

Acids, Bases & Salts

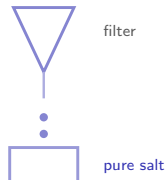
IGCSE Chemistry ■ Topic 7

IGCSE Chemistry



What we will cover

- 1 Acids & their reactions
- 2 Indicators
- 3 Strong vs weak acids
- 4 The pH scale
- 5 Oxides
- 6 Preparing salts



preparing salts

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Acids and bases

Acids and their reactions

An **acid** 酸 forms H^+ in water.

- metal $\rightarrow$ **salt** 盐 + hydrogen (effervescence)
- **base** 碱 $\rightarrow$ salt + water (**neutralisation** 中和)
- **carbonate** 碳酸盐 $\rightarrow$ salt + water + CO_2

You cannot see hydrogen – write **effervescence**, not “hydrogen is given off”.

Describing what you see

Naming the products is only half of what the exam wants.

“State the observations” asks what you would **see with your eyes**, and it carries its own marks – so learn the words on the next slide.

Indicators

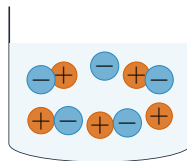
An **indicator** 指示剂 is a dye that changes colour.

	in acid	in alkali
litmus 石蕊	red	blue
methyl orange	red	yellow
thymolphthalein	colourless	blue

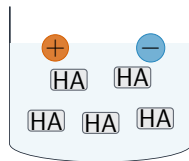
Strong vs weak acids

- **strong acid** 强酸 (HCl , H_2SO_4 , HNO_3): **fully** ionised
- **weak acid** 弱酸 (ethanoic): only **partly** ionised, mostly molecules

Same concentration: the weak acid has a **higher pH** and reacts **more slowly**.



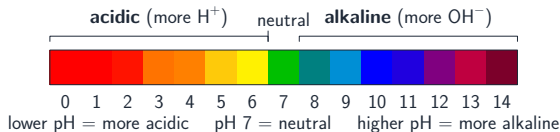
strong acid
fully split into
ions (e.g. HCl)



weak acid
mostly molecules,
few ions (e.g.
ethanoic acid)

The pH scale

- with **metals** 金属: acid + metal
→ a **salt** 盐 + **hydrogen** 氢气
- with bases: acid + **base** 碱 → a
salt + water (this is
neutralisation 中和)
- with **carbonates** 碳酸盐: acid +
carbonate → a salt + water +
carbon dioxide 二氧化碳



Universal indicator turns red in a strong acid, green at neutral (pH 7), and purple in a strong alkali

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Oxides and salts

Oxides

acidic

non-metal oxides
(SO_2 , CO_2)

basic

metal oxides
(CuO , CaO)

amphoteric 两性

react with both
(Al_2O_3 , ZnO)

Metal oxides tend to be basic; non-metal oxides tend to be acidic.

Making a soluble salt

React acid with **excess** solid (metal, base or carbonate):

- 1 add excess, then **filter** 过滤
- 2 **evaporate** 蒸发 some water
- 3 **crystallise** 结晶

An alkali needs **titration** 滴定 instead.

add an **excess** of an insoluble base, metal or carbonate to the acid

filter to remove the leftover solid (the salt stays dissolved)

evaporate some of the water to make a saturated solution

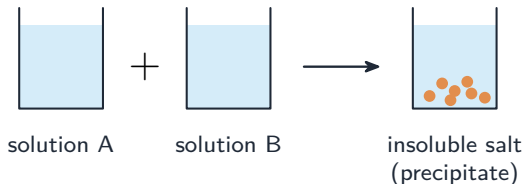
leave to **crystallise**, then dry the pure salt crystals

Describing what you see, and water in salts

bubbles of gas	say effervescence 泡腾 – fizzing and bubbling are also accepted
the solid getting smaller	say the solid dissolves or disappears
a colour change	name both colours – from blue to colourless, not just “it changes”
heat given out	the mixture warms – an exothermic reaction
hydrated 水合	a substance chemically joined with water – blue copper(II) sulfate crystals
anhydrous 无水	a substance containing no water – the same salt, white, after heating

Observations are marked separately from equations. Write what a person watching would actually be able to report.

Making an insoluble salt



By **precipitation** 沉淀: mix two solutions that each carry one needed ion.

The insoluble salt appears as a solid – then filter, wash & dry it.

Bases and alkalis



pH strips: alkalis turn universal indicator purple or blue ($\text{pH} > 7$)

Acids, bases, and the proton

An acid

An acid is a **proton** 质子 donor – it gives away H^+ ions, and a hydrogen ion is just a proton.

A base

Bases are **oxides** 氧化物 or **hydroxides** 氢氧化物 of metals; an alkali is a soluble base.

Strong and weak

Hydrochloric acid 盐酸 is strong – fully ionised. **Ethanoic acid** 乙酸 is weak, so its equation takes the reversible arrow.

Water of crystallisation

The water molecules trapped inside hydrated crystals are the **water of crystallisation** 结晶水 – driven off by heating, and taken back on cooling.

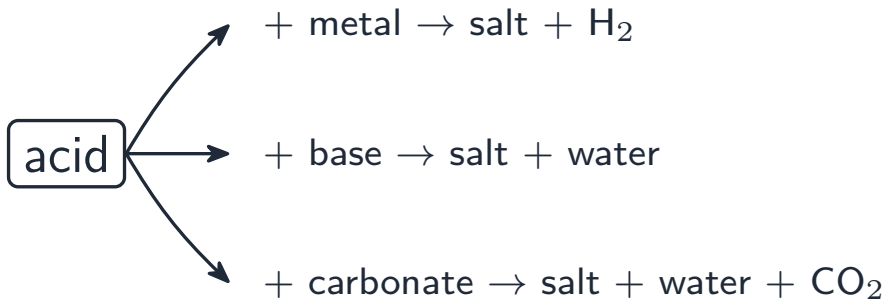
Strong is not the same as concentrated: strong is how far it ionises, concentrated is how much is dissolved.

Crystallising copper(II) sulfate



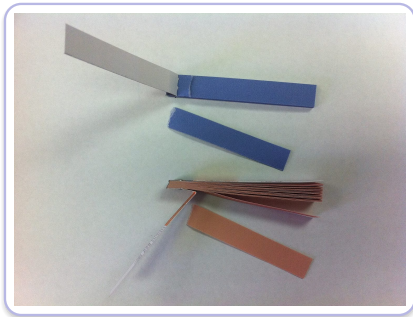
Letting the solution crystallise slowly gives well-shaped crystals – here, the blue crystals of copper(II) sulfate

Acids



Acids react with metals, bases and carbonates to give different products

Litmus in acid and alkali



Litmus paper: blue litmus turns red in an acid, and red litmus turns blue in an alkali

Limestone neutralises acids



Limestone is mostly calcium carbonate – a metal carbonate that acts as a base and neutralises acids

Sorting oxides, and the solubility rules

basic oxides	metal oxides – they react with acids to give a salt and water
acidic oxides	non-metal oxides – they react with alkalis
amphoteric oxides	react with both – aluminium and zinc oxide
neutral oxides	react with neither – carbon monoxide, water
always soluble	all sodium, potassium and ammonium salts 铵盐, and all nitrates
chlorides 氯化物	soluble except lead and silver; sulfates soluble except barium, calcium and lead; carbonates insoluble except sodium, potassium and ammonium

The solubility rules decide the method: a soluble salt is made by titration or by adding excess solid; an insoluble one by precipitation.

Exam tips

- Learn the three acid reactions: acid + metal $\rightarrow$ salt + hydrogen; acid + base $\rightarrow$ salt + water (neutralisation); acid + carbonate $\rightarrow$ salt + water + carbon dioxide.
- **Strong** and **weak** describe how much the acid splits into ions (dissociation), *not* how concentrated it is. A strong acid is fully dissociated; a weak acid only partly.
- A lower **pH** means a higher hydrogen-ion concentration. pH 7 is neutral, below 7 is acidic, above 7 is alkaline.
- Choose the salt method by solubility: a **soluble** salt is made from an acid + excess solid (then filter, evaporate, crystallise), or by titration with an alkali; an **insoluble** salt is made by precipitation (mix two solutions, then filter).
- Learn the solubility rules – all sodium, potassium, ammonium and nitrate salts are soluble.

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Recap

Worked example – choosing a salt preparation

How would you prepare (a) copper(II) sulfate and (b) lead(II) sulfate?

- (a) Copper(II) sulfate is **soluble**: add **excess** insoluble copper(II) oxide to warm sulfuric acid.
- Filter off the excess, then **crystallise** the filtrate.
- (b) Lead(II) sulfate is **insoluble**: mix two **solutions** (lead nitrate + sodium sulfate).
- **Precipitation**: filter, wash and dry the solid.

Ask “**is the salt soluble?**” first. Soluble $\Rightarrow$ acid + excess solid, filter, crystallise. Insoluble $\Rightarrow$ mix two solutions and filter the precipitate.

Topic 7 – key takeaways

1

Acids

make H^+ ; react with metals,
bases, carbonates

2

Strong/weak

full vs partial dissociation (not
conc.)

3

pH

< 7 acid, 7 neutral, > 7 alkali

4

Salts

soluble: filter/evaporate;
insoluble: precipitate

Check yourself

- 1 What gas forms when an acid reacts with a metal?
- 2 What does “strong acid” mean?
- 3 What is the pH of a neutral solution?
- 4 How do you make an insoluble salt?



Answers 1. hydrogen 2. fully dissociated into ions 3. 7 4. precipitation – mix two solutions