ASPIRE
INTERNATIONAL SCHOOL

Science Department

2023/2024

Year 7

Term 2, Revision Pack (Unit 8)

Name: …….

Class: ……

Unit 8: Changes to materials

8.1 Simple chemical reactions

We can describe a material using either its physical or chemical properties

Examples of physical properties:

Colour – Size – Shape – State of matter – Melting or boiling point – Mass

Examples of chemical properties:

acidic or alkaline – Rection with water, acids or metals – How readily it reacts

Physical change (Temporary)	Chemical change (Permanent)
Can be reversed	Can't be reversed
No new material is formed	New material is formed
Examples - Changes in the state (Melting, freezing, Boiling, evaporating and condensing could be changed back by cooling or heating) - Dissolving (The solute can be recovered by evaporation)	Examples - Heating (or cooking) - Burning - Rusting of metals - Mixing some materials & observing evidence like fizzes, a change in temperature, a change in colour

Examples of chemical reactions:

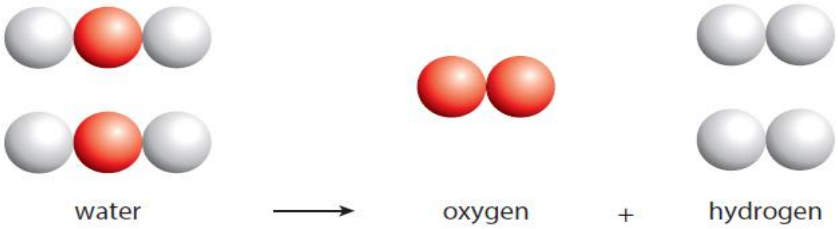
1- When iron and sulfur are heated together, they form a new substance (a compound called iron sulfide).

The iron and the sulfur have reacted together to form a new substance.
A **chemical reaction** has taken place. The iron atoms have combined and bonded with the sulfur atoms.

Reactants: Iron and Sulfur
Product: Iron sulfide

Note:
The reactants are the substances that react together.
The products are the new substances made in the reaction.

2- In some chemical reactions, a substance breaks apart to make new substances. For example, water can be split apart to form oxygen and hydrogen.



Other examples of chemical reactions:

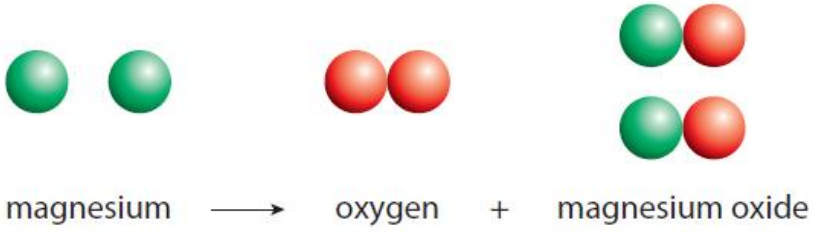
- Photosynthesis
- Digestion
- Respiration
- Growth and decaying of living things

Burning

Burning is a chemical reaction.
When a substance burns, the substance reacts with the oxygen in the air. Sometimes ashes are formed which contain new substances that are oxides.

- Charcoal is made up of the element carbon. When carbon burns it combines with oxygen in the air to make the gas carbon dioxide.

- When magnesium metal is burnt, a white powder is formed. This powder is magnesium oxide (a new substance has been formed).
(Magnesium and oxygen are the reactants while Magnesium oxide is the product).



- **The properties of the product are different from those of the reactants.**

	Reactants		Product
	magnesium	oxygen	magnesium oxide
Element or compound?	element	element	compound
State at room temperature	solid	gas	solid
Appearance	soft, shiny, malleable	colourless, has no smell	white, powdery
Conducts electricity?	yes	no	no
Melting point in °C	651	– 214	2800

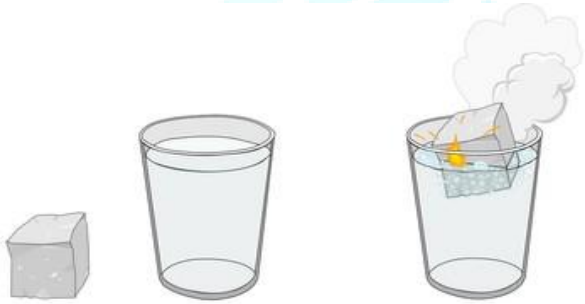
Reactions with water

Some substances react very violently with water. Some substances do not react with water at all.

Potassium (a metal) is very soft and can be cut with a knife. **This is a physical property**.

Potassium is so reactive that it has to be stored under oil to prevent it from reacting with the water vapour in the air. **This is a chemical property**.

When a very small piece of potassium is placed in a large trough of water, hydrogen gas is given off. The reaction produces so much heat that the gas burns.



$$2K + 2H_2O \rightarrow 2KOH + H_2$$

Reactions with acid

When magnesium is placed in hydrochloric acid, gas bubbles are given off.
The magnesium has reacted with the hydrochloric acid and formed new substances.
The gas is hydrogen, and magnesium chloride has been formed.
This is a chemical property of magnesium.

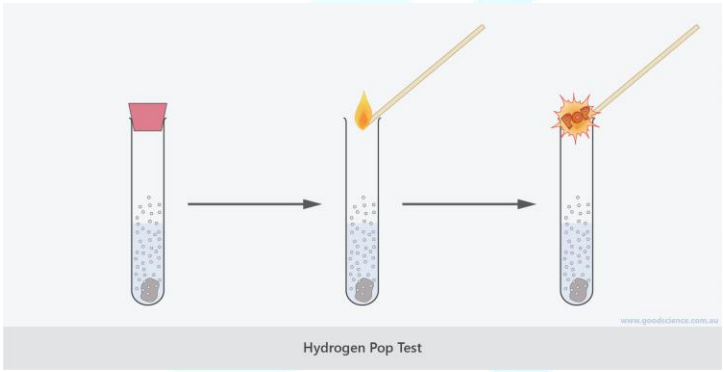
Note: when you see bubbles forming in a reaction, you know that a gas is being produced. But you cannot tell what **type** of gas it is.

Test the gas to find out if it is hydrogen. (Hydrogen gas burns with a squeaky pop).

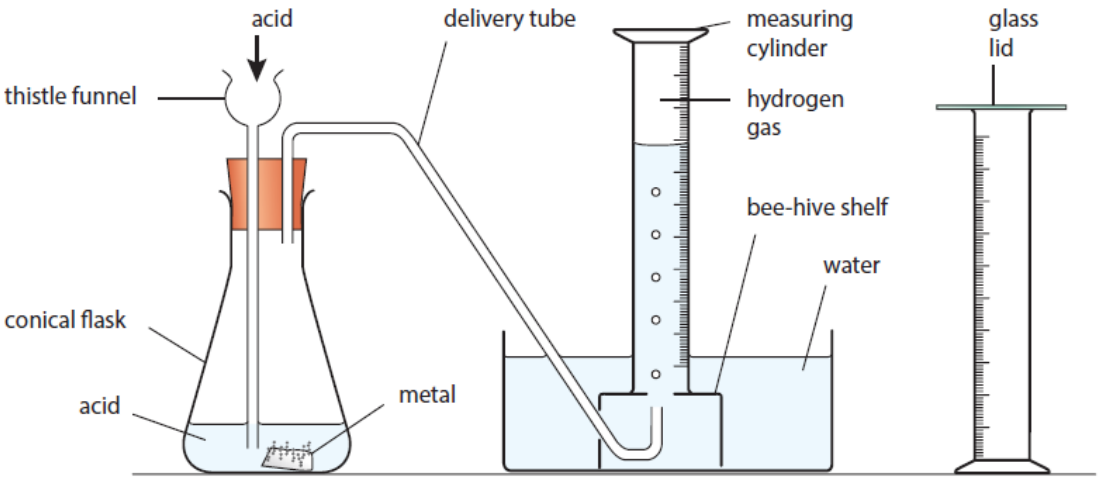
To carry out the test

1- Keep your finger over the end of the test tube until the last moment or you will have no hydrogen left to test. This is because hydrogen gas is lighter than air.
2- light a splint and place it in the mouth of the test tube.

When the hydrogen pops, it reacts with oxygen, in the air, to form water.



Hydrogen can be produced on a larger scale by collecting the gas produced in the reaction over water, as shown in this diagram.

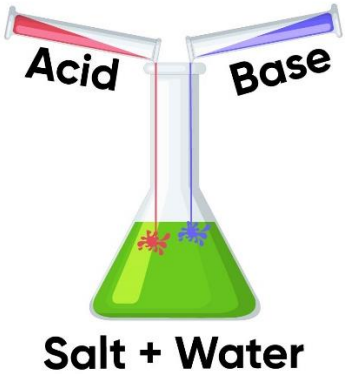


8.2 Neutralisation

When you mix acid and alkali, they react and make a neutral solution. This is called **neutralisation**. It's another chemical change. Neutrality is also a chemical property of a substance.

- If you add too much acid to an alkali, it makes an acidic liquid.
- If you add too little acid to an alkali, it stays as an alkaline liquid.

You can add the acid very slowly, adding a few drops at a time which makes it easier to judge exactly when it becomes neutral.



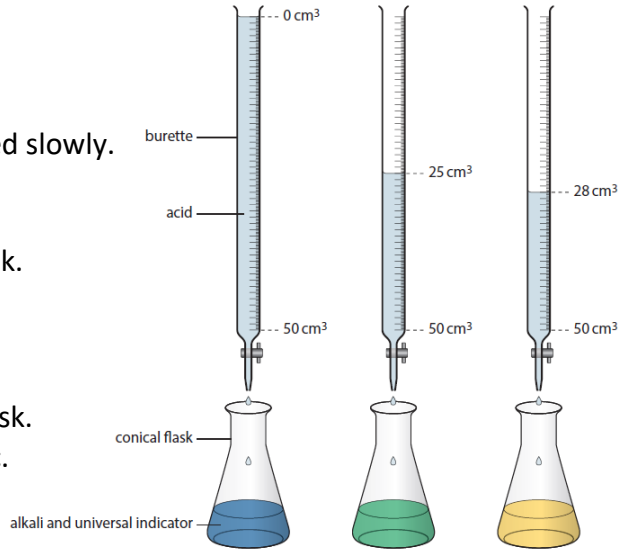
Making a neutral solution

You can use a special piece of equipment called a **burette** to neutralize an alkali very accurately. You add the universal indicator to the alkali in the flask to know when it reaches neutrality.

In the first flask, the pH in the flask is about 13.
As the acid is added, the pH becomes lower. The acid is added slowly.
The flask is shaken each time some acid is added.

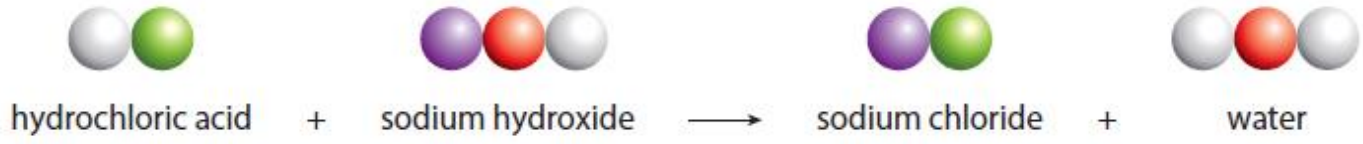
In the second flask, 25 cm_3 of acid has been added to the flask.
The pH in the flask is now 7. The liquid is now neutral.
(The acid has reacted with the alkali and **neutralised** it).

In the third flask, a little more acid has been added to the flask.
The pH in the flask is now about 6. The liquid is weakly acidic.



Using a burette to add acid to a flask of alkali.

That was a chemical reaction and new substances were formed. If you use hydrochloric acid and sodium hydroxide (an alkali), these are the reactants. When they react together, the products that form are sodium chloride and water.



Rainbow neutralisation:

To demonstrate the different colours shown by the universal indicator do the following steps:

1- Fix a test tube into a clamp stand and place it somewhere it will not get moved.
2- Place a crystal of washing soda in the bottom of a test tube.
3- Carefully add some water until the tube is about two-thirds full.
4- Add a few drops of universal indicator.
5- Carefully pour some acid on the top. Do not shake the tube.
6- Leave the tube to stand for a few days.

How does the rainbow appear?

At the top of the test tube

-The acid has turned the universal indicator red at the top of the tube. This shows it is strongly acidic.
-The acid particles gradually move down the tube and mix with more water and the universal indicator turns yellow. This is more weakly acidic.

In the middle of the test tube

-The acid and the washing soda solution mix and react together.
The universal indicator is yellow.
The washing soda solution and acid have neutralised each other.

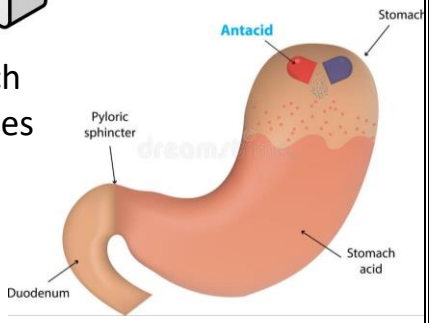
At the bottom of the test tube

-The washing soda has dissolved in the water around it. The universal indicator is purple or dark blue around the washing soda, as it's a strong alkali.
-The particles of the washing soda gradually move up the test tube and mix with more water and the universal indicator turns a lighter blue. This shows it is more weakly alkaline.

Neutralisation in everyday life

1- Indigestion

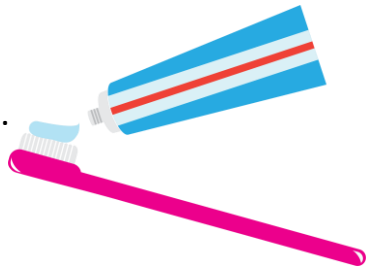
Your stomach produces hydrochloric acid. This acid gives the stomach the right conditions to **digest** your food. When your stomach produces too much acid, you have **indigestion**. It can be very uncomfortable.



Many medicines can help. They are all alkalis and they neutralise the acid. Sometimes these medicines are called antacids.

2- Toothpaste

Toothpaste contains alkali which helps to neutralise the acid that is produced from the feeding of bacteria on the left food in your mouth. This acid damages your teeth and makes them **decay**.



3- Growing crops

In some areas, the soil is very acidic and plants do not grow well. Farmers spread lime on the soil to neutralize the acid so that the plants can grow better.

4- Neutralising lakes

In some parts of the world, there are harmful chemicals in the air that make the rain acidic. This acid rain damages trees and changes the pH of the lakes, rivers and ponds, so plants and animals that live in the lakes cannot live in acid conditions. Some countries drop alkalis into the lakes to neutralise the acid.

8.3 Investigating acids and alkalis

To investigate any concept:

1- Ask an accurate question
2- Plan your investigation (Fair test)
3- Check the results and state a conclusion

- Asking questions

The scientific question has to be specific (precise).
For example:

- Which is the best indigestion **remedy** (treatment for an illness or injury)?
- It is not a very precise question. What does 'best' mean?
  Does 'best' mean the most pleasant tasting, the cheapest, the most effective or the most cost-effective?

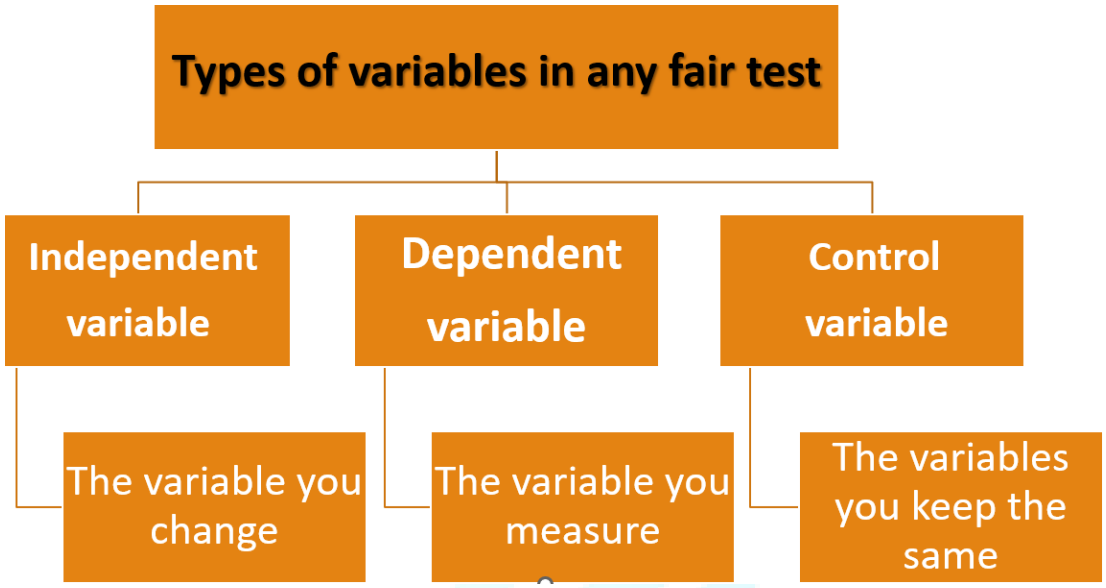
The previous question may change to 'Which indigestion powder neutralises the acid, using the least amount of powder?'

- Planning an investigation

- You have to think about:

1- How to make your experiment a fair test?
2- What will you test (change)?
3- What will you keep the same?
4- What will you measure?
5- How to keep yourself safe?
6- What are the required tools?

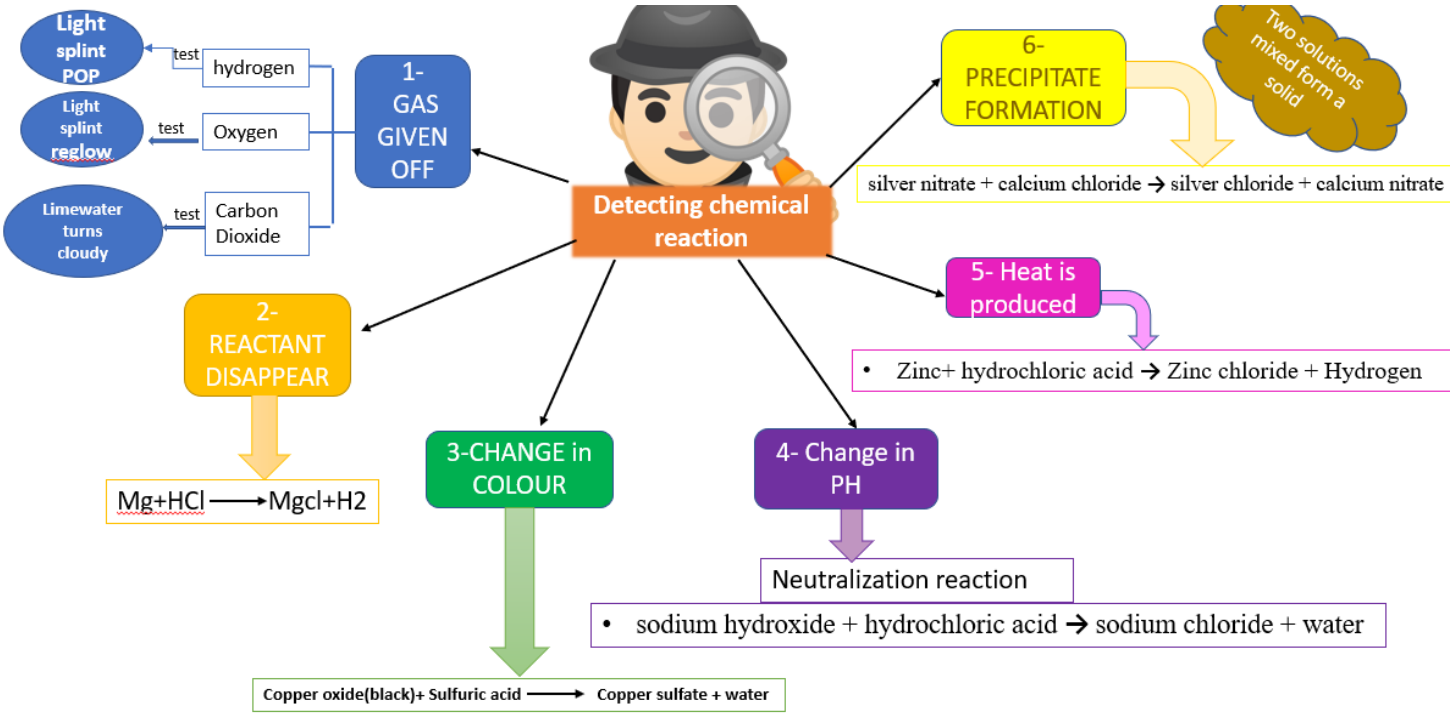
❖ In any investigation choose suitable safety precautions such as: (thermal gloves or tongs with heat, face musk with gases, goggles, lab coat,……..)



Frequently asked questions:

- **Why do we have a control variable? / Why do we use the same (time/amount/volume/….) of ……..**
  - To make it a fair test.
- **How can we make sure that we are making a fair test?**
  - Keep all variables the same except the independent variable.
- **Why do we need to repeat the test?**
  - To make sure our results are reliable.
- **What do we need to do to make sure our results are reliable and accurate?**
  - Repeat the test.
- **What is an anomalous (anonymous) result?**
  - It's a result that doesn't fit the pattern.
- **What should you do about it?**
  - Ignore it and repeat the investigation.
- **Should you include the anomalous 'wrong' result when working out the mean?**
  - No, ignore it and calculate the mean.

8.4 Detecting chemical reactions



Some signs of chemical reactions:

1- Gas is given off
2- Reactant disappear
3- Change in colour
4- Change in PH
5- Heat is produced
6- Precipitate formation.

1- Gas is given off:

- Bubbles can be seen
- More bubbles indicate a faster reaction
- When the bubbles stop, this means the reaction has ended.
- Types of gas given off in a chemical reaction:

a) Hydrogen:

- **Example:**

Zinc+ Hydrochloric acid ⟶ Zinc chloride + Hydrogen

Magnesium + water ⟶ Magnesium Hydroxide + Hydrogen

- Test: **Light splint** that produces a **squeaky pop**

b) Oxygen

- **Example:**

Hydrogen peroxide and a piece of apple produce bubbles of oxygen

- Test: **Glowing splint** that **relight**

c) Carbon dioxide:

- **Example:**

Vinegar and baking soda produce bubbles of carbon dioxide

- Test: adding **Limewater** turns **Cloudy.**

2- Reactant 'disappears'

- When the magnesium ribbon reacts with acid, hydrogen is produced and the magnesium ribbon 'disappears'. The magnesium is used up in the reaction; it combines with the chlorine from the hydrochloric acid to form magnesium chloride.

3- Colour change

copper oxide (black) + sulfuric acid ⟶ copper sulfate (blue) + water

Safety:

Do not boil the blue liquid, as harmful fumes will be given off.

4- Heat is produced:

- When potassium is placed in water, hydrogen gas is given off. The reaction produces so much heat the hydrogen burns.
- When you added zinc to hydrochloric acid, hydrogen gas was given off and the test tube felt hot.

Safety:

These reactions should only be done by a teacher.

5- Change in pH:

When you neutralise an alkali, there is a change in PH. It is called a neutralisation reaction.

sodium hydroxide + hydrochloric acid → sodium chloride + water

6- A precipitate is formed:

When the two solutions (liquids) are mixed, a solid is formed. This solid is called a **precipitate**

silver nitrate + calcium chloride → silver chloride + calcium nitrate

(liquid) (liquid) (solid)

Note:

The chemical reaction is getting faster when using a concentrated acid or warming the reactants, as there are less spaces between the particles, so they collide (hit each other while moving).