Acids, alkalis and indicator evidence

Student activity • small-scale investigation

YEAR 10 / LESSON 49 / CHEMISTRY + SCIENCE (DOUBLE AWARD)

The question

Can one indicator distinguish acid, neutral and alkali?

Compare three indicators across known acid, neutral buffer and alkali. Record actual colours before interpreting them. A colour can identify a range without proving an exact pH.

Equipment

- Eye protection; white nine-well spotting tile and labelled transfer pipettes
- 0.010 mol dm^{-3} HCl (A), pH 7 buffer (N), 0.010 mol dm^{-3} NaOH (B): 0.50 cm^3 per well
- Teacher-issued litmus, methyl orange and phenolphthalein indicator solutions; one drop per test

Wear eye protection; avoid contact with solutions and report splashes. Some indicator solvents are flammable: keep all flames and heat away. Do not taste samples or handle spills without teacher direction.

Course coverage: Shared core: 2.28 and 2.31. Litmus, phenolphthalein and methyl orange; aqueous acids supply H^+ and alkalis supply OH^-.

Plan, model or apparatus sketch

Sketch your nine-well layout and label the solutions and indicators.

Method and reasoning

Read the whole sequence before starting

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1. Wear eye protection. Label three rows for A, N and B and three columns for litmus, methyl orange and phenolphthalein. Use the teacher-issued solutions only.

2. Using separate labelled pipettes, place 0.50 cm^3 of the assigned solution in each well of its row. Keep pipettes separate and do not return liquid to stock bottles.

3. Add one drop of litmus to each well in its column, then one drop of each other indicator to its own column. Keep dropper tips above the liquid and avoid cross-contamination.

4. Observe against the white tile and record each actual colour. If a colour is unclear, report it and repeat in a clean well with fresh material rather than changing the recorded result.

5. Compare the neutral row with the acidic and alkaline rows. Identify any indicator that gives the same colour in two different conditions.

6. Use the results and reference colour ranges to explain what each indicator can and cannot tell you. Write $H^+(aq)$ and $OH^-(aq)$ with correct charges.

Cleanup

• Staff direct collection of small liquid residues under the school disposal plan. Rinse tiles, return droppers and wash hands.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Reference for checking after observation: litmus is red in sufficiently acidic solution and blue in alkaline solution, with purple in its middle range. Methyl orange changes from red to yellow across about pH 3.1–4.4. Phenolphthalein changes from colourless to pink across about pH 8.2–10.0. Reference colours are not your measured results.

Indicator	Acid A	Neutral N	Alkali B
Litmus			
Methyl orange			
Phenolphthalein			

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Complete the nine observations and describe any uncertainty.

2. Why can yellow methyl orange not, by itself, prove that a solution is alkaline?

3. Why can colourless phenolphthalein not, by itself, prove that a solution is acidic?

4. State the characteristic ions supplied by aqueous acids and alkalis, including charges.

5. Explain the difference between an alkali and a base.

6. Suggest how to distinguish a neutral solution from an acid or alkali more reliably.