Ikigai Academy

CLASS 10 · SCIENCE · GSEB / CBSE

CHAPTER 2 · QUICK NOTES

Acids, Bases & Salts

Short, exam-ready notes — every point in one line. Indicators, the pH scale, reactions, salts and the chemicals we make from common salt. Nothing extra to copy down.

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IN THIS CHAPTER — 6 SECTIONS

0–14	H^+ / OH^-	4
the pH scale	the two key ions	chemicals from salt

THE pH SCALE

ACIDIC							NEUTRAL · 7							BASIC
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14

more H^+ ions — more OH^- ions

1 Acids, Bases & Indicators

Definitions · colours · sources

ACID

- Tastes **sour**
- Blue litmus → **red**
- Gives **H^+ ions** in water
- Corrosive

BASE

- Tastes **bitter**, feels **soapy**
- Red litmus → **blue**
- Gives **OH^- ions** in water
- Soluble base = **alkali**

INDICATOR

Substance that **changes colour or smell** in acid / base.

Indicator colours

Indicator	In acid	In base	Neutral
Litmus	**Red**	**Blue**	Purple
Methyl orange	**Red**	**Yellow**	Orange
Phenolphthalein	Colourless	**Pink**	Colourless
China rose	**Dark pink**	**Green**	—
Turmeric	Yellow (no change)	**Red / brown**	Yellow

THREE TYPES OF INDICATORS

Natural — litmus (lichen), red cabbage, turmeric, china rose · **Synthetic** — methyl orange, phenolphthalein · **Olfactory** — smell changes: onion, vanilla, clove

Acids & their sources

Mineral acid	Found in
HCl	Stomach
H_2SO_4	Car battery
HNO_3	Fertiliser industry

Organic acid	Found in
Acetic	Vinegar
Citric	Lemon, orange
Lactic	Curd
Tartaric	Tamarind
Oxalic	Tomato
Methanoic	Ant / bee sting

MEMORY AID "**A**cid → **A**pple is sour, turns litmus **red**." · Phenolphthalein = **P**ink in **b**ase. · Litmus is **purple** when neutral.

2 Properties of Acids & Bases

Reactions · tests · neutralisation

Acid reactions — always give a SALT

1 · Acid + Metal → salt + H_2

$$Zn + 2\,HCl \rightarrow ZnCl_2 + H_2\uparrow$$

H_2 test: burning splint gives a **"pop"**

2 · Acid + Carbonate → salt + H_2O + CO_2

$$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2\uparrow$$

CO_2 test: lime water turns **milky**

3 · Acid + Metal oxide → salt + H_2O

$$CuO + 2\,HCl \rightarrow CuCl_2 + H_2O$$

Metal oxides are **basic**

4 · Acid + Base → salt + H_2O

$$NaOH + HCl \rightarrow NaCl + H_2O$$

This is **neutralisation**

Base reactions

1 · Base + Metal → salt + H_2

$$2\,NaOH + Zn \rightarrow Na_2ZnO_2 + H_2\uparrow$$

Not all metals react

2 · Base + Non-metal oxide → salt + H_2O

$$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$$

Non-metal oxides are **acidic**

Neutralisation · $H^+ + OH^- \rightarrow H_2O$

ACID + BASE → SALT + WATER

Gas	Test → Result
H_2	Burning splint → **"pop"**
CO_2	Lime water → **milky**
Excess CO_2	Milkiness **disappears**

Which metals give H_2?

Only metals **above H**: K, Na, Ca, Mg, Al, Zn, Fe.
Cu, Ag, Au do not react.

Acid + hydrogencarbonate

Also gives salt + water + CO_2.
$$NaHCO_3 + HCl \rightarrow NaCl + H_2O + CO_2\uparrow$$

Everyday neutralisation

Indigestion → antacid · Bee sting → baking soda · Acidic soil → lime

PATTERN Acid + metal / carbonate / metal oxide / base → **always a salt**. Metal oxide = basic; non-metal oxide = acidic.

3 Ions, Dilution & the pH Scale

Why acids act like acids — and how strong

Acids → H^+

H^+ cannot exist alone → forms **hydronium (H_3O^+)**

$$HCl + H_2O \rightarrow H_3O^+ + Cl^-$$

Bases → OH^-

Alkalis give hydroxide ions in water

$$NaOH \rightarrow Na^+ + OH^-$$

WATER IS ESSENTIAL

Dry HCl gas does not turn litmus red — no H^+ ions form without water.

Dilution

- Adding water = **exothermic** (gives heat)
- Lowers ion concentration

SAFETY RULE

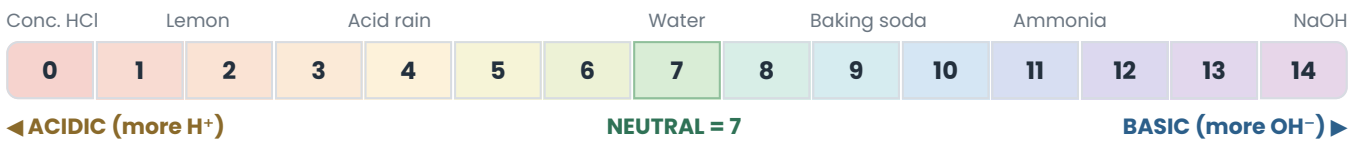
Always add **acid to water**, slowly, with stirring.
Never water to acid — it splashes and burns.

STRENGTH VS CONCENTRATION

Strong / weak = how much it **ionises** (fixed property). · **Concentrated / dilute** = how much **water** is present (you can change it).

	Strong (ionise fully)	Weak (ionise partly)
Acids	HCl · H_2SO_4 · HNO_3	CH_3COOH · H_2CO_3 · citric
Bases	$NaOH$ · KOH	NH_4OH · $Ca(OH)_2$ · $Mg(OH)_2$

The pH scale — 0 to 14



Measuring pH

Universal indicator / pH paper → gives the pH **value**.
Litmus only says acid or base.

Key fact

1 pH unit = 10× change in H^+.
pH 3 is 100× more acidic than pH 5.

EXAM TIP Lower pH = more H^+ = more acidic. A **dilute strong acid** and a **concentrated weak acid** are both possible.

4 pH in Daily Life & Salts

Where it matters · what salts are

Soil

Too acidic → add **lime / $CaCO_3$**.
Too basic → add organic matter.

Stomach

Makes **HCl**. Excess → acidity.
Cure: **antacid** — $Mg(OH)_2$, $NaHCO_3$.

Tooth decay

Starts below **pH 5.5**.
Enamel = **calcium phosphate**. Cure: basic toothpaste.

Stings

Bee / ant inject **methanoic acid**.
Cure: baking soda (mild base).

ACID RAIN

Rain with **pH below 5.6**. Caused by **oxides of S and N** dissolving in rain. Lowers river pH → harms aquatic life; corrodes marble.

Salts

WHAT IS A SALT?

Ionic compound from **acid + base**. **Positive part from base**, **negative part from acid**. e.g. NaCl ← HCl + NaOH.

Sodium family

same Na^+
NaCl · Na_2SO_4 · $NaNO_3$

Chloride family

same Cl^-
NaCl · KCl · $CaCl_2$

Sulphate family

same SO_4^{2-}
Na_2SO_4 · $CuSO_4$

pH of a salt = depends on its parents

Acid	Base	Salt	pH	Example
Strong	Strong	**Neutral**	7	NaCl
Strong	Weak	**Acidic**	< 7	NH_4Cl
Weak	Strong	**Basic**	> 7	Na_2CO_3

Antacids to remember

Milk of magnesia — $Mg(OH)_2$ · **Baking soda** — $NaHCO_3$ · **Tablets** — $CaCO_3$

Common salt — NaCl

From **sea water** & **rock salt**. Used in food, as preservative, and as raw material for 4 chemicals.

REMEMBER The **weaker partner decides** the pH of the salt. Common salt **NaCl** is the raw material for the next page.

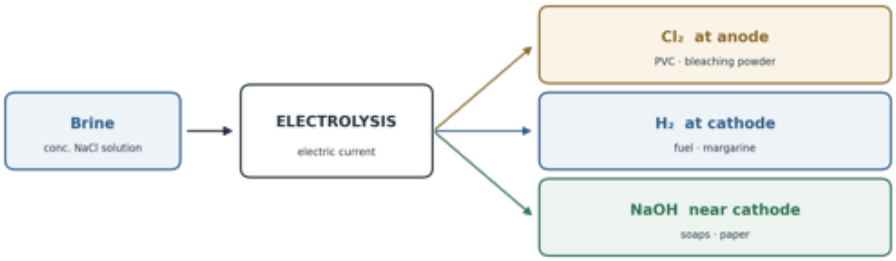
5 Chemicals from Common Salt

Four products you must know

1 · Sodium hydroxide — chlor-alkali process

Electricity through **brine** (conc. NaCl solution):

$$2\,NaCl(aq) + 2\,H_2O(l) \rightarrow 2\,NaOH(aq) + Cl_2\uparrow + H_2\uparrow$$



NaOH = **caustic soda**. All three products are useful — nothing is wasted.

2 · Bleaching powder — $CaOCl_2$

$$Ca(OH)_2 + Cl_2 \rightarrow CaOCl_2 + H_2O$$

- Bleaching cotton, linen, wood pulp
- Disinfecting drinking water
- Oxidising agent in industry

3 · Baking soda — $NaHCO_3$

$$NaCl + H_2O + CO_2 + NH_3 \rightarrow NH_4Cl + NaHCO_3$$

- **Antacid** — mild, edible base
- **Baking powder** = $NaHCO_3$ + tartaric acid
- Soda-acid fire extinguisher

4 · Washing soda — $Na_2CO_3{\cdot}10H_2O$

$$2\,NaHCO_3 \xrightarrow{\text{heat}} Na_2CO_3 + H_2O + CO_2 \rightarrow \text{recrystallise} \rightarrow Na_2CO_3{\cdot}10H_2O$$

- Glass, soap & paper industry
- Domestic cleaning agent
- Removes **permanent hardness** of water
- Making borax

Point	Baking soda	Washing soda
Formula	$NaHCO_3$	$Na_2CO_3{\cdot}10H_2O$
Nature	**Mild base — edible**	**Stronger base — not edible**
Main use	Antacid, baking	Cleaning, hard water

LINK All four come from **common salt**. The Cl_2 from the chlor-alkali process is used to make **bleaching powder**.

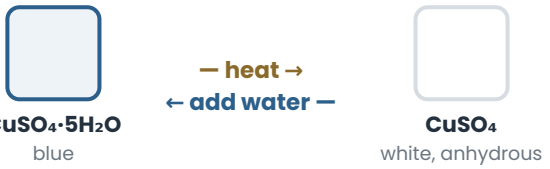
6 Water of Crystallisation & Plaster of Paris

Salts that hold water

WATER OF CRYSTALLISATION

Fixed number of water molecules in **one formula unit** of a salt. Gives crystals their shape and colour.

Copper sulphate — the classic test for water



$CuSO_4 \cdot 5H_2O$ — blue

$CuSO_4$ — white, anhydrous

Blue → white on heating · white → blue on adding water = **test for water**.

Salt	Formula	Water molecules
Copper sulphate	$CuSO_4 \cdot 5H_2O$	5
Washing soda	$Na_2CO_3 \cdot 10H_2O$	10
Gypsum	$CaSO_4 \cdot 2H_2O$	2
Plaster of Paris	$CaSO_4 \cdot \frac{1}{2}H_2O$	½

Plaster of Paris — $CaSO_4 \cdot \frac{1}{2}H_2O$

How it is made

Heat **gypsum** at **373 K (100 °C)**

$$CaSO_4 \cdot 2H_2O \rightarrow CaSO_4 \cdot \tfrac{1}{2}H_2O + 1\tfrac{1}{2}H_2O$$

Store away from moisture.

Uses of PoP

- Plaster casts for broken bones
- Toys, statues, decoration
- Smoothing walls before paint
- Fireproofing & making chalk

Gypsum · $CaSO_4 \cdot 2H_2O$ ⇄ heat 373 K (− water) ▶ / ◀ + water (sets hard) ⇄ PoP · $CaSO_4 \cdot \frac{1}{2}H_2O$

Hydrated vs anhydrous

Hydrated = has water of crystallisation (blue $CuSO_4 \cdot 5H_2O$).
Anhydrous = water removed (white $CuSO_4$).

Why PoP sets hard

PoP + water → **takes water back** → becomes gypsum again → hard solid.

EXAM TIP **$CaSO_4 \cdot \frac{1}{2}H_2O$** — the ½ means two units share one water molecule. PoP + water → gypsum again → sets hard.

One-Page Revision Sheet

The whole chapter at a glance

ACIDS — give H^+

+ metal → salt + H_2
+ carbonate → salt + H_2O + CO_2
+ metal oxide → salt + H_2O
+ base → salt + H_2O

BASES — give OH^-

+ metal → salt + H_2
+ non-metal oxide → salt + H_2O
+ acid → salt + H_2O

Soluble base = **alkali**

INDICATORS & pH

Litmus: acid **red** / base **blue** · Phenolphthalein: **pink in base** · Methyl orange: red / yellow
pH 0–14 · **7 = neutral** · <7 acidic · >7 basic · **1 unit = 10× H^+**

pH IN DAILY LIFE

- Tooth decay below **pH 5.5**
- Acid rain below **pH 5.6**
- Sting = methanoic acid → baking soda
- Stomach HCl → antacid $Mg(OH)_2$

SALTS

Strong+Strong → **neutral** (NaCl)
Strong acid+weak base → **acidic** (NH_4Cl)
Weak acid+strong base → **basic** (Na_2CO_3)

pH VALUES TO REMEMBER

- Gastric juice **1.2** · Lemon **2.2** · Vinegar **3**
- Pure water **7** · Blood **7.4**
- Baking soda **9** · Milk of magnesia **10** · NaOH **14**

STRENGTH vs CONCENTRATION

Strong / weak = how much it **ionises** — fixed.
Conc. / dilute = how much **water** — you can change it.
Both are independent!

SALT FAMILIES

Same **base radical** → Sodium family: NaCl · Na_2SO_4 · $NaNO_3$
Same **acid radical** → Chloride family: NaCl · KCl · $CaCl_2$

WATER OF CRYSTALLISATION

$CuSO_4 \cdot \mathbf{5}H_2O$ (blue→white on heating) · $Na_2CO_3 \cdot \mathbf{10}H_2O$
Gypsum $CaSO_4 \cdot \mathbf{2}H_2O$ · PoP $CaSO_4 \cdot \mathbf{½}H_2O$ (gypsum at **373 K**)

KEY FORMULAE

Caustic soda — **NaOH**
Bleaching powder — **$CaOCl_2$**
Baking soda — **$NaHCO_3$**
Washing soda — **$Na_2CO_3 \cdot 10H_2O$**
Gypsum — **$CaSO_4 \cdot 2H_2O$**
Plaster of Paris — **$CaSO_4 \cdot ½H_2O$**

MUST-KNOW TESTS

- **H_2** → burning splint gives a **"pop"**
- **CO_2** → lime water turns **milky**
- Excess CO_2 → milkiness **disappears**
- **Water** → white $CuSO_4$ turns **blue**

COMMON MISTAKES

- Strength (ionisation) ≠ concentration (water)
- Always **acid → water**, never reverse
- Do not forget the **½** in $CaSO_4 \cdot ½H_2O$
- Dry HCl gas does **not** turn litmus red

CHEMICALS FROM NaCl

- **NaOH** — chlor-alkali (brine electrolysis) → NaOH + Cl_2 + H_2
- **Bleaching powder** — $CaOCl_2$ from $Ca(OH)_2$ + Cl_2
- **Baking soda** — $NaHCO_3$ · **Washing soda** — $Na_2CO_3 \cdot 10H_2O$

MEMORY HOOKS ▸ Add **A**cid to **w**ater (A→W). · **P**ink in **b**ase. · Low pH = high H^+. · Weaker parent decides the salt's pH.