**Changing pH**

10cm3 of hydrochloric acid is added to a beaker.

Sodium hydroxide solution is gradually added.

Sodium chloride solution is formed.

A picture containing transport, satellite

Description automatically generated

* 1. Complete the table below to show what the beaker contains at each stage of the experiment.

|  |  |  |  |
| --- | --- | --- | --- |
| Substance | Start | Midway | End point |
| hydrochloric acid |  |  |  |
| sodium hydroxide solution |  |  |  |
| sodium chloride solution |  |  |  |
| water |  |  |  |

* 1. Describe how the pH changes during the reaction. The pH of the hydrochloric acid is 1.

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

|  |
| --- |
| **Response activity** |
| **Changing pH** |

**Overview**

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

This activity can help develop students’ understanding by addressing the misunderstandings revealed by the following diagnostic question:

* End point

|  |  |
| --- | --- |
| **B** | **BRIDGING**  This activity explores 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 activity**

This activity gives students the opportunity to clarify their thinking through discussion. To support this, students should answer the question in pairs or small groups.

Listening to individual groups as they work often highlights any difficulties they might have. These can often be overcome, through a whole class clarification or redirection part way through the activity.

*Differentiation*

If some students are working with a teaching assistant, then a list of prompt questions for the teaching assistant could help to make this activity more purposeful.

**Expected answers**

1a

|  |  |  |  |
| --- | --- | --- | --- |
| Substance | Start | Midway | End point |
| hydrochloric acid | ✓ | ✓ | X |
| sodium hydroxide solution | X | X | X |
| sodium chloride solution | X | ✓ | ✓ |
| water | ✓ | ✓ | ✓ |

b At the start the pH is one. At the end point the pH is 7. Midway through the reaction the pH should be somewhere in between.

**Acknowledgments**

Developed by Helen Harden (UYSEG).

Images: Helen Harden and Alistair Moore (UYSEG)

**References**

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