Lab Manual: Properties of Acids and Bases Class 10 Science (CBSE)

Objective / Aim To study the properties of acids (using dilute HCl) and bases (using dilute NaOH) through their reactions with:

- Litmus solution (blue and red)
- Zinc metal
- Solid sodium carbonate
- Ammonium salt (for bases only)

Materials Required

- Test tubes, test tube stand, test tube holder
- Corks, stoppers, droppers
- Boiling tube, matchbox, burner
- Flat-bottomed flask, thistle funnel, delivery tube
- Beakers, glass rods
- Litmus solution / litmus paper (red and blue)
- Phenolphthalein solution (optional)
- Zinc granules
- Freshly prepared lime water [$Ca(OH)_2$]
- Solid sodium carbonate (Na_2CO_3)
- Dilute hydrochloric acid (HCl)
- Dilute sodium hydroxide (NaOH)

Theory

Acids An acid is a substance that releases H^+ ions in water. Example: Hydrochloric acid (HCl).

Properties:

- Turn blue litmus red (no effect on red litmus).
- React with active metals (like Zn) to produce hydrogen gas and a salt. Example: $2HCl(aq) + Zn(s) \rightarrow ZnCl_2(aq) + H_2(g)\uparrow$ (Hydrogen gas burns with a pop sound.)
- React with carbonates to produce carbon dioxide gas. Example: $Na_2CO_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + CO_2(g)\uparrow + H_2O(l)$ (CO_2 turns lime water milky due to $CaCO_3$ formation; excess CO_2 clears it by forming soluble $Ca(HCO_3)_2$.)

Bases A base is a substance that releases OH^- ions in water. Example: Sodium hydroxide (NaOH).

Properties:

- Turn red litmus blue (no effect on blue litmus).

- React with ammonium salts to liberate ammonia gas (NH_3). Example: $NH_4Cl(s) + NaOH(aq) \rightarrow NaCl(aq) + NH_3(g)\uparrow + H_2O(l)$ (Ammonia has a pungent smell and turns moist red litmus blue.)

Indicators Substances that change colour in acidic or basic media. Litmus: blue → red in acid; red → blue in base. Phenolphthalein: colourless in acid/neutral, pink in base.

Procedure

1. **Litmus Test**
    - Take two clean test tubes labeled A and B.
    - Add ~5 mL blue litmus solution to A and ~5 mL red litmus solution to B.
    - Add a few drops of dilute HCl to each using a dropper; stir.
    - Observe and record colour changes.

Expected result: Blue litmus turns red; red litmus remains unchanged (shows acidic nature).

Repeat the test with dilute NaOH (red litmus turns blue; blue remains unchanged).

2. **Reaction of Acid with Zinc Metal**
    - Put a few zinc granules in a clean test tube.
    - Add dilute HCl to cover the granules.
    - Observe effervescence / gas evolution.
    - Test the gas by bringing a burning splinter near the mouth (or collect via delivery tube).

Expected result: Colourless, odourless gas evolves; burns with pale blue flame and produces a 'pop' sound → confirms H_2 gas.

3. **Reaction of Acid with Solid Sodium Carbonate**
    - Take a small amount of solid Na_2CO_3 in a flat-bottom flask; add water to make slurry.
    - Fit with double-bore cork: one bore with thistle funnel (for adding acid), other with delivery tube dipped in lime water.
    - Add dilute HCl slowly through thistle funnel.
    - Observe changes in lime water.

Expected result: Brisk effervescence; lime water turns milky (due to $CO_2 \rightarrow CaCO_3$); excess CO_2 clears milkiness (forms $Ca(HCO_3)_2$).

4. **Reaction of Base with Ammonium Salt**
    - Take small amount of solid NH_4Cl in a test tube.
    - Add dilute NaOH solution.
    - Warm gently if needed.
    - Smell cautiously and hold moist red litmus near mouth.

Expected result: Pungent-smelling gas evolves; moist red litmus turns blue → confirms NH_3 gas.

Observation Table (Format this as a table in Word)

Experiment No.	Test Performed	Substances Used	Observation / Colour Change / Gas Test	Inference
1	Litmus test (Acid)	Dil. HCl + Blue/Red litmus	Blue litmus → red; Red litmus → no change	Acidic nature
1	Litmus test (Base)	Dil. NaOH + Blue/Red litmus	Red litmus → blue; Blue litmus → no change	Basic nature
2	Acid + Zinc	Dil. HCl + Zn granules	Effervescence; gas burns with pop sound	H_2 gas liberated
3	Acid + Na_2CO_3	Dil. HCl + Na_2CO_3 + lime water	Lime water turns milky, then clears with excess gas	CO_2 gas liberated
4	Base + NH_4Cl	Dil. NaOH + NH_4Cl	Pungent smell; moist red litmus turns blue	NH_3 gas liberated

Result / Conclusion

- Dilute HCl shows typical acidic properties: turns blue litmus red, liberates H_2 with Zn, liberates CO_2 with Na_2CO_3 (turns lime water milky).
- Dilute NaOH shows typical basic properties: turns red litmus blue, liberates NH_3 from ammonium salt. These reactions confirm the characteristic chemical behaviours of acids and bases.

Precautions

- Handle dilute HCl and NaOH carefully — they are corrosive; avoid skin/eye contact.
- Use small quantities of chemicals.
- Perform gas tests (pop, lime water, smell) safely; never smell directly or inhale deeply.
- Wear safety goggles and lab coat.
- Conduct experiments under teacher supervision.