**Temperature change 2**

A spatula of citric acid is added to a test tube containing sodium hydrogen carbonate solution.

The temperature of the chemicals decreases.

The reaction finishes and the test tube is left.

**1.** What will happen to the temperature of the chemicals in the test tube?

Put a tick (✓) in the box next to the best answer.

|  |  |  |
| --- | --- | --- |
| **A** | remain the same |  |
|  |  |  |
| **B** | gradually decrease |  |
|  |  |  |
| **C** | continue to increase |  |

**2.** Explain your answer.

Put a tick (✓) in the box next to the best explanation.

|  |  |  |
| --- | --- | --- |
| **A** | The reaction will keep cooling the chemicals. |  |
|  |  |  |
| **B** | Energy is transferred to the surroundings |  |
|  |  |  |
| **C** | Energy is transferred from the surroundings |  |
|  |  |  |
| **D** | The products of the reaction are cooler than the reactants. |  |

*Chemistry > Big idea CCR: Chemical reactions > Topic CCR3: Energy and reactions > Key concept CCR3.1: Exothermic and endothermic reactions*

|  |
| --- |
| **Diagnostic question** |
| **Temperature change (2)** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | During a chemical reaction energy may be transferred to or from the surroundings. |
| Observable learning outcome: | Describe how the temperature of the chemicals will change with time after an endothermic reaction. |
| Question type: | Diagnostic, two-tier multiple choice |
| Key words: | temperature, energy, endothermic |

|  |  |
| --- | --- |
| **P** | **PRIOR UNDERSTANDING**  This diagnostic question probes understanding of ideas from an earlier key concept (PMA1.2), to aid transition from earlier stages of learning. |

**What does the research say?**

Research (Erickson and Tiberghien, 1985) found that student explanations differ from the scientific explanation because they do not always take into account all the systems which are interacting. For example, in this case students need to consider the surrounding air (and its temperature) as well as the reaction system. In order to correctly predict and explain the change in temperature of the chemicals, students need to recognise the temperature difference between the reaction system and the surroundings. They also need to recall that energy will move spontaneously from the surroundings (which are at a higher temperature) to the object (the reaction system) which is at a lower temperature.

**Ways to use this question**

Students should complete the questions 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. The follow-on question will give you insights into how they are thinking and highlight specific misconceptions that some may hold.

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.

At the end of the reaction the test tube will contain the products of the reaction and also any excess of a reactant. For this reason, the general word ‘chemicals’ was used to refer to the contents of the test tube.

*Differentiation*

It may help some students to demonstrate the experiment.

Practical work should be carried out in accordance with local health and safety requirements, guidance from manufacturers and suppliers, and guidance available from CLEAPSS.

Practical guidance which includes this reaction may be found at <http://www.rsc.org/learn-chemistry/resource/res00000406/exothermic-or-endothermic?cmpid=CMP00005103>

**Expected answers**

The temperature will gradually increase because energy will transfer from the surroundings.

**How to respond - what next?**

A student who thinks that the temperature will stay the same may not be considering the interaction between the chemical system and the warmer surroundings. A student who considers that the temperature will continue to decrease may not have recognised the significance of the information that the reaction has finished in terms of the chemical reaction being the reason for the decrease in temperature.

The follow-on answers may give you greater insight into student thinking.

If students have misunderstandings about the link between change in temperature and the transfer of energy you may wish to revisit key concept PMA1.2: Heating and cooling.

The following BEST ‘response activity’ could be used in follow-up to this diagnostic question:

* Endothermic reaction

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Images: none

**References**

Erickson, G. and Tiberghien, A. (1985). Heat and Temperature. In Driver, R., Guesne, E. & Tiberghien, A. (eds.) *Children's Ideas in Science.* Milton Keynes and Philadelphia: Open University Press.