

NEET

May 4, 2019

Do not open this TEST Booklet until you are asked to do so.

Read Carefully the Instructions on the Back Cover of this Test Booklet

Important Instructions:

- 1 The Answer Sheet is inside this Test Booklet When you are directed to open the Test Booklet, take out the Answer Sheet and fill in the particulars on **Side-1** and **Side-2** carefully with **blue/black** ball point pen only.
- 2 The test is of **3 hours** duration and Test Booklet contains 180 questions. Each question carries **4** marks. For each correct response, the candidate will get **4** marks. For each incorrect response, **one mark** will be deducted from the total scores The maximum marks are 720.
- 3 Use **Blue/Black Ball Point Pen** only for writing particulars on this page/marketing responses.
- 4 Rough work is to be done on the space provided for this purpose in the Test Booklet only.
- 5 **On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator before leaving the Room/Hall. The candidates are allowed to take away this Test Booklet with them.**
- 6 The CODE for this Booklet is **P2** Make sure that the CODE printed on **Side-2** of the Answer Sheet is the same as that on this Test Booklet. In case of discrepancy. the candidate should immediately report the matter to the invigilator for replacement of both the Test Booklet and the Answer Sheet.
- 7 The candidates should ensure that the Answer Sheet is not folded. Do not make any stray marks on the Answer Sheet. Do not write your Roll No. anywhere else except in the specified space in the Test Booklet/Answer Sheet.
- 8 Use of white fluid for correction is **not** permissible on the Answer Sheet.

1. Under isothermal condition, a gas at 300 K expands from 0.1L to 0.25 L against a constant external pressure of 2 bar. The work done by the gas is:

[Given that 1 L bar = 100 J]

- (1) -30 J
- (2) 5 kJ
- (3) 25 J
- (4) 30 J

Solution: (1)

Work done is given by w

$$W = -P_{\text{ext}} \times \Delta V$$

$$= -2 \times (V_2 - V_1)$$

$$= -2 \times (0.25 - 0.10)$$

$$= -0.35 \text{ L bar}$$

$$1 \text{ L bar} = 100 \text{ Joule}$$

$$W = -0.35 \times 100 = -35 \text{ Joule.}$$

2. A compound is formed by cation C and anion A. The anions form hexagonal close packed (hcp) lattice and the cations occupy 75% of octahedral voids. The formula of the compound is:

- (1) C_2A_3
- (2) C_3A_2
- (3) C_3A_4
- (4) C_4A_3

Solution: (3)

Cation (C) Anions (A)

In HCP lattice number of atoms present in unit cell

$$= 6$$

$$\text{Octahedral voids} = 6$$

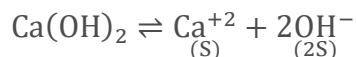
$$\text{Cations} = 6 \times \frac{75}{100} = \frac{9}{2}$$

$$= A_6 C_{\frac{9}{2}} \Rightarrow A_{12} C_9 = A_4 C_3$$

3. pH of a saturated solution of Ca(OH)_2 is 9. The solubility product (K_{sp}) of Ca(OH)_2 is:

- (1) 0.5×10^{-15}
- (2) 0.25×10^{-10}
- (3) 0.125×10^{-15}
- (4) 0.5×10^{-10}

Solution: (1)



pH of saturated solution = 9

$$\text{pH} = 9, [\text{H}^+] = 10^{-9}$$

$$\text{Hence } [\text{OH}^-] = \frac{10^{-14}}{10^{-9}} = 10^{-5}$$

$$2s = 10^{-5}, s = \frac{10^{-5}}{2}$$

$$K_{\text{sp}} \text{ for } \text{Ca(OH)}_2 \Rightarrow 4s^3$$

$$\Rightarrow 4 \times \left(\frac{10^{-5}}{2}\right)^3$$

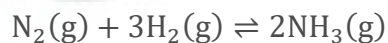
$$= \frac{10^{-5}}{2} = 0.5 \times 10^{-15}$$

4. The number of moles of hydrogen molecules required to produce 20 moles of ammonia through Haber's process is:

- (1) 10
- (2) 20
- (3) 30
- (4) 40

Solution: (3)

Haber's process



2 moles of ammonia – 3 moles of H_2

$$1 - \frac{3}{2} \text{ moles of } \text{H}_2$$

$$2 \text{ moles of ammonia} - \frac{3}{2} \times 20 = 30 \text{ moles of } \text{H}_2$$

Hence 30 moles is correct option.

5. For an ideal solution, the **correct** option is:

- (1) $\Delta_{\text{mix}} S = 0$ at constant T and P
- (2) $\Delta_{\text{mix}} V \neq 0$ at constant T and P
- (3) $\Delta_{\text{mix}} H = 0$ at constant T and P
- (4) $\Delta_{\text{mix}} G = 0$ at constant T and P

Solution: (3)

For an ideal solution,

$$\Delta H_{\text{mix}} = 0, \text{ also } \Delta V_{\text{mix}} = 0$$

At constant temperature and pressure.

6. For a cell involving one electron $E_{\text{cell}}^{\ominus} = 0.59 \text{ V}$ at 298 K, the equilibrium constant for the cell reaction is:

$$\left[\text{Given that } \frac{2.303 RT}{F} = 0.059 \text{ V at } T = 298 \text{ K} \right]$$

- (1) 1.0×10^2
- (2) 1.0×10^5
- (3) 1.0×10^{10}
- (4) 1.0×10^{30}

Solution: (3)

$$E^{\circ} = 0.59 \text{ V}$$

$$\Delta G^{\circ} = -nFE^{\circ}; \text{ Since } (n = 1)$$

$$\Delta G^{\circ} = -RT \ln K$$

$$-1 \times F \times 0.59 = -RT \times 2.303 \log K$$

$$0.59 = \frac{2.303 RT}{F} \log K$$

$$0.59 = 0.059 \log K$$

$$10 = \log K$$

$$K = 10^{10}$$

7. Among the following, the one that is not a green house gas is:

- (1) nitrous oxide
- (2) methane
- (3) ozone

(4) sulphur dioxide

Solution: (4)

Green House gases are Methane, water vapour, Nitrous oxide, CFCS and Ozone etc.,

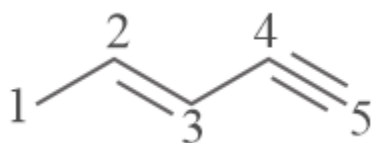
Hence SO_2 is not a green house gas.

8. The number of sigma (σ) and pi (π) bonds in pent-2-en-4-yne is:

- (1) 10 σ bonds and 3 π bonds
- (2) 8 σ bonds and 5 π bonds
- (3) 11 σ bonds and 2 π bonds
- (4) 13 σ bonds and no π bonds

Solution: (Bonus)

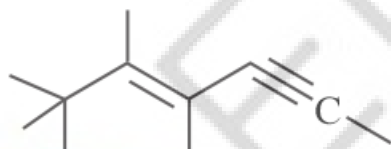
Pent-2en-4yne



Name should be Pent-3-en-1 yne

Number of π bonds = 3

Number of σ bonds



9. Which of the following diatomic molecular species has only π bonds according to Molecular Orbital Theory?

- (1) O_2
- (2) N_2
- (3) C_2
- (4) Be_2

Solution: (3)

$$\text{C}_2 = (12); \sigma 1s^2 < \sigma^* 1s^2 < \sigma 2s^2 < \sigma^* 2s^2 < \pi 2p_x^2 = \pi 2p_y^2$$

So according to MOT, the orbitals involved in bonding are only pie orbital.

Hence C_2 contains only π bonds.

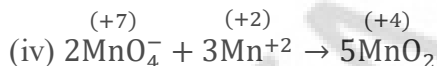
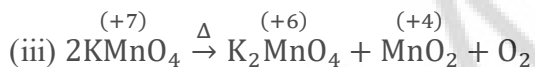
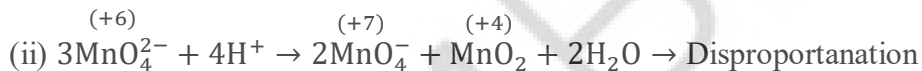
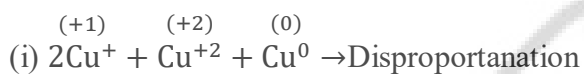
10. Which of the following reactions are disproportionation reaction?

- (a) $2\text{Cu}^+ \rightarrow \text{Cu}^{2+} + \text{Cu}^0$
(b) $3\text{MnO}_4^{2-} + 4\text{H}^+ \rightarrow 2\text{MnO}_4^- + \text{MnO}_2 + 2\text{H}_2\text{O}$
(c) $6\text{KMnO}_4 \xrightarrow{\Delta} \text{K}_2\text{MnO}_4 + \text{MnO}_2 + \text{O}_2$
(d) $2\text{MnO}_4^- + 3\text{Mn}^{2+} + 2\text{H}_2\text{O} \rightarrow 5\text{MnO}_2 + 4\text{H}^+$

Select the correct option from the following:

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

Solution: (1)



Hence correct option (i) and (ii) only.

11. Among the following, the narrow spectrum antibiotic is:

- (1) penicillin G
(2) ampicillin
(3) amoxycillin
(4) chloramphenicol

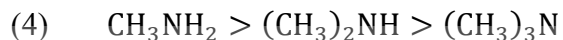
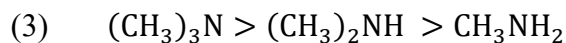
Solution: (1)

Those effective mainly against gram positive or gram negative bacteria are narrow spectrum antibiotics.

Penicillin G has a narrow spectrum.

12. The **correct** order of the basis strength of methyl substituted amines in aqueous solution is:

- (1) $(\text{CH}_3)_2\text{NH} > \text{CH}_3\text{NH}_2 > (\text{CH}_3)_3\text{N}$



Solution: (1)

Combined effect of the inductive effect of Alkyl group (+I), steric hindrance and the solvation of Amines causes the basicity order to be

Secondary Amine > Primary Amine > Tertiary Amine



13. Which mixture of the solutions will lead to the formation of negatively charged colloidal $[\text{AgI}]\text{I}^-$ sol?



Solution: (1 and 2)

Formation of negatively charged colloidal



\therefore it will form negatively charged solution.

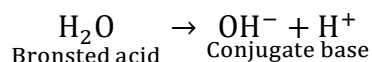


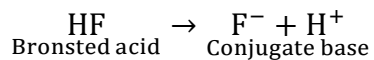
14. Conjugate base for Bronsted acids H_2O and HF are:



Solution: (3)

Conjugate base for Bronsted acid H_2O , HF are





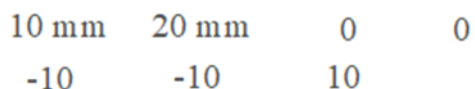
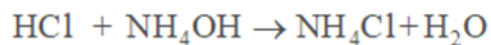
15. Which will make basic buffer?

- (1) 50 mL of 0.1 M NaOH + 25 mL of 0.1 M CH₃COOH
- (2) 100 mL of 0.1 M CH₃COOH + 100 mL of 0.1 M NaOH
- (3) 100 mL of 0.1 M HCl + 200 mL of 0.1 M NH₄OH
- (4) 100 mL of 0.1 M HCl + 100 mL of 0.1 M NaOH

Solution: (3)

Basic Buffer \Rightarrow weak base + conjugate base

100 ml of 0.1 M HCl + 200 ml of 0.1 M NH₄OH



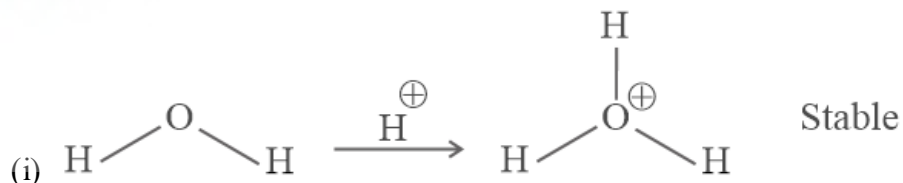
Hence option (3); (NH₄OH + NH₄Cl)

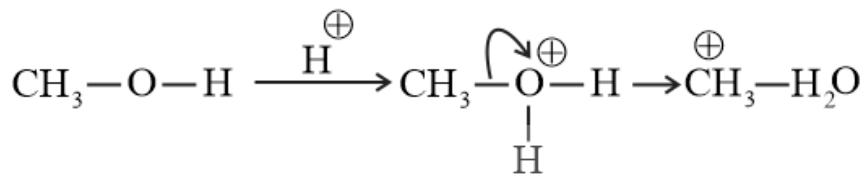
16. The compound that is most difficult to protonate is:

- (1)
- (2)
- (3)
- (4)

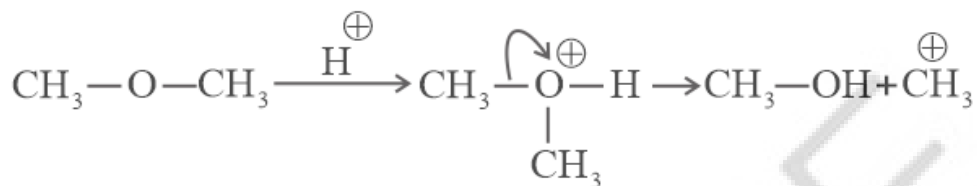
Solution: (4)

The compound that is more difficult to protonate is



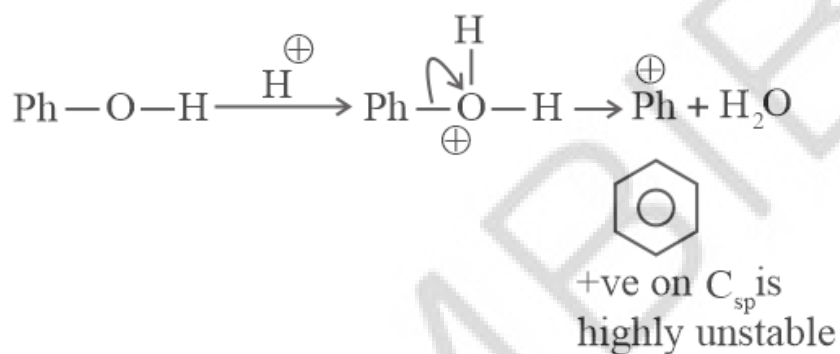


(ii)

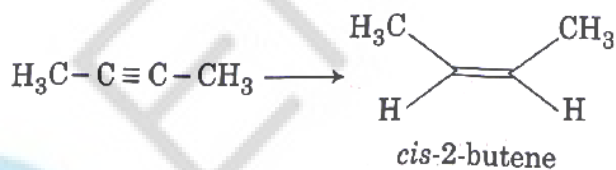


(iii)

(iv)

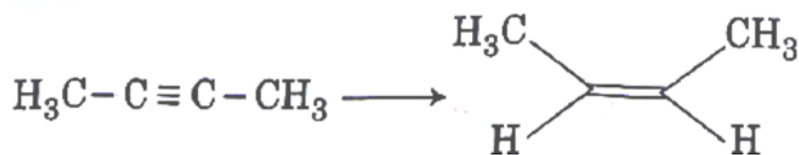


17. The most suitable reagent for the following conversion, is:



- (1) Na/liquid NH₃
- (2) H₂, Pd/C, quinoline
- (3) Zn/HCl
- (4) Hg²⁺/H⁺, H₂O

Solution: (2)



(i) Na/ Liquid NH₃ (Birch reduction) it reduce non terminal into alkene (trans/anti addition)

(ii) $\text{H}_2/\text{Pd} - \text{C}$, quinoline (lindlar catalyst) reduce alkyne into alkene by syn addition.

(iii) Zn/HCl is climenson reduction which reduced carbonyl into alkene.

(iv) $\text{Hg}^{+2}/\text{H}^{\oplus}$, H_2O is electrophilic addition reaction an convert alkyne into ketone.

18. Which of the following species is not stable?



Solution: (4)

$[\text{SiCl}_6]^{-2}$ is unstable due to steric hinderance.

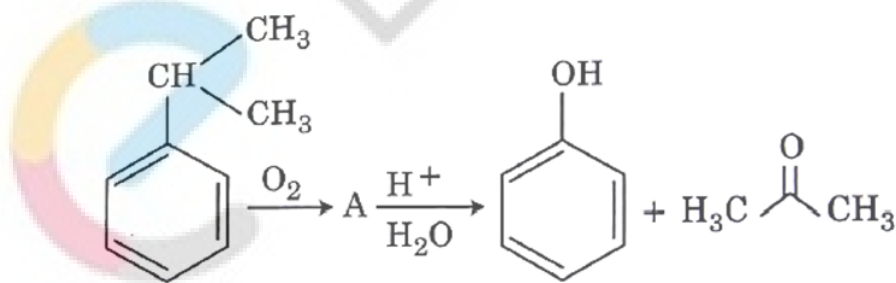
19. Which of the following is an amphoteric hydroxide?

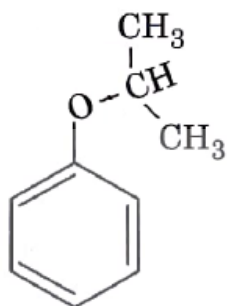


Solution: (4)

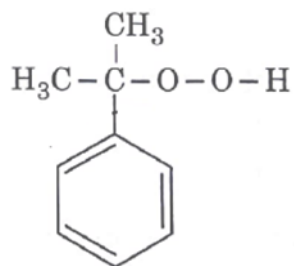
$\text{Be}(\text{OH})_2$ is amphoteric hydroxide.

20. The structure of intermediate A in the following reaction, is:

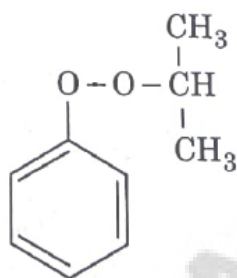




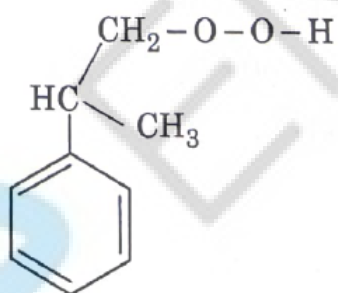
(1)



(2)

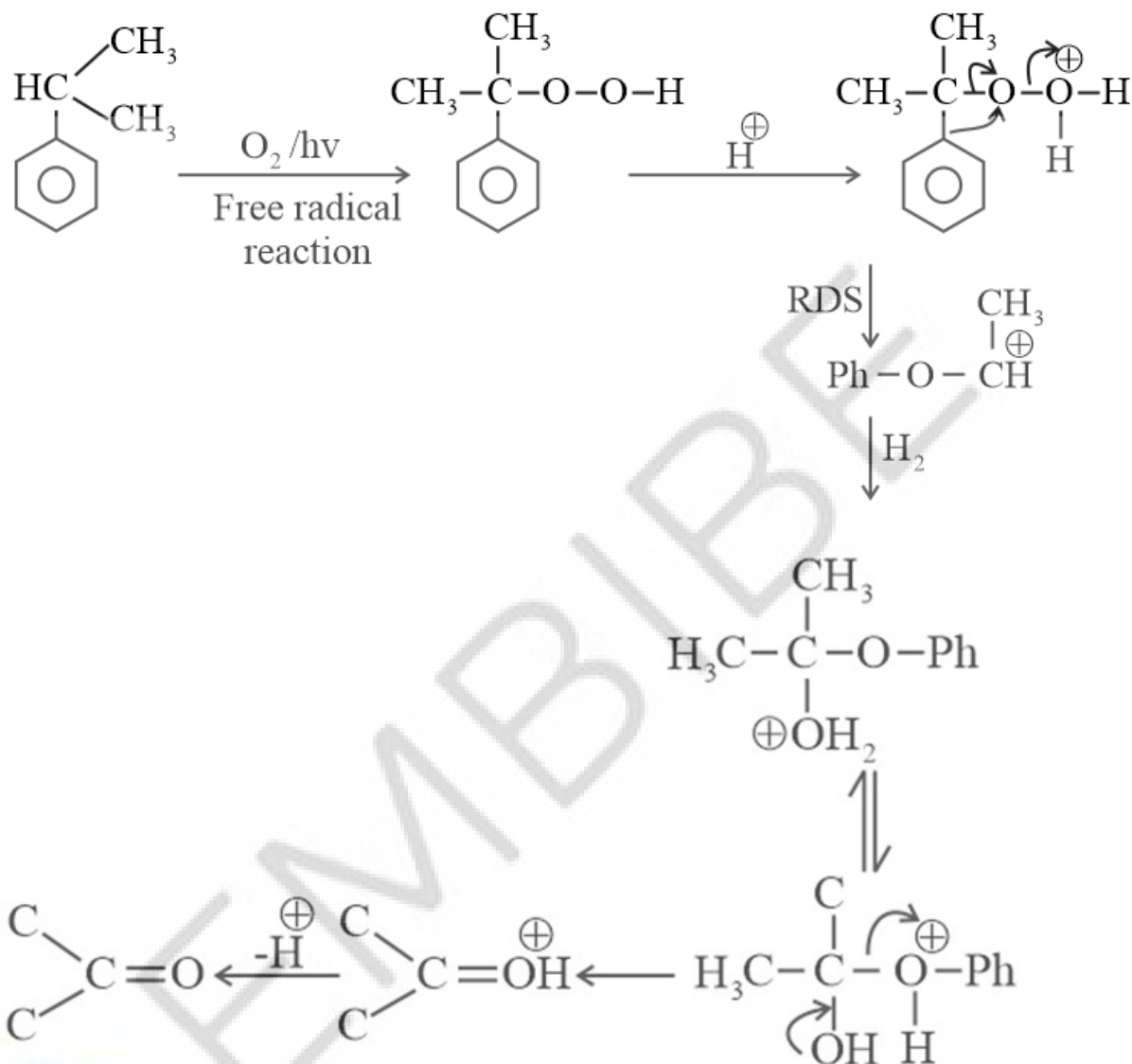


(3)



(4)

Solution: (2)

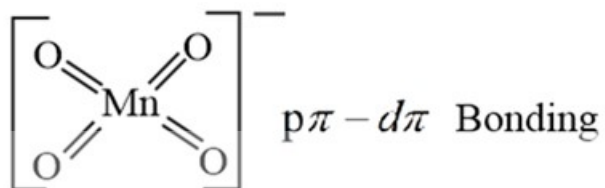


21. The manganate and permanganate ions are tetrahedral, due to:

- (1) The π -bonding involves overlap of p-orbitals of oxygen with d-orbitals of manganese
- (2) There is no π -bonding
- (3) The π -bonding involves overlap of p-orbitals of oxygen with p-orbitals of manganese
- (4) The π -bonding involves overlap of d-orbitals of oxygen with d-orbitals of manganese

Solution: (1)

The manganate and permanganate ions are tetrahedral due to the π – bonding involves overlap of p – orbitals of oxygen with d – orbitals of manganese.



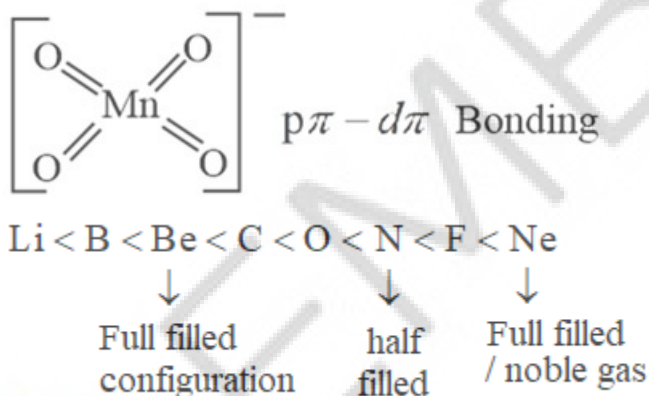
22. For the second period elements the **correct** increasing order of first ionization enthalpy is:

- (1) $\text{Li} < \text{Be} < \text{B} < \text{C} < \text{N} < \text{O} < \text{F} < \text{Ne}$
- (2) $\text{Li} < \text{B} < \text{Be} < \text{C} < \text{O} < \text{N} < \text{F} < \text{Ne}$
- (3) $\text{Li} < \text{B} < \text{Be} < \text{C} < \text{N} < \text{O} < \text{F} < \text{Ne}$
- (4) $\text{Li} < \text{Be} < \text{B} < \text{C} < \text{O} < \text{N} < \text{F} < \text{Ne}$

Solution: (2)

Ionisation Enthalpy $\propto Z_{\text{effective}} \propto$ Stable configuration

Left to right in a period $z_{\text{eff}} \uparrow$ so ionization enthalpy increases.



23. If the rate constant for a first order reaction is k , the time (t) required for the completion of 99% of the reaction is given by:

- (1) $t = 0.693/k$
- (2) $t = 6.909/k$
- (3) $t = 4.606/k$
- (4) $t = 2.303/k$

Solution: (3)

$$k = \frac{2.303}{t} \log \frac{a}{a-x}$$

$$a = 100$$

$$a - x = 100 - 99 = 1$$

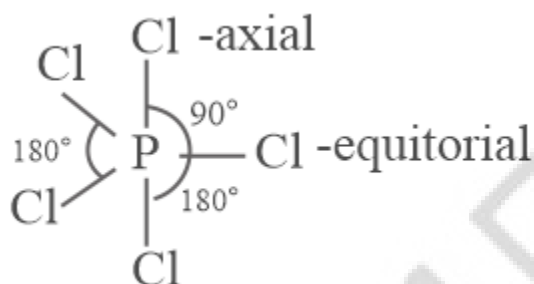
$$k = \frac{2.303}{t} \log \frac{100}{1}$$

$$t = 4.606$$

24. Identify the **incorrect** statement related to PCl_5 from the following:

- (1) Three equatorial P – Cl bonds make an angle of 120° with each other
- (2) Two axial P – Cl bonds make an angle of 180° with each other
- (3) Axial P – Cl bonds are longer than equatorial P – Cl bonds
- (4) PCl_5 molecule is non-reactive

Solution: (4)



- (i) Three equatorial P – Cl bonds make an angle of 120° with each other is correct
- (ii) Two axial P – Cl bonds make an angle of 180° with each other.
- (iii) Axial P – Cl bonds are longer than equatorial because according to Bent's rule the hybrid orbitals that contain more p – character or less s character. Put on axial position and has more bond length and less bond angle.
- (iv) PCl_5 molecule is reactive (W) is incorrect answer.

25. 4d, 5p, 5f and 6p orbitals are arranged in the order of decreasing energy. The **correct** option is:

- (1) $5f > 6p > 5p < 4d$
- (2) $6p > 5f > 5p > 4d$
- (3) $6p > 5f > 4d > 5p$
- (4) $5f > 6p > 4d > 5p$

Solution: (1)

$n + l$ value

$$4d = 4 + 2 = 6$$

$$5p = 5 + 1 = 6$$

$$5f = 5 + 3 = 8$$

$$6p = 6 + 1 = 7$$

Which has $(n + l)$ value high, have more energy. If $(n + l)$ is same for two orbitals then n value is more have more energy.

$$5f > 6p > 5p > 4d$$

26. The biodegradable polymer is:

- (1) nylon-6, 6
- (2) nylon 2-nylon 6
- (3) nylon-6
- (4) Buna-S

Solution: (2)

Nylon-2-nulone-6 is biodegradable polymer.

27. Match the Xenon compounds in **Column-I** with its structure in **Column-II** and assign the **correct** code:

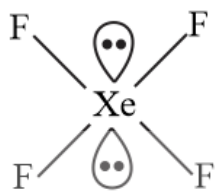
	Column-I		Column-II
(a)	XeF_4	(i)	pyramidal
(b)	XeF_6	(ii)	square planar
(c)	XeOF_4	(iii)	distorted octahedral
(d)	XeO_3	(iv)	square pyramidal

Code:

	(a)	(b)	(c)	(d)
(1)	(i)	(ii)	(iii)	(iv)
(2)	(ii)	(iii)	(iv)	(i)
(3)	(ii)	(iii)	(i)	(iv)
(4)	(iii)	(iv)	(i)	(ii)

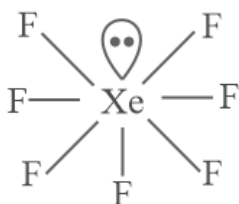
Solution: (2)

(a) XeF_4



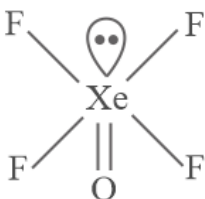
sp^3d^2 hybridisation square planar.

(b) XeF_6



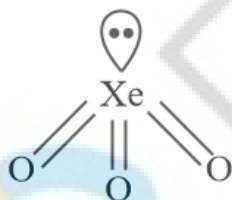
sp^3d^3 hybridisation distorted octahedral

(c)



sp^3d^2 hybridisation square pyramidal

(d)



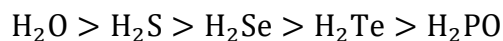
sp^3 hybridisation pyramid shape.

28. Which is the **correct** thermal stability order for H_2E ($E = O, S, Se, Te$ and Po)?

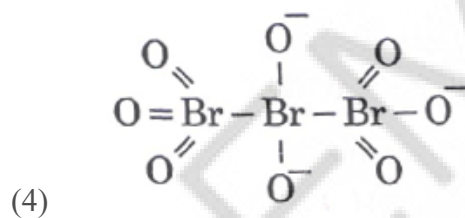
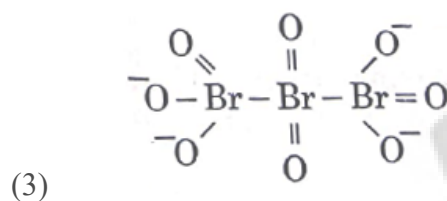
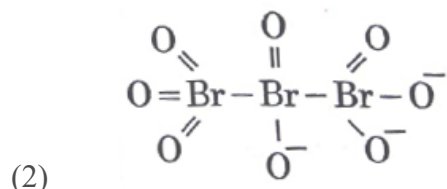
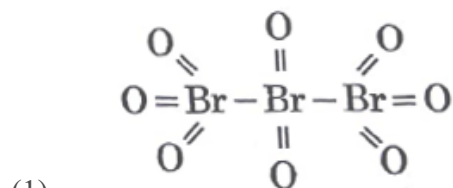
- (1) $H_2S < H_2O < H_2Se < H_2Te < H_2Po$
- (2) $H_2O < H_2S < H_2Se < H_2Te < H_2Po$
- (3) $H_2Po < H_2Te < H_2Se < H_2S < H_2O$
- (4) $H_2Se < H_2Te < H_2Po < H_2O < H_2S$

Solution: (3)

Thermal stability of H_2F is decrease in bond ($\text{H} - \text{E}$) dissociation enthalpy down the group. Thermal stability of hybrids also decreases from H_2O to H_2PO

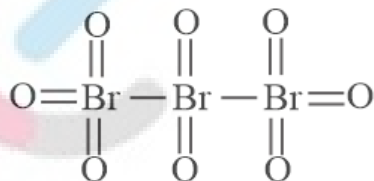


29. The correct structure of tribromo-octaoxide is:

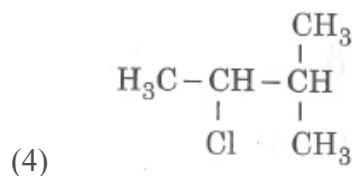
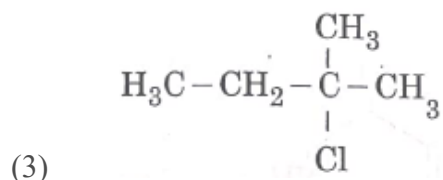
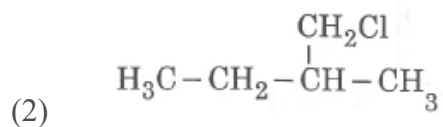
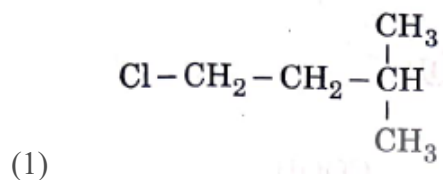


Solution: (1)

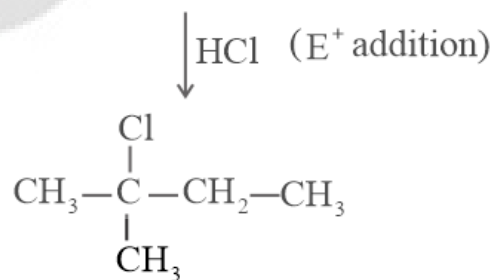
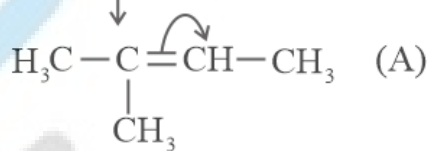
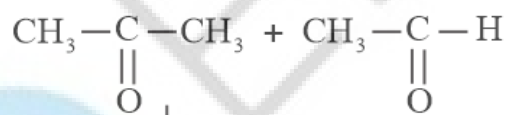
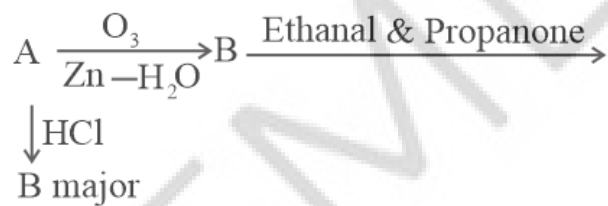
Tribromo octaoxide is



30. An alkene "A" on reaction with O_3 and $\text{Zn} - \text{H}_2\text{O}$ gives propanone and ethanal in equimolar ratio. Additional of HCl to alkene "A" gives "B" as the major product. The structure of product "B" is:



Solution: (3)



31. Enzymes that utilize ATP in phosphate transfer require an alkaline earth metal (M) as the cofactor. M is

- (1) Be
- (2) Mg
- (3) Ca
- (4) Sr

Solution: (2)

Magnesium is an essential element in biological systems. Over 300 enzymes require the presence of magnesium ions for their catalytic action, including all enzymes utilizing and synthesizing ATP.

32. Which one is malachite from the following?

- (1) CuFeS_2
- (2) $\text{Cu}(\text{OH})_2$
- (3) Fe_3O_4
- (4) $\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$

Solution: (4)

Malachite is a green copper carbonate hydroxide mineral with the chemical formula $\text{Cu} \cdot \text{CO}_3 \cdot \text{Cu}(\text{OH})_2$

33. Which of the following series of transitions in the spectrum of hydrogen atom falls in visible region?

- (1) Lyman series
- (2) Balmer series
- (3) Paschen series
- (4) Brackett series

Solution: (2)

Among the given series, lines of Balman series are the only lines in the hydrogen spectrum which appear in the visible spectrum lyman lies in the ultraviolet region while Paschen and Brackett series lie in the infrared region.

34. The mixture that forms maximum boiling azeotrope is:

- (1) Water + Nitric Acid
- (2) Ethanol + Water
- (3) Acetone + Carbon disulphide

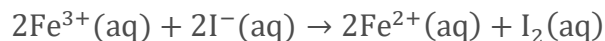
(4) Heptane+ Octane

Solution: (1)

The mixture that has point of azeotrope higher than the boiling point of constituents is called maximum boiling azeotrope.

Water and Nitric acid form maximum boiling azeotrope in 68% nitric acid solution.

35. For the cell reaction



$E_{\text{cell}}^{-} = 0.24 \text{ V}$ at 298 K. The standard Gibbs energy ($\Delta_r G^{-}$) of the cell reaction is:

[Given that Faraday constant $F = 96500 \text{ C mol}^{-1}$]

(1) $-46.32 \text{ kJ mol}^{-1}$

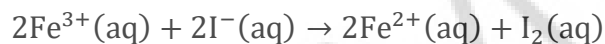
(2) $-23.16 \text{ kJ mol}^{-1}$

(3) $46.32 \text{ kJ mol}^{-1}$

(4) $23.16 \text{ kJ mol}^{-1}$

Solution: (1)

For the cell reaction



$$n = 2$$

$$F = 96500$$

$$E = 0.24 \text{ V}$$

$$\Delta G = -nFE = -2 \times 96500 \times 0.24$$

$$= -46320 \text{ J}$$

$$= -46.32 \text{ kJ}$$

36. In which case change in entropy is negative?

(1) Evaporation of water

(2) Expansion of a gas at constant temperature

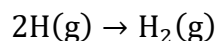
(3) Sublimation of solid to gas

(4) $2\text{H}(\text{g}) \rightarrow \text{H}_2(\text{g})$

Solution: (4)

In the change in entropy is negative, it implies that the system is getting ordered or organized.

Among the given options,



Is leading to order as atom are combining to form molecules.

37. Match the following:

(a)	Pure nitrogen	(i)	Chlorine
(b)	Haber process	(ii)	Sulphuric acid
(c)	Contact process	(iii)	Ammonia
(d)	Deacon's process	(iv)	Sodium azide or Barium azide

Which of the following is the **correct** option?

	(a)	(b)	(c)	(d)
(1)	(i)	(ii)	(iii)	(iv)
(2)	(ii)	(iv)	(i)	(iii)
(3)	(iii)	(iv)	(ii)	(i)
(4)	(iv)	(iii)	(ii)	(i)

Solution: (4)

Haber's process is the industrial process for production of ammonia.

Contact process is the industrial process for production of sulphuric acid.

Pure nitrogen is prepared from sodium azides.

Deacon's process is the commercial preparation of chlorine.

38. Which of the following is incorrect statement?

- (1) PbF_4 is covalent in nature
- (2) SiCl_4 is easily hydrolysed
- (3) GeX_4 ($\text{X} = \text{F}, \text{Cl}, \text{Br}, \text{I}$) is more stable than GeX_2
- (4) SnF_4 is ionic in nature

Solution: (1)

Except for first statement, all other statements are correct.

Lead tetrafluoride is an ionic compound and thus, is not covalent by nature.

39. The non-essential amino acid among the following is:

- (1) valine
- (2) leucine
- (3) alanine
- (4) lysine

Solution: (3)

There are 11 nonessential amino acids of which Alanine is one.

40. A gas at 350 K and 15 bar has molar volume 20 percent smaller than that for an ideal gas under the same conditions. The **correct** option about the gas and its compressibility factor (Z) is:

- (1) $Z > 1$ and repulsive forces are dominant
- (2) $Z > 1$ and attractive forces are dominant
- (3) $Z < 1$ and attractive forces are dominant
- (4) $Z < 1$ and repulsive forces are dominant

Solution: (3)

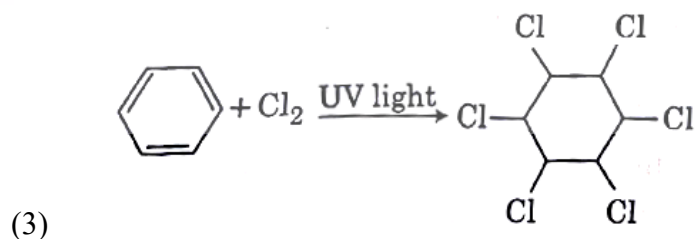
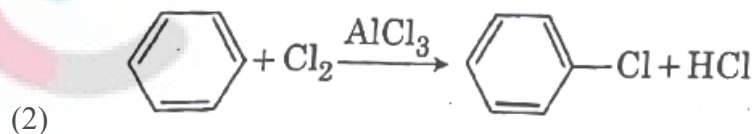
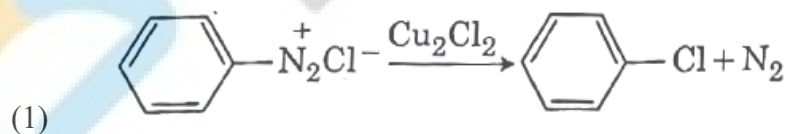
$Z = \frac{PV}{nRT}$ as V is 20% lesser than it would have been for an ideal gas.

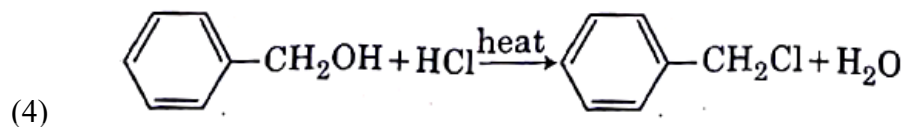
∴ PV will be lesser than expected

∴ $Z < 1$

Since volume is lesser, attractive forces are dominant.

41. Among the following, the reaction that proceeds through an electrophilic substitution, is:





Solution: (2)

Option 2 proceeds through an electrophilic substitution reaction.

Cl_2 is split by AlCl_3 to form

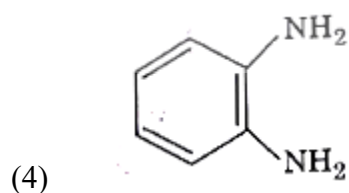
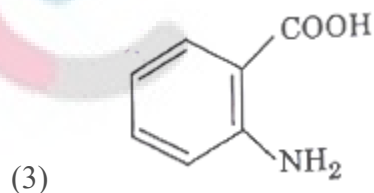
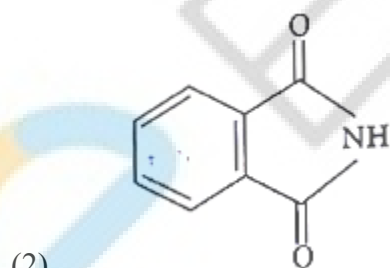
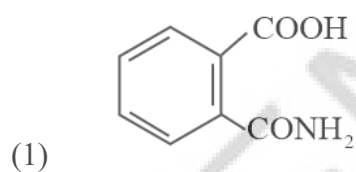
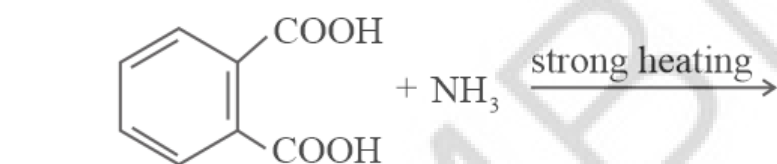
Cl^+ and $[\text{AlCl}_4]^-$. This Cl^+ attaches the molecule making it electrophilic substitution.

Option 1 is nucleophilic addition

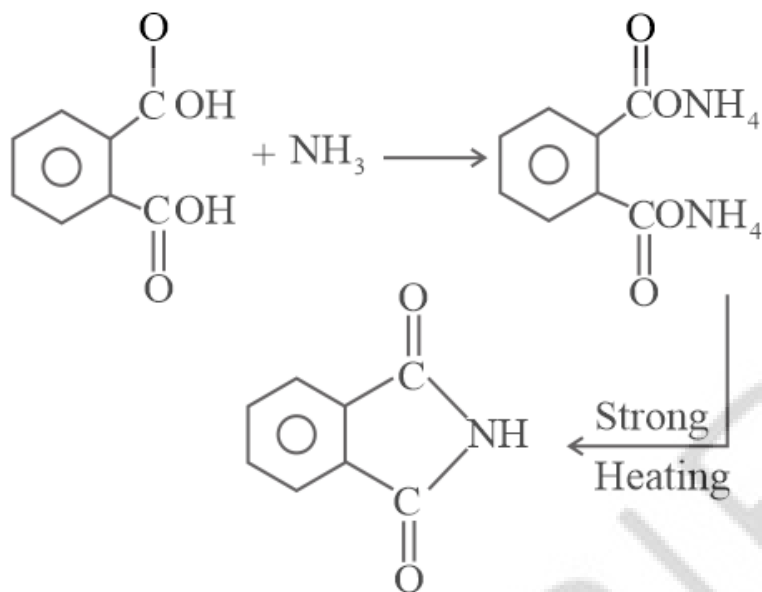
Option 3 is an addition reaction

Option 4 is nucleophilic substitution.

42. The major product of the following reaction is:



Solution: (2)



43. For the chemical reaction

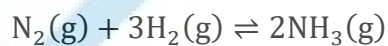
$$\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$$

 the **correct** option is:

- (1) $-\frac{1}{3} \frac{d[\text{H}_2]}{dt} = -\frac{1}{2} \frac{d[\text{NH}_3]}{dt}$
 (2) $-\frac{d[\text{N}_2]}{dt} = 2 \frac{d[\text{NH}_3]}{dt}$
 (3) $-\frac{d[\text{N}_2]}{dt} = \frac{1}{2} \frac{d[\text{NH}_3]}{dt}$
 (4) $3 \frac{d[\text{H}_2]}{dt} = 2 \frac{d[\text{NH}_3]}{dt}$

Solution: (3)

For the reaction



$$\text{Rate} = \frac{-d[\text{N}_2]}{dt} = \frac{-1}{3} \frac{d[\text{H}_2]}{dt} = \frac{1}{2} \frac{d[\text{NH}_3]}{dt}$$

$$\therefore \frac{-d[\text{N}_2]}{dt} = \frac{1}{2} \frac{d[\text{NH}_3]}{dt}$$

44. What is the correct electronic configuration of the central atom in $\text{K}_4[\text{Fe}(\text{CN})_6]$ based on crystal field theory?

- (1) $t_{2g}^4 e_g^2$
 (2) $t_{2g}^6 e_g^0$

(3) $e^3 t_2^3$

(4) $e^4 t_2^2$

Solution: (2)

Coordination compounds

In the complex: $K_4[Fe(CN)_6]$

Fe exists as Fe^{2+}

Electronic configuration

$= [Ar]3d^6$

$\uparrow\downarrow$	\uparrow	\uparrow	\uparrow	\uparrow
----------------------	------------	------------	------------	------------

\therefore CN is a strong ligand, it will cause pairing up \rightarrow

$\uparrow\downarrow$	$\uparrow\downarrow$	$\uparrow\downarrow$		
----------------------	----------------------	----------------------	--	--

\therefore Electronic configuration is $t_{2g}^6 e_g^0$

45. The method used to remove temporary hardness of water is:

- (1) Calgon's method
- (2) Clark's method
- (3) Ion-exchange method
- (4) Synthetic resins method

Solution: (2)

Clark's method is used to remove temporary hardness in water.

Calgon's method, ion-exchange method and synthetic resins method are used to remove permanent hardness in water.

46. In which of the following processes, heat is neither absorbed nor released by a system?

- (1) isothermal
- (2) adiabatic
- (3) isobaric
- (4) isochoric

Solution: (2)

46. In which of the following processes, heat is neither absorbed nor released by a system?

- (1) isothermal
- (2) adiabatic
- (3) isobaric
- (4) isochoric

Solution: (2)

Adiabatic process

47. Increase in temperature of a gas filled in a container would lead to:

- (1) increase in its mass
- (2) increase in its kinetic energy
- (3) decrease in its pressure
- (4) decrease in intermolecular distance

Solution: (2)

Increases in its kinetic energy with temperature

48. The total energy of an electron in an electron in an atom in an orbit is -3.4 eV. Its kinetic and potential energies are, respectively:

- (1) -3.4 eV, -3.4 eV
- (2) -3.4 eV, -6.8 eV
- (3) 3.4 eV, -6.8 eV
- (4) 3.4 eV, 3.4 eV

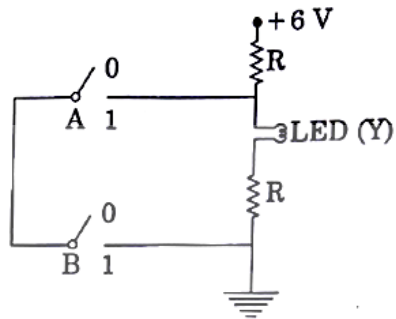
Solution: (3)

$$KE = -TE$$

$$\Rightarrow KE = 3.4 \text{ eV}$$

$$PE = 2 \cdot TE = -6.8 \text{ eV}$$

49. The **correct** Boolean operation represented by the circuit diagram drawn is:



- (1) AND
- (2) OR
- (3) NAND
- (4) NOR

Solution: (3)

Truth table

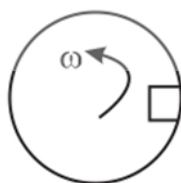
NAND gate

A	B	
0	0	1
1	0	1
0	1	1
1	1	0

50. A block of mass 10 kg is in contact against the inner wall of a hollow cylindrical drum of radius 1 m. The coefficient of friction between the block and the inner wall of the cylinder is 0.1. The minimum angular velocity needed for the cylinder to keep the block stationary when the cylinder is vertical and rotating about its axis, will be: ($g = 10 \text{ m/s}^2$)

- (1) $\sqrt{10} \text{ rad/s}$
- (2) $\frac{10}{2\pi} \text{ rad/s}$
- (3) 10 rad/s
- (4) $10\pi \text{ rad/s}$

Solution: (3)



$$N = m\omega^2 R$$

$$f = mg$$

For minimum angular velocity

$$f = \mu N$$

$$mg = \mu \cdot m\omega^2 R$$

$$\omega = \sqrt{\frac{g}{\mu R}} = \sqrt{\frac{10}{0.1 \times 1}} = 10 \text{ rad/s}$$

51. Body A of mass $4m$ moving with speed u collides with another body B of mass $2m$, at rest. The collision is head on and elastic in nature. After the collision the fraction of energy lost by the colliding body A is:

(1) $\frac{1}{9}$

(2) $\frac{8}{9}$

(3) $\frac{4}{9}$

(4) $\frac{5}{9}$

Solution: (2)



$$4mu + 0 = 4mv_1 + 2mv_2$$

$$\Rightarrow 2u = 2v_1 + v_2 \quad \dots (1)$$

For elastic collision

$$e = 1$$

$$\Rightarrow u = v_2 - v_1 \quad \dots (2)$$

from (1) and (2)

$$4u = 3v_2 \Rightarrow v_2 = \frac{4}{3}u$$

$$\text{and } v_1 = \frac{u}{3}$$

Fraction of energy lost by A

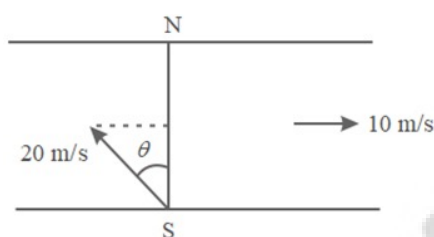
$$= \frac{\frac{1}{2}4mu^2 - \frac{1}{2}4mv_1^2}{\frac{1}{2}4mu^2}$$

$$= \frac{u^2 - \frac{u^2}{9}}{u^2} = \frac{8}{9}$$

52. The speed of a swimmer in still water is 20 m/s. The speed of river water is 10 m/s and is flowing due east. If he is standing on the south bank and wishes to cross the river along the shortest path, the angle at which he should make his strokes w.r.t. north is given by:

- (1) 30° west
- (2) 0°
- (3) 60° west
- (4) 45° west

Solution: (1)



$$\sin \theta = \frac{10}{20} = \frac{1}{2}$$

$$\theta = 30^\circ$$

30° west of North

53. A mass m is attached to a thin wire and whirled in a vertical circle. The wire is most likely to break when:

- (1) the mass is at the highest point
- (2) the wire is horizontal
- (3) the mass is at the lowest point
- (4) inclined at an angle of 60° from vertical

Solution: (3)

Tension is maximum at lowest point most likely string will break at lowest point

54. The displacement of a particle executing simple harmonic motion is given by

$$y = A_0 + A \sin \omega t + B \cos \omega t.$$

Then the amplitude of its oscillation is given by:

- (1) $A_0 + \sqrt{A^2 + B^2}$

$$(2) \quad \sqrt{A^2 + B^2}$$

$$(3) \quad \sqrt{A_0^2 + (A + B)^2}$$

$$(4) \quad A + B$$

Solution: (2)

$$y = A_0 + A \sin \omega t + B \cos \omega t$$

$$= A_0 + \sqrt{A^2 + B^2} \cdot \left[\frac{A}{\sqrt{A^2 + B^2}} \sin \omega t + \frac{B}{\sqrt{A^2 + B^2}} \cos \omega t \right]$$

$$= A_0 + \sqrt{A^2 + B^2} \cdot \sin(\omega t + \varphi)$$

$$\text{Amplitude} = \sqrt{A^2 + B^2}$$

55. A 800 turn coil of effective area 0.05 m^2 is kept perpendicular to a magnetic field $5 \times 10^{-5} \text{ T}$. When the plane of the coil is rotated by 90° around any of its coplanar axis in 0.1 s , the emf induced in the coil will be:

$$(1) \quad 2 \text{ V}$$

$$(2) \quad 0.2 \text{ V}$$

$$(3) \quad 2 \times 10^{-3} \text{ V}$$

$$(4) \quad 0.02 \text{ V}$$

Solution: (4)

$$e = \frac{\Delta \phi}{\Delta t}$$

$$= \frac{NBA}{\Delta t}$$

$$= \frac{800 \times 5 \times 10^{-5} \times 0.05}{0.1} \text{ V}$$

$$= 0.02 \text{ V}$$

56. Average velocity of a particle executing SHM in one complete vibration is:

$$(1) \quad \frac{A\omega}{2}$$

$$(2) \quad A\omega$$

$$(3) \quad \frac{A\omega^2}{2}$$

$$(4) \quad \text{Zero}$$

Solution: (4)

$$V_{\text{avg}} = 0$$

57. A soap bubble, having radius of 1 mm, is blown from a detergent solution having a surface tension of 2.5×10^{-2} N/m. The pressure inside the bubble equals at a point Z_0 below the free surface of water in a container. Taking $g = 10 \text{ m/s}^2$, density of water = 10^3 kg/m^3 , the value of Z_0 is:

- (1) 100 cm
- (2) 10 cm
- (3) 1 cm
- (4) 0.5 cm

Solution: (3)

$$\Delta P = \frac{4T}{R}$$

$$\text{Now } \frac{4T}{R} = \rho g Z_0$$

$$Z_0 = \frac{4T}{\rho g Z_0} = \frac{4 \times 2.5 \times 10^{-2}}{10^3 \times 10 \times 10^{-3}}$$

$$= \frac{1}{100} \text{ m}$$

$$= 1 \text{ cm}$$

58. A copper rod of 88 cm and an aluminum rod of unknown length have their increase in length independent of increase in temperature. The length of aluminum rod is: ($\alpha_{\text{Cu}} = 1.7 \times 10^{-5} \text{ K}^{-1}$ and $\alpha_{\text{Al}} = 2.2 \times 10^{-5} \text{ K}^{-1}$)

- (1) 6.8 cm
- (2) 113.9 cm
- (3) 88 cm
- (4) 68 cm

Solution: (4)

Increase in length is independent of temperature,

$$L_{\text{Cu}} \alpha_{\text{Cu}} = L_{\text{Al}} \alpha_{\text{Al}}$$

$$L_{\text{Al}} = (88 \text{ cm}) \frac{(1.7 \times 10^{-5})}{(2.2 \times 10^{-5})}$$

$$= 68 \text{ cm}$$

59. The unit of thermal conductivity is:

- (1) J m K^{-1}
- (2) $\text{J m}^{-1} \text{K}^{-1}$
- (3) W m K^{-1}
- (4) $\text{W m}^{-1} \text{K}^{-1}$

Solution: (4)

$$\frac{\Delta Q}{\Delta t} = KA \frac{\Delta T}{\Delta l}$$

$$K = \frac{\Delta Q}{\Delta t} \frac{\Delta l}{\Delta T} \frac{1}{A}$$

\therefore unit of K is $\text{W m}^{-1} \text{K}^{-1}$

60. When a block of mass M is suspended by a wire of length L, the length of the wire becomes $(L + l)$. The elastic potential energy stored in the extended wire is:

- (1) Mgl
- (2) MgL
- (3) $\frac{1}{2} Mgl$
- (4) $\frac{1}{2} MgL$

Solution: (3)

$$\frac{1}{2} K(l)^2 = \text{Energy}$$

$$K(l) = Mg$$

$$K = \frac{Mg}{l}$$

$$\therefore \text{Energy} = \frac{1}{2} Kl^2 = \frac{1}{2} \frac{Mg}{l} l^2$$

$$= \frac{Mgl}{2}$$

61. A disc of radius 2 m and mass 100 kg rolls on a horizontal floor. Its center of mass has speed of 20 cm/s. How much work is need to stop it?

- (1) 3 J
- (2) 20 kJ
- (3) 2 J
- (4) 1 J

Solution: (1)

$$\begin{aligned}
 \text{Energy of the cylinder} &= \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2 \\
 &= \frac{1}{2}mv^2 + \frac{1}{2} \frac{mr^2}{2} \frac{v^2}{r^2} \\
 &= \frac{3}{4}mv^2 \\
 &= \frac{3}{4} \times 100 \times (20 \times 10^{-2})^2 \\
 &= 3 \text{ J}
 \end{aligned}$$

62. In an experiment the percentage of error occurred in the measurement of physical quantities A, B, C and D are 1%, 2%, 3% and 4% respectively. Then the maximum percentage of error in the measurement X, where $X = \frac{A^2 B^{\frac{1}{2}}}{C^{\frac{1}{3}} D^3}$, will be:

- (1) $\left(\frac{3}{13}\right)\%$
- (2) 16 %
- (3) -10%
- (4) 10%

Solution: (2)

$$\begin{aligned}
 \frac{\Delta X}{X} \times 100 &= 2 \left(\frac{\Delta A}{A} \times 100 \right) + \frac{1}{2} \left(\frac{\Delta B}{B} \times 100 \right) + \frac{1}{3} \left(\frac{\Delta C}{C} \times 100 \right) + 3 \left(\frac{\Delta D}{D} \times 100 \right) \\
 &= 2 \times 1 + \frac{1}{2} \times 2 + \frac{1}{3} \times 3 + 3 \times 4 \\
 &= 16\%
 \end{aligned}$$

63. A body weighs 200 N on the surface of the earth. How much will it weigh half way down to the centre of the earth?

- (1) 150 N
- (2) 200 N
- (3) 250 N
- (4) 100 N

Solution: (4)

$$\text{Weight} = mg = m \frac{GM}{R^2} = W$$

$$\text{at half way down to the centre } W' = \frac{m \frac{GM \left(\frac{R}{2}\right)^3}{R^3}}{\left(\frac{R}{2}\right)^2}$$

$$= m \frac{GM}{2R^2}$$

$$= 100 \text{ N}$$

64. Which colour of the light has the longest wavelength?

- (1) red
- (2) blue
- (3) green
- (4) violet

Solution: (1)

Among the given lights red coloured light has longest wavelength

65. A solid cylinder of mass 2 kg and radius 4 cm is rotating about its axis at the rate of 3 rpm. The torque required to stop after 2π revolutions is:

- (1) $2 \times 10^{-6} \text{ N m}$
- (2) $2 \times 10^{-3} \text{ N m}$
- (3) $12 \times 10^{-4} \text{ N m}$
- (4) $2 \times 10^6 \text{ N m}$

Solution: (1)

From rotational kinematic equations,

$$\omega_f^2 - \omega_i^2 = 2 \alpha \theta$$

$$0^2 - \left(3 \frac{2\pi}{60}\right)^2 = 2 \alpha 2\pi(2\pi)$$

$$\alpha = -\frac{1}{800} \text{ rad/s}^2$$

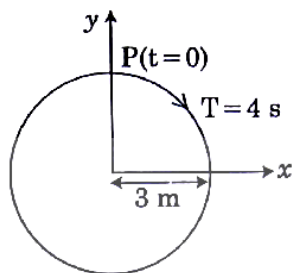
$$\therefore \text{torque required } \tau = |I\alpha|$$

$$= \frac{2(4 \times 10^{-2})^2}{2} \times \frac{1}{800}$$

$$= \frac{16 \times 10^{-4}}{800}$$

$$= 2 \times 10^{-6} \text{ N m}$$

66. The radius of circle, the period of revolution, initial position and sense of revolution are indicated in the fig.



y- projection of the radius vector of rotating particle P is:

- (1) $y(t) = -3 \cos 2\pi t$, where y in m
- (2) $y(t) = 4 \sin\left(\frac{\pi t}{2}\right)$, where y in m
- (3) $y(t) = 3 \cos\left(\frac{3\pi t}{2}\right)$ where y in m
- (4) $y(t) = 3 \cos\left(\frac{\pi t}{2}\right)$ where y in m

Solution: (4)

$$T = 4$$

$$\omega = \frac{2\pi}{4} = \frac{\pi}{2}$$

$$A = 3 \text{ m}$$

$$\text{at } t = 0, y = 3 \text{ m}$$

$$\therefore y = 3 \cos\left(\frac{\pi}{2}t\right)$$

67. A hollow metal sphere of radius R is uniformly charged. The electric field due to the sphere at a distance r from the centre:

- (1) increases as r increases for $r < R$ and for $r > R$
- (2) zero as r increases for $r < R$, decreases as r increases for $r > R$
- (3) zero as r increases for $r < R$, increases as r increases for $r > R$
- (4) decreases as r increases for $r < R$ and for $r > R$

Solution: (2)

Inside the sphere electric field is zero.

$$\text{Outside the sphere electric field is } E = \frac{1}{4\pi\epsilon_0} \frac{Q}{r^2}$$

\therefore It decreases with r, outside the sphere.

68. In which of the following devices, the eddy current effect is not used?

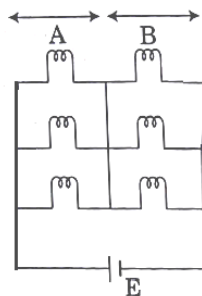
- (1) induction furnace
- (2) magnetic braking in train
- (3) electromagnet
- (4) electric heater

Solution: (4)

Eddy current effect is not used in electric heater

69. Six similar bulbs are connected as shown in the figure with a DC source of emf E , and zero internal resistance.

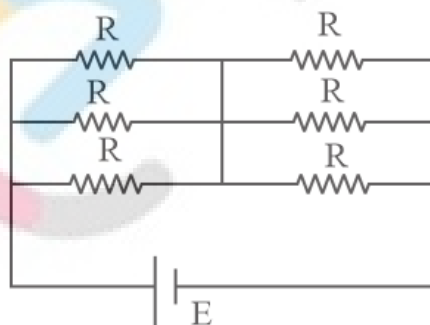
The ratio of power consumption by the bulbs when (i) all are glowing and (ii) in the situation when two from section A and one from section B are glowing will be:



- (1) 4 : 9
- (2) 9 : 4
- (3) 1 : 2
- (4) 2 : 1

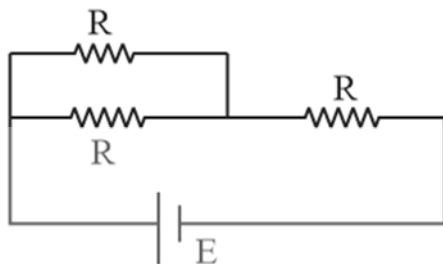
Solution: (2)

Case – 1:



$$(\text{Req})_1 = \frac{2}{3}R$$

Case – 2:



$$(\text{Req})_2 = \frac{3}{2}R$$

$$P = \frac{E^2}{\text{Req}}$$

$$\frac{P_1}{P_2} = \frac{(\text{Req})_2}{(\text{Req})_1} = \frac{\frac{3}{2}R}{\frac{2}{3}R} = \frac{9}{4}$$

70. At a point A on the earth's surface the angle of dip, $\delta = +25^\circ$. At a point B on the earth's surface the angle of dip, $\delta = -25^\circ$. We can interpret that:

- (1) A and B are both located in the northern hemisphere.
- (2) A is located in the southern hemisphere and B is located in the northern hemisphere.
- (3) A is located in the northern hemisphere and B is located in the southern hemisphere.
- (4) A and B are both located in the southern hemisphere

Solution: (3)

Positive dip \Rightarrow Northern hemisphere

Negative dip \Rightarrow Southern hemisphere

71. A force $F = 20 + 10y$ acts on a particle in y-direction where F is in newton and y in meter. Work done by this force to move the particle from $y = 0$ to $y = 1$ m is:

- (1) 30 J
- (2) 5 J
- (3) 25 J
- (4) 20 J

Solution: (3)

$$W = \int F \cdot dy$$

$$= \int_0^1 20 \, dy + \int_0^1 10y \, dy$$

$$= [20 y]_0^1 + 5[y^2]_0^1$$

$$= 20 + 5 = 25 \text{ J}$$

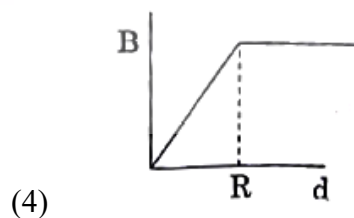
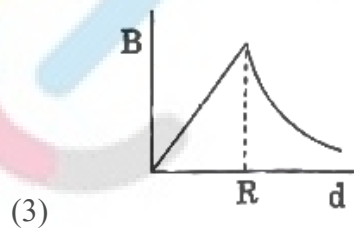
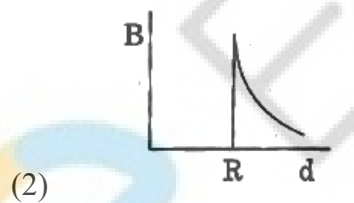
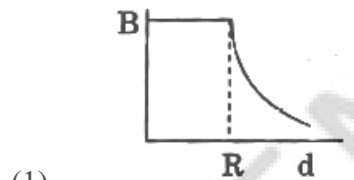
72. Pick the **wrong** answer in the context with rainbow.

- (1) When the light rays undergo two internal reflections in a water drop, a secondary rainbow is formed.
- (2) The order of colours is reversed in the secondary rainbow.
- (3) An observer can see a rainbow when his front is towards the sun.
- (4) Rainbow is a combined effect of dispersion, refraction and reflection of sunlight.

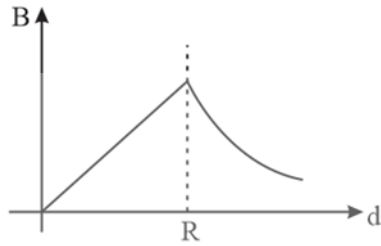
Solution: (3)

An observer cannot see a rainbow when his front is towards the sun.

73. A cylindrical conductor of radius R is carrying a constant current. The plot of the magnitude of the magnetic field, B with the distance, d , from the centre of the conductor, is correctly represented by the figure:



Solution: (3)



$$B \propto d \quad d < R$$

$$B \propto \frac{1}{d} \quad d > R$$

74. Two particles A and B are moving in uniform circular motion in concentric circles of radii r_A and r_B with speed v_A and v_B respectively. Their time period of rotation is the same. The ratio of angular speed of A to that of B will be:

(1) $r_A : r_B$

(2) $v_A : v_B$

(3) $r_B : r_A$

(4) 1:1

Solution: (4)

Same time period \Rightarrow same angular speed

75. Two similar thin equi-convex lenses, of focal length f each, are kept coaxially in contact with each other such that the focal length of the combination is F_1 . When the space between the two lenses is filled with glycerin (which has the same refractive index ($\mu = 1.5$) as that of glass) then the equivalent focal length is F_2 . The ratio $F_1 : F_2$ will be:

(1) 2:1

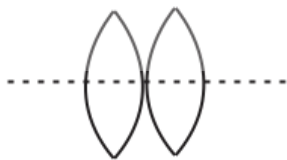
(2) 1:2

(3) 2:3

(4) 3:4

Solution: (2)

Case – I:



$$\frac{1}{F_{eq}} + \frac{1}{F} + \frac{1}{F}$$

$$F_1 = F_{eq} = \frac{F}{2}$$

Case – II:



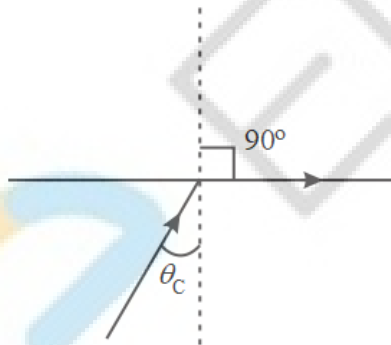
$$F_2 = F_{eq} = F$$

$$F_1 : F_2 = 1 : 2$$

76. In total internal reflection when the angle of incidence is equal to the critical angle for the pair of media in contact, what will be angle of refraction?

- (1) 180°
- (2) 0°
- (3) equal to angle of incidence
- (4) 90°

Solution: (4)

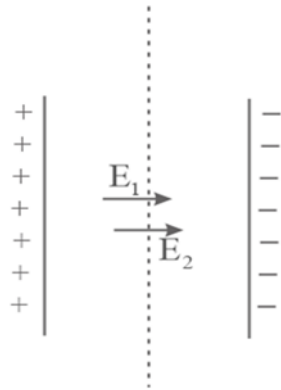


77. Two parallel infinite line charges with linear charge densities $+\lambda$ C/m and $-\lambda$ C/m are placed at a distance of $2R$ in free space. What is the electric field mid-way between the two-line charges?

- (1) zero
- (2) $\frac{2\lambda}{\pi\epsilon_0 R}$ N/C
- (3) $\frac{\lambda}{\pi\epsilon_0 R}$ N/C

$$(4) \quad \frac{\lambda}{2\pi\epsilon_0 R} \text{ N/C}$$

Solution: (3)



$$E_1 = \frac{\lambda}{2\pi\epsilon_0 R}$$

$$E_2 = \frac{\lambda}{2\pi\epsilon_0 R}$$

$$E_{\text{net}} = E_1 + E_2$$

$$= \frac{\lambda}{\pi\epsilon_0 R} \text{ N/C}$$

78. For a p-type semiconductor, which of the following statements is **true**?

- (1) Electrons are the majority carriers and trivalent atoms are the dopants.
- (2) Holes are the majority carriers and trivalent atoms are the dopants.
- (3) Holes are the majority carriers and pentavalent atoms are the dopants.
- (4) Electrons are the majority carriers and pentavalent atoms are the dopants.

Solution: (2)

Holes are the majority carriers and trivalent atoms are the dopants.

79. Which of the following acts as a circuit protection device?

- (1) conductor
- (2) inductor
- (3) switch
- (4) fuse

Solution: (4)

fuse

80. A parallel plate capacitor of capacitance $20 \mu\text{F}$ is being charged by a voltage source whose potential is changing at the rate of 3 V/s . The conduction current through the connecting wires, and the displacement current through the plates of the capacitor, would be, respectively:

- (1) zero, $60 \mu\text{A}$
- (2) $60 \mu\text{A}$, $60 \mu\text{A}$
- (3) $60 \mu\text{A}$, zero
- (4) zero, zero

Solution: (2)

$$q = CV$$

$$\frac{dq}{dt} = C \frac{dv}{dt}$$

$$= 20 \times 10^{-6} \times 3$$

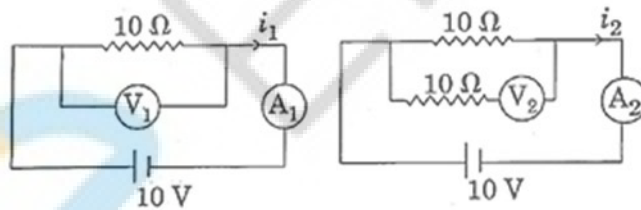
$$\text{Conduction current} = 60 \mu\text{A}$$

$$\text{Displacement current} = \epsilon_0 \frac{d\phi_e}{dt}$$

$$= \epsilon_0 \frac{A dv}{d dt}$$

$$= 60 \mu\text{A}$$

81. In the circuits shown below, the readings of the voltmeters and the ammeters will be:



Circuit 1

Circuit 2

- (1) $V_2 > V_1$ and $i_1 = i_2$
- (2) $V_1 = V_2$ and $i_1 > i_2$
- (3) $V_1 = V_2$ and $i_1 = i_2$
- (4) $V_2 > V_1$ and $i_1 > i_2$

Solution: (3)

For ideal ammeter and voltmeter, current drawn by voltmeters V_1 and V_2 is zero.

$$\therefore i_1 = i_2, V_1 = V_2$$

82. α -particle consists of:

- (1) 2 protons and 2 neutrons only
- (2) 2 electrons, 2 protons and 2 neutrons
- (3) 2 electrons and 4 protons only
- (4) 2 protons only

Solution: (1)

α - particle consists of 2 protons and 2 neutrons

83. An electron is accelerated through a potential difference of 10,000 V. Its de Broglie wavelength is, (nearly): ($m_e = 9 \times 10^{-31}$ kg)

- (1) 12.2×10^{-13} m
- (2) 12.2×10^{-12} m
- (3) 12.2×10^{-14} m
- (4) 12.2 nm

Solution: (2)

The energy of electron ' K ' = 10^5 eV

$$\lambda = \frac{h}{mv} = \frac{h}{\sqrt{2mK}} \cong 12.2 \times 10^{-12} \text{ m}$$

84. When an object is shot from the bottom of a long smooth inclined plane kept at an angle 60° with horizontal, it can travel a distance x_1 along the plane. But when the inclination is decreased to 30° and the same object is shot with the same velocity, it can travel x_2 distance. Then $x_1 : x_2$ will be:

- (1) $1 : \sqrt{2}$
- (2) $\sqrt{2} : 1$
- (3) $1 : \sqrt{3}$
- (4) $1 : 2\sqrt{3}$

Solution: (3)

The equation of motion in exclusive

$$v^2 = 2g \sin 60^\circ \cdot x_1 \dots (1)$$

$$v^2 = 2g \sin 30^\circ \cdot x_2$$

Equating

$$2g \sin 60^\circ \cdot x_1 = 2g \sin 30^\circ \cdot x_2$$

$$x_1 : x_2 = 1 : \sqrt{3}$$

85. A small hole of area cross-section 2 mm^2 is present near the bottom of a fully filled open tank of height 2 m. Taking $g = 10 \text{ m/s}^2$, the rate of flow of water through the open hole would be nearly:

- (1) $12.6 \times 10^{-6} \text{ m}^3/\text{s}$
- (2) $8.9 \times 10^{-6} \text{ m}^3/\text{s}$
- (3) $2.23 \times 10^{-6} \text{ m}^3/\text{s}$
- (4) $6.4 \times 10^{-6} \text{ m}^3/\text{s}$

Solution: (1)

$$\text{Velocity of efflux } v = \sqrt{2gh}$$

$$v = \sqrt{2 \times 10 \times 2}$$

$$= 2 \times \sqrt{10}$$

$$\text{rate of flow} = \text{area} \times v$$

$$= 2 \times 10^{-6} \times 2 \times \sqrt{10}$$

$$= 4 \times 3.14 \times 10^{-6}$$

$$\cong 12.6 \times 10^{-6}$$

86. Two point charges A and B, having charges $+Q$ and $-Q$ respectively, are placed at certain distance apart and force acting between them is F . If 25% charge of A is transferred to B, then force between the charges becomes:

- (1) F
- (2) $\frac{9F}{16}$
- (3) $\frac{16F}{9}$
- (4) $\frac{4F}{3}$

Solution: (2)

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

$$\text{After transferring 25\% of charge, } q_1 = \frac{3Q}{4} \text{ and } q_2 = -\frac{3Q}{4}$$

$$F_1 = \frac{9}{16} \frac{KQ^2}{r^2} = \frac{9}{16} F$$

87. Ionized hydrogen atoms and α – particles with same momenta enters perpendicular to a constant magnetic field, B. The ratio of their radii of their paths $r_H : r_\alpha$ will be:

- (1) 2 : 1
- (2) 1 : 2
- (3) 4 : 1
- (4) 1 : 4

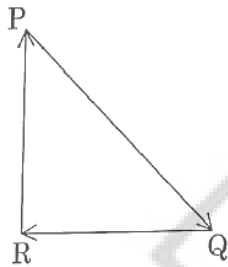
Solution: (1)

$$r = \frac{mv}{qB} = \frac{P}{qB}$$

$$\frac{r_H}{r_\alpha} = \frac{q_\alpha}{q_H} = \frac{2}{1}$$

$$r_H : r_\alpha = 2 : 1$$

88. A particle moving with velocity \vec{V} is acted by three forces shown by the vector triangle PQR. The velocity of the particle will:



- (1) increase
- (2) decrease
- (3) remain constant
- (4) change according to the smallest force \overrightarrow{QR}

Solution: (3)

$$\overrightarrow{F_{\text{net}}} = 0$$

Velocity will remain constant

89. The work done to raise a mass m from the surface of the earth to a height h, which is equal to the radius of the earth, is:

- (1) mgR
- (2) 2 mgR

$$(3) \quad \frac{1}{2} mgR$$

$$(4) \quad \frac{3}{2} mgR$$

Solution: (3)

$$W = U_f - U_i$$

$$= \frac{-GMm}{2R} - \left(\frac{-GMm}{R} \right)$$

$$= \frac{GMm}{2R}$$

$$W = \frac{1}{2} mg R \quad \left(\because \frac{GM}{R^2} = g \right)$$

90. In a double slit experiment, when light of wavelength 400 nm was used, the angular width of the first minima formed on a screen placed 1 m away, was found to be 0.2° . What will be the angular width of the first minima, if the entire experimental apparatus is immersed in water? $\left(\mu_{\text{water}} = \frac{4}{3} \right)$

$$(1) \quad 0.266^\circ$$

$$(2) \quad 0.15^\circ$$

$$(3) \quad 0.05^\circ$$

$$(4) \quad 0.1^\circ$$

Solution: (2)

$$\theta = \frac{\lambda}{b}$$

$$\theta' = \frac{\theta}{\mu} = \frac{0.2}{\frac{4}{3}} = 0.15^\circ$$

91. Which of the following statements is **incorrect** ?

(1) Viroids lack a protein coat

(2) Viruses are obligate parasites

(3) Infective constituent in viruses is the protein coat

(4) Prions consist of abnormally folded proteins

Solution: (3)

Infective constituent in virus is its genetic material i.e., DNA or RNA. Only genetic material enters into host cell, protein coat remains outside the host cell.

92. Purines found both in DNA and RNA are

- (1) Adenine and thymine
- (2) Adenine and guanine
- (3) Guanine and cytosine
- (4) Cytosine and thymine

Solution: (2)

Two types of nitrogen bases are found in both DNA and RNA

Purines : include Adenine and Guanine

Pyrimidines : include cytosine, Thymine and Uracil.

93. Which of the following glucose transporters is insulin-dependent ?

- (1) GLUT I
- (2) GLUT II
- (3) GLUT III
- (4) GLUT IV

Solution: (4)

Insulin dependent glucose transporter is GLUT IV and Insulin independent glucose transporter is GLUT I.

94. Identify the cells whose secretion protects the lining of gastro-intestinal tract from various enzymes.

- (1) Chief cells
- (2) Goblet cells
- (3) Oxyntic cells
- (4) Duodenal cells

Solution: (2)

Lining of Gastro – intestinal tract is protected by mucus from various enzymes and mucus is produced by Goblet cells. So Goblet cells helps in protection of lining of gastro-intestinal from various enzymes.

95. Which one of the following equipments is essentially required for growing microbes on a large scale, for industrial production of enzymes?

- (1) BOD incubator
- (2) Sludge digester
- (3) industrial oven
- (4) Bioreactor

Solution: (4)

Bioreactor (100-1000 litres) used to grow microbes on large scale. Bioreactor produce optimum conditions.

96. Which of the following is **true** for Golden rice?

- (1) It is Vitamin A enriched, with a gene from daffodil
- (2) It is pest resistance with a gene from *Bacillus thuringiensis*
- (3) It is drought tolerant, developed using *Agrobacterium* vector
- (4) It has yellow grains because of a gene introduced from a primitive variety of rice

Solution: (1)

Golden rice is vitamin 'A' enriched rice it is generically modified to enhance nutritional value of food.

97. Which one of the following is **not** a method of in situ conservation of biodiversity?

- (1) Biosphere Reserve
- (2) Wildlife sanctuary
- (3) Botanical Garden
- (4) Sacred Grove

Solution: (3)

In situ conservation include, Biosphere Reserve, National parks. Sanctuaries and sacred groves ex situ conservation include, zoological parks, botanical gardens, wildlife safari parks, cryopreservations etc.

98. Under which of the following conditions will there be no change in the reading frame of the following mRNA?

5'AACAGCGGUGCUAUU 3'

- (1) Insertion of G at 5th position
- (2) Deletion of G from 5th position
- (3) Insertion of A and G at 4th and 5th positions respectively
- (4) Deletion of GGU from 7th 8th and 9th positions

Solution: (4)

This is given in NCERT 6.6.1 page no 114

Insertion or deletion of three or its multiple bases insert or delete in one or multiple codon hence one or multiple amino acids and reading frame remains unaltered from that point onwards.

99. Which of these following methods is the most suitable for disposal of nuclear waste?

- (1) Shoot the waste into space
- (2) Bury the waste under Antarctic ice-water
- (3) Dump the waste within rocks under deep ocean
- (4) Bury the waste within rocks deep below the earth's surface

Solution: (4)

This is given in NCERT paragraph 16.5 page No. 280.

Disposal of nuclear waste, after sufficient pre-treatment, should be done in suitably shielded container buried within the rocks, about 500 m deep below the earth surface.

100. Match the following organisms with the products they produce:

- | | |
|-------------------------------------|-------------------|
| (a) <i>Lactobacillus</i> | (i) Cheese |
| (b) <i>Saccharomyces cerevisiae</i> | (ii) Curd |
| (c) <i>Aspergillus niger</i> | (iii) Citric acid |
| (d) <i>Acetobacter aceti</i> | (iv) Bread |
| | (v) Acetic acid |

Select the correct option.

- | | (a) | (b) | (c) | (d) |
|-----|-------|------|-------|-------|
| (1) | (ii) | (iv) | (v) | (iii) |
| (2) | (ii) | (iv) | (iii) | (v) |
| (3) | (iii) | (iv) | (v) | (i) |
| (4) | (ii) | (i) | (iii) | (v) |

Solution: (2)

Correct Matching.

(a)	<i>Lactobacillus</i>	Curd
(b)	<i>Saccharomyces cerevisiae</i>	Bread
(c)	<i>Aspergillus Niger</i>	Citric acid
(d)	<i>Acetobacter aceti</i>	Acetic acid

101. What map unit (Centimorgan) is adopted in the construction of genetic maps?

- (1) A unit of distance between two expressed genes, representing 10% cross over.

- (2) A unit of distance between two expressed genes, representing 100% cross over.
- (3) A unit of distance between genes on chromosomes, representing 1% cross over.
- (4) A unit of distance between genes on chromosomes, representing 50% cross over.

Solution: (3)

1 map unit or centimorgan is equivalent to 1% recombination between two genes. It was Sturtevant who first suggested that frequency of recombination can be used to depict relative distance between the genes. 10% crossing over is known as Morgan (M)

102. Select the hormone-releasing Intra-Uterine Devices

- (1) Vaults, LNG-20
- (2) Multiload 375, Progestasert
- (3) Progestasert, LNG-20
- (4) Lippes loop, Multiload 375

Solution: (3)

Given in NCERT XII page no. 60. Intra Uterine Devices are presently available as the non-medicated IUDs (e.g., Lippes loop), copper releasing IUDs (CuT, Cu7, Multiload 375) and the hormone releasing IUDs (Progestasert, LNG-20).

103. Which of the following can be used as a biocontrol agent in treatment of Plant diseases?

- (1) *Trichoderma*
- (2) *Chlorella*
- (3) *Anabaena*
- (4) *Lactobacillus*

Solution: (1)

Given in NCERT XII page no. 187. A biological control being developed for use in the treatment of plant disease is the fungus *Trichoderma*. *Trichoderma* species are free-living fungi that are very common in the root ecosystems. They are effective biocontrol agents of several plant pathogens.

104. Expressed Sequence Tags (ESTs) refers to:

- (1) Genes expressed as RNA
- (2) Polypeptide expression
- (3) DNA Polymorphism

(4) Novel DNA Sequences

Solution: (1)

Given in NCERT XII page no. 119. all the genes that are expressed as RNA (referred to as Expressed Sequence Tags (ESTs)).

105. Colostrum, the yellowish fluid, secreted by mother during the initial days of lactation is very essential to impart immunity to the newborn infants because it contains:

- (1) Natural killer cells
- (2) Monocytes
- (3) Macrophages
- (4) Immunoglobulin A

Solution: (4)

Colostrum is first milk produced by mother during lactation. It is rich in IgA.

106. Select the **incorrect** statement.

- (1) Inbreeding increases homozygosity.
- (2) Inbreeding is essential to evolve purelines in any animal.
- (3) Inbreeding selects harmful recessive genes that reduce fertility and productivity.
- (4) Inbreeding helps in accumulation of superior genes and elimination of undesirable genes.

Solution: (4)

107. Select the **correct** sequence for transport of sperm cells in male reproductive system.

- (1) Testis → Epididymis → Vasa efferentia → Rete testis → Inguinal Canal → Urethra
- (2) Seminiferous tubules → Rete testis → Vasa efferentia → Epididymis → Vas deferens → Ejaculatory duct → Urethra → Urethral meatus
- (3) Seminiferous tubules → Vasa efferentia → Epididymis → Inguinal Canal → Urethra
- (4) Testis → Epididymis → Vasa efferentia → Vas deferens → Ejaculatory duct → Inguinal Canal → Urethra → Urethral meatus

Solution: (2)

108. A gene locus has two alleles A, a. If the frequency of dominant allele A is 0.4, then what will be the frequency of dominant allele A is 0.4, then what will be the frequency of homozygous dominant, heterozygous and homozygous recessive individuals in the Population?

- (1) 0.36(AA); 0.48(Aa); 0.16(aa)
- (2) 0.16(AA); 0.24(Aa); 0.36(aa)
- (3) 0.16(AA); 0.48(Aa); 0.36(aa)
- (4) 0.16(AA); 0.36(Aa); 0.48(aa)

Solution: (3)

109. Match the following organisms with their respective characteristics:

- | | |
|--------------------------|-------------------------|
| (a) <i>Pila</i> | (i) Flame cells |
| (b) <i>Bombyx</i> | (ii) Comb plates |
| (c) <i>Pleurobrachia</i> | (iii) Radula |
| (d) <i>Taenia</i> | (iv) Malpighian tubules |

Select the **correct** option from the following:

- | | (a) | (b) | (c) | (d) |
|-----|-------|------|-------|------|
| (1) | (iii) | (ii) | (i) | (iv) |
| (2) | (iii) | (iv) | (ii) | (i) |
| (3) | (ii) | (iv) | (iii) | (i) |
| (4) | (iii) | (ii) | (iv) | (i) |

Solution: (2)

110. The shorter and longer arms of a submetacentric chromosome are referred to as :

- (1) s-arm and l-arm respectively
- (2) p-arm and q-arm respectively
- (3) q-arm and p-arm respectively
- (4) m-arm and n-arm respectively

Solution: (2)

111. What is the site of perception of photoperiod necessary for induction of flowering in plants?

- (1) Lateral buds
- (2) Pulvinus

- (3) Shoot apex
- (4) Leaves

Solution: (4)

112. Which part of the brain is responsible for thermoregulation?

- (1) Cerebrum
- (2) Hypothalamus
- (3) Corpus callosum
- (4) Medulla oblongata

Solution: (2)

113. Which of the following pair of organelles **does not** contain DNA?

- (1) Mitochondria and Lysosomes
- (2) Chloroplast and Vacuoles
- (3) Lysosomes and Vacuoles
- (4) Nuclear envelope and Mitochondria

Solution: (3)

Lysosomes are membrane-enclosed organelles that contain an array of enzymes capable of breaking down all types of biological polymers, they lack Genetic material in them.

Vacuoles are lytic compartments, function as reservoirs for ions and metabolites, including pigments, and are crucial to processes of detoxification and general cell homeostasis, Dna is absent in them.

114. What is the genetic disorder in which an individual has an overall masculine development, gynaecomastia, and is sterile?

- (1) Turner's syndrome
- (2) Klinefelter's syndrome
- (3) Edward syndrome
- (4) Down's syndrome

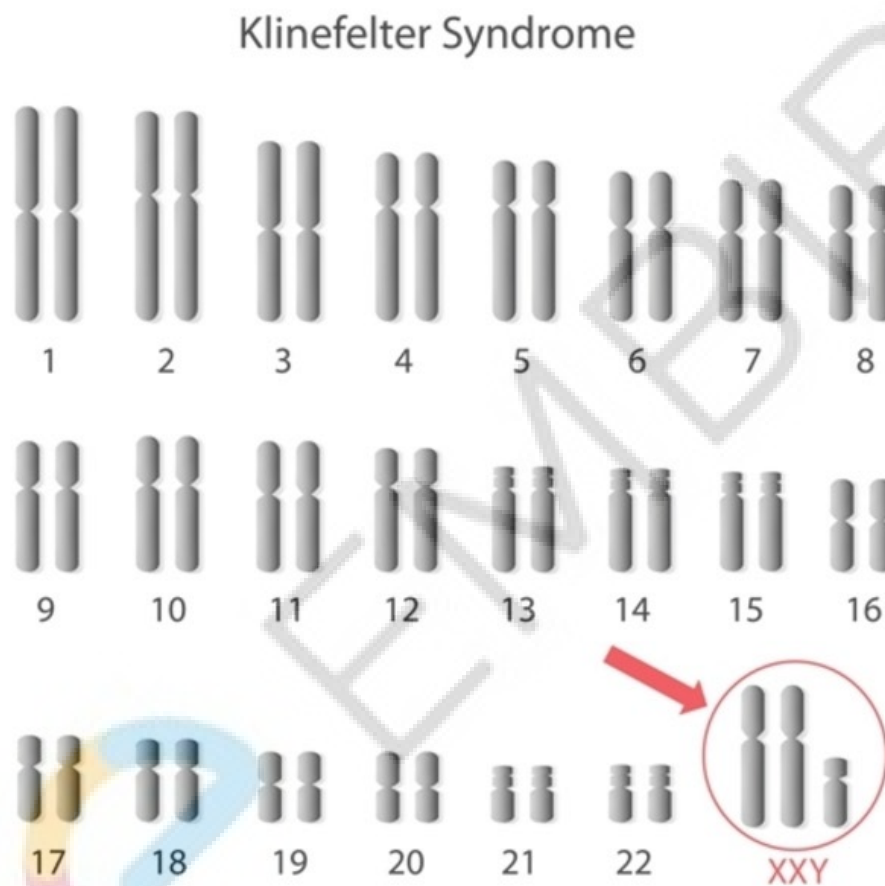
Solution: (2)

Klinefelter syndrome is where males are born with an extra X chromosome.

Chromosomes are packages of genes found in every cell in the body. Two types of the chromosome called the sex chromosomes, determine the genetic sex of a baby. These are named either X or Y.

Humans typically have 46 chromosomes in each cell, two out of which are the sex chromosomes. Female has two X chromosomes (46, XX), and a male has one X and one Y chromosomes (46, XY). Most often, boys and men with Klinefelter syndrome have the usual X and Y chromosomes, plus one extra X chromosome, to add up to 47 chromosomes (47, XXY).

Gynaecomastia is a condition with swelling of the breast tissue in boys caused by an imbalance of the hormones estrogen and testosterone. Gynecomastia might affect one or both breasts, sometimes unevenly. It is one of the symptoms of Klinefelter Syndrome.



115. Xylem translocates

- (1) Water only
- (2) Water and mineral salts only
- (3) Water, mineral salts and some organic nitrogen only
- (4) Water, mineral salts, some organic nitrogen and hormones

Solution: (4)

Xylem sap consists primarily of a fluidy solution of hormones, mineral elements, and other nutrients. Transport of sap in the xylem is characterized by movement from the roots toward the leaves.

116. Which of the following pairs of gases is mainly responsible for green house effect?

- (1) Ozone and Ammonia
- (2) Oxygen and Nitrogen
- (3) Nitrogen and Sulphur dioxide
- (4) carbon dioxide and Methane

Solution: (4)

Water vapor, carbon dioxide, methane, nitrous oxide, and ozone are the primary greenhouse gases in Earth's atmosphere. Hence, the right option is 4 Carbon dioxide and Methane.

117. Which of the following protocols did aim for reducing emission of chlorofluorocarbons into the atmosphere?

- (1) Montreal Protocol
- (2) Kyoto Protocol
- (3) Gothenburg Protocol
- (4) Geneva Protocol

Solution: (1)

Ozone depletion refers to the phenomenon of reductions in the amount of ozone in the stratosphere. The problem of ozone depletion is caused by high levels of chlorine and bromine compounds in the stratosphere. The origins of these compounds are chlorofluorocarbons (CFC), used as cooling substances in air conditioners and refrigerators, or as aerosol propellants, and bromofluorocarbons (halons), used in fire extinguishers. Ozone depletion refers to the phenomenon of reductions in the amount of ozone in the stratosphere. The problem of ozone depletion is caused by high levels of chlorine and bromine compounds in the stratosphere. The origins of these compounds are chlorofluorocarbons (CFC), used as cooling substances in air conditioners and refrigerators, or as aerosol propellants, and bromofluorocarbons (halons), used in fire extinguishers. As a result of depletion of the ozone layer This led to the adoption of the Montreal Protocol banning the use of chlorofluorocarbon (CFC) compounds, as well as other ozone-depleting chemicals such as carbon tetrachloride, trichloroethane (also known as methyl chloroform), and bromine compounds are known as halons.

118. In some plants, the female gamete develops into embryo without fertilization. This phenomenon is known as:

- (1) Autogamy
- (2) Parthenocarp
- (3) Syngamy
- (4) Parthenogenesis

Solution: (4)

Autogamy refers to the fusion of two gametes that come from one individual.

Syngamy is fusion of two nuclei as in case of sexual reproduction.

Parthenocarp is the development of fruit without prior fertilization

The correct answer is Parthenogenesis is a natural form of asexual reproduction in which growth and development of embryos occur without fertilization.

119. Which of the following sexually transmitted diseases is **not** completely curable?

- (1) Gonorrhoea
- (2) Genital warts
- (3) Genital herpes
- (4) Chlamydia

Solution: (3)

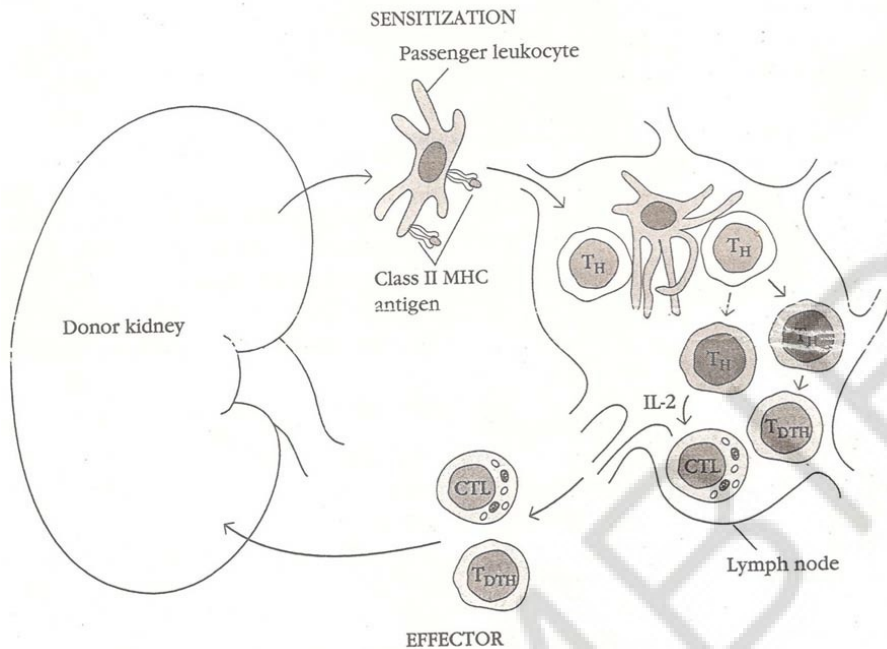
Herpes simplex type 1 or 2 viruses causes genital herpes, an infection of the skin and mucous membranes in the genital and surrounding areas. Herpes simplex virus usually spreads, when in contact with blisters. However, people with genital herpes can shed the virus from the genital area and infect others even without a blister being present. Cold sores on the mouth are a potential source of genital infection during mouth-to-genital contact. Medications can help decrease the severity of the herpes lesions and prevent recurrences, but they do not cure the infection.

120. Which of the following immune responses is responsible for rejection kidney graft?

- (1) Auto-immune response
- (2) Humoral immune response
- (3) Inflammatory immune response
- (4) Cell-mediated immune response

Solution: (4)

Transplantation of organs between genetically different individuals of the same species causes a T cell-mediated immune response that, if left unchecked, results in rejection and graft destruction.

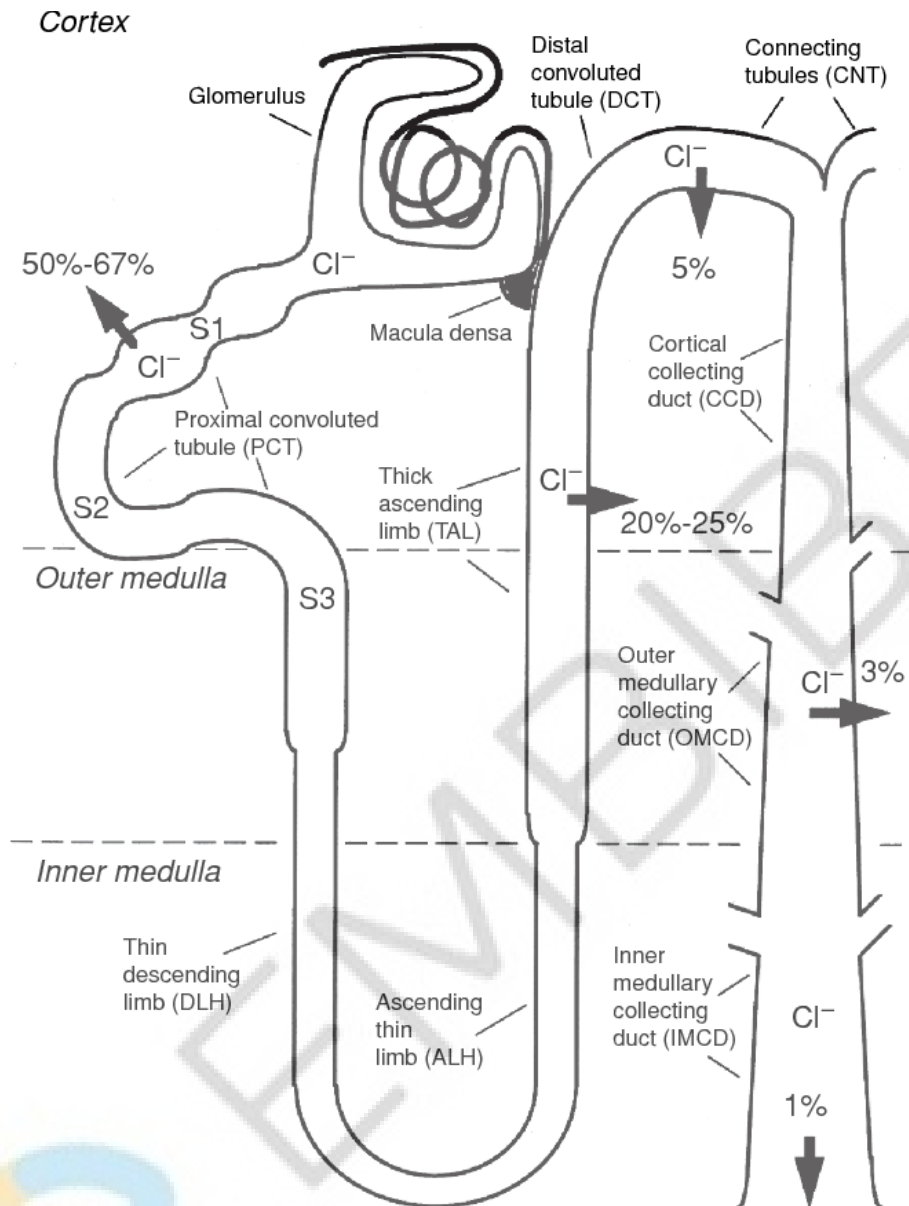


121. Which of the following factors is responsible for the formation of concentrated urine?

- (1) Low levels of antidiuretic hormone.
- (2) Maintaining hyperosmolarity towards inner medullary interstitium in the kidneys.
- (3) Secretion of erythropoietin by Juxtaglomerular complex.
- (4) Hydrostatic pressure during glomerular filtration.

Solution: (2)

A hyperosmotic renal medullary interstitium is critically important in concentrating the urine and provides the driving force for reabsorption of water from the collecting duct.



122. Which of the following features of genetic code does allow bacteria to produce human insulin by recombinant DNA technology?

- (1) Genetic code is not ambiguous
- (2) Genetic code is redundant
- (3) Genetic code is nearly universal
- (4) Genetic code is specific

Solution: (3)

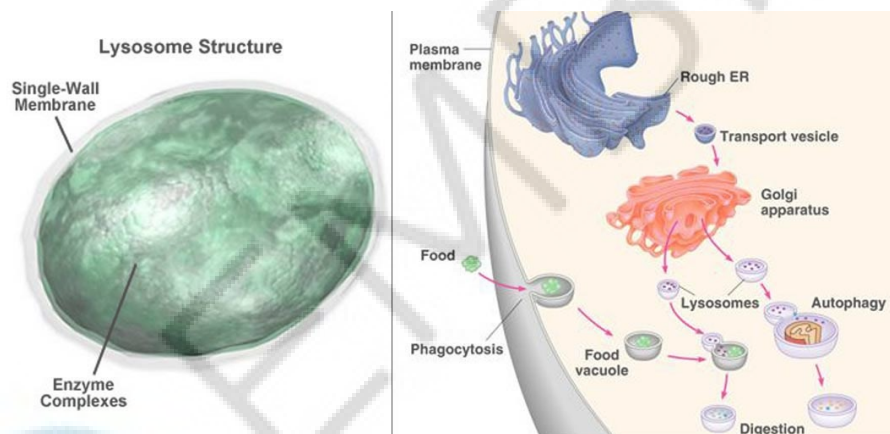
Although the code is based on work conducted on the bacterium *Escherichia coli* it is valid for other organisms. This important characteristic of the genetic code is called its universality. It means that the same sequences of 3 bases encode the same amino acids in all life forms from simple microorganisms to complex, multicelled organisms such as human beings.

123. Which of the following statements is **not** correct?

- (1) Lysosomes have numerous hydrolytic enzymes.
- (2) The hydrolytic enzymes of lysosomes are active under acidic pH.
- (3) Lysosomes are membrane bound structures
- (4) Lysosomes are found by the process of packaging in the endoplasmic reticulum.

Solution: (4)

Lysosomes are membrane-bounded cell organelles. they have numerous hydrolytic enzymes, The hydrolytic enzymes are active in acidic pH. They are formed by the process of packaging in the Golgi complex.



124. The concept of "*Omnis cellula -e cellula*" regarding cell division was first proposed by:

- (1) Rudolf Virchow
- (2) Theodore Schwann
- (3) Schleiden
- (4) Aristotle

Solution: (1)

Omnis cellula e cellula, that each cell derives from a pre-existing cell by division, is the culmination of a profound insight of the late 19th century and a dictum articulated by the German pathologist Rudolf Virchow.

125. Use of an artificial kidney during hemodialysis may result in:

- (a) Nitrogenous waste build-up in the body
- (b) Non-elimination of excess potassium ions
- (c) Reduced absorption of calcium ions from gastro-intestinal tract
- (d) Reduced RBC production

Which of the following options is the most **appropriate**?

- (1) (a) and (b) are correct
- (2) (b) and (c) are correct
- (3) (c) and (d) are correct
- (4) (a) and (d) are correct

Solution: (1)

Hemodialysis is a treatment to filter wastes and water from your blood. It leads to the elimination of nitrogenous waste build up in the body. Hemodialysis cannot eliminate excess potassium ions present in the blood.

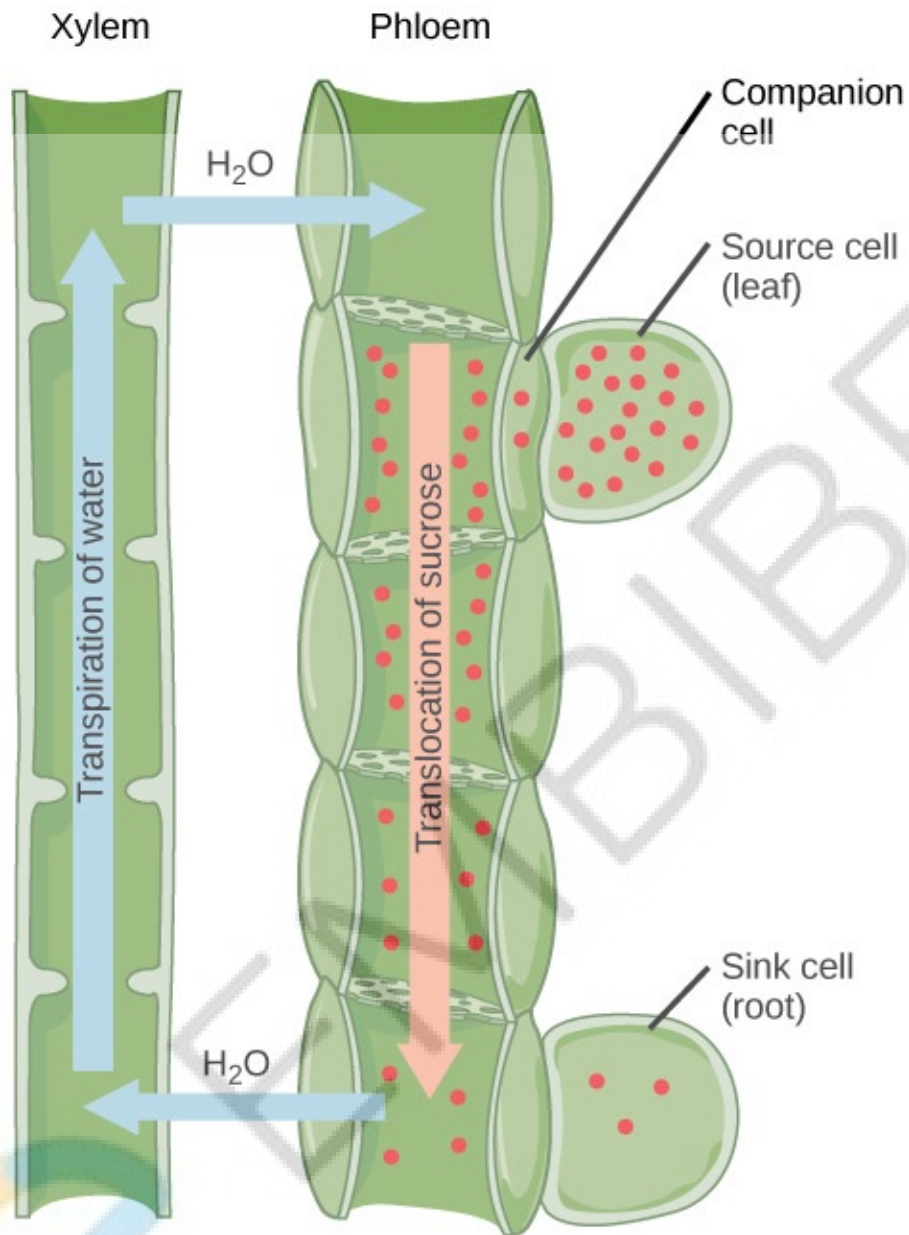
Hemodialysis can help in reducing the calcium ions from the GI tract and it can't reduce the production of RBC. so these 2 options are wrong.

126. What is the direction of movement of sugars in phloem?

- (1) Non-multidirectional
- (2) Upward
- (3) Downward
- (4) Bi-directional

Solution: (4)

Translocation of organic solutes via phloem is Bidirectional.



127. Which of the following muscular disorders is inherited?

- (1) Tetany
- (2) Muscular dystrophy
- (3) Myasthenia gravis
- (4) Botulism

Solution: (2)

Muscular dystrophy refers to a group of disorders that involve a progressive loss of muscle mass and consequent loss of strength. The most common form is

Duchenne muscular dystrophy. It typically affects young boys, but other variations can strike in adulthood.

Muscular dystrophy is caused by genetic mutations that interfere with the production of muscle proteins that are needed to build and maintain healthy muscles.

The causes are genetic. A family history of muscular dystrophy will increase the chance of it affecting an individual.

Tetany is a condition marked by intermittent muscular spasms, caused by malfunction of the parathyroid glands and a consequent deficiency of calcium. Myasthenia gravis is a chronic autoimmune neuromuscular disease that causes weakness in the skeletal muscles, which are responsible for breathing and moving parts of the body, including the arms and legs. The name myasthenia gravis, which is Latin and Greek in origin, means "grave, or serious, muscle weakness." Botulism is a bacterial food poisoning caused by bacterium *Clostridium botulinum*

128. Consider following features:

- (a) Organ system level of organisation
- (b) Bilateral symmetry
- (c) True coelomates with segmentation of body

Select the **correct** option of animal group which possess all the above characteristics.

- (1) Annelida, Arthropoda and Chordata
- (2) Annelida, Arthropoda and Mollusca
- (3) Arthropoda, Mollusca and Chordata
- (4) Annelida, Mollusca and Chordata

Solution: (1)

Organ system level organization, Bilateral Symmetry, True Coelomates with the segmentation of body are Seen in Annelida, Arthropoda, and Chordata.

Annelids possess metameric segmentation

Arthropods have segmented bodies, like the annelid worms. These segments have become specialized, however, with one pair of jointed appendages added to each segment. Among living arthropods, the millipedes most closely suggest what the ancestral arthropod might have looked like. Arthropod segments have also fused together into functional units called tagma

Chordates use heteromeric segmentation in which the link between segmented parts appears more subtly.

129. The frequency of recombination between gene pairs on the same chromosome as a measure of the distance gene was explained by:

- (1) T.H. Morgan
- (2) Gregor J. Mendel
- (3) Alfred Sturtevant
- (4) Sutton Boveri

Solution: (1)

The frequency of recombination between gene pairs on the same chromosome as a measure of the distance between genes is chromosome mapping. Thomas Hunt Morgan is a pioneer in the field of chromosome mapping

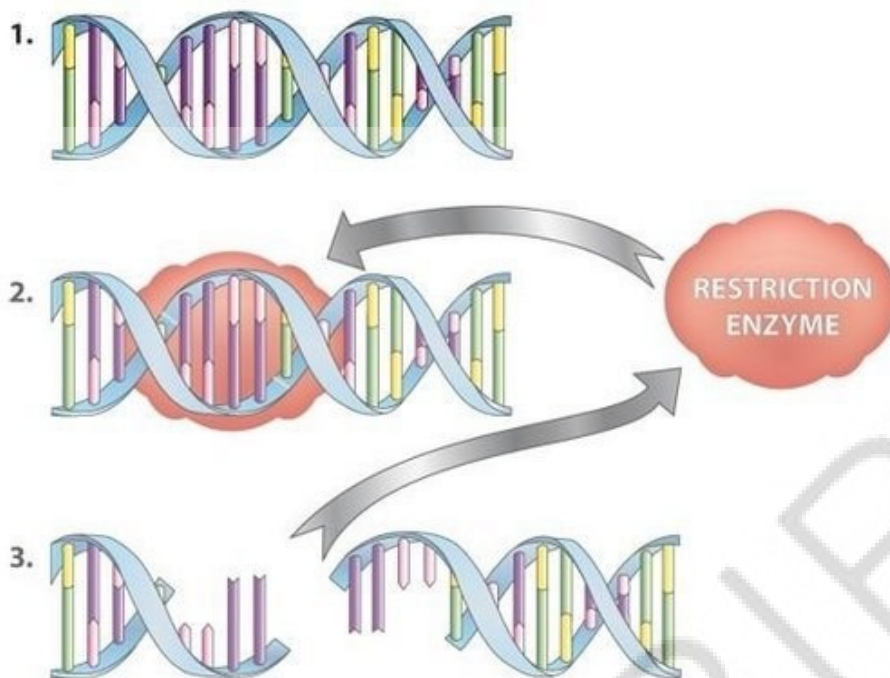
130. Following statements describe the characteristics of the enzyme Restriction Endonuclease. Identify the **incorrect** statement.

- (1) The enzyme cuts DNA molecules at identified position within the DNA.
- (2) The enzyme binds DNA at specific sites and cuts only one of the two strands.
- (3) The enzyme cuts the sugar-phosphate backbone at specific site on each strand.
- (4) The enzyme recognizes a specific palindromic nucleotide sequence in the DNA.

Solution: (2)

DNA consists of two complementary strands of nucleotides that spiral around each other in a double helix. Restriction enzymes cut through both nucleotide strands, breaking the DNA into fragments





131. Which of the following statements is **incorrect**?

- (1) Morels and truffles are edible delicacies.
- (2) *Claviceps* is a source of many alkaloids and LSD.
- (3) Conidia are produced exogenously and ascospores endogenously.
- (4) Yeasts have filamentous bodies with long thread-like hyphae.

Solution: (4)

Yeasts are unicellular eukaryotic fungi with completely different properties from those of bacteria, which are Prokaryotic microorganisms. Yeast contains almost the same organelles of a mature eukaryotic cell. Nucleus, Golgi apparatus, mitochondria, endoplasmic reticulum, vacuole, and cytoskeleton are the most important one.

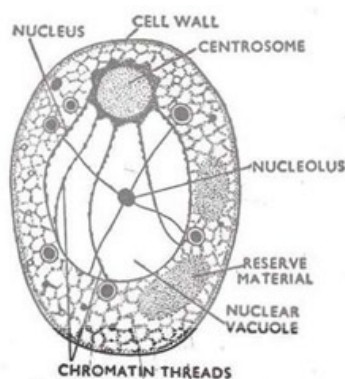


Fig. 214. Diagrammatic representation of parts of a yeast cell.

132. Placentation, in which ovules develop on the inner wall of the ovary or in peripheral part, is :

- (1) Basal
- (2) Axile
- (3) Parietal
- (4) Free central

Solution: (3)

The placenta is formed by the swelling up of cohering margins, and on the latter develop the ovules in rows. It occurs in bicarpellary or multicarpellary but unilocular ovary, e.g., Papaveraceae.

133. Which of the following is the most important cause for animals and plants being driven to extinction?

- (1) Habitat loss and fragmentation
- (2) Drought and floods
- (3) Economic exploitation
- (4) Alien species invasion

Solution: (1)

Destruction of Habitat – It is currently the biggest cause of current extinctions. Deforestation has killed off more species than we can count. Whole ecosystems live in our forests. It is predicted that all our rainforest can disappear in the next 100 years if we cannot stop deforestation

Habitat fragmentation describes the emergence of discontinuities (fragmentation) in an organism's preferred environment (habitat), causing population fragmentation and ecosystem decay. Causes of habitat fragmentation include geological processes that slowly alter the layout of the physical environment[1] (suspected of being one of the major causes of speciation[1]), and human activity such as land conversion, which can alter the environment much faster and causes the extinction of many species.

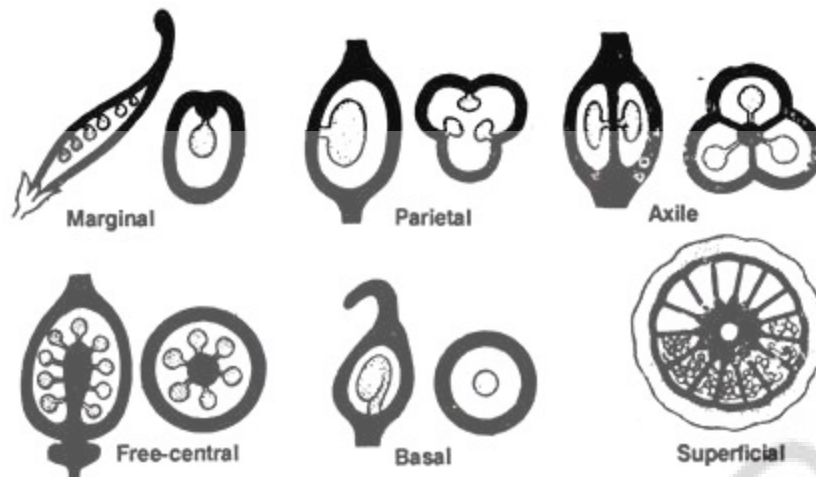


Fig. 88. Types of placentation.

134. Variations caused by mutation, as proposed by Hugo de Vries, are :

- (1) random and directional
- (2) random and directionless
- (3) small and directional
- (4) small and directionless

Solution: (3)

Option 2 is correct Hugo de Vries theory:

1. This theory is based on mutations.
2. Mutations cause evolution
3. Mutations are random and directionless
4. Sudden mutations cause evolution.

135. Respiratory Quotient (RQ) value of tripalmitin is :

- (1) 0.9
- (2) 0.7
- (3) 0.07
- (4) 0.09

Solution: (2)

Respiratory quotient is the ratio of the volume of carbon dioxide produced to the volume of oxygen consumed in respiration over a period of time. Its value can be one, zero, more than 1 or less than one.

$RQ = \frac{\text{Volume of CO}_2 \text{ evolved}}{\text{Volume of O}_2 \text{ absorbed}}$.

RQ of Tripalmitin(fat) is 0.7

136. In *Antirrhinum* (Snapdragon), a red flower was crossed with a white flower and in F_1 generation, pink flowers were obtained. When pink flowers were selfed, the F_2 generation showed white, red and pink flowers. Choose the **incorrect** statement from the following :

- (1) The experiment does not follow the Principle of Dominance.
- (2) Pink colour in F_1 is due to incomplete dominance.
- (3) Ratio of F_2 is $\frac{1}{4}$ (Red) : $\frac{2}{4}$ (Pink) : $\frac{1}{4}$ (White)
- (4) Law of Segregation does not apply in this experiment.

Solution: (4)

According to the law of segregation, only one of the two gene copies present in an organism is distributed to each gamete (egg or sperm cell) that it makes, and the allocation of the gene copies is random. When an egg and a sperm join in fertilization, they form a new organism, whose genotype consists of the alleles contained in the gametes. In this experiment, F_2 generation contradicts with law of segregation. So, option 4 is correct.

137. Select the **incorrect** statement.

- (1) Male fruit fly is heterogametic.
- (2) In male grasshoppers, 50% of sperms have no sex-chromosome.
- (3) In domesticated fowls, sex of progeny depends on the type of sperm rather than egg.
- (4) Human males have one of their sex-chromosome much shorter than the other.

Solution: (3)

1) The male fruit fly has XY sex chromosomes and produces two types of gametes. Hence, it is called heterogametic. 2) The female grasshopper is XX and the male XX-XO systems produce gametes with (X) or without (O) a sex chromosome. Hence, in male grasshopper, 50% of sperms have no chromosome. 3) Birds have a ZW sex-determination system. the sex of the embryo is determined by the egg in birds and not by the sperm. However, it is written here that the sperm decides the sex of the progeny. Hence, option 3 is incorrect. 4) In Humans, the Y chromosome is considerably smaller than the X chromosome and has a much lower density of genes. In fact, the Y has often been called a "genetic junkyard."

So, option 3 is an incorrect statement.

138. The **correct** sequence of phases of cell cycle is :

- (1) $M \rightarrow G_1 \rightarrow G_2 \rightarrow S$
- (2) $G_1 \rightarrow G_2 \rightarrow S \rightarrow M$
- (3) $S \rightarrow G_1 \rightarrow G_2 \rightarrow M$
- (4) $G_1 \rightarrow S \rightarrow G_2 \rightarrow M$

Solution: (4)

Interphase endures for almost 19% of the total time required for cell cycle. Interphase takes place in three stages; G₁, S, and G₂, proceeded by mitosis and cytokinesis. The nuclear content of DNA is duplicated during the synthesis phase.

139. *Thiobacillus* is a group of bacteria helpful in carrying out:

- (1) Nitrogen fixation
- (2) Chemoautotrophic fixation
- (3) Nitrification
- (4) Denitrification

Solution: (4)

Thiobacillus denitrificans, *Micrococcus denitrificans*, and some species of *Serratia*, *Pseudomonas*, and *Achromobacter* are implicated as denitrifiers. *Pseudomonas aeruginosa* can, under anaerobic conditions (as in swampy or water-logged soils), reduce the amount of fixed nitrogen (as fertilizer) by up to 50 percent.

140. Polyblend, a fine powder of recycled modified plastic, has proved to be a good material for:

- (1) making plastic sacks
- (2) use as a fertilizer
- (3) construction of roads
- (4) making tubes and pipes

Solution: (3)

It is a fine powder of recycled modified plastic developed by a Bangalore-based company. This mixture is mixed with the bitumen that is used to lay roads.

The Plastic sack manufacturer in Bangalore has managed to find the ideal solution to the ever increasing problem of accumulating plastic waste. Polyblend and bitumen, when used to lay roads, enhanced the bitumen - water repellant properties and helped to increase the road life by a factor of three.

141. From the evolution point of view, retention of the female gametophyte with developing young embryo on the parent sporophyte for some time, is first observed in:

- (1) Liverworts
- (2) Mosses
- (3) Pteridophytes
- (4) Gymnosperms

Solution: (3)

The megaspores and microspores germinate and give rise to female and male gametophytes, respectively.

- The female; gametophytes in these plants are retained on the parent sporophytes for variable periods.
- The development of the zygotes into young embryos takes place within the female gametophytes.
- This event is a precursor to the seed habit considered an important step in evolution.

142. Select the **correct** option.

- (1) 8th, 9th and 10th pairs of ribs articulate directly with the sternum.
- (2) 11th and 12th pairs of ribs are connected to the sternum with the help of hyaline cartilage.
- (3) Each rib is a flat thin bone and all the ribs are connected dorsally to the thoracic vertebrae and ventrally to the sternum.
- (4) There are seven pairs of vertebrosteral, three pairs of vertebrochondral and two pairs of vertebral ribs.

Solution: (4)

Each rib is a thin flat bone connected dorsally to the vertebral column and ventrally to the sternum. It has two articulation surfaces on its dorsal end and is hence called bicephalic. First seven pairs of ribs are called true ribs. Dorsally, they are attached to the thoracic vertebrae and ventrally connected to the sternum with the help of hyaline cartilage. The 8th, 9th and 10th pairs of ribs do not articulate directly with the sternum but join the seventh rib with the help of hyaline cartilage. These are called vertebrochondral (false) ribs. Last 2 pairs (11th and 12th) of ribs are not connected ventrally and are therefore, called floating ribs. Thoracic vertebrae, ribs and sternum together form the rib cage.

143. Concanavalin A is:

- (1) an alkaloid
- (2) an essential oil
- (3) a lectin
- (4) a pigment

Solution: (3)

Concanavalin A (ConA) is a lectin (carbohydrate-binding protein) originally extracted from the jack-bean, *Canavalia ensiformis*.

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

- (1) after entry of sperm but before fertilization.
- (2) after fertilization
- (3) before entry of sperm into ovum
- (4) simultaneously with first cleavage

Solution: (2)

The sperm entry stimulates the secondary oocyte to undergo a meiotic II division, which produces the ovum and the second polar body.

145. Pinus seed **cannot** germinate and establish without fungal association. This is because:

- (1) its embryo is immature.
- (2) it has obligate association with mycorrhizae.
- (3) it has very hard seed coat
- (4) its seeds contain inhibitors that prevent germination

Solution: (2)

Mycorrhiza is a symbiotic association of a fungus with a root system. Pinus cannot **germinate** without a fungal partner. It has an obligate association with the mycorrhizae.

146. The Earth Summit held in Rio de Janeiro in 1992 was called:

- (1) to reduce CO₂ emission and global warming.
- (2) for conservation of biodiversity and sustainable utilization of its benefits.
- (3) to assess threat posed to native species by invasive weed species.
- (4) for immediate steps to discontinue use of CFCs that were damaging the ozone layer.

Solution: (4)

In 1992, leaders from more than 100 countries participated in the first International Earth Summit at Rio de Janeiro in Brazil. The major objective was that every country should portray its own Agenda 21 for attaining sustainable development. The other objectives of the summit are (i) To achieve global sustainable development in the 21st century (ii) To conserve biological diversity (iii) To eliminate diseases with the help of shared welfare, requirements and obligations amongst various nations (iv) To prevent poverty and environmental damage.

147. DNA precipitation out of a mixture of biomolecules can be achieved by treatment with:

- (1) Isopropanol
- (2) Chilled ethanol
- (3) Methanol at room temperature
- (4) Chilled chloroform

Solution: (2)

DNA is highly polarised due to phosphate backbone. This makes it highly soluble in water. Generally, 0.3 M Sodium Acetate is used which neutralizes the negative charge on the PO_3^- groups on the nucleic acids, making the molecule far less hydrophilic, and therefore much less soluble in water. Then, three volumes of (at least) 95% ethanol is added that removes the hydration shell of H_2O molecules around the phosphate.

148. Grass Leaves curl inwards during very dry weather. Select the most appropriate reason from the following:

- (1) Closure of stomata
- (2) Flaccidity of bulliform cells
- (3) Shrinkage of air spaces in spongy mesophyll
- (4) Tyloses in vessels

Solution: (1)

The curling of leaves in dry weather occurs to reduce the transpiration. Transpiration is the loss of water from the aerial parts of plants in the form of water. This can be reduced by closure of stomata.

149. Match the following structures with their respective location in organs:

- | | |
|--------------------------|-----------------------|
| (a) Crypts of Lieberkuhn | (i) Pancreas |
| (b) Glisson's capsule | (ii) Duodenum |
| (c) Islets of Langerhans | (iii) Small intestine |

- (d) Brunner's Glands (iv) Liver

Select the **correct option**

- | | (a) | (b) | (c) | (d) |
|-----|-------|------|------|-------|
| (1) | (iii) | (i) | (ii) | (iv) |
| (2) | (ii) | (iv) | (i) | (iii) |
| (3) | (iii) | (iv) | (i) | (ii) |
| (4) | (iii) | (ii) | (i) | (iv) |

Solution: (3)

An intestinal gland (also crypt of Lieberkühn and intestinal crypt) is a gland found in between villi in the intestinal epithelium lining of the small intestine and large intestine (colon). b) Glisson's capsule is the capsule of the liver. A layer of connective tissue surrounding the liver and ensheathing the hepatic artery, portal vein, and bile ducts within the liver. c) The pancreatic islets or islets of Langerhans are the regions of the pancreas that contain its endocrine (hormone-producing) cells, discovered in 1869 by German pathological anatomist Paul Langerhans. The pancreatic islets constitute 1 to 2% of the pancreas volume and receive 10–15% of its blood flow. d) Brunner's glands (or duodenal glands) are compound tubular submucosal glands found in that portion of the duodenum which is above the hepatopancreatic sphincter (a.k.a. sphincter of Oddi).

150. Match the following hormones with the respective disease:

- | | |
|--------------------|-------------------------|
| (a) Insulin | (i) Addison's disease |
| (b) Thyroxin | (ii) Diabetes insipidus |
| (c) Corticoids | (iii) Acromegaly |
| (d) Growth Hormone | (iv) Goitre |
| | (v) Diabetes mellitus |

Select the **correct option**

- | | (a) | (b) | (c) | (d) |
|-----|------|------|-------|-------|
| (1) | (v) | (i) | (ii) | (iii) |
| (2) | (ii) | (iv) | (iii) | (i) |
| (3) | (v) | (iv) | (i) | (iii) |
| (4) | (ii) | (iv) | (i) | (iii) |

Solution: (3)

(a) Diabetes insipidus is not related to diabetes mellitus (type 1 and type 2 diabetes). Diabetes insipidus is caused by problems related to antidiuretic hormone (ADH) or its receptor and causes frequent urination. Hence, Insulin is related to Diabetes mellitus.

(b) Thyroxine- Thyroxine is the main hormone secreted into the bloodstream by the thyroid gland. The goiters caused by an overactive thyroid or hyperthyroidism. (c) Addison's disease is caused by damage to your adrenal glands, resulting in not enough of the hormone cortisol and, often, not enough aldosterone as well. All treatment for Addison's disease involves hormone replacement therapy to correct the levels of steroid hormones your body isn't producing. Some options for treatment include oral corticosteroids.

(d) Acromegaly is a hormonal disorder that develops when your pituitary gland produces too much growth hormone during adulthood. When this happens, your bones increase in size, including those of your hands, feet and face. Acromegaly usually affects middle-aged adults.

151. Which of the following contraceptive methods do involve a role of hormone ?

- (1) Lactational amenorrhea, Pills, Emergency contraceptives
- (2) Barrier method, Lactational amenorrhea, Pills
- (3) CuT, Pills, Emergency contraceptives
- (4) Pills, Emergency contraceptives, Barrier methods

Solution: (1)

(i) Lactational amenorrhea: Breastfeeding delays the resumption of normal ovarian cycles by disrupting the pattern of pulsatile release of GnRH from the hypothalamus and hence LH from the pituitary.

(ii) Progestin-only emergency contraceptive pills ("morning after pills") are pills that contain levonorgestrel, a type of the hormone progestin researchers have found prevents pregnancy when taken in the few days after sex.

(iii) There are two main kinds of birth control pills — combination birth control pills, which contain estrogen and progestin.

152. Drug called 'Heroin' is synthesized by :

- (1) methylation of morphine
- (2) acetylation of morphine
- (3) glycosylation of morphine
- (4) nitration of morphine

Solution: (2)

Heroin, also called diacetylmorphine, highly addictive morphine derivative. Heroin is made by treating morphine with acetic anhydride; causing acetylation of the two hydroxyl groups of morphine. The resulting substance is four to eight times as potent as morphine. (Morphine is an alkaloid found in opium, which is the dried milky exudate obtained from the unripe seedpods of the poppy plant.)

- 153.** In a species, the weight of newborn ranges from 2 to 5 kg. 97% of the newborn with an average weight between 3 to 3.3 kg survive whereas 99% of the infants born with weights from 2 to 2.5 kg or 4.5 to 5 kg die. Which type of selection process is taking place ?

- (1) Directional Selection
- (2) Stabilizing Selection
- (3) Disruptive Selection
- (4) Cyclical Selection

Solution: (2)

Stabilizing selection (not to be confused with negative or purifying selection) is a type of natural selection in which the population mean stabilizes on a particular non-extreme trait value. Karn & Penrose (1951) showed that birth weight follows a normal distribution, that mortality for newborns is greater for those either under- or over-weight, and that the mean birth weight (7 lbs) coincides with that showing minimum mortality. That is, natural selection reduces the variance in birth weight, in such a way that the distribution has become stabilized around the optimum size for maximum survival.

- 154.** Conversion of glucose to glucose-6-phosphate, the first irreversible reaction of glycolysis, is catalyzed by :

- (1) Aldolase
- (2) Hexokinase
- (3) Enolase
- (4) Phosphofructokinase

Solution: (2)

Hexokinase. In the first step of glycolysis, the glucose ring is phosphorylated. Phosphorylation is the process of adding a phosphate group to a molecule derived from ATP. As a result, at this point in glycolysis, 1 molecule of ATP has been consumed.

- 155.** Which of the following statements is **correct** ?

- (1) Cornea is an external, transparent and protective proteinaceous covering of the eye-ball.
- (2) Cornea consists of dense connective tissue of elastin and repair itself.
- (3) Cornea is convex, transparent layer which is highly vascularized.
- (4) Cornea consists of dense matrix of collagen and is the most sensitive portion of the eye.

Solution: (4)

156. Which of the following ecological pyramids is generally inverted ?

- (1) Pyramid of numbers in grassland
- (2) Pyramid of energy
- (3) Pyramid of biomass in a forest
- (4) Pyramid of biomass in a sea

Solution: (4)

The amount of living organic matter is called biomass . And the pyramid of biomass is graphical representation of biomass per unit area at different trophic levels with producer at the base and carnivorous at the top .

The pyramid of biomass in ocean inverted because :

- Food chain in the ocean - {Phytoplankton → zooplankton → predatory fish.}
- the biomass of zooplankton is greater than phytoplankton (the producer) because of their small size and low weight . The predatory fish is much larger than zooplankton .
- the producer in ocean or aquatic ecosystem producers are phytoplankton have short life span and turn over and have lower mass than zooplankton.
- the biomass of trophic level depends on the longevity of member

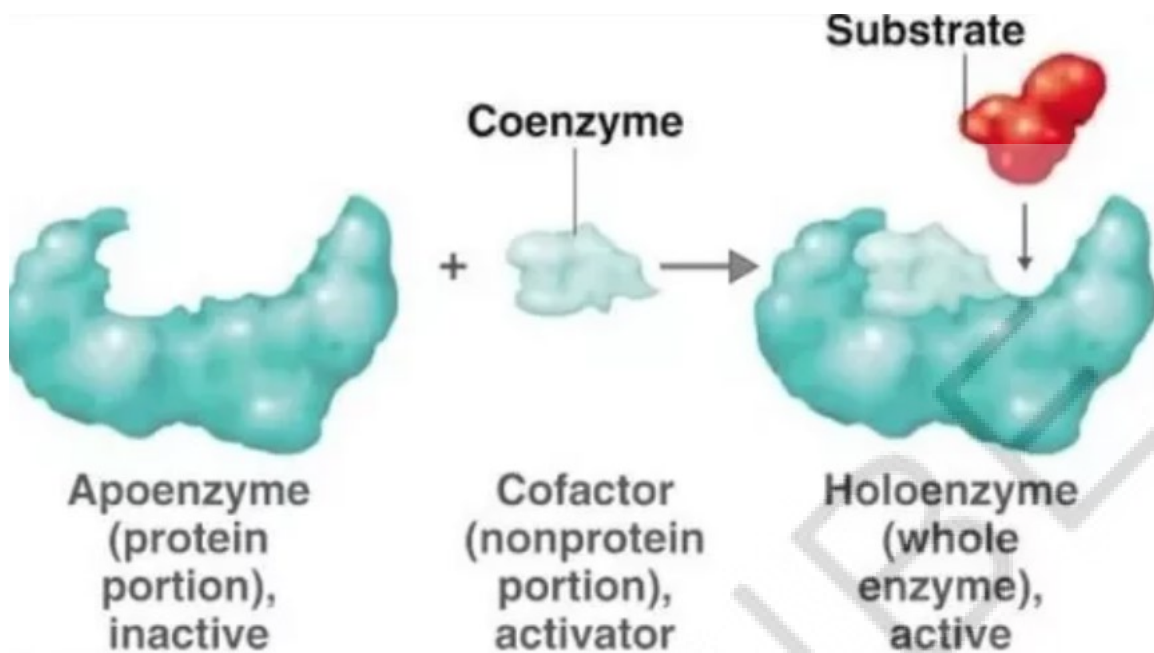
157. Consider the following statements:

- (A) Coenzyme or metal ion that is tightly bound to enzyme protein is called prosthetic group.
- (B) A complete catalytic active enzyme with its bound prosthetic group is called apoenzyme.

Select the **correct** option.

- (1) Both (A) and (B) are correct.
- (2) (A) is true but (B) is false.
- (3) Both (A) and (B) are false.
- (4) (A) is false but (B) is true

Solution: (2)



158. Due to increasing air-borne allergens and pollutants, many people in urban areas are suffering from respiratory disorder causing wheezing due to:

- (1) benign growth on mucous lining of nasal cavity.
- (2) inflammation of bronchi and bronchioles.
- (3) proliferation of fibrous tissues and damage of the alveolar walls.
- (4) reduction in the secretion of surfactants by pneumocytes.

Solution: (2)

Allergic bronchitis involves inflammation of the bronchi caused by an allergen, or something to which you are allergic. Airway irritants, such as pollen, dust, and mold, can trigger symptoms. It causes difficulty in breathing and followed with a severe cough, restlessness, cough and a wheezing sound while breathing.

159. Which one of the following statements regarding post-fertilization development in flowering plants is **incorrect**?

- (1) Ovary develops into fruit
- (2) Zygote develops into embryo
- (3) Central cell develops into endosperm
- (4) Ovules develop into embryo sac

Solution: (4)

Post -fertilization, the ovary expands to form fruit. In case of fruits with multiple seeds, multiple pollen grains are necessary to fertilize with each ovule.

160. Phloem in gymnosperms lacks:

- (1) Albuminous cells and sieve cells
- (2) Sieve tubes only
- (3) Companion cells only
- (4) Both sieve tubes and companion cells

Solution: (3)

Sieve elements are the chief conducting elements of the phloem which are of two types: sieve cells and sieve-tube members. Pores in sieve cells are narrow, there is seemingly uniformity in the structure of sieve areas and are found to be distributed evenly on all walls. The presence of sieve plates in sieve-tube members is one of the principal differences between sieve cells (absent) and sieve-tube members. In most gymnosperms and seedless vascular plants, Sieve cells are the only kind of food-conducting cells whereas sieve-tube members are present in angiosperms. Sieve tubes are made of sieve tube members arranged terminally to one another.

161. It takes very long times for pineapple plants to produce flowers. Which combination of hormones can be applied to artificially induce flowering in pineapple plants throughout the year to increase yield?

- (1) Auxin and Ethylene
- (2) Gibberellin and Cytokinin
- (3) Gibberellin and Absciscic acid
- (4) Cytokinin and Absciscic acid

Solution: (2)

The gibberellins, cytokinins, and auxins are found to be growth stimulators, while ethylene and abscisic acid are determined as growth inhibitors. Hence, 1,3,4 options are not valid. The function of cytokinin is the stimulation of cell division, growth of lateral buds, and apical dominance. Functions of Gibberellins is it Stimulates stem elongation, Leads to development of seedless fruits, Delays senescence in leaves and citrus fruits.

162. Persistent nucellus in the seed is known as :

- (1) Chalaza
- (2) Perisperm
- (3) Hilum
- (4) Tegmen

Solution: (2)

Perisperm: The residues of nucellus are sometimes persistent in few seeds, such as in beet and black pepper. This type of nucellus is the perisperm.

163. Cells in G_0 phase:

- (1) exit the cell cycle
- (2) enter the cell cycle
- (3) suspend the cell cycle
- (4) terminate the cell cycle

Solution: (3)

The cells remain in an inert state in the G_0 phase of the cell cycle. Hence, G_0 can be either viewed as the distinct inert stage which occurs outside the cell cycle or as an extension to the G_1 phase, where cell neither divides nor prepares for it. Sometimes, G_0 is also referred to as “post-mitotic” state where cells in G_0 are in non-dividing phase in the outside of cell cycle. Some types of cells, such as nerve and heart muscle cells, become post-mitotic when they reach maturity (i.e., when they are terminally differentiated) but continue to perform their main functions for the rest of the organism's life. Multinucleated muscle cells which don't undergo cytokinesis are also thought to be in the G_0 stage. Hence, it suspends the cell cycle.

164. Match **Column - I** with **Column - II**

Column-I		Column-II	
(a)	Saprophyte	(i)	Symbiotic association of fungi with plant roots
(b)	Parasite	(ii)	Decomposition of dead organic materials
(c)	Lichens	(iii)	Living on living plants
(d)	Mycorrhiza	(iv)	Symbiotic association of algae and fungi

Choose the **correct** answer from the options given below:

	(a)	(b)	(c)	(d)
(1)	(i)	(ii)	(iii)	(iv)
(2)	(iii)	(ii)	(i)	(iv)
(3)	(ii)	(i)	(iii)	(iv)
(4)	(ii)	(iii)	(iv)	(i)

Solution: (4)

Saprotrophs: these organisms obtain nutrients directly from the dead matter, especially fungi.

- **Myco-heterotrophs;** plants, fungi, or micro-organisms that live on dead or decomposing matter and parasitize fungi, rather than dead organic matter directly.

A parasite is an organism which lives in or on a host organism and gets its food from or at the cost of its host life. The three main classes of parasites which can induce disease in humans include protozoa, helminths and ectoparasites.

Lichens are complex life forms which is a symbiotic relationship between two separate organisms, an alga and a fungi. Fungus is dominant, which gives majority of its characteristics to the other partner, from its thallus shape to its fruiting bodies.

mycorrhizae, mycorrhiza or mycorrhizas) is a symbiotic relationship between a plant and a fungus.

The term mycorrhiza refers to the function of the fungus in the plant's root system or rhizosphere.

- 165.** What would be the heart rate of a person if the cardiac output is 5 L, blood volume in the ventricles at the end of diastole is 100 mL and at the end of ventricular systole is 50 mL?

- (1) 50 beats per minute
- (2) 75 beats per minute
- (3) 100 beats per minute
- (4) 125 beats per minute

Solution: (3)

$CO = HR \times (EDV - ESV)$ (Cardiac Output = Heart rate \times stroke volume; stroke volume = End Diastole volume - End Systole volume) ;

We have , $CO = 5 \text{ Liters}, 5000\text{ml}$

$EDV = 100\text{ml}$

$ESV = 50 \text{ ml}$

Hence, $CO = HR \times (EDV - ESV)$

$HR = CO / (EDV - ESV)$

$HR = 5000 / (100 - 50)$

$= 5000 / 50$

$HR = 100 \text{ bpm}$

- 166.** What triggers activation of protoxin to active Bt toxin of *Bacillus thuringiensis* in a boll worm?

- (1) Body temperature
- (2) Moist surface of midgut

- (3) Alkaline pH of gut
- (4) Acidic pH of stomach

Solution: (3)

Alkaline pH of gut triggers activation of protoxin to activate Bt toxin of *Bacillus thuringiensis* in bollworm.

167. The ciliated epithelial cells are required to move particles or mucus in a specific direction. In humans, these cells are mainly present in:

- (1) Bile duct and Bronchioles
- (2) Fallopian tubes and Pancreatic duct
- (3) Eustachian tube and Salivary duct
- (4) Bronchioles and Fallopian tubes

Solution: (4)

The human tracheobronchial tree is lined by pseudostratified, ciliated epithelium from the larynx down to the level of the terminal bronchiole. The nasal cavity (apart from its most anterior portion) and the paranasal sinuses are also lined by ciliated epithelium.

The epithelium of the human fallopian tube is a mixture of ciliated and nonciliated cells. Scattered ciliated cells are also found in the endometrium. The function of these ciliated cells is generally believed to be the transport of eggs, zygotes, and secretions. The cilia may further help to maintain the patency of the oviductal lumen

168. Which of the statements given below is **not** true about the formation of Annual Rings in trees ?

- (1) Annual ring is a combination of spring wood and autumn wood produced in a year.
- (2) Differential activity of cambium causes light and dark bands of tissue - early and late wood respectively.
- (3) Activity of cambium depends upon variation in climate.
- (4) Annual rings are not prominent in trees of temperate region.

Solution: (2)

The activity of cambium is non-uniform in plants growing in regions of favorable climatic conditions (rainy or spring season) that alternate regularly with unfavorable climatic conditions (dry hot summer or cold winter). In temperate climates, the cambium is more active giving rise to higher number of vessels with greater activities ,while in winter , it becomes less active and forms narrower and smaller vessels. Both spring and autumn wood contribute for an annual ring, forming one ring an year. The wood formed in the spring is known as spring

wood and that formed in the dry summer or cold winter autumn wood or late wood. Spring wood is light in colour while autumn wood is dark in colour. Therefore, the answer is 2.

169. What is the fate of the male gametes discharged in the synergid ?

- (1) One fuses with the egg, other(s) degenerate(s) in the synergid.
- (2) All fuse with the egg.
- (3) One fuses with the egg, other(s) fuse(s) with synergid nucleus.
- (4) One fuses with the egg and other fuses with central cell nuclei.

Solution: (4)

After a pollen grain germinates on the surface of the stigma, it forms a pollen tube that grows through the style and is guided through the micropyle (a minute opening at one end of the ovule). The pollen tube grows toward and into one of the synergid cells, which begins to degenerate as the pollen tube enters it (or shortly before). The pollen tube then ceases growth, ruptures, and releases its two sperm cells, which migrate to the egg and central cell, fertilization of which gives rise to the embryo and endosperm, respectively.

170. Match the following genes of the Lac operon with their respective products :

- | | |
|------------|----------------------------|
| (a) i gene | (i) β -galactosidase |
| (b) z gene | (ii) Permease |
| (c) a gene | (iii) Repressor |
| (d) y gene | (iv) Transacetylase |

Select the correct option.

- | | (a) | (b) | (c) | (d) |
|-----|-------|-------|------|------|
| (1) | (i) | (iii) | (ii) | (iv) |
| (2) | (iii) | (i) | (ii) | (iv) |
| (3) | (iii) | (i) | (iv) | (ii) |
| (4) | (iii) | (iv) | (i) | (ii) |

Solution: (3)

The lactose or lac operon of *Escherichia coli* is a cluster of three structural genes encoding proteins which is involved in lactose metabolism and the sites on the DNA taking part in regulation of the operon. The three genes are: (1) lacZ: it encodes for enzyme β -galactosidase (which splits lactose into glucose and galactose); (2) lacY: it encodes for lactose permease; and (3) lacA: It encodes for lactose transacetylase. Functional β -galactosidase and lactose permease are necessary for the usage of lactose by this bacterium. The concentration of these

proteins are in low quantity when the organism is grown on carbon sources other than lactose.

171. Select the **correct** sequence of organs in the alimentary canal of cockroach starting from mouth :

- (1) Pharynx → Oesophagus → Crop → Gizzard → Ileum → Colon → Rectum
- (2) Pharynx → Oesophagus → Gizzard → Crop → Ileum → Colon → Rectum
- (3) Pharynx → Oesophagus → Gizzard → Ileum → Crop → Colon → Rectum
- (4) Pharynx → Oesophagus → Ileum → Crop → Gizzard → Colon → Rectum

Solution: (1)

Digestion begins at the mouth where the structures such as mandibles and maxillae help chew the food. The enzymes salivary carbohydrases digest food partially and the saliva juice lubricates the food to help swallow it, from where the bolus moves to the esophagus and then onto the crop. Here food remains in its masticated form temporarily. The food now moves to the gizzard where its grinding takes place. A valve named stomodeal is present right at the joint of gizzard and stomach.

This valve prevents the regurgitation of food while ensuring the smooth passage of food in the stomach. The food that has entered the stomach are treated by the digestive enzymes created by the gastric caeca. The enzymes involved are invertase, amylase, tryptase, maltase, and lipase. The residual fats, proteins, and carbohydrates will be absorbed here.

172. Match the hominids with their **correct** brain size :

- | | |
|----------------------------------|------------------|
| (a) <i>Homo habilis</i> | (i) 900 cc |
| (b) <i>Homo neanderthalensis</i> | (ii) 1350 cc |
| (c) <i>Homo erectus</i> | (iii) 650-800 cc |
| (d) <i>Homo sapiens</i> | (iv) 1400 cc |

Select the correct option.

- | | (a) | (b) | (c) | (d) |
|-----|-------|-------|------|------|
| (1) | (iii) | (i) | (iv) | (ii) |
| (2) | (iii) | (ii) | (i) | (iv) |
| (3) | (iii) | (iv) | (i) | (ii) |
| (4) | (iv) | (iii) | (i) | (ii) |

Solution: (2)

H.habilis was also called “handyman” due to the findings of tools in the remains and are found to have existed between 1.5 to 2.4 million years ago. They are very

similar to australopithecines for many facts. The face is primitive yet projects less than *A. africanus*. The back tooth is smaller but larger than modern humans. The average size of the brain, at 650cc, is larger in australopithecines. Neanderthal or Neanderthal man had existed about 230000 to 300000 years ago. The average size of the brain is slightly larger than that of modern humans, about 1450cc, but is correlative with their greater bulk. Modern forms of *Homo sapiens* first appeared about 195000 years ago and with an average brain size of about 1350cc.

173. Identify the **correct** pair representing the causative agent of typhoid fever and the confirmatory test for typhoid.

- (1) *Plasmodium vivax*/ UTI test
- (2) *Streptococcus pneumoniae*/ Widal test
- (3) *Salmonella typhi*/ Anthrone test
- (4) *Salmonella typhi*/ Widal test

Solution: (4)

Salmonella typhi, the causative agent of typhoid fever, is approximately 50,000 years old. Assays that identify *Salmonella* antibodies or antigens support the diagnosis of typhoid fever, but these results should be confirmed with cultures or DNA evidence. The Widal test has been the anchor for diagnosis of typhoid fever for decades. It is used to quantify agglutinating antibodies against H and O antigens of *S. typhi*.

174. How does steroid hormone influence the cellular activities ?

- (1) Changing the permeability of the cell membrane.
- (2) Binding to DNA and forming a gene-hormone complex.
- (3) Activating cyclic AMP located on the cell membrane.
- (4) Using aquaporin channels as second messenger.

Solution: (2)

Hormones are chemicals which are produced and secreted by endocrine glands in the body. Hormones are given out into the bloodstream which travel to other parts of the body where they bring about specific responses from certain cells. The steroid hormones are obtained from cholesterol and are lipid-soluble in nature. Sex hormones (androgens, estrogens, and progesterone) produced by male and female gonads and hormones of the adrenal glands (aldosterone, cortisol, and androgens) are examples of steroid hormones.

The steroid hormone action mechanism can be summarized as follows:

- 1. Steroid hormones move through the cell membrane of the target cell.
- 2. The steroid hormone combines with a specific receptor in the cytoplasm.
- 3. The receptor-bound steroid hormone travels into the nucleus and binds to another specific receptor on the chromatin.

4. The steroid hormone-receptor complex calls for the production of messenger RNA (mRNA) molecules, which code for the production of proteins.
175. Tidal Volume and Expiratory Reserve Volume of an athlete is 500 mL and 1000 mL respectively. what will be his Expiratory Capacity if the Residual Volume is 1200 mL ?
- (1) 1500 mL
 - (2) 1700 mL
 - (3) 2200 mL
 - (4) 2700 mL

Solution: (3)

$$EC = ERV + RV$$

$$EC = 1000 + 1200 = 2200 \text{ mL}$$

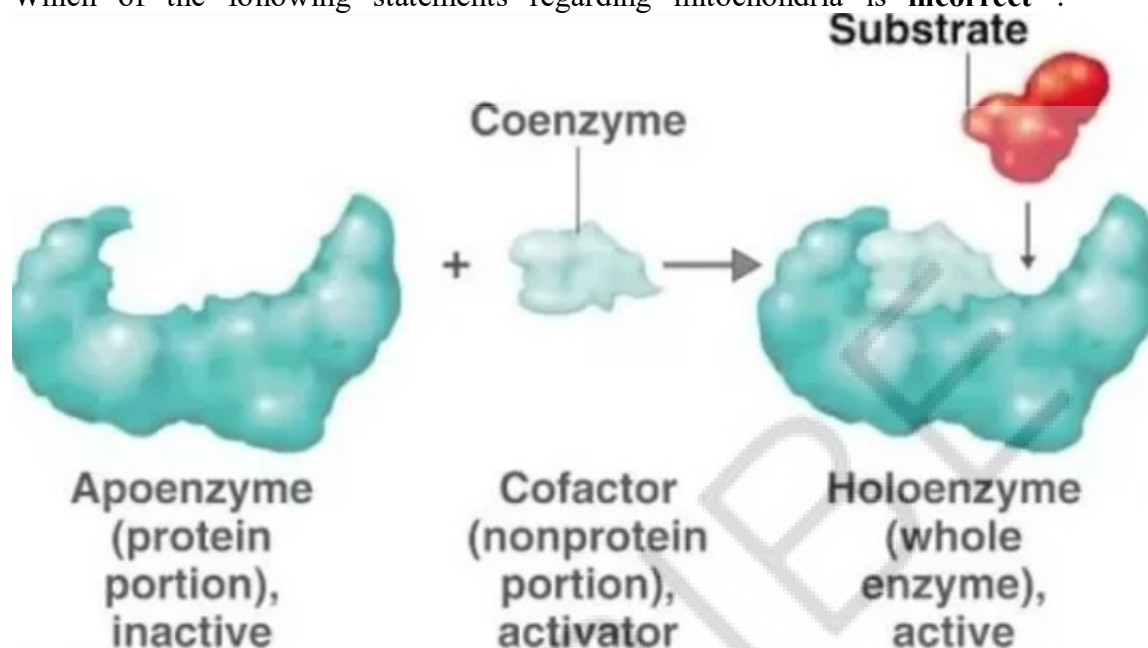
176. Which of the following is a commercial blood cholesterol lowering agent ?
- (1) Cyclosporin A
 - (2) Statin
 - (3) Streptokinase
 - (4) Lipases

Solution: (2)

Statins, also known as HMG-CoA reductase inhibitors, are a class of lipid-lowering medications that are thought to reduce illness and mortality in those who are at high risk of cardiovascular disease.



177. Which of the following statements regarding mitochondria is **incorrect** ?



- (1) Outer membrane is permeable to monomers of carbohydrates, fats and proteins.
- (2) Enzymes of electron transport are embedded in outer membrane.
- (3) Inner membrane is convoluted with infoldings.
- (4) Mitochondria matrix contains single circular DNA molecule and ribosomes.

Solution: (2)

The thickness of the outer mitochondrial membrane, which encloses the entire organelle, is 60 to 75 angstroms (Å). It has a protein-to-phospholipid ratio similar to that of the cell membrane (about 1:1 by weight). It consists of a large number of porins, an integral membrane proteins. The pore-forming voltage-dependent anion channel is the major trafficking protein.

The inner membrane of mitochondria has convoluted foldings.

The inner membrane encloses the matrix. It consists of 2/3 of the total protein in a mitochondrion. The matrix is important in ATP synthesis with the aid of the ATP synthase contained in the inner membrane. The matrix contains a highly concentrated mixture of hundreds of enzymes, special mitochondrial ribosomes, tRNA, and several copies of the mitochondrial DNA genome. Therefore, 2 is the answer.

178. Match the Column - I with Column - II:

- | Column – I | Column II |
|--------------|----------------------------------|
| (a) P – wave | (i) Depolarisation of ventricles |

- | | | | |
|-----|------------------|-------|------------------------------|
| (b) | QRS complex | (ii) | Repolarisation of ventricles |
| (c) | T – wave | (iii) | Coronary ischemia |
| | Reduction in the | | |
| (d) | size of T - wave | (iv) | Depolarisation of atria |
| | | (v) | Repolarisation of atria |

Select the correct option

- | | (a) | (b) | (c) | (d) |
|-----|------|-------|------|-------|
| (1) | (iv) | (i) | (ii) | (iii) |
| (2) | (iv) | (i) | (ii) | (v) |
| (3) | (ii) | (i) | (v) | (iii) |
| (4) | (ii) | (iii) | (v) | (iv) |

Solution: (1)

Depolarization and repolarization of Atrium and ventricle, represented on the ECG as a series of waves: the P wave followed by the QRS complex and the T wave.

The first deflection is the P wave linked with right and left atrial depolarization. Wave of which is invisible because of low amplitude.

Normal P wave is no higher than 2.5 mm (two-and-a-half 1-mm-divisions) tall and less than 120 ms (three 1-mm-divisions) in width in any lead.

The second wave is the QRS complex. The complex has a series of 3 deflections that reflects current associated with right and left ventricular depolarization. By convention, the first deflection in the complex, if negative, is called a Q wave. The first positive deflection in the complex is called an R wave. A negative deflection after an R wave is called an S wave. The most labile wave in the ECG is the T wave, which changes including low-amplitude T waves and abnormally inverted T waves, which may be the result of many cardiac and non-cardiac conditions.

179. Select the **correct** group of biocontrol agents.

- (1) *Bacillus thuringiensis*, Tobacco mosaic virus, Aphids
- (2) *Trichoderma*, *Baculovirus*, *Bacillus thuringiensis*
- (3) *Oscillatoria*, *Rhizobium*, *Trichoderma*
- (4) *Nostoc*, *Azospirillum*, *Nucleopolyhedrovirus*

Solution: (2)

Trichoderma is an efficient biological mean for soil born plant disease management.

It is a free-living fungus usually found in soil and root ecosystems. It is highly interactive in the root, soil, and foliar environments. Using mechanisms like competition, antibiosis, mycoparasitism, hyphal interactions, and enzyme secretion, it stunts growth, survival or infections developed by pathogens.

Baculoviruses are pathogens which attack insects and other arthropods of very small size (less than a thousandth of a millimeter across) and are composed primarily of double-stranded DNA encoding for genes needed for virus establishment and reproduction. The infective baculovirus particle (virion) is protected by a protein coat called a polyhedron (plural polyhedra). Because this genetic material is easily destroyed by exposure to sunlight or through conditions in the host's gut. The ingestion of the insect baculoviruses by the host to produce infection, causing fatality to the insect.

The insecticidal bacterium *Bacillus thuringiensis* (B.t.) is the most successful commercial biological control agent of insect pests. B.t. is a spore-forming bacterium that can be readily isolated on simple media such as the nutrient agar from a variety of habitats including soil, water, plants, grain dust, dead insects, and insect feces.

180. Select the correctly written scientific name of Mango Which was first described by Carolus Linnaeus:

- (1) *Magnifera indica* Car.Linn
- (2) *Magnifera indica* Linn
- (3) *Magnifera indica*
- (4) *Magnifera Indicas*

Solution: (3)

The binomial nomenclature was first implemented by Carl Linnaeus, every organism is described by the scientific name comprised of the two name, genus and species name. The genus name is capitalised and the rest of the letters are small and italicised. The correct answer is option 3

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2. No candidate, without special permission of the Superintendent or Invigilator, would leave his/her seat.
3. The candidates should not leave the Examination Hall without handing over their Answer Sheet to the Invigilator on duty and sign the Attendance Sheet twice. Cases where a candidate has not signed the Attendance Sheet second time will be deemed not to have handed over the Answer Sheet and dealt with as an unfair means case.
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