

Name: _____

Skill Sheet 23-B

Solubility



In this skill sheet you will practice solving problems about solubility. You will use solubility values to identify solutions that are saturated, unsaturated, or supersaturated. Finally, you will practice your skills in interpreting temperature-solubility graphs.

1. What is solubility?

A solution is made by dissolving a substance in another substance. The substance in the smaller amount is called the *solute* and the substance in the larger amount is called the *solvent*. The degree to which a solute dissolved is described by its *solubility value*. This value is the mass in grams of the solute that can dissolve in a given volume of solvent under certain conditions.

For example, the solubility of table salt (NaCl) is 1 gram per 2.7 milliliters of water at 25°C. Another way to state this solubility value is to say that 0.38 grams of salt will dissolve in one milliliter of water at 25°C. Do you see that these values mean the same thing?

$$\frac{1 \text{ gram NaCl}}{2.7 \text{ mL H}_2\text{O} \cdot 25^\circ\text{C}} = \frac{0.38 \text{ grams NaCl}}{1 \text{ mL H}_2\text{O} \cdot 25^\circ\text{C}}$$

Information about the solubility of table salt and other substances is presented in the table below. Use these values to complete the questions in part 2.

Substance	Solubility Value (grams/100 mL water 25°C)
Table salt (NaCl)	38
Sugar (C ₁₂ H ₂₂ O ₁₁)	200
Baking soda (NaHCO ₃)	10
Chalk (CaCO ₃)	insoluble
Talc (Mg silicates)	insoluble

2. Questions and problem solving

1. Chalk and talc are listed as “insoluble” in the table. What do you think this term means? In your response, come up with a reason to explain why chalk and talc cannot dissolve in water.

2. Come up with a reason to explain why table salt, sugar, and baking soda dissolve in different amount for the same set of conditions (same volume and temperature).

3. How much table salt would dissolve in 540 mL of water if the water was 25°C.

4. What volume of water would you need to dissolve 72 grams of salt at 25°C.

5. What volume of water at 25°C would you need to dissolve 50 grams of sugar?

6. How much baking soda will dissolve in 10 milliliters of water at 25°C.

3. Saturated, unsaturated, and supersaturated solutions

The solubility value for a substance indicates how much solute is present in a *saturated* solution. When the amount of solute is less than the solubility value for a certain volume of water, we say the solution is *unsaturated*. When the amount of solute is more than the solubility value for a certain volume of water, we say the solution is *supersaturated*.

Use the table in part 2, to help you fill in the table below. In each situation, is the solution saturated, unsaturated, or supersaturated?

Substance	Amount of substance in 200 mL of water at 25°C	Saturated, unsaturated, or supersaturated?
Table salt (NaCl)	38 grams	
Sugar (C ₁₂ H ₂₂ O ₁₁)	500 grams	
Baking soda (NaHCO ₃)	20 grams	
Table salt (NaCl)	100 grams	
Sugar (C ₁₂ H ₂₂ O ₁₁)	210 grams	
Baking soda (NaHCO ₃)	25 grams	

4. How temperature influences the solubility of solids and gases

Below is a table of some imaginary substances dissolved in water at different temperatures. Study the table and then answer the questions.

Substance dissolved in 100 mL of water	Solubility values (grams per 100 mL of water) at different temperatures				
	10°C	30°C	50°C	70°C	90°C
gas A	0.2	0.2	0.1	0.08	0.05
gas B	0.1	0.05	0.02	0.01	0.005
solid A	30	32	40	55	74
solid B	40	43	39	41	45

1. Use graph paper to make two graphs of the data in the table. On one graph, plot the data for gases A and B. On the other graph, plot the data for solids A and B. Use two different colors to plot the data for A and for B. Label the x -axis, "Temperature (°C)." Label the y -axis, "Solubility value (grams/100 mL H₂O)."
2. How does the solubility of gases A and B differ from the solubility of solids A and B in water? Explain your response.

3. For which substance does temperature seem to have the highest influence on the substance?

4. For which substance does temperature seem to have the lowest influence?

5. If you had 500 mL of water at 70°C and you made a saturated solution by adding 205 grams of a substance, which of the substances above would you be adding?

6. Organisms that live in ponds and lakes, depend on dissolved oxygen to survive. Explain how the amount of dissolved oxygen in a pond or lake might vary with the seasons (winter, spring, summer, and fall). Justify your ideas.