

CHEMISTRY

SECTION - A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Choose the correct answer :

1. The correct decreasing order of energy for the orbitals having, following set of quantum numbers:

- (A) $n = 3, l = 0, m = 0$ (B) $n = 4, l = 0, m = 0$
 (C) $n = 3, l = 1, m = 0$ (D) $n = 3, l = 2, m = 1$

- (A) $(D) > (B) > (C) > (A)$
 (B) $(B) > (D) > (C) > (A)$
 (C) $(C) > (B) > (D) > (A)$
 (D) $(B) > (C) > (D) > (A)$

Answer (A)

Sol. Energy of an orbital is directly proportional to the $(n + l)$ value

- | | | $(n + l)$ |
|--------------|---------|-----------|
| (A) $n = 3,$ | $l = 0$ | 3 |
| (B) $n = 4,$ | $l = 0$ | 4 |
| (C) $n = 3,$ | $l = 1$ | 4 |
| (D) $n = 3,$ | $l = 2$ | 5 |

If $n + l$ value is same then the orbital with lower value of 'n' will have lower energy.

$\therefore$ correct order of energy

$$D > B > C > A$$

2. Match List-I with List -II

- | List-I | List-II |
|-----------------------------------|--------------------------------------|
| (A) $\Psi_{MO} = \Psi_A - \Psi_B$ | (I) Dipole moment |
| (B) $\mu = Q \times r$ | (II) Bonding molecular orbital |
| (C) $\frac{N_b - N_a}{2}$ | (III) Anti-bonding molecular orbital |
| (D) $\Psi_{MO} = \Psi_A + \Psi_B$ | (IV) Bond order |

Choose the correct answer from options given below:

- (A) (A)-(II), (B)-(I), (C)-(IV), (D)-(III)
 (B) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)
 (C) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)
 (D) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)

Answer (C)

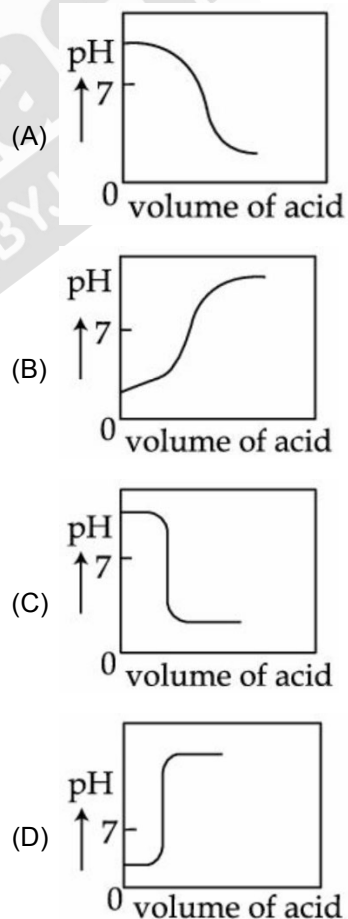
Sol. $\Psi_A - \Psi_B = \Psi_{MO}$ is anti-bonding molecular orbital

$\mu = Q \times r$ is dipole moment

$$\frac{N_b - N_a}{2} = \text{bond order}$$

$\Psi_A + \Psi_B = \Psi_{MO}$ is bonding molecular orbital.

3. The plot of pH-metric titration of weak base NH_4OH vs strong acid HCl looks like :

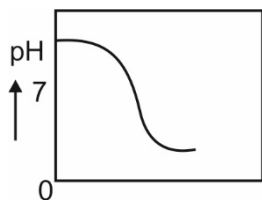


Answer (A)

Sol. NH_4OH is a weak base and HCl is a strong acid.

With the addition of HCl to NH_4OH , pH of solution will decrease gradually.

So, the correct graph should be



4. Given below are two statements :

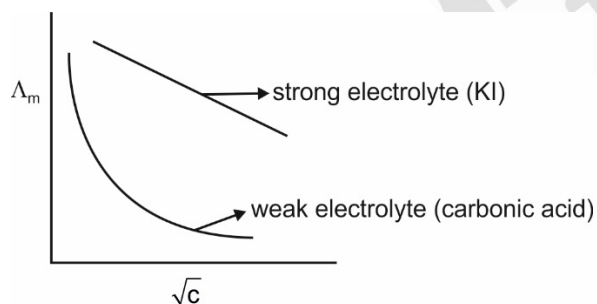
Statement-I : For KI , molar conductivity increases steeply with dilution.

Statement-II : For carbonic acid, molar conductivity increases slowly with dilution. In the light of the above statements, choose the **correct** answer from the options given below :

- (A) Both **Statement I** and **Statement II** are true
- (B) Both **Statement I** and **Statement II** are false
- (C) **Statement I** is true but **Statement II** is false
- (D) **Statement I** is false but **Statement II** is true

Answer (B)

Sol. For any electrolyte, molar conductivity decreases with dilution.



Both Statements are false.

5. Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)** :

Assertion (A) : Dissolved substances can be removed from a colloidal solution by diffusion through a parchment paper.

Reason (R) : Particles in a true solution cannot pass through parchment paper but the colloidal particles can pass through the parchment paper.

In the light of the above statements, choose the correct answer from the options given below

- (A) Both (A) and (R) are correct and (R) is the correct explanation of (A)
- (B) Both (A) and (R) are correct but (R) is not the correct explanation of (A)
- (C) (A) is correct but (R) is not correct
- (D) (A) is not correct but (R) is correct

Answer (C)

Sol. Parchment paper is a semi-permeable membrane which allows particles of true solution to pass through as their size are too small.

Assertion is correct but reason is incorrect.

6. Outermost electronic configurations of four elements A, B, C, D are given below :

- (A) $3s^2$ (B) $3s^2 3p^1$
- (C) $3s^2 3p^3$ (D) $3s^2 3p^4$

The **correct** order of first ionization enthalpy for them is:

- (A) $(A) < (B) < (C) < (D)$ (B) $(B) < (A) < (D) < (C)$
- (C) $(B) < (D) < (A) < (C)$ (D) $(B) < (A) < (C) < (D)$

Answer (B)

Sol Orbitals with fully filled and half-filled electronic configuration are stable, and require more energy for ionization

Elements with greater electronegativity require more energy for ionisation

Hence the correct order is $C > D > A > B$

7. An element A of group 1 shows similarity to an element B belonging to group 2. If A has maximum hydration enthalpy in group 1 then B is:

- (A) Mg (B) Be
- (C) Ca (D) Sr

Answer (A)

Sol Lithium belongs to group-1, which has maximum hydration enthalpy among the group-1 elements.

Lithium shows diagonal relationship with Mg

8. Given below are two statements: one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**

Assertion (A) : Boron is unable to form BF_6^{3-}

Reason (R) : Size of B is very small

In the light of the above statements, choose the correct answer from the options given below:

- (A) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**
 (B) Both **(A)** and **(R)** are true but **(R)** is not the correct explanation of **(A)**
 (C) **(A)** is true but **(R)** is false
 (D) **(A)** is false but **(R)** is true

Answer (B)

Sol The outer most shell of Boron is 2 and its maximum covalency is 4.

Therefore, boron cannot form BF_6^{3-} .

Hence Assertion is correct

Boron is the first element of group-13 of modern periodic table. It is very small in size.

But it does not provide correct explanation of Assertion

9. In neutral or alkaline solution, MnO_4^- oxidises thiosulphate to :

- (A) $\text{S}_2\text{O}_7^{2-}$ (B) $\text{S}_2\text{O}_8^{2-}$
 (C) SO_3^{2-} (D) SO_4^{2-}

Answer (D)

Sol $\text{H}_2\text{O} + 8\text{MnO}_4^- + 3\text{S}_2\text{O}_3^{2-} \rightarrow 8\text{MnO}_2 + 6\text{SO}_4^{2-} + 2\text{OH}^-$

10. Low oxidation state of metals in their complexes are common when ligands :

- (A) Have good π -accepting character
 (B) Have good σ -donor character
 (C) Are having good π -donating ability
 (D) Are having poor σ -donating ability

Answer (A)

Sol Ligands like :CO , are sigma donor and π -acceptor and they make stronger bond with lower oxidation state metal ion, in this case back bonding is more effective

11. Given below are two statements:

Statement I : The non bio-degradable fly ash and slag from steel industry used by cement industry.

Statement II : The fuel obtained from plastic waste is lead free.

In the light of the above statements, choose the most appropriate answer from the options given below:

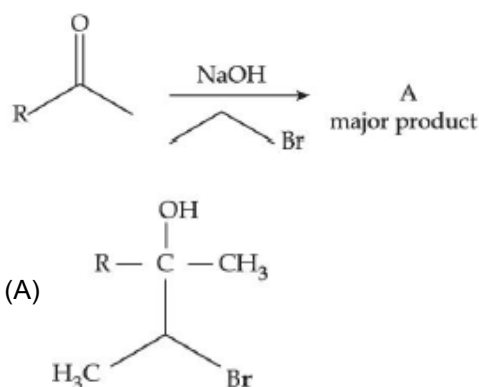
- (A) Both Statement I and Statement II are correct
 (B) Both Statement I and Statement II are incorrect
 (C) Statement I is correct but Statement II is incorrect
 (D) Statement I is incorrect but Statement II is correct

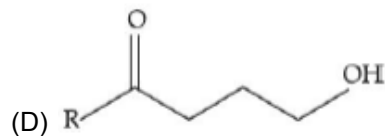
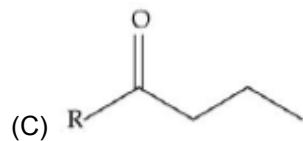
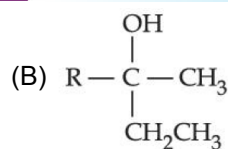
Answer (A)

Sol. Both Statement are correct.

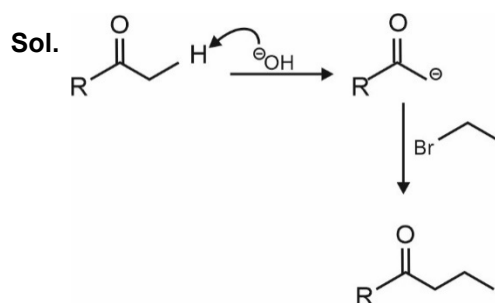
- Fuel obtained from plastic waste has high octane rating. It contain no lead and is known as "green fuel".
- The non bio-degradable fly ash and slag from steel industry can be used by cement industry.

12. The structure of A in the given reaction is:

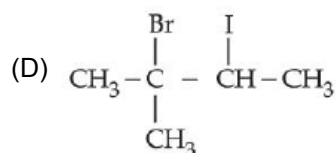
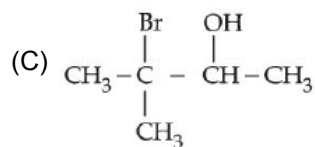
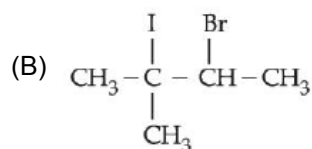
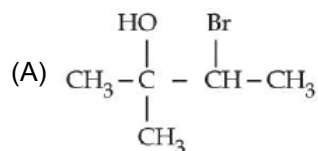
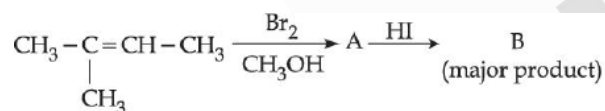




Answer (C)

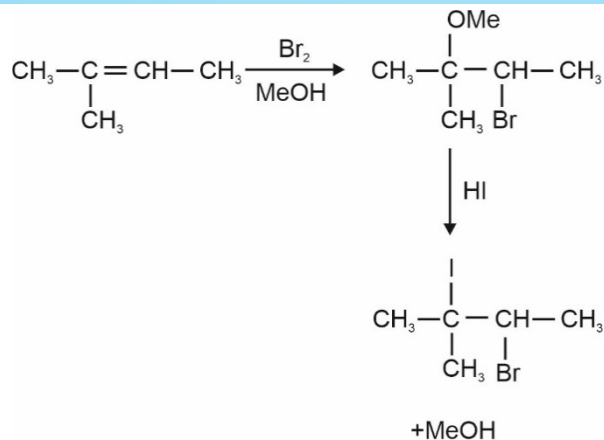


13. Major product 'B' of the following reaction sequence is:



Answer (B)

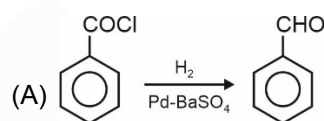
Sol.



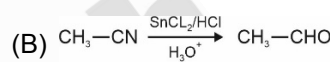
14. Match List-I with List-II

List-I

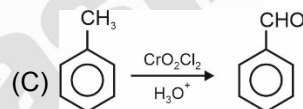
List-II



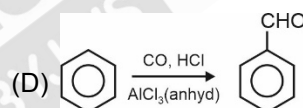
(I) Gatterman Koch reaction



(II) Etard reaction



(III) Stephen reaction



(IV) Rosenmund reaction

Choose the correct answer from the options given below:

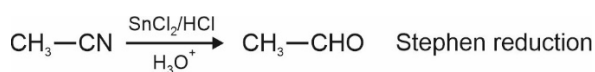
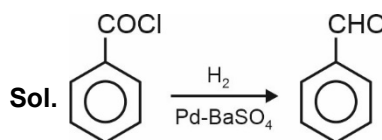
(A) (A) - (IV), (B) - (III), (C) - (II), (D) - (I)

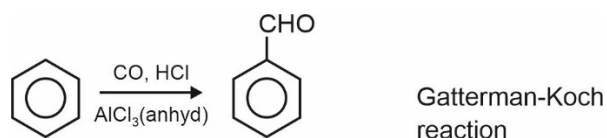
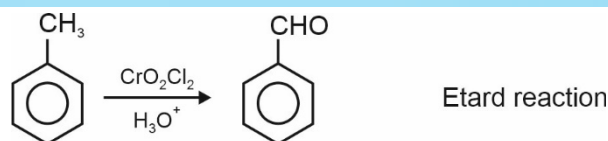
(B) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)

(C) (A) - (II), (B) - (III), (C) - (IV), (D) - (I)

(D) (A) - (III), (B) - (II), (C) - (I), (D) - (IV)

Answer (A)





15. Match List-I with List-II

List-I**(Polymer)**

- (A) Neoprene
(B) Teflon
(C) Acrilan
(D) Natural rubber

List-II**(Monomer)**

- (I) Acrylonitrile
(II) Chloroprene
(III) Tetrafluoroethene
(IV) Isoprene

Choose the correct answer from the options given below:

- (A) (A) - (II), (B) - (III), (C) - (I), (D) - (IV)
(B) (A) - (II), (B) - (I), (C) - (III), (D) - (IV)
(C) (A) - (II), (B) - (I), (C) - (IV), (D) - (III)
(D) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)

Answer (A)

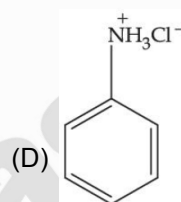
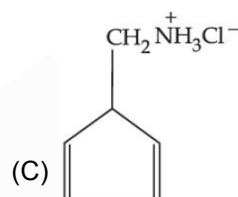
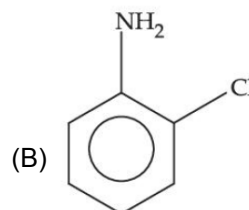
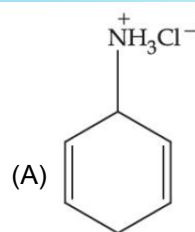
Sol. Polymer

- Neoprene
Teflon
Acrilan (PAN)
Natural rubber

Monomer

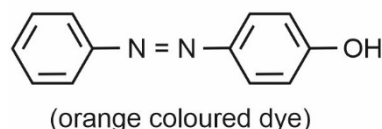
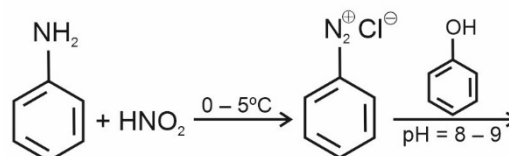
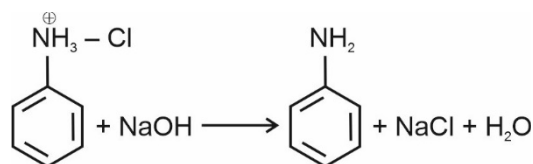
- Chloroprene
 $\text{CF}_2 = \text{CF}_2$
Acrylonitrile
Isoprene

16. An organic compound 'A' contains nitrogen and chlorine. It dissolves readily in water to give a solution that turns litmus red. Titration of compound 'A' with standard base indicates that the molecular weight of 'A' is 131 ± 2 . When a sample of 'A' is treated with aq. NaOH, a liquid separates which contains N but not Cl. Treatment of the obtained liquid with nitrous acid followed by phenol gives orange precipitate. The compound A is :



Answer (D)

Sol. is acidic in nature as it can undergo cationic (A) hydrolysis in aqueous solution.



17. Match List-I with List-II

List-I	List-II
(A) Glucose + HI	(I) Gluconic acid
(B) Glucose + Br ₂ water	(II) Glucose pentacetate
(C) Glucose + acetic anhydride	(III) Saccharic acid
(D) Glucose + HNO ₃	(IV) Hexane

Choose the correct answer from the options given below:

- (A) (A)-(IV), (B)-(I), (C)-(II), (D)-(III)
 (B) (A)-(IV), (B)-(III), (C)-(II), (D)-(I)
 (C) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)
 (D) (A)-(I), (B)-(III), (C)-(IV), (D)-(II)

Answer (A)

Sol. The correct match is:

- (A) Glucose+HI/Red P→(IV) Hexane
 (B) Glucose+Br₂/water→(I) Gluconic acid
 (C) Glucose + acetic → (II) Glucose pentacetate Anhydride
 (D) Glucose + HNO₃ → (III) Saccharic acid

All the above reactions establish open chain structure of glucose.

18. Which of the following enhances the lathering property of soap?

- (A) Sodium stearate (B) Sodium carbonate
 (C) Sodium rosinate (D) Trisodium phosphate

Answer (C)

Sol. A gum called rosin is added to soap which forms sodium rosinate. It helps to produce lather.

19. Match List-I with List-II

List-I (Mixture)	List-II (Purification Process)
(A) Chloroform & Aniline	(I) Steam distillation
(B) Benzoic acid & Napthalene	(II) Sublimation
(C) Water & Aniline	(III) Distillation
(D) Napthalene & Sodium chloride	(IV) Crystallisation

Choose the correct answer from the options given below:

- (A) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)
 (B) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)
 (C) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)
 (D) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

Answer (D)

Sol. The correct match is

- (A) Chloroform & Aniline (III) Simple distillation
 (B) Benzoic acid & Napthalene (IV) Crystallisation (Sublimation is not used as both sublime heating)
 (C) Water & Aniline (I) Steam distillation
 (D) Napthalene & Sodium chloride (II) Sublimation (only naphthalene has the tendency for sublimation)

20. Fe³⁺ cation gives a Prussian blue precipitate on addition of potassium ferrocyanide solution due to the formation of:

- (A) [Fe(H₂O)₆]₂ [Fe(CN)₆]
 (B) Fe₂[Fe(CN)₆]₂
 (C) Fe₃[Fe(OH)₂ (CN)₄]₂
 (D) Fe₄[Fe(CN)₆]₃

Answer (D)

Sol. Fe³⁺ + K₄[Fe(CN)₆]→Fe₄[Fe(CN)₆]₃

Prussian blue ppt

SECTION - B

Numerical Value Type Questions: This section contains 10 questions. In Section B, attempt any five questions out of 10. The answer to each question is a **NUMERICAL VALUE**. For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the second decimal place; e.g. 06.25, 07.00, -00.33, -00.30, 30.27, -27.30) using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.

1. The normality of H_2SO_4 in the solution obtained on mixing 100 mL of 0.1 M H_2SO_4 with 50 mL of 0.1 M NaOH is _____ $\times 10^{-1}$ N. (Nearest Integer)

Answer (01.00)

Sol.

	$\text{H}_2\text{SO}_4 + 2\text{NaOH} \longrightarrow \text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$			
Initial millimoles	10	5	—	—
Final millimoles	7.5	—	2.5	—

$$\text{Molarity of } \text{H}_2\text{SO}_4 = \frac{7.5}{150} = \frac{1}{20} \text{ M}$$

$$\text{Normality of } \text{H}_2\text{SO}_4 = \frac{1}{20} \times 2 = 0.1 \text{ N}$$

$$= 1 \times 10^{-1} \text{ N}$$

2. For a real gas at 25°C temperature and high pressure (99 bar) the value of compressibility factor is 2, so the value of Van der Waal's constant 'b' should be _____ $\times 10^{-2}$ L mol $^{-1}$ (Nearest integer)

(Given $R = 0.083$ L bar K $^{-1}$ mol $^{-1}$)

Answer (25.00)

Sol. For 1 mole at high pressure

$$P(V - b) = RT$$

$$PV - Pb = RT$$

$$\frac{PV}{RT} = 1 + \frac{Pb}{RT}$$

$$Z = 1 + \frac{Pb}{RT}$$

$$1 = \frac{99(b)}{0.083 \times 298}$$

$$b = \frac{0.083 \times 298}{99} \approx 0.249 \approx 25 \times 10^{-2}$$

3. A gas (Molar mass = 280 g mol $^{-1}$) was burnt in excess O_2 in a constant volume calorimeter and during combustion the temperature of calorimeter increased from 298.0 K to 298.45 K. If the heat capacity of calorimeter is 2.5 kJ K $^{-1}$ and enthalpy of combustion of gas is 9 kJ mol $^{-1}$ then amount of gas burnt is _____ g. (Nearest Integer)

Answer (35.00)

Sol. $\Delta U = C \Delta T$

$$= 2.5 \times 10^3 \times 0.45$$

$$= 1.125 \text{ kJ}$$

Considering $\Delta H \approx \Delta U$

$$\Delta H = 9 \text{ kJ/mol} \approx \Delta U$$

$$\therefore \text{Mass of gas burnt} = \frac{1.125}{9} \times 280 = 35 \text{ g}$$

4. When a certain amount of solid A is dissolved in 100 g of water at 25°C to make a dilute solution, the vapour pressure of the solution is reduced to one-half of that of pure water. The vapour pressure of pure water is 23.76 mmHg. The number of moles of solute A added is _____. (Nearest Integer)

Answer (06.00)

$$\text{Sol. } \frac{P_o - P_s}{P_s} = \frac{n_A}{n_B}$$

$$1 = \frac{n_A}{n_B}$$

$$n_A = n_B$$

$\therefore$ Moles of solute added considering it as a non-electrolyte

$$= \frac{100}{18} \approx 5.55$$

$$\approx 6$$

5. [A] $\rightarrow$ [B]

Reactant Product

If formation of compound [B] follows the first order of kinetics and after 70 minutes the concentration of [A] was found to be half of its initial concentration. Then the rate constant of the reaction is $x \times 10^{-6}$ s $^{-1}$. The value of x is _____. (Nearest Integer)

Answer (165)

Sol. A $\longrightarrow$ B

Reactant Product

$$k = \frac{0.693}{70 \times 60} = 165 \times 10^{-6} \text{ s}^{-1}$$

$$\therefore x = 165$$

6. Among the following ores Bauxite, Siderite, Cuprite, Calamine, Haematite, Kaolinite, Malachite, Magnetite, Sphalerite, Limonite, Cryolite, the number of principal ores of iron is ____.

Answer (04.00)

Sol. The principal ores of iron are :

Siderite, Haematite, Magnetite, Limonite.

7. The oxidation state of manganese in the product obtained in a reaction of potassium permanganate and hydrogen peroxide in basic medium is ____.

Answer (04.00)

Sol. $2\text{MnO}_4^- + 3\text{H}_2\text{O}_2 \rightarrow 2\text{MnO}_2 + 3\text{O}_2 + 2\text{H}_2\text{O} + 2\text{OH}^-$

Oxidation state of Mn in $\text{MnO}_2 = +4$

8. The number of molecules(s) or ions(s) from the following having non-planar structure is ____.

NO_3^- , H_2O_2 , BF_3 , PCl_3 , XeF_4 , SF_4 , SF_6 ,

XeO_3 , PH_4^+ , SO_3 , $[\text{Al}(\text{OH})_4]^-$

Answer (06.00)

Sol. $\text{NO}_3^- \rightarrow$ Trigonal planar (Planar)

$\text{H}_2\text{O}_2 \rightarrow$ Open book (Non-planar)

$\text{BF}_3 \rightarrow$ Trigonal planar (Planar)

$\text{PCl}_3 \rightarrow$ Pyramidal (Non-planar)

$\text{XeF}_4 \rightarrow$ Square planar (Planar)

$\text{SF}_4 \rightarrow$ See-Saw (Non-planar)

$\text{XeO}_3 \rightarrow$ Pyramidal (Non-planar)

$\text{PH}_4^+ \rightarrow$ Tetrahedral (Non-planar)

$\text{SO}_3 \rightarrow$ Trigonal planar (Planar)

$[\text{Al}(\text{OH})_4]^- \rightarrow$ Tetrahedral (Non-planar)

9. The spin only magnetic moment of the complex present in Fehling's reagent is ____ B.M. (Nearest integer).

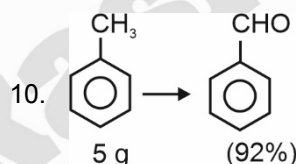
Answer (02.00)

Sol. In the complex present in Fehling's reagent, Cu^{+2} ion is present.

So, spin only magnetic moment

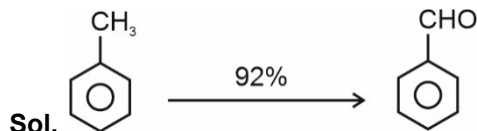
$$= \sqrt{1(1+2)}$$

$$= \sqrt{3} \approx 2 \text{ B.M.}$$



In the above reaction, 5 g of toluene is converted into benzaldehyde with 92% yield. The amount of benzaldehyde produced is ____ $\times 10^{-2}$ g. (Nearest integer).

Answer (530)



$$\text{Moles} = \frac{5}{92}$$

$$\text{Moles of benzaldehyde produced} = \frac{5}{92} \times 0.92 = 0.05$$

$\therefore$ Mass of benzaldehyde formed

$$= 0.05 \times 106$$

$$= 5.3 \text{ g}$$

$$= 530 \times 10^{-2}$$