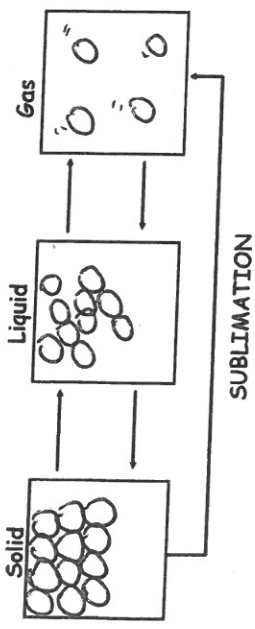


States of Matter

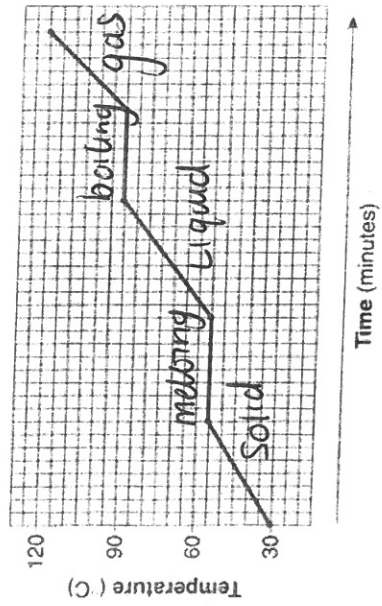
Draw the particle diagrams



What is meant by physical changes?

State changes - they can be reversed

Label where substance is a solid, liquid and a gas:



What is the melting point? 60°C

What is the boiling point? 90°C

At 65°C what state of matter is the substance in? liquid

CI Answers

Mixtures:

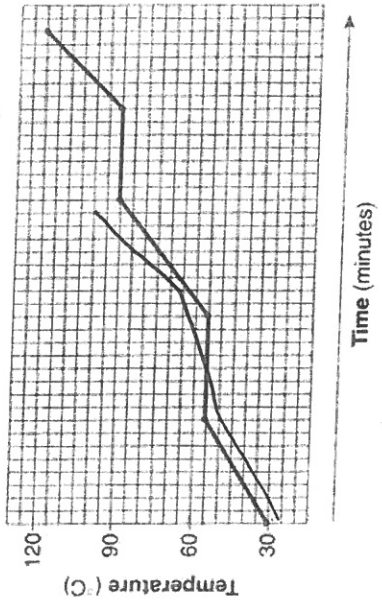
Define 'pure' substance:

Contain only one thing (a single element or compound)

Define a mixture:

More than one compound present or different elements that are not chemically joined together

Draw a heating curve for a mixture:

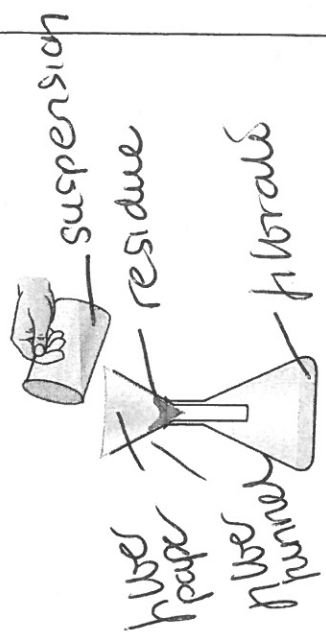


Describe what happens when a solid melts in terms of particles and forces of attraction

particles gain more energy vibrate more - weakens forces that hold the solid together. This makes the solid expand

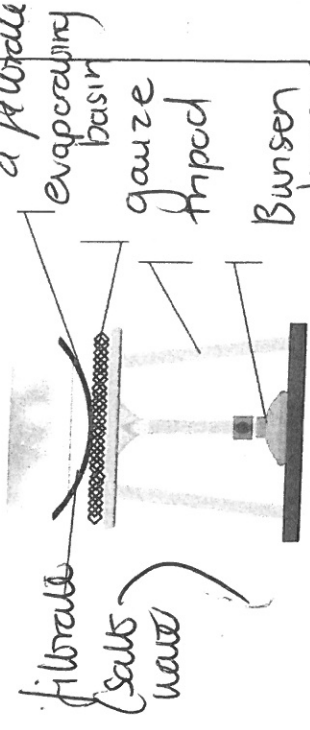
Filtration and Crystallisation:

Label the diagram including keywords: filtrate, residue and suspension



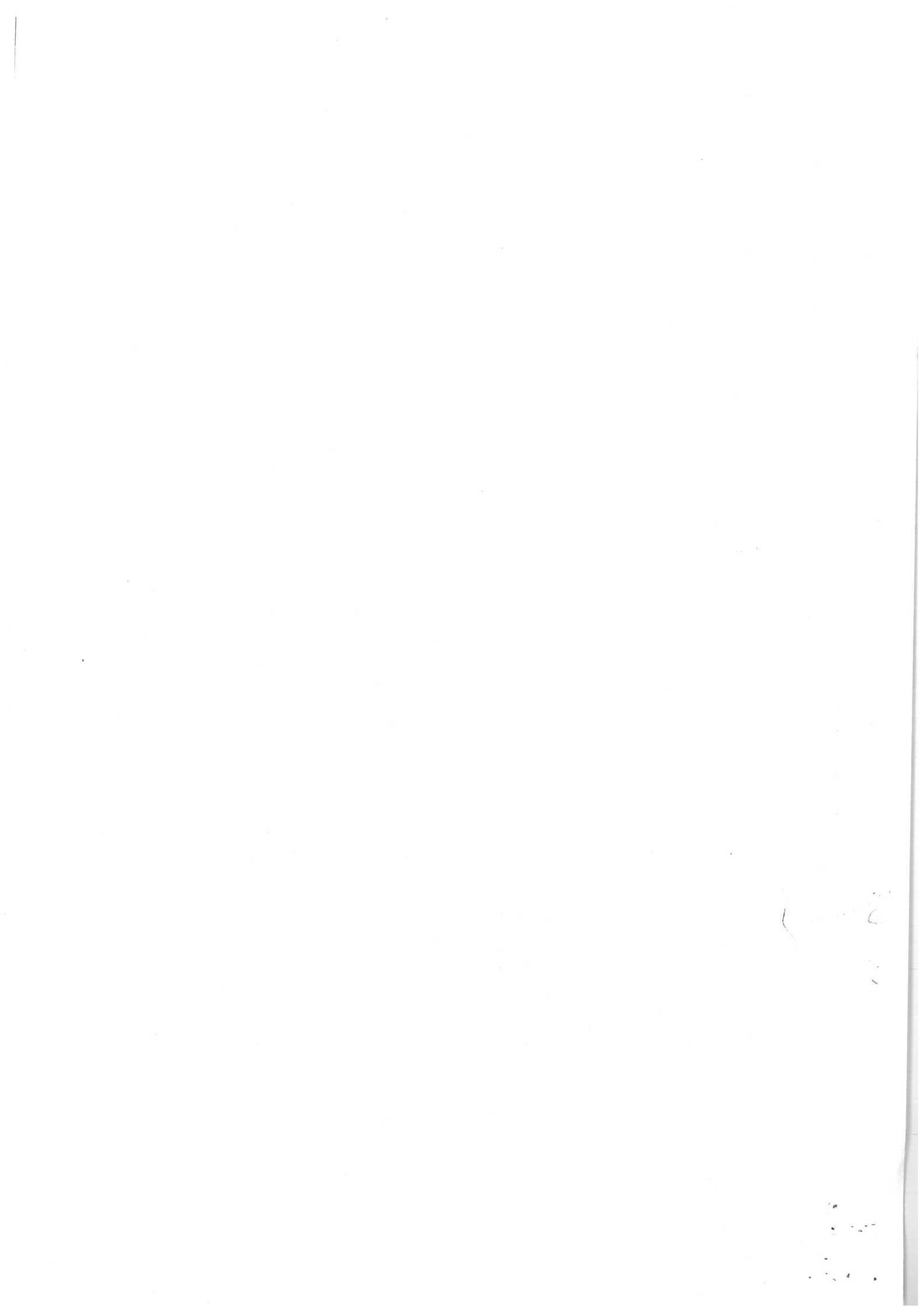
How does filtration separate mixtures (keywords: soluble and insoluble)

Filtration is used to separate an insoluble solid from a liquid. The insoluble solid stays in the filter paper + the soluble substance passes through as filtrate.



What process removes the liquid from the solution? Evaporation

Give a safety precaution goggles as splash

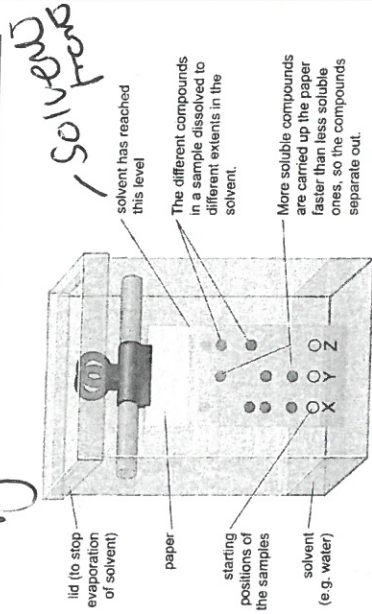


Chromatography, Distillation and Drinking water

Chromatography:

What is chromatography used for?

Used to separate a mixture of soluble substances + identify them



Name the mobile phase liquid - water (solvent)

What is the stationary phase?

Paper

What is the solvent front?

where the solvent has moved

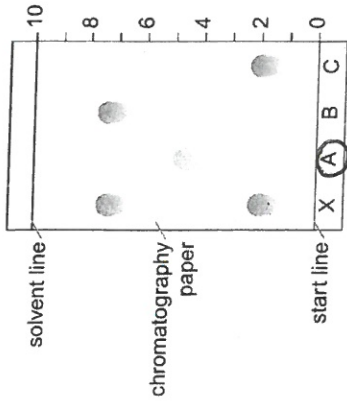
What is the reason why the baseline is drawn in pencil?

insoluble - won't move with the solvent

What is the equation for calculating Rf value?

$$R_f = \frac{\text{distance travelled by solute}}{\text{distance travelled by solvent}}$$

Chromatography:



Which food colourings (A, B or C) is in substance X? Mixture of C + B

Calculate the Rf value:

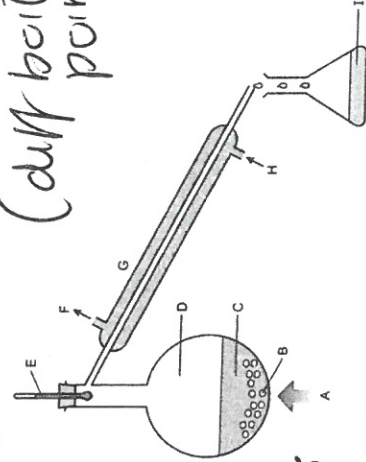
Food colouring A $\frac{2.5}{5.17} = 0.51$

Food colouring B $\frac{4.5}{5.17} = 0.78$

Distillation:

What two processes happen in distillation?

Evaporation + condensation (duff boiling points)

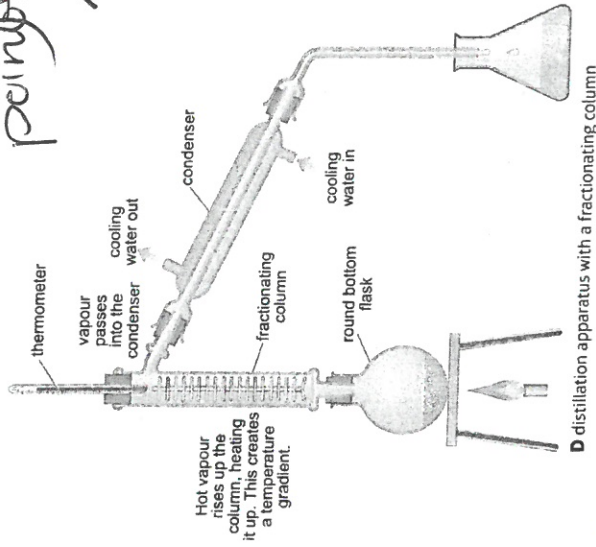


Distilled (loads of energy)

Fractional Distillation:

What is fractional distillation used for?

to separate a mixture of liquids (closer boiling points)



Drinking water: posable (drink)

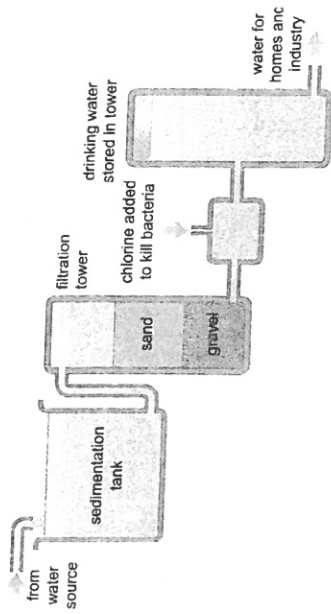
Describe a process how you could get pure water from sea water

1) Filtration (wire mesh)

2) Sedimentation (fine particles are dumped together)

3) Chlorination (Chlorine gas bubbled through to kill bacteria)

Drinking Water:



Describe the process of sedimentation.

Iron sulfate / aluminum sulfate is added to water - fine particles clump together + settle at bottom

Describe the process of filtration

wire mesh - screens out large things etc. Gravel + sand beds filter out all solid bits

Describe the process of chlorination

Chlorine gas is bubbled through to kill harmful bacteria + other microbes

Explain the importance of chemical analysis of water

Use deionised water - hard ions that are present in normal tap water removed

They can interfere with reactions.

Using normal water could give you experimental results

Structure of the atom:

Draw a diagram of an atom

Label the 3 subatomic particles



What particles are found inside the nucleus of an atom?

Neutron and proton

What particles are found in shells?

electrons

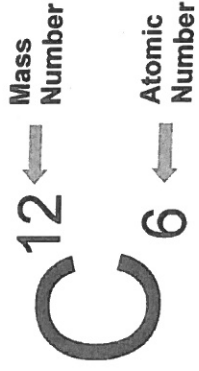
Complete the table:

	Relative mass	Relative charge
Proton	1	+1
Neutron	1	0
Electron	0.0005	-1

Explain why atoms have no overall charge

Equal N^os of positive protons + negative electrons which cancel each other out.

Atomic Number:



Define mass number:

Total no of protons + neutrons

Define atomic number: (proton n^o)

How many protons or electrons has ^{newtons}

How do you calculate the number of protons from the mass and atomic number?

Subtract the atomic number from the mass number

Symbol	Mass number	Atomic number	Protons	Neutrons	Electron
K					
Ar					
Si					
N					
O					

A manganese atom has 25 protons, 30 neutrons and 25 electrons.

What is the mass number? 55

What is the atomic number? 25

Isotopes

Define what an isotope is

Different forms of the same element which have the same number of protons but a different number of neutrons.

Calculate the relative atomic mass of the following isotopes:

1) 69% ⁶³Cu and 31% ⁶⁵Cu

$$\frac{(69 \times 63) + (31 \times 65)}{100} = 63.62$$

2) 79% ²⁴Mg, 10% ²⁵Mg and 11% ²⁶Mg

$$\frac{(79 \times 24) + (10 \times 25) + (11 \times 26)}{100} = 24.32$$

Neon has a relative atomic mass of 20.2 and is made up of 2 atoms: ²⁰Ne and ²²Ne.

Explain which of these isotopes is the most abundant.

The average is closer to 20 so the ²⁰Ne is the most abundant.

²⁰Ne (90%)



Elements and the periodic table:

Complete the table:

Element	Symbol	Metal or non metal?
Hydrogen	H	Non-metal
Sodium	Na	metal
Oxygen	O	Non-metal
Magnesium	Mg	metal
Fluorine	F	Non-metal
Copper	Cu	metal

How did Mendeleev arrange elements in the periodic table?

In order of atomic mass / left to right
 gaps / changed order to suit chemical properties

How does Mendeleev's periodic table and the modern periodic table differ?

order of atomic number
 period / groups / non-metals / metals

Explain Mendeleev's reasons for this difference.

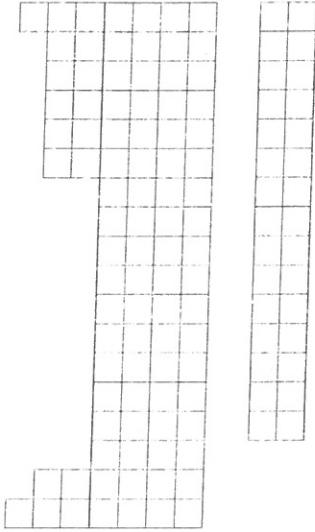
No knowledge of isotopes
 Explain why Mendeleev swapped the positions of Tellurium (Te) and Iodine (I).

To keep those with the same properties in the same columns

(Moseley)

Modern Periodic Table:

Shade in metals and non-metals in different colours.



What is meant by an element's atomic number?

No. of protons

What is a row called?

period

How are the elements arranged in rows?

Each new period represents an outer full shell of electrons
 What is a column called?
 groups

Why are elements placed in the same column?

Same No. of outer electrons
 Same similar chemical properties

What type of analysis did scientists carry out to identify atomic number?

Used high-energy electrons
 as different elements

Electronic configuration:

How many electrons fit in the first shell? 2

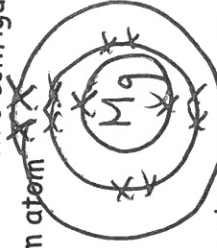
How many electrons fit in 2nd, 3rd, 4th etc? 8

Sodium has 11 electrons. Draw the electron shells



How would you write the electronic configuration of sodium? 2, 8, 1

Draw the electronic configuration of a magnesium atom



Write the electronic configuration

2, 8, 2

How does group number link to electron configurations?

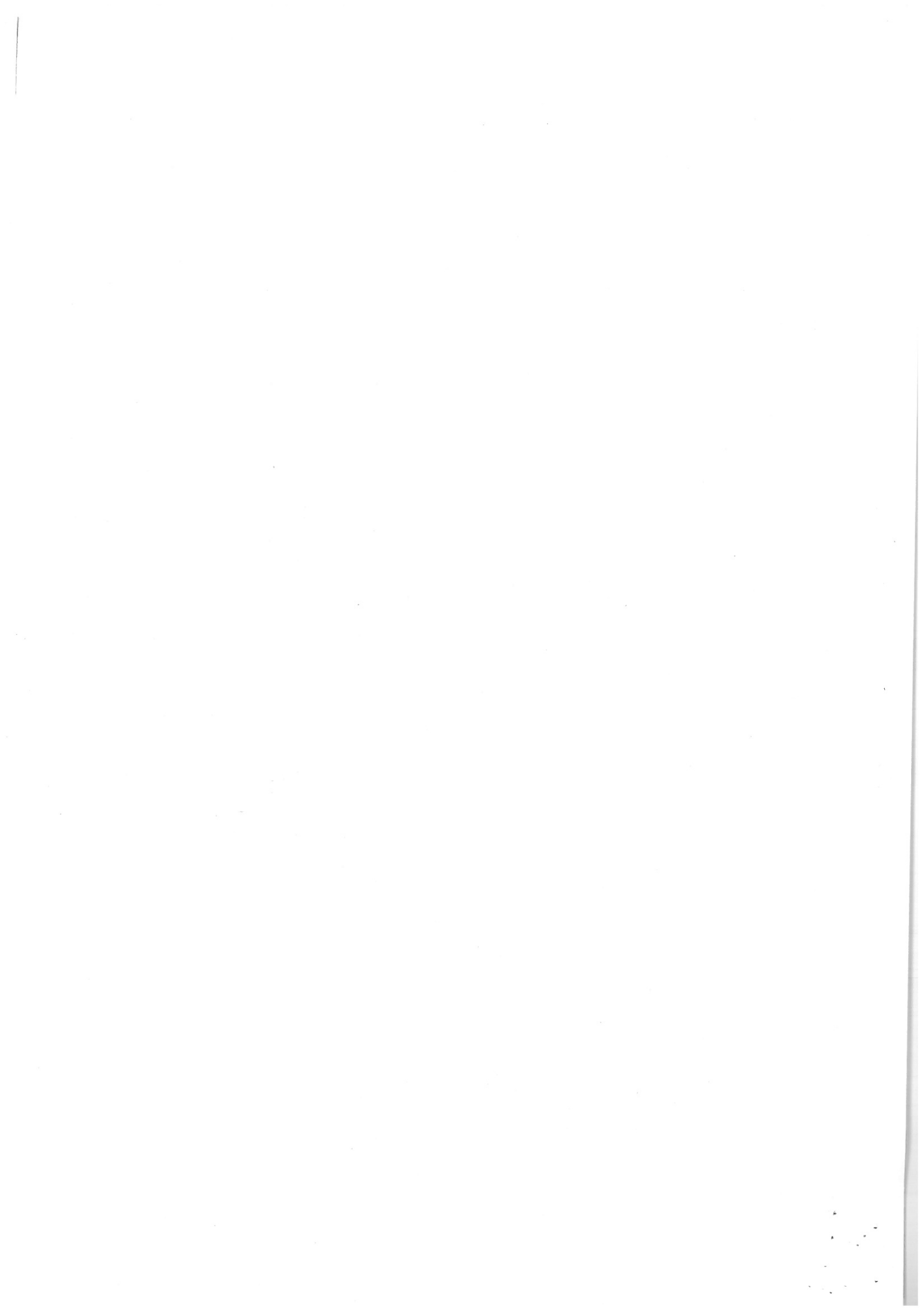
Same No. of outer electrons to group No

How does period number link to electron configurations?

Period is the No. of electron shells

Explain why oxygen is in group 6

It has 6 outer shell electrons



Ionic Bonds

Define an ion:

An atom with a positive or a negative charge

Anions are negatively charged ions

Cations are positively charged ions

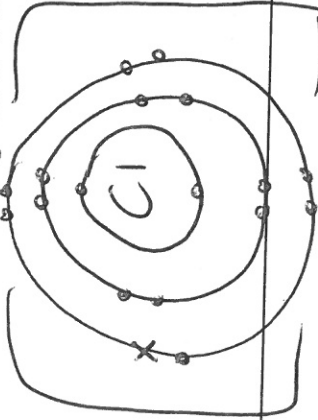
Complete the table:

Group Number	Charge on ion	Anion or Cation	Lost or gained and the number
1	+	Ca ²⁺	lost
2	2+	Ca ²⁺	lost
6	2-	An	gained
7	-	An	gained

Draw a dot and cross diagram of a sodium ion.



Draw a dot and cross diagram of a chloride ion.



pg 83-84-85-87

Ionic Lattices

Ionic compounds are arranged in a lattice structure.

Describe what is meant by the term 'lattice'

Regular arrangement of a large no. of atoms/ions

Ionic compounds have no overall charge

Deduce the formula of the following ionic compounds:

Sodium chloride: NaCl

Aluminium chloride: $\text{Al}^{3+} \text{Cl}^{-} \text{AlCl}_3$

Calcium bromide: $\text{Ca}^{2+} \text{Br}^{-} \text{CaBr}_2$

Aluminium chloride: $\text{Al}^{3+} \text{Cl}^{-} \text{AlCl}_3$

Explain why ionic compounds have high melting and boiling points

Strong electrostatic forces of attraction. takes a lot of energy to break

Explain why solid sodium chloride does not conduct electricity but sodium chloride solution does.

The ions cannot move when solid. They can when molten or in solution.

Covalent Bonds:

What is a covalent bond?

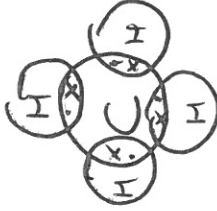
A shared pair of electrons

Draw dot and cross diagrams of the outer electrons only for the following covalent molecules:

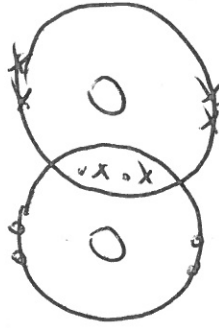
Hydrogen chloride (HCl):



Methane (CH₄):



Oxygen (O₂):



Carbon dioxide (CO₂):



Molecular Compounds

Explain why simple covalent compounds have low melting points and boiling points

Weak intermolecular forces of attraction - don't take much energy to break

Explain why simple covalent compounds do not conduct electricity

Have no overall charge + so cannot carry an electric current

What is a polymer?

Polymers (plastics) made of monomers - covalently bonded carbon chains

Explain why large polymer molecules have higher melting points and boiling points

Polymer molecules can have different lengths. Larger polymers have more intermolecular forces between them. The larger chains have higher melting + boiling

Allotropes of carbon

Polymers that share ones

Define allotrope

Different structural forms of the same element

Allotropes of carbon

Simple

Graphene

Diamond

Graphite

Properties	Fullerenes	Graphene	Diamond	Graphite
Structure	Spheres/Tubes Hexagons	one layer of graphite	4 covalent bonds Rigid lattice structure Really hard	3 covalent bonds layers soft/slippy
Bucky Ball (C ₆₀)	Sph + Slippy	Sheet of carbon atoms joined in hexagons are about thick		
Ability to conduct electricity		Yes - electrons move across surface	No - no free electrons or ions	Yes - each carbon atom has 1 electron delocalised High + can move
Melting and boiling points	low (weak intermolecular forces)	Very High	High	
Uses	Drug delivery mobile body cavity sensors	Mobile phone screens	Cutting tools (drill)	electrodes lubricating materials

Explain why graphite is softer than diamond

Only has 3 covalent bonds, not 4 weak intermolecular forces between the layers

Explain why fullerenes have low melting points

Weak intermolecular forces between the molecules - don't require much energy to break

Properties of metals

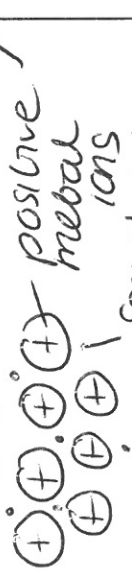
List some properties of metals

- Shiny
- High m.p/b.p
- Aren't soluble in water

List some properties of non-metals

- Dull / brittle
- lower melting/boiling points
- Don't conduct
- lower density (gain electrons)

Draw and label a diagram to represent the structure of a metal



Explain why metals are malleable

The layers can slide over each other - can be hammered or rolled into flat sheets...

Explain how metals conduct electricity

The delocalised electrons carry electrical current/heat so they are good conductors of electricity + heat

Properties of metals continued

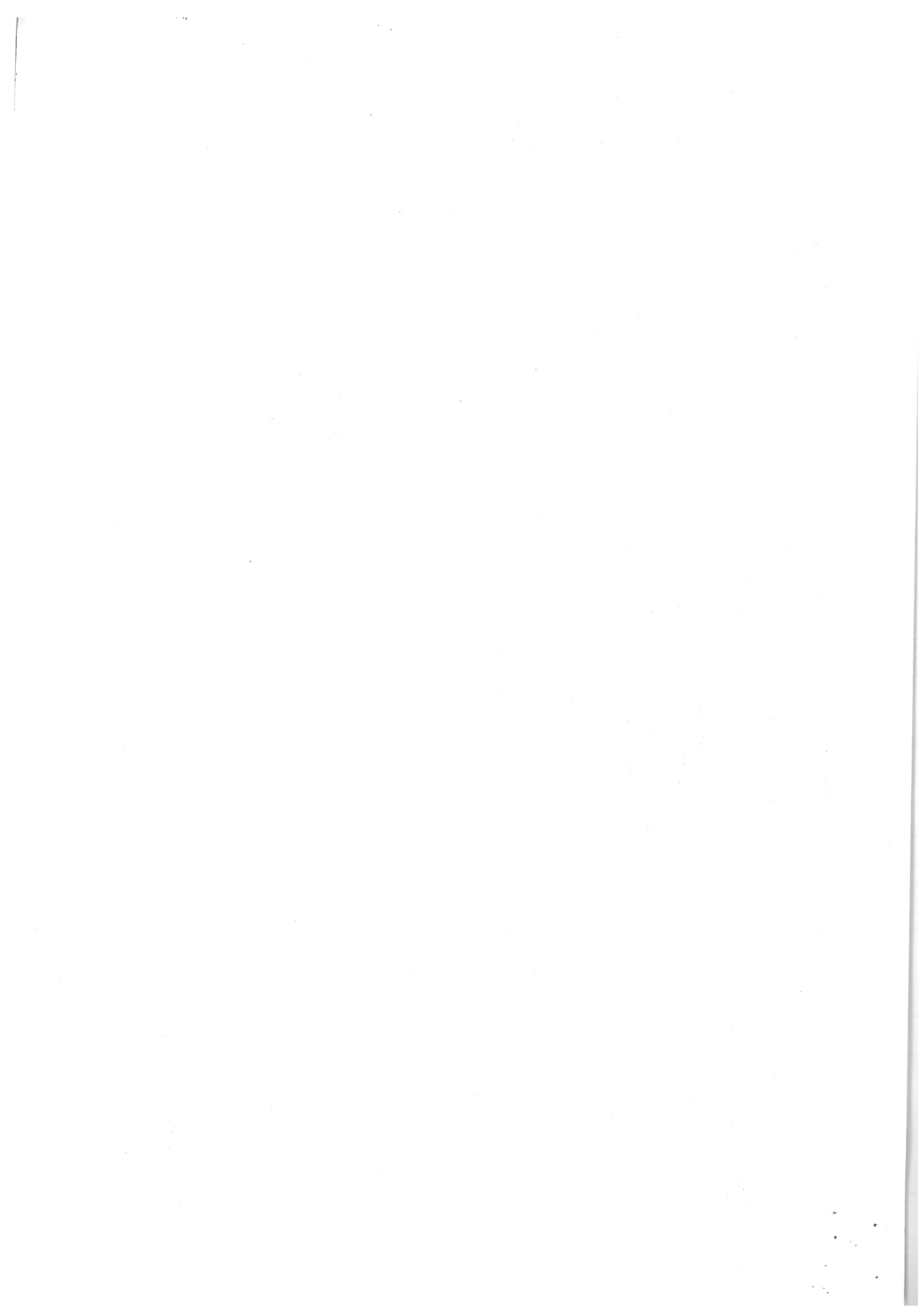
Explain why aluminium (forms Al^{3+} ions) has a higher electrical conductivity than sodium

Because it carries 3 electrons to the sea of electrons. Sodium only carries one.

	Ionic	Simple covalent	Giant covalent	Metallic
Melting and boiling points	High	low	High	High
Solubility in water	Many	A few	Insoluble	Insoluble
Ability to conduct electricity	When liquid or in solution	Most do not	Most do not (except graphite + graphene)	Conduct when solid or liquid

Bonding models

	Advantages	Disadvantages
Dot and cross diagrams	Show how electrons are shared	Do not show structure formed + it suggests (size) electrons are different
Metallic model	Shows metal ions held in a lattice + explain why it conducts electricity	Does not show ions vibrating
3d Ball and stick model	Show which atoms are joined together	Atoms too far apart Don't show correct scales of atoms or ions Not really sticks hiding the atoms



Acids, Alkalis and indicators

Type of solution	pH
Acid	0 - 6
Alkali	8 - 14
Neutral	7

What hazard symbols would you find on an acid/alkali?

- 1) Corrosive
- 2) Irritant

Indicators:

Indicator	Colour in acidic solutions	Colour in alkaline solutions
Litmus	Red	Blue
Methyl orange	Red	Yellow
Phenolphthalein	Colourless	Pink

Ions in acids and alkalis:

What is an ion?

An atom with a positive or negative charge

What ion is in excess in acids? H^+

What ion is in excess in alkalis? OH^- hydroxide

Describe what happens to the acidity and pH of a solution as more hydrogen ions are added

The higher the concentration - the more acidic the pH

Describe what happens to the alkalinity and pH of a solution as more hydroxide ions are added

The higher the concentration - the more alkaline the pH

What can be said about the concentration of ions in a neutral solution?

Concentration of H^+ ions and OH^- ions are equal

Ion	Formula
Chloride	Cl^-
Oxide	O^{2-}
Hydroxide	OH^-
Nitrate	NO_3^-
Sulfate	SO_4^{2-}

Common acid	Formula
Hydrochloric	HCl
Sulfuric acid	H_2SO_4
Nitric acid	HNO_3

Common alkali	Formula
Sodium hydroxide	NaOH
Potassium hydroxide	KOH
Calcium hydroxide	$Ca(OH)_2$

Looking at acids: (Higher)

$\div 1000$

Calculate the concentration if 5g is dissolved in $50cm^3$ concentration = amount dissolved (grams) \div volume (cm³) = 5 / 50 = 0.1

What is a concentrated solution? = 100g/dm³

contains a lot of dissolved solute per unit volume

pH	0	1	2	3	4	5	6	7
difference in concentration of H^+ ions	$\times 10$	$\times 10$	$\times 10$	$\times 10$	$\times 10$	$\times 10$	$\times 10$	$\times 10$

How many more times concentrated is a solution of pH 0 compared with a solution of pH 3? $10 \times 10 \times 10 = 1000$ times

Explain the difference between a strong and a weak acid.

Strong - ions dissociate (ionise completely) in water

Weak - ions don't dissociate fully (ionise partially) in water

Explain how a concentrated solution of a weak acid could have the same pH and similar reactions to a dilute solution of a weak acid

They can have similar concentrations of hydrogen ions

pg 105 - 109

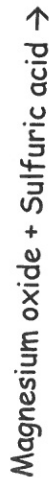
Bases and Salts

Complete the general equation:



Acid	Salt Formed
Hydrochloric acid	Chloride
Nitric acid	Nitrate
Sulfuric acid	Sulphate

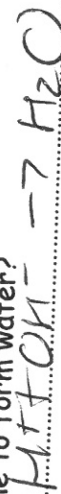
Complete the word equations:



Write a balanced symbol equation for the above reaction



During a neutralisation reaction what two ions combine to form water?



Describe how to prepare a soluble salt from copper oxide and sulphuric acid

insoluble base acid
Add copper oxide to warm sulphuric acid to make a solution of copper sulphate
Evaporate off some of the water + leave solution to crystallise

Bases and Salts

Explain why excess base is used in making a soluble salt

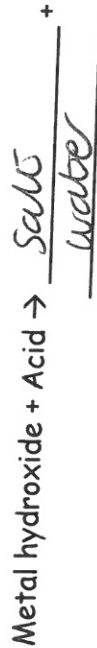
To ensure the acid has reacted fully

Write a word equation when insoluble nickel oxide with hydrochloric acid

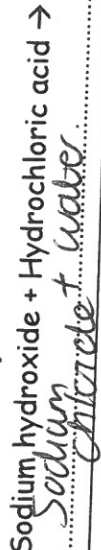
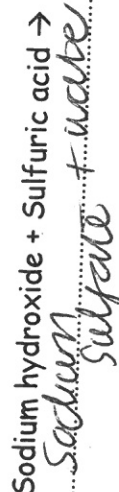
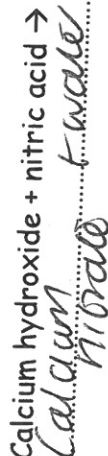
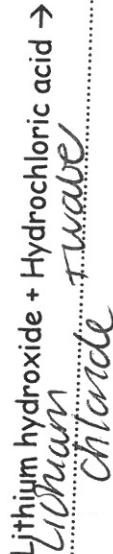
Nickel + hydrochloric acid \rightarrow nickel chloride + water

Alkalis and Balancing Equations

Complete the general equation:

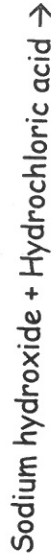
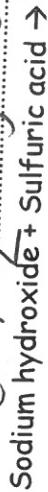
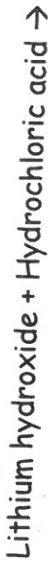


Complete word equations for the following reactions:



Alkalis and Balancing Equations

Write balanced symbol equations for the following reactions: Include state symbols.

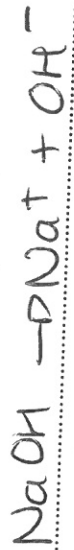


Alkalis and Neutralisation

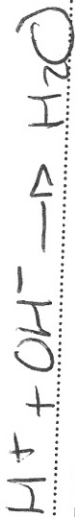
Write a symbol equation to show the dissociation of ions for hydrochloric acid:



Write a symbol equation to show the dissociation of ions for sodium hydroxide

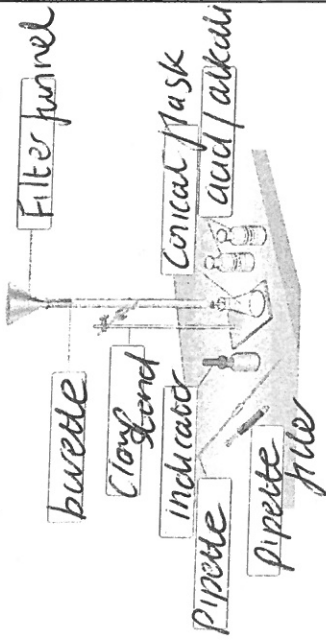


Write a symbol equation to show how water forms in a neutralisation reaction



Alkalis and Neutralisation

Titration: Label the equipment in the diagram



Explain why it is better to use a pipette rather than a measuring cylinder.

More accurate + repeatable measurements

How would you determine the end point of a titration?

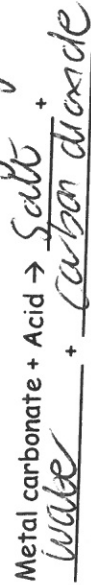
is when the indicator changes colour.

Explain why universal indicator is not a good choice of indicator to use in a titration reaction

It doesn't give a sharp end point.

Reactions of acids with metals and carbonates

Complete general equations:



effervescence

Reactions of acids with metals and carbonates

What would you see in a reaction when you add metals or metal carbonates with acids?

Fizzing \rightarrow Hydrogen + carbon dioxide

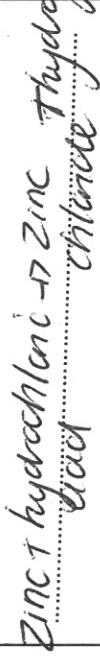
Describe the gas test for hydrogen

Squeaky pop test - lighted splint (hydrogen burns) - more oxygen

Describe the gas test for carbon dioxide

Bubbling in the gas through lime water - will turn cloudy

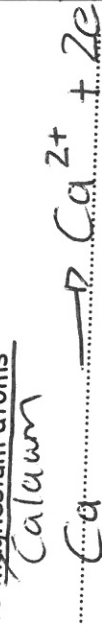
Write a word equation when zinc reacts with hydrochloric acid



Write a balanced symbol equation when calcium reacts with sulphuric acid



Write a half equation to show what happens to magnesium atoms



What are ions called if they do not change during a reaction?

Spectator ions (SO₄²⁻)

Reactions of acids with metals and carbonates

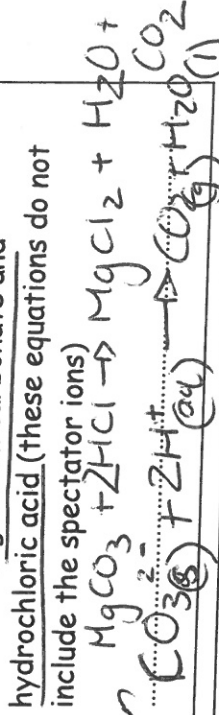
Write a word equation when copper carbonate reacts with sulphuric acid

Copper carbonate + sulphuric acid \rightarrow copper sulfate + carbon dioxide

Write a balanced symbol equation when copper carbonate reacts with nitric acid



Write the ionic equation for the reaction between magnesium carbonate and hydrochloric acid (these equations do not include the spectator ions)



Solubility

Soluble in water	Insoluble in water
all common sodium, potassium and ammonium salts	
all nitrates	
most chlorides	silver, lead chlorides
most sulfates	lead, barium, calcium sulfates
sodium, potassium and ammonium carbonates	most carbonates
sodium, potassium and ammonium hydroxides	most hydroxides

What is a precipitate?

An insoluble solid

Solubility:

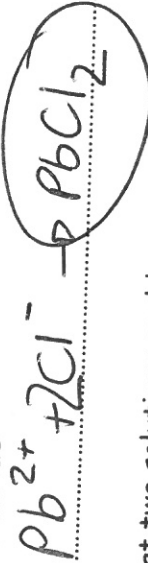
Write a word equation for the reaction between lead nitrate and sodium chloride.

lead nitrate + sodium chloride → lead chloride + sodium nitrate (soluble)

What is the insoluble salt formed from the above reaction? lead chloride

Lead forms Pb^{2+} ions.

Write the ionic equation for the formation of lead chloride



What two solutions could you use to make silver chloride?

Silver nitrate + sodium chloride → silver chloride + sodium nitrate (soluble)

(need a soluble silver salt + a soluble chloride salt to make it)

What two solutions could you use to make magnesium hydroxide?

magnesium nitrate + sodium hydroxide → magnesium hydroxide + sodium nitrate (soluble)

Describe how to prepare an insoluble salt of barium sulfate from barium nitrate and sodium sulfate - wear eye protection

- mix the two solutions in a beaker, filter
- rinse the beaker with a little distilled water
- pour through funnel
- pour a little distilled water over the precipitate
- carefully remove the filter paper in the funnel + dry in warm place

Insoluble salt XY - mixing X nitrate and Y chloride will always work.

Silver chloride X Y
Silver nitrate + sodium chloride

(Pg 89) - (95)

Masses and empirical formulae

Relative formula mass is the sum of the relative atomic masses of all the atoms/ions in its formula.

Define relative atomic mass (Ar)
 An average value for the isotopes of the element compared to the mass of carbon-12

Calculate the relative formula mass of:

- 1) N₂ $2 \times 14 = 28$
- 2) NaI $23 + 127 = 150$
- 3) NH₃ $14 + 3 = 17$
- 4) CO₂ $12 + (16 \times 2) = 44$
- 5) (NH₄)₂SO₄ $(2 \times 14 + 8 \times 1) + 32 + (16 \times 4) = 28 + 8 + 32 + 64 = 132$

Define empirical formula

The smallest whole number ratio of atoms in the compound

Deduce the empirical formula:

- 1) H₂O₂ HO
- 2) C₃H₆ CH₂
- 3) N₂H₄ NH₂

Masses and empirical formulae continued

Rules:

- 1) Divide the mass of each element by the relative atomic mass
- 2) Divide the answers by the smallest number to find the simplest ratio
- 3) Empirical formula

Calculate the empirical formula of a compound that contains 4.6g of sodium (Na) and 7.1g of chlorine (Cl)

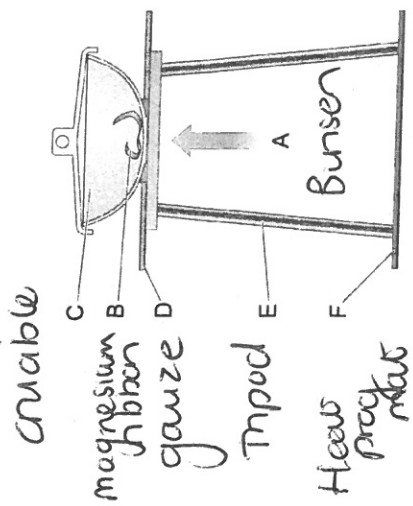
	Na	Cl
Mass	4.6g	7.1g
Ar	$\frac{4.6}{23} = 0.2$	$\frac{7.1}{35.5} = 0.2$
Ratio	$\frac{0.2}{0.2} = 1$	$\frac{0.2}{0.2} = 1$
Empirical formula	= NaCl	

Calculate the empirical formula of a compound that contains 3.6g magnesium and 10.65g of chlorine

	Mg	Cl
Mass	3.6	10.65g
Ar	$\frac{3.6}{24} = 0.15$	$\frac{10.65}{35.5} = 0.3$
Ratio	$\frac{0.15}{0.15} = 1$	$\frac{0.3}{0.15} = 2$
Empirical formula	MgCl ₂	

Calculating the empirical formula of magnesium oxide.

Label A-F



Describe how this apparatus can be used to find the empirical formula of magnesium oxide

- 1) Weigh crucible + lid
- 2) Add magnesium ribbon to crucible + re-weigh Mass of magnesium = difference (eg 1.08g)
- 3) Heat crucible (lft occasionally to allow oxygen in)
- 4) Heat for 10 mins - magnesium ribbon goes white.
- 5) Cool + reweigh. The mass of magnesium oxide is this reading, minus the initial reading for the mass of the crucible + lid (eg 1.87g)

Conservation of mass

Write the formula for calculating concentration and state the units

$$\text{Concentration} = \frac{\text{mass of substance}}{\text{volume of solution}} \quad \left(\frac{\text{g}}{\text{dm}^3} \right)$$

Calculate the concentrations in gdm^{-3} of 10g of sodium chloride in 1dm^3

$$= \frac{10}{1} = 10 \text{ gdm}^{-3}$$

Calculate the concentration in gdm^{-3} of 1.2g potassium chloride in 50cm^3

$$\text{conc} = \frac{1.2\text{g}}{2.05} = 0.59 \text{ gdm}^{-3}$$

Conservation of mass in reactions:

What is the difference between a closed and a non-enclosed system?

Closed system - no new substances are added or removed

Non-enclosed system - substances leave or gds can escape
Give examples of non-enclosed systems

gas escapes (p. reactants)
metal + oxygen \rightarrow metal oxide

Conservation of mass continued

1.34g of copper was heated in air and formed 1.76g of copper oxide. Calculate the mass of oxygen formed



Calculating masses of reactants or products

Rules:

- 1) Write a balanced equation
- 2) Calculate relative formula masses of substances needed
- 3) Calculate the ratio of masses (multiply Mr values by balancing numbers in equation if needed)
- 4) Work out the mass for 1g of reactant/product
- 5) Scale up or down

Worked example

Calculate the mass of chlorine needed to make 53.4g of aluminium chloride.

Write the balanced equation	$2\text{Al} + 3\text{Cl}_2 \rightarrow 2\text{AlCl}_3$
Calculate relative formula masses of the substances needed	$M_r \text{Cl}_2 = 2 \times 35.5 = 71$ $M_r \text{AlCl}_3 = 27 + (3 \times 35.5) = 133.5$
Calculate ratio of masses (multiply Mr values by the balancing numbers shown in the equation).	3Cl_2 makes 2AlCl_3 so $3 \times 71 = 213\text{g Cl}_2$ makes $2 \times 133.5 = 267\text{g AlCl}_3$
Work out the mass for 1g of reactant or product. (Here we want 1g of the product because that's the mass we know already)	213g Cl_2 makes 267g AlCl_3 267g Cl_2 makes 267g AlCl_3 0.798g Cl_2 makes 1g AlCl_3
Scale up or down (from 1g to the mass you are given)	$\times 53.4$ 42.6g Cl_2 makes 53.4g AlCl_3

Conservation of mass continued

Calculate the mass of oxygen that combines with 20.4g of magnesium to form 34.0g of magnesium oxide



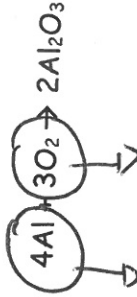
$$2 \times 24\text{g} + 32\text{g} = 76\text{g}$$

$$48\text{g} + 32\text{g} = 80\text{g}$$

$$\text{SF} = \frac{20.4\text{g}}{48\text{g}} = 0.425$$

$$= 13.6\text{g}$$

Calculate the mass of oxygen that combines with 5.4g of aluminium to form 10.2g of aluminium oxide



$$4 \times 27 + 3 \times (16 \times 2) = 96\text{g}$$

$$= 108\text{g}$$

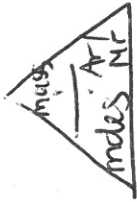
$$\text{SF} = \frac{5.4}{108} = 0.05$$

$$= 4.8\text{g}$$

Moles (Higher)

Write the formula triangle for calculating moles.

$$\text{moles} = \frac{\text{mass(g)}}{\text{Ar/Mr}}$$



Write Avogadro's constant in standard form:
602 204 500 000 000 000 000

$$6.02 \times 10^{23}$$

Calculate the number of moles in 88g of carbon dioxide molecules

$$\text{moles} = \frac{88\text{g}}{44} = 2 \text{ mol}$$

CO₂
12 16 x 2

Calculate the number of moles in 3.2g of methane.

$$\text{moles} = \frac{3.2\text{g}}{16} = 0.2 \text{ mol}$$

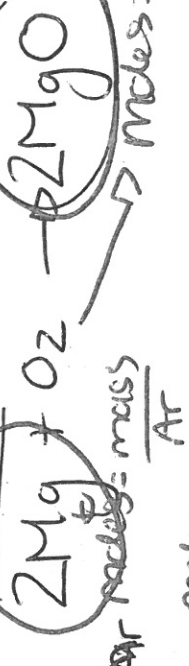
CH₄
12 4

What is meant by limiting reactant?

The reactant that's used up in a reaction is called the limiting reactant.

Moles (Higher)

Calculate the maximum mass of magnesium oxide that can be made from 2.4g of magnesium and 2.4g of oxygen



$$\text{moles of Mg} = \frac{2.4}{24} = 0.1 \text{ mol}$$

Working out balanced equations from masses of reactants and/or products

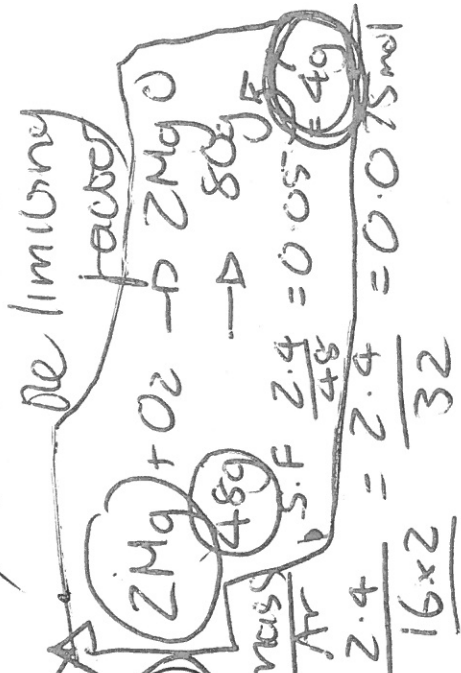
Rules:

- 1) Calculate the number of moles (Mass/Ar or Mr)
- 2) Divide by smaller
- 3) Simplest whole number ratio

15g of hydrogen gas reacts with 70g of nitrogen gas to produce ammonia, NH₃ - deduce the balanced equation for the reaction.

$\text{H}_2 \quad \frac{15}{2} = 7.5$	$\text{N}_2 \quad \frac{70}{28} = 2.5$
$\text{①} \quad \frac{7.5}{2.5} = 3$	$\text{②} \quad \frac{2.5}{2.5} = 1$

Which one is limiting factor?



need ratio 2:1

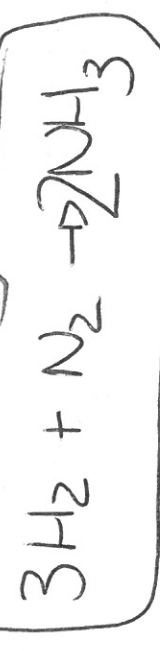
0.1 mol : 0.075 mol

0.1 mol : 0.075 mol

Mg O₂

(all will be used up) (have more)

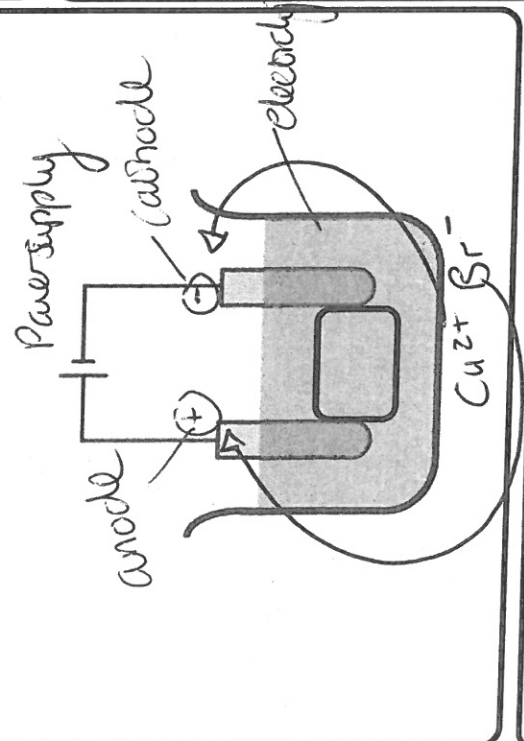
= limiting reactant



ELECTROLYTIC PROCESSES

What is electrolysis?
 The breaking down of a substance using electricity.
 An electric current is passed through an electrolyte (molten/dissolved) what do we call the substance that is broken down during electrolysis?

Electrolyte
 What is the positive electrode called?
Anode (anions)
 What is the negative electrode called?
Cathode (cations)
 Label a diagram showing the electrolysis of molten copper bromide (CuBr₂)



Why can solid ionic compounds not be electrolysed but molten ionic compounds can?
 The ions are in a fixed position in a solid and can't move.
 Molten - ions can freely move + conduct electricity.

Positive Anode
 Pa Ni c
 ↑ negative
 cathode

What does OILRIG stand for?
 Oxidation
 Is
 Loss of electrons
 Reduction
 Is
 Gain of electrons

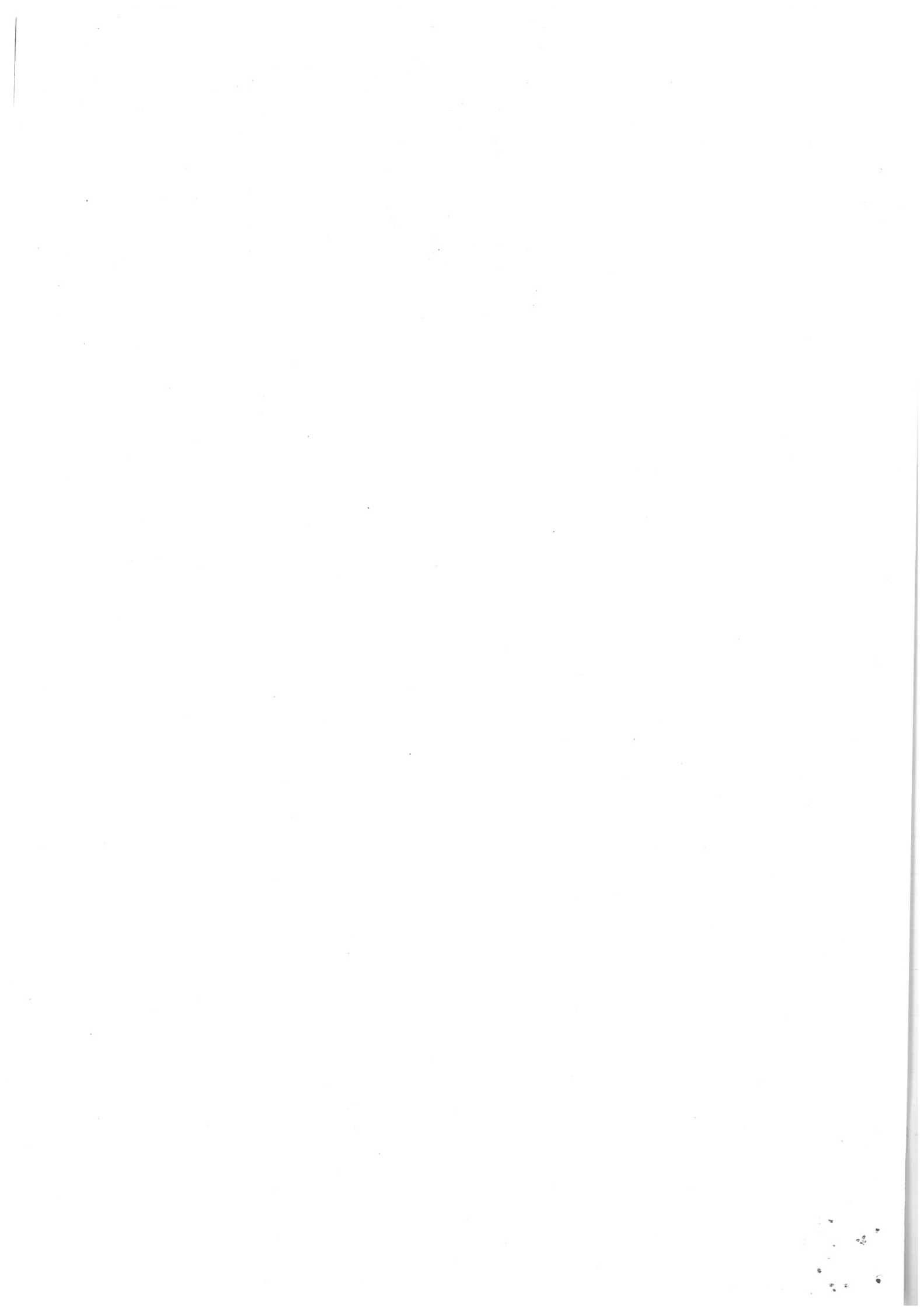
What is the rule for determining which element is formed at the cathode? (-)
~~The metals~~
 If the metal is more reactive than hydrogen, you get hydrogen.
 If less reactive → metal
 What is the rule for determining which element is formed at the anode? (+)
 Negative ion is simple e.g. Cl⁻ or Br⁻ → elements produced
 If negative ion is a complex ion (NO₃⁻, SO₄²⁻, CO₃²⁻), then oxygen is produced from the OH⁻.

Describe the movement of ions and electrons at each electrode when potassium iodide (KI) solution is electrolysed
 $K^+ I^- H^+ OH^-$
 cation anion cation anion
 Cathode: $H^+ \rightarrow$ hydrogen gas
 $2H^+(aq) + 2e^- \rightarrow H_2$
 Anode: $I^- \rightarrow$ iodine
 $2I^- - 2e^- \rightarrow I_2$
 Give a half equation for the reaction at the cathode:
 $2H^+(aq) + 2e^- \rightarrow H_2$
 Give a half equation for the reaction at the anode:
 $2I^- - 2e^- \rightarrow I_2$

Describe how to purify copper with electrolysis
 Anode(+): Impure copper + copper sulphate solution
 Cathode(-): Pure copper
 Impure copper anode loses mass + pure copper cathode gains mass

Complete the table

Ionic substance in solution	Element formed at cathode	Element formed at anode
NaCl ₂	Hydrogen	Chlorine
CuCl ₂	Pure Copper	Chlorine
LiBr	Hydrogen	Bromine
H ₂ SO ₄	Hydrogen	Oxygen (O ₂)
CuSO ₄	Copper	Oxygen (O ₂)



OBTAINING AND USING METALS

- Potassium
- Sodium
- Calcium
- Magnesium
- Aluminium
- Carbon
- Zinc
- Iron
- Copper
- Silver
- Gold

Complete the following word equations:

Copper oxide + Zinc → Zinc oxide + Copper
 What happened and why?
The zinc displaced the copper as it is more reactive than copper
 Aluminium oxide + Iron → No reaction

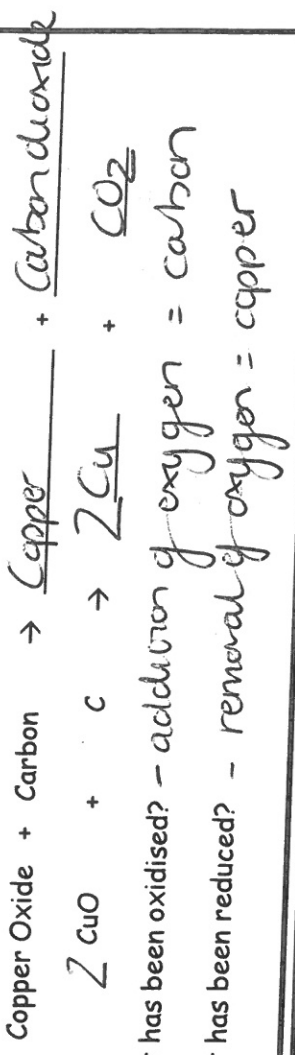
What happened and why?
Nothing - iron cannot displace aluminium as it is less reactive.

You have access to water, acid and a selection of metals. How do you determine the relative reactivity of the metals?
metal + water → metal hydroxide + hydrogen
very reactive - will react vigorously in water
less reactive - won't react much with cold water but will with steam
The more easily a metal atom loses / is a better electron

Outline the advantages of recycling metals
not from a positive ion, the more reactive is very reactive - p/zz vigorously

- conserves resources + energy
- natural reserves of metal ores will last longer
- less pollution produced - CO₂ / SO₂
- less waste metal ends up in landfill
- Mining - damages landscape / noise / dust / pollution

Less reactive metals are displaced by carbon. Complete the equations below



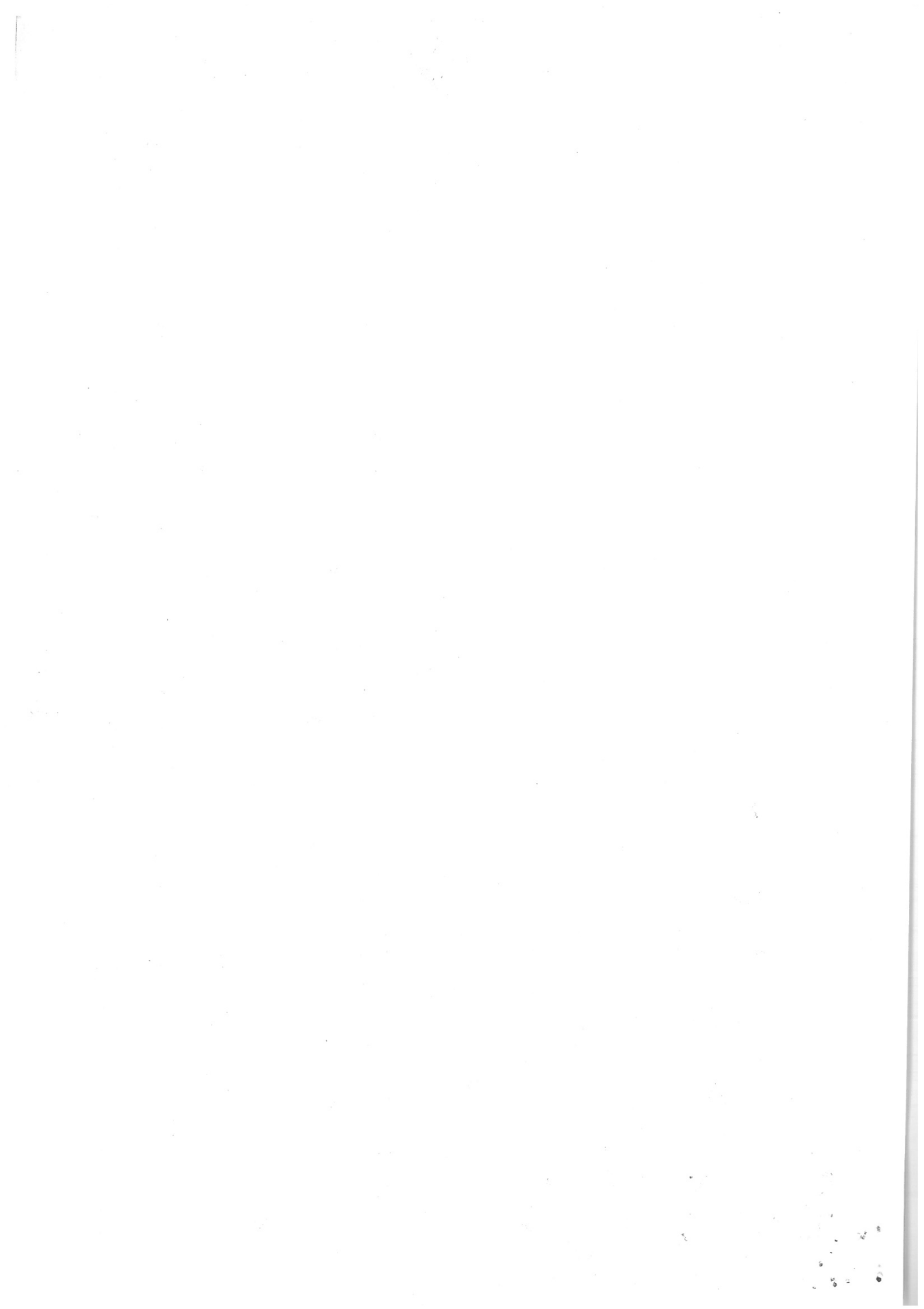
Explain why carbon can reduce zinc oxide but cannot reduce aluminium oxide
Carbon has to be less reactive more reactive than the metal
 How is aluminium extracted from aluminium oxide? electrolysis

What is meant by oxidation?
loss of electrons
addition of oxygen
 What is meant by reduction?
gain of electrons
removal of oxygen

Describe how metals are extracted with phytoextraction
plants in soil that contain metal compounds
harvested / dried / burned
ash contains metal compounds from which metal can be extracted by electrolysis or displacement reactions

What is a product life-cycle assessment?
 looks at each stage of the life of a product
 - raw materials
 - manufacture
 - product use
 - disposal
 It works out the potential environmental impact of each stage

Describe how metals are extracted with bioleaching
Bacteria to separate metals from ore
The leachate solution contains metal ions which can be extracted by electrolysis or displacement



REVERSIBLE REACTIONS AND EQUILIBRIA

What is a reversible reaction?

Can go forwards + backwards

Give the symbol that represents a reversible reaction:



What is a dynamic equilibrium?

The forward + backward reactions are both happening at the same time and at the same rate. The concentrations of reactants + products have reached a balance.

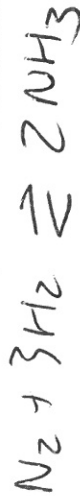
What is the Haber process?

Nitrogen + hydrogen react to form ammonia (reversible reaction)

Give the word equation for this reaction:

Nitrogen + hydrogen \rightarrow ammonia

Give the balanced symbol equation for the reaction:



Where are the raw materials sourced from?

Nitrogen (N_2) \rightarrow air (78%)
Hydrogen (H_2) \rightarrow hydrocarbons
Sources - natural gas, crude oil etc

List the reaction conditions needed for the reaction

- 450°C
- 200 atmospheres (pressure)
- Iron catalyst

[H] Describe how the following conditions affect a dynamic equilibrium:

Increasing the temperature:

Equilibrium will shift to decrease the temperature

Move in the endothermic direction to absorb the extra heat

Decreasing the temperature:

Equilibrium will shift to increase the temperature

Move in the exothermic direction to produce more heat

Increasing the pressure:

Equilibrium will shift to decrease the number of gas molecules to reduce pressure

Decreasing the pressure:

Equilibrium will shift to increase the number of gas molecules to increase pressure

Increasing the concentration of reactants:

Equilibrium will shift to reduce the concentration

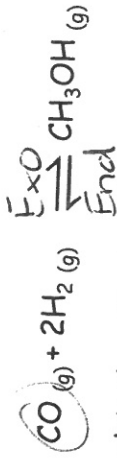
Move to the right to use up the reactants (more products)

Increasing the concentration of products:

Equilibrium will shift to reduce the concentration

Move to the left to use up the products (more reactants)

[H] The formation of methanol from carbon monoxide and hydrogen is a reversible reaction that is exothermic in the forward direction



Explain the effect on the position of equilibrium of increasing:

a) Temperature

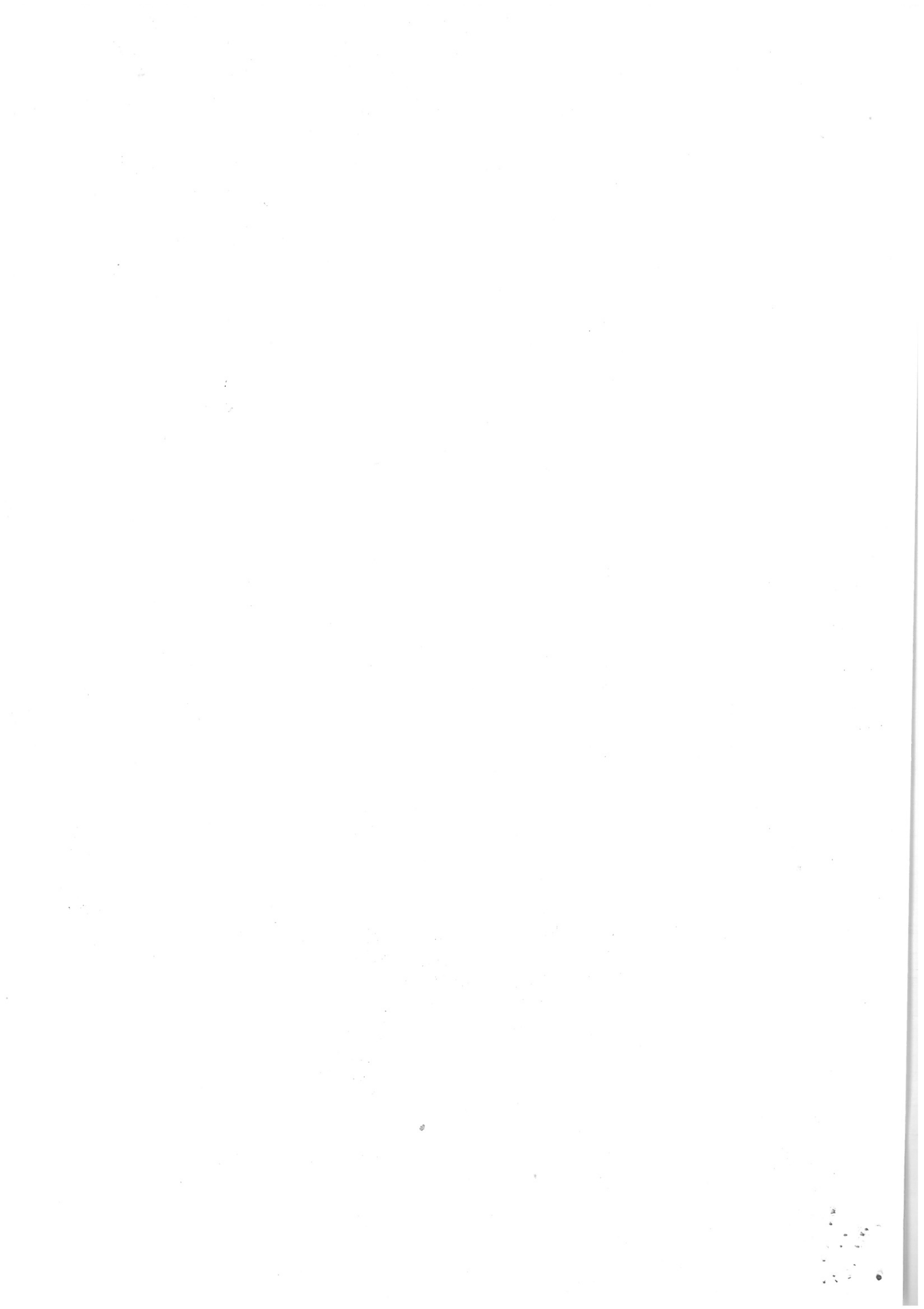
- Equilibrium will shift to decrease the temp
- Move in endo direction
- More reactants ($CO + 2H_2$)

b) Pressure

- Equilibrium will shift to decrease molecules
- Move to side with fewest molecules
- More product (CH_3OH)

c) Carbon monoxide concentration

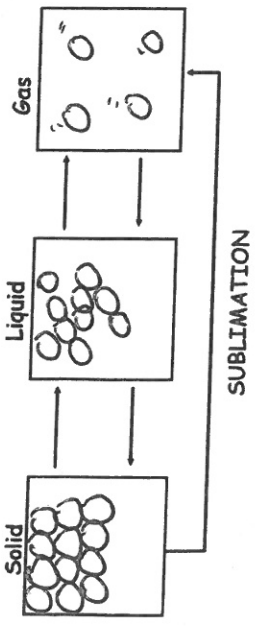
- Equilibrium will shift to reduce concentration
- Move to the right to use up the extra reactant
- More product (CH_3OH)



States of matter, mixtures, filtration and crystallisation

States of Matter

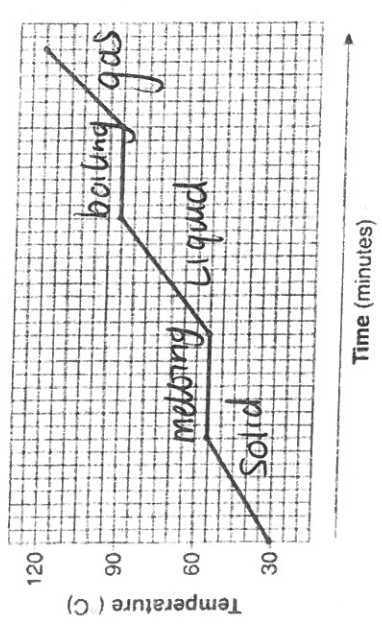
Draw the particle diagrams



What is meant by physical changes?

State changes - they can be reversed

Label where substance is a solid, liquid and a gas:



What is the melting point? 60°C

What is the boiling point? 90°C

At 65°C what state of matter is the substance in? liquid

Mixtures:

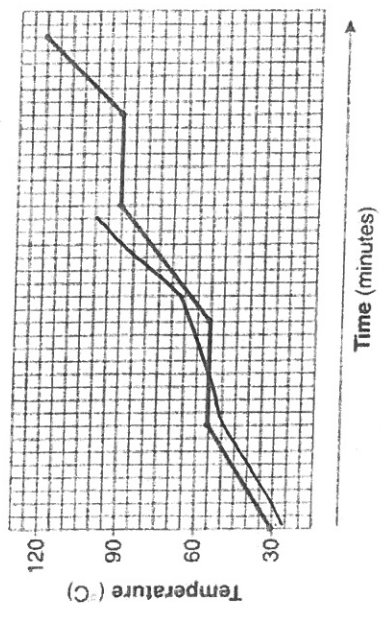
Define 'pure' substance:

Contain only one thing (a single element or compound)

Define a mixture:

More than one compound present or different elements that are not chemically joined together

Draw a heating curve for a mixture:

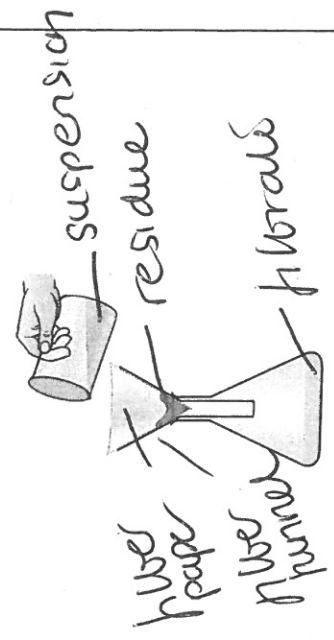


Describe what happens when a solid melts in terms of particles and forces of attraction

Particles gain more energy. Vibrates more - weakens forces that hold the solid together. This makes the solid expand.

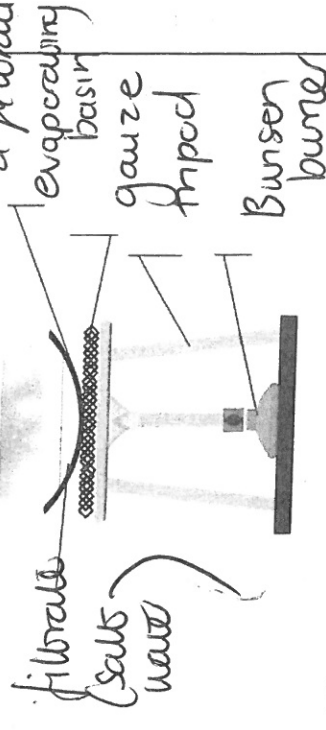
Filtration and Crystallisation:

Label the diagram including keywords: filtrate, residue and suspension



How does filtration separate mixtures (keywords: soluble and insoluble)

Filtration is used to separate an insoluble solid from a liquid. The insoluble solid stays in the filter paper + the soluble substance passes through as a filtrate.



What process removes the liquid from the solution? Evaporation

Give a safety precaution goggles as catch spilt.

