S2 Science

Acids and Metals

Name: _____ Form Class: _____

Science Teacher: _____

Contents:

Success Criteria

Level	Success Criteria - Acids	
3	List some uses of the three most common laboratory acids	
3	Describe how the strengths of acids and alkalis can be measured	
3	Some substances are not acids; they can be alkalis or neutral substances	
3	Give examples of pH values for some common household substances	
3	Give some examples of substances which can be used as indicators	
3	Explain what causes acid rain and describe the effects of acid rain	
3	Explain what a dilution is	
3	Explain what a neutralisation reaction is	

Level	Success Criteria - Metals	
2	I can list some properties of metals	
2	I can select the best use for a metal based on it's properties	
3	I can experiment with metals and water, acid and oxygen to place them in a Reactivity Series.	
3	I know that metals will produce a gas if they react with water or acid and that this gas is hydrogen	
3	I know the test for hydrogen gas	
3	I understand how the reactivity of a metal is related to how it is extracted from its ore.	
3	I can describe how to extract metals from their ores.	

Summary Notes

Working with Acids

☐ Acids and Alkali's are chemical substances which are found in the school lab but also in your home!
Some examples are shown in the table

Laboratory acids	hydrochloric acid sulfuric acid nitric acid.
Household acids	Vinegar lemon juice lemonade soda water coca cola.
Laboratory alkalis	sodium hydroxide potassium hydroxide lime water
Household alkalis	baking soda oven cleaner dishwater powder indigestion tablets bleach

☐ Care must always be taken even when using **dilute** acids and alkalis and safety goggles must always be worn; alkalis can be particularly damaging to your eyes.

☐ Acids and alkalis have HAZARD labels on them to warn you about the risks when working with them. You may find the following hazard label on a bottle of acid or alkali:

Hazard symbol	Name of hazard symbol	Meaning
 It also sometimes looks like this 	**Irritant**	These substances may cause reddening of the skin (but are not corrosive) May irritate eyes and lungs
	**Corrosive**	These substances burn living tissues, including eyes and skin. And can wear away solids

Uses of acids and alkalis

☐ Many acids and alkalis are very useful in making products that we depend on such as paint, dye, shampoo, fertilisers and cleaning products. They can also be used to help deal with problems caused by acids and alkalis such as indigestion, acid rain and tooth decay Examples of uses of laboratory acids and alkalis are shown in the table

Substance	acid or alkali	Use
Sulfuric acid	acid	used to make paints, dyes and shampoo
Nitric acid	acid	used to make fertilisers, explosives, dyes and medicines

Hydrochloric acid	acid	is used to make dyes and remove rust from metals.
Sodium Hydroxide	alkali	is used to make cleaning products such as oven cleaner and in the manufacture of soap
Potassium Hydroxide	alkali	Is used in the same was as sodium hydroxide and is also used to make fertilisers

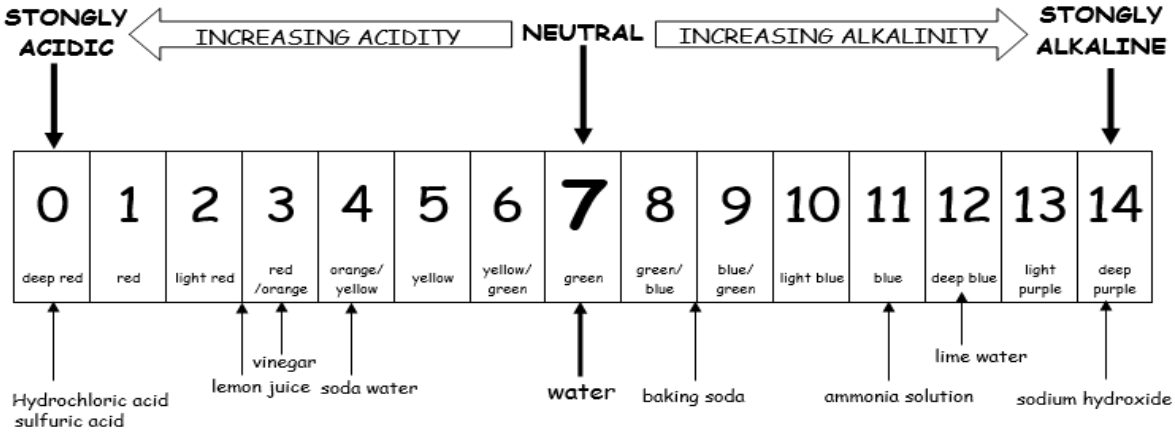
Indicators

- An INDICATOR is a substance that is a different colour in acids than it is in alkalis and allows us to tell them apart.
- An example of an indicator is **litmus**. This can be red, blue or sometimes purple.
- Some plants can be used as an INDICATOR - they will change different colours when they mix with acids or alkalis. Blackberry juice, beetroot, chrysanthemum flowers, red cabbage and tea can all be used as an indicator.

The pH Scale

- UNIVERSAL INDICATOR or pH paper is a mixture of lots of indicators and can also tell us <u>how</u> acidic or alkaline a substance is by using a pH scale to compare the colour. We can also use a pH meter
- The pH scale is numbered from 0 to 14 and to measure how acid/alkali something is and each pH number has a colour.

- Acids have a pH number less than 7
  - The lower the pH, the greater the acidity
- Alkalis have a pH number greater than 7
  - The higher the pH the greater the alkalinity
- Neutral substances have a pH = 7
  - Pure water is an example of a neutral substance



Acids and Alkalis in the home

☐ Some acids are safe enough for you to eat and drink, but this does not stop them from being corrosive.

☐ The acid in foods and drinks can attack the enamel of your teeth making it softer and allowing it to be worn away more easily.

☐ Household cleaners often contain alkalis. These powerful alkalis also contain hazard warning symbols on the back; this shows people how to stay safe when they are being used!

Problems with Acids

☐ A bee sting is acidic. It has a pH of about 3.5. Wasp stings are alkaline, about pH 10. They need to be neutralised to reduce their effect on the skin.

☐ Some plants like to grow in a slightly alkaline soil and crops can fail if the pH is not right.

☐ Your stomach needs an acidic lining to help digestion, but too much acid can cause indigestion. Drinking too many fizzy drinks can leave an acidic solution in your mouth which can damage your tooth enamel.

☐ Rain water is naturally acidic because carbon dioxide in the air dissolves in it. Over the last 200 years our rainwater has become even more acidic, with the pH sometimes dropping as low as 3! This is mainly caused by air pollution from burning **fossil fuels**.

☐ Acid Rain is an environmental problem which can:

- damage buildings made from carbonate rocks (e.g. marble)
- corrode metals structures made of iron and steel (e.g. bridges)
- affect plant life by changing the pH of soil (e.g. less crops grown)
- affect animal life by changing the pH of rivers/lakes (e.g. kills fish)

carbon + oxygen $\xrightarrow{\text{burning}}$ carbon dioxide

sulphur + oxygen $\xrightarrow{\text{burning}}$ sulphur dioxide

nitrogen + oxygen $\xrightarrow{\text{spark}}$ nitrogen dioxide

} All dissolve in rain water to form acidic solutions

Reducing Acid Rain

Acid rain could be reduced if the gases that cause acid rain were reduced:

- *Carbon dioxide* is released when fossil fuels like coal, petrol and gas are burned
  - If we burn less fossil fuels, then less carbon dioxide will be released
- *Sulphur dioxide* is released when fossil fuels like coal are burned
  - Use low-sulphur fuels instead of high sulphur fuels
  - Remove sulphur dioxide fumes before release into atmosphere
- *Nitrogen dioxide* is produced in car engines by the sparking of air with petrol to set the petrol on fire.

☐ Fit catalytic converters to cars to remove nitrogen dioxide fumes from car exhaust fumes.

Dealing with problems of acids

We can get rid of too much acid or alkali by DILUTING or by a chemical reaction called NEUTRALISATION

Diluting **Acids**	(Acids have a pH less than 7)
Adding water to acids	decreases the acidity. Increases pH number until it reaches 7. pH number never goes above 7.
Diluting **Alkalis**	(Alkalis have a pH above 7)
Adding water to alkalis	decreases the alkalinity. Decreases pH number until it reaches 7. pH number never goes below 7.

When an acid and an alkali are mixed, a **chemical reaction** called **neutralisation** occurs and new substances are made. This chemical reaction is called neutralisation because the pH is moved closer to neutral pH 7, if exactly the right amounts of acid and alkali are reacted, the pH will be exactly pH7.

- Neutralisation moves the pH of the **acid** up towards 7.
- Neutralisation moves the pH of the **alkali** down towards 7.

Alkalis and **acids** *neutralise* each other to form **water** and a type of chemical called **salt**.

Everyday examples of neutralisation

- reducing soil acidity by adding limestone (an alkali)
- treating alkaline wasp stings with an acid like vinegar
- treatment of acid indigestion by indigestion tablets containing a bases such as magnesium carbonate

Metals

Properties of metals

Metals have properties that make them good for certain uses. Examples are shown below:

Property	**Use of metal**
low density	aluminium used in aircraft bodies
malleablity	shaping steel to make armour
thermal (heat) conductivity	iron metal in a wire gauze in tripod
electrical conductivity	copper wires in electrical devices
strength	iron used in a bridge

Reactivity series

Most metals are reactive. We can observe reactions of metals to put them in order of reactivity.

The observations are experiments from:

1. Reactions of metals with oxygen (from the air)

Metal oxides are produced in the reactions of metals with oxygen:

- potassium corrodes very quickly in air
- tin corrodes very slowly in air
- gold does not corrode in air

e.g. iron + oxygen → iron oxide

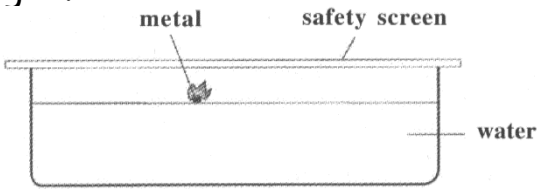
2. Reaction of metals with water

Reactions of metals with **water** produce hydrogen.

- Potassium
- Sodium
- Lithium

} vigorously react with water

- Calcium
- Magnesium very slowly reacts with water



The **test for hydrogen** is that it burns with a "pop".

3. Reactions of metals with acids

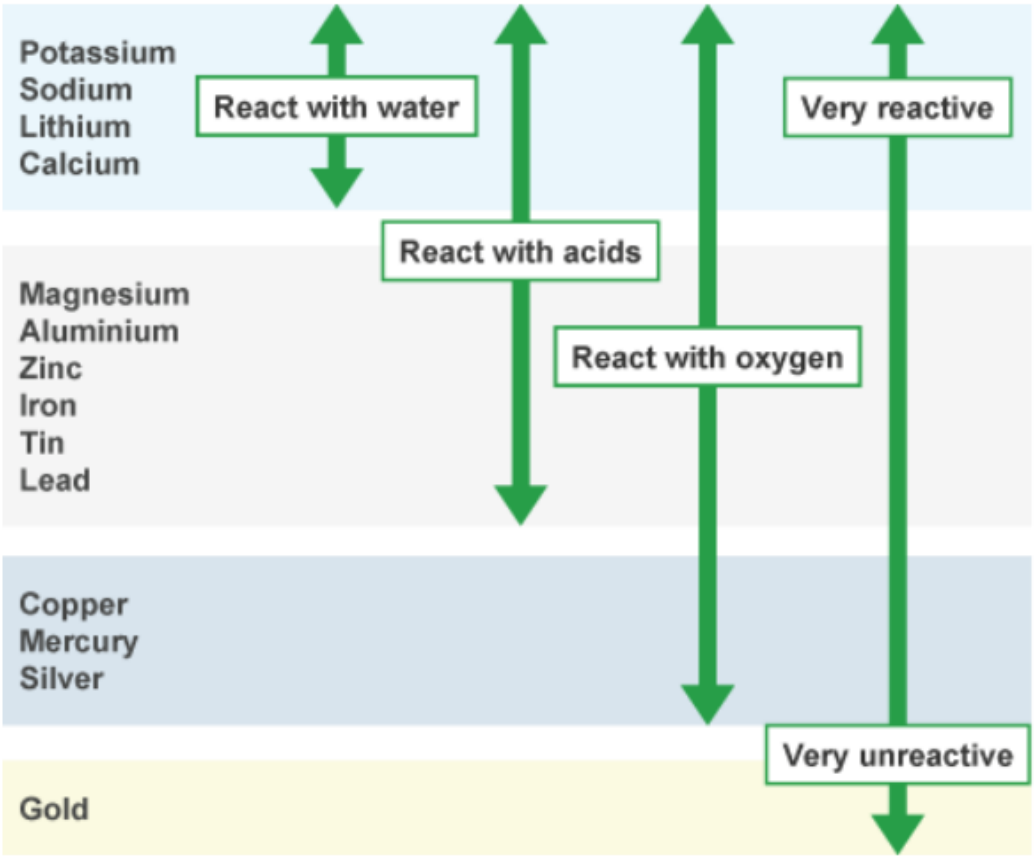
Reactions of metals with dilute **acid** produce a salt and hydrogen gas.

- Magnesium
- aluminium
- zinc
- tin
- lead

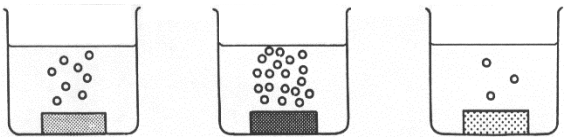
Unreactive metals do not react with oxygen, dilute acid or water

- silver
- gold
- platinum

A summary of this is show here:



Differences in the reactions give an indication of the **reactivity** of the metals.



Reactivity	Metal
most bubbles → most reactive	metal Y
medium reactivity	metal X
least bubbles → least reactive	metal Z

☐ Corrosion is another word for the metals reacting with oxygen to make oxides . Some metals do not corrode and stay shiny like gold and silver

We can write **word equations** to show this reaction

e.g. iron + oxygen → iron oxide

☐ More reactive metals corrode quicker than less reactive metals

☐ How reactive a metal is will decide if or how it can be used for a certain purpose and we can use this list to also help decide the best way of extracting a metal from its ore

☐ Most metals are found **combined** with other elements in rocks called **ores**. Some examples of metals and their ores are:

- Aluminum is found in an ore called bauxite
- Copper is found in an ore called pyrite
- Iron is found in an ore called hematite

☐ **Unreactive** metals are found **uncombined** in the Earth's crust and often don't need to be extracted:

- eg gold

☐ Some metals in the **middle** of the reactivity series are **extracted** from their ores by **heating with carbon**. This is done in a **blast furnace** in industry.

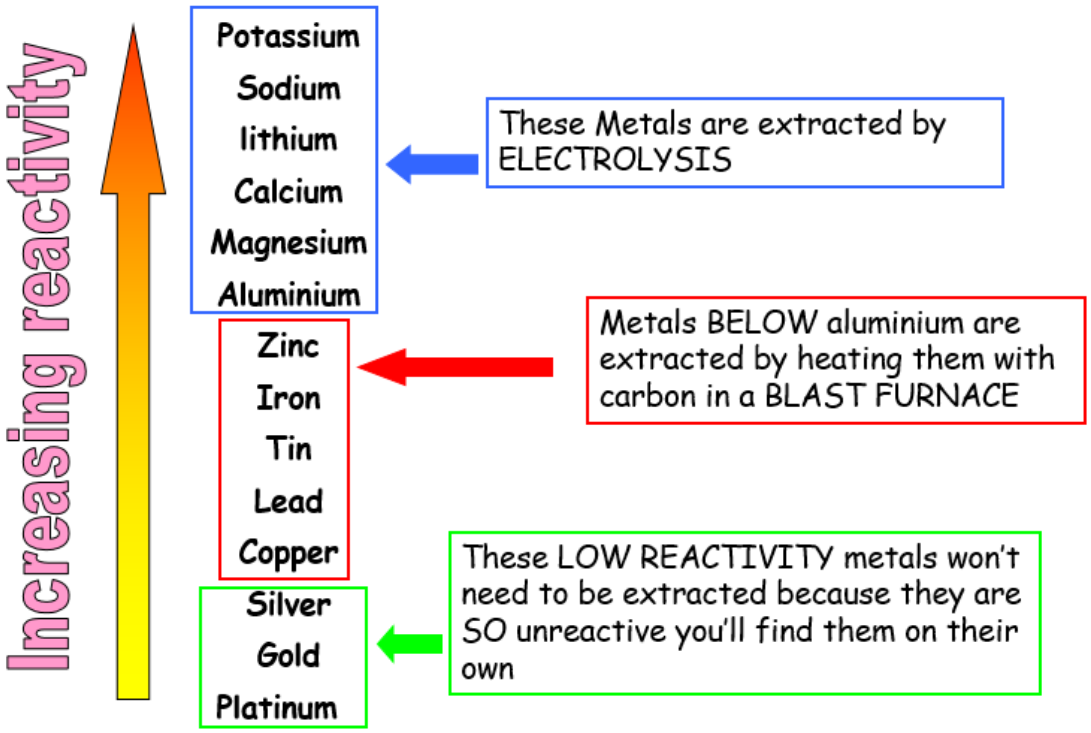
- eg Iron

☐ **Very reactive** metals are **extracted** from their ores using **electricity (electrolysis)**

- eg Aluminium

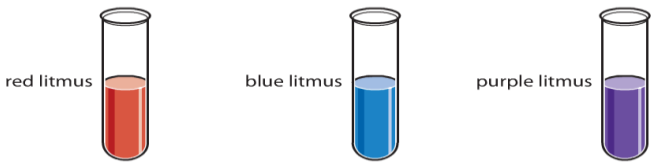
This is all summarized in the diagram:

Extraction from ores -How do we do it?



Homework

Homework 1 - Acids



1. Where are the two common places acids can be found?

_____

2. What is the name of the main substance used to measure the acidity of a substance?

_____

3. Colour in the pH scale below, using your jotter or the internet as a guide.

strong acid			weak acid			neutral	weak alkali			strong alkali			
1	2	3	4	5	6	7	8	9	10	11	12	13	14

stomach acid, vinegar, skin, pure water, indigestion powders, washing powder, oven cleaner

lemon juice, fizzy drinks, milk, blood, toothpaste

Homework 2 – Acids in the Home

1. Name some acids which you can eat and drink.

_____

2. What effect can these have on teeth?

_____

3. Name another problem of acids or alkalis.

_____

4. Acid rain is an acid causing problems in the environment. What causes acid rain?

_____

5. What are the two ways to reduce the danger of acids?

_____

Homework 3 – Metals

1. What property of iron (steel) makes it good to use for building bridges?

_____

2. What is the the reactivity series?

_____

3. Which metals will corrode first, high reactivity or low reactivity?

_____

4. list the following metals in order of reactivity (most reactive first):

Zinc, copper, potassium, silver, sodium, iron.

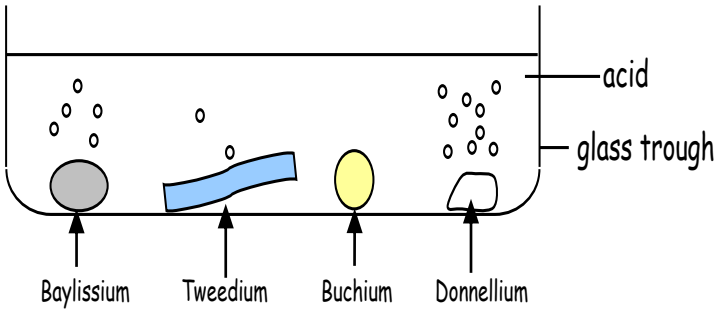
_____

_____

Homework 4 – Metal Reactions

1.

Four new metals are discovered and the following experiment is carried out to work out the order of reactivity of the new metals.



Place the elements in order of reactivity, with the most reactive metal first.

…… › …… › …… › …… ›

Use your reactivity series to answer the following questions

2. Name two metals which react quickly with water.

…… and ……

3. Name two metals which quickly react with dilute acid.

…… and ……

4. Name two metals which do not react with either water or acid.

…… and ……

5. When a metal reacts with water or an acid it produces a gas the burns with a pop. What is this metal?

_____

6. What is the name of the natural rock that metals are extracted from?

……

7. How is copper extracted from it's ore?

Useful Websites

Common acids in the home

Acids & Bases

Compound Chemistry

Reactivity Series

Metal Reactivity Video

Acid Reactions Video