**Solubility curve**

**Worked example**

120g of potassium nitrate is added to 100cm3 of water at 20°C.

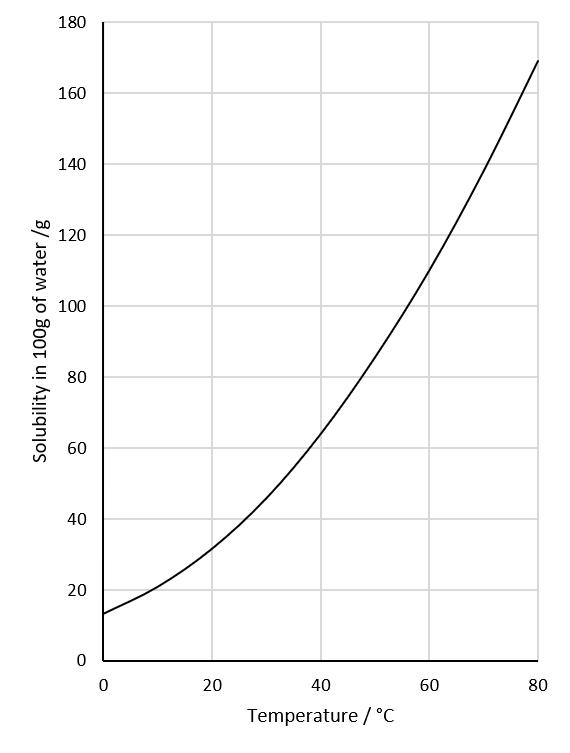
What do you expect to observe?

**Step 1 Plot the point for the solution on the solubility graph.**

See graph

**Step 2 Identify which area of the graph the point is located in.**

In this case the point is above the solubility curve. This means that more potassium nitrate has been added than is able to dissolve. You would expect to see some undissolved solid at the bottom of the beaker.



A solution plotted above the curve has more solute than the maximum that can dissolve.

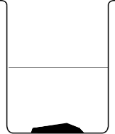
This means that some of the solute does not dissolve.

You would expect to observe undissolved solid.

A solubility curve shows the maximum mass of solute that will dissolve in 100cm3 at each temperature.

All the solute dissolves.

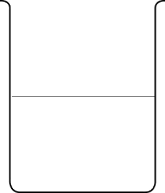
You would not expect to observe any undissolved solid.



A solution plotted underneath the curve has less solute than the maximum that can dissolve.

This means that all the solute dissolves.

You would not expect to observe any undissolved solid.

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1. Three beakers contain 100cm3 of water at different temperatures.

A student adds a different mass of potassium nitrate to each one.

Use the solubility graph below to work out what would you expect to observe in each case.

|  |  |  |  |
| --- | --- | --- | --- |
| Beaker | Temperature/°C | Mass of potassium nitrate/g | Undissolved solids? |
| 1 | 40 | 20 |  |
| 2 | 60 | 110 |  |
| 3 | 50 | 130 |  |

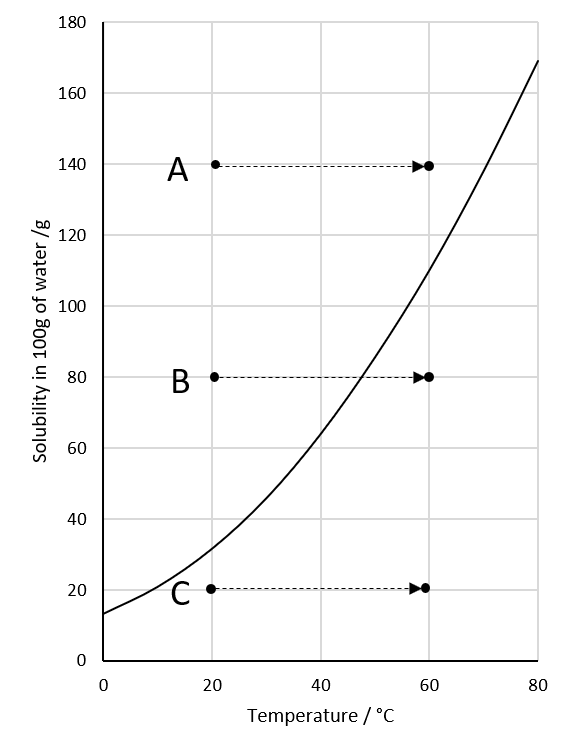
1. Some potassium nitrate is added to 100cm3 of water at 20°C.

The potassium nitrate does not all dissolve.

The solution is warmed to 60°C.

All the potassium nitrate dissolves.

Which arrow correctly shows the observed change?



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

|  |
| --- |
| **Response activity** |
| **Solubility curve** |

**Overview**

|  |  |
| --- | --- |
| Learning objective: | Solubility is a property of a substance that varies with temperature. |
| Observable learning outcome: | Link points on a solubility graph to macroscopic observations. |
| Activity type: | Response- Clarifying- worked example/ Application and practice- problem |
| Key words: | Solution, dissolve, solubility |

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

* Solubility graph

**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 activity aims to support students in moving between graphical information about the solubility of a solute and a macroscopic understanding of what would be observed.

**Ways to use this activity**

This first part of the activity provides support by students through a worked example. Students can then use question one to practise.

The second part of the activity presents the question in a different way, thereby requiring students to apply their understanding to a new situation.

**Expected answers**

**1**

|  |  |  |  |
| --- | --- | --- | --- |
| Beaker | Temperature/°C | Mass of potassium nitrate/g | Undissolved solids? |
| 1 | 40 | 20 | X |
| 2 | 60 | 110 | X |
| 3 | 50 | 130 | ✓ |

**2** Arrow B shows the observed change. It starts above the solubility curve indicating that not all of the solute is able to dissolve. It finishes below the solubility curve which is consistent with he observation that all the potassium nitrate dissolved at 60°C.

**Acknowledgments**

Developed by Helen Harden (UYSEG).

Images: Helen Harden

**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.