

PENANG SANGAM HIGH SCHOOL
P.O.BOX 44, RAKIRAKI

LESSON NOTES

Year/Level: 11 C/D

week 22

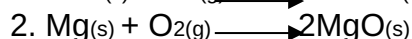
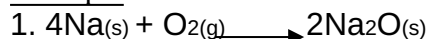
Subject: Chemistry

Strand	4 Materials
Sub Strand	4.2 oxides of metals and non-metals
Content Learning Outcome	<ul style="list-style-type: none">✓ Work out and write the names and formulae of oxides of metals and non-metals✓ Describe the properties of metallic oxides and non-metallic oxides with balanced equations considering the type of bonding in them✓ State the sources and properties of the oxides found in the atmosphere✓ Describe the effect of carbon monoxide on human beings

METAL OXIDES

- Metals react with oxygen to form metal oxides
- Rusting** is the common name for the slow oxidation of iron. The slow oxidation of other metals is called **corrosion**
- Metal oxides are ionic compound thus having ionic bond which holds the metal ion and the oxide ion.
- The ionic bond is the result of the transfer of electrons from the metal to oxygen.

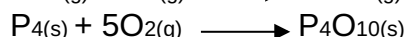
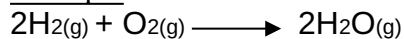
Example



NON-METAL OXIDES

- Oxides of non-metals are covalent compound formed when non-metals burn in oxygen.
- The covalent bond is formed from the non-metal and oxygen sharing electrons.

Example



Names and Formulas

Metal Oxides

Name	Formula	State	Colour	Solubility in water
Sodium oxide	Na ₂ O	Solid	White	Soluble
Magnesium oxide	MgO	Solid	White	Soluble

Calcium oxide	CaO	Solid	White	Soluble
Aluminium oxide	Al ₂ O ₃	Solid	White	Soluble
Copper oxide	CuO	Solid	Black	Soluble
Zinc oxide	ZnO	Solid	White	Soluble
Iron oxide	Fe ₂ O ₃	Solid	Red brown	Soluble
Lead oxide	PbO	Solid	Yellow	Soluble

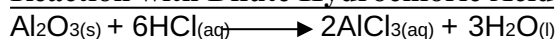
Reaction with Water

- Only highly reactive metal oxides react with water to produce metal hydroxides which are basic in nature.
- Metal oxides turn moist red litmus paper blue confirming that they are basic in nature.
- The less reactive metal oxides do not react with water but they can react with dilute hydrochloric acid to form metal chloride and water.
- There would be no change to the litmus paper since metal chloride and water are neutral.

Example



Reaction with Dilute Hydrochloric Acid



Non- Metal Oxides

Name	Formula	State	Colour	Solubility in water
Carbon monoxide	CO	Gas	Colorless	Soluble
Carbon dioxide	CO ₂	Gas	Colorless	Soluble
Sulphur dioxide	SO ₂	Gas	Colorless	Soluble
Sulphur trioxide	SO ₃	Gas	Colorless	Soluble
Nitrogen dioxide	NO ₂	Gas	Colorless	Soluble
Phosphorous oxide	P ₄ O ₁₀	Solid	White	Soluble

- Non-metals oxides are acidic in nature because they react with water to form acidic solutions.
- It turns the blue litmus to red

Complete the table given below;

Non-metal oxide	Reaction with water	Acid produced
CO	$\text{CO}_{(g)} + \text{H}_2\text{O}_{(l)} \longrightarrow \text{HCOOH}_{(as)}$	Mechanic acid
CO₂		Carbonic acid
SO₂		Sulphuric acid
SO₃		Sulphurous acid
NO₂		Nitric acid
P₄O₁₀	$\text{P}_4\text{O}_{10(s)} + 6\text{H}_2\text{O}_{(l)} \longrightarrow 4\text{H}_3\text{PO}_{4(aq)}$	Phosphoric acid

Sources of Carbon and Sulphur Dioxide

Carbon dioxide gas (CO₂ (g)) is produced from:

1. Naturally by decomposition of dead plants and animals, respiration in all living organisms and volcanic eruption.
2. Combustion or burning of fossil fuels in cooking, vehicles and other machines, forest fire and any other fire

Sulphur dioxide gas ($SO_{2(g)}$) is produced from:

1. Industrial activity that processes materials that contain sulphur, e.g. the generation of electricity from coal, oil or gas that contains sulphur.
2. Mineral ores also contain sulphur
3. Industrial activities that burn fossil fuels containing sulphur can be important sources of sulphur dioxide.
4. Motor vehicle emissions contain sulphur dioxide as the result of fuel combustion.

Effect of CO_2 gas on the Environment

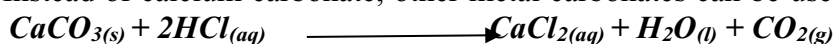
- Carbondioxide is used by the plants for photosynthesis
- Rise in sea level- the ice in the north and south pole are melting, this has increased the water level and many small atolls like Tuvalu and Kiribati are getting under water
- Change in world weather pattern- some areas are experiencing drought while others have flooding

Effect of SO_2 gas on the Environment

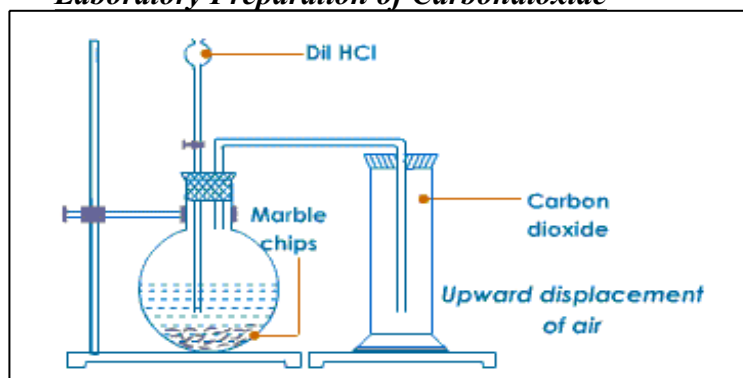
- Sulphur dioxide gas reacts with water vapour in the atmosphere to form sulphurous acid.
- This acid falls with rain as acid rain and is harmful to the plant growth and animal survival.

Preparation of Carbon Dioxide

Carbon dioxide can be prepared by adding dilute hydrochloric acid to calcium carbonate or marble chips. Instead of calcium carbonate, other metal carbonates can be used.

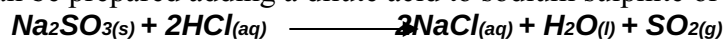


Laboratory Preparation of Carbondioxide

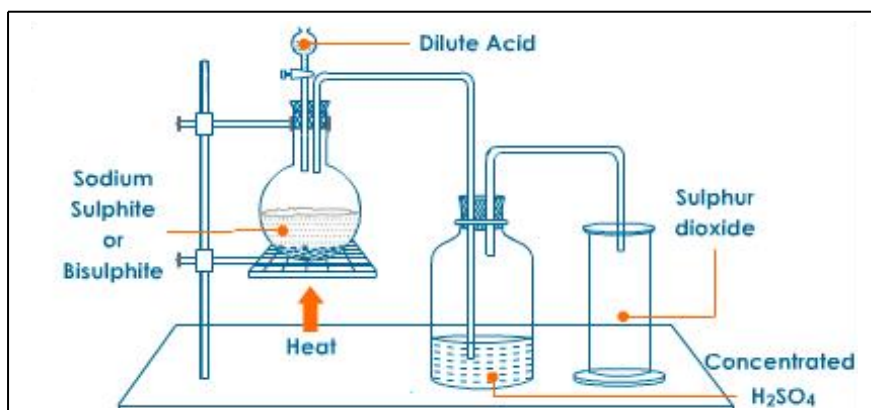


Preparation of Sulphur Dioxide

Sulphur dioxide can be prepared adding a dilute acid to sodium sulphite or Bisulphite



Laboratory preparation of sulphur dioxide



Comparison of Carbon Dioxide and Sulphur Dioxide

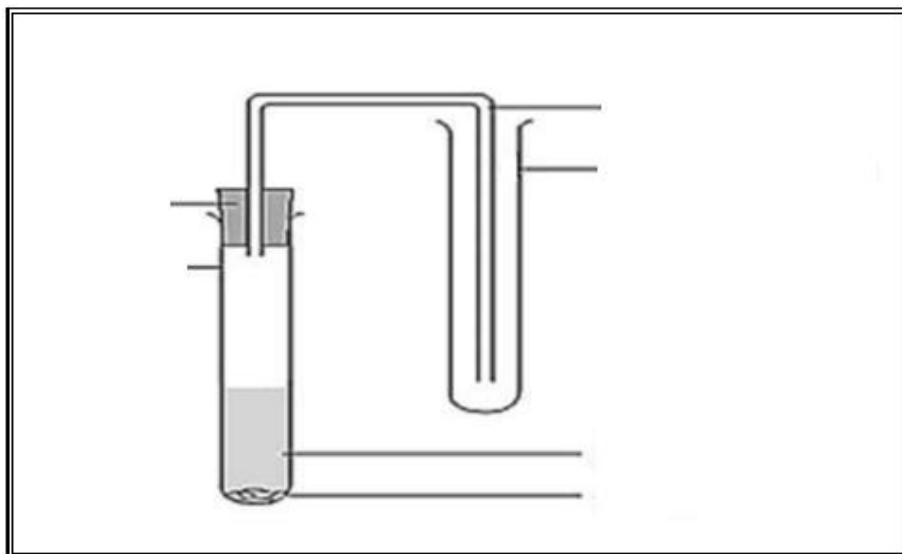
Properties	Carbon Dioxide	Sulphur Dioxide
Colour	Colourless	Colourless
State	Gas	Gas
Density	1.97kgm ⁻³ Heavier than air (1.29kgm ⁻³) so can be collected by upward displacement of air.	1.43kgm ⁻³ Heavier than air so can be collected by upward displacement of air.
Reaction with water	$\text{CO}_2 (\text{g}) + \text{H}_2\text{O} (\text{l}) \rightarrow \text{H}_2\text{CO}_3 (\text{aq})$	$\text{SO}_2 (\text{g}) + \text{H}_2\text{O} (\text{l}) \rightarrow \text{H}_2\text{SO}_3 (\text{aq})$
Reaction with sodium hydroxide	$2\text{NaOH} + \text{CO}_2 \rightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O}$	$2\text{NaOH} + \text{SO}_2 \rightarrow \text{Na}_2\text{SO}_3 + \text{H}_2\text{O}$
Effects on wet litmus paper	Turns damp blue litmus paper red showing acidic property.	Turns damp blue litmus paper red showing acidic property.
Test	Bubble CO ₂ gas in limewater, it turns milky.	Freshly made orange potassium dichromate solution turns green.
Uses	In carbonated beverages. Fire Extinguishers	Sulphur dioxide is a reducing agent and is used for bleaching and as a fumigant and food preservative.

Poisonous Nature of Carbon Monoxide

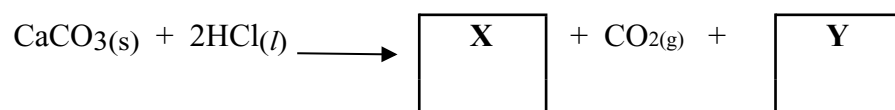
- Carbon monoxide (CO) is produced by the incomplete combustion of fuel.
- CO binds very strongly to the iron in haemoglobin (red blood pigment that carries oxygen). Once carbon monoxide attaches, it is very difficult to be released. If one breathes in carbon monoxide, CO sticks to the haemoglobin and takes up all of the oxygen binding sites. As a result the blood loses all of its ability to transport oxygen, hence a person suffocates.
- Since CO binds to haemoglobin so strongly, a person can be poisoned by carbon monoxide even at very low concentrations if one is exposed for a long period of time. Carbon monoxide is produced by cars, gas appliances, wood stoves and cigarettes.

ACTIVITY

1. The diagram given below shows the set-up for the preparation of carbon dioxide gas. Use this diagram to answer the questions that follow.



- (i) Why is carbon dioxide gas collected by upward displacement of air?
Identify the products **X** and **Y** in the equation given below:



- (iii) Describe the test for the presence of carbon dioxide gas.

2. Write the equations of the following oxides with dilute hydrochloric acid

- a. CuO b. ZnO c. Fe₂O₃ d. PbO