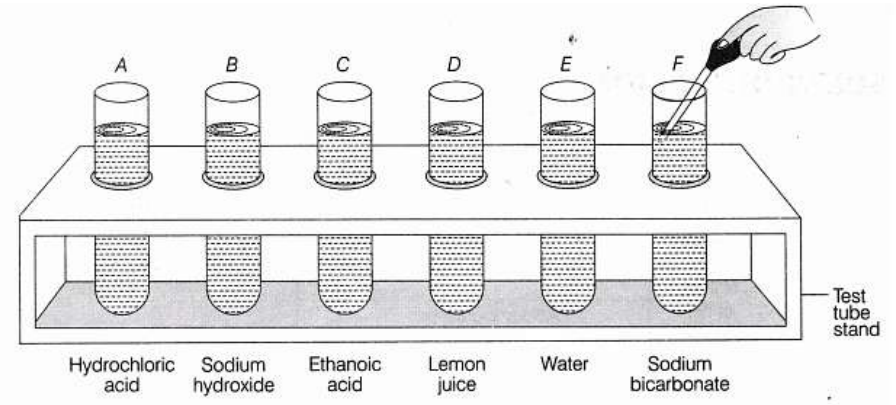
LAB MANUAL Experiment: Determination of pH of Given Samples Class: 10 Subject: Science (Chemistry)

Aim / Objective To find the pH of the following samples by using pH paper or universal indicator:

- Dilute hydrochloric acid (HCl)
- Dilute sodium hydroxide (NaOH) solution
- Dilute ethanoic acid (CH_3COOH) solution
- Lemon juice
- Water (H_2O)
- Dilute sodium bicarbonate ($NaHCO_3$) solution



Materials Required / Apparatus

- Six test tubes
- Test tube stand
- Glass rod
- pH paper (or universal indicator paper/solution)
- Dropper
- Standard pH colour chart
- Sample solutions: dilute HCl, dilute NaOH, dilute CH_3COOH, dilute $NaHCO_3$, water, lemon juice
- Clean white tile or white paper (for comparing colours)
- Distilled water and wash bottle (for cleaning)

Theory pH is a numerical scale used to express the **acidity** or **basicity (alkalinity)** of a solution. It is defined as the negative logarithm of the hydrogen ion concentration:

$pH = -\log[H^+]$ (or **$pH = -\log[H_3O^+]$**)

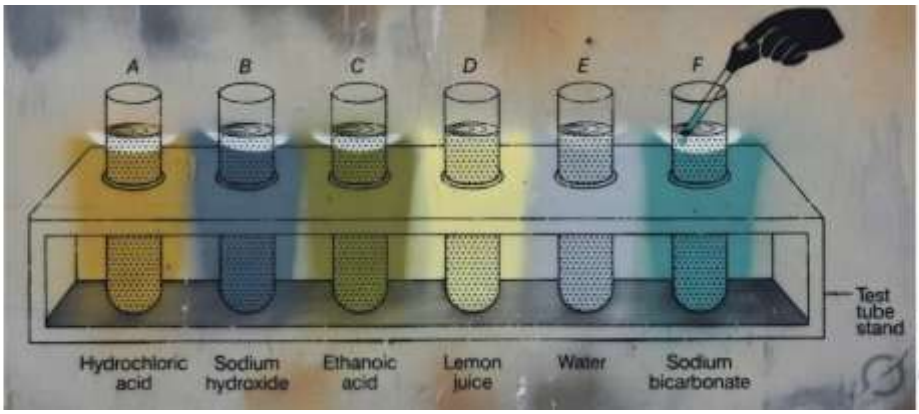
The pH scale ranges from **0 to 14**:

- **pH < 7** → Acidic
- **pH = 7** → Neutral (e.g., pure water at 25°C)
- **pH > 7** → Basic/Alkaline

Pure water is neutral due to equal $[H^+]$ and $[OH^-]$ from auto ionisation: $H_2O \rightleftharpoons H^+ + OH^-$

pH paper or universal indicator changes colour based on the pH. Compare the developed colour with the standard chart:

- Red/pink shades → Acidic
- Green → Neutral
- Blue/violet shades → Alkaline



Procedure

1. Label six clean test tubes as A, B, C, D, E, and F. Place them in a test tube stand.
2. Place a strip of pH paper on a clean, dry white surface (white tile or paper) for easy comparison.
3. Using a clean glass rod, take a small amount of sample from test tube A (dilute HCl) and place one or two drops on the pH paper.
4. Observe the colour developed and compare it carefully with the standard pH colour chart. Record the pH value and nature (acidic/basic/neutral).
5. Rinse and dry the glass rod thoroughly before the next sample to avoid contamination.
6. Repeat steps 2–5 for the remaining samples (dilute NaOH, dilute CH_3COOH, lemon juice, water, dilute $NaHCO_3$), using a fresh area or new strip of pH paper each time.
7. Clean all equipment after completing the experiment.

Observation Table

Test Tube	Sample	Colour on pH Paper / Universal Indicator	Approximate pH	Nature of Solution
A	Dilute HCl	(e.g., Red/Pink)	~1–3	Strong Acid
B	Dilute NaOH	(e.g., Dark Blue/Violet)	~11–14	Strong Base
C	Dilute CH_3COOH	(e.g., Orange)	~2.5–5	Weak Acid
D	Lemon juice	(e.g., Pink/Orange)	~2–3	Weak Acid
E	Water	(e.g., Green)	≈7	Neutral
F	Dilute $NaHCO_3$	(e.g., Light Blue)	~8–9	Weak Base

(Fill actual observations during the experiment. Typical values shown for guidance.)

Inference / Result The pH values indicate:

- Acids (HCl, CH_3COOH, lemon juice) have pH < 7
- Base (NaOH, $NaHCO_3$) have pH > 7
- Water is neutral (pH ≈ 7)

Precautions

- Use dilute solutions only and label test tubes properly.
- Avoid touching, smelling, or tasting any solutions.
- Compare colours quickly as they may fade.
- Rinse glass rod thoroughly between samples to prevent cross-contamination.
- Keep pH paper away from fumes and moisture.
- Use fresh samples (especially lemon juice) for accurate results.

Conclusion Using pH paper or universal indicator, we successfully determined the pH and nature (acidic, basic, or neutral) of various samples. This experiment demonstrates that acidic solutions have higher H^+ concentration (lower pH), basic solutions have higher OH^- (higher pH), and neutral solutions are balanced. For precise values, a pH meter is recommended.