Neutralisation: following the pH change

Student activity • small-scale investigation

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The question

What changes as an alkali is added to an acid?

Add dilute sodium hydroxide to dilute hydrochloric acid in measured portions. Follow approximate pH with indicator paper and locate a transition interval; this is not a precision titration.

Equipment

- Eye protection; small beaker/cup (at least 25 cm^3), white tile and stirring rod
- Needle-free 5 cm^3 measuring syringe for acid and separate 1 cm^3 graduated syringe for alkali
- 0.010 mol dm^{-3} HCl, 5.0 cm^3 per run; 0.010 mol dm^{-3} NaOH, up to 7.0 cm^3 per run
- Universal-indicator paper with matching chart; fresh strips and a clean sampling rod

Wear eye protection; avoid splashes and report contact or spills. Use labelled needle-free syringes only for measuring, never squirting towards anyone. No heating or mixing with other chemicals.

Course coverage: Shared core: 2.32, supported by 2.31 and the school ionic-equation objective. The example uses HCl and NaOH; do not generalise that every salt solution is neutral.

Plan, model or apparatus sketch

Sketch the measured additions and show how you test a small sample.

Method and reasoning

Read the whole sequence before starting

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1. Wear eye protection. Measure 5.0 cm^3 HCl into the beaker using its dedicated syringe. Transfer a small drop to fresh indicator paper and record the initial approximate pH.

2. Add alkali in measured portions using the separate syringe. Stir gently and test a small drop on fresh paper after each addition; rinse the sampling rod between checks.

3. Record cumulative alkali volume at 1, 2, 3 and 4 cm^3. Near the transition use the smaller additions needed to reach 4.5, 4.8, 5.0, 5.2 and 5.5 cm^3, then 6 and 7 cm^3. Do not exceed 7 cm^3.

4. Record actual volumes and chart intervals. If the colour skips neutral, record the interval where it changed; do not invent pH 7 or keep adding reagents back and forth.

5. Repeat the sequence with fresh acid and cleaned equipment. Compare the two runs; test drops remove some solution, so keep them small and consistent.

6. Plot approximate pH against total alkali volume. Explain the acidic-to-alkaline change and write $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$.

Cleanup

- Staff direct disposal of the final dilute mixtures; rinse apparatus, return separate syringes and wash hands.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Use actual readings. Both solutions have the same stated concentration and HCl:NaOH reacts 1:1. The nominal neutralisation volume is about 5 cm^3, but paper resolution, portion size, sampling loss and solution condition limit this method. Na^+ and Cl^- are spectator ions. Do not confuse a universal-indicator colour with a precision endpoint.

Alkali total / cm^3	Run 1 pH	Run 2 pH
0		
1		
2		
3		
4		
4.5		
4.8		
5		
5.2		
5.5		
6		
7		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Plot both runs and identify the interval in which the mixture changes from acidic to alkaline.

2. Write a word equation and balanced symbol equation for this reaction.

3. Write the net ionic equation with states and explain which ions are spectators.

4. Why does adding more alkali after neutralisation make this mixture alkaline?

5. Explain two reasons the experiment may not show a clear pH 7 reading.

6. Is every aqueous salt solution neutral? Explain why this example does not establish that claim.