**End point**A close up of a logo

Description automatically generated

10cm3 of hydrochloric acid is added to a beaker.

Sodium hydroxide solution is gradually added.

The end point of the reaction is reached when the sodium hydroxide has reacted exactly with the hydrochloric acid.

The chemical equation for the reaction is:

HCl(aq) + NaOH (aq) →NaCl(aq) +H2O (l)

Which of the following statements describe when the end point is reached?

For each statement, tick (✓) **one** column to show what you think*.*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| The end-point is reached when… | | I am **sure** this is right | I think this is right | I think this is wrong | I am **sure** this is wrong |
| **A** | 10cm3 of sodium hydroxide solution has been added. |  |  |  |  |
| **B** | the pH reaches 7. |  |  |  |  |
| **C** | the beaker contains only sodium chloride solution. |  |  |  |  |

*Chemistry > Big idea CCR: Chemical reactions > Topic CCR4: Acids and alkalis > Key concept CCR4.1: Neutralisation*

|  |
| --- |
| **Diagnostic question** |
| **End point** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | A salt is formed from a neutralisation reaction between an acid and a base. |
| Observable learning outcome: | Describe the end point of a neutralisation reaction between a strong acid and a strong alkali. |
| Question type: | confidence grid |
| Key words: | acid, alkali, neutralisation |

|  |  |
| --- | --- |
| **B** | **BRIDGING**  This diagnostic question probes understanding of ideas that are usually taught at age 14-16, to build a bridge to later stages of learning. |

**What does the research say?**

In the introduction to his paper “A label as a hidden persuader, chemists’ neutralisation concept” Schmidt (1991) explains that the original meaning of neutralisation has shifted over hundreds of years. Chemistry teaching refers to both old and new definitions.

The test items used in the research showed that many students understand the concept in the original meaning in which an acid and base react to form a neutral salt. Some of these older students considered a neutral solution to be formed even if the reaction included a weak acid or base. They also assumed that the reaction was irreversible. It appeared that the term ‘neutralisation’ triggered memories of students’ early learning about acids and bases before they had been taught about weak acids and bases and chemical equilibrium.

It may therefore be preferable, when introducing the concept of neutralisation, to make clear that this applies to typical strong laboratory acids and alkalis but may not be the case when other acids and alkalis have been learnt about. In this case, the reason the resulting solution is neutral is that at the end point the only substance in the beaker is sodium chloride solution which has a pH of 7. This way of thinking may be more applicable later than linking the neutrality of the product to the name of the neutralisation process.

**Ways to use this question**

Students should complete the confidence grid individually. This could be a pencil and paper exercise, or you could use an electronic ‘voting system’ or mini white boards and the PowerPoint presentation.

If there is a range of answers, you may choose to respond through structured class discussion. Ask one student to explain why they gave the answer they did; ask another student to explain why they agree with them; ask another to explain why they disagree, and so on. This sort of discussion gives students the opportunity to explore their thinking and for you to really understand their learning needs.

*Differentiation*

You may choose to read the questions to the class, so that everyone can focus on the science. In some situations, it may be more appropriate for a teaching assistant to read for one or two students.

**Expected answers**

At this stage it would be expected that students should be confident that at the end point the pH is 7 because the reaction is between a strong acid and a strong alkali. However, salts do not always have a pH of 7.

It is also correct that at the end point the beaker should only contain sodium chloride solution.

Volume may not be used to determine the end point unless the concentrations are stated to be the same and the reacting ratio in the chemical equation is 1:1.

**How to respond - what next?**

If a student is confident that volume may be used to determine the end point it may help to discuss the idea that the reaction is occurring between solutions. This means that it is the amount of each substance that is dissolved in the solution that is critical. If this is not specified, then one solution could be more dilute than another so equal volume would not equate to equal amounts.

Concentration is a concept that is generally introduced later but students should be familiar with dilution in terms of preparation of soft drinks.

If students have misunderstandings about the pH of the final solution at the end point, it may help to consider the contents of the beaker when different volumes of sodium hydroxide solution have been added (including excess). The following BEST ‘response activities’ could be used in follow-up to this diagnostic question:

* Changing pH

**Acknowledgments**

Developed by Helen Harden (UYSEG)

Images: Helen Harden and Alistair Moore (UYSEG)

**References**

Schmidt, H.-J. (1991). A label as a hidden persuader: chemists' neutralisation concept. *International Journal of Science Education,* 13(4)**,** 459-471.