

SECTION-A

1. The INCORRECT statement(s) about heavy water is (are)

- (a) Used as moderator in nuclear reactor
- (b) Obtained as a by-product in fertilizer industry
- (c) Used for the study of reaction mechanism
- (d) Has a higher dielectric constant than water

Choose the correct answer from the option given below:

- a. (B) only
- b. (B) and (D) only
- c. (C) only
- d. (D) only

Ans : d

Solution

D₂O = 78.06 (Dielectric constant)

H₂O = 78.39 (Dielectric constant)

2. Given below are two statements:

Statement I: Potassium permanganate on heating at 573 K forms potassium manganate.

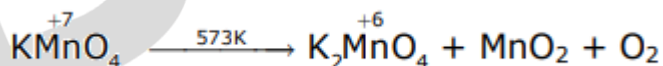
Statement II: Both potassium permanganate and potassium manganate are tetrahedral and paramagnetic in nature.

In the light of the above statements, choose the most appropriate Ans 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 and statement II is false
- d. Statement I is false but statement II is true

Ans: (c)

Solution



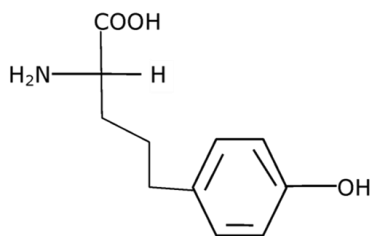
Dimagnetic

Potassium Manganate
one unpaired electron
(Paramagnetic)

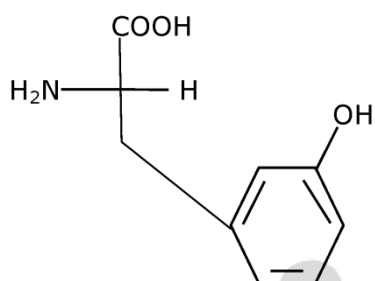


3. Which of the following is correct structure of tyrosine?

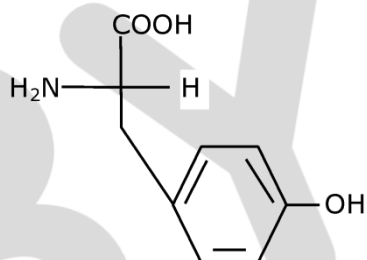
a.



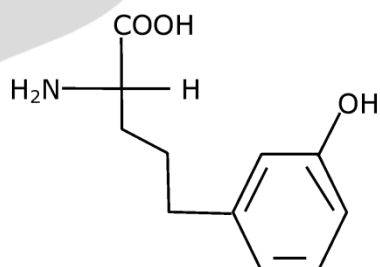
b.



c.



d.



Ans: (c)

Solution

Fact.

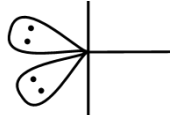
7. A central atom in a molecule has two lone pairs of electrons and forms three single bonds. The shape of this molecule is:
- Trigonal pyramidal
 - T-shaped
 - See-saw
 - Planar triangular

Ans: (b)

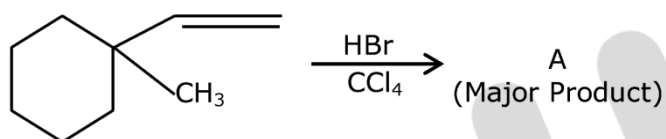
Solution

Steric number = 2 L.P + 3 B.P \Rightarrow 5 (sp^3d)

T-shape

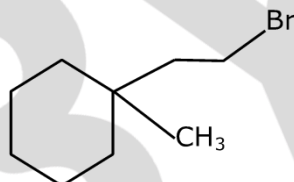


8.

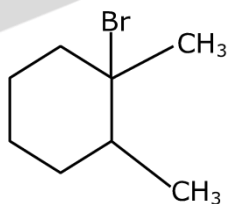


Product "A" in the above chemical reaction is:

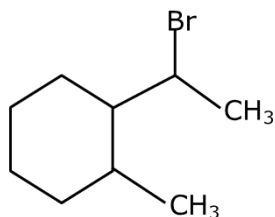
a.



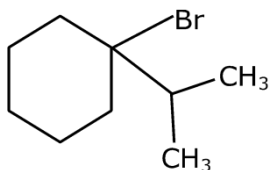
b.



c.

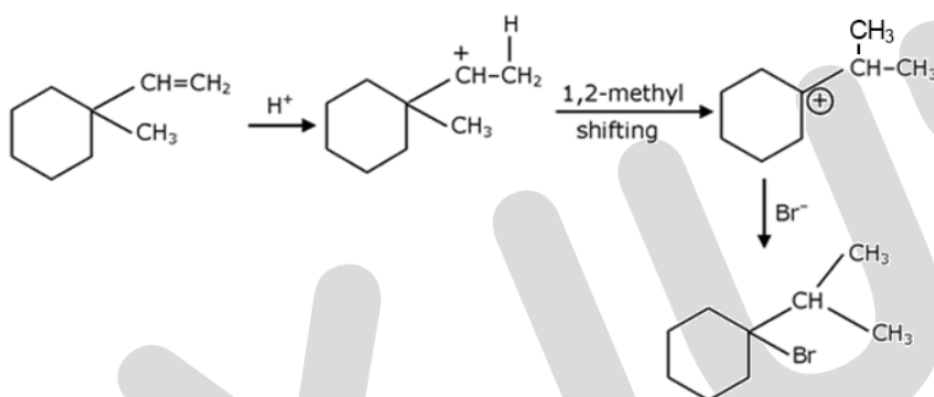


d.

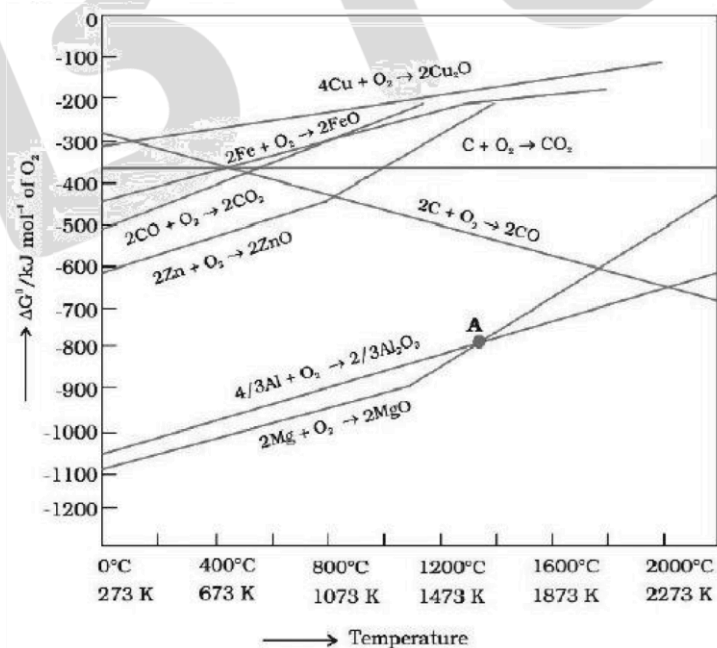


Ans: (d)

Solution



9. The point of intersection and sudden increase in the slope, in the diagram given below respectively, indicates :



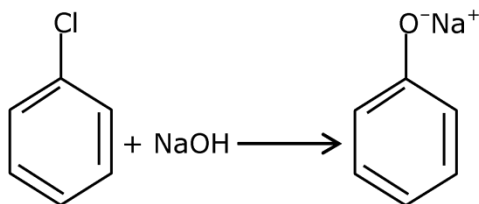
- a. $\Delta G = 0$ and melting or boiling point of the metal oxide.
- b. $\Delta G < 0$ and decomposition of the metal oxide.
- c. $\Delta G = 0$ and reduction of the metal oxide.
- d. $\Delta G > 0$ and decomposition of the metal oxide.

Ans: (a)

Solution

At the point of intersection $\Delta G = 0$ for involved reaction.

10.



The above reaction requires which of the following reaction conditions

- a. 623 K, 300 atm
- b. 573 K, 300 atm
- c. 573 K, Cu, 300 atm
- d. 623 K, Cu 300 atm

Ans: (a)

Solution

The required conditions were 623 K and 300 atm.

11. The correct order of conductivity of ions in water is:

- a. $\text{Cs}^+ > \text{Rb}^+ > \text{K}^+ > \text{Na}^+$
- b. $\text{K}^+ > \text{Na}^+ > \text{Cs}^+ > \text{Rb}^+$
- c. $\text{Rb}^+ > \text{Na}^+ > \text{K}^+ > \text{Li}^+$
- d. $\text{Na}^+ > \text{K}^+ > \text{Rb}^+ > \text{Cs}^+$

Ans: (a)

Solution

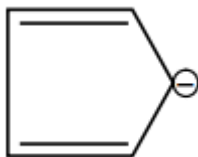
$\text{Cs}^+(\text{aq.})$ has lower hydrated radius so its electrical conductivity is higher.

12. A colloidal system consisting of a gas dispersed in a solid is called a/an:

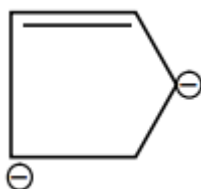
- a. Aerosol
- b. Solidsol
- c. Foam
- d. Gel

16. Which of the following is an aromatic compound?

a.



b.



c.

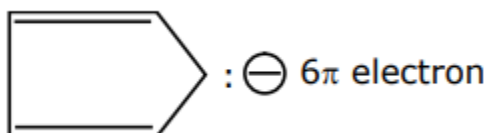


d.



Ans: (a)

Solution



17. With respect to drug-enzyme interaction, identify the wrong statement.

- a. Allosteric inhibitor competes with the enzyme's active site
- b. Competitive inhibitor binds to the enzyme's active site
- c. Non-competitive inhibitor binds to the allosteric site
- d. Allosteric inhibitor changes the enzyme's active site

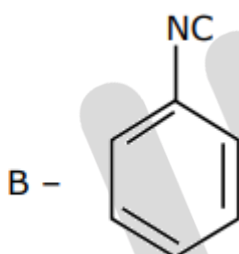
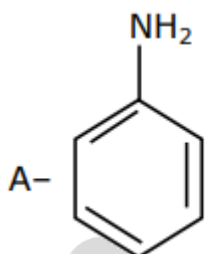
Ans: (a)

Solution:

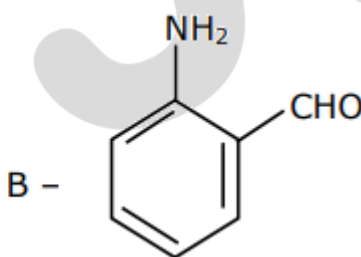
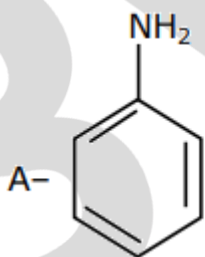
Lewis bases are electron donor and since PCl_5 donot contain a lone pair therefore it cannot act as a lewis base.

18. Hoffmann bromomide degradation of benzamide gives product A, which upon heating with CHCl_3 and NaOH gives product B. The structures of A and B are:

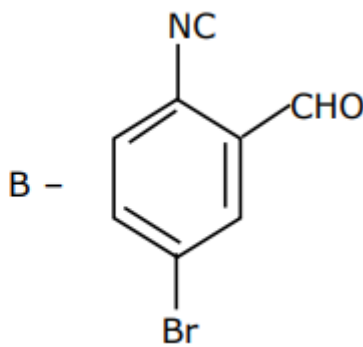
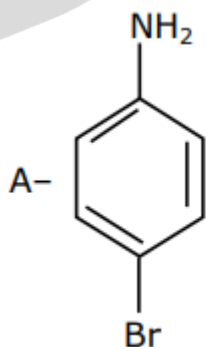
a.



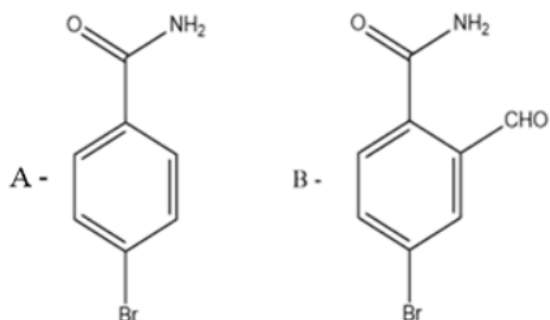
b.



c.

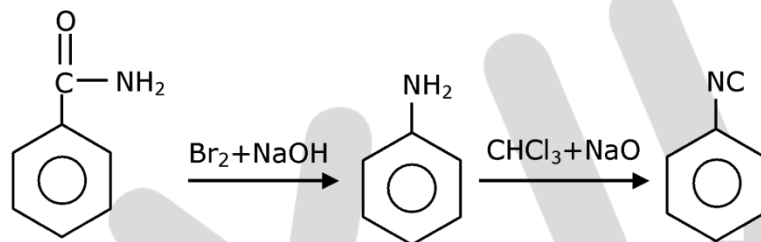


d.

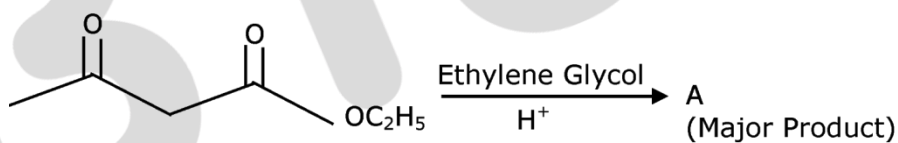


Ans: (a)

Solution

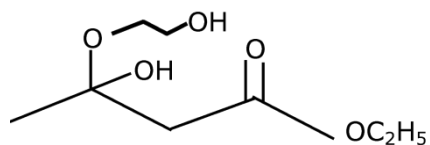


19.

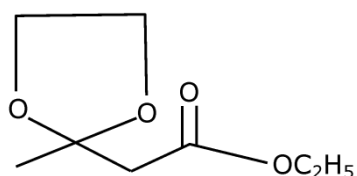


The product "A" in the above reaction is :

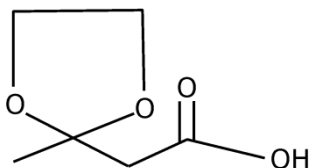
a.



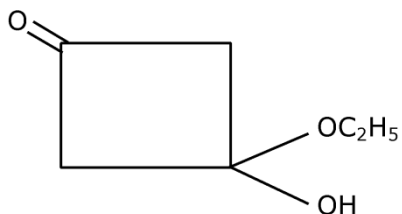
b.



c.

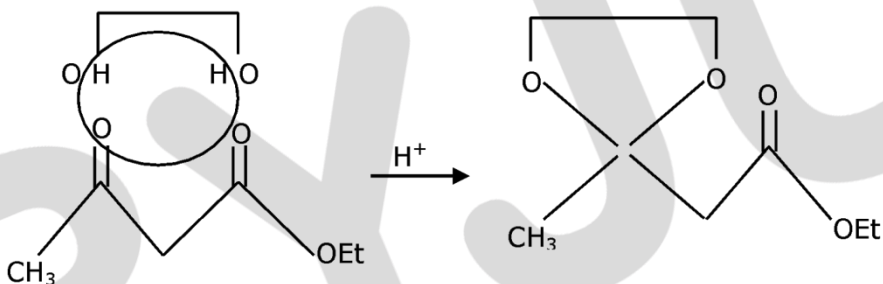


d.



Ans: (b)

Solution



17. Which of the following compound CANNOT act as a Lewis base?

- a. ClF_3
- c. NF_3

- b. PCl_5
- d. SF_4

Ans: (b)

Solution:

NF_3 has no vacant orbital neither in nitrogen nor in fluorine so it cannot accept the electron & hence cannot act as Lewis acid and but for PCl_5 P has no L.P & hence it cannot act as base but ClF_3 (3 B.P + 2 L.P) & SF_4 (4 B.P + 1 L.P)

Section-B

1. A certain orbital has $n = 4$ and $m_l = -3$. The number of radial nodes in this orbital is _____. (Round off to the Nearest Integer).

Ans: 0

Solution

Number of radial nodes = $n - l - 1$

$n = 4, m_l = -3$ so $l = 3$

radial nodes = $4 - 3 - 1 = 0$

2. 15 mL of aqueous solution of Fe^{2+} in acidic medium completely reacted with 20 mL of 0.03 M aqueous $\text{Cr}_2\text{O}_7^{2-}$. The molarity of the Fe^{2+} solution is $\text{_____} \times 10^{-2}\text{M}$. (Round off to the Nearest Integer).

Ans: 24

Solution

By law of equivalence M_{eq} of $\text{Fe}^{2+} = M_{\text{eq}}$ of $\text{Cr}_2\text{O}_7^{2-}$

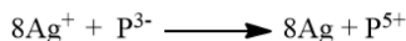
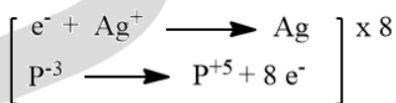
$M \times 15 \times 1 = 0.03 \times 6 \times 20$

$M = 0.24 \text{ M} = 24 \times 10^{-2} \text{ M}$

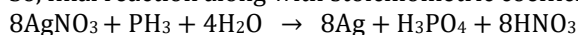
3. The reaction of white phosphorus on boiling with alkali in inert atmosphere resulted in the formation of product 'A'. The reaction of 1 mol of 'A' with excess of AgNO_3 in aqueous medium gives _____ mol(s) of Ag. (Round off to the Nearest Integer).

Ans: 8

Solution



So, final reaction along with stoichiometric coefficient is.



Excess 1 mol

Hence, 1 mol produce 8 mol Ag

4. The oxygen dissolved in water exerts a partial pressure of 20 kPa in the vapour above water. The molar solubility of oxygen in water is $\text{_____} \times 10^{-5} \text{ mol dm}^{-3}$. (Round off to the Nearest Integer).
[Given : Henry's law constant = $K_H = 8.0 \times 10^4 \text{ kPa}$ for O_2 .
Density of water with dissolved oxygen = 1.0 kg dm^{-3}]

Ans: 25

Solution

$$P_{(g)} = [K_H]X$$

$$20 \times 10^3 = [8.0 \times 10^3 \times 10^4] \times \text{Solubility}$$

$$\text{Solubility} = \frac{20 \times 10^3}{8.0 \times 10^7}$$

$$\text{Solubility} = 25 \times 10^{-5} \text{ mol/dm}^3$$

5. The standard enthalpies of formation of Al_2O_3 and CaO are $-1675 \text{ kJ mol}^{-1}$ and -635 kJ mol^{-1} respectively. For the reaction $3\text{CaO} + 2\text{Al} \rightarrow 3\text{Ca} + \text{Al}_2\text{O}_3$ the standard reaction enthalpy $\Delta_r H^\circ = \underline{\hspace{2cm}}$ kJ. (Round off to the Nearest Integer)

Ans: 230

Solution

$$\Delta_r H^\circ_f = \Delta_r H^\circ_f (\text{Products}) - \Delta_r H^\circ_f (\text{Reactants})$$

$$= \Delta_r H^\circ_f (\text{Al}_2\text{O}_3) - 3 \times \Delta_r H^\circ_f (\text{CaO})$$

$$= -1675 - 3(-635)$$

$$= 230 \text{ kJ}$$

6. For a certain first order reaction 32% of the reactant is left after 570s. The rate constant of this reaction is $\underline{\hspace{2cm}} \times 10^{-3} \text{ s}^{-1}$. (Round off to the Nearest Integer). [Given: $\log_{10} 2 = 0.301$, $\ln 10 = 2.303$]

Ans: 2

Solution

$$k = \frac{1}{t} \ln \frac{a}{[a-x]}$$

$$k = \frac{2.303}{570} \log \frac{100}{32}$$

$$k = \frac{2.303}{570} \times 0.5$$

$$k = 2 \times 10^{-3} \text{ s}^{-1}$$

7. The pressure exerted by a non-reactive gaseous mixture of 6.4 g of methane and 8.8 g of carbon dioxide in a 10 L vessel at 27°C is $\underline{\hspace{2cm}}$ kPa. (Round off to the Nearest Integer). [Assume gases are ideal, $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$ Atomic masses: C : 12.0u, H : 1.0u, O : 16.0 u]

Ans: 150

Solution

$$V = 10 \text{ L}, T = 27^\circ \text{C} = 300 \text{ K}$$

$$(m)_{\text{methane}} = 6.4 \text{ g}, \text{CO}_2 (m) = 8.8 \text{ g}$$

$$PV = n_{\text{total}}RT$$

$$P \times 10^{-2} = (0.4 + 0.2) \times 8.314 \times 300$$

$$P = 149652 \text{ Pa} \Rightarrow P = 149.652 \text{ kPa} \approx 150 \text{ kPa}$$

8. The mole fraction of a solute in a 100 molal aqueous solution is $\underline{\hspace{2cm}} \times 10^{-2}$. (Round off to the Nearest Integer). [Given : Atomic masses : H : 1.0 u, O : 16.0 u]

Ans: 64

Solution

Let weight of H₂O = 1000 g

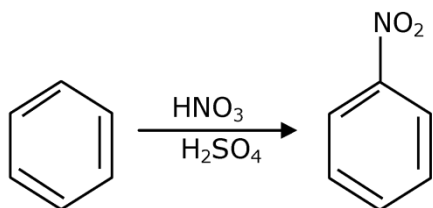
Moles of solute = 100

$$(\text{mole})\text{H}_2\text{O} = \frac{1000}{18}$$

$$\text{Mole fraction of solute} = \frac{\text{mole of solute}}{\text{Total moles}} = \frac{100}{2800}$$

$$X_{\text{solute}} = 64 \times 10^{-2}$$

9.



In the above reaction, 3.9 g of benzene on nitration gives 4.92 g of nitrobenzene. The percentage yield of nitrobenzene in the above reaction is ____%. (Round off to the Nearest Integer).

(Given atomic mass : C : 12.0 u, H : 1.0 u, O : 16.0 u, N : 14.0 u)

Ans : 80

Solution

$$\text{Moles of C}_6\text{H}_6 = 3.9/78 = 0.05 \text{ mol}$$

$$\text{Moles of C}_6\text{H}_5\text{NO}_2 = 4.92/123 = 0.04 \text{ mol}$$

By conserving moles of carbon, mole of C₆H₅NO₂ Formed theoretically are 0.05 mol

$$\% \text{yield} = \frac{\text{moles formed actually}}{\text{moles formed theoretically}} \times 100$$

$$\% \text{yield} = \frac{0.04}{0.05} \times 100 = 80 \%$$

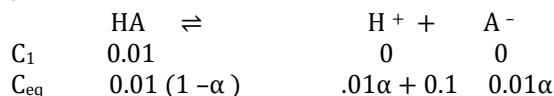
10. 0.01 moles of a weak acid HA ($K_a = 2.0 \times 10^{-6}$) is dissolved in 1.0 L of 0.1 M HCl solution.

The degree of dissociation of HA is _____ $\times 10^{-5}$

(Round off to the Nearest Integer). Assume degree of dissociation $\ll 1$

Ans : 2

Solution





$$K_a = \frac{[H^+][A^-]}{[HA]}$$

$$\Rightarrow 2 \times 10^{-6} = \frac{(0.1)(0.01 \alpha)}{0.01}$$

$$\alpha = 2 \times 10^{-5}$$

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