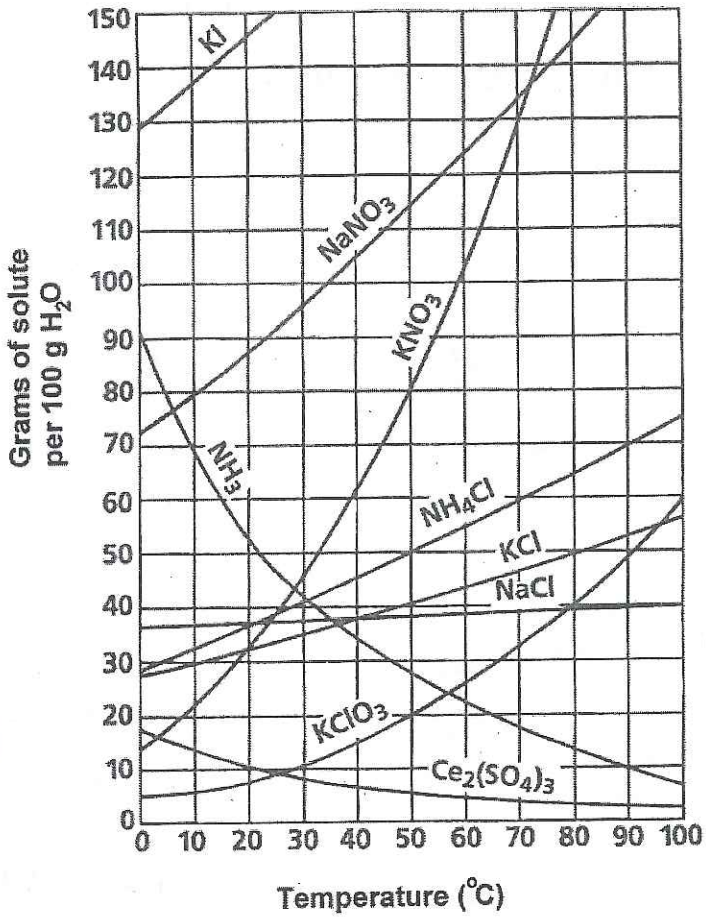
Intro to Solubility Curves & Types of Solutions

1. Define *solubility*- The ability of a substance to be dissolved

2. For most substances, solubility increases as temperature increases. What substances are the exceptions on the graph below?
   NH_3 & $Ce_2(SO_4)_3$



Part One: Reading Solubility Curves
Use the graph to answer the following questions. REMEMBER UNITS!

3. What mass of solute will dissolve in **100 mL** of water at the following temperatures?
   a) KNO_3 at 70°C 130 g
   b) NaCl at 100°C 40 g
   c) NH_4Cl at 90°C 70 g
   d) Which of the **above** three substances is most soluble in water at 15°C. NaCl

4. What mass of solute will dissolve in **200 mL** of water at the following temperatures?
   a. KNO_3 at 70°C 260 g
   b. NaCl at 100°C 80 g
   c. NH_4Cl at 90°C 140 g

Part Two: Types of Solutions *(saturated, unsaturated, supersaturated)*

- On a solubility curve, the lines indicate the concentration of a **saturated solution** = contains the maximum amount of solute that will dissolve at that specific temperature (no additional solute can be dissolved in these solutions at that temperature. If any more solid is added, it will remain undissolved at the bottom of the beaker)

- Values on the graph below a curve represent **unsaturated solutions** = more solute could still be dissolved into the solution at that temperature

- Values on the graph above a curve represent **supersaturated solutions** = contains more than the maximum amount of solute that can be dissolved at that temperature (HOW?!? - heat the water, add a LOT of solute and slowly cool the solution so that at the lower temperature the solution contains more solute than it should be able to)

Solubility & Solutions Practice

Directions: Use the solubility curve on the previous page to label the following solutions as saturated or unsaturated. If *unsaturated*, write how much more solute (grams) can be dissolved in the solution.

Solution	Saturated or Unsaturated?	If unsaturated: How much more solute can dissolve in the solution?
96 g $NaNO_3$ = saturated a solution that contains 70g of $NaNO_3$ at 30°C (in 100 mL H_2O)	unsaturated	96 g − 70g = (26g)
50g NH_4Cl = saturated a solution that contains 50g of NH_4Cl at 50°C (in 100 mL H_2O)	saturated	
20 g $KClO_3$ = saturated a solution that contains 20g of $KClO_3$ at 50°C (in 100 mL H_2O)	saturated	
129 g KI = saturated a solution that contains 70g of KI at 0°C (in 100 mL H_2O)	unsaturated	130 g − 70g = (60 g)

Additional Practice:

1. Use the solubility chart on the *previous page* to answer the following questions:

   a. At 90°C, you dissolved 10 g of KCl in 100. g of water. Is this solution saturated or unsaturated? unsaturated. How do you know?
   @ 90°C the solution must have 53g KCl to be saturated

   b. A mass of 100 g of $NaNO_3$ is dissolved in 100 g of water at 80°C. Is the solution saturated or unsaturated? unsaturated.
   As this solution is cooled, at what temperature will a precipitate (solid) form? @ 35°C (or below)

   Saturated = 145g $NaNO_3$

   at this temp 100g $NaNO_3$ = saturated

   c. Which compound is **most** soluble at 20 °C? KI

   d. Which compound is the **least** soluble at 40 °C? $Ce_2(SO_4)_3$

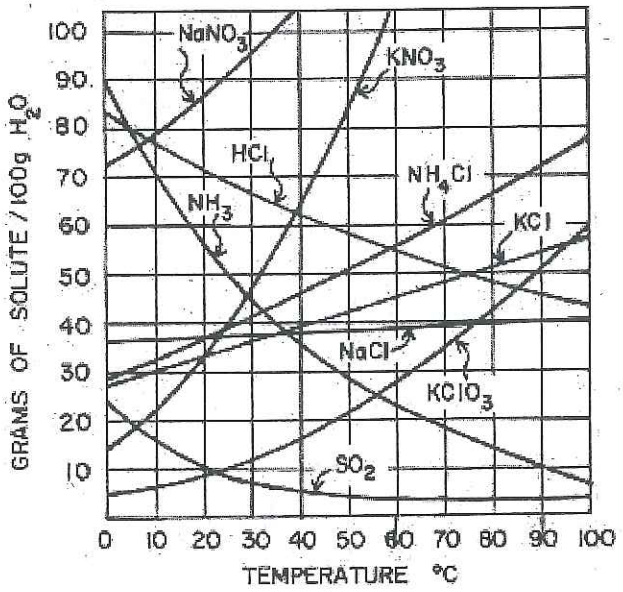
   e. Which substance on the chart is **least** soluble at 10°C? $KClO_3$

   f. A mass of 80 g of KNO_3 is dissolved in 100 g of water at 50 °C. This solution is then heated to 70°C. How many more grams of potassium nitrate must be added to make the solution saturated at this new, warmer temperature? Explain your reasoning.
   All 80g KNO_3 will dissolve in 100g H_2O to form a saturated solution at 50°C. If the solution is heated to 70°C an additional 50g KNO_3 must be dissolved to form a saturated solution.

   130 g KNO_3 = Saturated

Solubility Curve Practice Worksheet

Use the solubility chart below to answer the following questions:



Graph from U. Va Department of Physics.

1) What is the solubility of potassium nitrate at 30° C?

47 g KNO_3 per 100 g H_2O

2) How many grams of ammonia can I dissolve in 200 grams of water at a temperature of 45° C?

NH_3 → 31 g NH_3 per 100 g H_2O

62 g NH_3 per 200 g H_2O

3) At what temperature is the solubility of sodium chloride the same as the solubility of potassium chloride?

NaCl

35 °C

4) How many grams of ammonium chloride would I need to make 300 grams of a saturated solution at 70° C?

NH_4Cl → 60 g NH_4Cl per 100 g H_2O

180 g NH_4Cl per 300 g H_2O

5) What do all of the compounds that decreased in solubility over the temperature range in the graph have in common?

SO_2, NH_3, HCl

they are gases

6) What compound is least soluble at 40° C?

SO_2

7) What ionic compound is least soluble at 40° C?

↳ metal + nonmetal (or polyatomics)

$KClO_3$