

# Invisible Inks Experiment

## A-Level

**Intended learning:** Look at using indicators to reveal hidden messages. Calculate molar concentrations.

### Introduction notes:

- Commonly acids and bases are used as invisible ink, and these are subsequently revealed by indicators.
- Indicators are chemical compounds which are different colours when in contact with either acids or bases.
- Indicators are also used in chemistry to show when chemical reactions are finished.
- An acid is traditionally considered any chemical compound that, when dissolved in water, gives a solution with a pH less than 7.0, with the generic formula  $\text{HA}[\text{H}^+\text{A}^-]$ .
- Common examples include acetic acid (in vinegar) and sulphuric acid (in car batteries).
- Generally acids have the following properties:
  - Taste: Acids generally have a sour taste.
  - Touch: Strong or concentrated acids often produce a stinging feeling.
  - Reactivity: Strong acids react aggressively with or corrode many metals.
  - Electrical Conductivity: Acids, while not usually ionic compounds are electrolytes.
  - Acids turn litmus paper (an indicator) red.
  - Most commonly thought of as a substance that can donate protons.
  - Common examples are sodium hydroxide and ammonia.
- Bases can be thought of as the chemical opposite of acids.
- This is because the effect of an acid is to increase the hydronium ion concentration in water, and the effect of a base is to reduce it.
- A reaction between an acid and base is called neutralization.
- Bases react with acids to produce water and salts (or their solutions).
- Generally bases have the following properties:
  - Taste: Bitter taste
  - Touch: Slimy or soapy feel on fingers
  - Reactivity: Caustic on organic matter, react violently with acidic substances.
  - Electrical conductivity: Aqueous solutions or molten bases dissociate in ions and conduct electricity.
  - Bases turn litmus paper (an indicator) blue.

**Resources required:**

- NaOH pellets or NaOH solution (0.1M)
- Phenolphthalein
- Bromothymol Blue and/or Methyl Red Indicator
- Paper
- Paint Brush
- Glass Beakers

**Practical notes:**

Chemicals must not be ingested. Gloves should be worn to prevent skin contact. Safety glasses and lab coats should be worn at all times. Phenolphthalein is listed as R40 (limited evidence of carcinogenic effect) and therefore should be prepared as a solution.

**Further work:**

- Prove the concentration of your invisible ink by titrating it against an acid of known concentration and using an appropriate indicator. (E.g. HCl & Phenolphthalein)
- Change the NaOH concentration of the ink to see what happens when the concentration is varied.
- Experiment with different indicators to re-develop the ink.