Z

AQA GCSE CHEMISTRY NOTEBOOK

ALL THE KEY CONTENT IN 32 PAGES!

CONTENTS

CHEM PAPER 1

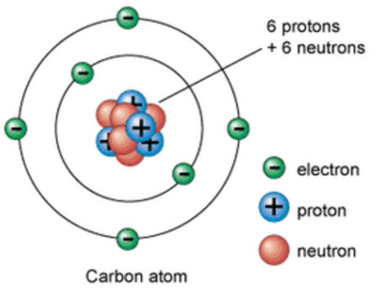
CHEM PAPER 2

ATOMS & ELEMENTS

- All substances → made of atoms (building blocks of matter)
- Atoms contain: protons (+1) / neutrons (0) / electrons (-1)
- Protons & neutrons in nucleus → most of atom's mass
- Electrons orbit nucleus in shells → tiny mass

ATOMIC STRUCTURE

- Atomic number = no. of protons = no. of electrons (in neutral atom)
- Mass number = protons + neutrons
- To find neutrons → mass number – atomic number
- 🧠 Example:
- Sodium (Na): atomic number = 11 / mass number = 23 → neutrons = 23 – 11 = 12



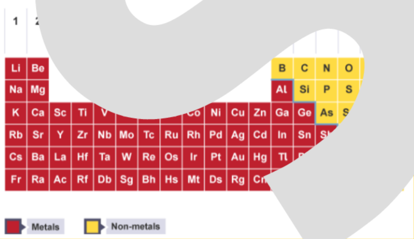
Subatomic Particle	Relative Charge	Relative Mass
Proton	1	1
Neutron	0	1
Electron	-1	Negligible (1/2000)

ELEMENTS & SYMBOLS

- Element = substance with only ... type of atom → same no. of protons
- Atoms of same element → sa... atomic number
- Symbols → 1 or 2 letters (first = capital, second = lowercase)
- E.g. Carbon = C / Oxygen = O / Sodium = Na / Iron = Fe
- Some elements exist as molecules → H_2, O_2, N_2, F_2, Cl...

PERIODIC TABLE ...

- Organises elemen... ...c number
- Groups (columns) → n... electrons
- Periods (rows) → no. of ele... shells
- Know n...es/symbols of first 2... elem...
- Le... ...n:
- Gr... ...kali metals
- G... halogens
- G... noble g...



COMPOUNDS

- Atoms react → fixed ratios → full outer shells → new substances = compounds
- A compound = 2+ elements chemicall... combined → cannot be separated by physical means
- Properties of compounds ≠ proper... elements they're made from
- Chemical formula shows ratio of atoms
- Example:
- H_2O → 2 hydrogen, 1 oxygen
- NH_3 → 3 hydrogen, 1 nitrogen

MOLECULE OF AMMONIA

- NH_3 = 1 nitrogen atom ... to 3 hydrogen atoms

COMMON MISTAKE

- Elements = pure substance... = also pure (NOT impure)

NAMING COMPOU... ...NON-METALS (Ionic)

- Metal name...
- Non-metal ...e' endin... oxygen is ... → '-ate')
- e.g. PbS ...ulphide | M... magne...
- $CuSO_4$ ... = sodium carb...
- $NaNO_3$ = sodium n... N... = sodium nitrite ...
- ... fewer oxygen ...

NON-... ...nt)

- Use ... e.g. ... | NO = n... ...onoxide ... ...on tetrachlo...
- Some use co... ...es you must learn: ... = sulfu... ...NH_3 = ammonia | ... -OH = ...
- ... names of HCl, H_2SO_4, HNO_3, ...her tier

HALF/IO... ...ATIONS (HT)

- ...ens to electrons in a ... reaction
- ...nt only half the process:
- ...e species gains electrons (reduction)
- ...nother species loses electrons (oxidation)
- ...xamples:
- ...$^{2+}$ + $2e^-$ → Pb (reduction)
- ... → Br_2 + $2e^-$ (oxidation)

IO... EQUATIONS

- Show only the ions that react in a solution
- Remove spectator ions (ions that don't change during the reaction)
- Full equation:
- HCl + NaOH → NaCl + H_2O
- Ionic equation:
- $H^+ + OH^- \rightarrow H_2O$
- Na^+ and Cl^- are spectator ions (present on both sides, unchanged)

...EQUATIONS

...RD EQUATIONS

E.g. sod... hydroxide + hydrochloric acid → ...chloride + water

- Key r...
- Re... left side ...roducts = ...ic...

...) = "form... ...ces" .../catal... ...e written

Examp...

- CO_2 → ... ...gen
- H_2SO_4 → 2 h... 1 sulfur, 4 oxygen
- $Ca(OH)_2$ ... calcium, 2 oxygen, 2 hydroge... ...et applies to both O and H)

...ONS

...al formulae instead of full

- ...H (aq) + HCl (aq) → NaCl (aq) + H_2...l)
- Include state symbols: (s), (l), (g), (aq)
- Write non-metal molecules as pairs: H_2, O_2, Cl_2, etc.

BALANCING EQUATIONS

- Atoms must be equal on both sides
- Balance by placing numbers in front of formulas (not changing subscripts!)
- Balance 1 element at a time → check → repeat

Word Equation:

- aluminium + copper(II) oxide → aluminium oxide + copper

Unbalanced Symbol Equation:

- Al + CuO → Al_2O_3 + Cu

Balanced Symbol Equation:

- 2Al + 3CuO → Al_2O_3 + 3Cu

1. Al: 2 on left, needed for Al_2
2. O: 3 on right (in Al_2O_3) → need 3 CuO
3. Cu: 3 on right to match CuO

Word Equation:

- magnesium oxide + nitric acid → magnesium nitrate + water
- Unbalanced Symbol Equation:
- MgO + HNO_3 → $Mg(NO_3)_2$ + H_2O
- Balanced Symbol Equation:
- MgO + $2HNO_3$ → $Mg(NO_3)_2$ + H_2O

Check:

- Reactants → 1Mg, 2H, $2NO_3$
- Products → 1Mg, 2H, $2NO_3$

✅ Balanced

TIPS

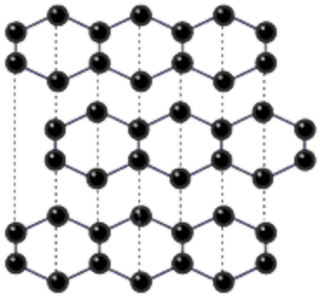
❌ Don't change small numbers in formulas (e.g. H_2O → H_2O_2)

✅ Only change big numbers in front of substances

ATOMIC STRUCTURE & PERIODIC TABLE

GRAPHITE

- Each carbon → 3 covalent bonds → forms layers of hexagons
- Layers held by weak forces → no covalent bonds between them → soft & slippery → used as a lubricant
- High melting point → strong covalent bonds within layers → need lots of energy to break
- 1 delocalised electron per carbon → moves freely → conducts electricity & thermal energy



TIP - Graphite ≠ lead. Pencil "lead" is graphite.

USES OF NANOPARTICLES

Catalysts – large surface area makes reactions faster using smaller quantities.

Medicine – drug delivery enter cells directly).

Electronics – conductors circuits and chips.

Antibacterial – silver nanoparticles in wound dressings, surgical masks, deodorants.

Cosmetics – sunscreens, moisturisers (TiO_2 b used for coverage)

Coatings & p durability and scrat nce.

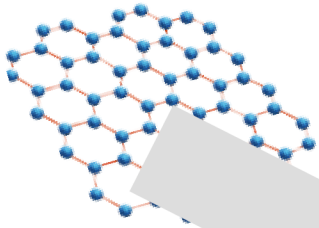
⚠️ RISKS & CONCERNS

- May enter the body or environment due to tiny s
- Could c alyse harmful reac produce toxic su inside cells.
- I m effects on vironment
- ces t early labe
- Some worry nanoparticle damage cells or accu organs or ecosyste

GRAPHENES & FULLERENES

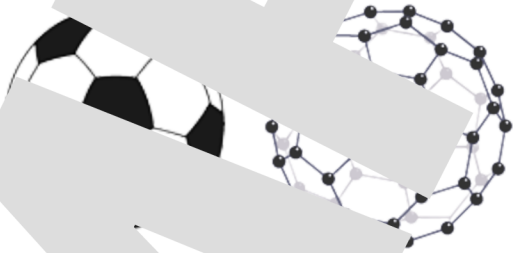
GRAPHENE

- One atom thick sheet → hexagon structure
- Strong covalent bonds → very + light → used in composites
- Delocalised electrons → condu through structure → used in electro



FULLERENES (e.g

- Hollow sph of hexag (+ penta
- Cage mo → drug | Large surface catalyst k interm forces → nts

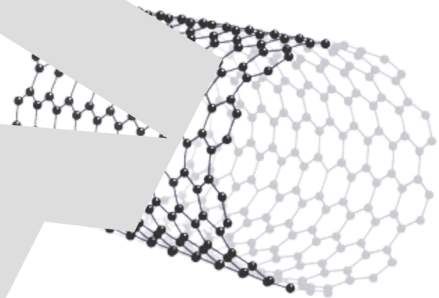


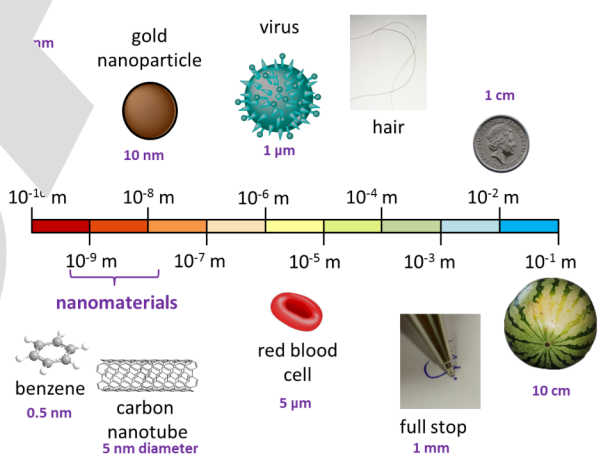
CARBON RES

- Cylindric nes → high length:diameter ratio

hermal energy → used

h tensile used to strengthen ls (e.g. tennis rackets)





SIZES OF PARTICLES & THEIR PROPERTIES

& CLASSIFICATION

articles uped by diamete
Coarse es (PM_{10}): nm (dust)
es ($PM_{2.5}$): nm
Na icles: 1–100 nm (contain only a few dred atoms)
= 1×10^{-9} m
Nanoparticles are uch smaller than fine particles, but larger than atoms.
👉 Study of these = Nanoscience; applications = Nanotechnology.

⚖️ SURFACE AREA TO VOLUME RATIO (SA:V)

- As particle size ↓, surface area:volume ratio ↑ (by a factor of 10 if size ↓ ×10).
- High SA:V = different properties from bulk material.

Means:

- → Smaller quantities needed for same effect.
- → Greater reactivity – useful in catalysis and surface chemistry.
- → Example: Fullerenes (carbon nanoparticles) act differently to graphite or diamond.

Formula:

- SA:V = Surface Area ÷ Volume
- Example ratios:
- 1 cm cube = 6:1 | 2 cm cube = 3:1 | 3 cm cube = 2:1

⚙️ PROPERTIES

- Very high SA:V ratio
- Can have different physical and chemical behaviours than bulk materials
- Often strong, conductive, transparent or catalytic depending on substance

REQUIRED PRACTICAL

➡️ Determine the reacting volumes of a strong acid and strong alkali by titration.

- Purpose:
- To calculate the concentration or volume needed for neutralisation.
- Used to analyse acid-base reactions and sometimes redox reactions.
- Can also be used to prepare salts.

🧪 EQUIPMENT & MATERIALS

- Volumetric pipette (25 cm^3) | Pipette filler | Conical flask (250 cm^3) | Burette (50 cm^3) | Clamp stand | Small funnel | White tile | 0.1 mol dm^{-3} NaOH | Unknown H_2SO_4 | Indicator (phenolphthalein / methyl orange)

🔬 METHOD

Use pipette + filler to transfer 25 cm^3 of alkali into a clean conical flask.

Add a few drops of indicator, place flask on a white tile.

Fill the burette with acid using a funnel, remove funnel before titration, and record the starting volume.

Add acid slowly from the burette while swirling the flask to mix.

As the end-point nears (colour about to cha… add acid drop by drop indicator change… permanently.

Record the final … reading to the nearest … cm^3.

Repeat the titration un… you get con…ordant results (within … cm^3).

C… …e mean titre usin… …dant values on…

🧠 …TIPS

✅ K… …at… …t (avo…

✅ Only …ant titres to calculate the mean.

✅ Write readings to 2 de… places.

TITRATION CALCULATIONS

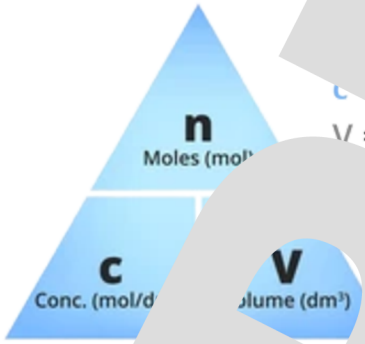
Once the average titre (mean volume) is known from the titration:

Write the balanced equation for th… reaction.

Calculate moles of the known substance:

Use the mole ratio from the balanced equation to find moles of the unknown substance.

Calculate concentration of the unknown solution



V = n :

🧪 WORKED Ex…

Question:

- 25.… cm^3 of 0.15 mo… hy… …tralises 12.8… ni…

Find … …itric acid.

Equation:

- $Ba(OH)_2$ + 2 … $Ba(NO_3)_2$ + 2H…O

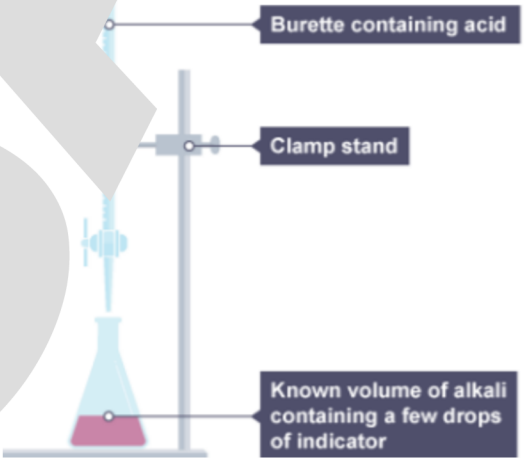
… of $Ba(OH)_2$ … 25 ÷ …5 x 10^{-3} mol

Step 2:

- Moles of … x 10^{-3} x 2 = 7.5 x 10^{-3} mol

… NO_3 = (7.5 x …00) = 0.59

m… (2 d.p.)



…RONG & WEAK ACIDS …)

…ong acid…

→ Disso… …mpletely in water

→ Hig… | Low …(1–3)

…: HCl, H_2… …O_3

… Cl^- | … H^+ + …

… → … $_4^{2-}$

Weak acid…

- → Dissociate … …y in water (⇌ reversible)
- → Low [H^+] … Higher pH (4–6)
- → Equilib… …s to the left
- → Exam… …COOH ⇌ H^+ + …-CO…

…h alkalis to form salts: … NaOH → CH_3COONa + …

- 🧠 **TIP:** Strength = how well acid dissociates, not how much is present

CONCENTRATION VS STRENGTH

- Concentration = how much acid is in a given volume (mol/dm^3)
- Strength = how much of the acid ionises (dissociates)
- You can have:
- A dilute strong acid (low mol/dm^3, fully ionised)
- A concentrated weak acid (high mol/dm^3, partially ionised)
- 🧠 pH depends on [H^+], not just concentration

HYDROGEN ION CONCENTRATION

- More H^+ ions → lower pH
- Fewer H^+ ions → higher pH
- A concentrated acid has more acid particles per dm^3
- A dilute acid has fewer acid particles per dm^3
- Dilute HCl can still be more acidic than concentrated CH_3COOH
- (because HCl fully dissociates, CH_3COOH does not)

🧠 Use pH to measure effective acidity (based on H^+ actually in solution)

RELATIVE ACIDITY (pH SCALE IS LOGARITHMIC)

- Each pH change of 1 = x10 difference in [H^+]
- → pH 3 is 10× more acidic than pH 4
- → pH 2 is 100× more acidic than pH 4
- Formula:
- H^+ conc. factor = 10^x
- (x = final pH - starting pH)
- Example: pH 7 → pH 4 → H^+ increases by 10^3 = 1000×

ENERGY CHANGES

ENERGY TRANSFER IN REACTIONS

- Energy is conserved → not created or destroyed, only transferred
- Measured with thermometer → indicates heat flow
- If energy released → products have less energy than reactants → exothermic
- If energy absorbed → products have more energy than reactants → endothermic

EXOTHERMIC vs ENDOTHERMIC

- Exothermic → heat out → temp ↑ → e.g. combustion | neutralisation | respiration
- Endothermic → heat in → temp ↓ → e.g. thermal decomposition | photosynthesis | citric acid + $NaHCO_3$

ENERGY FLOW SUMMARY

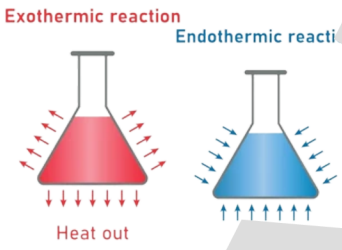
- Exothermic → surroundings get hotter → system energy ↓
- Endothermic → surroundings get cooler → system energy ↑

EXAMPLES

- Exothermic → self-heating cans | hand warmers
- Endothermic → cold packs

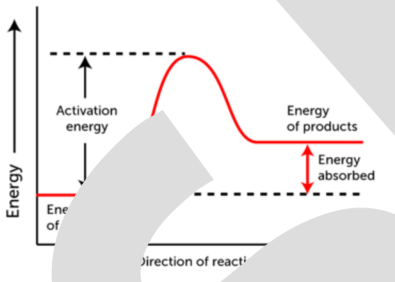
TIP

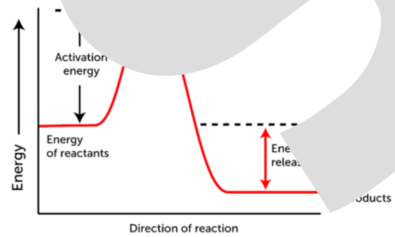
- Use temperature change of surroundings to identify reaction type
- ↑ temp = exothermic | ↓ temp = endothermic



REACTION PROFIL

Endothermic r





REQUIRED PRACTICAL: TEMP CHANGES

OBJECTIVE

- → To investigate temperature change during neutralisation (HCl + NaOH)

HYPOTHESIS

- → Temperature change depends on amount/concentration of reactants

MATERIALS

- Dilute HCl → acid
- Dilute NaOH → alkali
- Styrofoam cup + lid → in
- Thermometer + stirrer
- 25 cm^3 measuring cylinder

APPARATUS SET-UP

- Thermometer + st through lid → in holds reaction lid prevents heat

METHOD

- Measure calorimeter
- Record initial temp
- Add cm^3 HCl → stir → r max
- Re volumes of H
- Plot biggest

RESULTS TABL

Volume of acid	re
	19

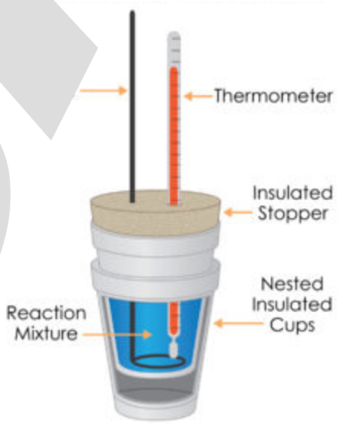
EVALUATION

- → Plot temp vs acid ne →

vs most

CON N

- r temp change = more transferred
- action is exothermic (temp



REACTION PR

ACTIVATION ENERGY

- Collision needed for reaction → must have:
- Enough energy
- Correct orientatio
- quent collisio
- n ener minimum energy ion
- start (more energy nee
- E_a shown ergy rise at the start of a reaction profile

ENERGY PROFILES

- Y-axis = energy | X-axis = progress of reaction
- Arrow shows overall energy change:
- 🔽 Exothermic → energy released (products have lower energy)
- 🔼 Endothermic → energy absorbed (products higher energy)
- ence in height = overall energy change

ENERGY CHANGE (BOND) (HT)

- Bond breaking → endothermic (energy in)
- Bond making → exothermic (energy out)
- ⚖️ Overall energy change = bond breaking − bond making

🔺 ENDOTHERMIC REACTIONS

- More energy absorbed than released → ΔH is positive
- Products have more energy than reactants

🔻 EXOTHERMIC REACTIONS

- More energy released than absorbed → ΔH is negative
- Products have less energy than reactants

🔗 BOND ENERGY CALCULATIONS

- Equation:

Energy change = Total energy in − Total energy out

Steps:

- Add all bond energies in reactants (breaking)
- Add all bond energies in products (making)
- Subtract: in − out

🧪 WORKED EXAMPLES

Example 1 - Reaction: $H_2 + Cl_2 \rightarrow 2HCl$

- Break: H–H (436) + Cl–Cl (242) = 678 kJ
- Make: 2 × H–Cl (431) = 862 kJ
- ΔE = 678 − 862 = −184 kJ → Exothermic

Example 2 -Reaction: $2HBr \rightarrow H_2 + Br_2$

- Bonds broken: 2 × H–Br = 732
- Bonds formed: H–H = 436, Br–Br = 193 → Total out = 629
- 732 − 629 = +103 kJ → Endothermic

🧠 TIP

- ✅ State whether overall energy change is + (endothermic) or − (exothermic)
- ✅ Use the word "energy is released/absorbed"

RATE & EXTENT OF CHEMICAL CHANGE

CALCULATING RATES OF REACTION

- Depends on: type of chemicals / physical state / temperature / concentration / catalysts.
- Measured by how fast → reactant used up / product formed.

CALCULATING RATE

Rate =

- → amount of reactant used ÷ time taken
- → amount of product made ÷ time taken

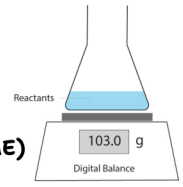
Units:

- → g/s (mass)
- → cm^3/s or dm^3/s (gas volume)

METHODS TO MEASURE RATE

1. MASS LOSS (GAS RELEASED)

- Mass recorded every few seconds using a balance.
- E.g. $CaCO_3 + HCl \rightarrow CO_2$



✅ Pros: very accurate
❌ Cons: gas escapes to air

2. GAS COLLECTION (VOLUME)

- Gas volume collected in:
- → measuring cylinder (downward displacement)
- → gas syringe
- E.g. $Mg + HCl \rightarrow H_2$
- Volume recorded over time

✅Pros: accurate, allows graph plotting
❌Cons: syringe can pop off if vigorous

3. PRECIPITATION (CLOUDY MIXTURE)

- Precipitate clouds solution → m… disappear
- E.g. sodium thiosulfate + HCl
- Time how long cross disappe…

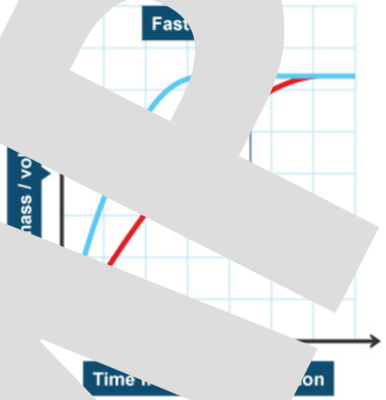
✅Pros: simple setup
❌Cons: subjective / only one data point … possible

RATE GRAPHS

- Y-axis → Product for… Reactant used
- X-axis → Time
- Steep line → Fast rate | Flat … → Reaction complete
- More product at end → More reactants used

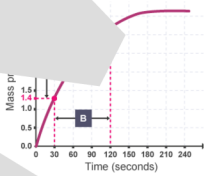
GRAPH SHAP…

- Product … ositive curve (steep …
- Reactant … ve (steep fall then …
- Initial rate → Straig… orig…
- … r reaction



…TE FROM GR…H

M… change in y / change in … points



F…RS AFFECTING … OF RE…TION

…ntration …s) / …(gases …

…)

→ Ca…

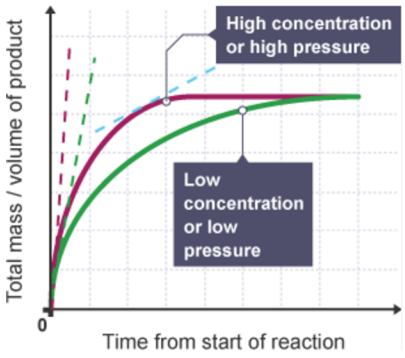
🧠 Higher … …ster product formation / fas… reactant use

📈 GE… …RAPH PATTERN FOR RAT… …ES

- …rs below:
- …per gradient = faster rate
- …izontal sooner = reaction …es quicker
- …ame final product amount

💨 CONCENTRATION / PRESSURE

- ⬆ Concentration/Pressure = more particles per cm^3→ ⬆ Frequency of collisions → ⬆ Rate



🌡️ TEMPERATURE

⬆ Temp → ⬆ Particle kinetic energy → ⬆ Frequency + Energy of collisions → ⬆ Rate

🧊 SURFACE AREA

⬆ Surface area (e.g. powder not lumps) → ⬆ Area exposed → ⬆ Collision frequency → ⬆ Rate

🟫 Cube cut into smaller cubes = larger total surface area

⚗️ CATALYST

Catalyst → Provides alternative pathway with lower activation energy

→ More particles have enough energy to react

→ Reaction speeds up, catalyst remains unchanged

Graph: Same final amount, steeper initial slope

💡TIPS

✅ Always mention collision frequency/energy
✅ Use graph comparisons: gradient + final plateau
✅ State particles per unit volume for concentration/pressure questions
✅ Explain surface area as smaller particle size

REACTION RA… USING MOL…

- Often more use…
- No direct way to … moles → must conve… mass/volume to moles

TO CONVERT TO MOL/S

- Mass per unit time ÷ Molar mass = …les per unit time
- Volu… …nit time ÷ 24,000 cm… …oles per unit time

EX…

- … CO_2 lost … the re…

1. T… …
2. Mass …
   - Moles = mass ÷ M_r = 6.0 ÷ 44.0 = 0.137 mol
3. Rate = moles ÷ time:
   - Rate = 0.137 ÷ 150 = 10^{-4} mol/s

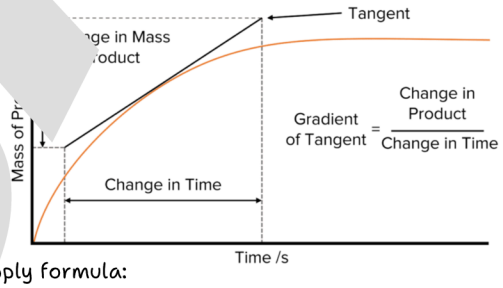
CALCULATING …RADIENTS (HT)

… POINT (USING A …

…aight line touching curve only …oint).

… two clear points on the tangent → …re change in y (product/amount) and x …e).

…dient = change in y / change in x



…pply formula:

- Rate (gradient) = ΔProduct ÷ ΔTime

✓ Know the difference between mean rate (overall change ÷ time) and instantaneous rate (tangent gradient at one point).

CRUDE OIL, HYDROCARBONS & ALKANES

- Organic Chemistry: Chemistry of carbon compounds.
- Hydrocarbons: Compounds made of carbon and hydrogen only.

TYPES OF FORMULAE

- General Formula: Shows the composition of any member of a homologous series (e.g. Alkanes: C_nH_{2n+2}).
- Displayed Formula: Shows all the atoms and bonds in a molecule.
- Molecular Formula: Shows the actual number of each atom in a molecule (e.g. Butane: C_4H_{10}).
- Structural Formula: Shows the structure without displaying all bonds (e.g. Pentane: $CH_3(CH_2)_3CH_3$).

HOMOLOGOUS SERIES

Characteristics:

- Same functional group.
- Same general formula.
- Similar chemical properties.
- Each member differs by $-CH_2-$.
- Gradually changing physical properties (e.g. boiling point, density).

CRUDE OIL

A complex mixture of hydrocarbons.

- Formation: From biomass (plants/animals) over millions of years under high pressure and temperature.
- Finite Resource: Formed much slower than it is used.

ALKANES

Saturated Hydrocarbons:

- Single C–C bonds only.
- General Formula: C_nH_{2n+2}.
- Unreactive but undergo com

First Four Alkanes:

- Methane: CH_4 (gas)
- Ethane: C_2H_6 (gas)
- Propane: C_3H_8 (gas)
- Butane: C_4H_{10} (gas)

Alkane	Molecular formula	
Methane	CH_4	
Ethane	C_2H_6	
Propane	C_3H_8	
Butane	C_4H_{10}	

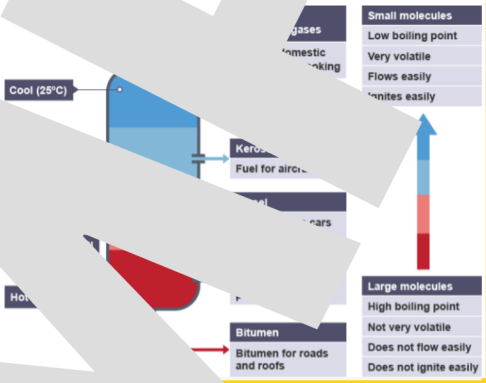
FRACTIONAL DISTILLATION & PETROCHEMICALS

- Crude oil is a mixture of differe hydrocarbons, separated by f distillation.
- Fractions have similar chai similar boiling points.
- Larger molecules have higher b condense at the bottom.
- Smaller molecules have lower boiling point condense at the top.
- Most fractions are alkanes (single bonds).

HOW FRACTIONAL TILLATION WORKS

- Crude oil is he urises → enters fractionating
- Column has a te hot at the bottom, cool at th
- Vapours rise, cool and cond reach th ts.
- Large her b.p.) cond low
- Sm ocar b.p.) condense h

C RACTIO



C EMISTRY

PROPERTIES OF HYDROCARBONS

T DS IN PHYSICAL IES

nd on mo ecule size | cosity (ea w) | ammabilit f burning) | Colour | C of burn | enc uels

- h molecule size | Strong ermolecular forces need more energy to overcome

V

f flow | High viscosity = , flows less easily | reases with chain length ore intermolecular forces) | ong-chain hydrocarbons used as lubricants to reduce friction

FLAMMABILITY

- Smaller hydrocarbons | More flammable, ignite easily | Release more energy when burned

COMBUSTION OF HYDROCARBONS

- Burn in air to form water and carbon dioxide | Oxidation: Hydrogen → water | Carbon → carbon dioxide

Examples:

- Methane: $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
- Octane (Petrol): $2C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O$

TIP:

- Balance elements in order: Carbon | Hydrogen | Oxygen | If oxygen is a fraction, multiply all coefficients by 2

CRA & HYDROCARBONS & ALKENES

Cracking Converts long-chain hydrocarbons (low demand) to short-chain ons (high demand).
Demand: Supply = production from crude oil | Demand = customer Short chains (e.g. petrol, kerosene) have high demand | Long chains (e.g. fuel oil) have low demand.

TYPES OF CRACKING

- Catalytic Cracking: Heat to 470 - 550°C → Vapourise → Pass over hot catalyst (e.g. aluminium oxide) → Thermal decomposition.
- Thermal Cracking: Higher temperatures and pressures → Produces more alkenes → Involves steam and heat.

PRODUCTS OF CRACKING

- Alkanes (saturated, single bonds) + Alkenes (unsaturated, double bonds).
- Example: Decane ($C_{10}H_{22}$) → Octane (C_8H_{18}) + Ethene (C_2H_4).

WRITING EQUATIONS FOR CRACKING

- Atoms on each side must balance (Law of Conservation of Mass).
- Example: $C_{20}H_{42} \rightarrow C_{18}H_{38} + C_2H_4$ | Unknown product is an alkane (CnH_{2n+2}).

ALKENES -Homologous series with at least one C=C double bond.

- General formula: CnH_{2n} | More reactive than alkanes | Used in polymers and as starting materials.

TEST FOR ALKENES - Bromine water test → Alkane: Stays orange (no reaction) | Alkene: Decolourises (reaction with double bond).

FLAME TESTS

- Used to identify metal ions (cations) by the colour of the flame they produce.
- Each metal ion gives a distinctive flame colour.

METHOD

1. Use nichrome/platinum wire.
2. Clean in acid + heat (no colour).
3. Dip in sample → place in blue Bunsen flame.

FLAME COLOURS

- Li^+ (Lithium) – Crimson
- Na^+ (Sodium) – Yellow
- K^+ (Potassium) – Lilac
- Ca^{2+} (Calcium) – Orange-red

REQUIRED PRACTICAL

Objective: → Identify ions in unknown ionic compounds using chemical tests.

- Hypothesis: → A salt's identity can be determined by its cation + anion.

MATERIALS

- Bunsen burner | test tubes + rack | teat pipette | nichrome wire | limewater |
- 0.4 mol/dm³ HCl | 0.1 mol/dm³ $BaCl_2$ | 0.4 mol/dm³ HNO_3 | 0.05 mol/dm³ $AgNO_3$ | salt samples.

METHOD

- Use tests for → flame, hydroxide, carbonate, sulfate, halide.
- Use small amount solids in distilled needed.
- Record all results nec repeat unclear ones for confirmation.

CONCLUSION

- Identifu from ions → e.g. Fe^{2+} $FeSO_4$ | Li^+ + Br^- → L

WO AMPLE

- Red flame (AgN
- Sa ur → Fe or Al (NaOH) → Fe^{2+} |
- No halide ppt ($AgNO_3$) | W ppt (HCl + $BaCl_2$) → SO_4 $FeSO_4$

METAL HYDROXIDES

SODIUM HYDROXIDE TEST

- Used to identify metal cations by the colour of the precipitate formed with NaOH.

METHOD

1. Add a few drops of NaOH to the solution slowly.
2. Observe the colour of the precipitate.
3. Add excess NaOH to see if the precipitate dissolves.

Note:

- Some hydroxides dissolve in excess NaOH.

OBSERVATION WITH NaO

- Cu^{2+} – Light blue precipitate – Insol
- Fe^{2+} – Green pre Insoluble
- Fe^{3+} – Brown te – Insoluble
- Ca^{2+} – Whit Insoluble
- Mg^{2+} – White precipit Insolubl
- Al^{3+} – ipitate – Disso colou

NOTES

- Ca^{2+} and Mg white & insoluble (us t to distinguish).
- Al^{3+} → white ppt dis

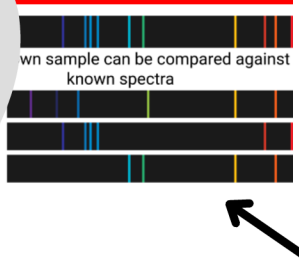
TIP

- "Colo "
- Colourles
- Clear: transp still be coloured).

MET

Exampl , IR, Mass ect as phy, Flame

- es →
- uracy
- Fa ier to use
- Mor ctive than
- aditi l methods



CARBONAT

PURPOSE

- Identify t nate ion (CO_3^{2-}).

METHOD

- Add
- the sa
- Observe effe this shows CO_2 g produced.
- Bubble the gas through limewater ($Ca(OH)_2$).
- Limewater turns udy/milky if CO_2 is

K

- CO_3
- (g) + H_2O
- (g) + Ca(
- (s) + H_2O (l)

R

✅ test: Limewater tu dy due to $CaCO_3$ p ce.

Connect the test tube imewater quickly so no es.

SULFA

OSE

the presence of s in a solution.

METHOD

1. Add dilute hydrochloric acid (HCl) to the sample. Removes any carbonate mpurities that could give false results.
3. Add barium chloride solution ($BaCl_2$) (or barium nitrate if avoiding chloride ions).

OBSERVATION

✅ White precipitate of barium sulfate ($BaSO_4$) forms if sulfate ions are present.

EQUATION

- Ba^{2+} (aq) + SO_4^{2-} (aq) → $BaSO_4$ (s)

TIP: HCl must be added first — without it, carbonates may also produce a white precipitate and interfere with the test.

ADVANTAGES

- → Accurate, fast, sensitive (detects small amounts).
- → Works for mixtures (unlike flame tests, which detect one ion at a time).

USING REFERENCE DATA

- → Compare sample spectrum with known reference spectra.
- → Matching lines identify metal ions present.

HALIDES

PURPOSE

- Identify halide ions (Cl^-, Br^-, I^-) — negative ions from Group aments.

METH

1. A acid (HNO_3) e impurities. use HCl — it s Cl^- ions that ere.
2. Au silver nitrate solution ($AgNO_3$). bserve the colour of the silver halide precipitate formed.

REACTIONS

Example (for chloride):

- KCl (aq) + $AgNO_3$ (aq) → KNO_3 (aq) + AgCl (s)

Ionic equation:

- Ag^+ (aq) + X^- (aq) → AgX (s)

OBSERVATIONS

- Cl^- – White precipitate – Silver chloride (AgCl)
- Br^- – Cream precipitate – Silver bromide (AgBr)
- I^- – Yellow precipitate – Silver iodide (AgI)

✅ Always acidify with nitric acid, not hydrochloric acid, to avoid false positives from chloride ions.

FLAME EMISSION SPECTROSCOPY

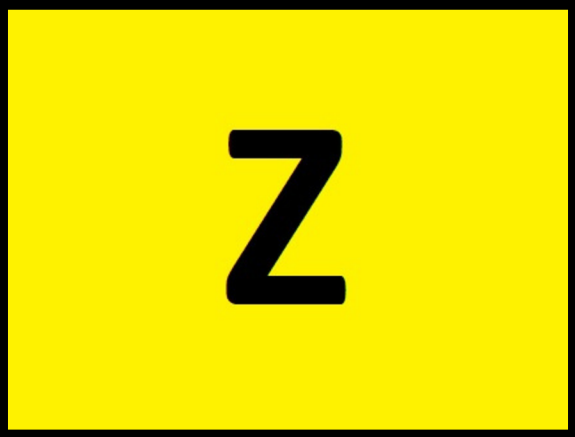
- An instrumental method used to identify metal ions in solution and determine their concentrations.

HOW IT WORKS

- Sample → placed in flame → ions excited → electrons fall back → emit light.
- Light → passes through spectroscope → splits into line spectrum (unique pattern).
- Each element → emits light at specific wavelengths → identifies ion + shows concentration.

KEY POINTS

- Each metal gives a distinct line pattern.
- Intensity of lines = concentration.



MR. ZEE'S RESOURCES