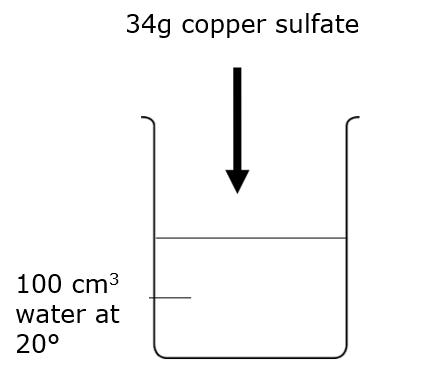
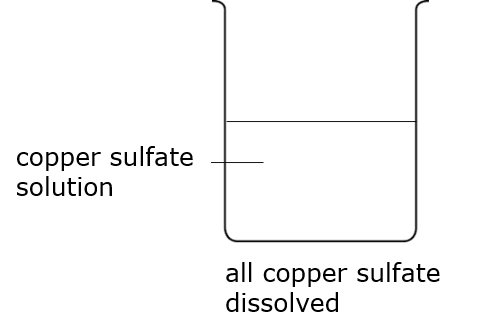
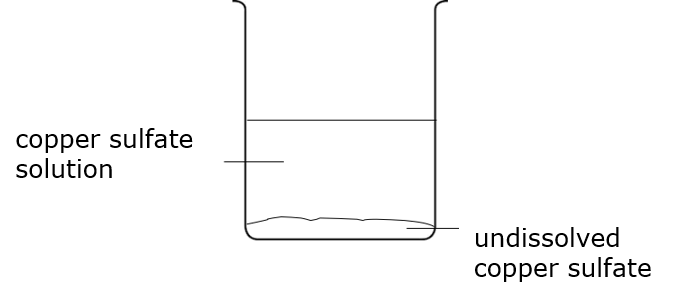
**Copper sulfate data**

**Worked example**

34g of copper sulfate is added to 100cm3 of water at 20°C.



Use the table below to work out whether all the copper sulfate dissolves.



**Answer:**

**Step 1: Use the table to look up the maximum mass of copper sulfate that can dissolve in 100cm3 (100g) of water at the given temperature.**

At 20°C the maximum mass of copper sulfate that can dissolve in 100cm3 (100 g) of water is 32g.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Temperature/ °C | 0 | 20 | 40 | 60 | 80 | 100 |
| Solubility / g in 100 g water | 23.1 | 32 | 44.6 | 61.8 | 83.8 | 114 |

**Step 2: Compare the value in the table with the mass of copper sulfate added.**

The maximum mass that can dissolve (32g) is less than the 34g added. This means that some of the copper sulfate (2g) will not dissolve.

**To answer**

1. For each experiment, use the data table to work out whether all the copper sulfate will dissolve or if some copper sulfate remains undissolved.
   1. 20g of copper sulfate in 100cm3 of water at 20°C.
   2. 50g of copper sulfate in 100cm3 of water at 40°C.
   3. 60g of copper sulfate in 100cm3 of water at 60°C.

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

|  |
| --- |
| **Response activity** |
| **Copper sulfate data** |

**Overview**

|  |  |
| --- | --- |
| Learning objective: | 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 |
| Activity type: | Response, clarifying – worked example |
| Key words: | solubility, mass, dissolve |

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

* Warming up

**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 activity**

This activity gives you the opportunity to re-teach a challenging concept from a more quantitative perspective. The worked example may be used with a whole class so that each step of the process (such as looking up a value in the table) is demonstrated before students attempt more similar questions for themselves.

*Differentiation*

Students that are confident in answering the question for whom the worked example may not be necessary could be challenged to work out answers to some similar questions that use volumes other than 100cm3.

**Expected answers**

1a All dissolved

b Some undissolved

c All dissolved

**Acknowledgments**

Developed by Helen Harden (UYSEG).

Images: Helen Harden and Alistair Moore (UYSEG), 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.

Johnstone, A. H. (1991). Why is chemistry difficult to learn? Things are seldom what they seem. *Journal of Computer Assisted Learning,* 7**,** 75-83.