**Cooling down**

Copper sulfate is added to 100 cm3 of water at 60°C until the solution is saturated (no more will dissolve).

The solution is left to cool until it is 30°C.

What do you expect to observe? Give reasons for your answer.

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

|  |  |  |
| --- | --- | --- |
| **A** | No change |  |
|  |  |  |
| **B** | Solid appears |  |
|  |  |  |

*Chemistry > Big idea CSU: Substance > Topic CSU2: Solubility > Key concept CSU2.1: Comparing solubility*

|  |
| --- |
| **Diagnostic question** |
| **Cooling down** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Solubility is a property of a substance that varies with temperature. |
| Observable learning outcome: | Predict observable changes following the cooling of a saturated solution. |
| Question type: | Diagnostic, simple multiple choice |
| Key words: | dissolve, solution, saturated |

**What does the research say?**

A study (Uzuntiryaki and Geban, 2005) investigated the impact of a conceptual change approach to understanding concepts relating to solutions. One of the concepts they tested was an understanding of what happens to a solution if it is cooled. In the control group who had received no specific input to correct misconceptions 30% of students thought that solution would remain the same when cooled. They did not recognise that at a lower temperature the solute would recrystallise because the mass of substance dissolved in a particular volume of solution is related to the temperature of the solution.

**Ways to use this question**

Students should complete the question 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 answers to the question will show you whether students understood the concept sufficiently well to apply it correctly.

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**

B

A solid will appear because copper sulfate is less soluble at lower temperatures. The maximum mass of copper sulfate that can dissolve will therefore be lower so some of the copper sulfate will recrystallise.

**How to respond - what next?**

A student who opts for A may think that once a solid has dissolved, it remains dissolved, even if the temperature is lowered. In fact, this depends upon its solubility at different temperatures.

If students have misunderstandings about changes of solubility upon cooling you may wish to demonstrate the phenomenon practically.

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

* Warming up and cooling down

**Acknowledgments**

Developed by Helen Harden (UYSEG).

Images: Helen Harden (UYSEG)

**References**

Uzuntiryaki, E. and Geban, O. (2005). Effect of conceptual change approach accompanied with concept mapping on understanding of solution concepts. *Instructional Science,* 33**,** 311-339.