



Triple Chemistry

Paper 1

Name: _____

Topic 1: Atomic Structure & Periodic Table

Topic 2: Structure & Bonding

Topic 3: Quantitative chemistry

Topic 4: Chemical Changes

Topic 5: Energy Changes

Exam Date: Monday 19th May 2025

Instructions

This booklet has been separated according to the topic that will be covered in the exam.

- Go through the revision mat for the topic and rate each box according to your understanding of that content. Use a typical RAG rating or 3 different colours of highlighter.

For example:

Revision mat for Chemistry topic 1. The mat is divided into several sections, each with a chemistry concept and a rating box (R, A, or G). The sections include: Atomic Structure (R), Periodic Table (A), Chemical Equations (R), Separating Mixtures (G), and various other topics. The ratings are: R (Red) for Atomic Structure, Periodic Table, and Chemical Equations; A (Amber) for Separating Mixtures; and G (Green) for various other topics.

OR

Revision mat for Chemistry topic 2. The mat is divided into several sections, each with a chemistry concept and a rating box (R, A, or G). The sections include: Atomic Structure (R), Periodic Table (A), Chemical Equations (R), Separating Mixtures (G), and various other topics. The ratings are: R (Red) for Atomic Structure, Periodic Table, and Chemical Equations; A (Amber) for Separating Mixtures; and G (Green) for various other topics.

R = Red 😞 Low understanding

A = Amber 😐 Some Understanding

G = Green 😊 Good Understanding

- Cut along the dotted lines of the question card template provided. Then produce a set of revision questions and answers for that topic – you should focus on those you have rated as red or amber on the revision mat. **For example:**

Front

What is the mass number of an atom?

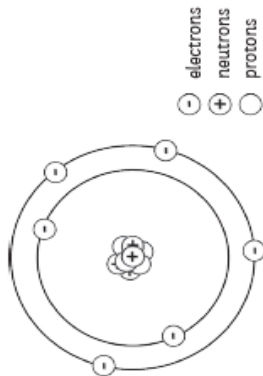
Back

The total number of protons and neutrons found in the nucleus

- Fold along the line indicated on the following page and glue where indicated to create a storage pocket for your question cards.
- Regularly test yourself using your question cards or ask someone to test you and return them to your storage pocket for safekeeping after each use.

Topic 1: Atomic Structure & Periodic Table

a Draw and label an atom. Include labels for the following:
neutron, proton, electron.



True or false?

1. The radius of an atom is 0.1nm. **True**
2. Most of the mass is in the shell of the atom. **False, most of the mass is in the centre**

b Fill in the table to show the charges and mass of the components of an atom.

Name	Charge	Relative Mass
proton	+1	1
neutron	0	1
electron	-1	very small

What is the overall charge of an atom?

No charge

c A compound is 2 or more elements, chemically joined.

Which of the following are compounds?

Put a ring round them.

oxygen, salt water, magnesium oxide, sodium chloride, nitrogen

Why have you circled the ones you have?

They have 2 or more elements in the word equation.

d What are the symbols for the following elements?

Element	Symbol
oxygen	O
lithium	Li
sodium	Na
potassium	K
helium	He
carbon	C
magnesium	Mg

e Complete the following diagram for sodium, include the atomic number and the atomic mass number.

23 mass number

Na

11 atomic number

What is the mass number?

Total number of protons and neutrons.

How do you calculate neutron number?

Atomic mass - proton number

f Isotopes are elements with a different number of neutrons but the same number of protons, e.g. carbon 12 and carbon 14.

How can you use isotopes to calculate the relative atomic mass? Write down the equation.

$$Ar = \frac{\text{sum of (isotope abundance} \times \text{isotope mass number)}}{\text{sum of abundances of all the isotopes}}$$

g Complete and balance the following equations. What is the name of the compound formed?



magnesium oxide



beryllium sulphide



beryllium fluoride



potassium chloride

h Mixtures

Write the definition of a mixture. Give two examples.

Two or more elements together, not chemically joined and can be easily separated.

Salt water, sand and water

i Name the compounds and the elements they contain.

NaCl - sodium chloride, sodium and chlorine

MgO - magnesium oxide, magnesium and oxygen

MgS - magnesium sulfide, magnesium and sulfur

FeS - iron sulfide, iron and sulfur

j What is the ratio of the elements in the following compounds?

e.g. CaO - 1:1

NaCl - 1:1

MgCl₂ - 1:2

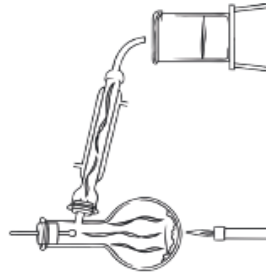
lithium fluoride - 1:1

K₂O - 2:1

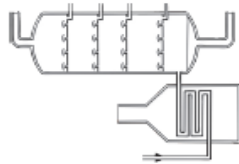
sodium hydroxide - 1:1:1

k Separating Mixtures

What are the following separation techniques?



Distillation



Fractional distillation

What separation technique would you use to separate out different inks in pens?

Chromatography

How can salt be collected using the process of crystallisation?

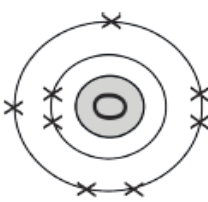

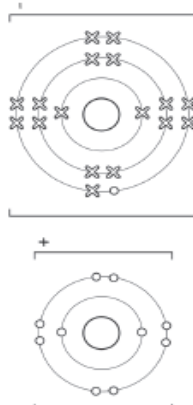
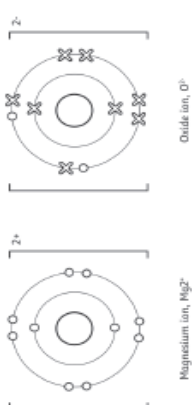
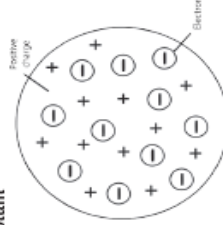
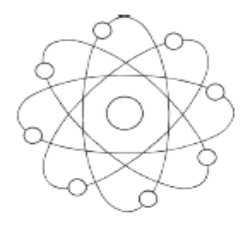
By heating up a mixture of salt and water, the water will evaporate and leave the salt in the bowl.

Sand and water can be separated by using a process called filtration.

Describe, in 4 steps, how to collect salt from rock salt.

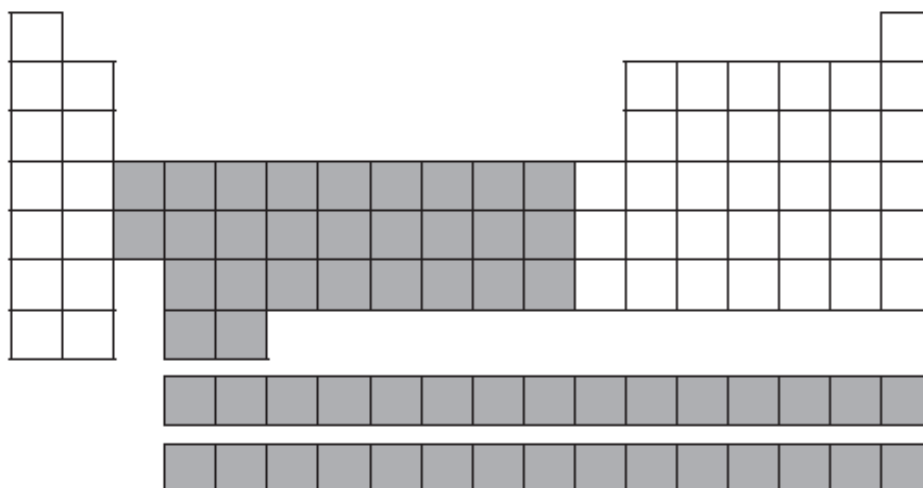
1. Grind the mixture;
2. Add water and stir;
3. Filter the mixture;
4. Evaporate the salt water and salt is left over.

Topic 1: Atomic Structure & Periodic Table

<p>a</p> <p>Complete the electronic structure diagrams for: oxygen</p>  <p>magnesium</p> 	<p>d</p> <p>List 3 halogens chlorine, fluorine, iodine, astatine</p> <p>How many electrons do they have in their outer shell? 7 electrons</p> <p>Describe how the reactivity changes as you go down the group. They become less reactive, the atom becomes larger because there are more electron shells, further from the nucleus so the pull of the nucleus is less. So the electron is less likely to be gained as there is less of a positive pull.</p> <p>Write balanced symbol equations for the following reactions:</p> <p>bromine + potassium iodide $\text{Br}_2 + 2\text{KI} \rightarrow 2\text{KBr} + \text{I}_2$</p> <p>chlorine + sodium iodide $\text{Cl}_2 + 2\text{NaI} \rightarrow 2\text{NaCl} + \text{I}_2$</p> <p>fluorine + potassium chloride $\text{F}_2 + \text{KCl} \rightarrow 2\text{KF} + \text{Cl}_2$</p>	<p>g</p> <p>Complete the following dot and cross diagrams for: NaCl</p>  <p>MgO</p> 	<p>j</p> <p>Describe the plum pudding model of the atom. Draw a diagram. A sphere of positive charge with electrons dotted about; looking like a plum pudding.</p>  <p>Plum pudding model</p> <p>Why did scientists believe this model? Lack of experimental evidence.</p>	<p>b</p> <p>Describe why the noble gases are so unreactive. Their outer shell is full of electrons.</p> <p>The boiling points of the noble gases increase as you go down the group. This is because there are more forces to bond the atoms together, therefore more energy is required to break the bonds.</p>	<p>e</p> <p>Underline the properties of metals and circle the properties of non-metals:</p> <p>Strong, <u>low density</u>, malleable, <u>dull</u>, good conductors, of heat and electricity, high melting and boiling point, brittle, not good conductors of electricity</p>	<p>h</p> <p>Complete word equations for the following reactions:</p> <p>sodium + chlorine → sodium chloride</p> <p>lithium + iodine → lithium iodide</p> <p>potassium + bromine → potassium bromide</p>	<p>k</p> <p>Describe what the alpha scattering experiment showed scientists.</p> <p>Most alpha particles go straight through, some are scattered, some rebound off the gold foil. This shows that the nucleus of an atom has a very small radius. Most of the mass is concentrated in the nucleus.</p>	<p>c</p> <p>Describe what happens to the reactivity of the alkali metals as you go down the group. It increases</p> <p>Why? The number of electrons increases. They are further away from the nucleus. There is less pull on the outer electrons so the atom is more likely to lose an electron.</p> <p>Complete the word and symbol equation for sodium reacting with water: sodium + water → sodium hydroxide + hydrogen</p> <p>$2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$</p>	<p>f</p> <p>James Chadwick discovered the... (underline the correct answer)</p> <p>proton</p> <p>neutron</p> <p>electron</p> 	<p>i</p> <p>How are the groups arranged in the periodic table? According to their properties.</p> <p>How can you tell that the alkali metals are very reactive? According to their properties.</p> <p>How can you tell the noble gases are unreactive? Full shell of outer electrons.</p>	<p>l</p> <p>Niels Bohr discovered that electrons orbit the nucleus in shells.</p> <p>Why did Mendeleev leave gaps in the periodic table? He knew that the elements existed but they hadn't been found, based on their mass.</p> <p>What happened to some of the gaps he left? They have been filled. Scientists have found some of the elements.</p>
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Topic 1: Atomic Structure & Periodic Table

The **transition elements** are a group of metals with similar properties which are different to the metals in group 1. Shade in the transition metals on the periodic table below.



Name three common transition metals.

Students may name some of the following: chromium, manganese, iron, cobalt, nickel, copper or any other transition metal.

Complete the sentences below to describe the properties of transition metals.

They form **coloured** compounds when reacting. They are **conductors** of heat and electricity. They are malleable. They have **high** densities.

Compared to the alkali metals, they are less reactive.

Complete the table to show the ions and colours formed by iron compounds. iron (III) oxide

Compound Name	Ion	Colour
iron (II) hydroxide	Fe^{2+}	pale green
iron (III) hydroxide	Fe^{3+}	orange-brown
iron (III) oxide	Fe^{3+}	red-brown

Page for Extra Notes

Topic 2: Structure & Bonding

a

The three types of chemical bonding are...

1. ionic
2. covalent
3. metallic

Describe the movement and arrangement of subatomic particles in each of the above.

1. Electrons are lost and gained to fill the outer shell.
2. Electrons are shared to fill the outer shell.
3. Positive metal ions are surrounded by free electrons.

b

Draw a dot and cross diagram for the following ionic bonding:

sodium chloride

Chlorine atom, Cl

Sodium atom, Na

Which four groups are more likely to make ions?

1, 2, 6 and 7

c

Describe the bonding in ionic compounds

They are held together by the strong ionic forces of oppositely charged ions. Metal ions have a positive charge and non-metals ions have a negative charge so they are attracted. They have very strong bonds.

Why can ionic compounds conduct electricity when in solution?

The ions are free to move about and can conduct electricity.

d

Using this example, draw dot and cross diagrams for H_2O , NH_3 and O_2

1. H_2O
2. NH_3
3. O_2

e

Describe how metals conduct heat and electricity.

Use the diagram to help explain.

Metals have free electrons that are able to move around and transfer energy.

f

Complete the polymer diagram for the following monomer.

Poly(ethene)

What is a monomer?

One molecule.

What is a polymer?

A long chain of monomers.

g

Properties of metals and alloys.

Describe how the 2 pictures are different to each other.

Alloys have different sized particles. In pure metals, all the atoms are the same.

Why are some alloys harder than pure metals?

They have different sized particles so the layers can not slide across each other as easily.

h

Match up the following with the state symbol.

solid (s)
liquid (l)
gas (g)
solution (aq)

What happens to the intermolecular forces when a liquid turns into a gas?

The forces of attraction become less as the particles gain energy and move about more.

i

Describe the changes of state during:

evaporation:
liquid changes to a gas.

condensation:
gas changes to a liquid.

melting:
solid changes to a liquid.

j

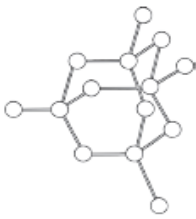
Small molecules form substances with low boiling points because they have weak intermolecular forces.

They do not conduct electricity because they do not have any free electrons.

Topic 2: Structure & Bonding

a

Draw a diagram of the structure of diamond.

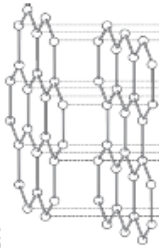


Why is this structure so strong? Choose the correct answer.

1. Many strong ionic bonds.
2. Many strong covalent bonds.
3. Many strong metallic bonds.

b

What is this a diagram of?



Graphite

Explain why it can conduct electricity and heat.
Graphite has free delocalised electrons that can pass between layers; the electrons can carry the charge.

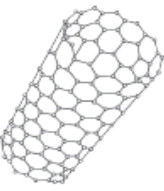
c

What is nanoscience?
The study of very small particles: 1 to 100nm diameter.

d

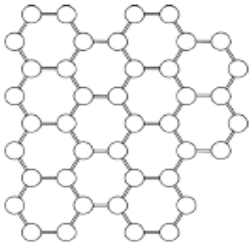
Why do the properties of a material made from nanoparticles change when it is in bulk?
This is because of the high surface area to volume ratio.

e



This is a carbon nanotube.
It has high tensile strength, high heat and electrical conductivity.

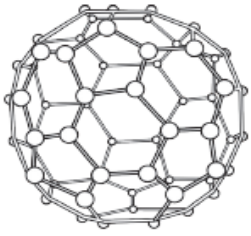
f



Graphene is a single layer of graphite.
Why is this material so strong?
It has strong covalent bonds.

Where is this product used?
In electronics and composites.

g

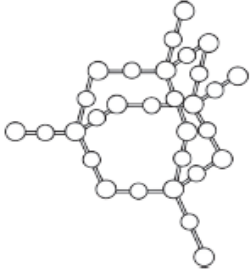


What is this structure?
Buckminsterfullerene

How many carbon atoms are there?
e) 60

h

Explain the differences and similarities between silicon dioxide and diamond.
Silicon dioxide contains silicon and oxygen atoms instead of carbon but has a similar structure to diamond.



i

What are the formulas for the following?
Match up the answers.

Iron (II) oxide	→	$\text{Fe}(\text{OH})_2$
Iron (II) hydroxide	→	FeO
Iron (III) oxide	→	Fe_2O_3

j

How many:
mm in 1m? 1000mm
m in 1mm? 0.001m

What are the abbreviated units for the following:

metre; m
centimetre; cm
millimetre; mm
nanometre; nm
micrometre; μm

k

Compare diamond and graphite.
Describe the structure, hardness and conductivity.

Both – forms of carbon.
Single covalent bonds
Have many atoms.
Graphite – flat sheets, conducts electricity, each carbon atom forms 3 covalent bonds.
Diamond – tetrahedral structure, each carbon atom forms 4 covalent bonds, does not conduct electricity.

l

Name four uses of nanoparticles.
Two from: medicine, electronics, cosmetics, sun creams, deodorants, catalysts.

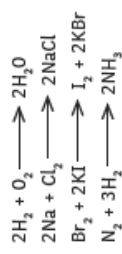
m

Explain why nanoparticles can be potentially harmful to human health.
The properties of nanoparticles are different to the properties of the same material in bulk. It is difficult for scientists to know how they will behave through studying the material that the nanoparticle has come from.

Topic 3: Quantitative Chemistry

a
Mass of the product must always equal the mass of the reactants.

Balance the following:

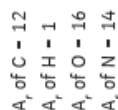


b
Complete the following sentences

The relative formula mass is the (M_r) of a compound.

It is the sum of the relative atomic masses (A_r) of the atoms.

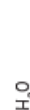
Calculate the relative formula mass for the following. Show your working out.



Example:



$$\begin{aligned} 12 + (16 \times 2) \\ 12 + 32 \\ = 44 \end{aligned}$$



$$\begin{aligned} (1 \times 2) + 16 \\ 2 + 16 \\ = 18 \end{aligned}$$



$$\begin{aligned} 12 + (1 \times 4) \\ 12 + 4 \\ = 16 \end{aligned}$$



$$\begin{aligned} 14 + (1 \times 4) + 14 + (16 \times 3) \\ 14 + 4 + 14 + 48 \\ = 80 \end{aligned}$$

c
When a gas is produced during a reaction, why might the mass go down?

The gas may be released into the environment.

Write the equation for when magnesium reacts with oxygen.



What happens to the mass of the product from the question above?

The mass increases because oxygen is added from the environment.

e
Use the A_r values below to calculate the molar mass of these elements. Don't forget the units.

E.g. A_r of sodium = 23, one mole = 23g

A_r of K = 39

A_r of F = 19

A_r of O = 16

A_r of Mg = 24

potassium (39×1) 39g/mol

fluorine (19×2) 38g/mol

oxygen (16×2) 32g/mol

magnesium (24×1) 24g/mol

g
What unit are chemical amounts measured in?

1. cm

2. m/s

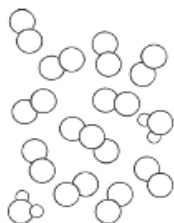
3. moles

Avogadro's constant is...

1. 6.03×10^{23} per mole

2. 6.02×10^{23} per mole

3. 6.05×10^{23} per mole



h
What mass of nitrogen is in 92g of NO_2 ?

A_r of N = 14

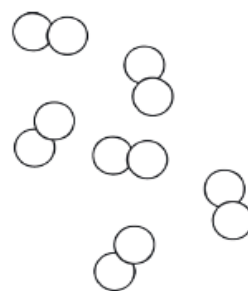
A_r of O = 16

$$M_r = 14 + (16 \times 2) = 46$$

N = 14

$$\frac{14}{46} = 0.304$$

$$0.304 \times 92 = 28\text{g}$$

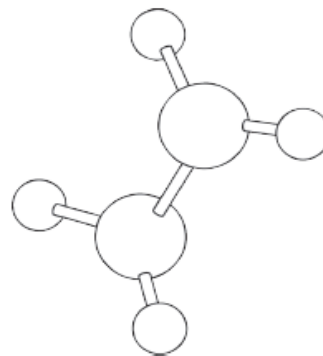


f
What is the equation to calculate the number of moles for a pure substance.

$$\text{moles} = \frac{\text{mass in g}}{M_r}$$

Rearrange the equation to calculate the mass.

$$\text{mass} = \text{moles} \times M_r$$



d
% mass = $\frac{A_r \times \text{number of atoms} \times 100}{M_r \text{ of the compound}}$

Using the equation above, calculate the % mass of sodium (Na) in NaCl.

A_r of Na = 23

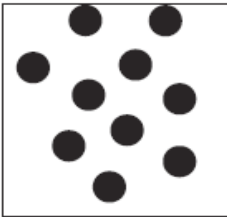
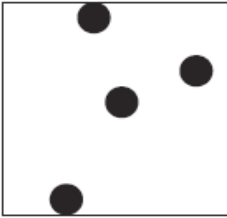
A_r of Cl = 35.5

$$\% \text{ mass} = \frac{23 \times 1 \times 100}{23 + 35.5}$$

$$= \frac{2300}{58.5}$$

$$= 39.3\% \text{ (to 1 d.p.)}$$

Topic 3: Quantitative Chemistry

<p>a</p> <p>Using the equation</p> $\text{Na}_2\text{CO}_3 + 2\text{HCl} \longrightarrow 2\text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$ <p>What mass of NaCl would be produced from 2.5 grams of sodium carbonate?</p> <p>A_r of Na = 23</p> <p>A_r of H = 1</p> <p>A_r of Cl = 35.5</p> <p>A_r of O = 16</p> <p>A_r of C = 12</p> <p>M_r of NaCl = 58.5</p> <p>M_r of Na_2CO_3 = 106</p> <p>$2.5 \div \frac{106}{106} = 0.0236$ moles (to 3 significant figures)</p> <p>$0.0236 \times 2 = 0.0472$ (1:2 ratio)</p> <p>$0.0472 \times 58.5 = 2.76$ grams of NaCl</p>	<p>b</p> <p>What is the mass of solute when the concentration of a solution is 4g/dm^3 and the volume is 600cm^3?</p> <p>Convert 600cm^3 to $\text{dm}^3 = 0.6\text{dm}^3$</p> <p>mass = concentration \times volume</p> <p>$4 \times 0.6\text{dm}^3 = 2.4\text{g}$</p>
<p>c</p> <p>concentration (gm/dm^3) = $\frac{\text{mass of solute}}{\text{volume}}$</p> <p>Using the equation above, calculate the following:</p> <p>The mass of a solute is 60g and the volume is 0.5dm^3, what is the concentration?</p> <p>Concentration = $\frac{60}{0.5}$</p> <p>= 120g/dm^3</p>	<p>d</p> <p>Rearrange the following equation to find volume.</p> <p>concentration (mol/dm^3) = $\frac{\text{mass of solute}}{\text{volume}}$</p> <p>volume = $\frac{\text{mass of solute}}{\text{concentration}}$</p>
<p>e</p> <p>Why, in some reactions, are the reactants in excess?</p> <p>To make sure that the reaction has completely finished and the other reactant has been completely used up.</p>	<p>f</p> <p>Define concentration.</p> <p>The amount of a substance in a certain volume of a solution is called its concentration.</p> <p>Draw a diagram to show a solution with a low concentration and a solution with a high concentration</p> <div></div>
<p>g</p> <p>Convert the following measurements in cm^3 to dm^3.</p> <ol style="list-style-type: none">1. 15cm^32. 60cm^33. 90cm^34. 0.5cm^3 <p>Divide by 1000</p> <ol style="list-style-type: none">1. 0.015dm^32. 0.06dm^33. 0.09dm^34. 0.0005dm^3	<p>h</p> <p>When a chemical reaction occurs, the amount of product made is not always equal to the amount calculated. Explain why.</p> <p>Some of the product is lost when it is being collected from the reacting mixture. Not all the reactants make products because the reaction is reversible. Some reactants may react differently to what is expected.</p>
<p>i</p> <p>The amount of a product obtained from a reaction is called the yield. The actual yield is compared to the maximum expected amount as a percentage. This is called the percentage yield.</p> <p>Complete the equation below:</p> <p>% yield = $\frac{\text{actual mass of product made}}{\text{expected mass of product}} \times 100$</p>	<p>j</p> <p>The equation below is used to calculate the atom economy of a reaction.</p> $\frac{\text{relative formula mass of desired product}}{\text{sum of relative formula masses of all reactants}} \times 100$ <p>$\text{CaCO}_3 \longrightarrow \text{CaO} + \text{CO}_2$</p> <p>In the reaction above, calcium oxide is a useful product and carbon dioxide is a waste product.</p> <p>Calculate the atom economy of the reaction.</p> <p>RFM of calcium oxide: $40 + 16 = 56$</p> <p>RFM of carbon dioxide: $12 + (16 \times 2) = 44$</p> <p>$(56 \div (56 + 44)) \times 100 = 56\%$</p>
<p>k</p> <p>What is atom economy?</p> <p>A measure of how many starting atoms are used to make the useful products.</p>	<p>l</p> <p>The chemist carried out a reversible reaction. She had expected to make 14.50kg of product, but only obtained 12.75kg. Calculate the percentage yield.</p> <p>$(12.75 \div 14.50) \times 100 = 87.93\%$</p>

Topic 3: Quantitative Chemistry

a
You are asked to prepare 100cm³ of sodium hydroxide solution (NaOH) with a concentration of 0.5mol dm⁻³. Calculate the amount of solute in grams. Show your working.

amount in mol = volume in dm³ × concentration in mol/dm³

volume = 100cm³ ÷ 1000 = 0.1dm³

= 0.1 × 0.5 = 0.05mol

RFM of NaOH: 22 + 16 + 1 = 39

0.05mol × 39 = 1.95g

b
What is the name of this piece of equipment?



burette

Name three other pieces of equipment required to carry out a titration reaction.

conical flask, pipette filler, pipette

c
A titration was carried out and 25.00cm³ sulfuric acid was reacted with 2.0mol/dm³ sodium hydroxide. 34.00cm³ sodium hydroxide was required to neutralise the sulfuric acid. Calculate the concentration of sulfuric acid in mol/dm³.



volume of acid: 25.00cm³, concentration of acid: ?

volume of alkali: 34.00cm³, concentration of alkali: 2.0mol/dm³

volume of acid: 25.00cm³ ÷ 1000 = 0.025dm³

volume of alkali: 34.00cm³ ÷ 1000 = 0.034dm³

amount in mol = volume in dm³ × concentration in mol/dm³

amount in mol (alkali): 0.034 × 2.0 = 0.068mol

from the equation: 1mol alkali (NaOH) : 2mol acid (2H₂SO₄)

amount in mol (acid): 0.068mol × 2 = 0.136mol

concentration in mol/dm³ = amount in mol ÷ volume in dm³

0.136 ÷ 0.025 = 5.44mol/dm³

d
The volume of one mole of any gas at room temperature and pressure (20°C and 1 atmosphere pressure) is 24dm³.

e
Calculate the volume of 0.25mol carbon dioxide at room temperature (rtp) using this equation:
volume of gas at rtp = number of moles × 24

volume = 0.25 × 24 = 6dm³

Calculate the number of moles of hydrogen which occupy 9dm³ at rtp.

moles = volume ÷ 24

moles = 9 ÷ 24 = 0.375mol

Page for Extra Notes

Topic 4: Chemical Changes

a

What is an oxidation reaction? (in terms of oxygen transfer)
The gaining of oxygen in a reaction.

Write an equation to show an oxidation reaction.
e.g. copper + oxygen → copper oxide

What is a reduction reaction?
The loss of oxygen in a reaction.

Write an equation to show a reduction reaction.
e.g. magnesium oxide → magnesium + oxide

b

Place the following metals in order of reactivity – adding the names to the symbols.

Na, Zn, Fe, Cu, Li, K, Mg, Ca

potassium	sodium	lithium	calcium	magnesium	zinc	iron	copper
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↑ carbon ↑ hydrogen

Why are hydrogen and carbon sometimes included in the reactivity series?
They are used in the extraction of the metals.

Place arrows on the reactivity series where hydrogen and carbon could go.

Why is gold often found in its pure state?
Gold is a very unreactive metal.

c

Complete the word equations.

zinc carbonate + sulfuric acid → zinc sulfate + water + carbon dioxide

magnesium oxide + hydrochloric acid → magnesium chloride + water

magnesium carbonate + nitric acid → magnesium nitrate + water + carbon dioxide

calcium carbonate + hydrochloric acid → calcium chloride + water + carbon dioxide

d

Describe what a metal reacting with an acid can tell you about the reactivity of the metal.

acid + metal → salt + hydrogen

The speed of a reaction is shown by the rate that hydrogen gas is given off by the reaction.

The more reactive the metal, the faster the reaction will be.

Slow reactions: copper, zinc, iron

Quick reactions: potassium, sodium, lithium

e

On the pH scale, label:

strong acid; (0 - 3)
 strong alkali; (12 - 14)
 neutral; (7)
 weak acid; (4 - 6)
 weak alkali. (8 - 11)

What does the pH show?
The measure of H⁺ ions in the solution.

Strong			Acid			Weak			Neutral			Weak			Alkali			Strong		
1	2	3	4	5	6	7	8	9	10	11	12	13	14							

f

Some metals react with water to produce
metal hydroxide and hydrogen

Some metals react with acid to produce
salt and hydrogen

g

To measure pH you can use... (select two)

universal indicator
pH meter

h

Describe how to make a soluble salt from an insoluble base.

1. Choose an **acid**.
2. Choose an **insoluble base**.
3. Warm the **acid**.
4. Add the insoluble base to the acid until there is no further reaction.
5. Filter the mixture.
6. Heat the solution to **evaporate** the water.
7. Crystals of salt will start to form.

i

Complete the neutralisation reaction.

acid + base → salt + water

$H^+ (aq) + OH^- (aq) \rightarrow H_2O (l)$

What is the pH of the products of a neutralisation reaction?
 a) 1 b) 7 c) 14

j

Complete the following:

Oxidation

Is

Loss

Reduction

Is

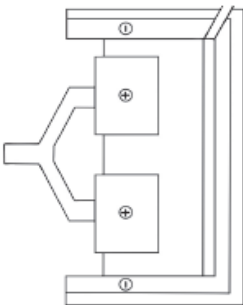
Gain

Oxidation is the loss of electrons and **reduction** is the gaining of electrons.

Topic 4: Chemical Changes

a

Describe how aluminium is extracted by electrolysis.



The positive Al^{3+} ions are attracted to the negative electrode (cathode) where they gain electrons (3) – making them neutral.

The negative O^{2-} ions are attracted to the positive electrode (anode) where they lose electrons (2) – making them neutral.

Why is aluminium oxide mixed with cryolite?

To lower the melting point.

What is the overall equation for the electrolysis of Al_2O_3 to make aluminium and oxygen?

aluminium oxide \rightarrow aluminium + oxygen

$$2\text{Al}_2\text{O}_3 \rightarrow 4\text{Al} + 3\text{O}_2$$

Why can aluminium not be extracted by carbon?

Aluminium is more reactive than carbon so cannot be displaced.

Write the equation for the reaction at the negative electrode.

$$\text{Al}^{3+} + 3\text{e}^- \rightarrow \text{Al}$$

Write the equation for the reaction at the positive electrode.

$$2\text{O}^{2-} \rightarrow \text{O}_2 + 4\text{e}^-$$

b

Which of the following reactions will occur? (displacement)

copper oxide + magnesium

magnesium oxide + iron

potassium oxide + zinc

zinc oxide + lithium

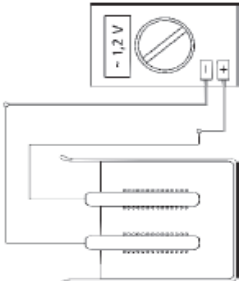
Why do some of them not work?

The metal has to be more reactive than the metal in the compound to take its place.

c

Describe what happens during the process of electrolysis.

When electricity is passed through the solution, the positive ions in the solution go towards the negative electrode where they gain electrons. The negative ions go towards the positive electrode where they lose electrons.



d

The pH of an acid or alkali is a measure of the concentration of H^+ ions.

A pH change from 4 to 2 increases H^+ concentration by a factor of...

a) 10 b) 100 c) 1000

(choose the correct answer)

The pH of a strong acid is less than the pH of a weaker acid if they have the same concentration.

Acids produce H^+ in aqueous solutions.

Alkalis produce OH^- in aqueous solutions.

e

In copper sulfate solution what forms at the:

cathode anode

copper oxygen and water

Why?

Copper is less reactive than hydrogen so copper is formed.

In sodium chloride solution what forms at the:

cathode anode

hydrogen chlorine

Why?

Sodium more reactive than hydrogen so hydrogen is formed.

What are the tests for:

chlorine; bleaches damp litmus paper

hydrogen; squeaky pop test

oxygen? relights a glowing splint

f

Strong acids are completely/partially ionised in an aqueous solution

A weak acid is completely/partially ionised in an aqueous solution.

The concentration of an acid is

a measure of the number of hydrogen ions in a solution.

g

I understand the following topic

I need to work on the following topic

Topic 4: Chemical Changes

a

Describe how you would carry out a titration reaction between sulfuric acid and sodium hydroxide.

1. Using the pipette and pipette filler, measure 25cm³ sodium hydroxide solution and pour into a conical flask.
2. Add several drops of phenolphthalein to the sodium hydroxide solution.
3. Swirl the flask and the mixture should be pink.
4. Place the conical flask on a white tile.
5. Place the burette into its stand, ensuring the tap is closed. Using the funnel, fill the burette with sulfuric acid to the 0cm³ line. Should you go above this line, open the tap and allow the excess to run off into a beaker.
6. Once the burette is correctly filled, place over the conical flask.
7. Carefully open the tap so the acid flows slowly into the conical flask. Swirl the flask and look for the indicator changing from pink to colourless.
8. Continue adding the acid to the flask until the indicator is permanently colourless.
9. Record the total volume of acid added to the sodium hydroxide in the results table.
10. Repeat the experiment twice more.

c

34.8cm³ of sodium hydroxide (NaOH) was neutralised by 50.0cm³ of hydrochloric acid (HCl), with a concentration of 0.150 mol/dm³. Find the concentration of the sodium hydroxide.



volume of acid: 50.0cm³

concentration of acid: 0.150mol/dm³

volume of alkali: 34.8cm³

concentration of alkali: ?

volume of acid: 50.00cm³ ÷ 1000 = 0.05dm³

volume of alkali: 34.80cm³ ÷ 1000 = 0.0348dm³

amount in mol = volume in dm³ × concentration in mol/dm³

amount in mol (acid): 0.05 × 0.150 = 0.0075mol

from the equation: 1mol acid (HCl) : 1mol alkali (NaCl)

amount in mol (acid): 0.0075mol

concentration in mol/dm³ = amount in mol ÷ volume in dm³

0.0075 ÷ 0.0348 = 0.22mol/dm³

b

Complete the risk assessment below.

Hazard	Risk	Emergency Procedure
sodium hydroxide solution	irritant	Wash off skin immediately and inform the teacher.
phenolphthalein solution	toxic	Inform teacher immediately.
sulfuric acid	irritant	Wash off skin and inform teacher.

Page for Extra Notes

Topic 5: Energy Changes

a

In an exothermic reaction heat exits the reaction to the surrounding environment.

The surrounding temperature increases .

In an endothermic reaction heat enters the chemical reaction.

The surrounding temperature decreases .

b

Circle the exothermic reactions and underline the endothermic reactions:

combustion **exothermic**
 photosynthesis **endothermic**
 electrolysis **exothermic**
 neutralisation **exothermic**
 water reacting with calcium oxide **exothermic**
 ammonium chloride reacting with water **endothermic**

Name some every day uses of exothermic reactions.

Hand warmers, self-heating cans, matches, etc.

Give an example of an every day use of an endothermic reaction.

sports injury packs, etc.

c

What is activation energy?

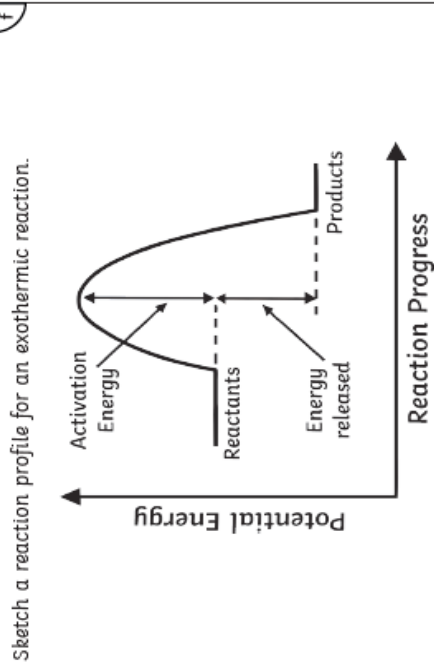
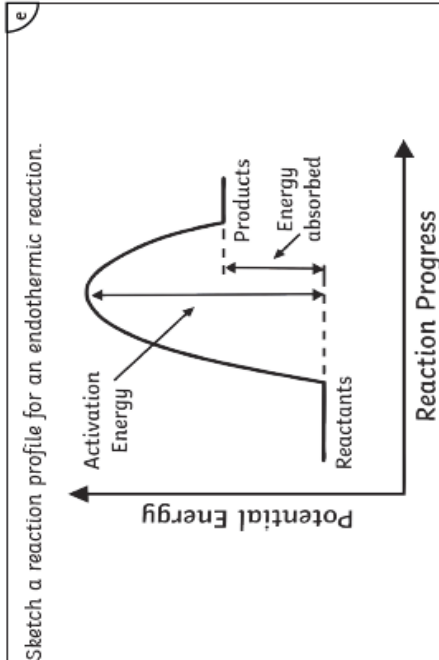
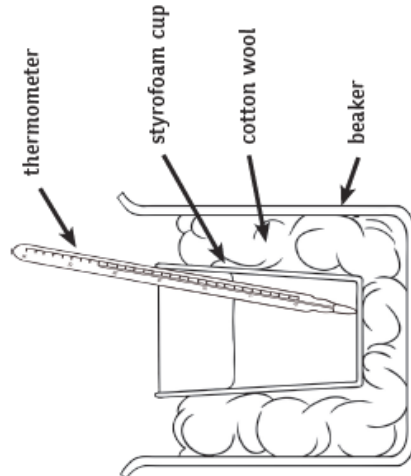
The minimum amount of energy needed by the reactants to start the reaction.

d

Describe how energy transfer can be measured in a practical.

Draw a diagram to show the practical.

1. Take the start temperature of the reactants.
2. Record the highest temperature.
3. Record the lowest temperature.
4. Take away the temperature from the temperature of the reactants.



g

Describe the reaction profile of an endothermic reaction.

The products are at a higher energy level because energy has been transferred from the surroundings into the chemical reaction.

Describe the reaction profile of an exothermic reaction.

The products are at a higher energy level because energy has been transferred from the chemical reaction to the surroundings.

h

Use the approximate bond energies to calculate the energy change in the following reaction.

$$\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$$

State whether the reaction is endothermic or exothermic.

$$\begin{array}{l} \text{H}-\text{H} = 436 \text{ kJ/mol} \quad \text{Cl}-\text{Cl} = 243 \text{ kJ/mol} \quad \text{H}-\text{Cl} = 432 \text{ kJ/mol} \\ 436 + 243 \rightarrow 432 + 432 \\ 679 \rightarrow 864 \\ - 185 \text{ kJ/mol} \end{array}$$

The energy change is negative so the reaction is exothermic.

Topic 5: Energy Changes

a

What is the difference between a cell and a battery?

A cell is made from two different metals in contact through an electrode. It contains chemicals which react to produce electricity.

A battery is two or more cells connected in series and they produce a higher voltage.

b

Compare the difference between non-rechargeable and rechargeable batteries.

In non-rechargeable batteries and cells, once all the reactants have been used, then the reaction stops and the battery no longer works.

Alkaline batteries are non-rechargeable.

In rechargeable batteries and cells, the chemical reaction can be reversed by supplying an external electrical current. This recharges the batteries.

d

Put these metals into order of reactivity, from least reactive to most reactive.

zinc, magnesium, silver, copper
silver, copper, zinc, magnesium

How could you test the metals for reactivity?

Place each metal in turn into a clean test tube of water and count the bubbles produced. (The gas can be collected and tested using a lit splint. Listen for a squeaky pop to identify hydrogen gas.)

e

What type of energy is transferred from a hydrogen fuel cell? Tick one answer.

☐ chemical
☐ thermal
☒ electrical
☐ elastic

f

Cross out the incorrect word from the bold choices so each sentence is correct.

In a fuel cell, energy is released through ~~oxidation/reduction~~ instead of a combustion reaction.

The reaction takes place at a ~~higher/lower~~ temperature than if it was to be burned.

The energy is released as ~~electrical/thermal~~ energy.

c

Complete the table below.

Positive Electrode		
	magnesium	zinc
Negative Electrode	magnesium	1.60V
	zinc	0.00V
	copper	-1.10V
		0.00V

Estimate the voltage that would be produced using magnesium for the negative electrode and silver for the positive electrode.

Any reasonable value over 2.70V (the difference in reactivity between magnesium and silver is greater than between magnesium and copper, so the voltage produced will be larger).

g

Complete the equation to show the reaction at the negative electrode of a fuel cell.

$$2\text{H}_2 + 4\text{OH}^- \longrightarrow 4\text{H}_2\text{O} + 4\text{e}^-$$

Complete the equation to show the reaction at the positive electrode of a fuel cell.

$$\text{O}_2 + 2\text{H}_2\text{O} + 4\text{e}^- \longrightarrow 4\text{OH}^-$$

When you add these two half equations together, what is the overall equation for the reaction?

$$2\text{H}_2 + \text{O}_2 \longrightarrow 2\text{H}_2\text{O}$$

