

SECTION A – Answer ALL questions. This section carries 60 marks.

1 Fill in the blanks using appropriate terms:

- Our atmosphere consists of a _____ of gases. The most abundant gas in the atmosphere is _____ which comprises approximately _____ per cent of the total.
- _____ comprises approximately 21 per cent. When a substance burns in air, one of the products formed is always an _____.
- The atmosphere also contains small amounts of other gases. One of the gases present in small amounts is _____ which is slightly soluble in water forming an acidic solution. The amount of this gas in the atmosphere has been on the increase in the past years due to the excessive use of fossil fuels. It is known as a _____ and is considered as the main culprit responsible for global warming.
- When a fossil fuel burns, other pollutant gases are formed. One of these is _____ which dissolves in rainwater to form sulfurous acid.
- Car engines emit other pollutant gases such as nitrogen oxides. The exhaust systems of modern vehicles are fitted with _____ in which harmful emissions are converted into _____.

[10]

2 Hydrogen is considered a possible alternative to fossil fuels and its use in cars, boats and aeroplanes will unquestionably be a major step forward in the world of technology. However, hydrogen is not readily available in nature.

- a. (i) Give the names of any **two** compounds, each of which contains hydrogen as one of its constituent elements.

- (ii) Give the names of any **two** substances that can be reacted together in the laboratory to produce hydrogen.

[4]

- b. (i) Hydrogen is an eco-friendly fuel. Suggest **one** reason for this.

- (ii) Name **one** disadvantage of using hydrogen as a fuel.

[2]

c. Hydrogen is used in the laboratory to reduce copper (II) oxide to copper metal.

- (i) Write down a word equation to represent this reaction.

- (ii) Give **one** observation that shows that the copper (II) oxide has been reduced to copper.

[2]

d. Besides the possible future use of hydrogen as a fuel, give **two** other industrial uses for hydrogen.

[2]

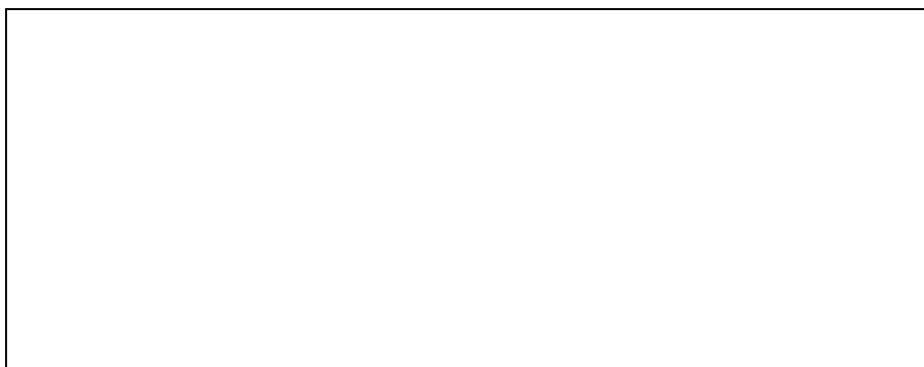
3a. An oxygen molecule comprises two oxygen atoms held together by a pair of covalent bonds.

(i) What do you understand by covalent bonding?

(ii) Give the name of a substance whose molecule is composed of:

- two atoms held together by one single covalent bond _____
- three atoms held together by two single covalent bonds _____

(iii) Draw a dot-and-cross diagram showing **all** electron shells to represent an oxygen molecule.
(Atomic number of oxygen: 8)



[7]

b. Magnesium metal burns in air when ignited to form magnesium oxide which is an ionic compound. Draw a dot-and-cross diagram showing **all** electron shells to show the bonding in magnesium oxide. (Atomic number of oxygen: 8; atomic number of magnesium: 12)



[3]

4a. Both magnesium and sulfur react with oxygen to form compounds. Fill in the table below.

	Reaction A: Magnesium + Oxygen	Reaction B: Sulfur + Oxygen
Balanced chemical equation including state symbols		
One observation for each reaction		

[6]

b. The product of Reaction A is different from the product of Reaction B. Give **two properties** of each product that show this difference.

	Product of Reaction A	Product of Reaction B
1.		
2.		

[4]

5a. Hydrogen and oxygen react together under suitable conditions to produce water. Write a balanced chemical equation for this reaction, including state symbols.

_____ [2]

b. (i) Tap water flowing through iron pipes may contain solid rust particles. Name the method you can use to remove these particles from a sample of water. _____

(ii) Tap water also contains dissolved solids. Name **one** method by which **all** dissolved solids may be removed. _____

(iii) Give the **name** and **formula** of the compound that is primarily responsible for temporary hardness of tap water in Malta.

Name: _____ Formula: _____ [4]

c. Using temporary hard water has both advantages and disadvantages. Fill in the table below giving two advantages and two disadvantages:

	Advantages of using temporary hard water	Disadvantages of using temporary hard water
1.		
2.		

[4]

6a. The base of a freshly-polished copper pot turned black when the pot was accidentally left unfilled on a burning gas stove.

(i) Explain what has happened to the base of the pot as it was exposed to the burning stove.

(ii) Write a chemical equation, including state symbols, to represent what has happened.

[3]

b. It was decided to clean the black base of the copper pot using a basic laboratory reagent that would dissolve the black layer without damaging the pot.

(i) Suggest a name of a suitable reagent. _____

(ii) Explain why the reagent you chose is suitable.

(iii) Write a chemical equation, including state symbols, to represent the reaction between the reagent you chose and the black layer.

[5]

c. Drops of the reagent used in question b. were spilt on the marble top of the kitchen cupboard.

(i) Which of the following materials found in the kitchen can be used to neutralize the effect of the reagent?

vinegar ☐

(contains ethanoic acid)

flour ☐

baking powder ☐

(contains sodium hydrogencarbonate)

(ii) Suggest a reason for your answer to question c. (i).

[2]

SECTION B – Answer TWO questions only on the foolscap provided.
This section carries 40 marks.

7 The following substances are basic reagents that are often used in the preparation of salts:

sodium metal, dilute hydrochloric acid, sodium hydroxide solution,
dilute sulfuric acid, calcium chloride solution, potassium carbonate solution.

- a. (i) Choose **two** substances from the list that can be reacted together safely to produce sodium sulfate.
- (ii) Describe an experiment that you can carry out in the laboratory to prepare dry crystals of sodium sulfate using the reagents you chose in question a. (i).

Your description must include:

- an appropriate method that can be used to prepare a fairly-pure sample of the crystalline solid.
- labelled diagrams that show the important steps to be followed in the method.
- a balanced chemical equation for the reaction. Include state symbols.

[16]

- b. (i) The salt calcium carbonate can be prepared by precipitation. Which **two** substances from the list can be used to prepare a sample of calcium carbonate?

(ii) Write a balanced chemical equation for the reaction. Include state symbols.

[4]

- 8 A laboratory technician weighed **3.175 g** of copper filings and placed them inside a silica tube. A stream of oxygen was passed over the copper while the silica tube was strongly heated. This was continued until **all** the copper reacted with the oxygen. After the apparatus cooled, the product was reweighed and its mass found to be **3.975 g**.

Relative Atomic Masses: Oxygen = 16; Copper = 64.

- a. (i) Give the name of the apparatus the technician used to weigh the copper filings.
- (ii) What colour change to the copper filings would you observe as the experiment proceeds?
- (iii) What is the chemical name of the product formed?

[3]

- b. (i) Find the mass of oxygen that reacted with the copper.
- (ii) Find the number of moles of:

- copper that reacted with the oxygen
- oxygen that reacted with the copper

(iii) Write down the empirical formula of the product.

[7]

- c. Red copper oxide is different from the product prepared in this experiment. Its percentage composition by mass is:

Copper: 88.8%

Oxygen: 11.2%

Use this information to deduce the empirical formula of red copper oxide.

All necessary calculations must be shown.

[10]

- 9 A solid white mixture is composed of three chemicals:

Calcium chloride,

ammonium chloride,

lead (II) chloride.

Information about these chemicals is found in the table below:

Name	Colour	Toxic	Solubility in Water	Action of heat
calcium chloride	white	no	yes	does not decompose
ammonium chloride	white	no	yes	sublimes
lead (II) chloride	white	yes	no	does not decompose

- a. Use the information in the table to design an appropriate experimental method that you may carry out in the laboratory to remove the ammonium chloride from the rest of the mixture. A **labelled diagram** and an **explanation** that show the appropriate technique used are required.

[10]

- b. Once the ammonium chloride was removed, the resulting mixture contains calcium chloride and lead (II) chloride. Describe laboratory techniques that may be used to obtain a sample of **dry calcium chloride** from the mixture.

A **labelled diagram** and an **explanation** that show the appropriate techniques used are required.

[10]