

Name:

Form:

Year 9 (2020)

REACTIVITY



1. Metals and Water
2. Metals and Acids
3. Displacement Reactions
4. Uses and Properties of Metals
5. Indicators, acids and alkalis
6. Making Salt Crystals
7. Neutralization and Heat
8. Acid Rain Research
9. Revision and Reflection on Learning
10. Assessment

9C Reactivity Target Sheet

Confidence codes: 1 – Novice / 2 – Competent / 3 - Expert

Lesson (textbook page(s))	LO	By the end of the unit you should be able to:	Confidence code: 1 / 2 / 3	Revised:	Practice d:
1 Acid and Metals	1	Organise metals into an order of reactivity based on their reactions with water and steam.			
	2	Describe the reactions, if any, between some metals and water.			
	3	Describe the reactions, if any between magnesium and steam.			
	4	Construct word, and simple balanced symbol equations from given formula, for metals reacting with water or steam.			
2 Metals, Acid and Oxygen	4	Rank metals in order of reactivity based on their reactions with acid and oxygen.			
	5	Construct word equations for metal + oxygen or metal + acid reactions.			
	6	Construct simple balanced equations for metals reacting with oxygen or acid from a given formula.			
	7	Explain what is meant by a fair test.			
3 Displace ment Reaction s	8	Recall that a more reactive metal will displace a less reactive metal from its compounds.			
	9	Deduce the order of reactivity of several metals from results of displacement reactions.			
	10	Construct word equations for displacement reactions.			
	11	Construct simple balanced equations for displacement reactions from given formulas.			
4 Properties and Uses 6 pH Indicator s	12	State a use of several common metals (Fe, Cu, Ag, Au).			
	13	Formulate a link between uses of metals and their properties.			
	14	Suggest why particular metals are used for certain purposes.			
	15	Identify and extract relevant information on the causes and effects of acid rain.			
	16	Recall the names and formula of some common acids, bases & salts.			
	17	Describe the use of UI to identify strong and weak acids and alkalis.			

5 Properties and Uses 7 Crystallisation	18	Describe the use of litmus, methyl orange & phenolphthalein to identify acids & alkalis.			
	19	Define the term neutralisation and determine the products made.			
	20	Describe how to produce dry crystals of a salt by reacting an insoluble metal oxide (or base) with acid.			
	21	Explain reasons for each step in the procedure to produce a salt.			
6 pH Indicators	22	Construct word equations, and simple balanced equations from given formula, for metal oxides or alkalis reacting with acids.			
	23	Recall that an alkali is a soluble base.			
	24	EXT: Define the terms hydrated, anhydrous and water of crystallisation.			
7 Using Heat.	25	Recall that neutralisation reactions produce heat (are exothermic).			
	26	Draw a line graph of experimental results with straight lines of best fit.			
	27	Describe how to use the temperature rise to determine the point of neutralisation of an acid and an alkali.			
8 and 9 Acid Rain	28	Identify and extract relevant information on the causes and effects of acid rain.			
10 Revision	29	Describe several causes, effects and ways to reduce acid rain.			

9C Reactivity Keyword Sheet

Word	Pronunciation	Meaning
acid	as-id	A substance with a pH less than 7
base		A chemical which reacts with an acid to form a salt.
alkali	al-ka-li	A soluble base
indicator	in-di-ca-ter	A substance which turns different colours in acid & alkali
litmus		A pH indicator which is red in acid and blue in alkali
Universal indicator		A pH indicator used to find the strength of acids and alkalis
Methyl Orange	meth-uh-l	A pH indicator which is red in acid and yellow in both neutral and alkali
Phenolphthalein	fin-nal-phay-lin	An indicator which is colourless in both acid and neutral. Pink in alkali.
salts		Compounds made in some reactions involving acids. They have a metal part and a non-metal part. The non-metal part is usually chloride, sulphate or nitrate (e.g. potassium sulphate).
weathered		Broken down by chemical or physical changes.
metal carbonate		A substance containing a metal, carbon & oxygen chemically bonded
metal oxide		A substance containing a metal and oxygen bonded together
neutralisation	neu-tra-li-sa-tion	Mixing an acid and a base together to make a solution with a pH of 7.
soluble		Able to be dissolved in water
insoluble		Not able to be dissolved in water
precipitate	pri-sip-i-tate	An insoluble solid made by mixing two solutions
combustion	com-bus-tion	A reaction where a substance burns in oxygen
Acid rain		Rain that is more acidic than normal
Fossil fuel		A fuel made from material which used to be living eg coal, oil
Displacement	Dis-play-s-ment	A displacement reaction is a type of reaction in which part of one reactant is replaced by another reactant.
Reactivity	Re-ac-tiv-vit-ee	The quality of being reactive or the degree to which something is reactive.

9C 1a Metals and Water

What to do: Fill in your observations during/after demonstrations.

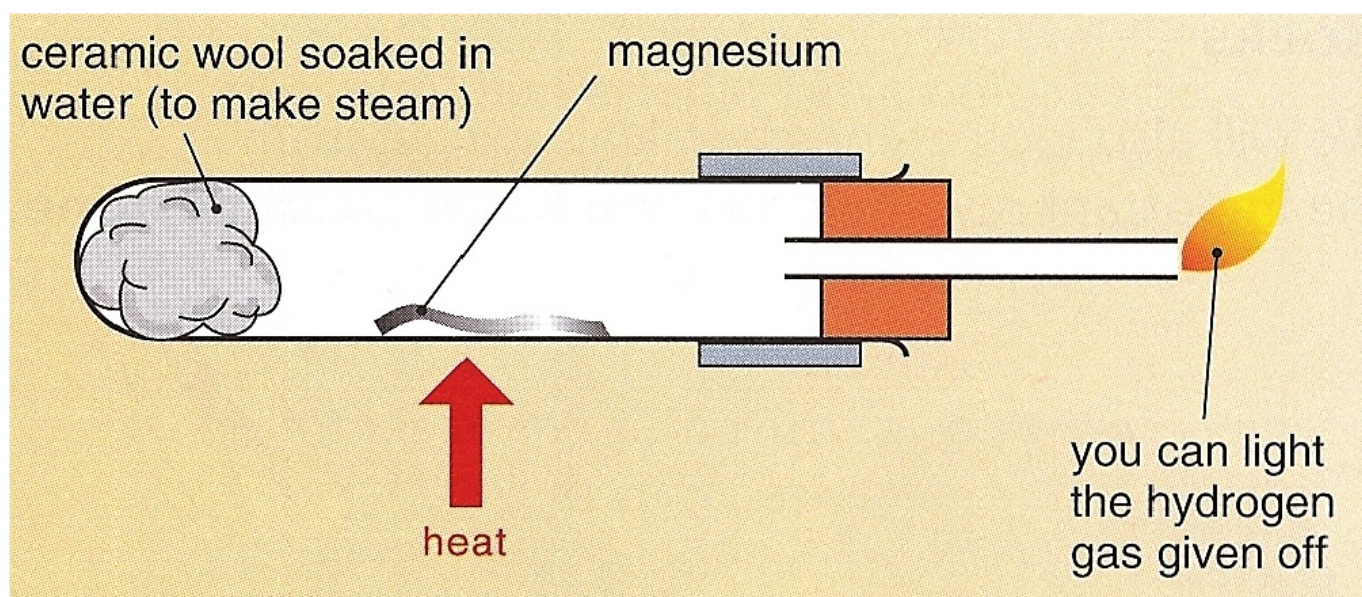
	Lithium	Sodium	Potassium	Calcium
Symbol				
Metal or Non-metal?				
Appearance		<i>Shiny silver only when freshly cut</i>		
Lighter or heavier than water				
Method of storage				
Reaction with water				

Products of reaction with water				
---------------------------------	--	--	--	--

Some metals do not react with cold water but will react with **steam**.

Suggest why

Your teacher will demonstrate **magnesium** and **steam**. Describe your observations.



Observations:

WORD EQUATIONS

Complete the following word equations for some of the reactions you observed:

Sodium + water →

Calcium + water →

Magnesium + steam →

More Challenging : BALANCED FORMULA EQUATIONS

Formula needed: **Mg** **Na** **H₂O_(l)** **H₂O_(g)** **MgO** **NaOH** **H₂**

Select the appropriate formula and write balanced formula equations for the reactions:

a) Magnesium and steam

b) Sodium and water

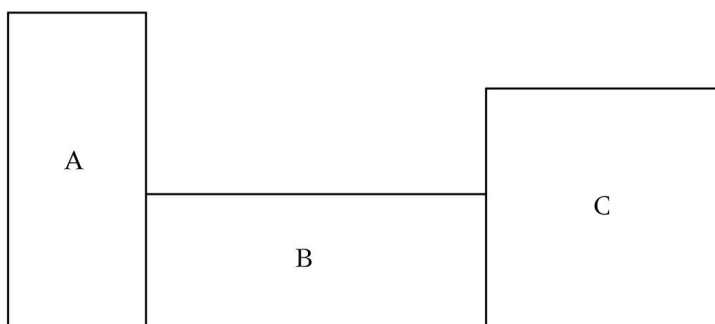
9C 1b Metals and Water Review

Choose your answers from the words in below. Each answer is used only once.

calcium copper iron lead magnesium potassium sodium

1. Give the name of:
 - a two metals which float on water and react very quickly to form alkalis
 - b a metal which burns with a bright white flame and reacts slowly with cold water
 - c a metal which goes rusty if you leave it in water
 - d a metal which reacts quickly with water and makes the water go white
 - e a metal which is still used for piping because it does not react with water
 - f a metal which used to be used for piping but is no longer used because of the risk of poisoning the water supply.

2. Look at the sketch of the Periodic Table.



Which section of the table includes:

- a unreactive metals and non-metals
- b the most reactive metals
- c metals that are less reactive.

3. Two of the metals in the list below react with water, giving off a gas and producing metal hydroxides. The other two metals do not react.

sodium lead copper calcium

a Which two metals do *not* react?

b Write word equations for the reactions of the other two metals with water.

4. Carlton wrote in his exercise book:

The metals that react best with oxygen are the same as the ones which react best with water. If you put them in order of reactivity, the order is exactly the same. All the metals which burn also react with water.

Do you agree with Carlton or not? Explain your answer.

Reactions with water

aluminium

Al

No reaction with cold or hot water. Will react with steam to produce aluminium oxide and hydrogen.



magnesium

Mg

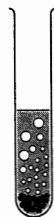
Very slow reaction with cold water. Slow reaction with hot water. Reacts readily with steam to form magnesium oxide and hydrogen.



calcium

Ca

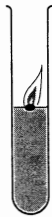
Reacts rapidly with cold water. Hydrogen gas is given off. The water turns milky white.



potassium

K

Violent reaction. Potassium floats on the surface of the water, melts and then catches fire. Burns with a lilac coloured flame. Hydrogen gas given off.



copper

Cu

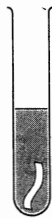
No reaction with cold or hot water. No reaction with steam.



silver

Ag

No reaction with cold or hot water. No reaction with steam.



gold

Au

No reaction with cold or hot water. No reaction with steam.



sodium

Na

Rapid reaction. Sodium floats on water, and moves around rapidly. Heat from the reaction melts the sodium. Hydrogen gas given off.



iron

Fe

Iron will rust slowly in cold water.



zinc

Zn

No reaction with cold or hot water. Will react slowly with steam to produce zinc oxide and hydrogen.



Reactions with oxygen

aluminium

Al

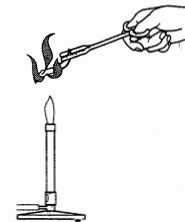
No reaction when in block form unless heated very strongly indeed. Burns readily in powder form.



magnesium

Mg

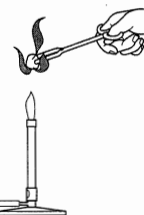
Magnesium ribbon burns brightly when heated in a flame. Magnesium powder burns very rapidly with a white flash.



calcium

Ca

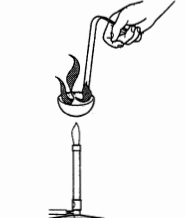
Calcium pieces burn strongly if heated in a flame for several minutes.



potassium

K

Melts very easily and then catches fire. Burns very rapidly with a lilac coloured flame.



copper

Cu

Metal glows red when heated in a strong flame but does not burn. There is a black coating on the metal at the end.



silver

Ag

No reaction in a flame. Silver will melt if it is heated to a high temperature, but it will not burn. Will react very slowly with the air to form silver oxide.



gold

Au

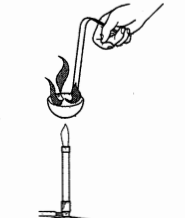
No reaction. Gold will melt if it is heated to a high temperature, but it will not burn. It does not oxidise in the air.



sodium

Na

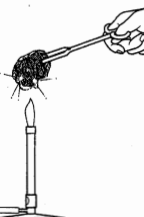
Melts easily and then sets on fire. Burns rapidly with a yellow/orange flame.



iron

Fe

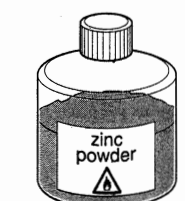
No reaction in block form. Fine wire or filings will sparkle when put in a flame. Iron will rust slowly in moist air.



zinc

Zn

No reaction when in block form. Burns in powder form.



9C 2b Reaction of Metals and Acids Practical

Aim: Rank metals in order of reactivity based on their reactions with acid. Construct word equations and simple balanced equations for metal + acid reactions.

Planning

1. What factors should you keep the same to make it a fair test?
 -
 -
 -
2. Why is it difficult in this case to make the test completely fair?

Materials required:

- Calcium metal
- Copper pieces
- Magnesium ribbon
- Iron nails
- Zinc pieces
- Dilute hydrochloric acid
- Test tube rack
- 5 test tubes
- Wooden splint
- Lighter
- goggles

Safety:

Do not touch the pieces of calcium. Your teacher will handle the calcium using forceps.

Wear eye protection

What to do:

1. Your teacher will add a piece of calcium to a test tube about 1/3 full with dilute hydrochloric acid. Note the results.
2. Fill a different test tube about 1/3 full with dilute hydrochloric acid.
3. Add a piece of one of the metals shown in the table below.
4. If any gas is given off, test it with a lighted splint.
5. Feel the tube to see if it is warm.
6. Look to see if the metal has reacted in the acid.
7. Record your results in the table.
8. Repeat the test with other metals.

Results :

Metal	Did you get bubbles?	Did the gas burn with a pop?	Did the metal react?	Did the tube get warm?
calcium				
copper				
iron				
magnesium				
zinc				

Analysis of your results :

How many metals reacted? _____

How many did not react? _____

What is the name of the gas that is given off ? _____

List the metals in order of reactivity, from the highest to the lowest.

1	_____
2	_____
3	_____
4	_____
5	_____

Write word equations for the reactions that have taken place.

More challenging: *(HINT: Look at the Powerpoint 'Reactivity' on ISLE if unsure)*

Write balanced equations for each of the word equations you gave above.

The formula for hydrochloric acid is HCl, hydrogen gas is H₂ and magnesium chloride is MgCl₂. All the other salts have a similar formula to magnesium chloride.

9C 2c Metals and Acids Review and Application

1. When metals react with acids, a gas may be given off.

a Name the gas_____

b How do we test for this gas? _____

2. Complete the word equations for these reactions. Here is an example:

calcium + hydrochloric acid → calcium chloride + hydrogen

a calcium + nitric acid → calcium nitrate + _____

b _____ + hydrochloric acid → zinc chloride + hydrogen

c magnesium + _____ acid → magnesium chloride + hydrogen

d _____ + sulphuric acid → iron sulphate + _____

3. Put these formulae next to the correct acid in the table below.



Acid	Chemical formula
nitric	
sulphuric	
hydrochloric	

4. You have got some sulphuric acid that you need to store. You could store it in a metal can, a glass jar or a plastic bottle.

Suggest advantages and disadvantages for each type of container, and say which one you think would be the best to choose.

Advantages of a metal can _____

Advantages of a glass jar _____

Advantages of a plastic bottle _____

Disadvantages of a metal can _____

Disadvantages of a glass jar _____

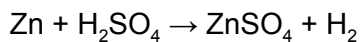
Disadvantages of a plastic bottle _____

Which would you choose? _____

Why? _____

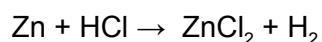
9C 2d Metals and Acids Formulae and Equations

- 1** The symbol equation for the reaction of zinc with sulphuric acid is:

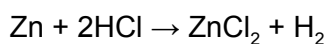


- a** How many atoms are there in a molecule of hydrogen gas?
- b** Name one compound in this equation that does not contain a metal.
- c** What is the name of the compound with the formula ZnSO_4 ?
- d** This is a *balanced* equation. Explain the meaning of 'balanced' in terms of numbers of atoms.
- e** Write a similar balanced symbol equation for the reaction of magnesium with sulphuric acid.

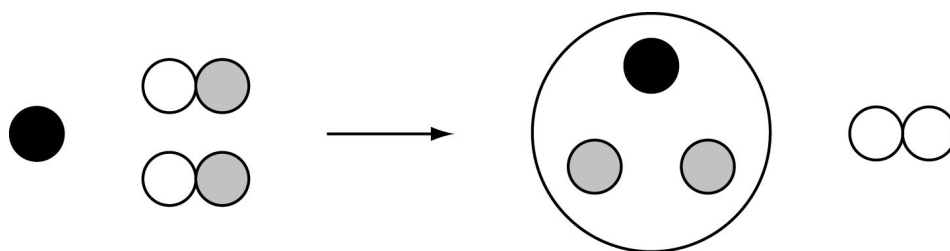
- 2** The formula of zinc chloride is ZnCl_2 . Here is an equation which shows the formulae of all the substances that take part in the reaction:



- a** Write the formulae for:
- the two reactants
 - the two products.
- b** The equation above is not fully correct. It is not balanced. Explain why it is wrong.
- The balanced equation is written like this:



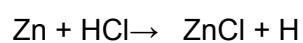
c This diagram illustrates the equation.



In the diagram, which symbol represents:

- i an atom of zinc
- ii an atom of hydrogen
- iii a molecule of hydrogen?

d Kevin wrote that the correct symbol equation should be



Kevin's equation is balanced, but it is not correct. Explain why Kevin's equation is not correct.

9C 3a Displacement Reactions

Aim: Deduce the order of reactivity of several metals from results of displacement reactions.
Construct word equations for displacement reactions.

Information

A **displacement reaction** is one where a **more reactive metal** will displace a **less reactive metal** from its compounds

Planning

- a Choose a colour, and underline the four elements on the results table overleaf.*
- b Choose a different colour, and underline the four compounds.*
- c Fill in the key by your table*

Materials required:

- Copper foil
- Magnesium ribbon
- Iron nails
- Zinc foil

Solutions of:

- Copper sulphate
- Magnesium sulphate
- Iron(III)sulphate
- Zinc sulphate
- Spotting tile

Safety:

Wear eye protection

What to do:

- 1 Fill 3 wells on a spotting tile (dimple tile) with copper sulphate solution.
- 2 Add 1 piece of zinc to one, an iron nail to the second and 1 piece of magnesium to the third.
- 3 Leave the solutions for several minutes. Check to see if there is any reaction. Look for:
 - colour changes on the surface of the metal
 - colour changes in the solution
 - bubbles of gas given off
- 4 Write your results in the table.
- 5 Repeat the experiment with the other solutions.

Results :

	copper sulphate	zinc sulphate	Iron sulphate	magnesium sulphate	total reactions
copper	X				
zinc		X			
iron			X		
magnesium				X	
total					

Key



elements



compounds

Order of reactivity of metals:

1 _____

2 _____

3 _____

4 _____

Order of reactivity of compounds:

1 _____

2 _____

3 _____

4 _____

Analysis

1. How does the list of metals compare with the list of compounds?
2. Here is a word equation for the reaction of lead with copper sulphate:

lead + copper sulphate → copper + lead sulphate

Write word equations ***for the reactions that took place*** in your experiments

9C 3b Reactivity Series of Metals

Aim: Recall the reactivity series of metals : *potassium, sodium, lithium, calcium, magnesium, aluminium, zinc, iron, (hydrogen), copper, silver and gold.*

Remembering the Reactivity Series

Find a way of remembering the Reactivity Series. Some ideas are given below:

1. Look for Patterns – colour all the Group 1 metals in red, group 2 metals in green, group 3 metals in yellow and transition metals in blue:

Potassium	K
Sodium	Na
Lithium	Li
Calcium	Ca
Magnesium	Mg
Aluminium	Al
Zinc	Zn
Iron	Fe
(Hydrogen)	(H)hydrogen is not a metal but sometimes reacts like one
Copper	Cu
Silver	Ag
Gold	Au

2. Make up a rhyme (or mnemonic). A suggestion is given below:

Potassium	Peter
Sodium	Smith
Lithium	Loves
Calcium	Catching
Magnesium	Monkeys
Aluminium	And
Zinc	Zebras
Iron	If
(Hydrogen)	His
Copper	Catch
Silver	Smells
Gold	Good

See if you can do better! Try making a rhyme of your own.

Share rhymes and vote for the best one – adopt it as a class mnemonic!

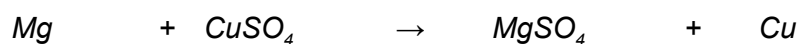
9C 3c Displacement Equations and Applications

1. Complete the following word equations and then use the formula given below to write balanced equations for these reactions. An example is done for you.



e.g.

magnesium + copper sulphate → magnesium sulphate + copper



a) zinc + iron chloride →

b) magnesium + copper oxide →

2. Explain what happens in a **displacement** reaction?

.....

3. Use the Reactivity Series to help you to decide which of the pairs below will react.

IF THEY DO REACT then complete the word equation, otherwise write 'no reaction'

Zinc + copper oxide →

Iron + magnesium oxide →

Magnesium + sulphuric acid →

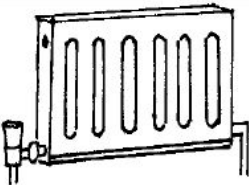
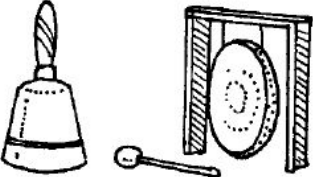
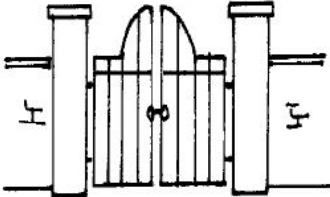
Copper + silver nitrate →

Copper + magnesium chloride →

4. You have 3 unknown metals A, B and C. You know that C displaces B from its oxide when heated. However, there is no reaction when C is heated with the oxide of A.

Rank the 3 metals in order of reactivity (most reactive first). Explain how you reached your decision.

9C 4a Metals in the Home Card Activity

	this hamster is kept in its cage by thin metal bars	strong
	copper, steel and aluminium are used for saucepans	malleable – can be bent into different shapes
	ladders are often made from aluminium	shiny
	the pins and cables in this plug are metal	strong but lightweight
	iron is used to make garden gates	good conductor of heat
	jewellery is made from different metals	ductile – can be stretched into thin wires
	bells and gongs are made of metal	good conductor of electricity
	radiators are made of metal	sonorous – they 'ring' when hit

9C 4b Metals in the Action Card Activity

Look at each of the 'Fact cards'. Each of the 'Reason cards' matches one of the 'Fact cards'. You could:

- write out each of the facts with the correct reason
- cut out the cards and stick each 'Fact card' next to the correct 'Reason card'.

Fact 1:

Ships made of iron sometimes have blocks of magnesium attached to the hull.



Fact 2:

Iron can be galvanised by coating it with zinc. This can protect the iron and stop it rusting.



Fact 3:

Steel cans are sometimes coated with tin. Dented cans can be dangerous because rust can get into the food.



Fact 4:

Although aluminium is more common in the ground than iron, in Victorian times aluminium was a very expensive metal.



Fact 5:

Ancient gold jewellery is often in very good condition when it is discovered.



Fact 6:

The bronze age came before the iron age.



Reason A

Zinc is a more reactive metal than iron. The zinc will react first so that the iron is protected.

Reason B

Tin is less reactive than iron, so rust will not affect the metal can in normal conditions. When the can is dented, the iron can be exposed, and rust can get into the food.

Reason C

Gold is an unreactive metal. Even after thousands of years it doesn't react with air or water.

Reason D

Aluminium is a reactive metal and it is very difficult to extract it from its compounds without modern technology.

Reason E

Magnesium is a reactive metal. The magnesium block reacts with the water before the iron. When the block has all reacted, it can be replaced before the hull of the ship gets damaged.

Reason F

Bronze is mostly made of copper. Copper is an unreactive metal. It is possible to make bronze by heating some types of rock in a fire. Iron ore has to be heated to a much higher temperature to make iron.

9C 4c Marketing Metals

Making and Presenting : Task Sheet

Aim: Formulate a link between uses of metals and their properties. Suggest why particular metals are used for certain purposes. Present information clearly and logically

We use metals for so many things but why is that?

For example, why do we use metals to make saucepans or church bells?

Why are car bodies made of so much metal?

Imagine you have just discovered metal; the world has never seen any metals before.



Your Task:

Design an **advertising poster** which will tell everyone exactly what metals are and what they can be used for.

- ☐ Include the properties all metals have.
- ☐ Also include properties only some metals have, giving examples.
- ☐ Link each property to a possible use, giving examples of where they could be used (obviously they already are, but just pretend!).
- ☐ Give **reasons OR explanations OR use detailed scientific knowledge** for why metals would be good for the uses you suggest.

The detail you give will depend on the level you are working at:

- 'reasons' **novice level**
- 'explanations' **confident level**
- 'detailed scientific knowledge' **expert level**

Use the 'ECN' Learning Ladder below to help you do your best.

Use your own words throughout the project and ensure any external sources of information are referenced accurately.

'ECN' LEARNING LADDER

Assessment level	The types of things you can do:
Expert	• Design a detailed poster, drawing on detailed scientific knowledge and understanding. • Explain at least seven properties of metals. • Link these properties to uses of metals, using some particle diagrams to explain why they are suitable. • Compare the suitability of metals for uses, considering more than one property. • Use a range of scientific words, symbols and units accurately.
Confident	• Design a poster, drawing on scientific knowledge and understanding. • Explain at least five properties of metals. • Link these properties to uses of metals. • Explain why some metals with the same properties may be better than others at given jobs. • Use a range of appropriate scientific words, symbols and units.
Novice	• Design a simple poster, drawing on some scientific knowledge and understanding. • Describe at least three properties of metals. • State roles that metals are suitable for, giving a reason. • State why some metals are not suitable for certain uses. • Use some appropriate scientific words, symbols and units.

9C 4d Properties of Metals and Non Metals

Your task is to fill in this table to compare the properties of metals and non-metals. You might use the internet, reference books and CD-ROMs to help you. (*This is revision of work you did in Year 8.*)

Property	Metal	Non-metal
Are they solids, liquids or gases at room temperature?		
Do they have high or low melting points ?		
Do they conduct electricity ?		
Do they conduct heat ? (ie conductor or insulator)		
Are they flexible or brittle ?		
Can they be shaped by hitting them with a hammer? This property is called malleability .		
What sound do they make if you hit them? sonorous		
Are they magnetic ?		
Are their oxides acids or bases ? (Remember an alkali is a soluble base.)		

9C 5a Acids and Alkalis Introduction

Acids

Most people are familiar with acids and some of the things that acids do, such as dissolving away metals and causing burns if it comes in contact with the skin.

Find out where these acids are found and write your answers in this table.

Acids	Places where found
acetic acid (ethanoic acid)	
formic acid (methanoic acid)	
citric acid	
oxalic acid	
hydrochloric acid	
tartaric acid	
lactic acid	

You may have been surprised to see hydrochloric acid in that list. It is used by the body to digest food. It is of course very dilute. Even the 'dilute acid' in the laboratory is much more concentrated.

In the **laboratory**, the main acids used are:

Acid	Chemical formula	
hydrochloric acid	HCl	These are used a lot
nitric acid	HNO ₃	
sulphuric acid	H ₂ SO ₄	
Phosphoric acid	H ₃ PO ₄	These are sometimes used
carbonic acid	H ₂ CO ₃	
nitrous acid	HNO ₂	
sulphurous acid	H ₂ SO ₃	

Bases

You may not be so familiar with the group of chemicals called ***BASES***. Bases are the chemical opposites of acid. They are oxides or hydroxides of metals. Some of the bases normally found in the laboratory are shown in the table below.

Bases	Chemical formula	solubility
copper(II) oxide	CuO	These bases are <i>insoluble</i> in water
iron(II) oxide	FeO	
zinc oxide	ZnO	
sodium hydroxide	NaOH	These bases are <i>soluble</i> in water

potassium hydroxide	KOH	
calcium hydroxide	Ca(OH) ₂	

The bases that dissolve in water are given a special name. They are called ***ALKALIS***. Sodium hydroxide, potassium hydroxide, and calcium hydroxide are all *ALKALIS*. One other alkali which is a little unusual is ammonium hydroxide, NH₄OH. It does not contain a metal like the other bases but is a solution of ammonia gas (NH₃) in water.

9C 5b pH Indicators

Aim: To describe the use of litmus, universal indicator, methyl orange & phenolphthalein to identify acids & alkalis

Background Scientific Information:

The presence of acids or alkalis may be shown using **INDICATORS**. An indicator changes from one colour when mixed with an acid, to another colour when mixed with an alkali.

e.g. litmus, methyl orange and phenolphthalein

pH and the strength of acids and alkalis

Different acids have different strengths, e.g. sulphuric acid is a strong acid and citric acid is a weak acid. The same applies to alkalis. Some are strong, some are weak. Sometimes it is useful to know the strength of acids or alkalis. Unfortunately, indicators such as litmus, methyl orange and phenolphthalein do not tell us which acids and alkalis are strong and which are weak. However, there is another indicator called Universal Indicator that can be used to tell the difference between strong and weak acids and alkalis.

Universal Indicator gives a different colour depending on the strength of the acid or alkali. The colour can be compared with a chart from which you can read a number known as the pH number.

Colour in this chart

1	2	3	4	5	6	7	8	9	10	11	12	13	14
STRONG ACID			WEAK ACID		NEUTRAL			WEAK ALKALI			STRONG ALKALI		

Method (Part 1):

1. Quarter fill three test tubes with distilled water.
2. Add a few drops of the **methyl orange** to the first test tube. Record the colour in the table below.
3. Repeat using the other two indicators (phenolphthalein and UI).
4. Repeat step 1 to 3 with all test substances.

(Part 2):

5. Line up several strips of red and blue litmus paper on a **white tile**.
6. Place approximately 2cm^3 of the household substance (salt solution, vinegar or lemon juice) in a test tube.
7. Use a glass rod to put few drops of test substance onto *both* litmus papers. (Rinse the glass rod each time)
8. Add 2 drops of UI solution to the substance in the test tube.
9. Record the results and complete the table on worksheet 1e.

Chemical required:

- ☐ Red and blue litmus papers
- ☐ Methyl orange
- ☐ Phenolphthalein
- ☐ Universal indicator

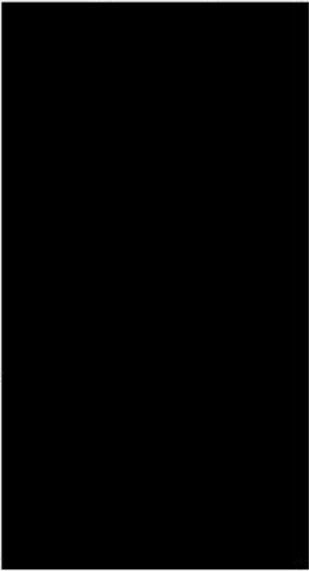
Part 1:

- ☐ Hydrochloric acid
- ☐ Distilled water
- ☐ Sodium hydroxide

Part 2:

- ☐ Salt solution
- ☐ Lemon juice
- ☐ Vinegar

Title: Results Table for Indicator Experiment

Substance\ indicator	Methyl orange	Phenolphthalein	Universal Indicator	Blue litmus	Red litmus	pH	Type of Substance
Sulphuric acid	Red	Colourless	Turned red	Red	Red	1	Strong acid
Distilled water							
Hydrochloric acid (HCl)							
Sodium hydroxide (NaOH)							
Salt solution							
Lemon juice							
Vinegar							

9C 5c Acids, Alkalis and Indicators - EXTENSION

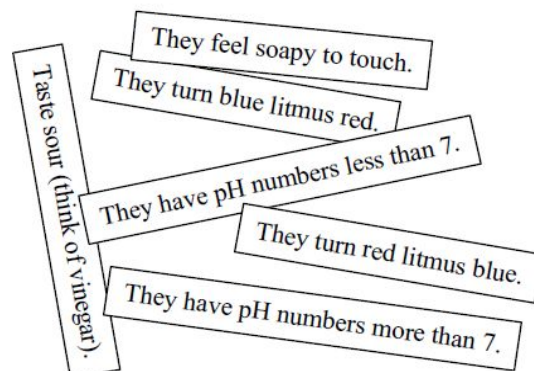
Acids, alkalis and indicators

10b

1. The sentences on the right are to do with acids and alkalis. Three describe acids, and the other three describe alkalis.

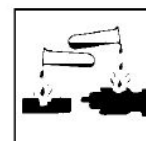
Make a table with the headings shown below, then copy the sentences into the correct columns. You will need four lines in your book.

Acids	Alkalis



2. Acids and alkalis often have one of these hazard symbols on the bottle.

Copy the symbols into your book. Find out what each one means. Write down what they mean next to the symbols in your book.



3. For each of these substances, write down whether they are:

strongly acidic, weakly acidic, neutral, weakly alkaline, or strongly alkaline.

- | | | |
|-----------------------------|-----------------|----------------------|
| a) grapefruit juice, pH 3.0 | c) beer, pH 5.0 | e) sea water, pH 8.5 |
| b) blood, pH 7.4 | d) rain, pH 6.2 | f) saliva, pH 7.0 |

4. Universal indicator paper has the following range of colours:

colour	red	orange	yellow	green	blue	purple
pH	0 – 4	5	6	7	8 – 10	11 – 14

An experiment to find the pH of some substances gave these results:

substance	colour of universal indicator paper
orange juice	red
egg white	blue
oven cleaner	purple
milk	yellow

For **each** substance, write down the **name** of the substance, its **pH**, and what the pH **means**.

5. Copy the table below into your book. Complete your table to show the colour that each indicator turns (if it does) in acidic, neutral and alkaline solutions.

	blue litmus paper	red litmus paper	universal indicator
acidic			
neutral			
alkaline			

6. Write a brief description of an experiment you have done to find out whether different substances are acidic, neutral or alkaline. You can do a diagram to help your answer if you want to.

Title: Making Salts

Salts are made when acids react with various substances such as alkalis, metals or alkaline solutions.

The name of the salt will depend upon the acid and the other substance in the reaction.

Here are some examples:

- Sulphuric Acid + Copper Oxide → Copper Sulphate
- Hydrochloric Acid + Magnesium → Magnesium Chloride
- Sulphuric Acid + Copper Oxide → Copper Sulphate
- Nitric Acid + Zinc → Zinc Nitrate

Acid	Substance	Salt Formed
Hydrochloric	Copper Oxide	
Hydrochloric	Calcium Carbonate	
Sulphuric Acid	Magnesium Oxide	
Sulphuric Acid	Zinc	
Nitric Acid	Magnesium	
Nitric Acid	Sodium Hydrogen Carbonate	

Conclusion:

1. When a substance reacts with hydrochloric acid a _____ is formed.
2. When a substance reacts with sulphuric acid a _____ is formed.
3. When a substance reacts with nitric acid a _____ is formed.
4. The other products in the reactions are _____ , _____ and _____.

Title: Making Copper Sulphate Crystals

Aim: To produce pure, dry crystals of copper sulphate by reacting a base (copper oxide) and sulphuric acid

Materials required

Dilute (0.5M) sulphuric acid
Copper oxide
Filter paper, filter funnel
250cm³ beaker
Glass rod
250cm³ conical flask
Evaporating basin
Tripod, gauze, bunsen

Safety.
Wear safety goggles.
Be careful when heating the acid using the Bunsen.
Heat the acid for just 1 minute.

Method

Put 50cm³ of dilute sulphuric acid in a 250cm³ beaker using a measuring cylinder.

Very carefully heat the acid using a Bunsen for 1 minute.

Turn off the Bunsen burner.

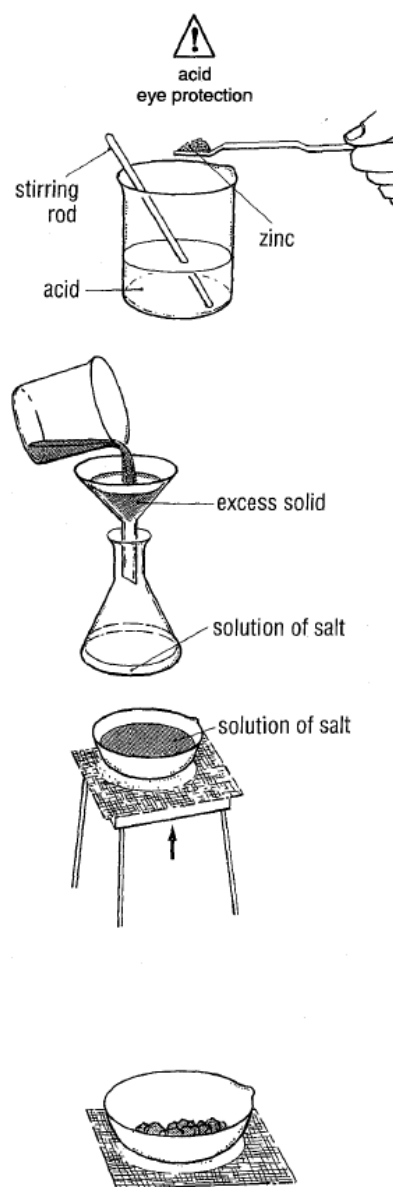
Add the copper oxide base to the acid *one spatula measure at a time*, until no more reacts. **Stir** the mixture with a glass rod.

Filter the mixture. Collect the liquid (**filtrate**) in a conical flask.

Put the liquid in an evaporating dish. You should only fill this up to 2/3 full. Carefully **evaporate** the filtrate to *half its original volume*. (Heat gently to stop the solution from spitting).

Leave the basin to *cool*. The *crystals* of salt should form slowly. This may take a few days and is best left on the window sill in the lab.

After the crystals have formed, **decant** the excess solution and **blot** the crystals **dry** on a paper towel.

**Considering Your Results**

Pictures of the different stages of preparation are shown. Draw **diagrams** of each stage – use a pencil & ruler and draw in 2D.

Describe the colour, shape and size of the crystals. Are they transparent and clear or dull and opaque? This will tell you how pure the salt crystals are.

Extension: How are the size of the crystals related to the speed of evaporation?

Questions on Acid Base Salt Preparation₂₀₁₇**Questions:**

Copper sulphate crystals were made by adding **excess base** to an **acid**.

Bases are **metal oxide** solids (e.g. copper oxide, CuO)

Q1:

i) Name and give the *formula* of the **acid** used to make **copper sulphate** crystals.

name:.....*formula:*.....

ii) Give the name and formula of the **base** used to make these **salt** crystals.

name:.....*formula:*.....

Complete the general equation that describes this reaction.

ACID + BASE +

Write a **word** and **chemical equation** for this reaction

.....
.....

During this reaction, the acid becomes neutral. How could this be tested?

When an acid is made neutral, what type of reaction is this called?

Why was **excess** copper oxide used in this reaction?

How was the excess copper oxide removed?

Why was the solution only partially evaporated?

Describe how **dry** crystals are obtained from the cooled solution.

Alkalis are soluble bases.

Alkalis are soluble **metal hydroxide** solutions. (e.g.sodium hydroxide NaOH).

Alkalis react in the same way as **bases**.

j) Complete the general equation that describes a reaction between an acid and an alkali.

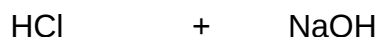


k) Are alkali's solids or solutions?

Are alkali metal oxides or metal hydroxides?

Complete this equation about how an alkali and an acid react.

Hydrochloric acid + sodium hydroxide



The acid is made into a neutral substance during this reaction. If the salt were tested with U.I paper, what colour should it be?

Q2. Give the word equations and symbol equations for the following acid base reactions.
(you will need these formula **ZnSO₄** and **KNO₃**)

a)i) Sulfuric acid + Zinc oxide



b)i) Nitric acid + potassium hydroxide.



EXTENSION:

The crystals of copper sulphate contain **water of crystallisation**.

This is water which is *chemically joined* to the crystals. The crystals are said to be **hydrated**.

If **hydrated copper sulphate** crystals are heated they give off steam and **anhydrous copper sulphate** is formed.



Write the formula for **hydrated** copper sulphate.

Write the formula for **anhydrous** copper sulphate.

Using the Heat

Aim: Recall that neutralisation reactions produce heat (are exothermic). Describe how to use the temperature rise to determine the point of neutralisation of an acid and an alkali. Draw a line graph of experimental results with straight lines of best fit. Make a conclusion by explaining what your results show.

Introduction

When an **acid** reacts with an **alkali** a **neutralisation** reaction occurs:



Suggest, using previous knowledge, how you could find the volume of acid needed to exactly neutralise 20cm³ of an alkali.

.....
Neutralisation reactions **produce heat** and the temperature rises during the reaction. The reactions are said to be **exothermic**. This heat can also be used to determine the volume of acid required for neutralisation.

What to do:

Obtain a polystyrene cup with a lid and sit it in a 250cm³ beaker to give it stability.

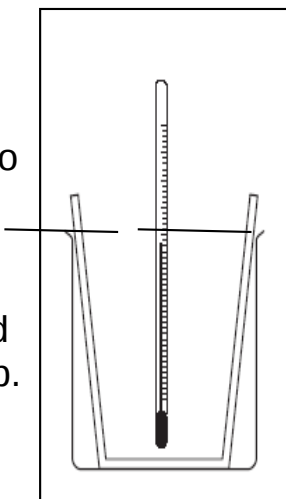
Use a 25cm³ measuring cylinder to carefully measure out 20cm³ of sodium hydroxide solution and pour this into the polystyrene cup.

Record the temperature of the alkali.

Using a 10cm³ measuring cylinder carefully measure out 5cm³ of hydrochloric acid solution. Pour this into the sodium hydroxide solution and stir.

Record the new temperature.

Repeat steps 4 & 5 until you have added a total of 40cm³ of hydrochloric acid



Materials required

Polystyrene cups + lids
250cm³ beakers
Thermometers
25cm³ and 10cm³ measuring cylinders
Glass rod
2 teat pipettes
1M hydrochloric acid
1M sodium hydroxide

Safety.

Sodium hydroxide is corrosive
Hydrochloric acid is an irritant
Wear safety goggles

Q: Why was a polystyrene cup used in the experiment rather than a glass beaker?

Results:

Volume of sodium hydroxide used =

Analysis of your results:

*The rest of the report should be completed on A4 paper or a google doc.
State your answers clearly so that they make sense without having to look back at the questions*

Plot a graph of volume of acid (x-axis) vs temperature of solution (y-axis)

Draw **TWO** best fit straight lines through the points, starting from both ends of the graph, meeting at a peak (*your teacher may show you a powerpoint of what this graph looks like OR may ask you to look at it on ISLE*)

The point where the lines cross on the graph indicates the maximum temperature reached in the experiment.

What was the maximum temperature in your experiment (**from the graph**)?

What volume of hydrochloric acid exactly neutralised the 20cm³ of sodium hydroxide solution?

What was the reacting ratio of volume of sodium hydroxide: volume of hydrochloric acid?

Why did the temperature start to fall after neutralisation?

Write a word equation for the reaction.

Write a balanced equation for this reaction. (*You should know the formulas of all the substances from the acids topic – look them up if you have forgotten!*)

What is the reacting ratio of sodium hydroxide to hydrochloric acid from your equation? Does this agree with what you obtained in the experiment?

Suggest 3 reasons that the results to this experiment are not totally accurate and suggest ways to improve the accuracy.

Title: Acid Rain (Communication Skills)

- **Aim:** To know the causes, effects and ways to reduce acid rain and to use your communication skills to clearly explain these concepts.

Starter question to think about:

- What is the pH of normal rain?
- What is acid rain?
- Name two gases that dissolve in the rainwater to create acid rain?
- What are the causes of acid rain?
- What are the effects of acid rain?
- Who or what is affected by acid rain?
- What substance is able to neutralise some of the acid rain & where does this substance come from?
- How can we prevent and reduce the levels of acid rain?
- Where in the world does acid rain form most often?
- Is acid rain a major problem in Hong Kong?

Resources

- 'Reading About Chemistry' by Lawrie Ryan
- Sc9.3 Acids & Bases on ISLE

**Include a
bibliography,
correctly listed, with
your report.**

Your Task:

You are to use this class period to get a general idea about what acid rain is and what the causes and effects of acid rain are – some starter questions are given above. You then need to research more about acid rain and prepare your information in one of the following ways:

- a letter to the government
outlining your concern of the growing levels of acid rain in your area (this place can be fictional), describing the effect it has on the people, animals, wildlife, parks etc in your area, and list some strategies or ideas on how the government can reduce the level of acid rain.
- an informative poster or information leaflet
design a creative poster (or information leaflet) clearly illustrating the causes and effects of acid rain. Include a section which shows how to prevent or reduce levels of acid rain. This needs to be clearly set out, easy to read and informative.
- powerpoint
produce a powerpoint clearly illustrating the causes and effects of acid rain. Include a section which shows how to prevent or reduce levels of acid rain. This needs to be clearly set out, easy to read and informative.
- a case study
research into a particular area/town that is affected by acid rain. Give the reader a bit of background information on the area, for example information on the population, climate, and other relevant features. Discuss the effects the acid rain has had on the area and the measures they are taking to deal with the problem.

The Good Project Guide

Whenever you do research, use this research guide to get the best information.

Research tips

- Decide on **what** you are trying to find out.
- Decide on **keywords** that will be useful.
- Use the **internet, magazines or books** to find the information you need.
- Select the **relevant** information.
- Present the relevant information using your **own words**. Use tables or diagrams to present information and explain it.
- **List** all your sources of information in a '**Bibliography**' at the end of your work.

Literacy checklist

Make sure you have:

- Written with the **audience** in mind.
- Started each **sentence** with a **capital letter**.
- Written **correct sentences** (e.g. with full stops at the end, correct use of commas).
- Organised your sentences into **paragraphs**.
- Checked your **spelling** of simple words and science keywords.
- Used **apostrophes** to show contraction and possession.

Internet safety

Good internet research skills are valuable in the modern world. Be safe online! Use the websites your teacher suggests first, make sure your filters are set to 'safe', search responsibly, don't give out personal information and tell an adult or use the CEOP button if you find something that upsets you.

A good bibliography

A good bibliography allows the reader to find out exactly where you found the information.

Websites:

www.sciencestuff.com (date accessed) – do not just name your search engine!

Books:

A. Scientist (Year) Science for All.
Publisher pp. 23-29.

Magazines:

Author Name (Year) Title of article, Title of Magazine, edition number, page numbers.

Read with caution

When reading information, think about the following things:

- When was it written?
- Who wrote it?
- Why did they write it?
- What evidence is used to support claims?
- Does the article contain facts or opinions?
- Is the source reliable?

Make sure you check information for bias (one-sided). If it is biased, try to find some information that takes the opposite view.

Year 9 Science

Communication Skills

Complete the following self-evaluation by ticking the boxes. Reflect on your/your partner's performance on this task and try to set some targets to improve.

N = Novice

R = Reasonable

G = Good

E = Expert

	N	R	G	E
1. Structure: Your work or presentation is really well organized and structured. This helps you communicate your understanding to others.				
2. Knowledge and understanding: You really understand the concepts that you are presenting and have lots of knowledge about this topic or concept. This helps you to communicate to others to help them understand.				
3. Use of Scientific Words & Terminology: You use lots of important and relevant scientific terms, symbols, words and equations. This helps others better understand your work.				
4. Use of Scientific Diagrams, Photo's, Video clips, and Simulations: You use relevant digital media to help explain concepts and ideas.				
5. Clarity of Communication: Your written, oral or digital media presentation is really clear, confident and easy for others to follow. For oral presentations, your tone, speed and volume of voice is really easy for others to follow.				
6. Engaging and Interesting: You make your presentation interesting and show lots of enthusiasm and passion. You use words, phrases, pictures or media applications that really capture the imagination of your audience.				
7. Reading and use of Sources: You have done lots of background reading to help you make your presentation. You quote at least 2 or 3 sources of information at the end of your presentation.				
8. Summarizing: You are able to sum up concisely, so that your audience is clear what your final thoughts, opinions or conclusions are.				
9. Quality of final product: Your presentation is of a really high standard. Your audience, either reading or listening, seems to really understand what you are trying to communicate.				
10. Non-verbal Communication (oral presentations only): You are confident and mature. You use body language that engages your listeners and helps them to understand.				

Highlight a few of these skills as targets for your future development. If you want, give yourself a grade and discuss these targets with your teacher/tutor/parent or a friend.

Mainly Expert = A*(7)

Mainly Expert/Good = A(6)

Mainly Good = B(5)

Mainly Good/Reasonable = C(4)

Mainly Reasonable = D(3)

Mainly Novice/Reasonable = E(2)

Mainly Novice = F(1)

Grade =

(if appropriate)

Student/peer feedback.

This was good because.....

Student/peer Targets: The most important thing I learnt was.....

This could be better if.....

Teacher/tutor/friends signature _____

Parent/student signature _____

Title: Acid Rain – guided internet activity

- **Aim:** To know the causes, effects and ways to reduce acid rain.

Visit: https://www3.epa.gov/acidrain/education/site_students/index.html

Click on ***What is Acid Rain?***

Explain in your own words what acid rain is.

What pH is an acid? _____

What pH is a base? _____

What do you call a solution that is neither acidic or basic? _____

Click on ***What causes acid rain?***

Explain in your own words what causes acid rain?

What human activities do we do that causes acid rain?

Click on ***Why is acid rain harmful?***

What respiratory problems can result from air pollution?

Why is acid rain harmful to forests?

What are the effects to lakes and streams from acid rain?

What can happen to building as a result of acid rain?

Click on '***What is being done?***

Explain what is being done to reduce the level of acid rain?

Click on '***What can you do?***

List three things that you can do to help reduce the level of acid rain?

Click on ***Watch an Acid Rain Animation***

Watch the animation and then write down three facts from the animation below

Click on ***Food Web***

How does acid rain affect an entire food web?

Click on ***Games and Activities***

Click on the last activity – crossword puzzle and complete the crossword. When you have finished print it out and show your teacher.

Title: Acid Rain – guided internet activity part 2

Visit: <http://pubs.usgs.gov/gip/acidrain/2.html>

What does Acid Rain mean?

What pH is distilled water? _____

What pH are liquids that are termed acidic? _____

What pH is normal (clean) rain? _____

What reacts with the water in the air to make rain form carbonic acid?

What are the two pollutants in the atmosphere that cause acid rain?

Where do these pollutants come from?

Study the map of the United States on the website:

What area has the most acidic acid rain? _____

What area has the least acidic acid rain? _____

What is acid rain increasing the deterioration of in Europe?

<http://www.ec.gc.ca/acidrain/>

Click on Acid Rain and the

What causes Acid Rain?

When does damage occur?

What colour will an acid turn blue litmus paper? _____

What can strong acids do? _____

What is a pH scale used for?

What pH is battery acid? _____

What pH is baking soda? _____

Is baking soda an acid or a base? _____

What pH are acids? _____

What pH are bases? _____

What is a solution called that is neither acidic or basic? _____

Complete these statements about the pH scale:

The smaller the number the more _____ the solution

The higher the number the more _____ the solution

Small changes on the pH scale actually mean _____ changes in acidity

Rain measuring between _____ and _____ is acidic and therefore called acid _____

What is sulphur dioxide a by product of?

Look at the pie chart of SO₂ emissions from Canada and answer the following questions

What percentage of SO₂ emissions was from industrial sources? _____

What percentage of SO₂ emissions was from transportation? _____

Quick Quiz : Reactivity Topic

- 1** The gas in the air that reacts with metals most easily is:
A argon. **B** carbon dioxide. **C** nitrogen. **D** oxygen.
- 2** A metal that does not react with the air is:
A calcium. **B** gold. **C** iron. **D** magnesium.
- 3** The gas which is given off when metals react with water is:
A carbon dioxide. **B** hydrogen. **C** oxygen. **D** nitrogen.
- 4** Sodium reacts with water to form:
A sodium chloride.
B sodium oxide.
C sodium hydroxide.
D sodium carbonate.
- 5.** The gas which is given off when metals react with acids is:
A carbon dioxide. **B** hydrogen. **C** oxygen. **D** nitrogen.
- 6.** When magnesium reacts with sulphuric acid, it forms:
A magnesium oxide.
B magnesium chloride.
C magnesium sulphate.
D magnesium carbonate.
- 7** Choose the correct statement to complete this word equation:
zinc + sulphuric acid $\rightarrow$
A zinc + sulphur + acid
B zinc hydrate + sulphur
C zinc sulphate + hydrogen
D zinc hydroxide + hydrogen

8. Iron is more reactive than copper. If a piece of iron is put into copper sulphate solution, what would you see?

- A Brown copper would appear on the iron.
- B Blue copper would appear on the iron.
- C Nothing would happen.
- D the iron would dissolve completely.

9 Zinc is more reactive than tin. It will displace tin from a compound. Choose the correct statement to complete this word equation:

zinc + tin sulphate $\square$

- A zinc + tin sulphate
- B zinc + zinc sulphate
- C tin + zinc sulphate
- D tin + zinc chloride

10 Copper is more reactive than silver. Iron is more reactive than copper. This means that:

- A copper will react with iron nitrate solution.
- B silver will react with iron nitrate solution.
- C iron will react with silver nitrate solution.
- D silver will react with copper nitrate solution.

11 Zinc reacts with copper sulphate solution and silver nitrate solution. This means that zinc:

- A is more reactive than copper and silver.
- B is less reactive than copper and silver.
- C is less reactive than copper but more reactive than silver.
- D is less reactive than silver but more reactive than copper.

12 Which of these materials is used to make most car bodies?

- A plastic
- B aluminium
- C copper
- D steel

13 Some window frames are made of aluminium. It is a good metal to use because:

- A it conducts electricity.
- B it conducts heat.
- C it does not melt easily.
- D it does not react very quickly with air or water.

14 Magnesium would react more slowly with acid if you:

- A added more acid.
- B added more water.
- C heated the acid.
- D used a more concentrated acid.

15 Which of these statements is true?

- A Many reactive metals have been known since ancient times.
- B Magnesium was discovered before iron.
- C Reactive metals can be extracted by heating their compounds with charcoal.
- D Most reactive metals were discovered after the invention of the electric battery.

Questions: Acids and Bases

- 1 When some acid is put onto a piece of metal:
A there is always a reaction which burns a hole in the metal.
B there is never a reaction.
C some metals will react with the acid and produce bubbles of gas.
D there is always a reaction, which produces a powder.
- 2 Which of the following is the correct way to test for hydrogen gas?
A Bubble the gas through limewater.
B Bubble the gas through universal indicator solution.
C Put a glowing splint into a tube of the gas (the splint will burn brightly).
D Put a burning splint into a tube of the gas (the gas will explode with a squeaky pop).
- 3 If an acid reacts with a metal, the products are:
A a salt and water.
B a salt and hydrogen gas.
C only hydrogen gas.
D a salt, water and carbon dioxide.
- 4 Which of the following is **not** needed to make a prediction about the products of a reaction between a metal and an acid?
A general information about the reactions between metals and acids
B information about the properties of the metal
C the name of the metal used
D the name of the acid used
- 5 When some acid is put onto a piece of rock:
A it always reacts and gives off a gas.
B it reacts if the rock contains a carbonate.
C it always reacts explosively and shatters the rock.
D it won't react.
- 6 The best test for carbon dioxide uses:
A universal indicator solution. B a burning splint.
C litmus paper D limewater.
- 7 When an acid reacts with a metal carbonate, the products are:
A the metal and carbon dioxide.
B a salt and water.
C carbon dioxide, water and a salt.
D the metal, a salt and water.
- 4 Which of these is **not** a sign that a reaction has taken place?
A The substance catches fire.
B The substance has changed from a solid to a liquid.
C A gas is given off.
D There is an explosion.

- 8 A neutral solution is made when:
 A two acids are added together.
 B an acid and an alkali are added together.
 C water is added to an acid.
 D water is added to an alkali.
- 9 When an acid and an alkali react together:
 A a salt and water are both produced.
 B only a salt is produced.
 C a metal is formed.
 D a gas is given off.
- 10 Which of these word equations is correct?
 A copper oxide + hydrochloric acid $\rightarrow$ copper sulphate + water
 B copper oxide + hydrochloric acid $\rightarrow$ copper chloride + carbon dioxide + water
 C copper oxide + hydrochloric acid $\rightarrow$ copper chloride + hydrogen
 D copper oxide + hydrochloric acid $\rightarrow$ copper chloride + water
- 11 Which of these is **not** a salt?
 A magnesium sulphate
 B iron sulphide
 C tin chloride
 D zinc nitrate
- 12 Which of the following is **not** responsible for making rainwater acidic?
 A lead dioxide
 B carbon dioxide
 C sulphur dioxide
 D nitrogen dioxide
- 13 Which of the following is one of the main causes of acid rain?
 A weathering of rocks
 B photosynthesis in plants
 C power stations burning fossil fuels
 D farmers putting peat on their soil
- 14 Which of the following types of rock is most affected by acid rain?
 A slate
 B granite
 C marble
 D sandstone

Summary Sheets – Acids, Bases & Salts

Acids and alkalis

Indicators are coloured dyes which often come from plants such as red cabbage and beetroot.

Acids make indicators change colour. **Litmus** is an indicator which turns **red** in acids. Common acids include **vinegar** and **lemon juice**.

Alkalis have a different effect on indicators to acids. Litmus turns **blue** in alkalis.

The strengths of acids and alkalis can be measured on the **pH scale**, which runs from 1 to 14. pH numbers **1 to 6.9** are acids, **7** is neutral, and **7.1 to 14** are alkalis. You can find out the pH number using a **universal indicator**, or by using a **pH meter**.

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

Metals and acids

Many metals react with acids. Some unreactive metals will only react very slowly with strong acids, some will not react at all. Some metals are more reactive and explode when added to acid.

When a metal reacts with an acid, **hydrogen** gas is given off. The reaction also produces a compound called a **salt**.

There are three main types of **salt**:

Chlorides are made when **hydrochloric** acid is used.

Sulphates are made when **sulphuric** acid is used.

Nitrates are made when **nitric** acid is used.

We can test for **hydrogen** by putting a **burning splint** into a test tube of gas. If hydrogen is present, it will explode with a **squeaky 'pop'**.

KEY WORDS: red, vinegar, indicators, universal indicator, lemon juice, blue, hydrogen, burning splint, hydrochloric, nitric, sulphuric,

The general equation is:



For example:



Bases

Bases are compounds which react with acids. All **metal oxides**, **metal hydroxides** and **metal carbonates** are bases. Bases which dissolve in water are called **alkalis** (e.g. sodium hydroxide).

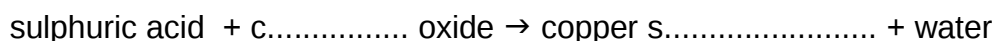
Metal oxides and hydroxides and acids

A metal oxide or a metal hydroxide reacts with an acid to form water and a salt. This reaction is called **n.**

The general equation is:



For example:



We can check to see if neutralisation has occurred using universal indicator. The pH of the solution gets closer to neutral (pH7).

Metal carbonates and acids

A metal carbonate will also neutralise an acid. This time the products are a salt, carbon dioxide and water.

The general equation is:



For example:



We can test for **carbon dioxide** using **l.** Limewater goes milky if carbon dioxide is bubbled through it.

Some rocks, like **l.** and **m.**, contain calcium carbonate. The rock fizzes when an acid is added and some of the rock is worn away. The rock is **weathered**.

KEY WORDS: neutralisation, copper, sulphate, zinc, limewater, hydrogen, carbon dioxide, limestone, marble

Preparation of Salts: Soluble Salts

Dry crystals of **soluble salts** can be prepared by reacting an acid with a metal, metal oxide or metal carbonate:

1. Measure out 25cm³ of **acid** using a m..... C.....
2. Add **excess solid** to the acid and stir
3. **F.....** off the excess solid
4. Pour the filtrate into an e..... basin
5. Heat to **partially e.....** the solution
6. Leave the solution to **c.....** and **c.....**
7. **Decant** the excess solution and blot the crystals **dry** on a paper towel

Acid Rain

The air contains small amounts of the following gases:

- **carbon dioxide**, produced by **combustion** of fuels and **respiration**
- **sulphur dioxide**, formed when sulphur burns in volcanoes
- **nitrogen oxides**, produced during lightening storms.

These gases dissolve in water to form acids, so rainwater is naturally acidic (pH between 5.6 and 5.9).

Our rainwater has become even more acidic (pH between 3 and 5.5) due to air pollution from burning **f..... f.....**. This is what we call **acid rain**. The main sources of this pollution **are p..... s.....** and **cars**. Both power stations and cars burn large amounts of fossil fuels and release more carbon dioxide, sulphur dioxide and nitrogen oxides.

S..... d..... and **nitrogen oxides** are the main contributors to acid rain.

The **g.....** the **concentration** of these gases, the **f.....** the rate of reaction.

KEY WORDS: measuring cylinder, evaporating, filter, evaporate, crystallise, power stations, wash, cool, fossil fuels, greater, sulphur dioxide, faster

Problems caused by acid rain

Acid rain causes damage to our environment in several ways:

- M..... and c..... rocks (like limestone and marble) react faster with acid rain than with normal rainwater.
- P..... and w..... l..... are damaged and killed by acid rain.

Pollution has been reduced by several actions:

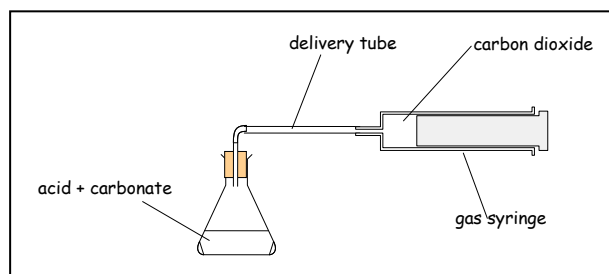
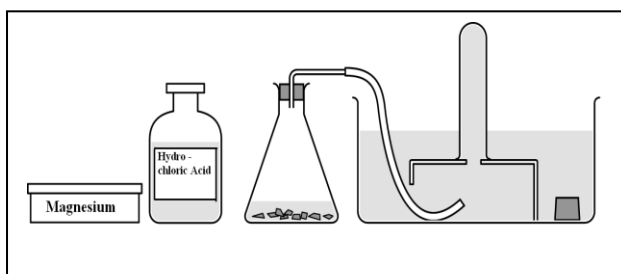
- reducing the sulphur content in diesel and petrol so less sulphur dioxide is produced by combustion
- fitting **c.....** **c.....** in car exhausts, which change harmful gases into harmless gases
- spraying the gases from power station chimneys with an a..... mixture to remove sulphur dioxide.

Making and Collecting Gases

H..... is made by reacting **magnesium** or **zinc** with **acid**

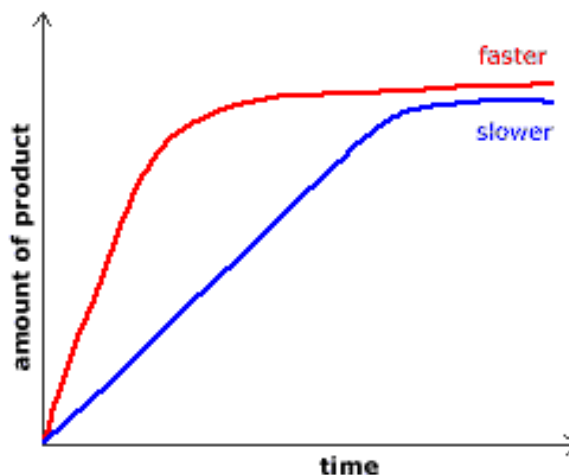
C..... **d.....** is made by reacting **marble chips** with **acid**

Gases can be collected in one of the following ways:



Measuring Rates of Reaction

The rate of a reaction can be measured by measuring the volume of gas produced at regular time intervals and then plotting the results on a graph of volume vs time. The steeper the slope, the faster the rate of reaction.



KEY WORDS: carbonate, plants, metals, catalytic convertors, water life, alkaline, hydrogen, carbon dioxide,

Title: Acids & Salts Revision Questions**Aim:** To review ideas and consolidate learning**Questions:**

1. Give an example of:

- a) a strong acid b) a weak acid
c) a strong base..... d) a weak base(4)

2. State whether the following substances are strongly acidic; weakly acidic; neutral; weakly basic or strongly basic:

3. In this topic you made different salts. Salts are made when an acid is **neutralised** by a base or when an acid reacts with a metal or a carbonate.

Complete the following by filling in the blank spaces and by naming the compounds.

Sulphuric acid (formula H_2SO_4) forms a salt called

Hydrochloric acid (formula HCl) forms salts called

.....(formula HNO_3) forms salts called nitrates

4. Metals above hydrogen in the reactivity series react with acids as follows:

Complete the following word equations by writing the names of the substances in the appropriate place.

zinc + sulphuric acid + 2

magnesium + hydrochloric acid + 2

iron + sulphuric acid + 2

5. Bases react with acids as follows;

Complete the following word equations:

a) *copper oxide + sulphuric acid* + 2

b) *magnesium oxide + nitric acid* + 2

c) *iron oxide + hydrochloric acid* + 2

6. Metal carbonates react with acids as follows;

Complete the following word equations:

copper carbonate + hydrochloric acid + + 3

calcium carbonate + hydrochloric acid + + 3

zinc carbonate + sulphuric acid + + 3

7. Alkalis are soluble bases and these react with acids in a similar way to bases;

Complete the following word equation:

a) *sodium hydroxide + hydrochloric acid* + 2

Acids & Salts Revision Questions

Q8. Hydrochloric acid is a strong acid.

(a) Winston used universal indicator solution to find the pH of some hydrochloric acid.

(i) Suggest the **colour** of the universal indicator in the hydrochloric acid.(1)

(ii) Suggest the **pH** of the hydrochloric acid. (1)

Q9. (a) Neutral litmus paper is purple in neutral solutions, red in acids & blue in alkalis.
Use this information to answer the questions.

(i) A piece of neutral litmus paper turned red in some grapefruit juice. What does this show about the grapefruit juice?

..... (1)

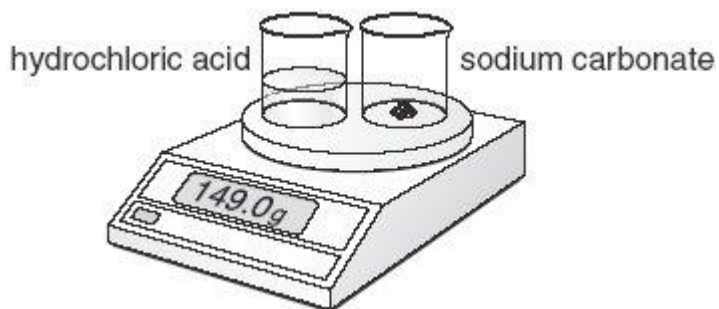
(ii) Gwen added drops of sodium hydroxide solution to the grapefruit juice. The litmus paper soon turned blue. What does the blue colour show about the sodium hydroxide solution?

..... (1)

(b) What name is given to the reaction between an acid and an alkali? Circle the correct answer (1)

distillation neutralisation precipitation separation

Q10. In an experiment, Molly put two beakers on a balance. One contained 20 cm³ of hydrochloric acid. The other contained 5 g of sodium carbonate. She poured the acid onto the sodium carbonate. They reacted.



(a) Complete the word equation with the names of the **three** products. (1)

sodium + hydrochloric → + +
carbonate acid

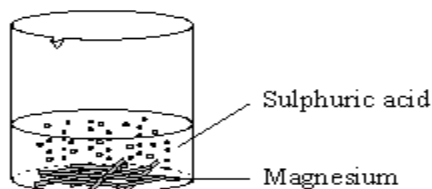
- (b) The total mass at the start was 149.0 g. When the reaction stopped, the reading on the balance was 147.0 g. Why was there a loss of mass in this reaction?

..... (1)

- (c) When the reaction stopped, Molly tested the contents of the beaker with universal indicator paper. The sodium carbonate had neutralised the acid. What is the colour of universal indicator paper in a neutral solution?

..... (1)

- Q11.** A student tried to make some magnesium sulphate (MgSO_4). Excess magnesium was added to dilute sulphuric acid (H_2SO_4). During this reaction fizzing was observed due to the production of a gas, hydrogen (H_2).



- (i) Complete and balance the chemical equation for this reaction.

..... + H_2SO_4 → + (2)

- (ii) At the end of the reaction the solution remaining was filtered. Why was the solution filtered?

..... (1)

- (iii) The filtered solution was left in a warm place. Explain why the filtered solution was left in a warm place.

.....
..... (2)

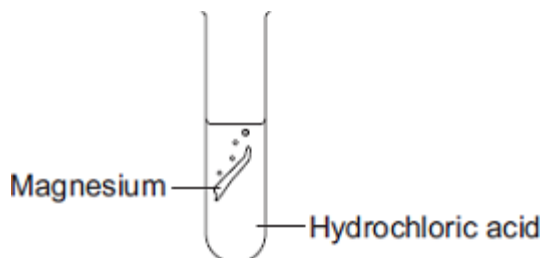
- Q12.** Which **two** pollutants cause acid rain?

1.
2. (2)

- Q13.** Sulfur dioxide dissolves in water. What colour is universal indicator in a solution of sulfur dioxide? Give a reason for your answer.

..... (2)

Q14. A student investigated the reaction between magnesium and hydrochloric acid.



(a) Give **two** observations the student could make during the reaction.

1

2 (2)

(b) Write a word equation for this reaction

..... (1)

(c) The student investigated how the rate of this reaction changed when the concentration of hydrochloric acid was changed.

Write a plan the student could use.

In your plan you should:

- describe how you would carry out the investigation and make it a fair test (make it clear which variables you change, measure and control)
- describe the measurements you would make (ie give the method)

.....

.....

.....

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.....

.....

.....

.....

.....

(6)