


As partial double bond is character found between C–N bond, the bond length of C–N in protein should be smaller than usual C–N bond length.

**The right choice is (c).**

**Sol. 74 (a)****Fig. 4.24**

Shows the structure of 2, 3-dimethyl pentane.



This molecule shows the property of optical isomerism due to the the presence of an asymmetric  $C^*$  atom.

**The right choice is (a).**

**Sol. 75 (c)**

When a biochemical reaction is carried out in laboratory from outside a human body in the absence of enzyme, the rate of reaction obtained is  $10^{-6}$  times than the activation energy of reaction in the presence of the enzyme. It is different from the value of  $E_a$  obtained in laboratory.

That is because for a given chemical reaction:

$$K = Ae^{E_a/RT} \text{ (Arrhenius equation)}$$

**The right choice is (c).**

**Sol.76 (c)**

$$\text{Density} = 1.17 \text{ g-cc}^{-1}$$

$$= 1170 \text{ g-L}^{-1}$$

$$\text{Molarity of solution} = \frac{\text{strength in g-L}^{-1}}{\text{Molecular Weight}}$$

$$= \frac{1170}{36.5} M$$

$$= 32.05 M$$

**The right choice is (c).**

**Sol. 77 (c)**

**Reverse Osmosis:** The minimum external pressure applied to a solution separated from a solvent with the help of a semipermeable membrane for preventing osmosis is called **Osmotic Pressure**. When the pressure applied to the solution is more than osmotic pressure, the solute will pass from solution into solvent through the semi permeable membrane. This phenomenon is known as **Reverse Osmosis**.

The osmotic pressure of sea water is 25 atm at 15<sup>0</sup> C when pressure greater than 26 atm is applied on sea water that I separated by a rigid semipermeable membrane, pure water is obtained. This is also called **Desalination of Sea Water**.

**The right choice is (c).**

**Sol.78 (a)**

Adsorption is the ability of a substance to concentrate or hold gases, liquids or dissolved substances upon its surface. Solids absorb greater amounts of substances at lower temperatures. In general, adsorption decreases with increasing temperature.

**The right choice is (a).**

**Sol. 79 (a)**

The compounds having the same structure and same hybridization are known as **Iso Structural Species**.

**Examples:** XeF<sub>2</sub> and IF<sub>2</sub><sup>-</sup> are sp<sup>3</sup>d hybridised and both have a linear shape.



**The right choice is (a).**

**Sol.80 (a)**

$\text{La(OH)}_3$  is more basic than  $\text{Li(OH)}_3$ . In lanthanides, the basic character of hydroxides decreases as ionic radius decreases.

The right choice is (a).

**Sol. 81 (b)**

The amount of energy required for removing an electron from the outer-most orbit of a gaseous atom is known as **Ionisation Potential**. Elements having half-filled or completely filled orbitals are more stable than those having partially filled orbitals. In a period from left to right in the Periodic Table, ionisation potential decreases as atomic number increases. The given elements (Be, B, C, O, N) are present in the second period. Ionisation potential increases as we move from Be to N. Refer **Fig.4.25**.

But in case of Be and b, Be has higher ionisation potential due to its stable electronic configuration.

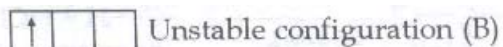
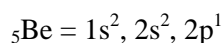
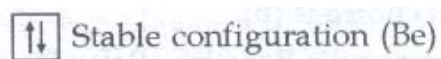
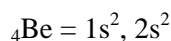


Fig. 4.25

In the same way, N has a higher value of ionization potential than O due to this stable electronic configuration. Refer **Fig.4.26**

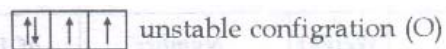
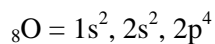
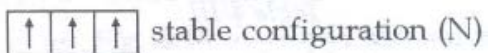
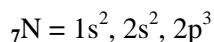
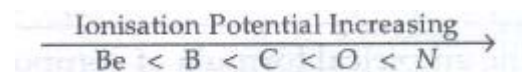


Fig. 4.26

So, the correct order of increasing (first) ionization potential is:



The right choice is (b).



**Sol. 82 (b)**

The proteins that provide all essential amino acids in the right proportion for human nutrition are known as Complete Proteins. Examples include meat, fish, milk, eggs, etc. Incomplete proteins are deficient in one or more essential amino acids. Examples include rice, wheat and corn. Rice lacks threonine and lysine. Corn lacks tryptophan. Lysine is absent in rice, corn and wheat. Beans, peas and legumes lack methionine. So, almost all plant proteins are incomplete. In order to make up for this protein deficit, we must consume pulses along with vegetables. Also note that ten essential amino acids have been listed in **Table 4-IV**

**Table 4- IV Top Ten Amino Acids**

<i>SN.</i>	<i>Amino Acid</i>	<i>SN</i>	<i>AminoAcid</i>
1.	Valine	6.	Tryptophan
2.	Leucine	7.	Threonine
3.	Isoleucine	8.	Lysine
4.	Phenylalanine	9.	Arginine
5.	Methionine	10.	Histidine

**The right option is (b).**

**Sol.83 (d)**

Adsorption is a surface phenomenon. In this case, the concentration on the surface of adsorbent is different from that in bulk (in absorption). It occurs on surface only. Its rate is high to begin with. Then, the rate falls till equilibrium is obtained. Absorption, on the contrary, is a bulk phenomenon. It occurs throughout the body of material. The concentration is same throughout the material. The rate remains the same throughout the process.

Fig. 4.27 shows the process of adsorption

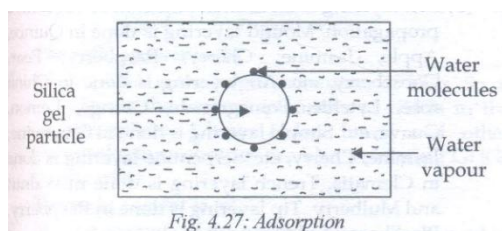
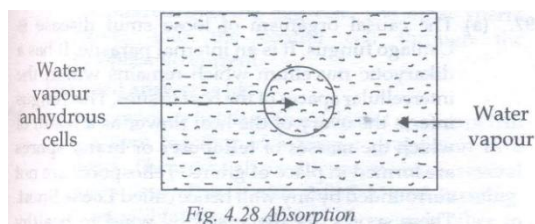


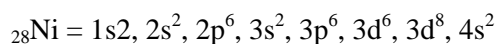
Fig. 4.28



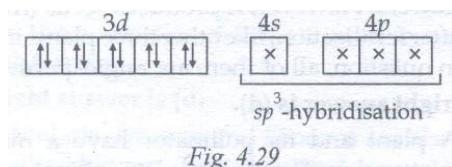
**The right choice is (d).**

**Sol. 84 (c)**

In  $\text{Ni}(\text{CO})_4$ , Ni has zero oxidation number.



In the excited state and during the formation of  $\text{Ni}(\text{CO})_4 \rightarrow \text{Ni}$  shows  $sp^3$  hybridisation Refer **Fig. 4.29**.



Hence, no unpaired electron is present in Ni. So,  $\text{Ni}(\text{CO})_4$  shows the property of diamagnetism and tetrahedral structure.

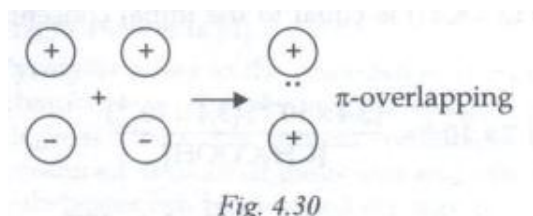
**Sol. 85 (a)**

$\text{X}-\text{H}-\text{Y}$ , X and Y are Electronegative elements. Thus, the electron density on X will increase. The electron density on H will decrease.

**The right choice is (a).**

**Sol.86 (a)**

Refer Fig. 4.30. For a  $\pi$ -overlap, the lobes of the atomic orbitals are perpendicular to the line joining the nuclei.



**The right choice is (a).**

**Sol.87(c)**

The basic strength is proportional to the rate of acceptance of proton. In  $R-\text{NH}_2$ , N—has a lone pair of electrons which intensifies due to the electron-releasing R—group and increases the tendency to donate a lone pair of electrons to  $\text{H}^+$  secondly, as the size of ion increases, there is less attraction for  $\text{H}^+$ . Thus, it forms a weaker bond with H—atom and is less basic in nature. The order of the given series is



**The right choice is (c).**

**Sol.88 (b)**

Ferrocene is a  $\pi$ -bonded organometallic compound. **Fig. 4.31** shows its structure.

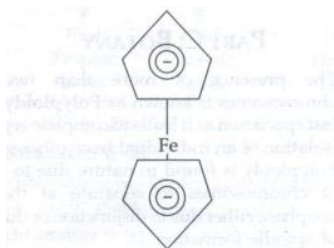


Fig. 4.31: Ferrocene ( $\text{Fe}(\eta^5\text{-C}_5\text{H}_5)_2$ )

The examples of  $\pi$ -bonded organometallic compounds are Ferrocene, Dibenzene chromium  $[\text{Cr}(\eta^6\text{-C}_6\text{H}_6)_2]$  and Zeise's salt  $[\text{K}(\text{PtCl}_3(\eta^2\text{-C}_2\text{H}_4))]_2$ .

The examples of  $\sigma$ -bonded organometallic compounds are—Grignard reagent ( $\text{R-Mg-X}$ ), Diethyl zinc  $[(\text{CH}_3\text{CH}_2)_2\text{Zn}]$  and Tetramethyl tin  $[(\text{CH}_3)_4\text{Sn}]$

**The right choice is (b).**

**Sol.89(d)**

$$K_a = \frac{[\text{CH}_3\text{COO}^-][\text{H}^+]}{[\text{CH}_3\text{COOH}]}$$

Given that  $[\text{CH}_3\text{COO}^-] = [\text{H}^+] = 3.4 \times 10^{-4} \text{ M}$

$$K_a \text{ for } \text{CH}_3\text{COOH} = 1.7 \times 10^{-5}$$

$\text{CH}_3\text{COOH}$  is a weak acid. So, the concentration of  $(\text{CH}_3\text{COOH})$  is equal to the initial concentration in it.

$$1.7 \times 10^{-5} = \frac{(3.4 \times 10^{-4})(3.4 \times 10^{-4})}{[\text{CH}_3\text{COOH}]}$$

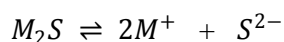
$$[\text{CH}_3\text{COOH}] = \frac{3.4 \times 10^{-4} \times 3.4 \times 10^{-4}}{1.7 \times 10^{-5}}$$

$$= 6.8 \times 10^{-3} \text{ M}$$

**The right choice is (d).**

**Sol.90 (b)**

Solubility of  $M_2S$  salt is  $3.5 \times 10^{-6} \text{ M}$



$$3.5 \times 10^{-6} \text{ M} \quad 2 \times 3.5 \times 10^{-6} \text{ M} \quad 3.5 \times 10^{-6} \text{ M}$$

On 100% ionisation

Solubility product of  $M_2S = K_{sp}$

$$= [M^+]^2[S]$$

$$= (7.6 \times 10^{-6})^2 (3.5 \times 10^{-6})$$

$$= 171.5 \times 10^{-18}$$

$$= 1.71 \times 10^{-16}$$

**The right choice is (b).**

### **PART C: BOTANY**

**Sol.91(c)**

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

**The right answer is (c).**

**Sol.92 (d)**

When parthenogenesis occurs in larva, it is called Paedogenetic Parthenogenesis. Obligatory breed exclusively through parthenogenesis. Complete parthenogenesis and obligatory parthenogenesis are one and the same concept. Incomplete parthenogenesis, also called Cyclic Parthenogenesis, is found in those animals in which both sexual production and parthenogenesis take place.

**The right answer is (d).**

**Sol.93(c)**

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

**The right answer is (c).**

**Sol.94 (a)**

Strains of *Saccharomyces cerevisiae* are extensively used for leavening of bread. During fermentation, the yeast produces alcohol and CO<sub>2</sub> which leaves the leavened bread, making it slightly porous.

*Bacteria* – Unicellular prokaryotic micro-organism

*Virus* – Particulate obligate parasite.

*Protozoa* – Unicellular eukaryotic micro-organisms.

**The right answer is (a).**

**Sol.95 (a)**

Methane is generated by methanogenic bacteria in a biogas plant. So, organic acids are converted into CH<sub>4</sub> and CO<sub>2</sub> by these bacteria.

**The right answer is (a).**

**Sol.96 (b)**

Soil layering is an artificial method of vegetative propagation. Mound layering is done in Quince, Apple, Jasmine, Cherry, Raspberry, Pear, Gooseberry, etc. Air layering is done in China rose, Lythium, Pomegranate, Orange, Lemon, Guava, etc. Simple layering is done in Grapevine, Jasmine, Cherry, etc. Serpentine layering is done in Clematis. Trench layering is done in Walnut and Mulberry. Tip layering is done in Raspberry, Blackberry and Dewberry.

**The right answer is (b).**

**Sol.97 (a)**

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

**The right answer is (a).**

**Sol.98 (d)**

Pinus is a gymnospermic plant. The ovules of Pinus are uncovered which lie on the megasporophyll. Hence these plants do not have flowers. However, it produces seeds (from ovule after fertilization) like other three plants mentioned in questions; all of them are angiosperms.

**The right answer is (d).**

**Sol.99 (a)**

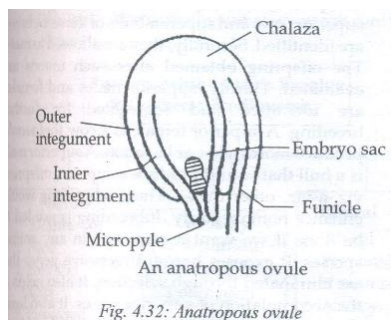
A plant and its pollinator have a mutualistic relationship. The plant uses its pollinator to ensure cross-pollination while the pollinator uses the plant as food.

Commensalism: One organism is benefited while the other living vicinity, the first one neither getting any benefit nor being harmed.

**The right answer is (a).**

**Sol.100 (b)**

In anatropous ovules, the micropyle comes to lie close to the funiculus due to unilateral growth of the ovule. Refer **Fig. 4.32**



**Sol.101 (c)**

The USA is the largest consumer of fuels. So, it releases the highest quantities of GHGs in the atmosphere. China, India, Brazil and other developing countries are also producing GHGs in excess.

**The right answer is (c).**

**Sol.102 (d)**

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

**The right answer is (d).**

**Sol.103 (b)**

In composite fish farming, selected species of fish are kept together in a proper proportion in a pond. Then, the fish production increases several times over. This is also called mixed farming. Compatible species do not harm each other in this type of fish farming. The pond is also properly utilized that way.

**The right answer is (b).**

**Sol.104 (d)**

The first three options are correct. *Catla catla* is a surface feeder. *Labeo rohita* is a column feeder. Finally, *Cirrhina mrigala* is a bottom feeder. All the three varieties of fish are used in composite fish farming.

**The right answer is (d).**

**Sol.105 (c)**

*Utricularia*, *Drosera* and *Dionaea* are also known as Bladderwort, Sun dew and venus fly trap, respectively. They all are insectivorous plants.

**The right answer is (c).**

**Sol.106 (d)**

The development of disease in a plant depends upon the host's genotype, pathogen's genotype and the environment in which host and pathogen survive.

**The right answer is (d).**

**Sol.107 (d)**

Option (d) has the wrong statement Microorganisms play a little roles in the process of energy flow. Other statements are correct.

**The right answer is (d).**

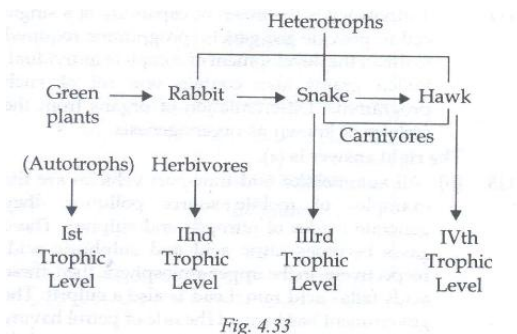
**Sol.108(c)**

Pyrolysis refers to the combustion of material in chambers in the absence of oxygen at 1650 degrees C. In this process, pollutions are not produced. Industrial gases and other useful substances can be obtained through it.

**The right answer is (c).**

**Sol.109 (a)**

Refer Fig. 4.33. plants, being photosynthesis, occupy first trophic level ( $T_1$ ) in the food chain. A trophic level is a step in the flow of energy through an ecosystem, such as the step at which plants manufacture food or the step at which carnivores feed on other animals.



**The right answer is (a).**

**Sol.110 (a)**

Cucuta, commonly known as dodder or amarbel, is a parasite plant.

**The right answer is (a).**

**Sol.111 (d)**

The first three options are correct Nuclear plants and research reactors can generate low-intermediate- and high-level radiations. High-level radiations can also cause loss of hair and tumours of various types. The spent fuel of atomic reactors is equally dangerous for the staff handling it.

**The right answer is (d).**

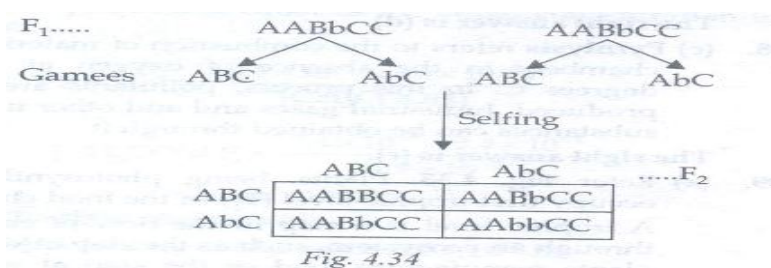
**Sol.112(c)**

A mining quarry and an industrial estate (spread over a large area) are the examples of area source pollution. Note that pollution is of many types, it depends upon the origin of pollutant. Thus, point source, line source, area source, diffuse source, fixed source and pollution are the major categories of pollution genres.

**The right answer is (c).**

**Sol.113 (a)**

Since AABbCC contains only one heterozygous allelic pair 'Bb' the cross would behave as monohybrid cross leading to 3:1 phenotypic ratio in F<sub>2</sub>. Refer **Fig. 4.34**



The phenotypic ratio is 3:1      **The right answer is (a).**



**Sol.114 (a)**

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

**The right answer is (a).**

**Sol.115 (b)**

All automobiles and transport vehicles are the examples of mobile source pollution. They generate oxides of nitrogen and sulphur. These gases become nitric acid and sulphuric acid, respectively, in the upper atmosphere then, these acids fall as acid rain. Lead is also a culprit. The government has banned the sale of petrol having lead. Despite all these measures, automobile pollution remains a chief area of concern for environmentalists. Also read the answer of Question number 112.

**The right answer is (b).**

**Sol.116 (a)**

Refer Fig. 4.35. Cashew nut, potato and rubber are new world crops. Mango, tea and coffee are old world crops.

**The right answer is (a).**

**Sol.117 (a)**

It is difficult for the developing countries to maintain such crops.

**The right answer is (a).**

**Sol.118 (b)**

Embryogenesis leads to the formation of organs. This is also called Organogenesis. Gametogenesis leads to fertilisation. Parthenogenesis refers to the development of an egg into a complete individual without fertilisation.

**The right answer is (b).**

**Sol.119 (c)**

Castor, cereals and Coconut are endospermic or albuminous. On the other hand, Pea, bean and Sunflower are Non-endospermic or exalbuminous.

**The right answer is (c).**

**Sol.120 (c).**

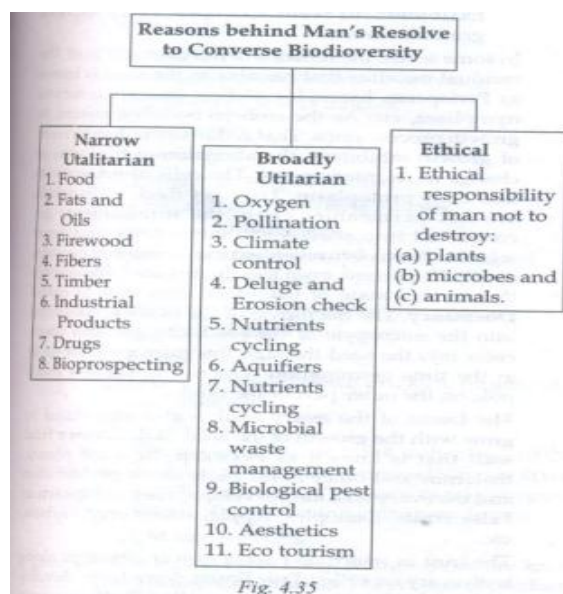
Inbreeding is done between the animals of the same breed for 4-6 generations. Cows, buffaloes and poultry chickens are bred that way. Firstly, superior cows and superior bulls of the same breed are identified. Secondly, they are allowed to mate. The offspring obtained after such unions are evaluated. Thirdly, superior males and females are identified and segregated for further breeding. A superior is a cow that would produce more milk per lactation. A superior male is a bull that would produce a superior offspring viz.-a-viz. other males. Thus, inbreeding would enhance homozygosity. Inbreeding is needed to be done if we want a pure line in any animal species. It exposes harmful recessive genes that are eliminated through selection. It also leads to the accumulation of superior genes. It also leads to the elimination of less desirable genes. However, continuous inbreeding leads to reduced fertility and productivity may take a beating if it is continued over a many a generation. This phenomenon is called Inbreeding Depression. So, only selected animals of the breeding population ought to be mated with the superior animals of the same breed but they should not be related to the breeding population. Outbreeding, on the contrary, is the breeding of two unrelated animals. It can be done between the animals of the same breed but the animals do not have the common ancestors; in this case, it is called outcrossing. It can also be done by cross-breeding superior males of one breed with the superior females of another breed, in that case, it is called cross-breeding. Finally it can be done by letting the male and female animals of two different species and obtaining the species that is different from both parents; in that case, it is called Interspecific Hybridization. Example: A mule is produced through the Outbreeding process in which a female horse and a male donkey are allowed to mate. The offspring (males) are much tougher than both of their parents. They do pretty well in high-altitude areas. Note that Outbreeding has three subtypes (outcrossing, cross-breeding and interspecific hybridization ).

**The right answer is (c).**

**Sol.121 (d)**

Bioprospecting refers to the exploration of molecularly genetic and species level products of economic significance. Scientists are trying to use rich biodiverse regions of the world for generating such products on a commercial scale. These products enhance the living standards of man and add to the wealth of corporate firms. Example: Biocon is a firm that is focusing on biodiversity related products its CEO is Ms. Kiran Majumdar Shaw.

Basically, there are three reasons behind man's resolve to conserve biodiversity. Fig. 4.35 shows them in nutshell. You can also read books on botany regarding this topic. Alternatively.



**The right answer is (d).**

**Sol.122 (b)**

The plants of dry areas are called Xerophytes. They modify their own structure to enhance water absorption. They also adapt themselves to the dry environment by reducing transpiration and storing absorbed water. Some animals like Kangaroo Rat do not drink water at all. They use the water of the food they eat. They use their metabolism to survive. The animals of dry areas released solid faeces and urine and thus retain water in their bodies for long durations. The options (a), (c) and (d) are suitable for hydrophytes (aquatic plants) or other plants and animals depending upon vegetation (option (d) suits them).

**Here, the right answer is (b).**

**Sol.123 (d)**

A food chain can be defined as a sequence of population or organisms of an ecosystem through which the food and the energy is possessed pass through each one of the members thus becoming the food of later member of the sequence. Fig. 4.36 shows a food chain. Note that there is a progressive decline in the amount of energy available in the food chain even as we move from the sun and reach the head of the food chain (predator, snake in this case).

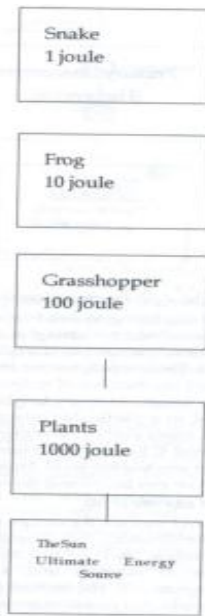


Fig. 4.37 shows the pyramid on numbers in a grassland ecosystem.

**Fig. 4.37** shows the pyramid on numbers in a grassland ecosystem

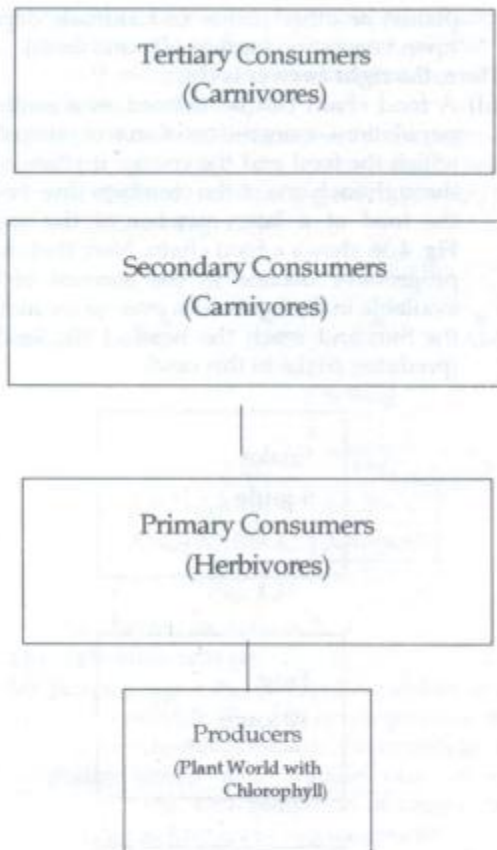


Fig. 4.37: Pyramid of numbers

A food chain has grassland ecosystem a series of population related by 'eating' and 'be eaten.' It is a straight chain. The number of trophic levels in it varies from 3 to 6. There is progressive reduction in biomass, energy and the number of individuals with the rise in trophic levels. At every trophic level, biomass is consumed in a particular quantity for generating energy. A major part of the energy available at every trophic level is lost as heat. Humans can operate at more than one trophic level. Finally, food chains are sustained by producers and decomposers.

**The right answer is (d).**

**Sol.124 (d)**

Seed and fruit are the end products of the process of fertilization. In angiosperms, double fertilization leads to two structures—a diploid zygote or oospore and a triploid primary endosperm cell. The triploid primary endosperm cell produces a nutritive tissue which is known as Endosperm. Zygote creates the embryo. Endosperm gives nutrition to embryo. Even as the embryo grows, the central section of the endosperm is consumed. The endosperm corrodes the nucleus. In some seeds, the endosperm remains in the seed as a food storage tissue. Such seeds are known as Endospermic Seeds or Albuminous Seeds. Examples: Castor maize, wheat, barley, rubber, coconut, etc. In other seeds, endosperm is totally consumed by the embryo; the embryo grows even as it does so. The food for the development in the future is stored in cotyledons. The cotyledons become very big because of the food stored inside them. Such seeds are called Nonendospermic Seeds or Exalbuminous Seeds. Examples: Pea, gram, bean, groundnut etc.

In some seeds, the remains of nucellus still exist. The residual nucellus that remains in the seed is known as Perisperm. Examples: Coffee, castor, cardamom nymphaea, etc. As the embryo becomes mature its, growth process stops. That is due to the development of growth inhibitors, the abscission of funiculus or change in its integuments. The cells of integuments lose their protoplasm. They get thick walls which are not permeable. Then the integuments get converted into seeds coats, outer testa and inner tegmen. The moisture content inside the seed becomes nearly 15 percent, even less in this seed, the embryo thrives in a state of inactivity; this state is called Doemancy. The micropyle of the seed. Oxygen and water enter into the seed through this micropyle (of seed) at the time germination. The micropyle is a small pole on the outer part of the seed.

The tissue of the ovary wall is also stimulated to grow with the growth of the seed. It develops a fruit wall that is known as Pericarp. In some plants, thalamus and other floral parts show proliferation and the ovary wall also develops. They are known as False fruits. Examples: Apple, strawberry, cashew, etc. The fruit in which no part of flower develops along with ovary are called True Fruits. Some fruit develop without fertilization. They are called Parthenocarpic Fruits. Examples: Banana. Parthenocarpy, the process of production of seedless fruits, can be done through hormonal treatment. In options (a), (b) and (c), the residual nucellus persists. So, they are all perisperms. In the case of groundnut (option(d)), the endosperm is totally consumed by the growing embryo. The food for the later development of embryo is stored in cotyledons. Such seeds are called Nonendospermic Seeds.

**The right answer is (d).**

**Sol.125 (b)**

The polymerase Chain Reaction (PCR) technology was developed by Kary Mullis (1985). Kary Mullis and Michael Smith had won the Nobel Prize in Chemistry (1993). We can define PCR as the DNA replication in vitro. It leads us to the selective amplification of a particular part of a DNA molecule. It can be used for creating a DNA fragment for the purpose of cloning. When a double-stranded DNA strands become separate from each other. So, they become single-stranded molecules. If these molecules are copied by a DNA polymerase, the process is repeated several times over, the multiple copies of the original DNA sequence can be generated. In order to effect a PCR, we need the following :

1. DNA template.
2. Two nucleotide primers.
3. DNA polymerase (a kind of enzyme).

The process of PCR is as follows:

1. Denaturation
2. Annealing
3. Extension or polymerisation

The application of PCR are as follows:

1. Detection of pathogens.
2. Diagnosis of mutations of a particular kind.
3. DNA finger printing.
4. Detection of microorganisms.
5. Diagnosis of plant pathogens.
6. Prenatal diagnosis.
7. Palaeontology (cloning of DNA fragments of extinct animals)
8. Gene therapy.

Note that the recombinant DNA technology (rDNA) is used for cutting DNA at particular locations. It is not part of PCR. Note that PCR likely to take over most applications of gene cloning in the near future.

**The right answer is (b).**

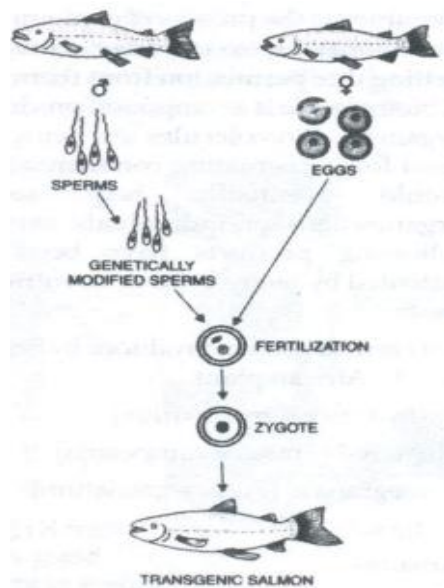
**Sol.124(d)**

The animals that carry foreign genes are known as Transgenic Animals. The process of producing a transgenic animal involves the following steps.

1. Location, identification and separation of the desired gene.
2. Selection of an apt vector (a virus in most cases) or direct transmission.
3. Combination of the desired gene with the vector.
4. Introduction of the transferred vector in cells, tissues, embryo or mature individual.
5. the demonstration of the final integration of the foreign gene in the transgenic tissue a animal.

The salmon fish was the first ever transgenic animal produced for food production. Fig. 4.38 shows the process of genetic modification which the Atlantic Salmon had gone through. All other options are correct but the Salmon was the pioneer, especially in the realm of food production through the transgenic production process (in animals).

**The right answer is (d).**



*Fig. 4.38*

**Sol.127 (b).**

Gene therapy is a process of genetic engineering. We used this therapy to replace faulty genes in an organisms with a healthy functional gene. It has many applications. For example, the faulty genes of a diabetic can be replaced by healthy ones for making him free from diabetes. The Possibilities of gene therapy are gargantuan and scientists have just started their marathon run in this vast field

There are two types of gene therapy, as follows:

1. Greenline Gene Therapy: In this therapy, green cells (sperms, eggs or zygotes) are modified by introducing healthy functional genes which are individually integrated into their genomes.
2. Somatic Cell Gene Therapy: In this therapy, genes are introduced only in somatic cells.

Currently, the law allows the entry of new genes into somatic cells. Further, the genetic modification of the germ cells of offspring is not allowed.

**The right answer is (b).**

**Sol.128 (c).**

Human insulin was made by Tsan for the first time. The process of its manufacture is as follows:

1. Isolation of donor or DNA segment.
2. Formation of recombinant DNA.
3. production of multiple copies of and rDNA
4. Introduction of rDNA in the recipient organisms.
5. Screening of transformed cells

**The right answer is (c).**

**Sol.129(b)**

Biopiracy is the process of exploiting or patenting the bioresources of other countries without getting due permission from them in legal terms. A biomolecule is a compound produced by a living organism. Biomolecules are being patented and used for perpetuating commercial activities that would eventually help some nations, organizations or individuals earn money. The following products have been illegally got patented by many firms or countries in the recent past:

1. Brazzerin (a protein produced by *Pentaclethra*) a west African Plant
2. Basmati rice (*Oryza sativa*)
3. Mustard (Brassica campestris)
4. Pomegranate (*Punica granatum*)



5. Ginger
6. Amaltas
7. Castor
8. Goosebeary
9. Turmeric
10. Margosa (Neem)
11. Bahera (an Indian Ayurvedic herb)
12. Marine (fungi of Thailand (200 strains))

The companies a Japan, Germany and the USA are the chief bio-pirates against which strict actions were contemplated but never taken.

**The right answer is (b).**

**Sol.130 (c)**

According to the Indian Patent Act (1970), the patents are value for a period of 7 or 14 years. The patent of bioresources also fall under this genre of patent law.

**The right answer is (c).**

**Sol.131 (a)**

The ozone layer is being formed and photodissociated in the stratosphere. It dissipates the energy a ultra-violet secretion. It is the only gas in the atmosphere that can check the harmful ultraviolet radiation emanating from the sun. the UV radiation of the sun converts  $O_3$  into  $O_2$ . Study the following reaction carefully.

### **IMAGE PAGE NO 142**

The ozonesphere, a sublayer of the stratosphere, is the layer in which  $O_3$  exists in an independent state. it blocks UV radiation. The thicker the  $O_3$  layer in the atmosphere, the safer we are on the earth from the lethal UV radiation. At the poles of the earth, the  $O_3$  content is less. So, people living there are more vulnerable to the harmful effects of UV radiations. This radiation can cause skin cancer among humans. The industrialised nations of Europe released lots of CFCs during the past 30 years. These CFCs have depleted the ozone layer over the poles.

**The right answer is (a).**

**Sol.132 (d)**

GHGs are needed for keeping the mother earth cosy enough for our survival. They are radiatively active gases. They absorb long-wave radiations emitted by the earth and do not allow them to go into the outer space. Further, they reflect a part of these radiations back to the earth. This is called Green House Flux(GHF). Due to GHF, the means yearly temperature of the earth is 15°C. if they are absent, the mean yearly temperature would be - 18°C. Refer Table 4-V. Recently, the introgovernmental Panel on Climate chan

CO <sub>2</sub>	CHG	CFCs	N <sub>2</sub> O
(60%)	(20%)	(14%)	(6%)

ge (IPCC) has declared that GHGs are given more that to the earth than it plausibly needs. Thus, the concept of global warming has become a major issue for marine biologists and countries all over the world.

**The right answer is (d).**

**Sol.133 (b)**

Sunderbal Bahnguna led the Chipko movement. He ordered his volunteers to stick to the trees (chipko) that were being felled in the mountainous regions of Uttarakhand. He became a crusader against tree felling and worked for the cause of environmental protection. Medha Patkar was associated with the Narmada Bachao Aandolan. Maneka Gandhi handles issues related to the cruelty done to animals. Dr. Verghese Kurien was the pioneer of the white revolution in India which had led to the production of record quantities of milk and the creation of India's best milk brand—Amul.

**The right answer is (b).**

**Sol.134 (b)**

This is the only correct statement. All differences have been listed in Table 4-VI

**Multiple Fission**

1. A number of daughters produced
2. No immortality is present in this fission
3. Residue is left behind
4. The nucleus of parent body divides repeatedly
5. It can occur under favourable conditions as well as unfavourable

**Binary Fission**

1. Only two daughters produced
2. Organism becomes immortal
3. No residue is left behind.
4. The nucleus of parent body divides only once
5. It occurs during favourable conditions only

**The right answer is (b).**

**Sol.135 (d)**

All three options are incorrect A critically endangered species, as per the Red Data Book of the World Conservation Union (WCU), is the one that is facing a very high risk of extinction in the wild and may be extinct at any point of time in the immediate future. The number of critically endangered animals in India is 18. The number of critically endangered plants in India is 44.

**The right answer is (d).**

**PART D: ZOOLOGY****Sol.136 (d)**

The patient lacks vitamin K, a natural agent for clotting blood.

**The right answer is (d).**

**Sol.137 (b)**

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

**The right answer is (b).**

**Sol.138 (a)**

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

**The right answer is (a).**

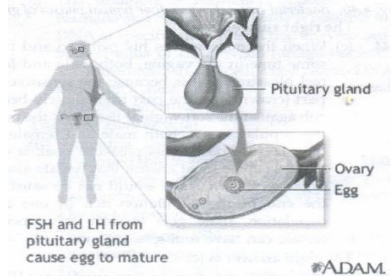
**Sol.139 (a)**

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

**The right answer is (a).**

**Sol.140 (c)**

The Follicle Stimulating Hormone (FSH), Leutenising Hormone (LH) and Estrogen all play important roles in controlling the menstrual cycle in human females. Refer Fig. 4.39



*Fig. 4.39 : FSH and LH (horomones)* **The right answer is (c).**

**Sol.141 (c)**

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

**The right answer is (c).**

**Sol.142 (a)**

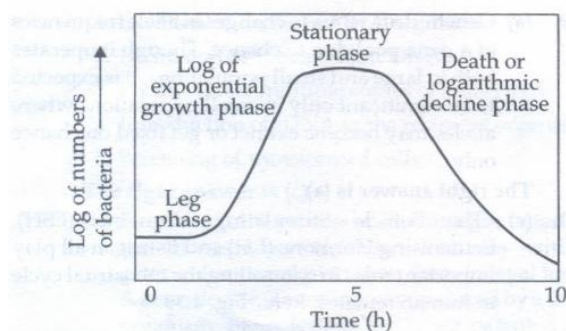
The middle part of the epididymis is called Corpus Epididymis. Epididymis is a mass of long, narrow and closely coiled tubule that lies along the inner side of male testis. Its three parts are- Caput Epididymis, Corpus Epididymis and Cauda Epididymis.

**The right answer is (a).**

**Sol.143 (a)**

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

Fig. 4.40 shows a bacterial curve that depicts four typical phases of growth.



*Fig. 4.40: Bacterial curve showing four typical phases of growth*

**The right answer is (a).**

**Sol.144(c)**

When the male moves his penis to and fro for some time in the vagina, both male and female feel pleasure. That is because the sensitive front part (crown) and the part immediately below it rub against the soft vaginal tissue. At the peak of the copulation act, both male and female have the pleasure peak. This pleasure peak is called Orgasm. Male must ensure that female also gets orgasm otherwise she would not be satisfied at the end of the copulation act. In one act of copulation, male gets orgasm only once but female can have multiple orgasms.

**The right answer is (c).**

**Sol.145 (d)**

The initiation factors in procaryotes are IF3, IF2 and IF1.

**The right answer is (d).**

**Sol.146 (a)**

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

**The right answer is (a).**

**Sol.147 (d)**

Replication is the process of making the copies of human D A. The human D A acts as its own template in this process. DNA replication is an autocatalytic function of DNA. It normally occurs during the S-phase of cell cycle. When chromosomes are in a highly extended form.

**The right answer is (d).**

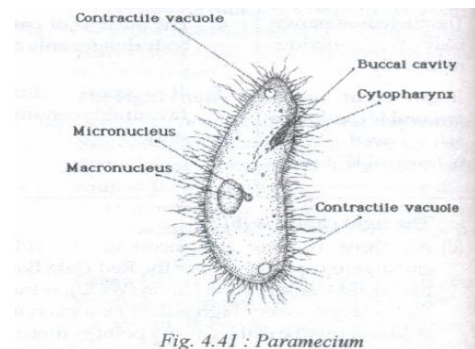
**Sol.148 (b)**

The organisms obtaining energy by chemical reactions independent of light are called Chemoautotrophs. The reactants obtained from the environment may be inorganic (in case of Chemoautotroph) or organic (in case of chemoheterotrophs). Photoautotrophs organisms are the ones that make their own food by photosynthesis, using the energy of sun. Saprophytic organisms are the ones that obtain food from dead and decaying matter.

**The right answer is (d).**

**Sol.149 (d)**

Paramecium is heterokaryotic-it possesses a dimorphic nuclear apparatus (a single large macronucleus which controls metabolism; and one or more small micronuclei concerned with reproduction). Refer Fig. 4.41.



**The right answer is (d).**

**Sol.150 (d)**

Common ancestor is the typical feature of any species. All members of a species living anywhere in the world have been derived from a common ancestor.

**The right answer is (d).**

**Sol.151(c)**

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

**The right answer is (c).**

**Sol.152 (c)**

A dominant gene would lead to the expression of its phenotype irrespective of the fact whether its allelic gene is dominant or recessive. E.g. :R gene, which is responsible for red colour, is dominant over r gene which is responsible for white colour. Then R will express itself in homozygous i.e., RR as well as in heterozygous i.e., Rr conditions.

**The right answer is (c)**

**Sol.153 (c)**

The ability of a gene to affect an organism in many ways is called Pleiotropy (Greek: *Pleion* – more) and that gene is called Pleiotropic Gene. For example, the individuals heterozygous for the sickle cell anaemia ( $Hb^A Hb^S$ ) are resistant to malaria.

**The right answer is (c).**

**Sol.154 (a)**

Jacob and Monod's operon concept is basically the theory of gene expression in prokaryotes.

**The right answer is (a).**

**Sol.155 (a)**

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

**The right answer is (a).**

**Sol.156 (c)**

Total DNA (100) = A + T + C + G

A = 20% (Given)

A = T (Base pairing rule)

$100 = 20 + 20 + C + G$

$C + G = 100 - 40 = 60$

C/G = 30 (because C = G)

Thus, the percentage of Guanine is 30%.

**The right answer is (c).**

**Sol.157(c)**

In option (c), the opposite of the fact has been mentioned. In Prokaryotic transcription, the processing of released RNA does occur in cytoplasm. All statements are correct, except the one mentioned in option (c).

**The right answer is (c).**

**Sol.158 (b)**

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

**The right answer is (b).**

**Sol.159 (a)**

Transduction involves the picking up of DNA by bacteriophage from one bacterial cells and transfer of the same to another where the DNA fragment may get incorporated into the bacterial host's genome.

**The right answer is (a).**

**Sol.160 (b)**

Colchicum autumnal provides an alkaloid called Colchicine which is used in plant breeding for doubling the chromosome number. Treatment with 0.1 percent colchicine inhibits spindle formation so that chromatids fail to separate during anaphase.

**The right answer is (b).**

**Sol.161 (b)**

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

**The right answer is (b).**

**Sol.162 (a)**

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

**The right answer is (a).**

**Sol.163 (a)**

The codon is found in DNA and mRNA but anticodon is found in tRNA.

**The right answer is (a).**

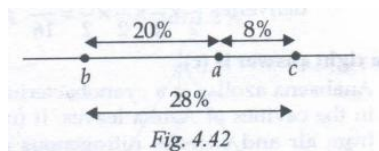
**Sol.164 (a)**

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

**The right answer is (a).**

**Sol.165(a)**

**Refer Fig. 4.42.**



**The right answer is (a).**

**Sol.166 (a)**

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

**The right answer is (a).**

**Sol.167 (b)**

Sympatric species is the one that has been developed due to reproductive isolation. Thus, it occurs in an overlapping or the same area of geographical distribution as its sister species.

**The right answer is (b)**



**Sol.168 (a)**

The interferons IFN- $\gamma$  are produced by Tlymphocytes induced by antigenic stimulation. The interferons IFN- $\alpha$  are produced when lymphocytes and leucocytes are exposed to viruses. The interferons IFN- $\beta$  are produced by fibroblasts, epithelial cells, macrophytes and leucocytes in response to viral infection.

**The right answer is (a).**

**Sol.169 (d)**

In case of complementary genes, the ratio of 9: 7 is obtained in F<sub>2</sub> generation. This was first discovered by Batesian and Punnet. Complementary genes are those genes which express themselves when present together. None of these. Two genes expresses itself when present alone.

**The right answer is (d).**

**Sol.170 (b)**

Linked genes occur on the same chromosome and do not separate during inheritance (complete linkage). Refer Fig. 4.43.

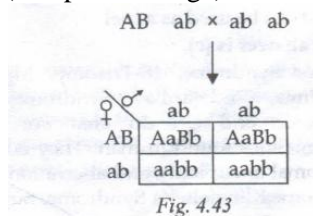


Fig. 4.43

Genotype is AaBb and aabb.

**The right answer is (b).**

**Sol.171(c)**

Probability of having a son in one delivery =  $\frac{1}{2}$

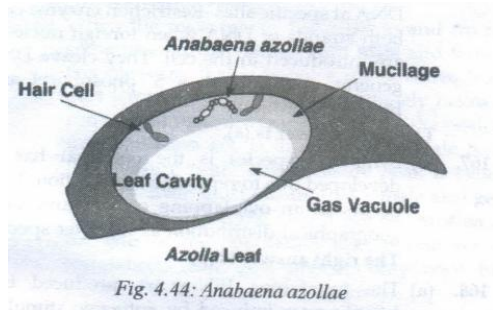
$\therefore$  probability of having four sons in four

$$\text{Deliveries } \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{16}$$

**The right answer is (c).**

**Sol.172 (a)**

Anabaena azollae is a cyanobacterium that lives in the cavities of Azolla leaves. It fixes nitrogen from air and excretes nitrogenous compounds. BGA(Blue-Green Algae-Cyanobacterial) are also nitrogen fixers. Refer Fig. 4.44.



**The right answer is (a).**

**Sol.173 (d)**

In complementary genes, two separate pairs of genes interact to produce the phenotype in such a way that neither of the dominant genes is expressive unless the other one is present.

**The right answer is (d).**

**Sol.174 (a)**

Salmonella typhi causes typhoid fever. The incubation period is about two weeks. The patient first suffers from high fever of 40° Celsius and incessant headache. Polio, TB and Tetanus are caused by the polio virus, Mycobacterium tuberculosis and Clostridium tetani, respectively.

**The right answer is (a).**

**Sol.175 (c)**

Molasses can be processed with help of Saccharomyces cerevisiae, a kind of yeast. It can be used as material for fermentation. Ethanol can be distilled after fermentation. the solid mass left behind can be used as a fuel.

**The right answer is (c)**

**Sol.176 (d)**

Down's Syndrome, 18-Trisomy, Myelogenous Leukemia, Edward's Syndrome, Patau's syndrome and Cri du chat are autosomal abnormalities found in man. They occur due to autosomal aneuploidy and aberrations. Turner's Syndrome, Klinefelter's Syndrome, Superfemales and Supermales occur due to sex chromosomal abnormalities.

**The right answer is (d).**

**Sol.177 (b)**

The word mutation is derived from Latin word mutatus means a change and ion means result of a process. Mutation is a heritable change in the kind structure, sequence or number of the component part of a DNA molecule. Mutation is the original source of genetic variation. It may be harmful. For mutation, the forthcoming generations are less adaptive than their parental generations. As a result of natural selection, the frequency of genes of non-adaptive value is greatly reduced thus leading to diminished diversity and diminished adaptability to further changes.

**The right answer is (b).**

**Sol.178 (b)**

Epimorphosis is the replacement of a lost organ of the body by proliferating new cells from the surface of the wound or injured part. Morphogenesis (Greek term 'Morphe' = form and 'genesis' = origin) is the growth, shaping, and arrangement of body parts according to genetically predefined patterns. The extent, direction, and rate of morphogenesis depend on genetic controls and environmental factors, refer Fig. 4.45.

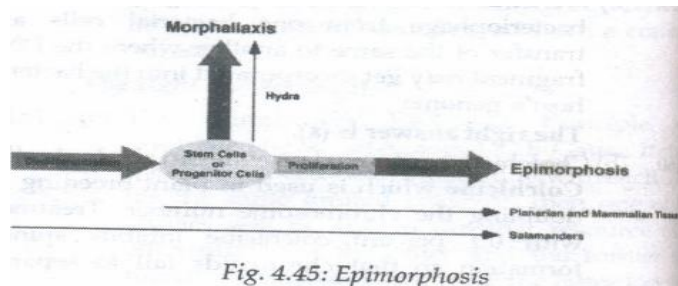


Fig. 4.45: Epimorphosis

The right answer is (b).

**Sol.179 (b)**

In the parlance of "Molecular basis of Inheritance," an inducer is a substrate, hormone or metabolite that, after coming in contact with a repressor, changes the repressor into a non-DNA binding state. It does this to make the operator gene free. For example, the inducer for the lac-operon of *Escherichia coli* is Lactose.

The right answer is (c).

**Sol.180 (b)**

In the model of B-DNA, the base pairs lie at nearly 90 degrees to the axis of the helix. B-DNA is also called Balanced DNA. The DNA Duplex Model was proposed by Watson and Crick. This model is a right-handed spiral.

The right answer is (b).