Lab 3. Solubility of NaCl in Water

There is a link between lab and demo this week. The common thread is the presence of things in water. You will think about things dissolving in water (in lab) and see how to remove dissolved things from water (in demo). It should be evident to all why having a clean source of water is important. Knowing how and how much a contaminant gets into water in the first place can lead to new and better ideas of how to remove it.

Student Preparation. (to be done <u>before</u> arriving to lab)
The ***solubility*** of a solid in a liquid is ***the maximum amount (mass) of that solid that dissolves in 100 grams of a solvent at a given temperature***. Some solids have a very low solubility in water; others have a much higher solubility. For example the solubility of silver chloride AgCl in water at 20 ºC is 0.000089 g per 100 g of water while the solubility of potassium nitrate KNO_3 at the same temperature is 32 g per 100 g of water. In this experiment you will determine the solubility of sodium chloride, NaCl, in water at room temperature.

1. Read part C of the lab procedure and the process for calculating solubility. Think about the laws we covered in class. Which law will be used in determining the solubility of NaCl?

2. The definition of solubility states "at a given temperature". What would happen to the solubility of NaCl if the temperature is increased? (Answer from your own experiences with dissolving and temperature.)

3. Student Q performed the experiment last week with a different solid. Q has the following data but doesn't know what to do with it. Calculate the solubility of Q's solid in g/100 g H_2O. Show all of your work. (Use the steps laid out in the Data and Calculation Table below.)

Mass of initial solid	24.314 g
Volume of water used	50.0 mL
Mass of dry filter paper	0.808 g
Mass of paper and filtered solid	18.433 g

TA signature_____

Procedure

A. **Initial investigation.** Take 2 clean Erlenmeyer flasks and put 10.0 g NaCl in each flask. To one flask, add 50.0 mL (50.0 g) of water, measured with a graduated cylinder. In the other, put 50.0 mL of ethyl alcohol. Stir (or swirl) the flasks at the same time for a few minutes.

1) Record your observations. (What did you see happen?)

Is all the sodium chloride dissolved in one of the flasks? _____

If yes proceed. If no, check with your instructor.

2) What do you conclude about your results? (Interpret what you saw happen.)

B. **Solution preparation.** Place 50.0 mL (50.0 g) of distilled water in a clean Erlenmeyer flask. Add to it 25.0 g NaCl. (Put your exact mass of NaCl in the table below, line 1.) Stir (or swirl) the mixture for several minutes (longer than you did the flasks in part A).

3) Record your observations.

C. **Determination of solubility.**

Before doing anything else, measure the temperature of your solution, being careful to not get any undissolved sodium chloride on it. Record the temperature in the table below (line 7).

Weigh a small size filter paper and put the mass in the table below (line 2). Equip a funnel with the filter paper using the method demonstrated by your instructor. Swirl the flask to suspend any undissolved sodium chloride and pour the suspension into the filter, being careful not to overflow the filter paper.

It is important that all of the undissolved sodium chloride be transferred to the filter paper. Any remaining undissolved sodium chloride can be transferred to the filter paper using the following method. Add a few milliliters of **ethyl alcohol** to the flask, swirl the mixture, and transfer the suspension to the filter paper. Make sure that you transfer all the undissolved sodium chloride from the flask to the filter paper.

Carefully remove the filter paper from the funnel and unfold it making sure that none of the sodium chloride retained by the filter paper is lost. Then air dry the filter paper and undissolved sodium

chloride by leaving the filter paper and undissolved on the bench for 10–15 minutes. While your things are drying, answer the post lab questions. When you are done, weigh the filter paper/undissolved NaCl, put the mass in the data table (line 3) and perform the calculations.

Data and Calculation Table

(1) Weight of NaCl added to water. _____ g (1)

(2) Weight of small size filter paper _____ g (2)

(3) Weight of the dried filter paper with the undissolved sodium chloride _____ g (3)

(4) Determine the mass of the undissolved sodium chloride (3) – (2) _____ g (4)

(5) Determine the mass of the dissolved sodium chloride:
Subtract the answer in (4) from (1) _____ g (5)

(6) Multiply the answer in step (5) by 2 because you used only 50 g of water instead of 100 g. This is the solubility of sodium chloride in water at the measured temperature.

_____ g/100 g H_2O

(7) Temperature of the aqueous solution. _____ ºC

Post lab questions.

1) Why do we use ethyl alcohol to transfer the undissolved sodium chloride remaining in the flask rather than water?

2) It is common with labs that involve calculations to identify sources of error. Consider the following list of things that can go wrong. How would each affect the calculation of the solubility? If the error would cause the calculated solubility to be higher than if the error hadn't occurred, state "higher than should be". If the error would cause a lower calculated solubility, state "lower than should be".

Source of error	Calculated solubility would be…
Mass of filter paper wasn't accounted for in the calculations	
Filter paper/undissolved solid wasn't completely dry	
Undissolved solid missed the filter paper and ended up with the dissolved solid	
Graduated cylinder was read incorrectly and 47 mL was actually used instead of 50 mL	