

**YEAR 8
CHEMISTRY UNIT THREE**



In this topic you will learn about chemical reactions. You will learn about the difference between acids, bases and alkalis and how the pH scale can be used to measure their strength. You will learn what can cause acid rain and what the effects of acid rain can be. You will learn about the difference between different types of reactions including displacement reactions, neutralisation reactions, endothermic reactions and exothermic reactions and how catalysts can affect chemical reactions. You will also learn what state symbols can tell us and how the reactivity of metals can be measured.

This will build up on the work you did in primary school on chemical changes that are difficult reverse. It will also build on the work you did in biology unit 1 on the digestive system and chemistry units 1 and 2 on elements, the periodic table, metals and non-metals, compounds, the states of matter, chemical formula, testing unknown gases and chemical reactions and writing word equations.

This will help you to prepare for the work you will do in years 9, 10 and 11 when you will learn more about different chemical reactions, how to use state symbols, how catalysts work and how to write word and symbol equations. You will also learn more about the difference between acids, bases and alkalis. You will also learn more about the reactivity of metals and how this knowledge can be used to decide the best ways to extract metals from the earth so they can be used in our everyday lives.

Name:

Class:

Teacher:

Expected Performance Level:

The Periodic Table of Elements

		1	2	3	4	5	6	7	0
7	Li lithium 3	1	2	3	4	5	6	7	0
9	Be beryllium 4								
23	Na sodium 11								
24	Mg magnesium 12								
39	K potassium 19								
88	Sr strontium 38								
133	Cs caesium 55								
[223]	Fr francium 87								
45	Sc scandium 21								
48	Ti titanium 22								
51	V vanadium 23								
52	Cr chromium 24								
55	Mn manganese 25								
56	Fe iron 26								
59	Co cobalt 27								
59	Ni nickel 28								
63.5	Cu copper 29								
65	Zn zinc 30								
70	Ga gallium 31								
73	Ge germanium 32								
75	As arsenic 33								
77	Se selenium 34								
79	Br bromine 35								
84	Kr krypton 36								
88	Sr strontium 38								
89	Y yttrium 39								
91	Zr zirconium 40								
93	Nb niobium 41								
96	Mo molybdenum 42								
[97]	Tc technetium 43								
101	Ru ruthenium 44								
103	Rh rhodium 45								
106	Pd palladium 46								
108	Ag silver 47								
112	Cd cadmium 48								
115	In indium 49								
119	Sn tin 50								
122	Sb antimony 51								
127	I iodine 53								
131	Xe xenon 54								
137	Ba barium 56								
139	La* lanthanum 57								
178	Hf hafnium 72								
181	Ta tantalum 73								
184	W tungsten 74								
186	Re rhenium 75								
190	Os osmium 76								
192	Ir iridium 77								
195	Pt platinum 78								
197	Au gold 79								
201	Hg mercury 80								
204	Tl thallium 81								
207	Pb lead 82								
209	Bi bismuth 83								
[209]	Po polonium 84								
[210]	At astatine 85								
[222]	Rn radon 86								
[227]	Ac* actinium 89								
[226]	Ra radium 88								
[267]	Rf rutherfordium 104								
[270]	Db dubnium 105								
[270]	Bh bohrium 107								
[270]	Hs hassium 108								
[278]	Mt meitnerium 109								
[281]	Ds darmstadtium 110								
[281]	Rg roentgenium 111								
[285]	Cn copernicium 112								
[286]	Nh nihonium 113								
[289]	Fl flerovium 114								
[289]	Mc moscovium 115								
[293]	Lv livermorium 116								
[293]	Ts tennessine 117								
[294]	Og oganesson 118								

1	H	hydrogen	1
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relative atomic mass
atomic symbol
<small>name</small>
atomic (proton) number

* The Lanthanides (atomic numbers 58 – 71) and the Actinides (atomic numbers 90 – 103) have been omitted. Relative atomic masses for Cu and Cl have not been rounded to the nearest whole number.



RETRIEVAL ACTIVITY

	Question	Answer	Mark
1	What is made up of one type of atom?		
2	What is made up of two or more different elements chemically joined together?		
3	What is made up of two or more different substances not chemically joined together?		
4	True or false. The elements in a compound are easy to separate?		
5	True or false. The substances in a mixture are easy to separate?		
6	What is the scientific name for the substances you make in a chemical reaction?		
7	What process would you use to separate a mixture of salt dissolved in water?		
8	What process would you use to separate a mixture of sand and water? (Sand does not dissolve in water)		
9	What process would you use to separate a mixture of two liquids with different boiling points?		
10	What process would you use to separate a mixture of inks or dyes?		
	Score:		



ACTIVATE KNOWLEDGE

The substances below are examples of elements, compounds or mixtures.

Put a **circle** around any names of elements and put a **box** around any names of compounds.

gold

sodium

magnesium carbonate

air

carbon dioxide

saltwater

iron

sodium chloride

sand and water

aluminium sulphate

chlorine

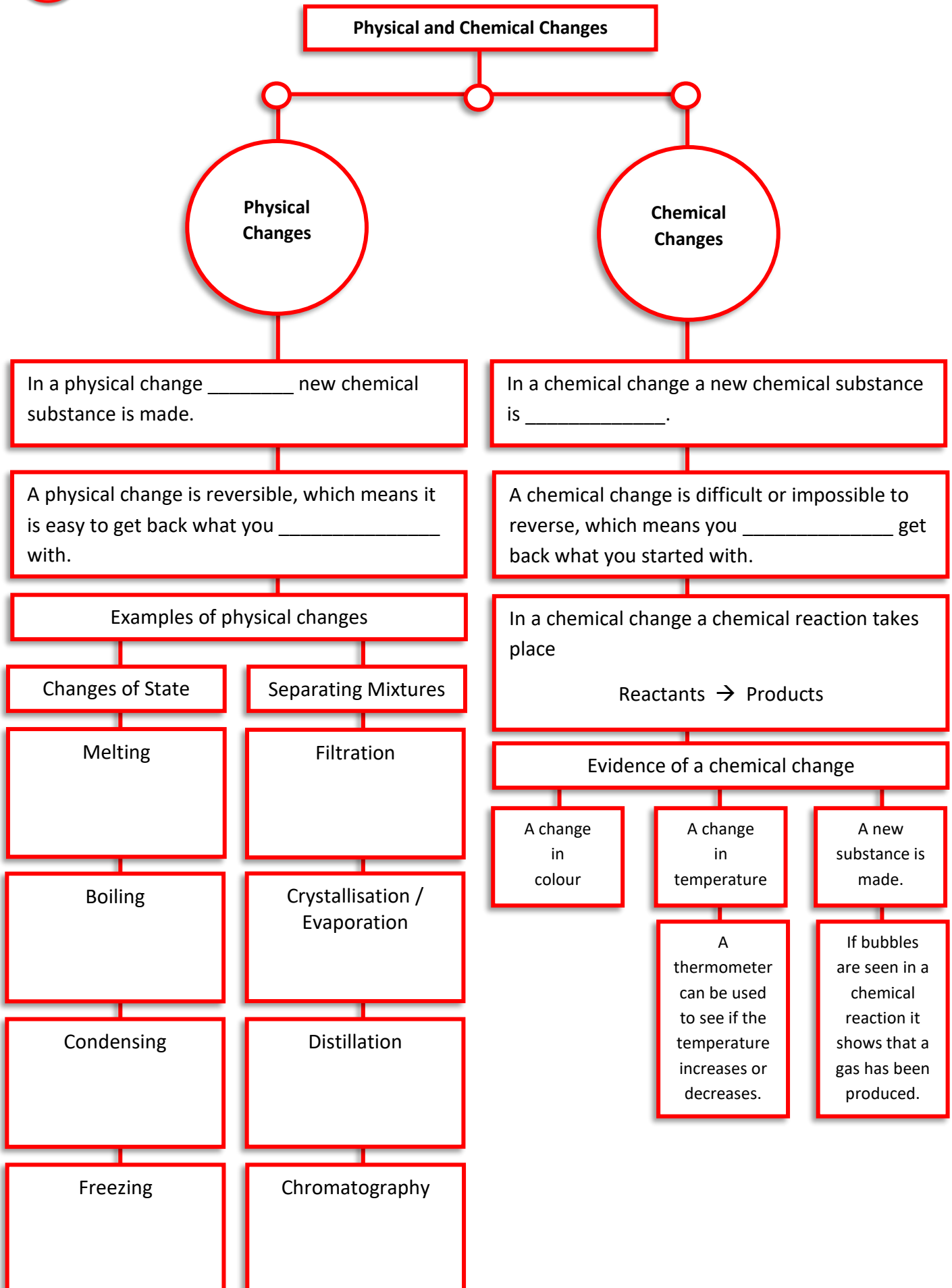
carbon

iron sulphide

lithium nitrate



CONTENT



Carrying out a physical and chemical change

Physical Changes

Place a cube of ice in a beaker.
Leave the ice for 10 minutes and then observe what has happened to it.

What happened to the ice in the beaker?

How would you be able to get back the ice that you started with?

How do you know this was an example of a physical change?

Chemical Changes

1. Half fill a test tube with hydrochloric acid.
2. Take the temperature of the acid.
3. Add a 3cm long piece of magnesium.
4. Take the temperature of the acid again and observe any changes in the test tube.

What was the temperature of the acid at the start? _____

What was the temperature of the acid at the end? _____

What did you observe that suggested that a chemical change had taken place?

How do you know this was an example of a chemical change?

What is the difference between a physical change and a chemical change?



RETRIEVAL ACTIVITY

	Question	Answer	Mark
1	Is filtration an example of a physical change or a chemical change?		
2	Is lighting a match an example of a physical change or a chemical change?		
3	What can change in an experiment that can show a chemical change has taken place?		
4	If bubbles are seen in a chemical change what does this show has been produced?		
5	What are the three states of matter?		
6	Is a change of state a chemical change or a physical change?		
7	What is the scientific name for a process that can go backwards, where you can get back what you started with?		
8	What is the scientific name for the substances you start off with in a chemical reaction?		
9	What happens to a liquid at its boiling point?		
10	What happens to a gas at its boiling point?		
	Score:		



ACTIVATE KNOWLEDGE

Complete the table below to correctly identify the definitions of the following terms:

Solvent Soluble Solute Insoluble

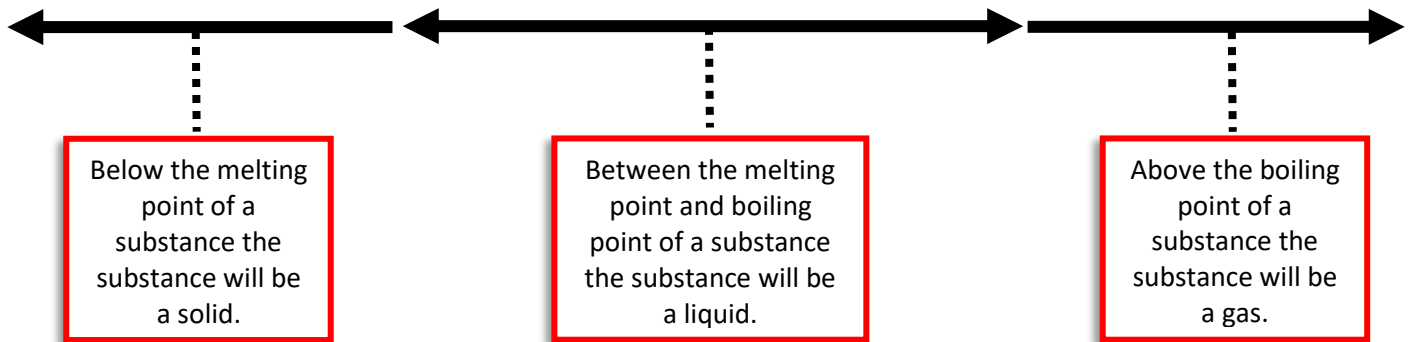
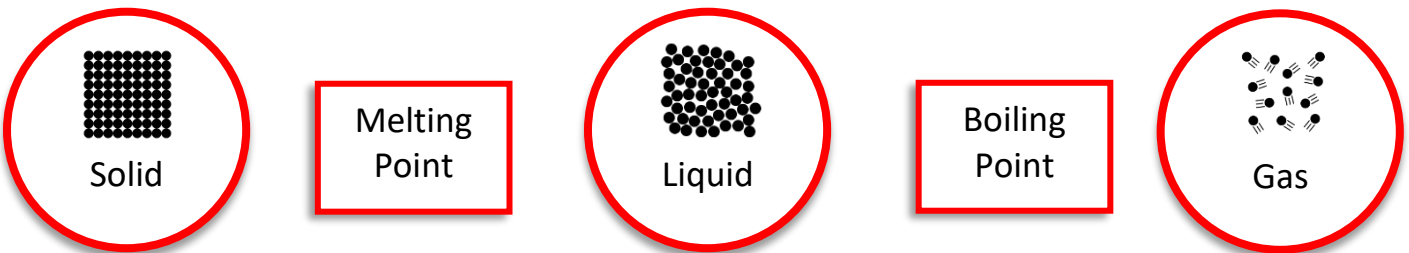
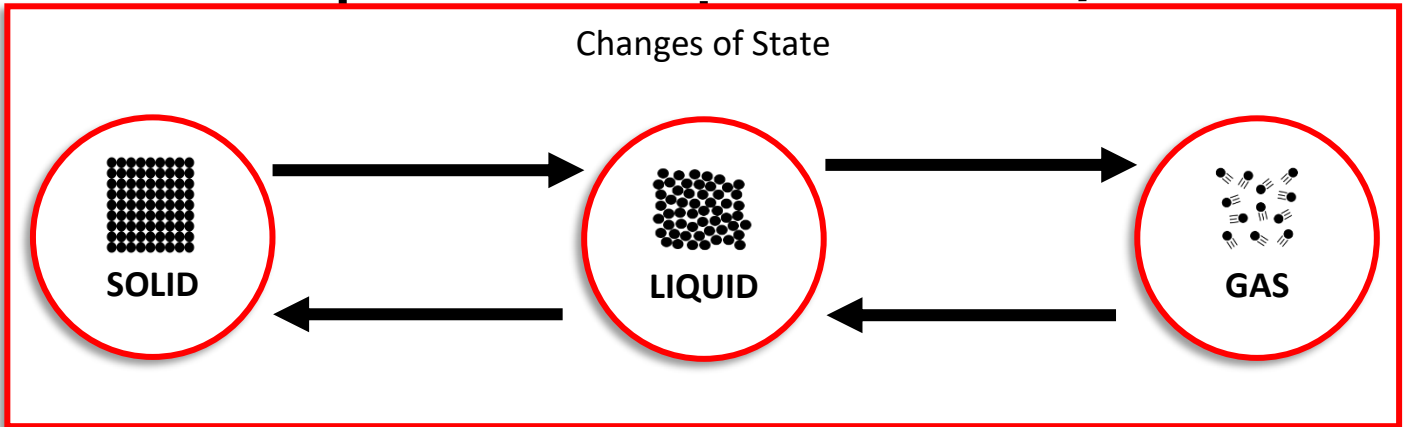
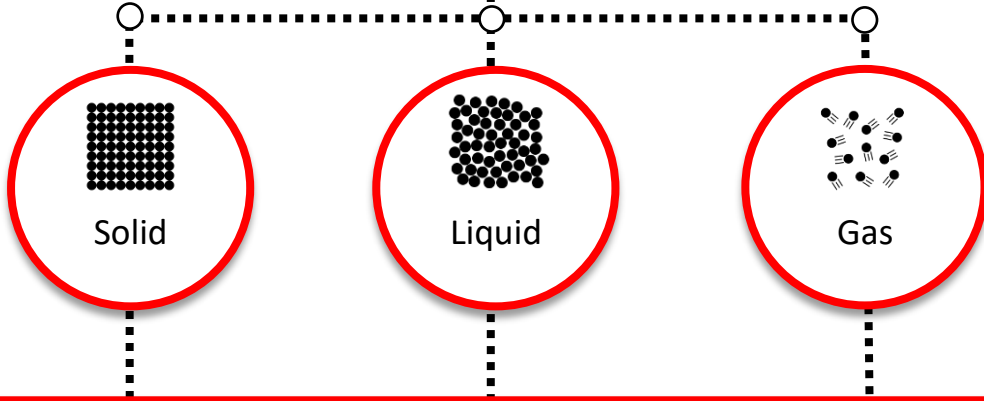
A substance that is able to dissolve is this.	
A substance that is unable to dissolve is this.	
The scientific name for the solid that dissolves in a liquid.	
The scientific name for the liquid that a solid dissolves in.	

In science, what is a solution?



CONTENT

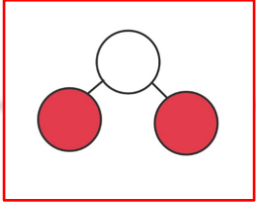
The three states of matter

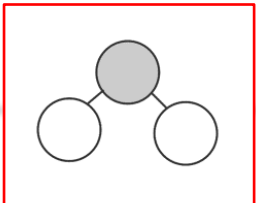


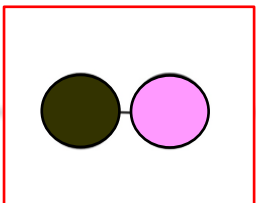
Chemical Formula

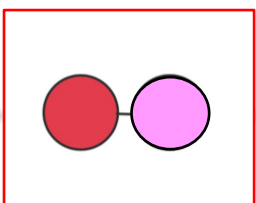
A chemical formula uses the symbols from the periodic table to show which elements a substance contains.

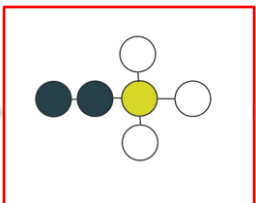
The number to the bottom right of an element's symbol also tells you how many atoms of each element there are – if there is no number to the bottom right of a symbol then there is 1 atom of that element.

H_2O			Name of element	Number of atoms
		H		
		O		
		Name of Compound:		

CO_2			Name of element	Number of atoms
		C		
		Name of Compound:		

$NaCl$			Name of element	Number of atoms
		Name of Compound:		

HCl			Name of element	Number of atoms
		Name of Compound:		

Na_2CO_3			Name of element	Number of atoms
		Name of Compound:		

Chemical Formula and States of Matter

Scientists add state symbols to chemical formula to show what state of matter they are.

The three rules for writing state symbols are that they are always:

- to the bottom right of the chemical formula
- in a bracket
- lower case letters – they are never capital letters.

There are four state symbols:

(s)

This symbol tells us the chemical is a solid.

(l)

This symbol tells us the chemical is a liquid.

(g)

This symbol tells us the chemical is a gas.

(aq)

This symbol tells us the chemical is aqueous.

This means the chemical is dissolved in water – so it is a solution.

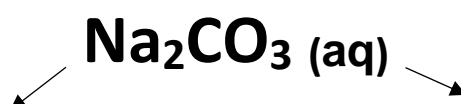
Making a solution

Equipment: 100ml beaker, 25ml measuring cylinder, weighing boat, spatula, stirring rod, sodium carbonate

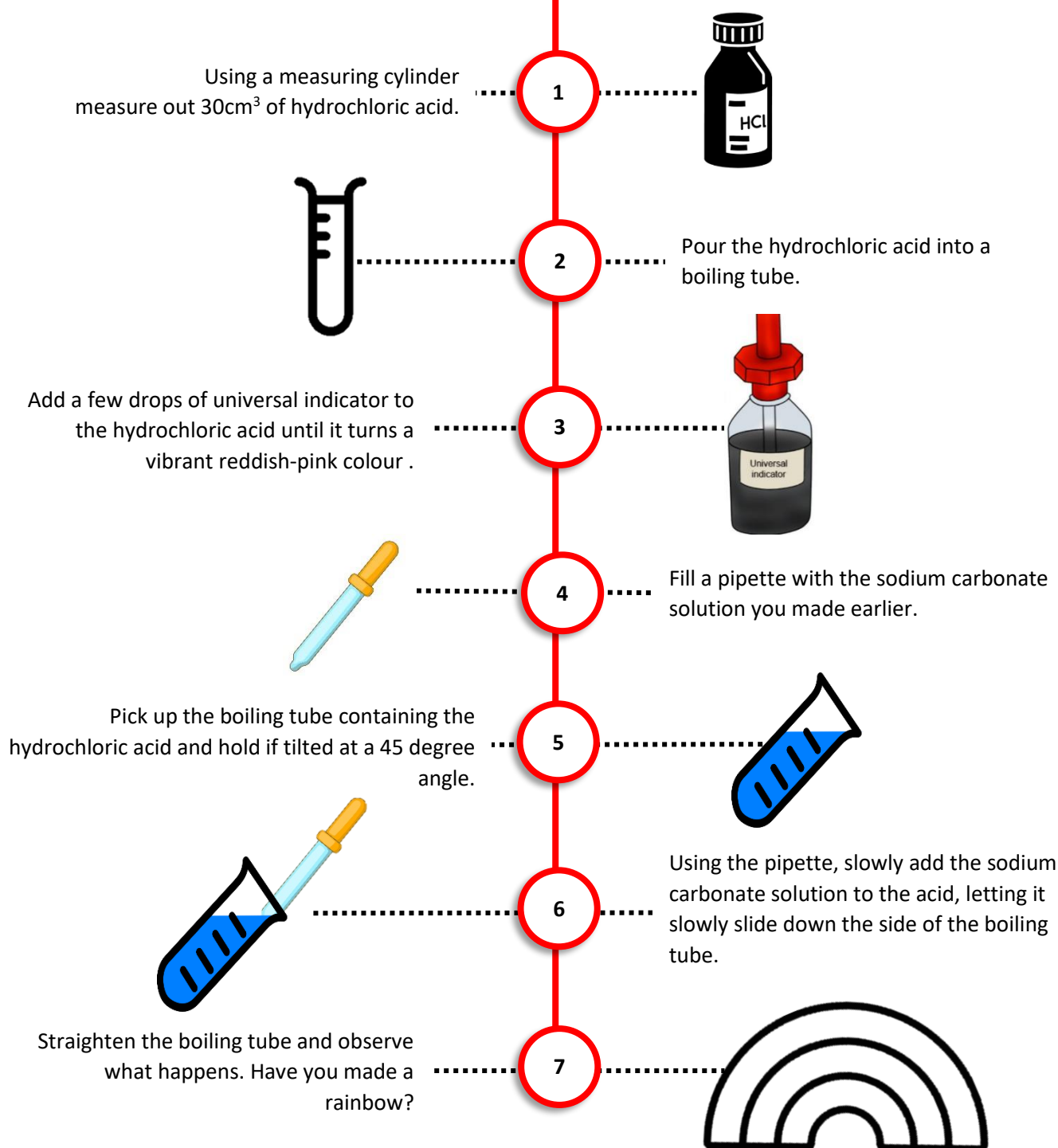
Method

1. Measure out 20ml of water using the measuring cylinder.
2. Pour the water into a beaker.
3. Switch on the balance
4. Place a weighing boat on the balance
5. Set the balance to zero.
6. Using the spatula measure out 1g of sodium carbonate into the weighing boat.
7. Add the sodium carbonate to the beaker of water.
8. Stir using the stirring rod so that the sodium carbonate dissolves in the water.

You have made sodium carbonate solution, by dissolving solid sodium carbonate in water:



Rainbow Fizz – Can you make a rainbow?



This equation shows the experiment you have carried out:



Discuss with your partner what this equation tells us.



RETRIEVAL ACTIVITY

	Question	Answer	Mark
1	What is the name given to the mixture of a solute dissolved in a solvent?		
2	What is the state symbol for a gas?		
3	What can change in an experiment that can show a chemical change has taken place?		
4	If bubbles are seen in a chemical change what does this show has been produced?		
5	What is the state symbol for a liquid?		
6	Is a change of state a chemical change or a physical change?		
7	What is the state symbol for a solid?		
8	What is the state symbol for a solution?		
9	What state would a substance be at a temperature above its boiling point?		
10	If you had solid sodium chloride, how would you make sodium chloride solution?		
	Score:		



ACTIVATE KNOWLEDGE

What do you know about acids?

Have you heard of any acids?

Is there anything else you know about acids?



CONTENT

Examples of Acids

Acids can be found in the home, in the wild and in our bodies. All of these substances are acidic.

Orange Juice



Bee Sting



Coca-Cola



Stomach Acid



Acids tend to have a sour taste – when milk goes off it tastes sour, this is because an acid called lactic acid is being produced in the milk.

Acids in the laboratory

Scientists use lots of acids in the laboratory. Here are some examples with their chemical formulas.

Hydrochloric acid



Sulphuric acid



Nitric acid



Which element do all acids contain?

Examples of Bases

Bases can also be found in our home and in the wild. All of these substances are bases.

Soap



Wasp Sting



Toothpaste



Washing Up Liquid



Bases tend to have a bitter taste and be soapy to the touch – many household cleaning products such as detergents and washing powder are bases.

Neutral Substance

Some substances are not an acid or a base. These substances are neutral.

Water



Saliva



Table Salt



Sugar Solution



Testing whether a substance is an acid, a base or neutral

To test what a substance is we can use litmus paper.

In an acid:

Litmus paper
turns red

In neutral:

Litmus paper
doesn't change
colour

In a base:

Litmus paper
turns blue

You will test some chemicals with litmus paper and identify if they are acids, bases or neutral substances.

Test the following substances with litmus paper.

Fill in your results table and identify if they are acids, bases or neutral substances.

Substance	Colour of litmus paper	Acid, Base or Neutral?
Bleach		
Plant Food		
Water		
Lemon Juice		
Washing Powder		
Vinegar		
Hydrochloric Acid		
Baking Soda		
Oven Cleaner		
Methylated Spirit		
Bee Sting		
Soapy Water		

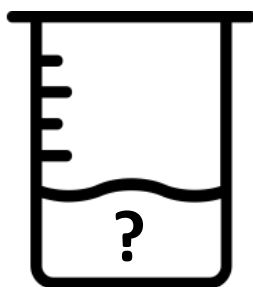


RETRIEVAL ACTIVITY

	Question	Answer	Mark
1	If bubbles are seen in a chemical change what does this show has been produced?		
2	What can change in an experiment that can show a chemical change has taken place?		
3	What colour does litmus paper turn in an acid?		
4	What is the chemical formula for sulphuric acid?		
5	What is a substance if it is not an acid or a base?		
6	What colour does litmus paper turn in a base?		
7	What is the chemical formula for nitric acid?		
8	What state would a substance be at a temperature below its melting point?		
9	Which element do all acids contain?		
10	What is the chemical formula for hydrochloric acid?		
	Score:		



ACTIVATE KNOWLEDGE



You have an unknown substance. You put litmus paper in it. What could litmus paper tell us about the substance?



CONTENT

The limitations of litmus paper

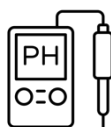
Litmus paper can only tell us whether a substance is an acid or a base, but it cannot tell us how strong the acid or the base is.

The pH scale is used to measure the strength of an acid or base. The pH scale goes from pH 0 to pH 14, it can be a decimal number.

The pH of a solution can be measured using a piece of equipment called a pH probe or a chemical called universal indicator.

A pH probe will give you a pH number as a digital reading. Universal indicator changes colour depending on how strong the acid or base is.

Solution	pH	Colour with universal indicator
Strong Acid	0 – 3	Red / Orange
Weak Acid	4 – 6	Yellow
Neutral	7	Green
Weak Base	8 – 10	Blue
Strong Base	11 - 14	Purple



You will test different solutions with universal indicator to find out their pH.

We call a base that dissolves in water an alkali – so you will be testing solutions to find out if they are an acid, alkali or neutral.

All alkalis are bases, but not all bases are alkali because not all bases dissolve in water.

Your teacher will then test the same solutions with a pH probe, to see if the digital reading matches the pH you have identified using your pH scale.

Stick your pH scale in your booklet, label it to show a strong acid, weak acid, neutral, weak alkali or base and strong alkali or base.

Use your pH scale to identify the pH of different solutions.

Equipment: spotting tile, solutions with pipettes in, universal indicator

Method:

1. Using a pipette put 3 drops of solution into one of the wells on your spotting tile.
2. Make sure that you put the pipette back in the same solution, and use a different pipette for each solution so they don't get mixed together.
3. Add 2 drops of universal indicator to the solution in the well of your spotting tile.
4. Record the colour that the universal indicator changes to in your table and use your pH scale to decide on the pH of the solution.
5. Decide if the solution is a strong acid, weak acid, neutral, weak alkali or base or strong alkali or base and record this in your table.
6. Repeat for the other solutions, using a different well in your spotting tile for each one.
7. Once you have used all the wells in your spotting tile, rinse it out and dry it so it can be used again.

Your teacher will then test all of the solutions with a pH probe.

Do the results match the pH you decided on using universal indicator and your pH scale?

Substance	Colour of universal indicator	pH using pH scale	Acid, Alkali or Neutral?	pH using pH probe
Bleach				
Plant Food				
Water				
Lemon Juice				
Washing Powder				
Vinegar				
Hydrochloric Acid				
Baking Soda				
Oven Cleaner				
Methylated Spirit				
Bee Sting				
Soapy Water				



RETRIEVAL ACTIVITY

	Question	Answer	Mark
1	What is the state symbol of a solution?		
2	What colour does universal indicator turn in a strong acid?		
3	What colour does universal indicator turn in a strong base?		
4	What is the scientific name for a base that can dissolve in water?		
5	What piece of equipment can be used to find the pH of an unknown substance?		
6	What is (s) the state symbol for?		
7	What type of substance has a pH less than 7?		
8	What type of substance has a pH of 7?		
9	Do bases have a pH of less than 7 or more than 7?		
10	Would a strong base have a higher or lower pH value?		
	Score:		



ACTIVATE KNOWLEDGE

You have a sample of rain and want to find out if it is acidic.
What could you do to investigate this, and how would the results tell you if the rain was acidic or not?



CONTENT

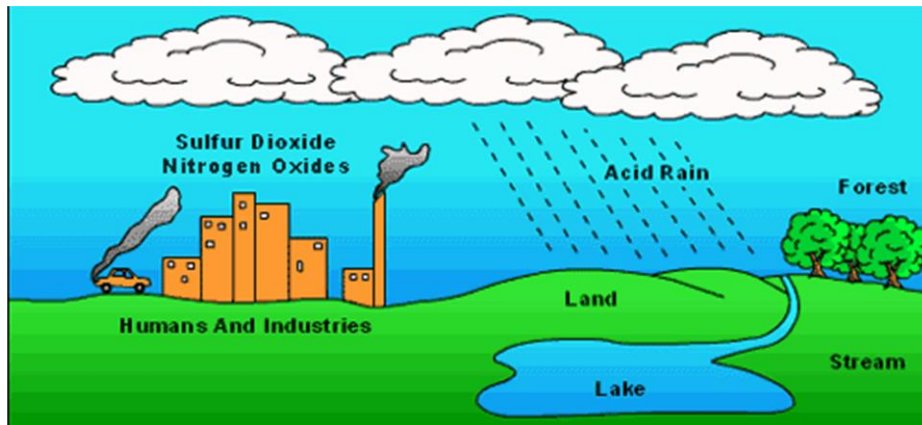
Acid rain is caused by the gases sulphur dioxide and nitrogen oxide.

Sulphur dioxide is released when fuels containing sulphur are burned. Fossil fuels such as coal often contain sulphur, so they release sulphur dioxide into the air when they are burned.

Acidic gases are released into the air and dissolve in clouds. The rain that falls from these clouds is then acid rain.

2. Acidic gases like sulphur dioxide and nitrogen oxide are released in to the air.

1. Fossil fuels are burned



3. These gases dissolve in rain clouds.

4. The rain that falls from these clouds is acidic.

To measure how acidic rain is we use the pH scale.

We can use a pH probe to find out the pH of the rain.

The lower the number the more acidic the rain is.

We are going to measure the pH of rainwater from 3 different places.

Where the rain was collected from...	pH
In a large field	
Next to a factory	
Near a busy road	

The most acidic rain was found _____

This was because: _____

Effects of Acid Rain

Effect on Trees.

Acid rain can cause trees to lose their leaves and die.

This is because trees without leaves cannot carry out photosynthesis – this means the tree cannot produce its own food and so the tree dies.

Effect on buildings and statues.

The rock that statues and buildings are made from can be broken down by acid rain.

This causes the stone to wear away.

Effect on rivers and lakes.

Acid rain can cause the water in lakes and rivers to become too acidic for the animals that normally live there to survive.

The pH is too low, and the water is too acidic for animals to survive.



RETRIEVAL ACTIVITY

	Question	Answer	Mark
1	Name a gas which causes acid rain.		
2	What is the scientific name for a base that can dissolve in water?		
3	What scale can be used to measure how acidic rain is?		
4	Using this scale would the numbers be lower or higher if the rain was a stronger acid?		
5	What is (l) the state symbol for?		
6	Do bases have a pH of less than 7 or more than 7?		
7	How can acid rain affect the appearance of trees?		
8	What type of substance has a pH of 7?		
9	Do acids have a pH of less than 7 or more than 7?		
10	How can statues and buildings be affected by acid rain?		
	Score:		



ACTIVATE KNOWLEDGE

What piece of equipment would you use to measure temperature?

You carry out an experiment. At the start of the experiment the reactants have a temperature of 22°C. At the end of the experiment the products have a temperature of 31°C. What has been the temperature change?

You carry out a second experiment. At the start of the experiment the reactants have a temperature of 21°C. At the end of the experiment the products have a temperature of 14°C. What has been the temperature change?

The words endothermic and exothermic both end in 'thermic'. What does this make you think of?



CONTENT

Exothermic and Endothermic Reactions

Exothermic Reactions

Energy Exits an Exothermic Reaction

As an exothermic reaction happens energy is given out to the surroundings.

This means the temperature of the surroundings increases.

1. Add one spatula of anhydrous copper sulphate to a test tube.
2. Add 10 drops of water using a pipette.
3. Hold the test tube in your hand so you can feel any change in temperature.

How did the test tube feel at the end of the experiment?

What colour was the anhydrous copper sulphate at the start of the experiment?

What colour was the product at the end of the experiment?

What happened in this experiment that showed it was an exothermic reaction?

Endothermic Reactions

Energy Enters an Endothermic Reaction

As an endothermic reaction happens energy is taken in from the surroundings.

This means the temperature of the surroundings decreases.

1. Half fill a test tube with hydrochloric acid.
2. Take the temperature of the acid.
3. Add one spatula of bicarbonate of soda.
4. Take the temperature of the acid again and observe any changes in the test tube.
5. Hold the test tube in your hand so you can feel any change in temperature.

Temperature at start: _____

Temperature at end: _____

Temperature change: _____

How did the test tube feel at the end of the experiment?

What happened in this experiment that showed it was an endothermic reaction?



RETRIEVAL ACTIVITY

	Question	Answer	Mark
1	Does the temperature increase or decrease in an exothermic reaction?		
2	Does the temperature increase or decrease in an endothermic reaction?		
3	What type of reaction takes energy in from the surroundings?		
4	What type of reaction releases energy to the surroundings?		
5	Would a strong alkali have a pH of 14, 8, 6 or 1?		
6	Would a weak acid have a pH of 14, 8, 6 or 1?		
7	Water is a neutral substance, what would its pH be?		
8	Is melting a chemical change or a physical change?		
9	What is the state symbol of a solution?		
10	If a gas is made in a chemical reaction, what will you observe?		
	Score:		



ACTIVATE KNOWLEDGE

Which side of the periodic table are metals on?

At the top of the periodic table, each column of elements has a group number.
 What group are the metals lithium, sodium and potassium in?

What group are the metals beryllium, magnesium and calcium in?

What group are the metals aluminium and gallium in?



CONTENT

The reactions of metals in group one of the periodic table.

Group one is the first column of the periodic table.

The elements lithium, sodium, potassium, rubidium, caesium and francium are metals in group one of the periodic table.

Observe your teacher adding lithium, sodium and potassium to water. Write down your observations in the table below and consider which of these metals is most reactive.

Reaction	Observations
Lithium + Water	
Sodium + Water	
Potassium + Water	



GUIDED PRACTICE

1. Which of the group 1 metals that you observed was the least reactive?

2. Which of the group 1 metals that you observed was the most reactive?

3. What does this suggest happens to the reactivity of the group 1 metals as you move down the group from top to bottom?

The group 1 metals get more reactive as you go down the group.

The group 1 metals get less reactive as you go down the group.

The group 1 metals are all equally reactive



CONTENT

The reactions of metals in group two and three of the periodic table.

Group two is the second column of the periodic table.

The elements beryllium, magnesium, calcium, strontium, barium and radium are metals in group two of the periodic table.

The elements in the block between group two and group three of the periodic table are all metals. They are called the transition metals.

Observe your teacher adding calcium, magnesium and aluminium to water. Write down your observations in the table below and consider which of these metals is most reactive.

Reaction	Observations
Aluminium + Water	
Calcium + Water	
Magnesium + Water	

Magnesium and aluminium show little reaction with water. Can you suggest what they could be added to instead, to show more of a reaction, so that we could find out which one is more reactive?

Observe your teacher adding calcium, magnesium and aluminium to _____. Write down your observations in the table below and consider which of these metals is most reactive.

Reaction	Observations
Aluminium + _____	
Calcium + _____	
Magnesium + _____	

Order of Reactivity

Most Reactive

Least Reactive



CONTENT

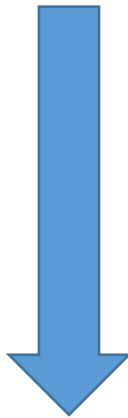
The group 1 metals are the most reactive metals.

The group 2 metals are less reactive than group 1 metals, but more reactive than group 3 metals.

The transition metals are less reactive than the group 3 metals.

We can use this information to create a reactivity series of metals – you will need to learn the order of these metals from most reactive to least reactive.

Reactivity Series of Metals

Name	Symbol	Reactivity		
Potassium	K	The most reactive metals are in group 1 – they get more reactive as you go down the group.	MOST REACTIVE	
Sodium	Na			
Lithium	Li			
Calcium	Ca	The group 2 metals come next – they also get more reactive as you go down the group.		
Magnesium	Mg			
Aluminium	Al	Aluminium is in group 3 .		
Zinc	Zn	These metals are all quite unreactive transition metals . You can remember the order of these four metals using 'ZITL'		
Iron	Fe			
Tin	Sn			
Lead	Pb			
Copper	Cu	These metals are all very unreactive transition metals . You can make jewellery out of these metals because they are so unreactive, so won't cause rashes or burns.		LEAST REACTIVE
Silver	Ag			
Gold	Au			
Platinum	Pt			



RETRIEVAL ACTIVITY

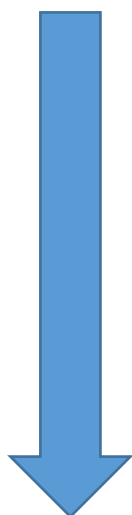
	Question	Answer	Mark
1	What is made up of one type of atom?		
2	What is made up of two or more different elements chemically joined together?		
3	Which group in the periodic table are the most reactive metals found in?		
4	Which groups of the periodic table are magnesium and calcium found in?		
5	Which group of the periodic table is aluminium found in?		
6	What is the name given to the metals in the periodic table between groups 2 and 3?		
7	What are the ZITL metals in the correct order of reactivity, from most to least reactive?		
8	What are the jewellery metals in the correct order of reactivity, from most to least reactive?		
9	True or false. Group 1 metals get more reactive as you go down the group?		
10	True or false. Group 2 metals get more reactive as you go down the group?		
	Score:		



ACTIVATE KNOWLEDGE

Complete the reactivity series of metals below:

MOST REACTIVE: Potassium



- _____
- Lithium
- Calcium
- _____
- Zinc
- _____
- Tin
- _____
- Copper
- Silver
- _____

LEAST REACTIVE: Platinum




CONTENT

Non-Metals and the Reactivity Series

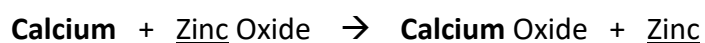
There are two non-metals that can be placed in the reactivity series of metals. They are carbon and hydrogen.

Reactivity Series of Metals

Name	Symbol	Reactivity			
Potassium	K	These metals are more reactive than carbon.	These metals are more reactive than hydrogen.	MOST REACTIVE	
Sodium	Na				
Lithium	Li				
Calcium	Ca				
Magnesium	Mg				
Aluminium	Al				
Carbon	C				
Zinc	Zn	These metals are less reactive than carbon.	These metals are less reactive than hydrogen.		
Iron	Fe				
Tin	Sn				
Lead	Pb				
HYDROGEN	H				
Copper	Cu				
Silver	Ag				
Gold	Au				
Platinum	Pt				LEAST REACTIVE

Displacement Reactions.

In a displacement reaction a more reactive element can push out or displace a less reactive element from a compound. The word equation below shows a displacement reaction.



What does this word equation tell us?

The calcium displaces the zinc. It pushes the zinc away from the oxide and joins with it instead. The zinc is left on its own

This happens because calcium is more reactive than zinc.

You will react carbon with copper oxide. What do you predict the products will be?



Why have you made this prediction?

Reacting Carbon with Copper Oxide

Set up a Bunsen Burner on a heatproof mat with a tripod and clay pipe triangle. Attach the Bunsen burner to the gas tap.

1

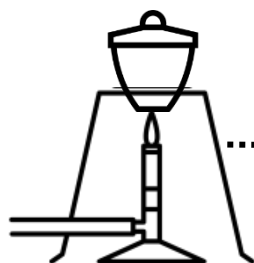
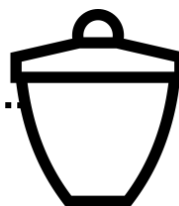


2

Put two spatulas of carbon and two spatulas of copper oxide in a crucible and mix it.

Place a lid on the crucible and rest it in the centre of the clay pipe triangle.

3

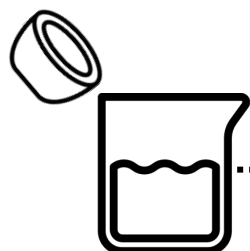
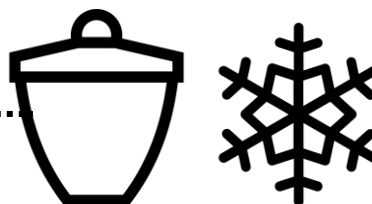


4

Heat the crucible on the blue Bunsen flame for 5 minutes.

Turn your Bunsen burner off and leave the crucible to cool.

5

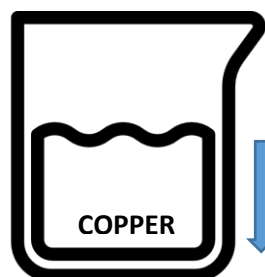


6

Pour the contents of the crucible into a half-filled beaker of water.

Any copper metal you have produced will sink to the bottom of the beaker and be copper coloured. Did you make any copper?

7





RETRIEVAL ACTIVITY

	Question	Answer	Mark
1	Which element is present in all acids?		
2	What is the name given to a reaction where a more reactive element pushes out a less reactive element?		
3	What is the state symbol for a solution?		
4	Are state symbols written with capital letters or lower-case letters.		
5	An unknown chemical turns red with universal indicator. What must it be?		
6	Are group 1 and 2 metals in the periodic table more reactive or less reactive than carbon?		
7	Are zinc, iron, tin and lead more reactive or less reactive than carbon?		
8	Are copper, silver, gold and platinum more reactive or less reactive than carbon?		
9	Are zinc, iron, tin and lead more reactive or less reactive than hydrogen?		
10	Are copper, silver, gold and platinum more reactive or less reactive than hydrogen?		
	Score:		



ACTIVATE KNOWLEDGE

Which acid is HCl the chemical formula for?

Which acid is H₂SO₄ the chemical formula for?

Which acid is HNO₃ the chemical formula for?

When acids react with metals hydrogen gas is produced. What would you see that shows a gas is produced?

How could you test for hydrogen gas?



CONTENT

Acids + Metals

When an acid reacts with a metal the temperature increases, this is because it is an _____ reaction.

The more reactive the metal the _____ the increase in temperature.

When an acid reacts with a metal the products are hydrogen gas and a metal compound.



The metal compound that is produced depends on:

- the metal being used
- the acid being used

If you use hydrochloric acid



You make a metal compound with a name ending in **chloride**

If you use sulphuric acid

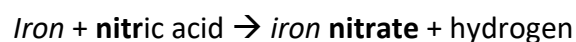
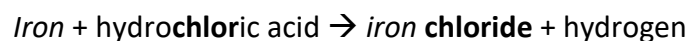


You make a metal compound with a name ending in **sulphate**

If you use nitric acid



You make a metal compound with a name ending in **nitrate**



Metals that are less reactive than hydrogen do not react with acids.



GUIDED PRACTICE

1. Complete the following word equations for different metals reacting with acids.

a) zinc + hydrochloric acid → _____

b) zinc + sulphuric acid → _____

c) zinc + nitric acid → _____

d) iron + _____ acid → iron chloride + hydrogen

e) tin + sulphuric acid → _____ sulphate + hydrogen

f) lead + nitric acid → lead nitrate + _____

g) calcium + hydrochloric acid → calcium _____ + hydrogen

h) magnesium + sulphuric acid → magnesium _____ + hydrogen

i) _____ + nitric acid → aluminium nitrate + hydrogen

g) calcium + _____ acid → _____ nitrate + hydrogen

g) lead + _____ acid → _____ chloride + hydrogen

2. When a metal reacts with an acid it is an exothermic reaction. What does this mean happens to the temperature?

3. Which of the following is a correct description of an exothermic reaction? Tick the correct box.

In an exothermic reaction energy is taken in from the surroundings

In an exothermic reaction energy is given out to the surroundings

In an exothermic reaction energy is created from the surroundings

<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>

4. Which gas is produced when a metal reacts with an acid? _____

5. What is the state symbol for a gas? _____

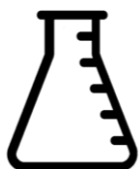
6. Which metals in the reactivity series will not react with acids?

7. Why don't these metals react with acids?

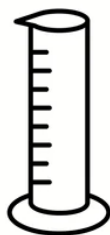


CONTENT

You will investigate how the temperature changes when different metals react with acid using the equipment below:



Conical flask



Measuring cylinder



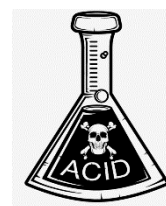
Different metals



Thermometer



Spatula



Acid



GUIDED PRACTICE

Writing up the practical experiment.

You will identify the variables in the experiment. There will be one independent variable that you _____ in the experiment, one dependent variable that you _____ in the experiment and a number of control variables that you keep the _____ in the experiment. You must keep the control variables the same to make it a _____ test and make your results more trustworthy.

You will write a method for your experiment. A method is a set of _____ that can be followed to carry out the experiment. A good method is written in _____ points, has instructions in the correct _____ and names all the _____ that will be used in the experiment.

You will also include a _____ assessment for the experiment. This will identify the main risks in the experiment, and what steps you will take to _____ the risk.

You will record your results in a results table that should be drawn with a pencil and _____. The results table should include the independent and dependent variable along with their _____.

You will then display your results in a graph. The graph should also be drawn with a _____ and a ruler. The _____ variable should go on the x-axis (bottom of the graph) and the _____ variable should go on the y-axis (side of the graph). You must make sure you label the axes with the names of the variables and their _____.

You will write a conclusion for your experiment to describe what your _____ show. You should use _____ from your results to back up your conclusion. You should also try and _____ your results using your scientific knowledge.

You will then write an evaluation for your experiment to suggest how the method could be _____ to make the results more _____. You can consider whether your results were _____ when you repeated the experiment and whether other people carrying out the _____ experiment got similar results to you. If your repeat results are similar it means your data is _____. If other people got similar results to you it means your data is _____.

You should also identify if any of your results are _____. Anomalous results are results that don't fit the _____ and are _____ higher or lower than your other results.



INDEPENDENT PRACTICE

Practical Aim: _____

Equipment List: _____

Labelled Diagram: (in pencil)

Variables:

The independent variable is:

The dependent variable is:

The control variables are:

Control: How will you keep the control variables the same to make sure it is a fair test?

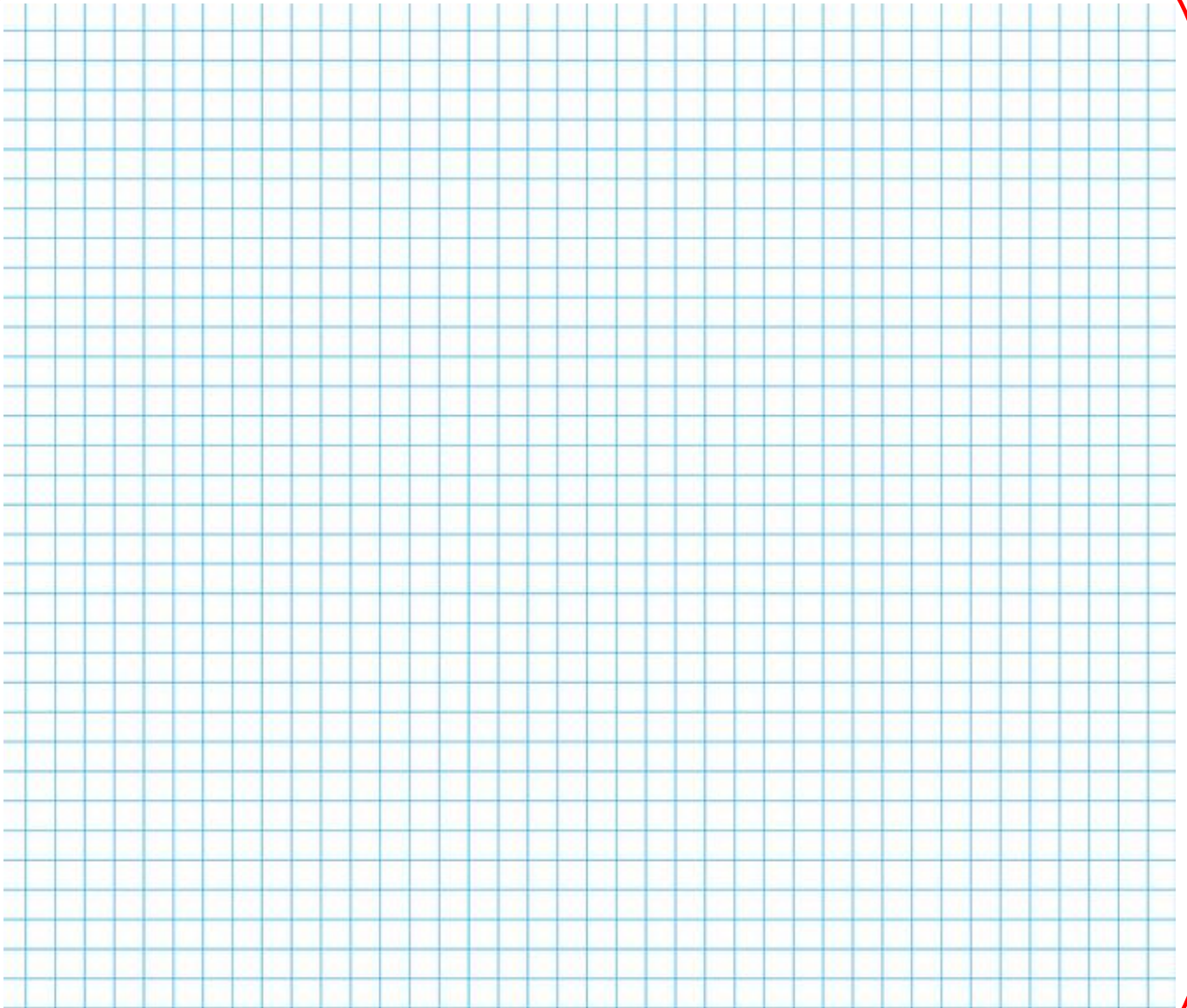
Method: (Step by step instructions how to carry out the practical)

Risk Assessment: What are the main hazards or risks in this experiment?

How could you work safely to reduce this risk?

Results Table: (You should use a ruler and pencil to draw your results table)

Graph: (You should use a ruler and pencil to draw your results table. The independent variable should be on the x-axis and the dependent variable should be on the y-axis)



Conclusion: (What the results of your experiment show.) How did changing the independent variable affect the dependent variable? Use data from your results to back up your findings. Can you explain why this happened using your scientific knowledge?

Evaluation: (Whether results are trustworthy and if the method could be improved) Did you get similar results when you repeated the experiment and did others in the class get similar results to you? How could you improve the experiment if you did it again?

Section	Key Point (Each bullet point is worth 1 mark)	SA	PA
Title	<ul style="list-style-type: none"> Title 		
Variables	<ul style="list-style-type: none"> Independent variable stated 		
	<ul style="list-style-type: none"> Dependent variable stated 		
	<ul style="list-style-type: none"> Control variables listed 		
	<ul style="list-style-type: none"> Detail about how the control variables will be kept the same 		
Equipment	<ul style="list-style-type: none"> All equipment listed 		
	<ul style="list-style-type: none"> Labelled diagram (if appropriate) 		
Method	<ul style="list-style-type: none"> Written in bullet points 		
	<ul style="list-style-type: none"> Instructions in the correct order 		
	<ul style="list-style-type: none"> Includes all equipment 		
	<ul style="list-style-type: none"> Includes independent and dependent variable, used correctly 		
Risk Assessment	<ul style="list-style-type: none"> Main hazard(s) identified e.g. boiling water 		
	<ul style="list-style-type: none"> Includes safety measures that will be used to reduce risk 		
Results	<ul style="list-style-type: none"> Results are recorded 		
	<ul style="list-style-type: none"> Table is drawn with a pencil and ruler 		
	<ul style="list-style-type: none"> Columns have correct headings 		
	<ul style="list-style-type: none"> Headings have appropriate units 		
	<ul style="list-style-type: none"> Average is calculated correctly 		
Graph (if appropriate)	<ul style="list-style-type: none"> Appropriate scale used 		
	<ul style="list-style-type: none"> Scales the correct way round (independent variable on x axis) 		
	<ul style="list-style-type: none"> X-axis correctly labelled with unit 		
	<ul style="list-style-type: none"> Y-axis correctly labelled with unit 		
	<ul style="list-style-type: none"> Correct plotting (Allow 1 in 5 error) 		
	<ul style="list-style-type: none"> Correct line of best fit for line graph or clear bars for bar charts drawn with a pencil and ruler 		
Conclusion	<ul style="list-style-type: none"> Says what the results show. 		
	<ul style="list-style-type: none"> Any pattern or relationship is described e.g. if ___ increases then ___ decreases. 		
	<ul style="list-style-type: none"> Back up your conclusion with data from your results. 		
	<ul style="list-style-type: none"> Attempt to explain results using scientific ideas 		
Evaluation	<ul style="list-style-type: none"> Identify if your results were similar when you repeated them (repeatable) 		
	<ul style="list-style-type: none"> Identify if other peoples results were similar to yours (reproducible) 		
	<ul style="list-style-type: none"> Identify whether or not you have any anomalous results. 		
	<ul style="list-style-type: none"> Improvements suggested 		
Presentation	<ul style="list-style-type: none"> Overall presentation good and written in full sentences. 		
Spellings	<ul style="list-style-type: none"> Science keywords, such as the equipment used, spelt correctly 		

Score	Pathway
0 - 5	5
6 -13	4
14 - 24	3
25 - 29	2
29 - 34	1

Target Pathway = _____ Score = _____ / 34 Pathway Achieved = _____
 I am *developing* / *secure* / *advanced* for my pathway.

P.A.L. (How will I do better in the future?)



REVIEW

	Question	Answer	Mark
1	What is the name given to the variable you measure in an experiment?		
2	What is the name given to the variable you change in an experiment ?		
3	What is the name given to the variables you keep the same in an experiment ?		
4	Give an example of a unit used to measure temperature.		
5	Give an example of a unit used to measure time.		
6	What piece of equipment would you use to measure temperature?		
7	What piece of equipment would you use to measure out 10cm ³ of water?		
8	What piece of equipment would you use to measure time?		
9	What piece of equipment would you use to measure height or length?		
10	Which variable goes on the x-axis (bottom) of a graph?		
	Score:		



RETRIEVAL ACTIVITY

	Question	Answer	Mark
1	Name a gas which causes acid rain.		
2	If bubbles are seen in an experiment what does this show has been produced?		
3	What scale can be used to measure how acidic rain is?		
4	Using this scale would the numbers be lower or higher if the rain was a stronger acid?		
5	What is (l) the state symbol for?		
6	What chemical can be used to find the pH of an unknown substance?		
7	How can acid rain affect the appearance of trees?		
8	What type of substance has a pH of 7?		
9	Do acids have a pH of less than 7 or more than 7?		
10	How can statues and buildings be affected by acid rain?		
	Score:		



ACTIVATE KNOWLEDGE

You have a sample of an acid.

You put _____ paper in it and it turns red, showing that it is an acid.

You add universal indicator to it, and it turns red, showing that it is a _____ acid.

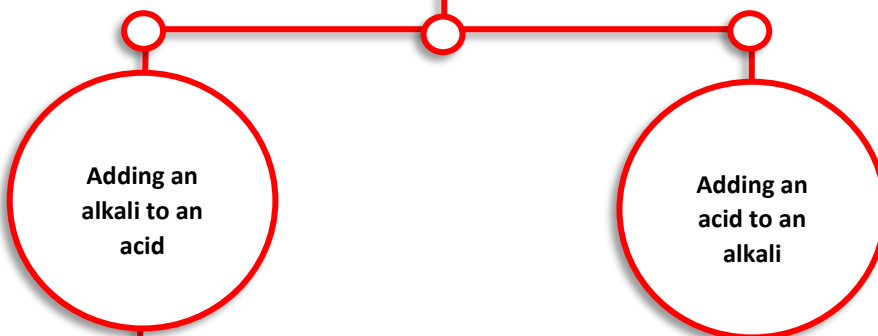
You use a pH _____ and find out the pH of the acid is pH 1.7.

What do you think would happen to the pH if you added an alkali to it?



CONTENT

Neutralisation Reactions



Adding an alkali to an acid

Adding an acid to an alkali

You begin with an acid which has a pH less than 7.

You begin with an alkali which has a pH greater than 7.

You add an alkali.

You add an acid.

The pH increases.

The pH decreases.

The end goal is for the pH to become pH 7 – so the pH is neutral.

When an acid reacts with an alkali a metal compound and water is produced.



The water that is made in the reaction is neutral – which is why it is called a neutralisation reaction.

The metal compound that is produced depends on the metal that is present in the alkali and the acid that is used.

Examples of neutralisation reaction word equations:

sodium hydroxide + hydrochloric acid → *sodium chloride* + water

sodium hydroxide + **sulphuric** acid → *sodium sulphate* + water

sodium hydroxide + **nitric** acid → *sodium nitrate* + water

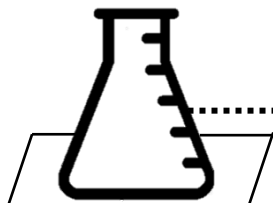
calcium hydroxide + hydrochloric acid → *calcium chloride* + water

aluminium hydroxide + **sulphuric** acid → *aluminium sulphate* + water

Neutralisation – Can you neutralise an alkali?

Using a measuring cylinder measure out 10cm³ of the alkali sodium hydroxide.

1



2

Pour the sodium hydroxide into a conical flask and place it on top of a white tile.

Add four drops of universal indicator to the sodium hydroxide.

3



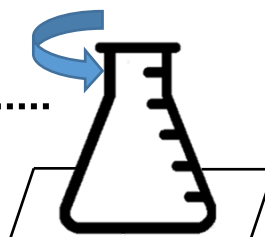
4

Using a measuring cylinder measure out 20cm³ of hydrochloric acid and pour it into a dropper bottle.



Add the hydrochloric acid to the sodium hydroxide a drop at a time. Swirl the conical flask gently after each drop is added.

5



GREEN ✓

6

Keep adding the acid a drop at a time until the universal indicator turns green, showing that the alkali has been neutralised and water has been produced.

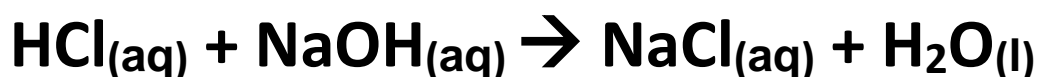
If the universal indicator turns yellow, orange or red you have added too much acid and gone past the point of neutralisation.

7

RED / ORANGE / YELLOW ✗

Challenge: Can you work out how much hydrochloric acid you needed to neutralise 10cm³ of sodium hydroxide? How?

This equation shows the experiment you have carried out:



Discuss with your partner what this equation tells us.



RETRIEVAL ACTIVITY

	Question	Answer	Mark
1	What is the name of the chemical used to test if a substance is an acid, alkali or neutral?		
2	What is the pH of a neutral substance?		
3	What is the name ending of the metal compound produced when a reaction takes place using hydrochloric acid?		
4	What is the name ending of the metal compound produced when a reaction takes place using nitric acid?		
5	What is the name ending of the metal compound produced when a reaction takes place using sulphuric acid?		
6	Do alkalis have a pH of less than 7 or more than 7?		
7	What is the name given to the reaction when an acid reacts with an alkali?		
8	What is the name given to the reaction when a more reactive element displaces a less reactive element?		
9	Which group of the periodic table contains the most reactive metals?		
10	True or false. Group 1 and 2 metals get less reactive as you go down the groups?		
	Score:		



ACTIVATE KNOWLEDGE

In biology unit one you studied the different organ systems of the body.

One of the organ systems you studied was the digestive system.

What do you remember about what enzymes do in the digestive system?





CONTENT

Catalysts

Catalysts speed up chemical reactions.

Catalysts are not used up or chemically changed in reactions – so they can be used over and over again.

Biological Catalysts

Chemical reactions inside living things are sped up by catalysts called enzymes.

Enzymes speed up chemical reactions inside the cells of all living things including plants, bacteria and us.

Enzymes are vital for our survival – without enzymes the reactions that we need to keep us alive wouldn't be able to happen quickly enough at our body temperature of 37°C.

Chemical Catalysts

Chemical reactions outside living things can be sped up using chemical catalysts.

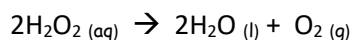
Catalytic converters are found in the exhaust systems of vehicles. They use metals such as platinum to speed up chemical reactions that can reduce the pollution released by the vehicle.

Catalysts are specific – you need different catalysts for different reactions.

The best catalyst for one reaction is unlikely to have any effect at all on a different reaction.

Using catalysts

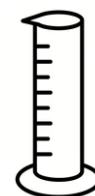
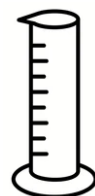
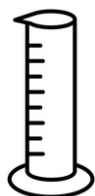
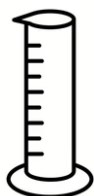
A chemical called hydrogen peroxide breaks down to produce water and oxygen.



This reaction happens very slowly, but it can be sped up using a catalyst.

We are going to try and find the best catalyst for the reaction.

Your teacher will set up five 250cm³ measuring cylinders. Each containing 1cm³ of washing up liquid. To each one a different catalyst will be added.



Catalyst:
0.5g of
manganese
dioxide

Catalyst:
0.5g of
lead
dioxide

Catalyst:
0.5g of
iron
oxide

Catalyst:
0.5g of
potato

Catalyst:
0.5g of
liver

Add 25cm³ of hydrogen peroxide to each measuring cylinder and time how long it takes for the measuring cylinder to fill with foam.

Time for
measuring
cylinder to fill
with foam:

Time for
measuring
cylinder to fill
with foam:

Time for
measuring
cylinder to fill
with foam:

Time for
measuring
cylinder to fill
with foam:

Time for
measuring
cylinder to fill
with foam:

Which was the best catalyst?

How could you prove that the gas produced in this reaction is oxygen?
