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TOPIC 7.2: SALTS

THE ABOUT

CHAPTER ANALYSIS

TIME

- Complex chapter
- Salt preparation requires high level of mastery

EXAM

- Requires strong knowledge from Acid & Bases
- Very important chapter for Qualitative Analysis

WEIGHTAGE

- Light-Medium overall weightage
- Constitute to **3.5%** of marks for past 5 year papers

KEY CONCEPT

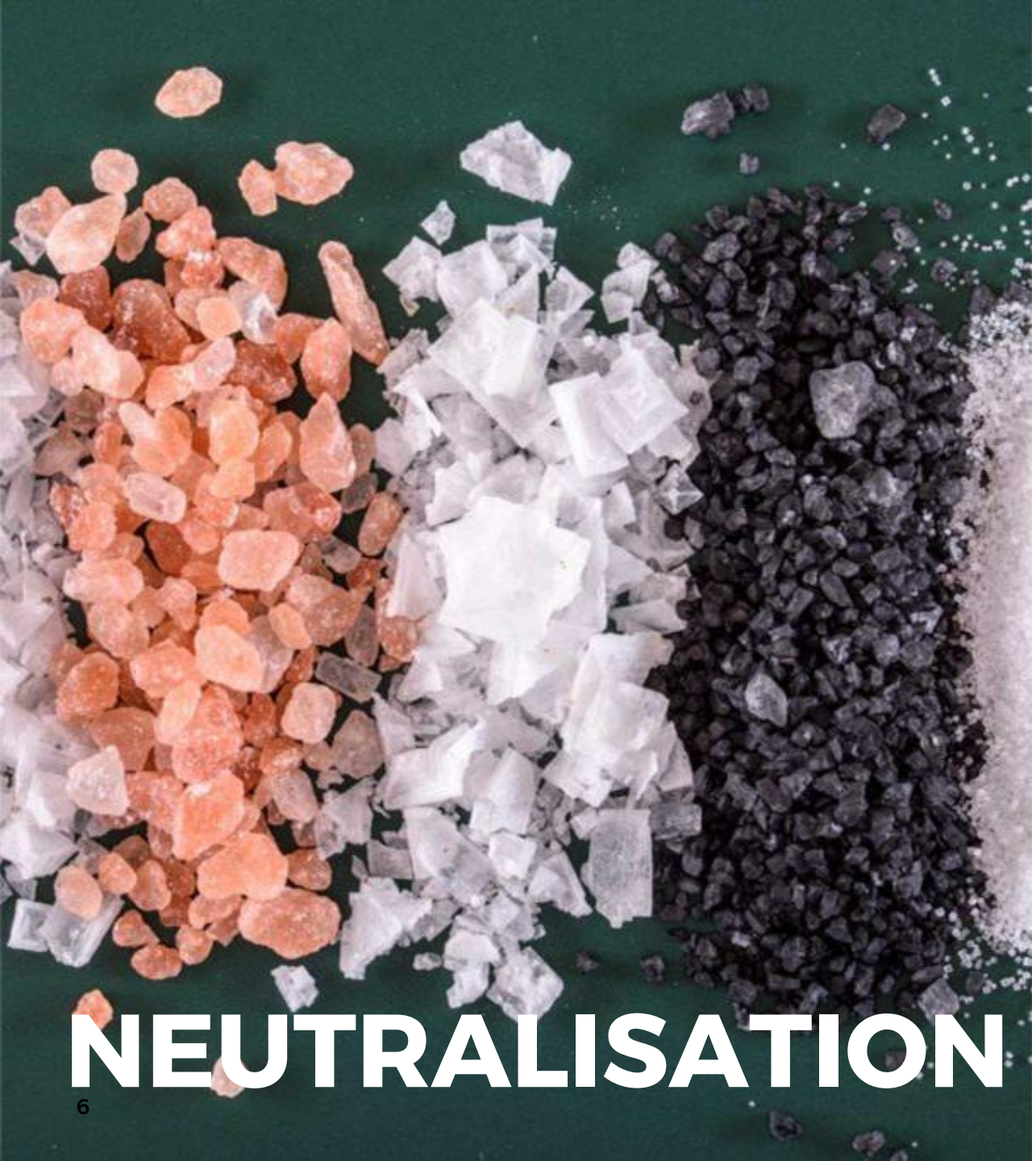
OXIDES
NEUTRALISATION
APPLICATION OF NEUTRALISATION

4 TYPES OF OXIDES

SUMMARY TABLE

OXIDES

Oxides	Basic Oxides	Acidic Oxides	Amphoteric Oxides	Neutral Oxides
Element type	Metal oxides	Non-metal oxides	Some metal oxides	Some non-metal oxides
Chemical properties	Behaves like an alkali, neutralise with acid	Behaves like an acid, neutralise with alkali	Can behave like an acid or an alkali, can react with both acid and alkali	Does not react
Examples	- Sodium oxide - Potassium oxide - Calcium oxide	- Carbon dioxide - Sulfur dioxide - Phosphorus (V) oxide	- Aluminium oxide, Al_2O_3 - Lead (II) oxide, PbO - Zinc oxide, ZnO	- Water, H_2O - Carbon monoxide, CO - Nitrogen monoxide, NO



NEUTRALISATION

NEUTRALISATION

Neutralisation is the process where acid reacts with a base to produce salt & water.

ACID + BASE → SALT + WATER

REAL-LIFE APPLICATIONS

- Regulating the pH of soil

Farmers will add bases like slaked lime (calcium hydroxide) or quicklime (calcium oxide) to **ensure the soil maintains the optimal pH** for growth of plants.

- **Treating indigestion**

Overeating can result in the overproduction of hydrochloric acid by our stomach, causing indigestion. In order to neutralise the excess hydrochloric acid, we would need to intake antacid (a type of base).

- **Toothpaste**

Bacteria on our teeth produce acids which can result in tooth decay.

Toothpastes contain magnesium hydroxide help to remove bacteria & neutralise the acids in our mouth.

KEY CONCEPT

SALT SOLUBILITY TABLE
ACID + EXCESS INSOLUBLE SUBSTANCE
TITRATION
PRECIPITATION

SUMMARY TABLE

SALT SOLUBILITY TABLE

SPA
Anything with sodium, potassium & ammonium are definitely soluble.

	Soluble salts	Insoluble salts
SPA - Sodium - Potassium - Ammonium	ALL	NONE
Nitrates	ALL	NONE
Chlorides	ALL except	Lead(II) chloride, $PbCl_2$ Silver chloride, AgCl
Sulfates	ALL except	Lead(II) sulfate, $PbSO_4$ Barium sulfate, $BaSO_4$ Calcium sulfate, $CaSO_4$
Carbonates	SPA salts	ALL except
Oxides & Hydroxides	Group I & some Group II elements	ALL except

All **Group I metals** form soluble salts.
(Sodium, Potassium…)

Ba, Ca (oxide / hydroxide) are *slightly soluble.*

*Find your own method for memorising. Make your life easier by finding a methodology that works for you!

*If you find the next couple of slides too complicated, feel free to skip to SLIDE 20.

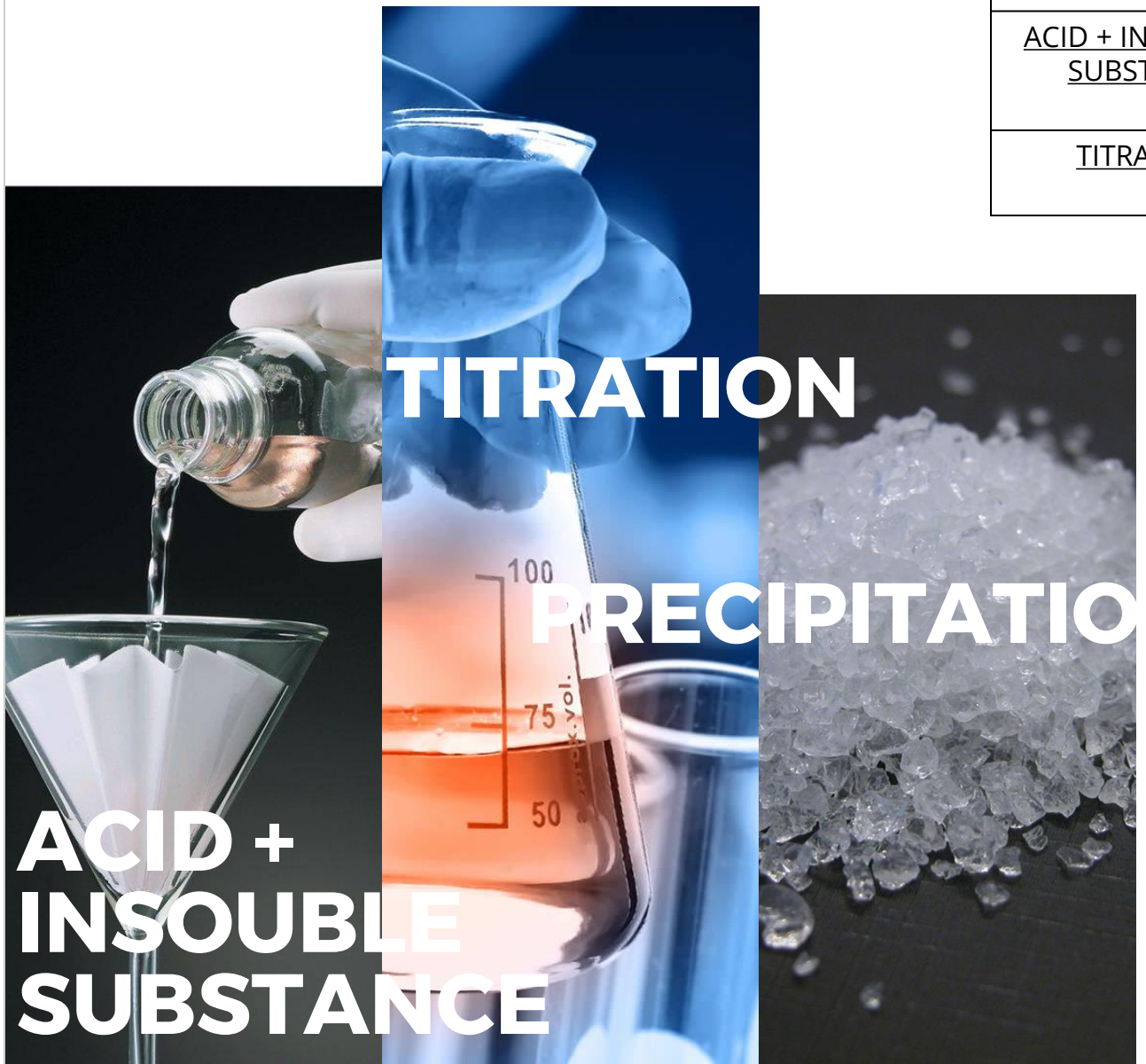
Due to the seemingly complex nature of salt preparation, many students opt to memorise the procedure for salt preparation and attempt regurgitate the content in exams.

While that might work to an extent, they will not be able to solve application questions and might remember some parts wrongly.

In this upcoming section, I will attempt to break down the logic behind salt preparation and show you ***why you do not need to memorise anything once you have understood salt preparation***.

UNDERSTANDING SALT PREPARATION VS MEMORISING

NAME	REACTION
PRECIPITATION	SOLUBLE + SOLUBLE → **INSOLUBLE SALT**
ACID + INSOLUBLE SUBSTANCE	SOLUBLE + INSOLUBLE → **SOLUBLE SALT**
TITRATION	SOLUBLE + SOLUBLE → **SOLUBLE SALT**



3 methods

There are only 3 ways to prepare a salt.

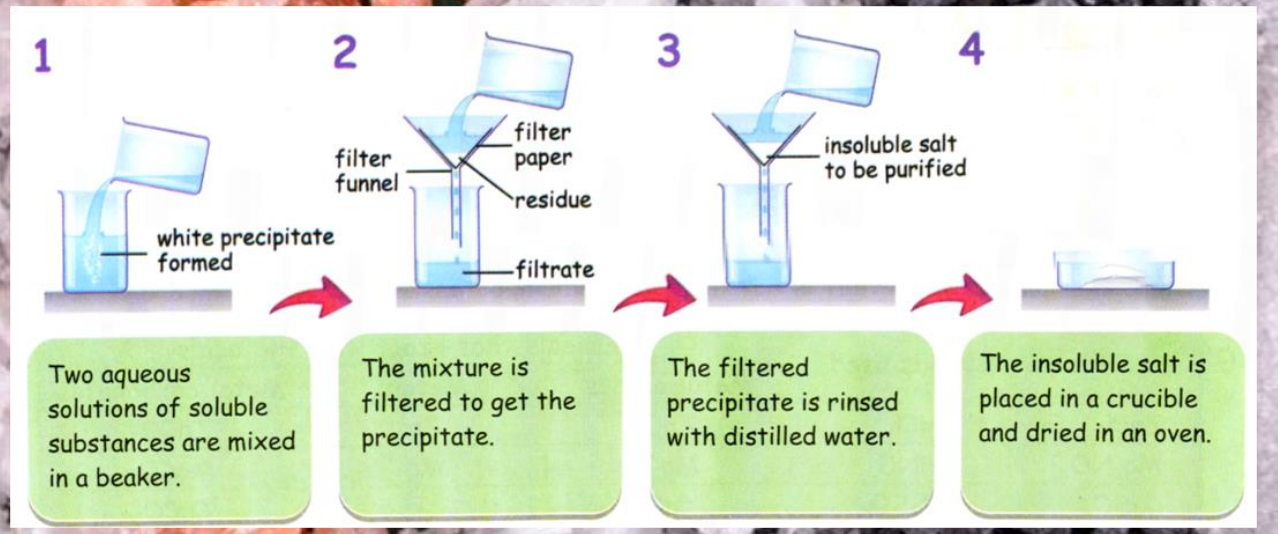
Choosing which method to use depends on the **solubility of the salt** and the **solubility of the reagents.**

Use the table above to see how each preparation method is different!

SUMMARY TABLE

SALT PREPARATION

PREPARATION METHOD	PRECIPITATION	TITRATION	ACID + INSOLUBLE SUBSTANCE
SOLUBILITY OF SALT (Product in reaction)	**INSOLUBLE**	**SOLUBLE**	**SOLUBLE**
Common elements' salt	**ALL INSOLUBLE SALTS**	**Group I salts / SPA salts**	- **Group II salts** - **Group III salts** - **Transition metal salts** - **Unreactive metal salts**
EXAMPLE OF SALTS	-All carbonates except SPA - Silver Chloride - Lead Chloride - Barium Sulfate - Calcium Sulfate - Lead Sulfate - Group II oxides/ hydroxides	- Sodium nitrate - Potassium chloride - Sodium sulfate - Potassium carbonate	- Magnesium sulfate - Aluminium nitrate - Zinc chloride - Iron sulfate - Lead nitrate - Copper chloride
REASONING (MOST IMPORTANT)	Mix 2 soluble reactants that contain the correct ions. **Get an insoluble salt** as the only solid in the reacting solution and collect using filtration.	Reactants are soluble. So is the product. The only way to get a pure substance is to **find the exact volume to react through titration.**	Use excess of the insoluble to is ensure that all the acid is fully reacted. The only liquid in the resultant solution is the soluble salt.
CHEMICAL EQUATION (Example)	barium nitrate + sodium sulfate → barium sulfate (insoluble) + sodium nitrate (salt collected using filtration) SOLUBLE + SOLUBLE → INSOLUBLE SALT	sodium hydroxide + sulfuric acid → sodium sulfate (soluble) + water (neutralisation reaction) (water removed through crystallisation) SOLUBLE + SOLUBLE → SOLUBLE SALT	**acid + carbonate** → salt + water + carbon dioxide gas (water removed through crystallisation) **acid + base** → salt + water (water removed through crystallisation) **acid + metal** → salt + hydrogen gas SOLUBLE + INSOLUBLE → SOLUBLE SALT



PRECIPITATION

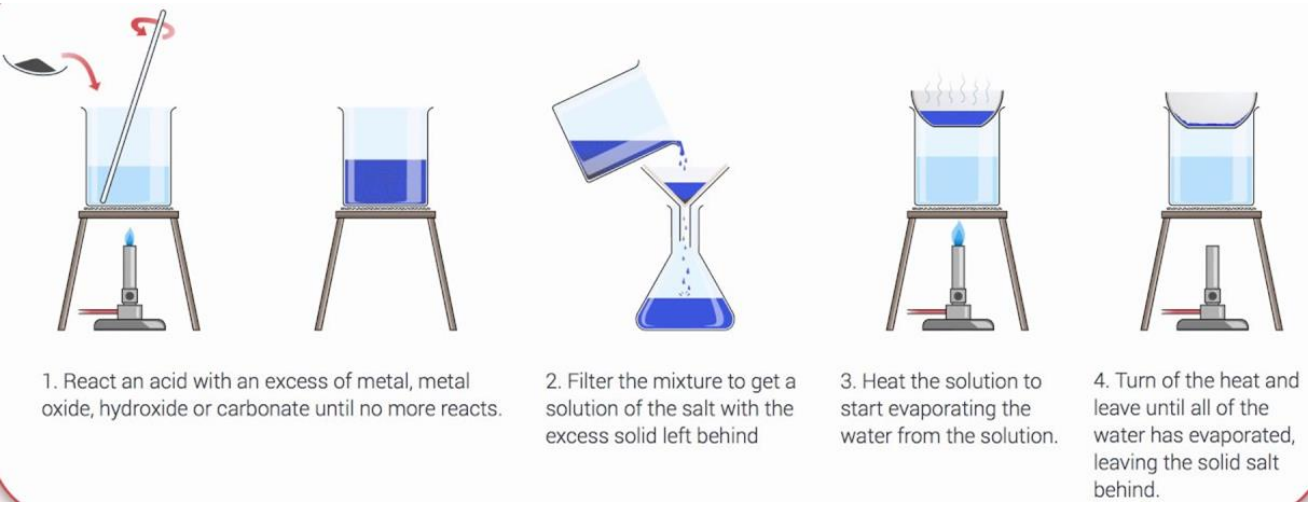
PRECIPITATION

The aqueous solutions of two soluble salts should be mixed; one salt must contain the cation while the other must contain the anion.

When the two salt solutions are mixed, a **resultant insoluble salt will form.**

The insoluble salt can be filtered out and washed with distilled water and dried with filter paper.

Steps:
1) Mix the 2 reactants.
2) Filter and collect residue.
3) Wash & dry with filter paper.

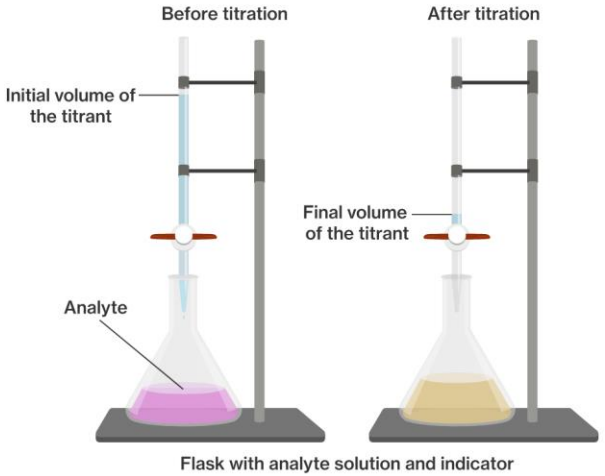


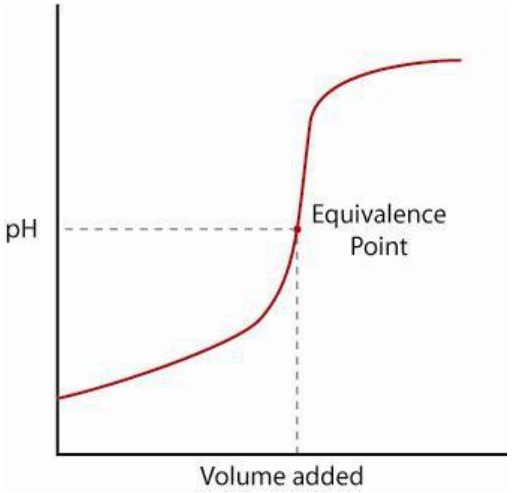
ACID + INSOLUBLE SUBSTANCE

React excess of insoluble substance (metal, carbonate, oxide/hydroxide) with an appropriate **acid**.

Add **excess insoluble substance so that all the acid will be fully reacted**. This ensures that the filtrate collected is the pure soluble salt.

Steps:
1) Mix the 2 reactants.
2) Filter and collect filtrate.
3) Heat till saturation & allow to cool. Crystals will form.
4) Filter to collect crystals.
5) Wash & dry with filter paper.





TITRATION

Soluble salts can also be prepared by reacting an acid with an alkali. However, we will need to know the **exact amount of alkali needed to react with a fixed amount of acid.**

Steps:

1. Using a pipette, add 25.0 cm^3 of dilute acid into a conical flask.
2. Add a few drops of indicator to the acid.
3. Fill a burette with dilute alkali. Record the initial burette reading. Slowly release the dilute alkali into the conical flask and swirl the flask until a change in colour is observed.
4. Record the final burette reading. The initial and final reading gives the volume of alkali needed to completely neutralise the acid.
5. Repeat the experiment with the same exact amount of acid & alkali, but without the indicator. The flask now contains only the soluble salt and water.
6. Pour the solution into an evaporating dish. Heat till saturation.
7. Allow the solution to cool and crystals will form. Filter and dry between sheets of filter paper.

3 methods

There are only 3 ways to prepare a salt.

Choosing which method to use depends on the **solubility of the salt** and the **solubility of the reagents.**

Is everything clearer now? Hopefully lel.

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