

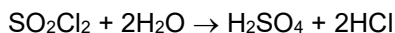
CHEMISTRY

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 :

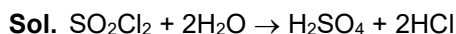
1. SO_2Cl_2 on reaction with excess of water results into acidic mixture



16 moles of NaOH is required for the complete neutralisation of the resultant acidic mixture. The number of moles of SO_2Cl_2 used is

- (A) 16
(B) 8
(C) 4
(D) 2

Answer (C)



Moles of NaOH required for complete neutralisation of resultant acidic mixture = 16 moles

And 1 mole of SO_2Cl_2 produced 4 moles of H^+ .

$$\therefore \text{Moles of } \text{SO}_2\text{Cl}_2 \text{ used will be} = \frac{16}{4} = 4 \text{ moles}$$

2. Which of the following sets of quantum numbers is not allowed?

- (A) $n = 3, l = 2, m_l = 0, s = +\frac{1}{2}$
(B) $n = 3, l = 2, m_l = -2, s = +\frac{1}{2}$
(C) $n = 3, l = 3, m_l = -3, s = -\frac{1}{2}$
(D) $n = 3, l = 0, m_l = 0, s = -\frac{1}{2}$

Answer (C)

Sol. If $n = 3$, then possible values of $l = 0, 1, 2$

But in option (C), the value of l is given '3', this is not possible.

3. The depression in freezing point observed for a formic acid solution of concentration 0.5 mL L^{-1} is 0.0405°C . Density of formic acid is 1.05 g mL^{-1} . The Van't Hoff factor of the formic acid solution is nearly (Given for water $k_f = 1.86 \text{ k kg mol}^{-1}$)

- (A) 0.8
(B) 1.1
(C) 1.9
(D) 2.4

Answer (C)

Sol. ΔT_f of formic acid = 0.0405°C

Concentration = 0.5 mL/L

and density = 1.05 g/mL

$$\therefore \text{Mass of formic acid in solution} = 1.05 \times 0.5 \text{ g} = 0.525 \text{ g}$$

\therefore According to Van't Hoff equation,

$$\Delta T_f = i k_f m$$

$$0.0405 = i \times 1.86 \times \frac{0.525}{46 \times 1}$$

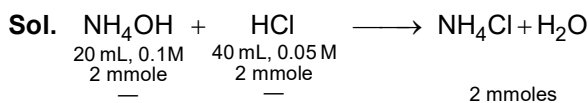
(Assuming mass of 1 L water = kg)

$$i = \frac{0.0405 \times 46}{1.86 \times 0.525} = 1.89 \approx 1.9$$

4. 20 mL of 0.1 M NH_4OH is mixed with 40 mL of 0.05 M HCl. The pH of the mixture is nearest to (Given : $K_b(\text{NH}_4\text{OH}) = 1 \times 10^{-5}$, $\log 2 = 0.30$, $\log 3 = 0.48$, $\log 5 = 0.69$, $\log 7 = 0.84$, $\log 11 = 1.04$)

- (A) 3.2
(B) 4.2
(C) 5.2
(D) 6.2

Answer (C)



\therefore In final solution 2 millimoles of NH_4Cl is present.

$$\therefore [\text{NH}_4\text{Cl}] = \frac{1}{30} \text{ molar}$$

$$\begin{aligned} \text{pH} &= \frac{1}{2} [\text{p}K_w - \text{p}K_b - \log C] \\ &= \frac{1}{2} [14 - 5 - (-1.48)] \\ &= 5.24 \end{aligned}$$

5. Match **List-I** with **List-II**.

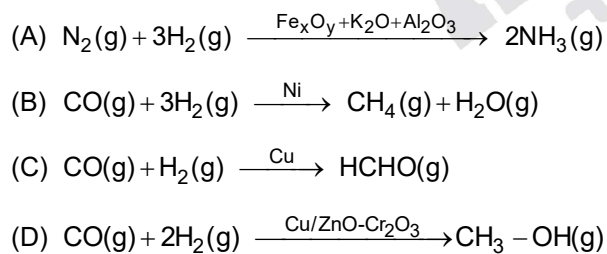
List-I	List-II
(A) $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$	(I) Cu
(B) $\text{CO}(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow \text{CH}_4(\text{g}) + \text{H}_2\text{O}(\text{g})$	(II) Cu/ZnO - Cr_2O_3
(C) $\text{CO}(\text{g}) + \text{H}_2(\text{g}) \rightarrow \text{HCHO}(\text{g})$	(III) $\text{Fe}_x\text{O}_y + \text{K}_2\text{O} + \text{Al}_2\text{O}_3$
(D) $\text{CO}(\text{g}) + 2\text{H}_2(\text{g}) \rightarrow \text{CH}_3\text{OH}(\text{g})$	(IV) Ni

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

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

Answer (C)

Sol. Here, we have to match the reactions with their correct catalyst :



∴ Option (C) is correct option.

6. The IUPAC nomenclature of an element with electronic configuration $[\text{Rn}] 5f^{14}6d^{17}s^2$ is

- (A) Unnilbium (B) Unnilunium
 (C) Unnilquadium (D) Unniltrium

Answer (D)

Sol. The element with electronic configuration $[\text{Rn}] 5f^{14}6d^{17}s^2$ has atomic number $\rightarrow 103$

∴ Its IUPAC name is : Unniltrium

7. The compound(s) that is(are) removed as slag during the extraction of copper is

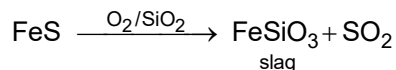
- (A) CaO
 (B) FeO
 (C) Al_2O_3
 (D) ZnO
 (E) NiO

Choose the correct answer from the options given below :

- (A) (C), (D) only (B) (A), (B), (E) only
 (C) (A), (B) only (D) (B) only

Answer (D)

Sol. The compound(s) that are removed as a slag during the extraction of copper is :



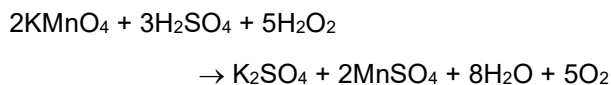
∴ Only iron oxide (FeO) formed slag during extraction of copper.

8. The reaction of H_2O_2 with potassium permanganate in acidic medium leads to the formation of mainly

- (A) Mn^{2+} (B) Mn^{4+}
 (C) Mn^{3+} (D) Mn^{6+}

Answer (A)

Sol. The reaction of KMnO_4 with H_2O_2 in acidic medium is as



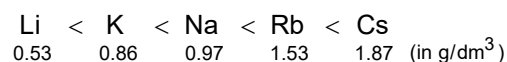
∴ Mn^{2+} will be formed as the product.

9. Choose the **correct** order of density of the alkali metals.

- (A) $\text{Li} < \text{K} < \text{Na} < \text{Rb} < \text{Cs}$
 (B) $\text{Li} < \text{Na} < \text{K} < \text{Rb} < \text{Cs}$
 (C) $\text{Cs} < \text{Rb} < \text{K} < \text{Na} < \text{Li}$
 (D) $\text{Li} < \text{Na} < \text{K} < \text{Cs} < \text{Rb}$

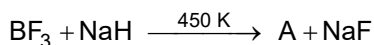
Answer (A)

Sol. The increasing order of density of alkali metals as



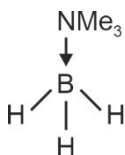
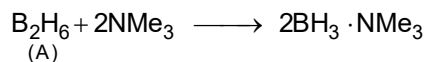
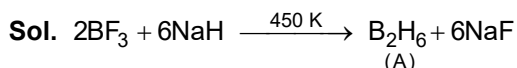
'K' metal has less density as compare to 'Na' metal.

10. The geometry around boron in the product 'B' formed from the following reaction is



- (A) Trigonal planar
(B) Tetrahedral
(C) Pyramidal
(D) Square planar

Answer (B)

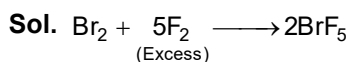


∴ Geometry of boron will be tetrahedral.

11. The interhalogen compound formed from the reaction of bromine with excess of fluorine is a :

- (A) hypohalite
(B) halate
(C) perhalate
(D) halite

Answer (B)



If BrF_5 undergoes hydrolysis it will produce halide.

12. The photochemical smog does not generally contain :

- (A) NO
(B) NO_2
(C) SO_2
(D) HCHO

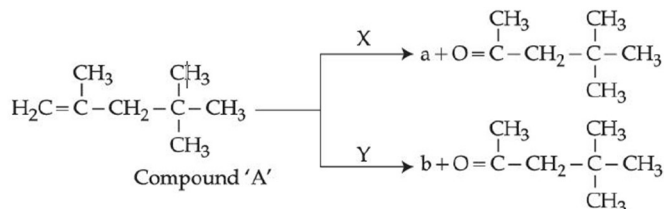
Answer (C)

Sol. Photochemical smog contain:

Ozone, nitric oxide, organic compounds, nitrogen dioxide, formaldehyde.

∴ SO_2 is not the part of photochemical smog.

13. A compound 'A' on reaction with 'X' and 'Y' produces the same major product but different by product 'a' and 'b'. Oxidation of 'a' gives a substance produced by ants.

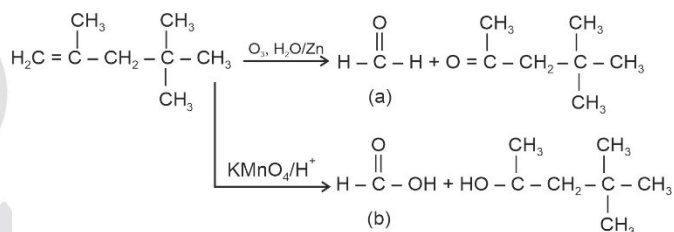


'X' and 'Y' respectively are

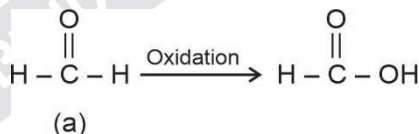
- (A) KMnO_4/H^+ and dil. KMnO_4 , 273 K
(B) KMnO_4 (dilute), 273 K and KMnO_4/H^+
(C) KMnO_4/H^+ and O_3 , $\text{H}_2\text{O}/\text{Zn}$
(D) O_3 , $\text{H}_2\text{O}/\text{Zn}$ and KMnO_4/H^+

Answer (D)

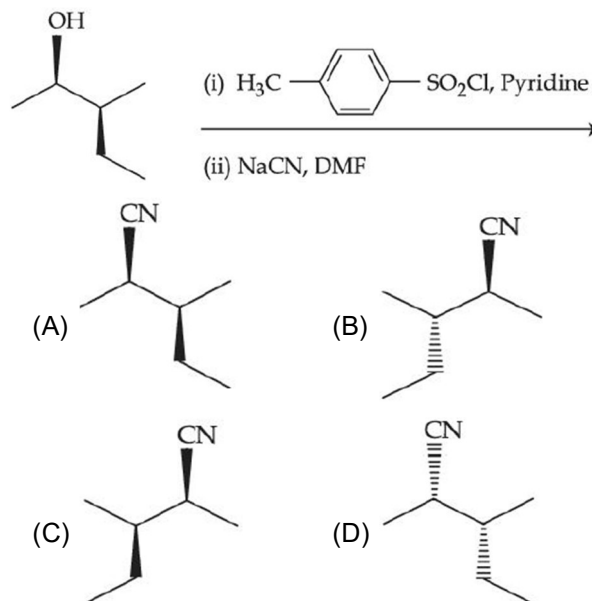
Sol.



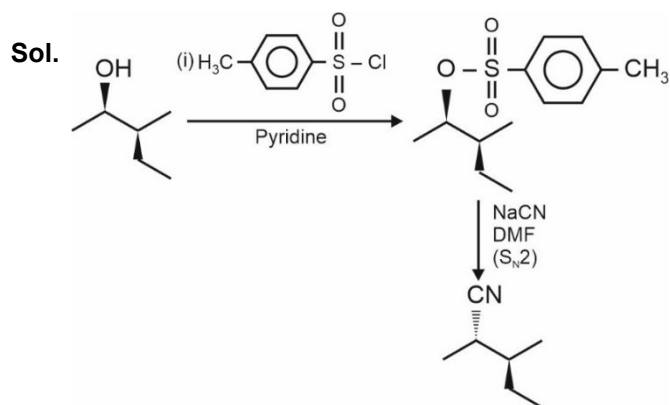
* Ants produce formic acid in their venom gland.



14. Most stable product of the following reaction is :

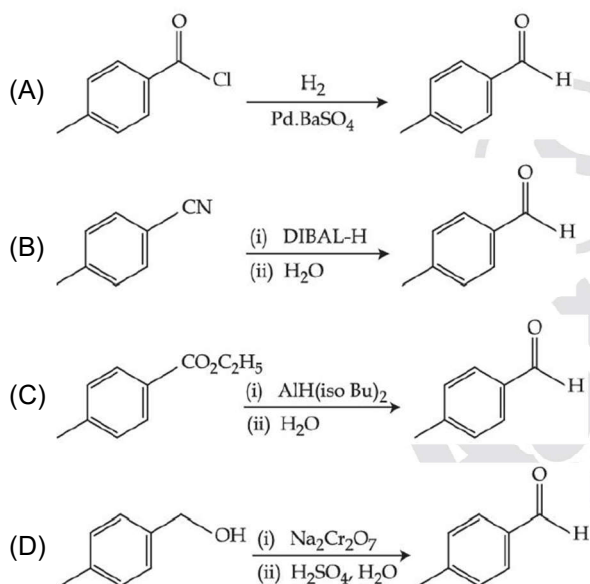


Answer (B)

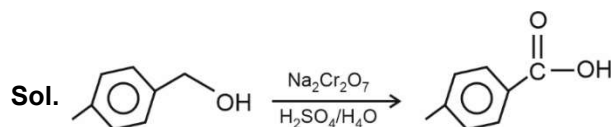


∴ Option (B) is correct option.

15. Which one of the following reactions does not represent correct combination of substrate and product under the given conditions?

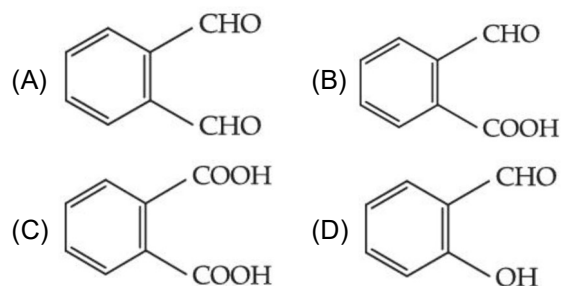


Answer (D)



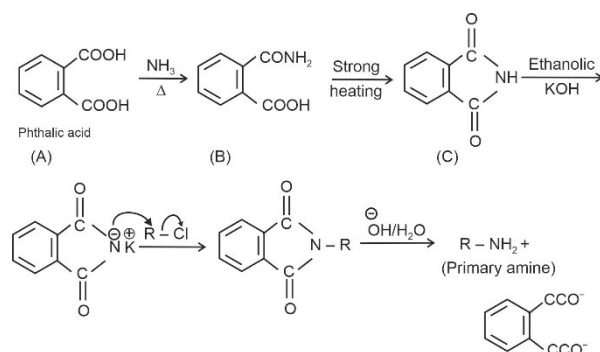
$\text{Na}_2\text{Cr}_2\text{O}_7$, $\text{H}_2\text{SO}_4/\text{H}_2\text{O}$ is the strongest oxidising agent and it will oxidise 1° alcohol into acids.

16. An organic compound 'A' on reaction with NH_3 followed by heating gives compound B. Which on further strong heating gives compound C ($\text{C}_8\text{H}_5\text{NO}_2$). Compound C on sequential reaction with ethanolic KOH, alkyl chloride and hydrolysis with alkali gives a primary amine. The compound A is :



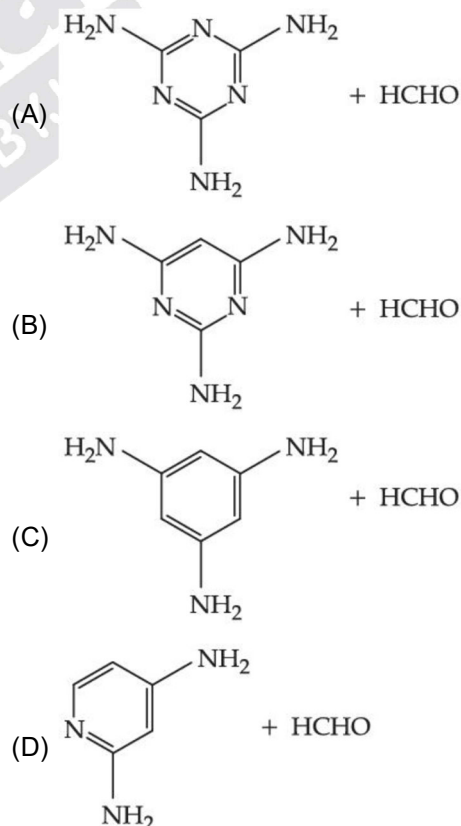
Answer (C)

Sol.



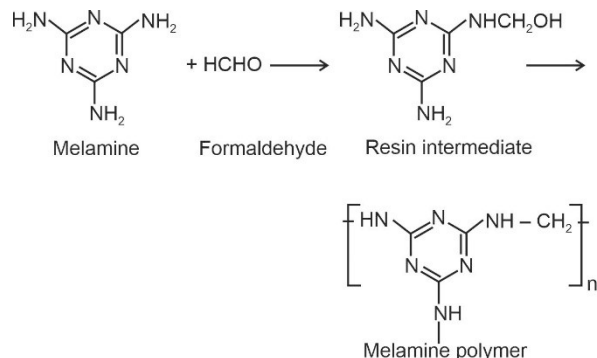
All the given reactions can be explained if organic compound (A) is phthalic acid.

17. Melamine polymer is formed by the condensation of :



Answer (A)

Sol. Melamine polymer is formed by the condensation polymerisation of melamine and formaldehyde.



18. During the denaturation of proteins, which of these structures will remain intact?

- (A) Primary (B) Secondary
(C) Tertiary (D) Quaternary

Answer (A)

Sol. During the denaturation of proteins hydrogen bonds are disturbed. As a result, the secondary and tertiary structures are destroyed but the primary structures remain intact.

19. Drugs used to bind to receptors, inhibiting its natural function and blocking a message are called:

- (A) Agonists (B) Antagonists
(C) Allosterists (D) Anti histaminists

Answer (B)

Sol. Drugs that bind to the receptor site and inhibit its natural function are called Antagonists.

20. Given below are two statements:

Statement I: On heating with KHSO_4 , glycerol is dehydrated and acrolein is formed.

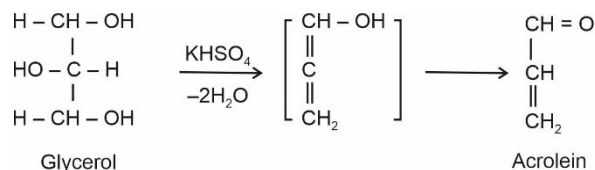
Statement II: Acrolein has fruity odour and can be used to test glycerol's presence.

Choose the **correct** option.

- (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 (C)

Sol. Glycerol, on heating with KHSO_4 , undergoes dehydration to give unsaturated aldehyde called acrolein. So, statement I is correct.



Acrolein has piercing unpleasant smell. So, statement-II is incorrect.

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.

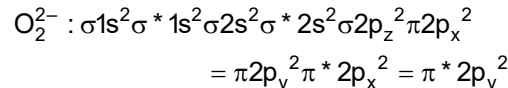
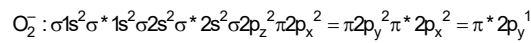
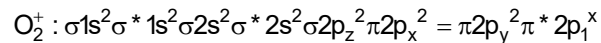
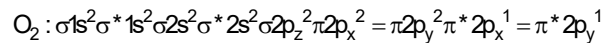
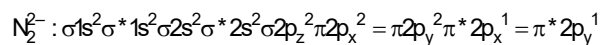
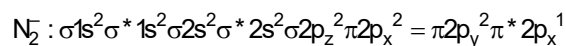
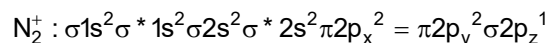
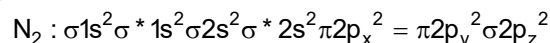
1. Among the following species



the number of species showing diamagnetism is _____.

Answer (2)

Sol. According to molecules orbital theory. The electronic configurations of the given species are



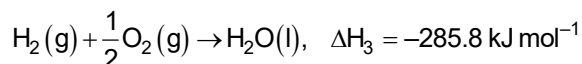
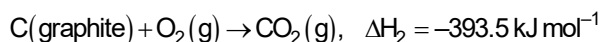
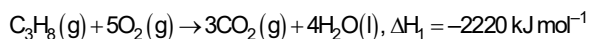
Diamagnetic species are N_2 and O_2^{2-}

\therefore Number of species showing diamagnetism = 2

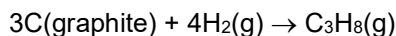
2. The enthalpy of combustion of propane, graphite and dihydrogen at 298 K are $-2220.0 \text{ kJ mol}^{-1}$, $-393.5 \text{ kJ mol}^{-1}$ and $-285.8 \text{ kJ mol}^{-1}$ respectively. The magnitude of enthalpy of formation of propane (C_3H_8) is _____ kJ mol^{-1} . (Nearest integer)

Answer (104)

Sol. Enthalpy of combustion of propane, graphite and H_2 at 298K are



The desired reaction is



$$\begin{aligned} \Delta H_f &= 3\Delta H_2 + 4\Delta H_3 - \Delta H_1 \\ &= 3(-393.5) + 4(-285.8) - (-2220) \\ &= -103.7 \text{ kJ mol}^{-1} \end{aligned}$$

$$|\Delta H_f| = 104 \text{ kJ mol}^{-1}$$

3. The pressure of a moist gas at 27°C is 4 atm. The volume of the container is doubled at the same temperature. The new pressure of the moist gas is _____ $\times 10^{-1}$ atm. (Nearest integer)
(Given: The vapour pressure of water at 27°C is 0.4 atm.)

Answer (22)

Sol. From ideal gas equation,

$$P \propto \frac{1}{V}$$

$$P_1V_1 = P_2V_2$$

$$\text{Pressure of the gas} = 4 - 0.4 = 3.6 \text{ atm}$$

$$3.6 V_1 = P_2 (2V_1)$$

$$P_2 = 1.8 \text{ atm}$$

Hence, new pressure of moist gas is $1.8 + 0.4 = 2.2 \text{ atm} = 22 \times 10^{-1} \text{ atm}$

4. The cell potential for $\text{Zn}|\text{Zn}^{2+}(\text{aq})||\text{Sn}^{+2}|\text{Sn}$ is 0.801 V at 298 K. The reaction quotient for the above reaction is 10^{-2} . The number of electrons involved in the given electrochemical cell reaction is _____.

$$\left(\text{Given: } E_{\text{Zn}^{2+}|\text{Zn}}^\circ = -0.763 \text{ V}, E_{\text{Sn}^{+2}|\text{Sn}}^\circ = +0.008 \text{ V and } \frac{2.303RT}{F} = 0.06 \text{ V} \right)$$

Answer (4)

Sol. A: $\text{Zn} \rightarrow \text{Zn}^{2+} + 2\text{e}^-$

C: $\text{Sn}^{+2} + 2\text{e}^- \rightarrow \text{Sn}$

$$E_{\text{Cell}}^\circ = E_{\text{Zn}|\text{Zn}^{2+}}^\circ + E_{\text{Sn}^{+2}|\text{Sn}}^\circ$$

$$\Rightarrow 0.763 + 0.008 = 0.771 \text{ V}$$

From Nernst equation,

$$E_{\text{Cell}} = E_{\text{Cell}}^\circ - \frac{2.303 RT}{nF} \log Q$$

$$0.801 = 0.771 - \frac{0.06}{n} \log 10^{-2}$$

$$0.03 = \frac{0.06}{n} \times 2$$

$$n = 4$$

5. The half-life for the decomposition of gaseous compound A is 240 s when the gaseous pressure was 500 torr initially. When the pressure was 250 torr, the half-life was found to be 4.0 min. The order of the reaction is _____. (Nearest integer)

Answer (1)

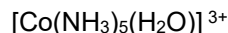
Sol. $(t_{1/2})_A = 240 \text{ s}$ when $P = 500 \text{ torr}$

$$(t_{1/2})_A = 4 \text{ min} = 4 \times 60 = 240 \text{ sec when } P = 250 \text{ torr}$$

If means half-life is independent of concentration of reactant present.

$$\therefore \text{Order of reaction} = 1$$

6. Consider the following metal complexes:



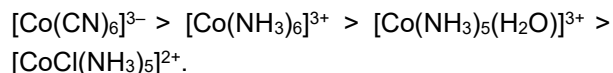
The spin-only magnetic moment value of the complex that absorbs light with shortest wavelength is _____ B.M. (Nearest integer)

Answer (0)

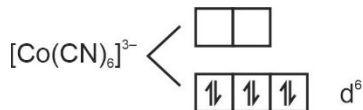
Sol. In all complexes, Co is present in +3 oxidation state and all complexes are low spin or inner orbital complex.

Stronger the ligand, higher the crystal field splitting.

So, order of crystal field splitting is



Shortest wavelength is shown by complex having maximum crystal field splitting.



Spin only magnetic moment = $\sqrt{0(0+2)} = 0$ B.M

7. Among Co^{3+} , Ti^{2+} , V^{2+} and Cr^{2+} ions, one if used as a reagent cannot liberate H_2 from dilute mineral acid solution, its spin-only magnetic moment in gaseous state is _____ B.M. (Nearest integer)

Answer (5)

Sol. Co^{3+} will not liberate H_2 gas an reaction with dilute acid

$$E^\circ_{\text{Co}^{3+}/\text{Co}^{2+}} = +1.97$$

And Co^{3+} has electronic configuration = $[\text{Ar}] 3d^6$

\therefore 4 unpaired e^- are present in it

$$\begin{aligned} \therefore \text{Spin-only magnetic moment} &= \sqrt{4(4+2)} \\ &= 4.92 \\ &\approx 5 \end{aligned}$$

8. While estimating the nitrogen present in an organic compound by Kjeldahl's method, the ammonia evolved from 0.25 g of the compound neutralized 2.5 mL of 2 M H_2SO_4 . The percentage of nitrogen present in organic compound is _____.

Answer (56)

Sol. NH_3 gas is neutralized by 2.5 mL of 2 M H_2SO_4

$$\begin{aligned} \therefore \text{Moles of } \text{NH}_3 \text{ neutralized} &= 2.5 \times 2 \times 2 \text{ millimole} \\ &= 10 \times 10^{-3} \text{ moles} \end{aligned}$$

$$\begin{aligned} \therefore \text{Weight of N present in compound will be} &= 10 \times 10^{-3} \times 14 \\ &= 0.14 \text{ g} \end{aligned}$$

$$\begin{aligned} \therefore \% \text{ of 'N' in compound} &= \frac{0.14}{0.25} \times 100 \\ &= 56\% \end{aligned}$$

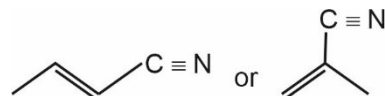
9. The number of sp^3 hybridised carbons in an acyclic neutral compound with molecular formula $\text{C}_4\text{H}_5\text{N}$ is _____.

Answer (1)

Sol. $\text{C}_4\text{H}_5\text{N}$

$$\begin{aligned} \text{DBE} &= (\text{C} + 1) - \left(\frac{\text{H} + \text{X} - \text{N}}{2} \right) \\ &= 4 + 1 - \left(\frac{5 - 1}{2} \right) = 5 - 2 = 3 \end{aligned}$$

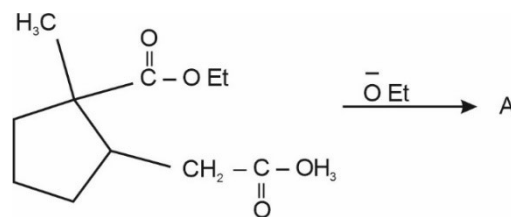
3 double bond equivalent are present in compound



Only 1 sp^3 hybridised carbon is there

(Keeping compound as acyclic)

10. In the given reaction,

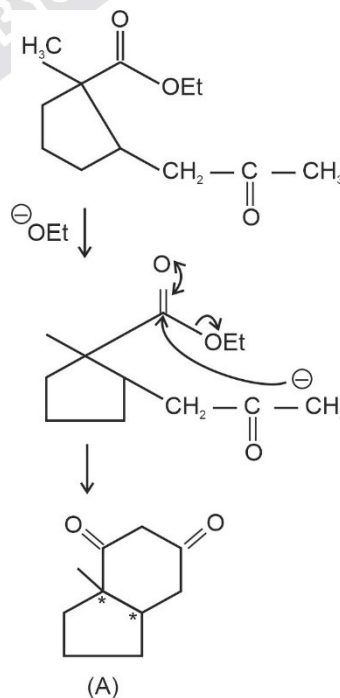


(where Et is $-\text{C}_2\text{H}_5$)

The number of chiral carbon(s) in product A is _____.

Answer (2)

Sol.



2 chiral carbons are there in product A.