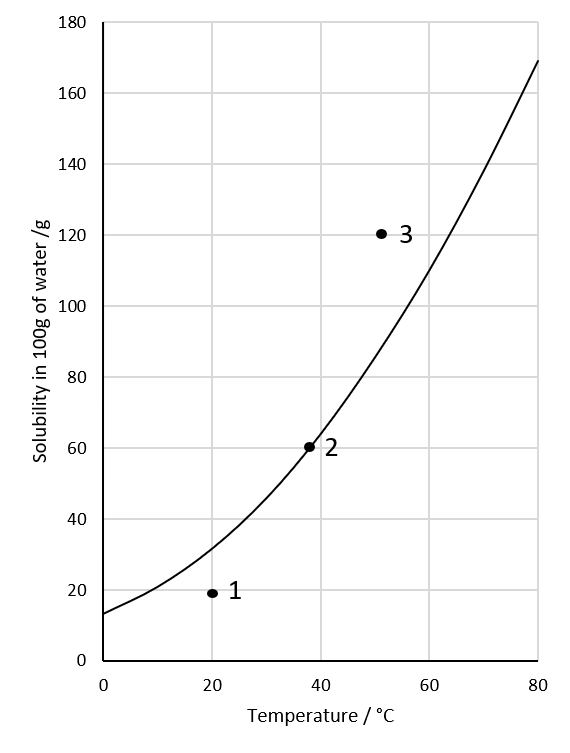
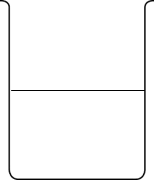
**Solubility graph**

The graph below shows the solubility of potassium nitrate at different temperatures.

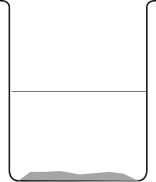


Which beaker of solution does each point on the graph represent?

**A** All the potassium nitrate is dissolved.



**B**  Some potassium nitrate cannot dissolve.



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

|  |
| --- |
| **Diagnostic question** |
| **Solubility graph** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Solubility is a property of a substance that varies with temperature. |
| Observable learning outcome: | Link points on a solubility graph to macroscopic observations. |
| Question type: | Diagnostic, simple multiple choice |
| Key words: | solubility, 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 graphical 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 disagreement on which beaker goes with which point, 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*

It may help some students to show them a fully dissolved solution and one with undissolved solid remaining in order to make sure they are correctly interpreting the diagrams in the question.

**Expected answers**

1A, 2A, 3B

**How to respond - what next?**

First it is important to establish that students understand the graph mathematically. You may wish to check that they understand what each of the points represent in terms of mass of solute and temperature of solution.

It may then help to establish whether students have sufficient chemistry understanding to interpret the meaning of the solubility curve. For example, you may wish to check whether students understand the significance of a point being plotted in the area below the curve. It may benefit students to understand that points plotted below the curve represent solutions containing less than the maximum mass of solute that can dissolve so no undissolved solid will be observed. Points plotted in the area above the curve represent solutions that contain more than the maximum mass of solute that will dissolve therefore undissolved solids will be observed. Any point on the actual curve represents a solution containing the maximum mass of solute that can dissolve so no undissolved solid should be present.

If students still have misunderstandings about how the graph links to macroscopic observations, you may need to show them real life examples of solutions where all the solute can dissolve as well as a solution where more solute was added than could dissolve.

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

* Solubility curve

**Acknowledgments**

Developed by Helen Harden (UYSEG)

Images: Helen Harden, Alistair Moore and A.H. Johnstone

**References**

Adadan, E. and Savasci, F. (2012). An analysis of 16 to 17 year old students' understanding of solution chemistry concepts using a two-tier diagnostic instrument. *International Journal of Science Education,* 34(4)**,** 513 to 544.

Gültepe, N. (2016). Reflections on high school students' graphing skills and their conceptual understanding of drawing chemistry graphs. *Educational sciences: Theory and practice,* 16**,** 53-81.

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