What Stays Dissolved?

Use solubility data to separate the effects of temperature and pressure.

CHE.5.d "Analyze and interpret data to explain the effects of temperature on the solubility of solid, liquid, and gaseous solutes in a solvent and the effects of pressure on the solubility of gaseous solutes."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the three table entries for the substances at 20°C and 1 atm. Circle the two rows you can compare to isolate the effect of pressure on dissolved carbon dioxide.

A Drink Maker's Dissolving Tests

1 A drink maker tests three substances dissolving in water. Potassium nitrate is a solid, acetone is a liquid, and carbon dioxide is a gas. The table gives grams of solid or gas per 100 grams of water at equilibrium. "Mixes completely" means acetone and water form one uniform liquid at any mixing ratio.

SOLUBILITY IN WATER UNDER DIFFERENT CONDITIONS

Temperature (°C)	CO_2 partial pressure (atm)	Potassium nitrate (g/100 g water)	Acetone in water	CO_2 (g/100 g water)
20	1	31.6	Mixes completely	0.169
40	1	63.9	Mixes completely	0.097
60	1	110	Mixes completely	0.058
20	2	31.6	Mixes completely	0.338

2 At the same carbon dioxide partial pressure of 1 atm, warming the water from 20°C to 60°C changes the dissolved amounts in different ways. Potassium nitrate dissolves in greater amounts, while carbon dioxide dissolves in smaller amounts. Acetone still mixes completely at all three temperatures. This result for acetone does not describe every liquid solute.

3 For the gas, pressure means carbon dioxide's partial pressure above the water, not total air pressure. At a fixed temperature, dissolved carbon dioxide is approximately proportional to its partial pressure over this range. Opening a fizzy drink lowers that pressure toward carbon dioxide's tiny partial pressure in air. Some dissolved gas escapes as bubbles.

2 ANSWER WITH EVIDENCE

Use the passage

1. At 1 atm CO_2 partial pressure, how does the amount of potassium nitrate that dissolves change from 20°C to 60°C? Use both table values.

2. At 1 atm CO_2 partial pressure, how does warming from 20°C to 60°C affect the amount of CO_2 that dissolves?

3. Compare the two 20°C rows. What happens to dissolved CO_2 when its partial pressure doubles?

4. At 1 atm CO_2 partial pressure, how does acetone's behavior from 20°C to 60°C differ from potassium nitrate's?

3 YOUR TURN

Your own words

A plant compares water at 20°C under 0.5 atm CO_2 with water at 40°C under 2 atm CO_2. In two sentences, estimate how much CO_2 dissolves in each per 100 g water, then explain which water holds more despite the temperature difference.

What Stays Dissolved?

PART 1 · READ AND MARK

Underline the three table entries for the substances at 20°C and 1 atm. Circle the two rows you can compare to isolate the effect of pressure on dissolved carbon dioxide. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	At 1 atm CO_2 partial pressure, how does the amount of potassium nitrate that dissolves change from 20°C to 60°C? Use both table values.	**It increases from 31.6 to 110 g per 100 g water.**
2	At 1 atm CO_2 partial pressure, how does warming from 20°C to 60°C affect the amount of CO_2 that dissolves?	**It decreases from 0.169 to 0.058 g per 100 g water.**
3	Compare the two 20°C rows. What happens to dissolved CO_2 when its partial pressure doubles?	**It doubles, from 0.169 to 0.338 g per 100 g water.**
4	At 1 atm CO_2 partial pressure, how does acetone's behavior from 20°C to 60°C differ from potassium nitrate's?	**Acetone mixes completely at all three temperatures, while the amount of potassium nitrate that dissolves increases as temperature rises.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

At 20°C and 0.5 atm CO_2, about 0.0845 g dissolves per 100 g water, while at 40°C and 2 atm, about 0.194 g dissolves. The warmer water holds more CO_2 here because the higher CO_2 partial pressure more than offsets the effect of warming.

Accept reasonable rounding in the open response. Students should compare temperatures only at the same CO_2 partial pressure and pressures only at the same temperature.