Solubility Worksheet
Physical Science – Matter **Name:**_____ **Per:**__

Background Information:
A *solution* is defined as a mixture of two or more substances that is homogenous at the molecular level. The substance present in the greatest amount is called the *solvent*. The other substances are known as *solutes*. 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 0.37 grams of salt will dissolve in one milliliter of water at 25°C. These values mean the same thing as demonstrated below:

$$\frac{1 \text{ gram NaCl}}{2.7 \text{ mL } H_2O \bullet 25°C} = \frac{0.37 \text{ gram NaCl}}{1.0 \text{ mL } H_2O \bullet 25°C}$$

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

Substance	Solubility Value (grams/100 mL water at 25°C
Table salt (NaCl)	37
Sugar ($C_{12}H_{22}O_{11}$)	200
Baking Soda ($NaHCO_3$)	10
Chalk ($CaCO_3$)	insoluble
Talc (Mg silicates)	insoluble

Questions: (show your work where applicable)

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 amounts 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?

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 on the previous page 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)	37 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	

The influence of temperature on solubility

Have you noticed that sugar dissolves much easier in hot tea than in iced tea? The solubility of some substances increases greatly as the temperature of the solvent increases. For other substances, the dissolving rate changes very little. A solubility graph (sometimes called a solubility curve) can be used to show how temperature affects solubility.

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

	Solubility values (g/100 mL H_2O) at different temperatures				
Substance dissolved in 100 mL of water	**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 solubility 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 H_2O)."

2. How does the solubility of gases A and B differ from the solubility of solids A and B in water? Explain your answer.

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

4. For which substance does temperature seem to have the least 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. Justify your ideas.