Interpreting Solubility Curves

Why?

Solubility is a measure of the amount of solute that will dissolve in a given amount of solvent – usually water. A solubility curve shows how much solute dissolves in a given volume of a solvent at a given temperature. How much sugar dissolves in a cup of hot coffee? How much salt can dissolve in cold water? Chemists use this type of information when preparing solutions. Solutions are combinations of two or more substances that exist together in a homogeneous mixture.

Learning Objectives

- Determine solubilities based on information presented in table format.
- Distinguish solubility trends between solids and gases with changes in temperature.

Success Criteria

- Interpret a solubility table.
- Deduce the amount of solute in a given amount of solvent based on a solubility table.

Vocabulary

- solute
- solubility
- supersaturated
- solvent
- saturated
- solution
- unsaturated
- independent variable
- dependent variable

Use a vocabulary term to answer the first two questions below.

1. Which term applies to a sponge that is dry?

2. Which term applies to a sponge that is soaked?

3. Can you add more water to a sponge that is already soaked?

Authored by E. Graham and R. McGrath, Modified by L. Tumminello, R. Quackenbush K. Levy and K. Levy
Edited by Linda Padwa and David Hanson, Stony Brook University

Model

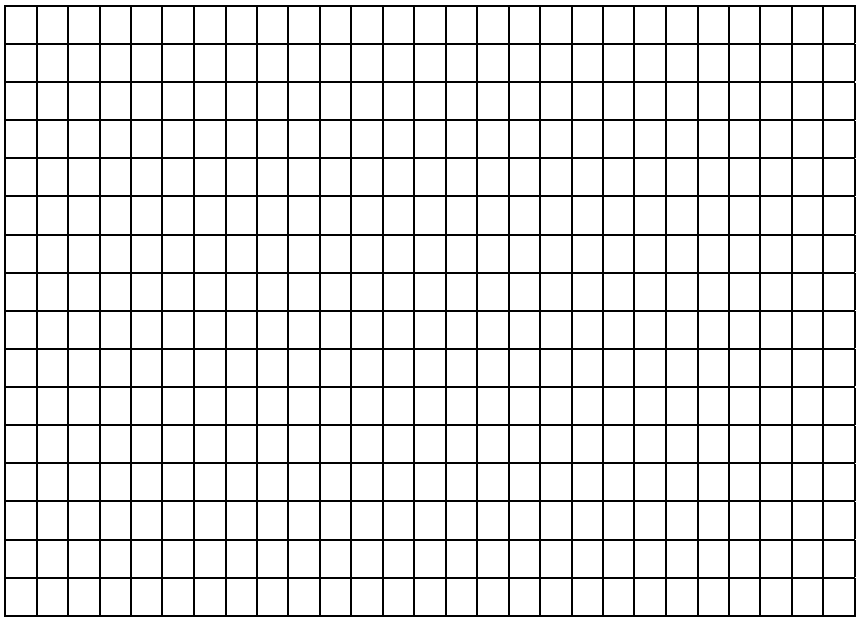
Table1. Solubility Data

Temperature (°C)	Solute (g) per 100g of H_2O (*l*)
10	33
30	42
50	52
70	62
90	73

Task

Complete the model: Using the grid below make a graph of the solubility data in Table 1.

a. Label x-axis, y-axis and create appropriate scales for each.
b. Plot points *using a pencil*



Key Questions

1. What information is provided by the data in Table 1?

2. What is the relationship between temperature and solubility for this solute?

Authored by E. Graham and R. McGrath, Modified by L. Tumminello, R. Quackenbush K. Levy and K. Levy
Edited by Linda Padwa and David Hanson, Stony Brook University

3. What will happen to this solute when 12 g is added to 100 g of water at 20°C?

4. What type of solution is obtained when 12 g of this solute is added to 100 g of water at 20°C (unsaturated, saturated, or supersaturated)?

5. At 20°C, what is the maximum amount of this solute that can be dissolved in 100 g of water?

6. What type of solution is obtained when the maximum amount of a solute is dissolved in water (unsaturated, saturated, or supersaturated)?

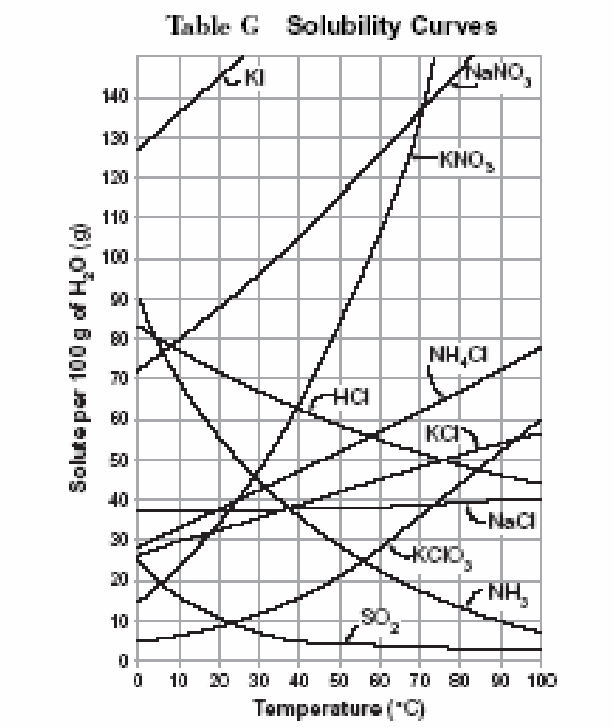
7. At 20°C, 50 g of this solute is added to 100 g of water. What will happen to the extra solute?

8. What type of solution is obtained under the conditions in Question #7 (unsaturated, saturated, or supersaturated)?

Authored by E. Graham and R. McGrath, Modified by L. Tumminello, R. Quackenbush K. Levy and K. Levy
Edited by Linda Padwa and David Hanson, Stony Brook University

1. Exercise

Use Table G to answer the following questions.



(http://nysedregents.org/testing/reftable/archreftable/ChemRef1-7.pdf)

1. Compare the graph that you constructed from the data in Table 1 to graphs in Table G. Which of the solutes in Table G is the solute in your graph?

2. Identify the substance in Table G that is most soluble at 60°C.

3. Identify the substance in Table G that is least soluble at 60°C.

4. Identify and state the difference between the solubility curves for ammonia and sodium nitrate. Note that ammonia is a gas and sodium nitrate is a solid at room temperature.

Authored by E. Graham and R. McGrath, Modified by L. Tumminello, R. Quackenbush K. Levy and K. Levy
Edited by Linda Padwa and David Hanson, Stony Brook University

5. Use the temperature dependence of solubility to identify whether the substances in Table G are gases or solids. Make two lists below, one for gases and one for solids.

6. Suggest a reason why solubility decreases with increasing temperature for gaseous solutes but increases for solid solutes.

Problems

1. Everyday Jen walks in to Dunkin' Donuts and orders a medium iced coffee with four sugars or hot coffee with four sugars. She notices that the iced coffee is never as sweet as the hot coffee. Why?

2. Ryan would like to make rock candy. The recipe calls for 200 g of sugar dissolved in 100 g of water. Ryan makes the observation that there is still sugar left on the bottom of the pan. Based on your knowledge about solubility, what could Ryan do to ensure that all of the sugar dissolves?

3. A standard driveway is 550 cm by 305 cm (18' by 10'). If there is 5 cm of snow (about 2 inches) on the driveway – what is the maximum amount of rock salt that can be dissolved by the water from the snow? Rock salt is NaCl. *(Hint: density of water is approx 1 g/cm^3 because 1 mL = 1 cm^3. Is this exact? No, but it is close enough for our purposes here.)*

Authored by E. Graham and R. McGrath, Modified by L. Tumminello, R. Quackenbush K. Levy and K. Levy
Edited by Linda Padwa and David Hanson, Stony Brook University