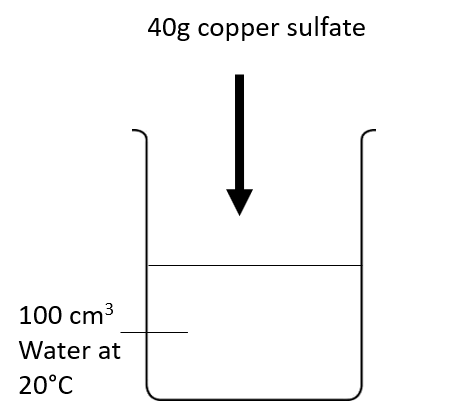
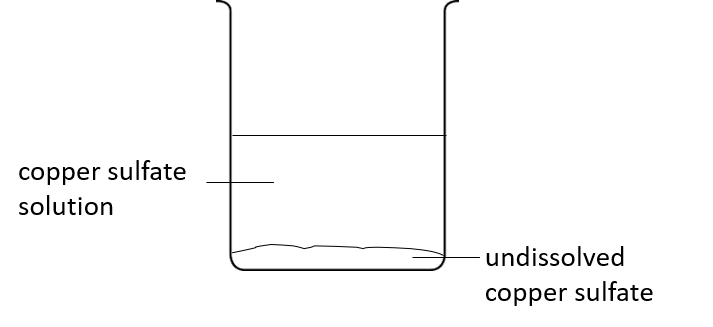
**Warming up**

40g of copper sulfate is added to 100cm3 of water at 20°C.



Not all the copper sulfate dissolves.



The solution is warmed until it reaches 40°C.

The solubility of copper at 40°C is 44.6g in 100g (100cm3­) of water.

What do you expect to observe?

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

|  |  |  |
| --- | --- | --- |
| **A** | Less undissolved copper sulfate |  |
|  |  |  |
| **B** | The same amount of undissolved copper sulfate |  |
|  |  |  |
| **C** | More undissolved copper sulfate |  |
|  |  |  |
| **D** | No undissolved copper sulfate |  |
|  |  |  |

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

|  |
| --- |
| **Diagnostic question** |
| **Warming up** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Solubility is a property of a substance that varies with temperature. |
| Observable learning outcome: | Use data to predict observations of 100 cm3 of solution where the mass of solute is above, below or equal to the solubility |
| Question type: | Diagnostic, simple multiple choice |
| Key words: | dissolve, solution |

**What does the research say?**

A research paper (Gültepe, 2016) reports the finding of an investigation into students’ ability to interpret graphs in chemistry. Clearly a mathematical understanding was essential for the correct interpretation of graphs however this was not found to be sufficient. A conceptual understanding of the chemistry being represented was also needed.

Johnstone’s triangle (Johnstone, 1991) illustrates the need in chemistry to move between three different representational levels.



*Fig. 1 Johnstone’s triangle*

Adadan and Savasci (2012) describe a graph as a symbolic representation and highlight difficulties students may have in moving between this and other levels of representation.

This question aims to find out whether students can move between numerical information about the solubility of a solute and a macroscopic understanding of what would be observed.

**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.

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.

This question introduces the commonly used description of solubility as the maximum number of grams of solute that dissolve in 100g of water. If necessary, remind students that 100g of water has a volume of 100 cm3.

*Differentiation*

It may help some students to talk through the experiment before answering the question to ensure they understand the description in the question.

**Expected answers**

D

**How to respond - what next?**

A student who considers that A is correct may be able to link understanding that solubility of copper sulfate increases with temperature with the observation of less undissolved solid. However, they have not used the quantitative information provided to recognise that all the copper sulfate can dissolve.

A student who selects answer B may not be linking the observation of undissolved copper sulfate with the concept of solubility.

Students are unlikely to choose option C, but it is included for completeness.

If students have misunderstandings about the affect of solubility on temperature students could be shown a data table that gives the solubility of copper sulfate at different temperatures.

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

* Copper sulfate data

**Acknowledgments**

Developed by Helen Harden (UYSEG)

Images: Helen Harden (UYSEG) and A.H. Johnstone

**References**

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