

Acids, Bases & Salts

IGCSE Chemistry • Topic 7

IGCSE Chemistry



Acids, Bases & Salts

What we will cover

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



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Acids and bases

Acids, Bases & Salts

└─ Acids and bases

Acids and their reactions

An **acid** 酸 forms H^+ in water.

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

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

Acids, Bases & Salts

└─ Acids and bases

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.

Acids, Bases & Salts

└─ Acids and bases

Indicators

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

- **litmus** 石蕊 – red in acid, blue in alkali
- methyl orange – red in acid, yellow in alkali
- thymolphthalein – colourless in acid, blue in alkali

Acids, Bases & Salts └─ Acids and bases Strong vs weak acids A strong acid 强酸 (HCl, H₂SO₄, HNO₃) is fully ionised. A weak acid 弱酸 (ethanoic) is only partly ionised, so at the same concentration it has a higher pH and reacts more slowly.	Acids, Bases & Salts └─ Acids and bases 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
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Acids, Bases & Salts └─ Acids and bases The pH scale, in detail acidic (more H⁺) neutral alkaline (more OH⁻)  0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 lower pH = more acidic pH 7 = neutral higher pH = more alkaline Universal indicator turns red in a strong acid, green at neutral (pH 7), and purple in a strong alkali	2 Oxides and salts
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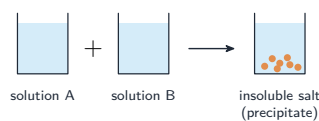
Acids, Bases & Salts └─ Oxides and salts Oxides acidic non-metal oxides (SO₂, CO₂) basic metal oxides (CuO, CaO) amphoteric 两性 react with both (Al₂O₃, ZnO) Metal oxides tend to be basic; non-metal oxides tend to be acidic.	Acids, Bases & Salts └─ Oxides and salts Making a soluble salt React acid with excess solid (metal, base or carbonate): - add excess, then filter 过滤 evaporate 蒸发 some water 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
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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 (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.

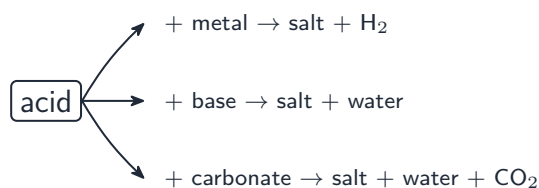
Strong is not the same as concentrated: strong is how far it ionises, concentrated is how much is dissolved.

Making a soluble salt, continued



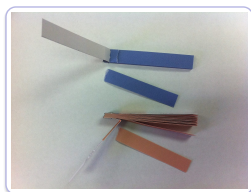
Letting the solution crystallise slowly gives well-shaped crystals – here, the blue crystals of copper(II) sulfate

Acids



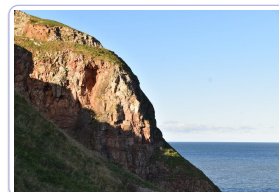
Acids react with metals, bases and carbonates to give different products

Indicators, continued



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

Oxides, continued



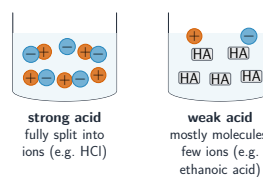
Limestone is mostly calcium carbonate – a metal carbonate that acts as a base and neutralises acids

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**.

Strong and weak acids



A strong acid is fully split into ions; a weak acid stays mostly as molecules (only partly dissociated)

Exam tips

- Learn the three acid reactions: acid + metal → salt + hydrogen; acid + base → salt + water (neutralisation); acid + carbonate → 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?

acid 7 alkali

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