

Sour. Soapy. Salty!

The colour-changing mystery of
Acids, Bases and Salts



INSTITUTE Prodigy Educlasses	CLASS VII (Class 7)	BOARD CBSE / ICSE / WB Board
TOPIC Acids, Bases and Salts	CHAPTER / UNIT Acids, Bases and Salts	FACULTY Surajit Sir (Chemistry)

Hello, young chemists! Let me start with a small mystery.

Squeeze a lemon into a glass of purple cabbage juice and it turns pink. Now pour a spoon of soap water into another glass of the same juice and it turns green. Nobody touched the cabbage. So who is doing the talking?

By the end of this note you will know the answer. More than that, you will be able to run this whole show in your own kitchen, with things you already have at home.

The Mystery Box: 4 questions to keep in your head

- Why does a lemon taste sour, while soap feels slippery and tastes awful?
- How can a vegetable tell you what is inside an unlabelled bottle?
- Why does a curry stain on a white shirt turn red the moment soap touches it?
- Why does a doctor give an antacid for acidity, and why does baking soda soothe an ant bite?

1 Meet the three chemical families

Almost everything you taste, touch or use at home can be sorted into three families. Two of them are rivals, and one is what you get when the rivals finally shake hands.

	ACIDS	BASES	SALTS
Taste (kitchen items only!)	Sour	Bitter	Often salty
Touch	Sharp, can sting	Soapy and slippery	Usually dry crystals
Blue litmus paper	Turns red	No change	No change
Red litmus paper	No change	Turns blue	No change
Everyday examples	Lemon juice, vinegar, curd, tamarind	Soap, lime water, milk of magnesia, baking soda solution	Common salt, copper sulphate (blue crystals), potassium nitrate

Careful! Common Mistake

Being sour is a clue for kitchen acids only. In a laboratory we **never taste, and never touch** an unknown liquid. Hydrochloric acid, sulphuric acid and nitric acid are strong acids and they can burn skin badly. Strong bases like caustic soda burn just as badly. Sniffing directly from a bottle is also a no-no.

Where do the acids in your kitchen come from? Nature made most of them.

Sour thing	Acid hiding inside	Fun detail
 Lemon, orange	Citric acid	The word 'citrus' gives it the name
 Curd, buttermilk	Lactic acid	Made when friendly bacteria turn milk sugar sour
 Vinegar, pickles	Acetic acid (ethanoic acid)	Vinegar is about 5 to 8% acetic acid in water
 Tamarind, grapes	Tartaric acid	The sour punch of imli chutney
 Ant sting	Formic acid	Named after the Latin word for ant, <i>formica</i>
 Amla, guava	Ascorbic acid (vitamin C)	An acid you are happy to eat

Did you know?

Your stomach makes hydrochloric acid every day. It helps digest food and kills germs. A layer of mucus protects the stomach wall, so the acid does not eat you from the inside. When there is too much acid, we call it 'acidity', and we will fix it later in this note.

2 Indicators: the chemical spies

How do we know if something is an acid or a base, without tasting it? We use a spy. A chemist calls this spy an **indicator**: a substance that changes its colour when it meets an acid or a base. The word says it all. It *indicates* what is inside.

Some indicators come from nature (litmus, turmeric, China rose, red cabbage) and some are made in labs (phenolphthalein, methyl orange). Look at how each one behaves:

	In an ACID	In water	In a BASE
 Litmus solution (from lichens)			
 Turmeric (haldi paste)			
 China rose (hibiscus petals)			
 Red cabbage juice (kitchen chemist)			
 Phenolphthalein (lab indicator)			
 Methyl orange (lab indicator)			

Phenolphthalein stays colourless in acid AND water. It turns pink only in a base!

Fig 1. The colour code of six indicators. Colours are approximate: the exact shade depends on how concentrated the solution is.

Litmus is the most famous one. It is taken from **lichens**, those flat greenish patches you see on old walls and tree bark. It comes as red and blue paper strips. Now here is a question that most textbooks skip: **why do we keep both red and blue papers?**

Because each paper answers only half the question. Blue litmus changes only for an acid. Red litmus changes only for a base. If **neither** paper changes, the liquid is neutral, like pure water or sugar solution. One paper alone can fool you.

Teacher's Trick

Acids embarrass blue litmus, so it blushes red. Bases bring the blue back. Say it once out loud and you will not forget it in the exam.

Did you know?

Ever seen a curry stain on a white shirt turn **reddish-brown** when you scrub it with soap? You have accidentally performed a chemistry test. Turmeric is yellow in acid and in water, but soap is a base, so the turmeric turns red. Rinse out the soap, and the yellow slowly comes back.

Try This at Home

Your own indicator, made in 15 minutes. Ask an adult to be around. Use only kitchen items. Do not taste anything.

- Tear 3 or 4 red cabbage leaves. Soak them in warm water for 10 to 15 minutes (or blend them). Strain. You now have purple juice.
- Pour a little juice into 6 clear glasses.
- Add a few drops to each glass: lemon juice, diluted vinegar, plain water, sugar solution, baking soda solution, soap solution.
- Watch the colours change. Note them down in your detective log below.

Same cabbage juice, different mystery liquids

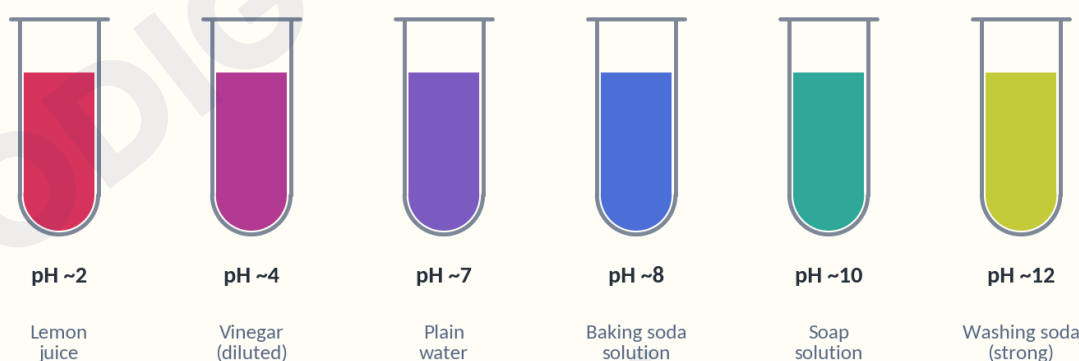


Fig 2. Red cabbage juice as a pH rainbow: red in strong acid, purple in water, blue-green in bases, and yellowish in a very strong base.

Liquid you test	Colour you will likely see	Verdict	Your result
Lemon juice	Pink to red	Acid	
Vinegar	Pink to red-purple	Acid	
Plain water / sugar solution	Purple, no change	Neutral	
Baking soda solution	Blue	Weak base	
Soap solution	Blue-green to green	Base	

3 Sneak peek: a ruler for sourness

Is lemon juice more sour than tomato juice? Scientists measure this on the **pH scale**, which runs from 0 to 14. Below 7 is acidic, exactly 7 is neutral, above 7 is basic. In acids, the **smaller** the number, the **stronger** the acid. In bases, the **bigger** the number, the stronger the base.

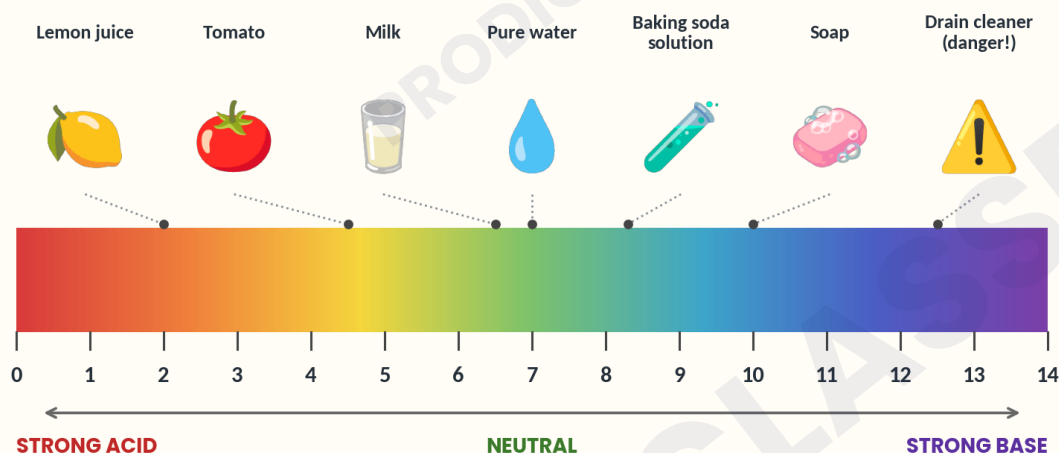


Fig 3. Where common things sit on the pH scale (approximate values). You will study this properly in Class 10.

4 Neutralisation: when rivals meet

Put an acid and a base together and something calming happens. They cancel each other's special powers. The acid loses its sourness, the base loses its soapiness, and we get two peaceful products: a **salt** and **water**. A little heat is released too, so the beaker feels warm. This reaction is called **neutralisation**.

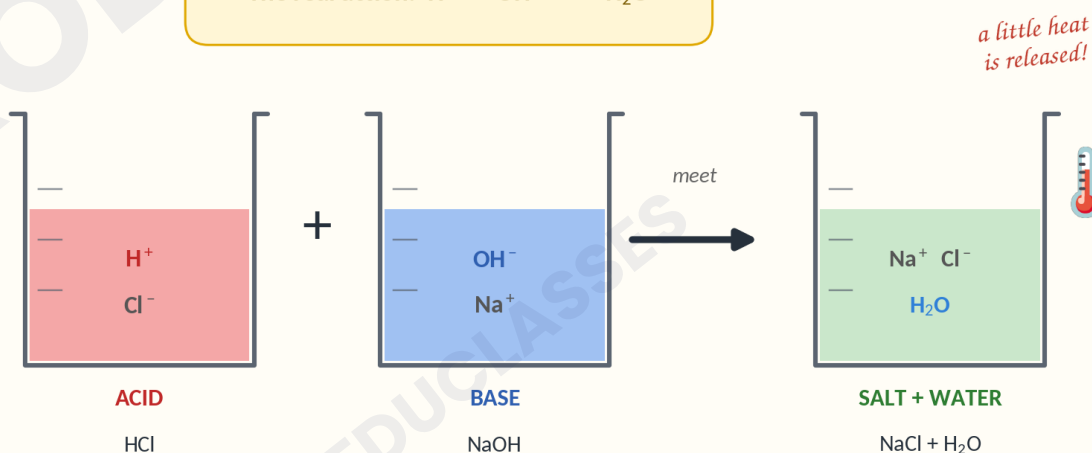
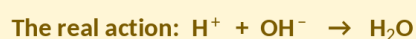


Fig 4. Neutralisation of hydrochloric acid with sodium hydroxide. Underneath, it is always the same story: H^+ meets OH^- and makes water.

Acid	+ Base	Salt	+ Water
Hydrochloric acid HCl	Sodium hydroxide NaOH	Sodium chloride NaCl (common salt)	H ₂ O
Nitric acid HNO ₃	Potassium hydroxide KOH	Potassium nitrate KNO ₃	H ₂ O
Sulphuric acid H ₂ SO ₄	Sodium hydroxide 2NaOH	Sodium sulphate Na ₂ SO ₄	2H ₂ O

Teacher's Trick

Naming a salt is easy. The first name comes from the base (sodium, potassium, calcium). The second name comes from the acid: hydrochloric acid gives **chloride**, nitric acid gives **nitrate**, sulphuric acid gives **sulphate**, and ethanoic (acetic) acid gives **acetate**. So *sodium hydroxide + sulphuric acid* gives sodium sulphate. Done.

Neutralisation is not just a lab word. It is quietly working around you all day:

Situation	What is going on	The fix
 Acidity / indigestion	Too much hydrochloric acid in the stomach	Antacid such as milk of magnesia (a base) neutralises the extra acid
 Ant sting	Formic acid injected under the skin	Rub baking soda paste or calamine lotion (mild bases)
 Tooth decay	Bacteria turn leftover sugar into acids that attack enamel	Brush after meals. Toothpaste is basic and neutralises the acid
 Farmer's soil	Soil that is too acidic hurts crops	Add quicklime or slaked lime (bases). For basic soil, add organic manure
 Factory waste	Acidic waste can kill fish and river life	Factories neutralise it with bases before releasing it

Did you know?

Gardeners can 'paint' flowers with soil chemistry. Hydrangea flowers come out blue in acidic soil and pink in neutral to basic soil. Same plant, different soil pH, different colour.

Careful! Common Mistake

Never mix household cleaners. A toilet cleaner (an acid) and bleach (a base-type cleaner) can release poisonous chlorine gas. Neutralisation should be done by chemists in controlled ways, not by guessing at home.

5 Salts: the peaceful children

When you hear 'salt', you think of the white crystals on your dining table. Chemists use the word in a bigger way. A **salt** is any substance formed, along with water, when an acid reacts with a base. Common salt is only one member of a very large family.

Did you know?

Sea water carries about **35 grams of dissolved salts in every litre**. On sunny coasts, people let sea water evaporate in shallow pans and collect the white crystals left behind. Gujarat produces the biggest share of India's salt this way. Under a magnifying glass, table salt crystals look like tiny perfect cubes.

Salt	Formula	Where you meet it
Common salt (sodium chloride)	NaCl	Every kitchen. Also preserves pickles and fish
Baking soda (sodium hydrogencarbonate)	NaHCO ₃	Makes idli batter, cakes and dhokla soft and fluffy
Washing soda (sodium carbonate)	Na ₂ CO ₃	Removes grease and softens hard water
Blue vitriol (copper sulphate)	CuSO ₄	Beautiful blue crystals, used to spray crops
Epsom salt (magnesium sulphate)	MgSO ₄	Foot soaks. It tastes bitter, not salty!
Saltpetre (potassium nitrate)	KNO ₃	Fertilisers and fireworks

6 One-page cheat sheet

- ✓ **Acid:** sour, turns blue litmus red. **Base:** bitter and soapy, turns red litmus blue. **Salt:** made from an acid and a base.
- ✓ An **indicator** changes colour in acids and bases (litmus, turmeric, China rose, red cabbage, phenolphthalein, methyl orange). If neither litmus paper changes, the substance is **neutral**.
- ✓ **pH 0 to 6** is acidic, **7** is neutral, **8 to 14** is basic.
- ✓ **Neutralisation:** Acid + Base → Salt + Water + heat. Salt names: hydrochloric → chloride, nitric → nitrate, sulphuric → sulphate.
- ✓ Uses: antacids for acidity, baking soda for ant bites, lime for acidic soil, treating factory waste. Never taste or touch unknown chemicals in the lab.

7 Test yourself

- Q1. Fill in: An acid turns _____ litmus _____. A base turns _____ litmus _____.
- Q2. A liquid changes neither red nor blue litmus. What do you conclude?
- Q3. Why can turmeric **not** tell an acid apart from plain water?
- Q4. Write the word equation for hydrochloric acid reacting with sodium hydroxide. Name the salt formed.
- Q5. Your friend is stung by an ant. What would you rub on the sting, and why does it help?
- Q6. The soil in a farmer's field is acidic. What would you advise him to add?
- Q7. Predict the colour of red cabbage juice when milk of magnesia is added.
- Q8. Think: why is 'tasting to check for an acid' a terrible idea in a laboratory?

Peek only after trying!

Answers. 1) blue, red; red, blue. 2) It is neutral. 3) Turmeric stays yellow in both acids and water, it changes only in bases. 4) Hydrochloric acid + sodium hydroxide → sodium chloride + water; the salt is sodium chloride (common salt). 5) Baking soda paste or calamine lotion. Ant stings contain formic acid, a base neutralises it. 6) Quicklime or slaked lime, which are bases. 7) Blue to green, because it is a base. 8) Many lab chemicals are corrosive or poisonous, and taste is not a safe test.



A last word from your teacher

If a simple cabbage can read chemistry, so can you. Ask questions, test safely, and write down what you see. That is exactly how real scientists work. **Keep exploring!** - Surajit Sir