SOLUBILITY OF A SALT

Pre-Lab Discussion

The solubility of a pure substance in a particular solvent is the quantity of that substance that will dissolve in a given amount of the solvent. Solubility varies with the temperature of the solvent. Thus, solubility must be expressed as quantity of solute per quantity of solvent at a specific temperature. For most ionic solids, especially salts, in water, solubility varies directly with temperature. That is, the higher the temperature of the solvent (water), the more solute (salt) that will dissolve in it.

In this experiment, you will study the solubility of potassium nitrate (KNO_3) in water. You will dissolve different quantities of this salt in a given amount of water at a temperature close to the water's boiling point. Each solution will be observed as it cools, and the temperature at which crystallization of the salt occurs will be noted and recorded. The start of crystallization indicates that the solution has become saturated. At this temperature, the solution contains the maximum quantity of solute that can be dissolved in that amount of solvent.

After solubility data for several different quantities of solute have been collected, the data will be plotted on a graph. A solubility curve for KNO3 will be constructed by connecting the plotted points.

Purpose:

Collect the experimental data necessary to construct a solubility curve for potassium Nitrate (KNO_3) in water.

Equipment:

Goggles	balance
	beaker, 400 mL
graduated cylinder, 10mL	thermometer
micro spatula	stirring rod
test tubes, (4)	test tube holder
test tube racks	

Materials:

Potassium nitrate (KNO_3)
Distilled water

Safety: Goggles worn at all times.

Procedure:

While one lab partner carries out the instructions in Steps 1 through 4, the other partner should go on to Step 5.

1. Clean and number 4 test tubes at your station.
   Place the numbered test tubes in a test tube rack.

2. Using the electronic balance and a weighing boat, measure out exactly 0.80 g of potassium nitrate (KNO_3).
   Pour the salt into test tube #1.

3. Repeat step 2 for the following masses of KNO_3. Add each quantity to the test tube indicated:
   1.6g to test tube #2
   2.4g to test tube #3
   3.2g to test tube #4

4. Add exactly 2.0 mL distilled water to each test tube.

5. Fill a 400 mL beaker about three-fourths (3/4) full of tap water. This will be used as a water bath for all test tubes. Using a Hot Plate, heat the water bath to about 90^oC, maintain the water at this temperature. Place all 4 test tubes into the water bath.

6. Using a glass stirring rod carefully stir the KNO_3 water mixture until the KNO_3 is completely dissolved. Remove the stirring rod and rinse it off.

7. Once dissolving is complete, remove test tube #1 from the hot water bath. Place a WARMED thermometer into the test tube, raise the test tube to the light and begin to observe at what temperature crystallization occurs.

8. Procedural steps 6 & 7 should be followed for all 3 remaining test tubes.
   Record all temperatures in your data table.

9. If any doubtful results are obtained, the procedure can be repeated by re-dissolving the KNO_3 in the hot-water bath and allowing it to once again re-crystallize.

10. While running water, dispose of KNO_3 down the drain. Rinse all test tubes.

OBSERVATION AND DATA

Test Tube #	**grams of KNO_3/2.0 mL H_2O**	**Crystallization temperature (^oC)**
1	0.80 g/2.0 mL	_____
2	1.6 g/2.0 mL	_____
3	2.4 g/2.0 mL	_____
4	3.2 g/2.0 mL	_____

Calculations:

1. Using proportions, convert the experimental mass/volume rations to equivalent g/100mL ratios. Show work below.

   0.80 g/2.0 mL = _____ g/100 mL

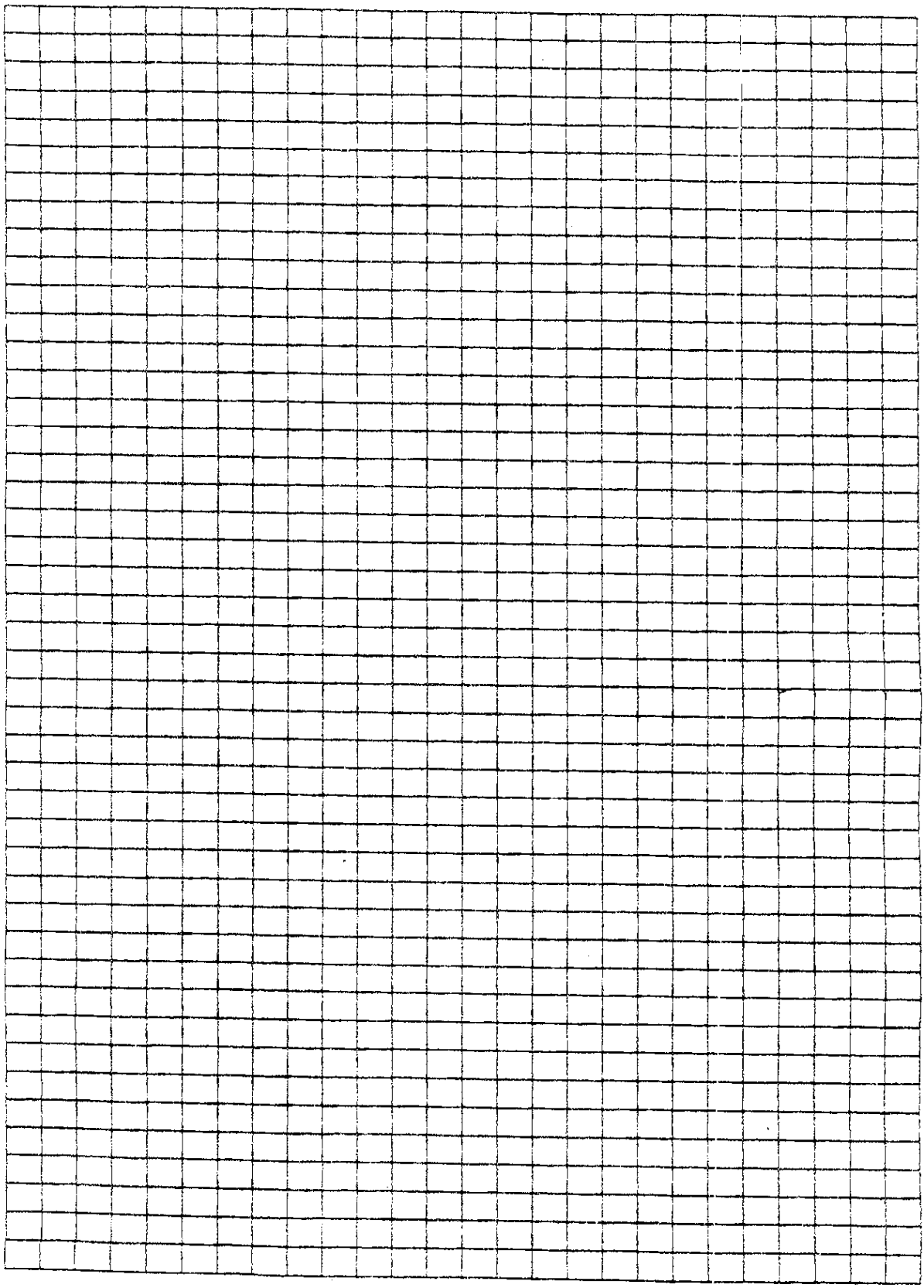
   1.6 g/2.0 mL = _____g/100 mL

   2.4 g/2.0 mL = _____g/100 mL

   3.2 g/2.0 mL = _____g/100 mL

2. Plot your experimental data on the attached graph paper. Plot mass of solute per 100 mL of water on the y – axis and temperature on the x – axis.

3. Construct a solubility curve by connecting the plotted points on your graph.



***CONCLUSIONS AND QUESTIONS*:**

1. Based on your graph, how many grams of KNO_3 can be dissolved in 100mL of H_2O at the following temperature?

   a. 30^oC _____

   b. 60^oC _____

   c. 70^oC _____

2. Define the following:
   Saturated - _____

   _____

   Unsaturated- _____

   _____

   Supersaturated - _____

   _____

3. Classify the following KNO3 solutions as saturated, unsaturated, or supersaturated. Explain your answer.

   a. 75g KNO_3/100 mL H_2O at 40^oC _____

   b. 60g KNO_3/100 mL H_2O at 50^oC _____

4. According to page 474 do the solubility of all ionic solids increase as the temperature increases?

   _____

5. How does the solubility of a gas change with increasing temperature? Draw a rough sketch showing the general shape of a solubility curve of a gas.