Chemistry

CISCE

Academic Year: 2023-2024
(English Medium)
Date & Time: 11th March 2024, 11:00 am

Duration: 2h **Marks: 100**

1. Answers to this Paper must be written on the paper provided separately.
2. You will not be allowed to write during the first 15 minutes.
3. This time is to be spent in reading the question paper.
4. The time given at the head of this Paper is the time allowed for writing the answers.
5. Section A is compulsory. Attempt any four questions from Section B.
6. The intended marks for questions or parts of questions are given in brackects [ ].

SECTION-A (40 Marks) (Attempt all questions from this Section.)

Q1. Choose the correct answers to the questions from the given options. (Do not copy the questions, write the correct answers only.)

1.1. The unsaturated hydrocarbons undergo _____.

1. A substitution reaction
2. An oxidation reaction
3. An addition reaction
4. None of the above
5. Redox reaction

Solution

The unsaturated hydrocarbons undergo an addition reaction.

Explanation:

Because double and triple bonds in unsaturated hydrocarbons are broken down into single bonds, they are subject to addition reactions.

1.2. In the 2nd period Neon has maximum Ionization Potential because _____.

1. It has unstable electronic configuration.
2. It easily accepts electrons.
3. It easily loses electrons.
4. The outer most shell is completely filled.

Solution

In the 2nd period Neon has maximum Ionization Potential because **the outer most shell is completely filled**.

Explanation:

Neon's valence shell is completely filled, making it extremely stable and requiring more energy to remove an electron, giving it the highest ionisation potential in the second period.

1.3. Copper, zinc, and Tin are the metals alloyed to form _____.

1. Duralumin
2. Brass
3. Bronze
4. Solder

Solution

Copper, zinc, and Tin are the metals alloyed to form **bronze**.

Explanation:

Duralumin consists of 90% Al and 4% Cu, while bronze is an alloy with 80% Cu, 4% Zn, and 16% Sn. Cu and Zn combine to form brass. Pb and Sn are alloyed using solder.

1.4. The metal hydroxide which reacts with both acids and alkalis to form salt and water is _____.

1. Calcium hydroxide

2. Magnesium hydroxide
3. Aluminium hydroxide
4. Ferric hydroxide

Solution

The metal hydroxide which reacts with both acids and alkalis to form salt and water is **aluminium hydroxide**.

Explanation:

Because $Al(OH)_3$ is amphoteric in nature, it can generate salt and water as well as behave as a base with a strong acid.

1.5. Reaction of an alcohol with a carboxylic acid in the presence of concentrated H_2SO_4 is termed as _____.

1. Halogenation
2. Esterification
3. Hydrogenation
4. Dehydrohalogenation

Solution

Reaction of an alcohol with a carboxylic acid in the presence of concentrated H_2SO_4 is termed as **esterification**.

Explanation:

The process that produces an ester when an alcohol reacts with carboxylic acid in the presence of H_2SO_4 is known as an esterification reaction.

$$\underset{\text{Ethanol}}{CH_3CH_2OH} + \underset{\text{Acetic acid}}{HOOC - CH_3} \longrightarrow \underset{\text{Ethyl Ethanoate (ester)}}{CH_3CH_2 - O - \overset{\overset{O}{\|}}{C} - CH_3} + H_2O$$

1.6. Conversion of ethanol to ethene by the action of concentrated sulphuric acid is an example of _____.

1. Dehydration

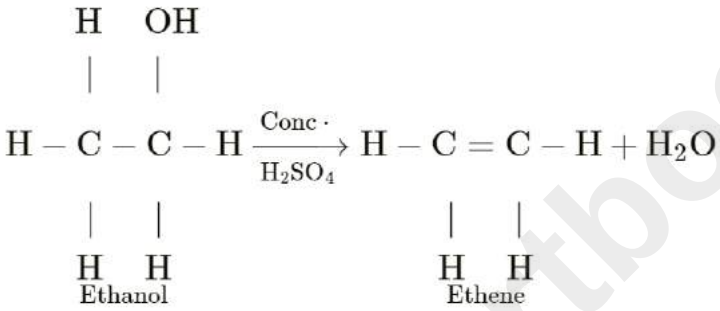
2. Dehydrogenation
3. Dehydrohalogenation
4. Hydrolysis

Solution

Conversion of ethanol to ethene by the action of concentrated sulphuric acid is an example of **dehydration**.

Explanation:

Conc. H_2SO_4 is a useful dehydrator since it turns alcohol into an alkene by removing the water molecule.



1.7. The oxidizing agent in the equation $S + 2H_2SO_4 \longrightarrow 3SO_2 + 2H_2O$ is _____.

1. Sulphur
2. Sulphuric acid
3. Sulphur dioxide
4. Water

Solution

The oxidizing agent in the equation $S + 2H_2SO_4 \longrightarrow 3SO_2 + 2H_2O$ is **sulphuric acid**.

Explanation:

The reaction is as follows:

$S + 2H_2SO_4$ (conc.) $\longrightarrow 3SO_2 + 2H_2O$

The oxidizing agent in this process is concentrated H_2SO_4. While being converted to SO_2, it oxidizes sulphur (S) to produce sulphur dioxide SO_2.

1.8. Electron Affinity is maximum in _____.

1. Mg
2. Ar
3. Li
4. Br

Solution

Electron Affinity is maximum in **Br**.

Explanation:

From left to right in the periodic table, electron affinity generally increases because atoms become more prone or unstable to gaining an electron in order to achieve a stable electronic configuration, such as that of noble gases. Because they need one electron to complete their octet, halogens such as bromine (Br) have an excessively high electron affinity. Metals like magnesium (Mg) and lithium (Li) have lesser propensities to lose electrons than noble gases like argon (Ar), which have entire outer shells.

1.9. The compound that is not a constituent of the electrolytic mixture used in Hall-Heroult's process is _____.

1. Al_2O_3
2. $NaAlO_2$
3. Na_3AlF_6
4. CaF_2

Solution

The compound that is not a constituent of the electrolytic mixture used in Hall-Heroult's process is **$NaAlO_2$**.

Explanation:

Aluminum from aluminum oxide is extracted using the Hall-Heroult technique (alumina, Al_2O_3). In order to lower the melting point of alumina and increase the conductivity of the solution, an electrolytic mixture made primarily of molten

alumina, a mixture of cryolite (Na_3AlF_6), and additional fluxes such as calcium fluoride (CaF_2) is employed in this process.

1.10. On passing ammonia gas over heated copper oxide for some time, a reddish-brown residue is left behind. What property of ammonia is demonstrated here?

1. Basic property
2. Oxidising property
3. Reducing property
4. Acidic property

Solution

Reducing property

Explanation:

CuO functions as a reducing agent because it is reduced to Cu (reddish brown ppt.) in the presence of ammonia.

$$3\,CuO + 2\,NH_3 \longrightarrow 3\,Cu + N_2 + 3\,H_2O$$

$\uparrow$ (Reduction) $\uparrow$

1.11. Rotten egg smell is due to the liberation of _____.

1. HCl gas
2. H_2S gas
3. Cl_2 gas
4. SO_2 gas

Solution

Rotten egg smell is due to the liberation of **H_2S gas**.

Explanation:

Hydrogen sulfide (H_2S) release is frequently the cause of the stench of rotting eggs. Hydrogen sulphide is a colorless gas with a foul odour reminiscent of rotten eggs. As they break down organic waste, microorganisms naturally create it.

1.12. Ammonia gas is collected by downward displacement of air since ammonia is _____.

1. Very slightly soluble in water
2. Heavier than air
3. Lighter than air
4. Insoluble in water

Solution

Ammonia gas is collected by downward displacement of air since ammonia is **lighter than air**.

Explanation:

Ammonia gas is collected in an inverted gas jar by displacing air downward due to its lighter density. Ammonia is very soluble and cannot be collected over water.

1.13. Which of the following would occupy 22.4 litres at S.T.P.?

1. 32 g of oxygen gas
2. 2 moles of hydrogen gas
3. 6.022×10^{23} molecules of ammonia

[Atomic weights: O = 16, H = 1, N = 14]

1. 1 and 2
2. 1 and 3
3. 2 and 3
4. 1, 2 and 3

Solution

1 and 3

Explanation:

Gram molecular = 1 mole

= 6.022×10^{23} molecules

= 22.4 L

∴ Molecular Mass of O_2 gas = 32 g

= 6.022×10^{23} molecules

= 22.4 L

Similary, 6.022×10^{23} molecule of NH_3 = 22.4 L

Since 1 mole of any gas occupies 22.4 litres at STP, 2 moles of hydrogen gas would occupy 2 × 22.4 = 44.8 litres, which is more than 22.4 litres.

1.14. In the molecule of water, oxygen atom has _____.

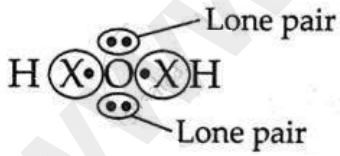
1. One shared pair of electrons
2. Three shared pairs of electrons
3. Two lone pairs of electrons
4. One lone pair of electrons

Solution

In the molecule of water, oxygen atom has **two lone pairs of electrons**.

Explanation:

A water molecule has 2H atoms and 10 atoms. O has an electrical configuration of 2, 6 and requires 2 electrons to complete its octet.
∴ it shares $2e^-$ with 2H–atoms



1.15. A mineral from which the metal can be extracted economically and conveniently is known as _____.

1. Matrix
2. Ore
3. Flux
4. Alloy

Solution

A mineral from which the metal can be extracted economically and conveniently is known as **ore**.

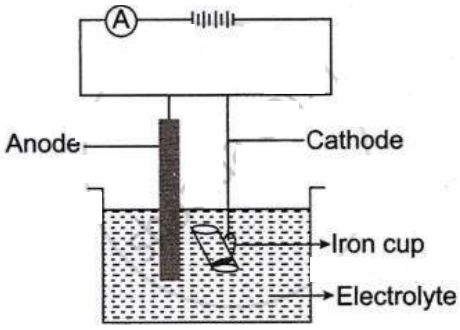
Explanation:

An ore is a mineral that allows for profitable metal extraction.

Q2.

2.1. The following sketch represents the electroplating of an Iron cup with Nickel metal.

Study the diagram and answer the following questions:



a. During electroplating, the iron cup is placed at the cathode. Why?

b. Name the ion that must be present in the electrolyte.

c. State one condition that is necessary to ensure that the deposit is smooth, firm and even.

d. Write the reaction taking place at the cathode.

e. What change would you observe at the anode?

Solution

a. In electroplating, the iron cup is put at the cathode because the cathode is a negative terminal that attracts metals that are positively charged. This leads to the reduction and formation of metal ions.

b. The electrolyte used is a water-based solution of $NiSO_4$, so the ions formed are Ni^{2+}, H^+, SO_4^{2-}, OH^-.

c. To ensure smooth deposition, current should be passed slowly and over a longer period of time.

d. Cathode: $Ni^{2+} + 2e^- \longrightarrow Ni$ (Reduction)

e. The anode, a Ni plate, is etched after the Ni ions finish in the electrolyte.

2.2. Match the Column A with Column B.

Column A		Column B	
(a)	Water	1.	Lithium
(b)	Alkali metal	2.	Iodine
(c)	Halogen	3.	Covalent compound
(d)	Calcium oxide	4.	Acetic acid
(e)	Weak acid	5.	Ionic compound
		6.	Sulphuric acid

Solution

Column A		Column B	
(a)	Water	3.	Covalent compound
(b)	Alkali metal	1.	Lithium
(c)	Halogen	2.	Iodine
(d)	Calcium oxide	5.	Ionic compound
(e)	Weak acid	4.	Acetic acid

2.3. Complete the following sentences by choosing the correct answer from the brackets:

2.3. (a) The salt prepared by the method of direct combination is _____.

1. Iron (II) chloride ($FeCl_2$)
2. **Iron (III) chloride ($FeCl_3$)**

Solution

The salt prepared by the method of direct combination is **Iron (III) chloride ($FeCl_3$)**.

2.3. (b) The metallic oxide which can be reduced by using common reducing agents is _____.

1. Fe_2O_3
2. Al_2O_3

Solution

The metallic oxide which can be reduced by using common reducing agents is **Fe_2O_3**.

2.3. (c) The metal nitrate which on thermal decomposition forms a black residue is _____.

1. zinc nitrate
2. copper nitrate

Solution

The metal nitrate which on thermal decomposition forms a black residue is **copper nitrate**.

2.3. (d) During the electrolysis of copper sulphate solution, if _____ is used as electrodes, the colour of the electrolyte does not fade.

1. copper
2. platinum

Solution

During the electrolysis of copper sulphate solution, if **copper** is used as electrodes, the colour of the electrolyte does not fade.

2.3. (e) The process of heating the concentrated ore in a limited supply or absence of air is _____.

1. Roasting
2. Calcination

Solution

The process of heating the concentrated ore in a limited supply or absence of air is **calcination**.

2.4. (a) State the term for the following:

The group obtained by removing one hydrogen atom from the parent alkane.

Solution

Alkyl group

2.4. (b) State the term for the following:

Two metal plates or wires through which the current enters and leaves the electrolytic cell.

Solution

Electrodes

2.4. (c) State the term for the following:

The amount of substance which contains the same number of units as the number of atoms in carbon-12.

Solution

Mole

2.4. (d) State the term for the following:

The tendency of an atom to pull a shared pair of electrons towards itself in a compound.

Solution

Electronegativity

2.4. (e) State the term for the following:

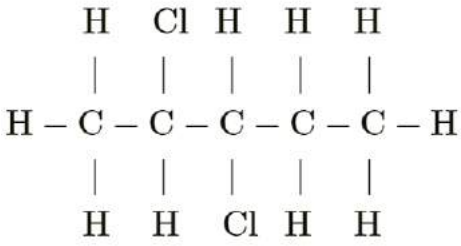
The formula which represents the simplest ratio between the atoms of elements present in a compound.

Solution

Empirical formula

2.5. (a)

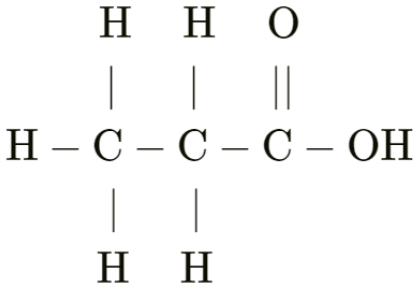
1. Give the IUPAC name of the organic compound represented by the structural formula given below:



Solution

The IUPAC name of the given organic compound is 2, 3-Dichloropentane.

2. Give the IUPAC name of the organic compound represented by the structural formula given below:



Solution

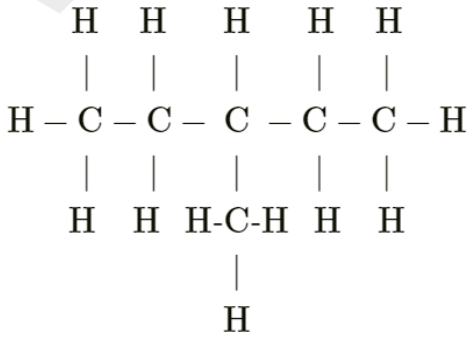
The IUPAC name of the given organic compound is propan-1-oic acid.

2.5. (b)

1. Draw the structural diagram for the following organic compound:

3-methyl pentane

Solution

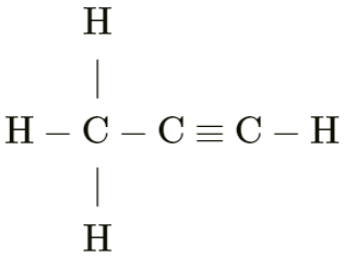


2. Write the structural formula of propyne.

Draw the structural diagram for the following organic compound:

Solution

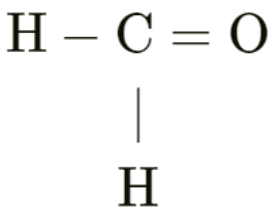
The structural formula of propyne is as follows:



3. Give the structural formula of the following organic compound:

Methanal

Solution



SECTION-B (40 Marks) (Attempt any four questions from this Section.)

Q3.

3.1. (a) Rewrite the following statement by adding the correct word, as shown in the example:

Example:
Given Statement: Ammonia changes moist red litmus to blue.
Correct Statement: Aqueous ammonia changes moist red litmus to blue.

Sulphuric acid acts as a dehydrating agent.

Solution

Concentrated sulphuric acid acts as a dehydrating agent.

Explanation:

Conc. H_2SO_4 has a strong affinity for water and so reduces it from the molecule, whereas dilute acid dissolves in water.

3.1. (b) Rewrite the following statement by adding the correct word, as shown in the example:

Example:

Given Statement: Ammonia changes moist red litmus to blue.

Correct Statement: Aqueous ammonia changes moist red litmus to blue.

Ammonia reacts with chlorine to give ammonium chloride and nitrogen.

Solution

Excess ammonia reacts with chlorine to give ammonium chloride and nitrogen.

Explanation:

Ammonia reacts in two ways:

1. If ammonia is in excess,

$$\underset{\text{(Excess)}}{NH_3} + Cl_2 \longrightarrow \underset{\substack{\text{Ammonium}\\\text{chloride}}}{NH_4Cl} + \underset{\text{Nitrogen}}{N_2}$$

2. If ammonia is in limited supply,

$$\underset{\text{(Limited)}}{NH_3} + \underset{\text{(Excess)}}{Cl_2} \longrightarrow \underset{\text{(Nitrogen trichloride)}}{NCl_3} + \underset{\text{(Hydrogen chloride)}}{HCl\,(g)}$$

3.2. (a) Identify only the anion present in the following compound:

The compound, on heating, produces a colourless, odourless gas which turns lime water milky and has no effect on acidified potassium dichromate solution.

Solution

The anion present is carbonate CO_3^{2-}. Heating the appropriate component causes CO_2 to be released, turning lime water milky and not affecting acidified potassium dichromate solutions.

3.2. (b) Identify only the anion present in the following compound:

The solution of the compound which on treating with concentrated sulphuric acid and freshly prepared ferrous sulphate solution produces a brown ring.

Solution

The anion present is nitrate NO_3^-. The nitrate-containing chemical undergoes the following reactions to generate a brown ring.

$$NO_3^- + H_2SO_4 \longrightarrow HNO_3 + HSO_4^-$$

$$2\,HNO_3 \longrightarrow H_2O + 2\,NO + 3\,[O]$$

$$FeSO_4 + NO + 5\,H_2O \longrightarrow \underset{\text{(Brown ring)}}{[Fe(H_2O)_5NO]\,SO_4}$$

3.3. (a) Mohan has three solutions P, Q and R having a pH of 13, 5 and 2 respectively. Which of the above solutions P, Q or R will react with magnesium to liberate hydrogen gas?

Solution

Highly acidic with pH-2, 'R' interacts with metal to create salt and release H_2 gas.

$Mg + R \longrightarrow$ Salt of acid + H_2

3.3. (b) Mohan has three solutions P, Q and R having a pH of 13, 5 and 2 respectively. Which of the above solutions P, Q or R will liberate ammonia gas when it reacts with ammonium chloride?

Solution

'P' reacts with ammonium chloride to produce ammonia due to the fact that it is highly basic at pH-13.

$NH_4Cl + NaOH \longrightarrow NH_3 + NaCl + H_2O$

3.3. (c) Mohan has three solutions P, Q and R having a pH of 13, 5 and 2 respectively. Which of the above solutions P, Q or R will contain molecules as well as ions?

Solution

With a pH of 5, 'Q' is a weak acid. Because it is partially dissociated, it contains both molecules and ions, making it unionised.

3.4. The following table is related to an industrial process of an acid.

Name of the process	Reactant	Catalyst	Final product
(a)	$SO_2 + O_2$	(b)	(c)

Identify (a), (b) and (c).

Solution

Name of the process	Reactant	Catalyst	Final product
(a) **Contact process**	$SO_2 + O_2$	(b) **Vanadium oxide**	(c) **Sulphuric acid**

The contact process is an industrial method used to produce sulphuric acid through a sequence of reactions.

1. **Combustion of Sulphur:** $\mathrm{S + O_2\,(g) \longrightarrow SO_2\,(g)}$
2. **Formation of SO_3:** $\mathrm{SO_2 + O_2 \xrightarrow[2-3\ atm]{V_2O_5,\ 450^\circ C} SO_3\,(g)}$
3. **Formation of Oleum:** $\mathrm{SO_2 + H_2SO_4 \longrightarrow \underset{Oleum}{H_2S_2O_7}}$

Formation of Sulphuric acid

$$\mathrm{H_2S_2O_7 + H_2O \longrightarrow 2\,H_2SO_4}$$

Q4.

4.1. (a) Define the term.

Molar volume

Solution

One mole of any gaseous molecules occupies 22.4 dm^3 (litre) or 22400 cm^3 (ml) at standard temperature and pressure (STP). This volume is known as the molar volume.

"The molar volume of a gas can be defined as the volume occupied by one mole of a gas at standard temperature and pressure."

4.1. (b) Define normal salt.

Solution

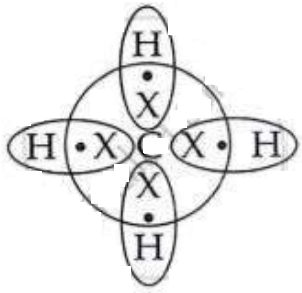
Normal salts are the salts formed by the complete replacement of the ionizable hydrogen atoms of an acid by a metallic or ammonium ion. For example: Sodium chloride (NaCl).

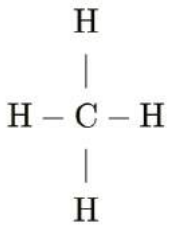
4.2. (a) Draw the electron dot structure of Methane molecule.

[Atomic number: N = 7, C = 6, H = 1]

Solution

Methane: CH_4, C = 2, 4 H = 1





4.2. (b) Draw the electron dot structure of Nitrogen molecule.

[Atomic number: N = 7, C = 6, H = 1]

Solution

Nitrogen: N_2, N = 2, 5

$:N \equiv N:$

4.3. (a) Complete and balance the following equation:

$Al_2O_3 + NaOH \longrightarrow$

Solution

$$Al_2O_3 + 2\,NaOH \longrightarrow \underset{\text{Sodium aluminate}}{2\,NaAlO_2} + H_2O$$

4.3. (b) Complete and balance the following equation:

$$C_2H_5COONa + NaOH \xrightarrow[CaO]{\Delta}$$

Solution

$$C_2H_5COONa + NaOH \xrightarrow[CaO]{\Delta} \underset{\text{Ethane}}{C_2H_6} + Na_2CO_3$$

4.3. (c) Complete and balance the following equation:

$$C_2H_4Br_2 + \text{alcoholic KOH} \xrightarrow{\Delta}$$

Solution

$$C_2H_4Br_2 + 2\,\text{alc}\cdot KOH \xrightarrow{\Delta} \underset{\text{Ethyne}}{CH \equiv CH} + 2\,KBr + 2\,H_2O$$

4.4. Choose the organic compound from the list given below to answer the following questions:

4.4. (a) The compound which does not have a double bond in its structure.

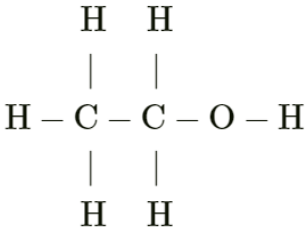
1. Ethene
2. Ethanoic acid
3. Ethanol
4. Methanal

Solution

Ethanol

Explanation:

The structural formula clearly represents all single bonds.



4.4. (b) The compound in its pure form turns into an ice like solid on cooling.

1. Ethene
2. Ethanoic acid
3. Ethanol
4. Methanal

Solution

Ethanoic acid

Explanation:

Melting point of ethanoic acid is 289.5 K, or 16°C. It so freezes below this temperature and is also known as glacial acetic acid.

4.4. (c) The compound which is used for artificial ripening of fruits.

1. Ethene
2. Ethanoic acid
3. Ethanol
4. Methanal

Solution

Ethene

Explanation:

Fruits start their ripening process with gaseous ethylene emissions. So, a chemical called ethephon (2-chloroethyl phosphonic acid) is also used to make fruits ripen faster. This chemical gets inside the fruit and breaks down into ethylene calcium carbide.

Q5.

5.1. (a) Name the main constituent metal in the following alloy:
Duralumin

Name the main metal used in making the alloy given below:

Duralumin

Solution

Aluminium

Explantion:

Duralurnin is actually a composition with 95% Al, 4% Copper, 0.5% Mg and 0.5% Mn.

5.1. (b) Name the main constituent metal in the following alloy:
Stainless steel

Name the main metal used in making of the alloy given below:

Stainless steel

Solution

Iron

Explanation:

Iron and carbon make up most of stainless steel, in minor amounts. Therefore, steel is just stainless steel with a 10% Ni and a 15% Cr addition.

Stainless steel

- Fe (73%)
- Cr (18%)
- Ni (8%)
- C (1%)

5.2. (a) Differentiate between the following pairs based on the odourless gas which turns lime water milky and the criteria given:

Sulphuric acid and Nitric acid (using barium chloride solution)

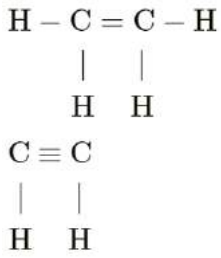
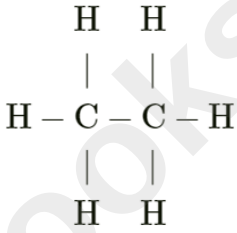
Solution

Sulphuric Acid	Nitric Acid
When sulphuric acid reacts with barium chloride, a white ppt. of barium sulphate is formed. $BaCl_2 + H_2SO_4 \longrightarrow BaSO_4 + 2HCl$	Barium chloride does not react with nitric acid.

5.2. (b) Differentiate between the following pairs based on the criteria given:

Unsaturated and Saturated hydrocarbons (type of bond present)

Solution

Unsaturated Hydrocarbon	Saturated Hydrocarbon
Unsaturated hydrocarbons are those where carbon atoms self-catenate through double and triple bonds (σ and π bonds).	Saturated hydrocarbons are those where carbon atoms self catenate through a single bond (σ bond).
E.g. 	E.g. 

5.3. (a) Calcium carbonate react with dilute hydrochloric acid as given below:

$CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO_2$

What is the mass of 5 moles of calcium carbonate? (Relative molecular mass of calcium carbonate is 100)

Solution

1 mole of $CaCO_3$ = 100 g

5 moles of $CaCO_3 \longrightarrow 5 \times 100 = 500$ g

Hence, the mass of 5 moles of $CaCO_3$ will be 500 g

5.3. (b) Calcium carbonate react with dilute hydrochloric acid as given below:

$CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO_2$

How many moles of HCl will react with 5 moles of calcium carbonate?

Solution

2 moles of HCl are used for 1 mole of $CaCO_3$

i.e., $CaCO_3$ HCl

1mole ⟶ 2 mole

5mole ⟶ 5 × 2 = 10 moles

Hence 10 moles of HCl will react with 5 moles of calcium carbonate.

5.3. (c) Calcium carbonate react with dilute hydrochloric acid as given below:

$CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO_2$

What is the volume of carbon dioxide liberated at S.T.P. at the same time?

Solution

$100\ \text{g of } CaCO_3 \longrightarrow 22.4\ \text{l of } CO_2$

$500\ \text{g of } CaCO_3 = \dfrac{22.4 \times 500}{100}$

= 112.0

$\therefore$ 112.0 of CO_2

Hence, 112 l of CO_2 is liberated from 5 moles of calcium carbonate.

5.4. (a) Identify the gas evolved in the following reaction:

Methane undergoes complete combustion.

Solution

Carbon dioxide

Explanation:

Methane burns completely to produce carbon dioxide and water.

$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$

5.4. (b) Identify the gas evolved in the following reaction:

Copper carbonate is heated.

Solution

Carbon dioxide

Explanation:

On heating, green copper carbonate breaks down to produce black copper oxide and releases CO_2.

$$CuCO_3 \xrightarrow{\Delta} CuO + CO_2$$

5.4. (c) Identify the gas evolved in the following reaction:

MnO_2 reacts with concentrated HCl.

Solution

Chlorine

Explanation:

Manganese oxide reacts with cone. HCl, releasing greenish colored chlorine and forming manganese chloride.

$MnO_2 + HCl_2 \longrightarrow MnCl_2 + Cl_2 + 2\ H_2O$

Q6.

6.1. (a)

X - $HCl \rightleftharpoons H^{1+} + Cl^{-}$ (in solution state)

Y - $PbBr_2 \rightleftharpoons Pb^{2+} + 2\,Br^{1-}$ (in molten state)

From the above reaction X or Y, identify the reaction which exhibit:

electrolytic dissociation

Solution

'Y' Electrolytic dissociation of $PbBr_2$ occurs when energy in the form of heat induces molecules to generate ions, breaking the electrostatic interaction between ions.

6.1. (b)

X - $HCl \rightleftharpoons H^{1+} + Cl^{-}$ (in solution state)

Y - $PbBr_2 \rightleftharpoons Pb^{2+} + 2\,Br^{1-}$ (in molten state)

From the above reaction X or Y, identify the reaction which exhibit:

Ionization

Solution

'X' HCl is a powerful acid; therefore, in solution, it completely dissociates and generates independent ions that are not held together by any force.

6.2. (a) Give a reason for Inert gases do not form ions.

Solution

Inert gases do not produce ions because their outermost shell is completely filled, resulting in a stable electronic state. As a result, atoms cannot absorb or lose electrons in order to create ions.

6.2. (b) Give reason for the following:

Covalent compounds have a low melting and boiling point.

Solution

Covalent compounds are held together by modest intramolecular forces. As a result, breaking the bonds between two or more molecules requires only a minimal amount of energy.

Therefore, these compounds have low melting and boiling points.

6.3. (a) Arrange the following as per the instruction given in the bracket:

Carbon, Fluorine, Beryllium (decreasing order of atomic size).

Solution

Beryllium > Carbon > Fluorine

Explanation:

As we proceed along a period, the size of the atom decreases due to increased nuclear pull.

6.3. (b) Arrange the following as per the instruction given in the bracket:

Sulphuric acid, Phosphoric acid, Acetic acid (increasing order of number of replaceable H atoms per molecule).

Solution

Acetic acid < sulphuric acid < phosphoric acid.

Explanation:

Acetic acid is CH_3COOH when it ionizes, it has only one H^+ ion ($CH_3COOH - CH_3COO^- + H^+$) While sulphuric has 2 replaceable Hydrogen atoms ($H_2SO_4 \longrightarrow 2H^+ + SO_4^{2-}$). Phosporic acid is H_3PO_5 which ionises to give 3-H atoms ($H_3PO_4 = 3H^+ + PO_4^{3-}$).

6.3. (c) Arrange the following as per the instruction given in the bracket:

Potassium, Lithium, Sodium (increasing order of ionization potential).

Solution

Lithium < Sodium < Potassium.

Explanation:

Li's electrical configuration 2, 1 will result in least ionization potential. Atomic number 11 for sodium corresponds to 2, 8, 1. With an atomic number of 19, potasium exhibits electrical configuration as 2, 8, 8, 1. This indicates that the atomic radii change from Li to Na to Kand from shell count. As size grows, nuclear attraction reduces and the distance from nucleus rises; so, electron can readily exit with great energy. Greater and smaller the atom's size will be the nuclear pull.

6.4. (a) Identify the following:

An element in Period 1 which can be placed in both Group 1 and Group 17 of the Periodic Table.

Solution

Hydrogen

Explanation:

Hydrogen has an electronic configuration of 1, which allows it to take e^- and complete its duplet as halogen (Group 17), as well as donate 1 e^- as alkali metals (Group 1).

6.4. (b) Identify the following:

The element having electronic configuration 2, 8, 6.

Solution

Sulphur

Explanation:

The atomic number of S is 16. The electronic arrangements are 2, 8, 6.

6.4. (c) Identify the following:

The most electronegative element of Period 3.

Solution

Chlorine

Explanation:

Electronegativity grows from left to right during a certain duration.

Q7.

7.1. Rita was given an unknown salt for identification. She prepared a solution of the salt and divided it into two parts.

- To the first part of the salt solution, she added a few drops of ammonium hydroxide and obtained a reddish-brown precipitate.
- To the second part of the salt solution, she added a few drops of silver nitrate solution and obtained a white precipitate.

Name:

a. The cation present and

b. The anion present in the salt given for identification.

Solution

a. Cation Fe^{3+} (ferric ion)

When Fe^{3+} reacts with NH_4OH it forms ferric hydroxide.

$$Fe^{3+} + 3\,NH_4OH \longrightarrow \underset{\text{(Reddish brown ppt.)}}{Fe(OH)_3} + 3\,NH_4{}^{+}$$

b. Anion: Cl^- (Chloride ion)

When Cl^- reacts with silver nitrate, it forms a white ppt. of silver chloride.

$$Cl^- + AgNO_3 - \underset{\text{Silver chloride}}{AgCl} + NO_3^-$$

7.2. Fill in the blanks by choosing the correct answer from the bracket:

7.2. (a) Carbon tetrachloride is a _____ covalent molecule.

1. Polar
2. Non-polar

Solution

Carbon tetrachloride is a **non-poplar** covalent molecule.

7.2. (b) During electrolysis of acidulated water, the gas liberated at the anode is _____.

1. Oxygen
2. Hydrogen

Solution

During electrolysis of acidulated water, the gas liberated at the anode is **oxygen**.

7.3. Ammonia burns in oxygen, as shown below.

$4NH_3 + 3O_2 \longrightarrow 2N_2 + 6\ H_2O$

If 240 cc of ammonia is burnt in 300 cc of oxygen, find out the composition of the resultant gaseous mixture at room temperature.

Solution

$4NH_3 + 3O_2 \longrightarrow 2N_2 + 6\ H_2O$ (vapour)

By Gay Lussac's Law

For N_2:

4 vol. of NH_3 results 2 vol. of N_2

$$240 \text{ cc of } NH_3 \text{ will result} = \frac{2 \times 240}{4}$$

= 120 cc of N_2

For H_2O (vapour phase):

4 Vol. of NH_3 results 6 vol. of H_2O

$$240 \text{ cc of } NH_3 \text{ will result} = \frac{240 \times 6}{4}$$

= 360 cc of H_2O

For O_2:

4 vol. of NH_3 reacts with 3 vol. of H_2O

$$240 \text{ cc of } NH_3 \text{ will react with } = \frac{3 \times 240}{4}$$

= 180 cc of O_2

7.4. The following table shows the electronic configuration of the atoms A, B, C and D.

Element	A	B	C	D
Electronic configuration	2, 8, 8, 2	2, 6	2, 8, 7	2, 4

a. Write the formula of the compound formed between:

   1. A and B
   2. D and C

b. Which of the above elements will exhibit catenation?

Solution

(a) (1)

	Electronic Configuration	Valency
A :	2, 8, 8, 2	+ 2
B :	2, 6	- 2

Formula: AB

(2)

	Electronic Configuration	Valency
D :	2, 4	± 4
C :	2, 8, 7	- 1

Formula: DC_4

(b) 'D' will exhibit catenation.

Q8.

8.1. Choose the correct answer from the list given below:

8.1. (a) The ore which can be concentrated by magnetic separation.

1. Zinc blende
2. C_2H_2
3. Calamine
4. CH
5. Haematite

Solution

Haematite

Explanation:

Haematite, an iron ore, is magnetically attractive.

8.1. (b) Empirical formula of Ethyne.

1. Zinc blende
2. C_2H_2
3. Calamine
4. CH
5. Haematite

Solution

CH

Explanation:

C_2H_2 is a molecular formula that represents the simple ratio in which atoms are joined; consequently, the empirical formula is CH.

8.2. (a) Give a balanced equation for the following reaction:

Copper reacts with concentrated nitric acid.

Solution

$$Cu + 4\,HNO_3 \longrightarrow \underset{\text{Copper nitrate}}{Cu(NO_3)_2} + 2\,NO_2 + 2\,H_2O$$

8.2. (b) Write the equation for the reaction:

Aluminum, Nitride and Water.

Give balanced equation for the following reaction:

Aluminium nitride is treated with warm water

Solution

$$AlN + 3\,H_2O \longrightarrow \underset{\text{Aluminium hydroxide}}{Al(OH)_3} + \underset{\text{Ammonia}}{NH_3}$$

8.3. Match the salts underlined in Column A with the most suitable method of preparation given in Column B.

Column A	Column B
(a) from $ZnCl_2$ from Zn	1. Precipitation
(b) from KNO_3 from KOH.	2. Direct combination
(c) from $CaCO_3$ from $CaCl_2$.	3. Displacement reaction
	4. Neutralization

Solution

Column A	Column B
(a) from $ZnCl_2$ from Zn	3. Displacement reaction
(b) from KNO_3 from KOH.	4. Neutralization
(c) from $CaCO_3$ from $CaCl_2$.	1. Precipitation

Explanation:

a. Displacement Reaction
   $Zn + HCl \longrightarrow ZnCl_2 + H_2$
   Displace H from HCl because zinc is more reactive than hydrogen.

b. Neutralization Reaction

$KOH + HNO_3 \longrightarrow KNO_3 + H_2O$

Base + Acid ⟶ Salt + water; Neutralization reaction

c. Precipitation Reaction

$CaCl_2 + Na_2CO_3 \longrightarrow 2\ NaCl + CaCO_3\downarrow$

Sodium chloride and a calcium carbonate precipitate follow from the double displacement reaction.

8.4. (a) Hydrogen chloride gas is prepared in the laboratory by the action of concentrated sulphuric acid on sodium chloride.

Give a balanced chemical equation for the above reaction.

Solution

$2\ NaCl + H_2SO_4 \longrightarrow 2\ HCl + Na_2SO_4$

Sodium's greater reactivity than hydrogen replaces 'H' from acid to produce matching salts and strong volatile acid (HCl).

8.4. (b) Hydrogen chloride gas is prepared in the laboratory by the action of concentrated sulphuric acid on sodium chloride.

State the method of collection of the gas formed above.

Solution

Upward displacement of water.

8.4. (c) Hydrogen chloride gas is prepared in the laboratory by the action of concentrated sulphuric acid on sodium chloride.

What is the property of sulphuric acid that makes it a suitable reagent for the reaction?

Solution

Sulphuric acid's low volatility and high boiling point qualify it as a suitable reagent for this reaction.