

A student required to answer all questions from all sections.

SECTION A (15 Marks)

1.

i	ii	iii	iv	v	vi	vii	viii	ix	x
E	E	C	D	B	C	D	C	B	C

(@ 01 = 10 marks)

2.

LIST A	i	ii	iii	iv	v
LIST B	H	A	G	E	I

(@ 01 = 05 marks)

SECTION B (70 Marks)

3. (a) - Appropriately dispose off any wastes. Use the litter bins and not the sink to dispose any solid waste.

Do not return unused substances to their original containers.

- Clean up the equipment and store it safely.
- Turn off gas and water taps.
- Clean the working surfaces, benches, and sinks.
- Wash your hands with soap and running water.

(@01 = 03 marks)

(b) The next two steps were filtration and evaporation.

(02 marks)

- Filtration was done so as to obtain copper(II) sulphate solution as filtrate and small pieces of glass as residue.

(01 mark)

- Evaporation was done so as to recover the copper(II) sulphate crystals. During evaporation, water escapes as vapour leaving behind copper(II) sulphate crystals.

(01 mark)

(c) - **Dependent variables:**

These are the factors in the experiment that change their values when the values of the other variables change. They are factors being measured.

- **Independent variables:**

These are the factors which are manipulated so as to obtain different values for comparison.

- **Controlled variables:**

These are the factors in the experiment that do not change; they are kept constant. They do not affect the outcomes of the experiments.

(@01 = 03 marks)

4. (a) (i) Chemical change

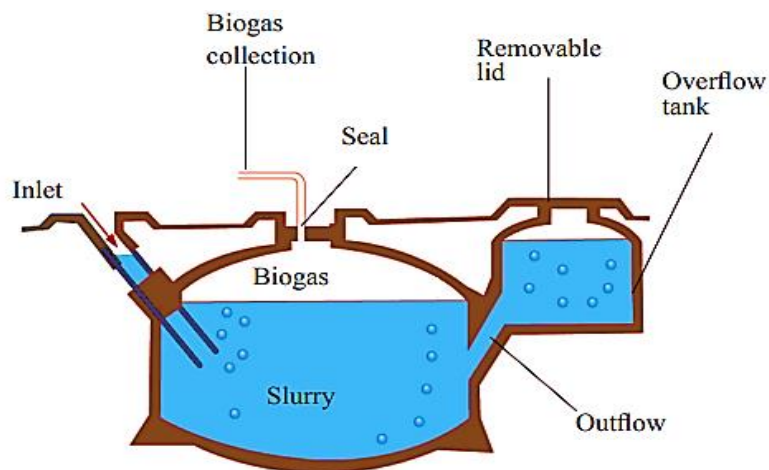
(ii) Physical change

(iii) Chemical change

(iv) Chemical change

(@00 $\frac{1}{2}$ = 02 marks)

(b) SKETCH OF BIOGAS DIGESTER (BIOGAS PLANT)



(03 marks)

WORKING MECHANISM OF A BIOGAS PLANT

- Pour animal dung or other waste and water in equal proportions into the mixing tank every day. The slurry flows into the digester. It takes 30 to 60 days for the slurry to fill the digester, depending on the capacity of the digester. Biogas collects in the dome under pressure.
- The biogas pressure, forces the spent slurry into the overflow tank. The spent slurry is removed and used as manure.
- The operation of a biogas plant is a continuous process as new slurry is added and the spent slurry is removed.

(03 marks)

(c) Four (4) advantages of a biogas in everyday life are:

- It is cheap source of energy because it uses available materials.
- It keeps the environment clean because does not leave any residue.
- It is renewable source of energy.
- It has high calorific value.
- It burns readily.

(02 marks)

5. (a) Two (2) similarities between combustion and rusting are:

- Both are chemical change.
- Both occurs in presence of air (oxygen).

(01 mark)

(b) (i) The aim of the experiment was to verify the necessary conditions for rusting of iron. (01 mark)

(ii) The observations in each test tube (A – D) after three days are as follows:

- The nail in test tube 'A' will have rusted to some extent. This is because air entering the test tube contains water vapour which contributes rusting. **(01 mark)**
- The nail in test tube 'B' do not rust due to presence of anhydrous calcium chloride which absorbs any water vapour which could have been in this test tube. **(01 mark)**
- The nail in test tube 'C' will have rusted. Because the water in this test tube contain dissolved oxygen. Iron reacts with oxygen in presence of water to form rust. **(01 mark)**
- The nail in test tube 'D' do not rust. This is because all the dissolved oxygen in water has been removed and the oil layer prevents oxygen in the air from dissolving in the water. **(01 mark)**

(iii) Boiled water was used because it does not contain oxygen. All the dissolved oxygen in water has been removed by boiling. (01 mark)

(iv) The layer of oil prevents oxygen in the air from dissolving in the water. Oil layer does not allow any oxygen to enter in water. (01 mark)

(v) Anhydrous calcium chloride absorbs any water vapour which could have been in test tube 'B'. Anhydrous calcium chloride is a drying agent. (01 mark)

(vi) Rusting occurs only when an iron material reacts with oxygen/air in presence of water. (01 mark)

6. (a) (i) MnO_2 : Manganese(iv) oxide. (01 mark)

H_2O_2 : Hydrogen peroxide. (01 mark)

(ii) MnO_2 remains unchanged at the end of the reaction because it is a catalyst. (01 mark)

(iii) Hydrogen peroxide $\xrightarrow{\text{Manganese(IV) oxide}}$ Water + Oxygen gas (01 mark)

(iv) Gas Q (oxygen gas) relights a glowing wooden splint. When a glowing wooden splint is dipped into a gas jar containing gas Q, a glowing wooden splint will relight up. (01 mark)

(v) Two (2) uses of gas Q in relation to its properties are:

➤ **Solubility in water**

The usefulness of oxygen to aquatic organisms is due to its solubility in water. Oxygen is slightly soluble in water, therefore, water contains some dissolved oxygen that is used by aquatic living organisms.

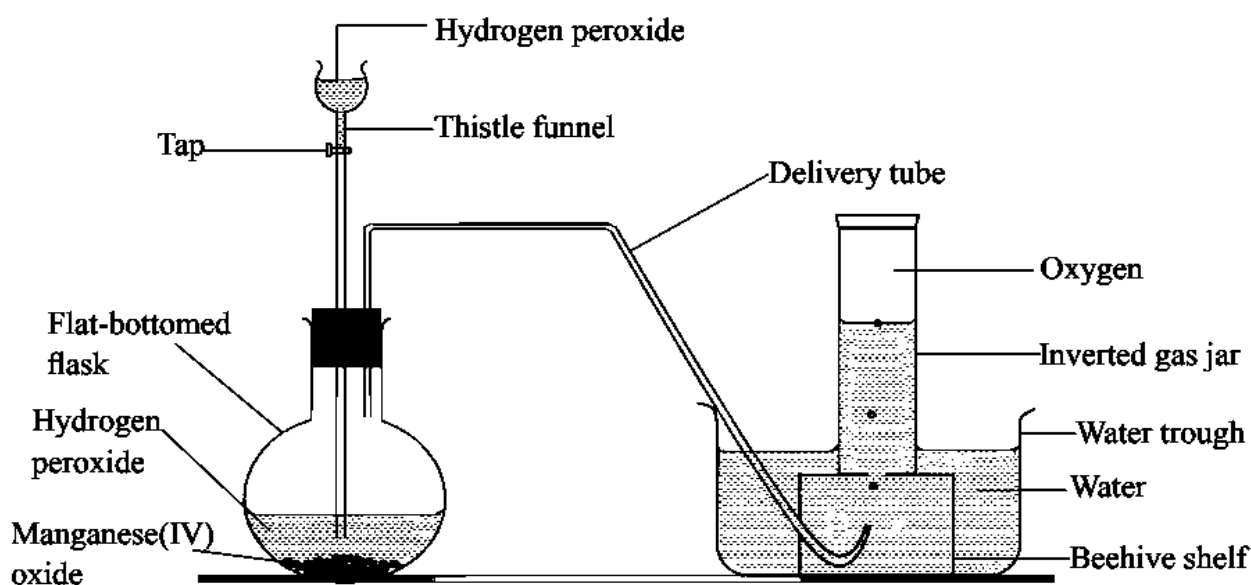
➤ **Combustibility**

Oxygen supports combustion. Therefore, it is used in incineration or burning of substances, welding, and metal cutting. In living organisms, oxygen is used to support burning of food in the body through respiration.

➤ **Reactivity with elements**

Oxygen reacts with many elements. This makes it useful in industrial chemical processes such as manufacturing of chemicals, glass, pulp, and paper. (@01 = 02 marks)

(b) THE DIAGRAM FOR THE LABORATORY PREPARATION OF GAS Q (OXYGEN GAS)



(03 marks)

7. (a) (i) - J. J. Thomson carried out experiments and described an atom as a sphere of positive charge, with negative particles called electrons spread throughout the sphere.
- Ernest Rutherford challenged (reasoned) that if Thomson's model was correct, then the mass of the atom was evenly spread throughout the atom. **(01 mark)**
- (ii) - Protons, the positively charged particles of an atom are located in the nucleus.
- Most of the mass of the atom is located in the nucleus.
 - The nucleus has a relatively smaller volume compared to the whole atom.
 - Electrons have very small masses compared to the protons.
 - Electrons are the negatively charged particles in an atom. They move around the nucleus in orbits.
 - Most of the space in an atom is empty. **(@01 = 03 marks)**
- (b) The relative atomic mass of an element is the average mass of one atom of the element relative to $\frac{1}{12}$ the mass of one atom of carbon-12. **(01 mark)**

Mathematical expression:

$$\text{Relative atomic mass (R.A.M)} = \frac{\text{Average mass of atom of an element}}{\frac{1}{12} \text{ the mass of carbon -12 atom}}$$

For isotopic elements, the relative atomic mass (R.A.M.) can be calculated using the following formula:

$$\text{Relative atomic mass (R.A.M)} = \text{The sum of isotopic mass} \times \text{Percentage abundance} \quad \textbf{(01 mark)}$$

(c) DATA

- Given three isotopes of hydrogen; Protium (${}^1_1\text{P}$), Deuterium (${}^2_1\text{D}$) and Tritium (${}^3_1\text{T}$).
- The percentage abundance of Protium = 98.9 %.
- The percentage abundance of Deuterium = ten times that of Tritium.
- The relative atomic mass of hydrogen = Required

First step: To find the percentage abundance of Deuterium and Tritium individually.

$$\text{The percentage abundance of Deuterium and Tritium} = 100 \% - 98.9 \% = 1.1 \% \quad \textbf{(01 mark)}$$

$$\text{But; D} = 10 \text{ T} \quad \dots\dots\dots \text{(i)}$$

$$\text{D} + \text{T} = 1.1 \quad \dots\dots\dots \text{(ii)}$$

Solving equation (i) and (ii) simultaneously, we have D = 1 and T = 0.1

The percentage abundance of Deuterium (D) and Tritium (T) are respectively 1 % and 0.1 %. (01 mark)

Second step: To find the relative atomic mass of hydrogen.

From the formula:

$$\text{Relative atomic mass (R.A.M)} = \text{The sum of isotopic mass} \times \text{Percentage abundance} \quad \textbf{(01 mark)}$$

$$\text{R.A.M} = \left[1 \times \frac{98.9 \%}{100 \%} \right] + \left[2 \times \frac{1 \%}{100 \%} \right] + \left[3 \times \frac{0.1 \%}{100 \%} \right]$$

$$\text{R.A.M} = \frac{98.9 + 2 + 0.3}{100} = \frac{101.2}{100} = 1.012$$

Therefore, the relative atomic mass of hydrogen = 1.012 (01 mark)

8. (a) - It is iron rather than zinc that makes most structures due to its high tensile strength, thus iron is the metal that needs protection and vice versa.
- Zinc via galvanization process, forms a thin impermeable, insoluble and invisible zinc oxide layer which remain on iron material for a long time even if zinc coat is removed. Zinc oxide layer prevents water and oxygen from reaching iron, hence plays a big role for further protection of iron. **(03 marks)**
- (b) Damp blanket cuts off the oxygen supply, hence the fire goes off. I.e. damp blanket stops (prevents) oxygen from reaching the burning material. **(02 marks)**
- (c) (i) Because the flame is not very hot since it is a luminous flame.
- (ii) Because white anhydrous copper(II) sulphate absorbs water vapour from the atmosphere to form a blue hydrated copper(II) sulphate.
- (iii) This is because:
- The salts present in our body could dissolve in distilled water and causing health problem.
- Distilled water has no taste since it lacks dissolved matter like air, carbon dioxide and minerals.
- (iv) The compounds are neutral and there are no charged particles (no ions or electrons) to move and carry charge.
- (v) Group eight (VIII) elements have full outermost shells, hence cannot share there outermost shell electrons to form bonds. These elements have the most stable configuration, thus they can't lose or gain even a single electron. **(@01 = 05 marks)**

9. (a) This is because empirical formula does not show the exact number of each atom of the element in the compound.

While

A molecular formula shows the actual number of each atom in a compound. Hence, the molecular formula is the actual formula of the compound. **(02 marks)**

- (b) (i) ■ $\text{Cu}(\text{NO}_3)_2$: Copper(II) nitrate **(01 mark)**
 ■ $(\text{NH}_4)_2\text{CO}_3$: Ammonium trioxocarbonate(IV) **(01 mark)**

(ii)

Compound	Formula	Name of ion	Formula	Name of ion
	$\text{Cu}(\text{NO}_3)_2$		$(\text{NH}_4)_2\text{CO}_3$	
Cation	Cu^{2+}	Copper(II) ion	NH_4^+	Ammonium ion
Anion	NO_3^-	Nitrate ion	CO_3^{2-}	Carbonate ion

(02 marks)

- (iii) ■ Required to find oxidation state of copper (Cu) in $\text{Cu}(\text{NO}_3)_2$

$\text{Cu}(\text{NO}_3)_2$ contains NO_3^- radical with charge of -1

(01 mark)

$$\text{Cu} + (-1 \times 2) = 0$$

$$\text{Cu} = +2$$

The oxidation state of Cu = +2

(01 mark)

- Required to find oxidation state of Carbon (C) in $(\text{NH}_4)_2\text{CO}_3$

$(\text{NH}_4)_2\text{CO}_3$ contain NH_4^+ radical with charge of +1

(01 mark)

$$\text{C} + (-2 \times 3) + (+1 \times 2) = 0$$

$$\text{C} + (-6) + (+2) = 0$$

$$\text{C} = +6 - 2$$

The oxidation state of C = +4

(01 mark)

SECTION C (15 Marks)

10. (a)

<i>Element</i>	A	B	C	D
<i>Atomic number</i>	6	11	19	16
<i>Number of protons</i>	6	11	19	16
<i>Number of neutrons</i>	6	12	20	16
<i>Mass number</i>	12	23	39	32
<i>Electronic configuration</i>	2:4	2:8:1	2:8:8:1	2:8:6

(@00 $\frac{1}{2}$ = 06 marks)

(b) Elements B and C are metallic in nature.

(02 marks)

(c)

<i>Element</i>	A	B	C	D
<i>Valency</i>	4	1	1	2

(@00 $\frac{1}{2}$ = 02 marks)

(d) C₂D

(02 marks)

(e) The compound in (d) above it is ionic compound.

(02 marks)

This is because;

- The compound is formed between a metal (element C) and a non-metal (element D).
- The compound is formed by transferring of electrons from atom of a metal (element C) to atom of a non-metal (element D).

(01 mark)

XXX --- THE END --- XXX

BY: MWANDA. A.J

Email: dottoalphonce@gmail.com

Phone: + 255 767 660 163