

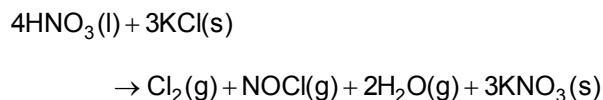
CHEMISTRY

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. Consider the reaction

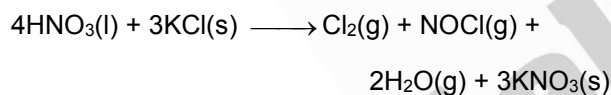


The amount of HNO_3 required to produce 110.0 g of KNO_3 is

(Given : Atomic masses of H, O, N and K are 1, 16, 14 and 39 respectively.)

- (A) 32.2 g (B) 69.4 g
(C) 91.5 g (D) 162.5 g

Answer (C)



$$\begin{aligned} \therefore 110 \text{ g of } \text{KNO}_3 &\Rightarrow \text{moles of } \text{KNO}_3 = \frac{110}{101} \\ &= 1.089 \text{ mol} \end{aligned}$$

As, 4 mole of HNO_3 produces 3 mol of KNO_3 .
Hence, the moles of HNO_3 required to produce

$$1.089 \text{ moles of } \text{KNO}_3 = \frac{4}{3} \times 1.089 = 1.452 \text{ mol}$$

Hence, mass of HNO_3 required is $1.452 \times 63 = 91.5 \text{ g}$ (approx.)

2. Given below are the quantum numbers for 4 electrons.

- A. $n = 3, l = 2, m_l = 1, m_s = +1/2$
B. $n = 4, l = 1, m_l = 0, m_s = +1/2$
C. $n = 4, l = 2, m_l = -2, m_s = -1/2$
D. $n = 3, l = 1, m_l = -1, m_s = +1/2$

The correct order of increasing energy is

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

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

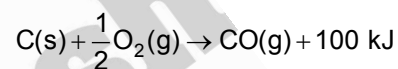
Answer (B)

Energy of the sub-shell is given by, $(n + l)$ rule.

	$(n + l)$
For, A	5
B	5
C	6
D	4

Hence, the correct order of increasing energy is $D < A < B < C$

3. $\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 400 \text{ kJ}$



When coal of purity 60% is allowed to burn in presence of insufficient oxygen, 60% of carbon is converted into 'CO' and the remaining is converted into 'CO₂'. The heat generated when 0.6 kg of coal is burnt is _____.

- (A) 1600 kJ (B) 3200 kJ
(C) 4400 kJ (D) 6600 kJ

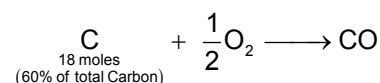
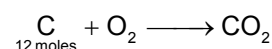
Answer (D)

Weight of coal = 0.6 kg = 600 gm

\therefore 60% of it is carbon

$$\text{So weight of carbon} = 600 \times \frac{60}{100} = 360 \text{ g}$$

$$\therefore \text{moles of carbon} = \frac{360}{12} = 30 \text{ moles}$$



$$\therefore \text{Heat generated} = 12 \times 400 + 18 \times 100 = 6600 \text{ kJ}$$

4. 200 mL of 0.01 M HCl is mixed with 400 mL of 0.01 M H₂SO₄. The pH of the mixture is ____.

[Given log 2 = 0.30, log 3 = 0.48, log 5 = 0.70, log 7 = 0.84, log 11 = 1.04.]

- (A) 1.14 (B) 1.78
(C) 2.34 (D) 3.02

Answer (B)

Molarity of resultant solution is given by

$$\begin{array}{r} m_1 v_1 n_1 + m_2 v_2 n_2 = m v \\ 200 \text{ mL of } 0.01 \text{ m HCl} + 400 \text{ mL of } 0.01 \text{ m H}_2\text{SO}_4 \\ 200 \times 0.01 \times 1 + 400 \times 0.01 \times 2 = m \times v \end{array}$$

$$\text{Molarity} = \frac{10}{600} \text{ of equivalents.}$$

$$[H^+] = \frac{10}{600}$$

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

$$\text{pH} = -\log\left[\frac{10}{600}\right] = 1.778$$

5. Given below are the critical temperatures of some of the gases :

Gas	Critical temperature (K)
He	5.2
CH ₄	190.0
CO ₂	304.2
NH ₃	405.5

The gas showing least adsorption on a definite amount of charcoal is

- (A) He (B) CH₄
(C) CO₂ (D) NH₃

Answer (A)

Extent of adsorption $\propto T_c$ (critical temperature)

\therefore Lower the T_c , Lower will be the adsorption

Hence, Helium shows least adsorption on a definite amount of charcoal.

6. In liquation process used for tin (Sn), the metal
(A) is reacted with acid
(B) is dissolved in water
(C) is brought to molten form which is made to flow on a slope
(D) is fused with NaOH

Answer (C)

Sol In liquation method, a low melting metal like tin can be made to flow on a sloping surface.

7. Given below are two statements.

Statement-I: Stannane is an example of a molecular hydride.

Statement-II: Stannane is a planar molecule

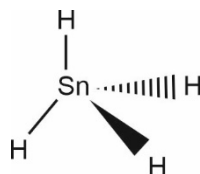
In the light of the above statement, choose the **most appropriate** answer from the options given below.

- (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 (C)

Sol Stannane or tin hydride is an inorganic compound with formula SnH₄

Structure of SnH₄ is



\therefore It is a non-planar molecule.

8. Portland cement contains 'X' to enhance the setting time. What is 'X'?

- (A) CaSO₄ · $\frac{1}{2}$ H₂O
(B) CaSO₄ · 2H₂O
(C) CaSO₄
(D) CaCO₃

Answer (B)

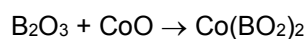
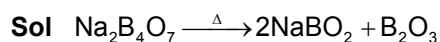
Sol Setting of cement: When mixed with water, the setting of cement takes place to give a hard mass.

This is due to the hydration of the molecule of the constituents and their rearrangement. The purpose of adding gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) is only to slow down the process of setting of the cement so that it gets sufficiently hardened.

9. When borax is heated with CoO on a platinum loop, blue coloured bead formed is largely due to

- (A) B_2O_3 (B) $\text{Co}(\text{BO}_2)_2$
(C) CoB_4O_7 (D) $\text{Co}[\text{B}_4\text{O}_5(\text{OH})_4]$

Answer (B)



Cobalt metaborate
(blue coloured)

10. Which of the following 3d-metal ion will give the lowest enthalpy of hydration ($\Delta_{\text{hyd}}H$) when dissolved in water?

- (A) Cr^{2+} (B) Mn^{2+}
(C) Fe^{2+} (D) Co^{2+}

Answer (B)

$\Delta_{\text{hyd}}H$ (M^{+2})

Cr -1925

Mn -1862

Fe -1560

Co - 1640

Mn^{+2} has lowest $\Delta_{\text{hyd}}H$

11. Octahedral complexes of copper(II) undergo structural distortion (Jahn-Teller). Which one of the given copper(II) complexes will show the maximum structural distortion ?

(en – ethylenediamine; $\text{H}_2\text{N}-\text{CH}_2-\text{CH}_2-\text{NH}_2$)

- (A) $[\text{Cu}(\text{H}_2\text{O})_6]\text{SO}_4$ (B) $[\text{Cu}(\text{en})(\text{H}_2\text{O})_4]\text{SO}_4$
(C) cis- $[\text{Cu}(\text{en})_2\text{Cl}_2]$ (D) trans- $[\text{Cu}(\text{en})_2\text{Cl}_2]$

Answer (D)

Sol. Jahn teller distortion: Any non-linear compound remove its degeneracy to attain the stability.

Extent of Jahn teller distortion depends upon metal ion as well as nature of ligand.

Stronger the ligand, more will be the Jahn Teller distortion and more will be the stability.

Hence Trans $[\text{Cu}(\text{en})_2\text{Cl}_2]$ will exhibit maximum Jahn Teller distortion.

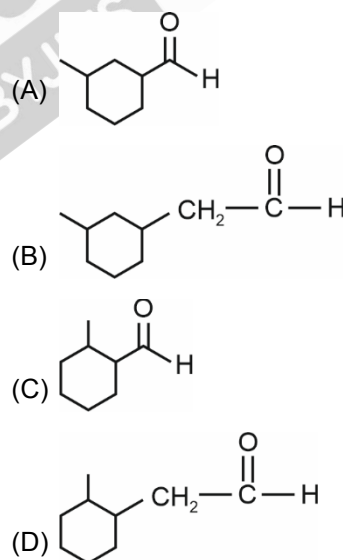
12. Dinitrogen is a robust compound, but reacts at high altitudes to form oxides. The oxide of nitrogen that can damage plant leaves and retard photosynthesis is

- (A) NO (B) NO_3^-
(C) NO_2 (D) NO_2^-

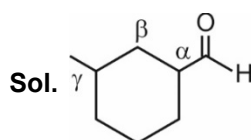
Answer (C)

Sol. Higher concentration of NO_2 damages the leaves of plant and retards photosynthesis.

13. Correct structure of γ -methylcyclohexane carbaldehyde is



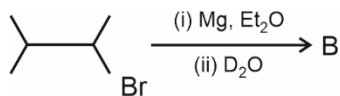
Answer (A)



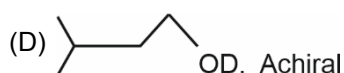
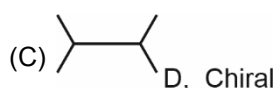
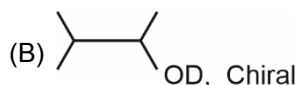
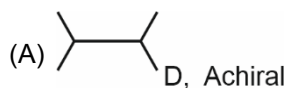
γ -Methyl cyclohexane carbaldehyde

14. Compound 'A' undergoes following sequence of reactions to give compound 'B'. The correct structure and chirality of compound 'B' is

[where Et is $-C_2H_5$]

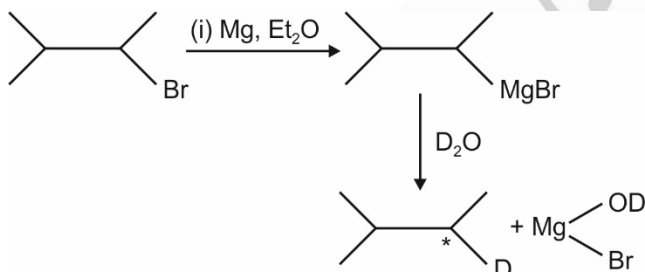


Compound 'A'



Answer (C)

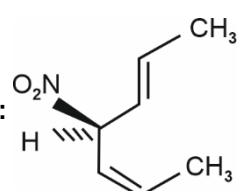
Sol.



15. Given below are two statements.

Statement I: The compound  (A) is

optically active.

Statement II:  is mirror image of

above compound A.

In the light of the above statement, 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 (C)

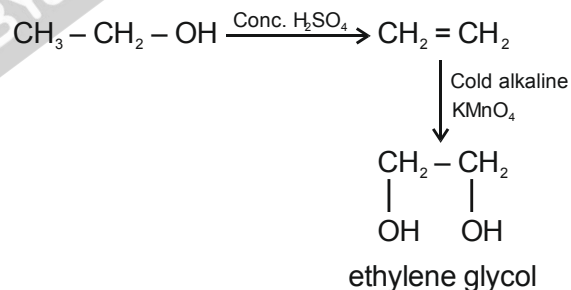
Sol. Compound (A) in Statement-I and compound in Statement-II is not the mirror image of (I).

16. When ethanol is heated with conc. H_2SO_4 , a gas is produced. The compound formed, when this gas is treated with cold dilute aqueous solution of Baeyer's reagent, is

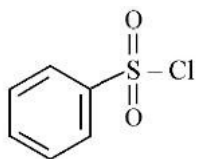
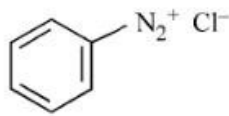
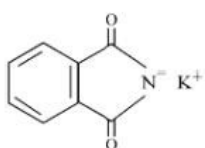
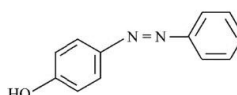
- (A) Formaldehyde
 (B) Formic acid
 (C) Glycol
 (D) Ethanoic acid

Answer (C)

Sol.

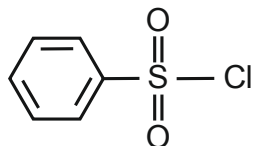


17. The Hinsberg reagent is

- (A)  (B) 
 (C)  (D) 

Answer (A)

Sol. Hinsberg reagent is :



18. Which of the following is not a natural polymer?

- (A) Protein (B) Starch
(C) Rubber (D) Rayon

Answer (D)

Sol. Rayon is not natural polymer. It is semi-synthetic, rest all are natural polymers

19. Given below are two statements. One is labelled as **Assertion A** and the other is labelled as **Reason R**.

Assertion A : Amylose is insoluble in water.

Reason R : Amylose is a long linear molecule with more than 200 glucose units. 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 (D)

Sol. Amylose is a linear polymer formed by combination of α -D glucose through 1, 4- glycosidic linkage.

It is water soluble

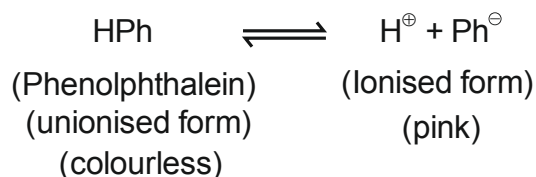
So, assertion is incorrect

20. A compound 'X' is a weak acid and it exhibits colour change at pH close to the equivalence point during neutralization of NaOH with CH_3COOH . Compound 'X' exists in ionized form in basic medium. The compound 'X' is

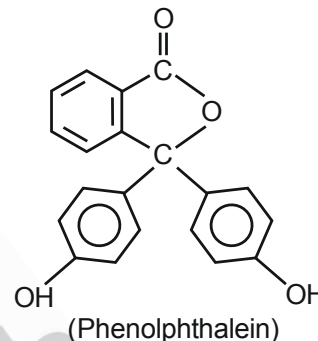
- (A) Methyl orange
(B) Methyl red
(C) Phenolphthalein
(D) Eriochrome Black T

Answer (C)

Sol.



In basic medium, $[\text{H}^{\oplus}]$ decreases & therefore more of (Ph^{\ominus}) is produced



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. 'x' g of molecular oxygen (O_2) is mixed with 200 g of neon (Ne). The total pressure of the non-reactive mixture of O_2 and Ne in the cylinder is 25 bar. The partial pressure of Ne is 20 bar at the same temperature and volume. The value of 'x' is ____.

[Given : Molar mass of $\text{O}_2 = 32 \text{ g mol}^{-1}$.

Molar mass of Ne = 20 g mol^{-1}]

Answer (80)

Sol. $P_{\text{O}_2} = 25 - 20 = 5 \text{ bar}$

$$P_{\text{O}_2} = x_{\text{O}_2} \times P_{\text{Total}}$$

$$\frac{5}{25} = \frac{n_{\text{O}_2}}{n_{\text{O}_2} + n_{\text{Ne}}}$$

$$\frac{1}{5} = \frac{x/32}{\frac{x}{32} + \frac{200}{20}} \Rightarrow \frac{x}{32} + 10 = \frac{5x}{32}$$

$$\Rightarrow \frac{x}{8} = 10$$

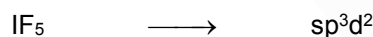
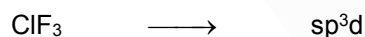
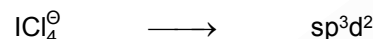
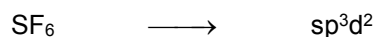
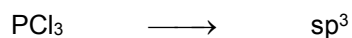
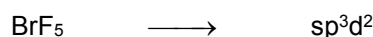
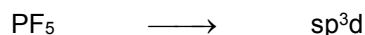
$$x = 80 \text{ gm}$$

2. Consider, PF₅, BrF₅, PCl₃, SF₆, [ICl₄]⁻, ClF₃ and IF₅.

Amongst the above molecule(s)/ion(s), the number of molecule(s)/ion(s) having sp³d² hybridisation is _____.

Answer (4)

Sol. Hybridisation of Central atom



3. 1.80 g of solute A was dissolved in 62.5 cm³ of ethanol and freezing point of the solution was found to be 155.1 K. The molar mass of solute A is _____ g mol⁻¹.

[Given : Freezing point of ethanol is 156.0 K.

Density of ethanol is 0.80 g cm⁻³.

Freezing point depression constant of ethanol is 2.00 K kg mol⁻¹]

Answer (80)

Sol. ΔT_f = k_f m

$$0.9 = \frac{2 \times 1.8 \times 1000}{62.5 \times 0.8 \times M}$$

$$M = \frac{2 \times 1800}{62.5 \times 0.8 \times 0.9}$$

$$= 80 \text{ g/mol}$$

4. For a cell, Cu(s) | Cu²⁺ (0.001M) || Ag⁺ (0.01M) | Ag(s) the cell potential is found to be 0.43 V at 298 K. The magnitude of standard electrode potential for Cu²⁺/Cu is _____ × 10⁻² V.

$$\left[\text{Given : } E_{\text{Ag}^+/\text{Ag}}^\ominus = 0.80 \text{ V and } \frac{2.303RT}{F} = 0.06 \text{ V} \right]$$

Answer (34)

$$\text{Sol. } E = E^\ominus - \frac{0.06}{2} \log \frac{[\text{Cu}^{+2}]}{[\text{Ag}^\oplus]^2}$$

$$= E^\ominus - \frac{0.06}{2} \log \frac{0.001}{(0.01)^2}$$

$$0.43 = E^\ominus - 0.03$$

$$E^\ominus = 0.46 \text{ V}$$

$$E_{\text{Ag}^\oplus/\text{Ag}}^\ominus - E_{\text{Cu}^{+2}/\text{Cu}}^\ominus = 0.46$$

$$\therefore E_{\text{Cu}^{+2}/\text{Cu}}^\ominus = 0.8 - 0.46$$

$$= 0.34 \text{ V}$$

$$= 34 \times 10^{-2} \text{ V}$$

5. Assuming 1 μg of trace radioactive element X with a half life of 30 years is absorbed by a growing tree. The amount of X remaining in the tree after 100 years is _____ × 10⁻¹ μg.

[Given : ln 10 = 2.303; log 2 = 0.30]

Answer (1)

$$\text{Sol. } kt = \ln \frac{1}{1-X}$$

$$\frac{0.693}{30}(100) = \ln \frac{1}{1-X}$$

$$2.303 = 2.303 \log \frac{1}{1-X} \Rightarrow \frac{1}{1-X} = 10$$

$$\Rightarrow 1 = 10 - 10X$$

$$\Rightarrow X = \frac{9}{10}$$

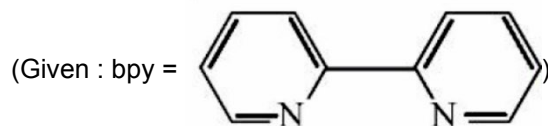
$$= 0.9 \mu\text{g}$$

$$\text{Amount of X remaining} = 1 - X$$

$$= 1 - 0.9 = 0.1 \mu\text{g}$$

$$= 1 \times 10^{-1} \mu\text{g}$$

6. Sum of oxidation state (magnitude) and coordination number of cobalt in $\text{Na}[\text{Co}(\text{bpy})\text{Cl}_4]$ is ____.



Answer (9)

Sol. $\text{Na}[\text{Co}(\text{bpy})\text{Cl}_4]$

Oxidation state of cobalt = + 3

Coordination number of cobalt = 6

[As bpy is bidentate]

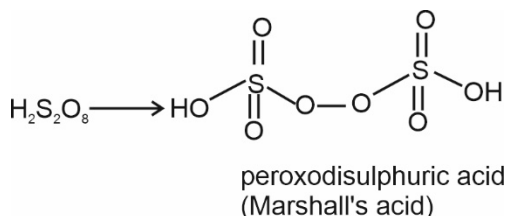
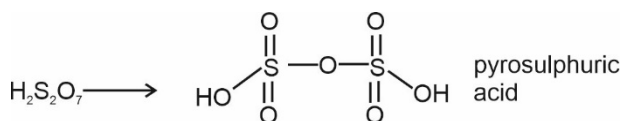
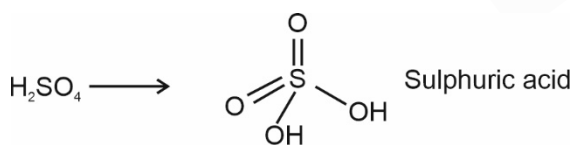
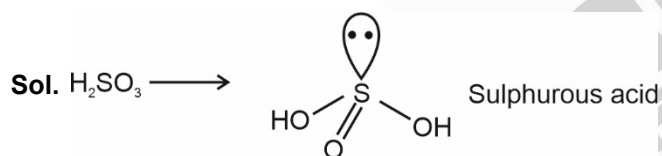
So, sum = 9

7. Consider the following sulphur based oxoacids.

H_2SO_3 , H_2SO_4 , $\text{H}_2\text{S}_2\text{O}_8$ and $\text{H}_2\text{S}_2\text{O}_7$.

Amongst these oxoacids, the number of those with peroxo (O–O) bonds is ____.

Answer (1)



8. A 1.84 mg sample of polyhydric alcoholic compound 'X' of molar mass 92.0 g/mol gave 1.344 mL of H_2 gas at STP. The number of alcoholic hydrogens present in compound 'X' is ____.

Answer (6)

Sol. Moles of H_2 produced at STP

$$= \frac{1.344 \times 10^{-3}}{22.4}$$

$$= 6 \times 10^{-5} \text{ mole}$$

\therefore Moles of hydrogen atom produced

$$= 12 \times 10^{-5} \text{ mol}$$

Moles of organic compound

$$= \frac{1.84 \times 10^{-3}}{92}$$

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

\therefore Number of alcoholic hydrogen present

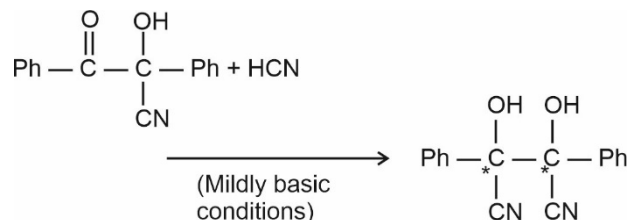
$$= \frac{12 \times 10^{-5}}{2 \times 10^{-5}} = 6$$

9. The number of stereoisomers formed in a reaction of $(\pm) \text{Ph}(\text{C}=\text{O})\text{C}(\text{OH})(\text{CN})\text{Ph}$ with HCN is ____.

[where Ph is $-\text{C}_6\text{H}_5$]

Answer (3)

Sol.



Number of stereoisomers = 3

10. The number of chlorine atoms in bithionol is ____.

Answer (4)

Sol. Number of chlorine atoms in bithionol = 4

