

# Acids, Bases & Salts

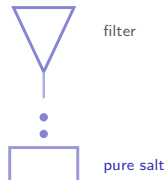
## IGCSE Chemistry ■ Topic 7

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*



# Acids and their reactions

An **acid** forms  $\text{H}^+$  in water.

- metal  $\rightarrow$  **salt** + hydrogen (**effervescence**)
- **base**  $\rightarrow$  salt + water (**neutralisation**)
- **carbonate**  $\rightarrow$  salt + water +  $\text{CO}_2$

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** is a dye that changes colour.

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

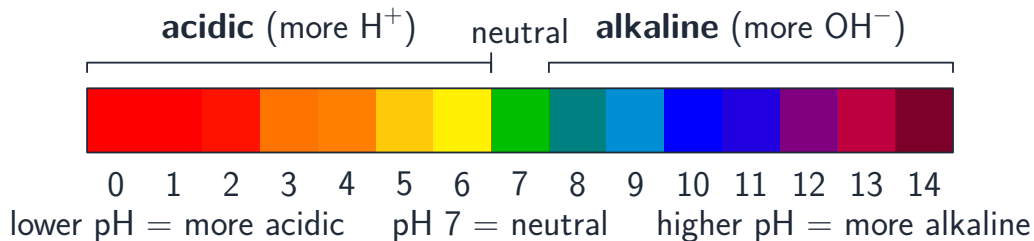
## Strong vs weak acids

A **strong acid** ( $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ ) is fully ionised. A **weak acid** (ethanoic) is only partly ionised, so at the same concentration it has a higher pH and reacts more slowly.

# The pH scale

- with **metals** : acid + metal  $\rightarrow$  a **salt** + **hydrogen**
- with bases: acid + **base**  $\rightarrow$  a salt + water (this is **neutralisation** )
- with **carbonates** : acid + carbonate  $\rightarrow$  a salt + water + **carbon dioxide**

## The pH scale, in detail



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



# Oxides

**acidic**

non-metal oxides  
( $\text{SO}_2$ ,  $\text{CO}_2$ )

**basic**

metal oxides  
( $\text{CuO}$ ,  $\text{CaO}$ )

**amphoteric**

react with both  
( $\text{Al}_2\text{O}_3$ ,  $\text{ZnO}$ )

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**
- 2 **evaporate** some water
- 3 **crystallise**

An alkali needs **titration** 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** – 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**

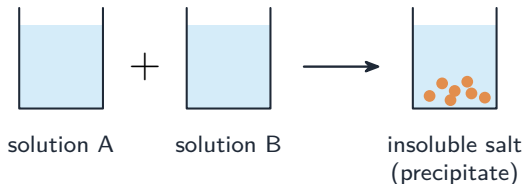
a substance **chemically joined with water** – blue copper(II) sulfate crystals

**anhydrous**

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** : 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** donor – it gives away  $\text{H}^+$  ions, and a hydrogen ion is just a proton.

## A base

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

## Strong and weak

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

## Water of crystallisation

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

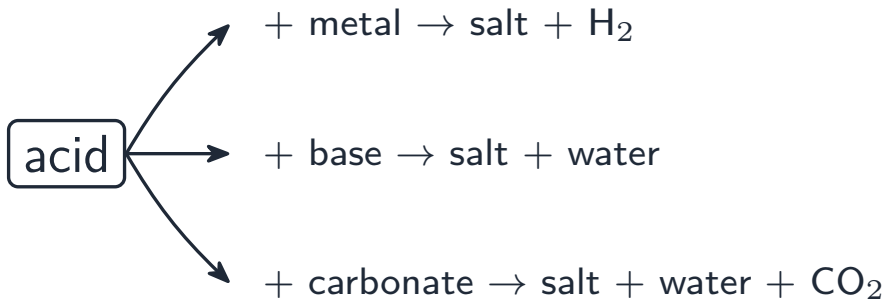
Strong is not the same as concentrated: strong is how far it ionises, concentrated is how much is dissolved.

## Making a soluble salt, continued



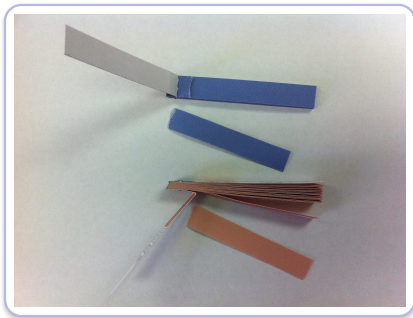
Letting the solution crystallise slowly gives well-shaped crystals – here, the blue crystals of copper(II) sulfate

# 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**

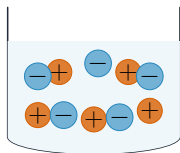
all sodium, potassium and **ammonium salts** , and all nitrates

**chlorides**

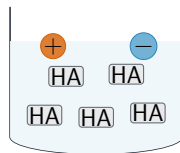
soluble **except lead and silver**; sulfates soluble except barium, calcium and lead; carbonates **insoluble** except sodium, potassium and ammonium

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



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



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

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  $\rightarrow$  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.



## 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  $\text{H}^+$ ; 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