# 7.2: Solubility Graph Calculations

**Remember:**

- Have your **7.2 notesheet** ready!
- You can **pause** the video anytime.
- You can **rewind** the video anytime.
- Write down **questions/comments** as you go for discussion in class.

**Are you ready???**

## Part I: Reading the Graph

- remember, the solubility curve/ graph has **three variables** on it:
    - on the x axis = **temperature**
    - on the y axis = **grams of solute** that can be dissolved
    - also on the y axis = **grams of solvent** (in this case, 100g water) that the solute is dissolving in
    - the grams of solvent is always held **constant** on the graph (you can't manipulate 3 variables at once)
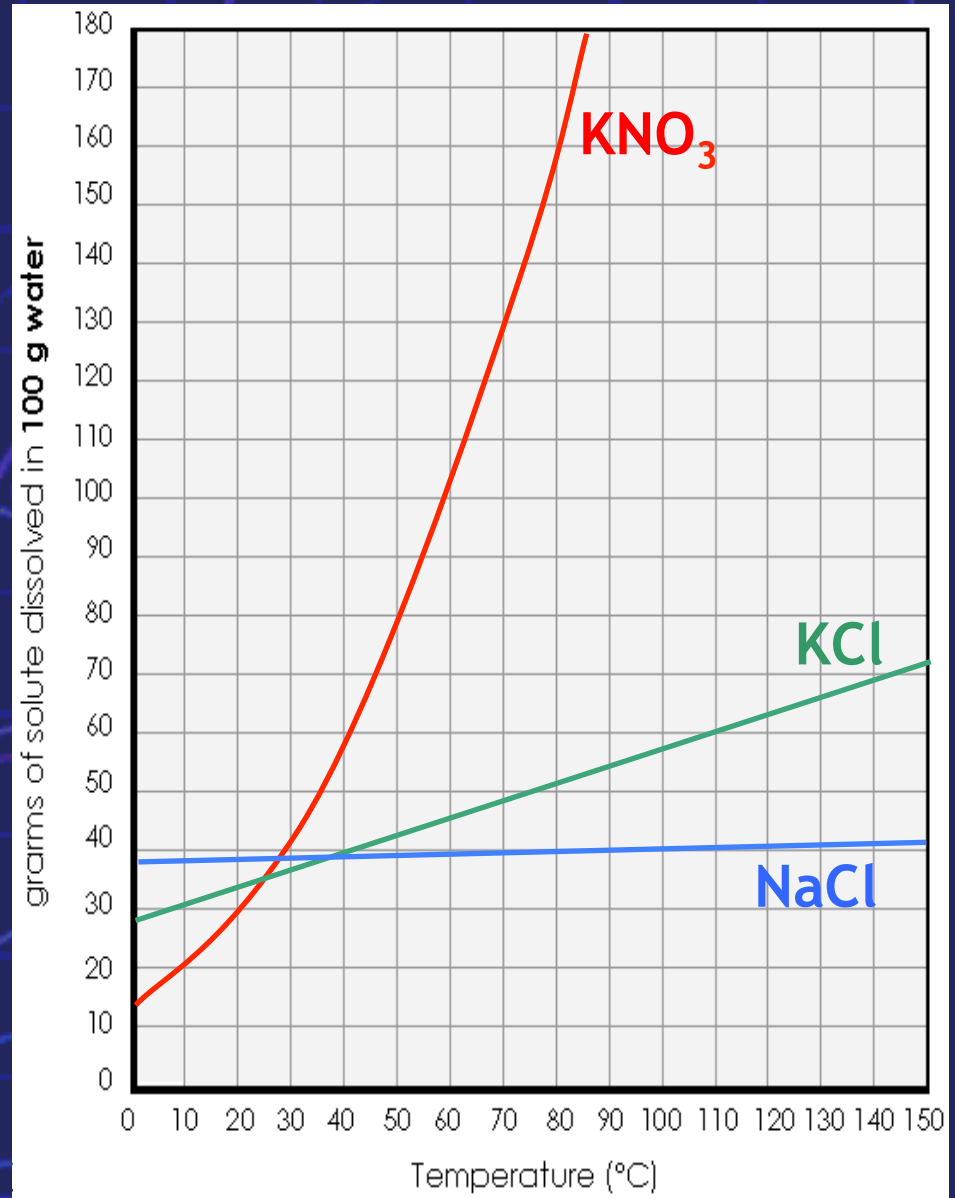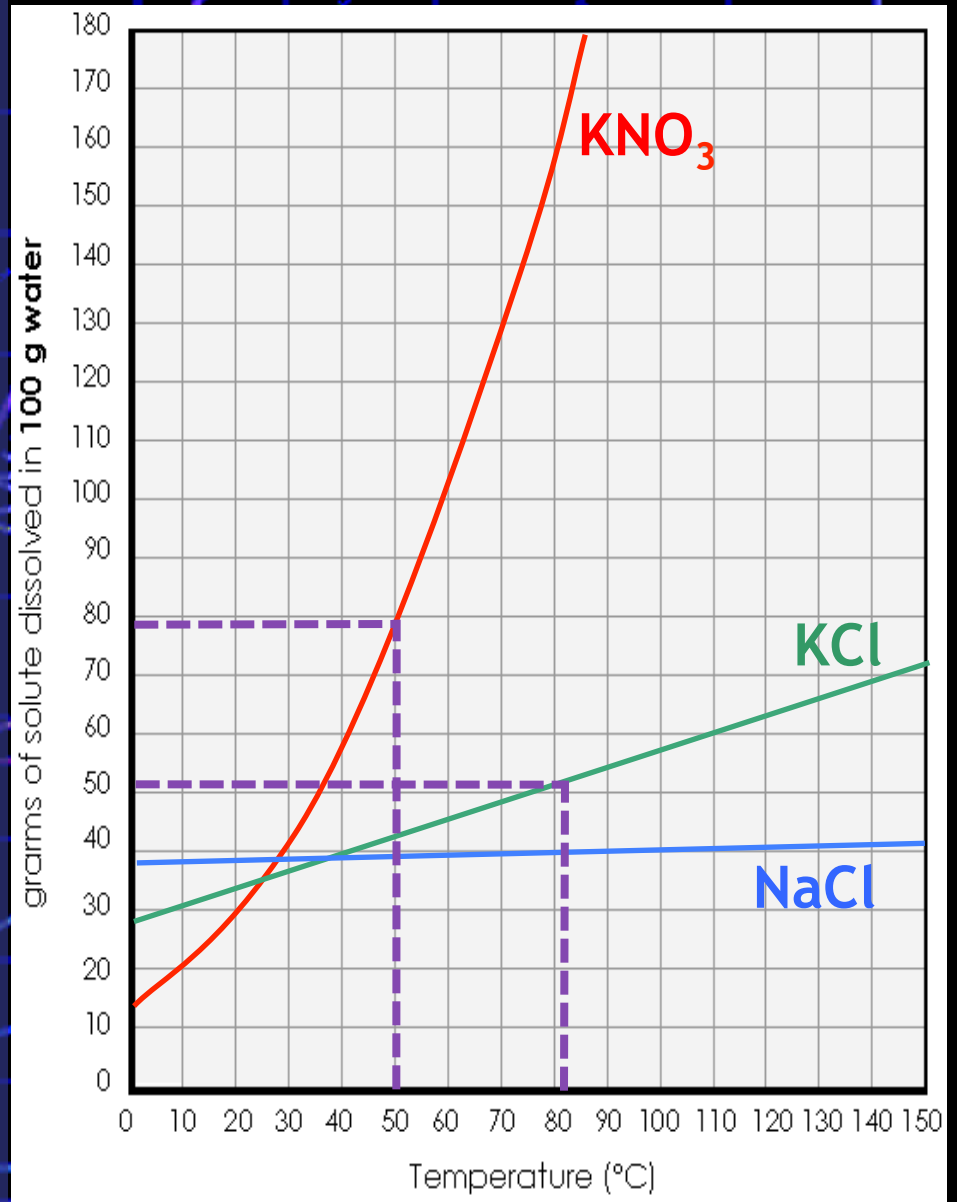
- to read the graph:
- look for the **given info** first,
- read up or over until you **hit the line** (for your compound),
- go to the **other axis** for the information you are looking for.

  **Ex1**: *How many grams of $KNO_3$ will dissolve in 100g $H_2O$ at 50°C?*

  _____79_____ g

  **Ex2**: *How many grams of KCl will dissolve in 100g $H_2O$ at 82°C?*

  _____52_____ g

**Ex1**: *How many grams of KNO$_3$ will dissolve in 100g H$_2$O at 50 °C?*

___79___ g

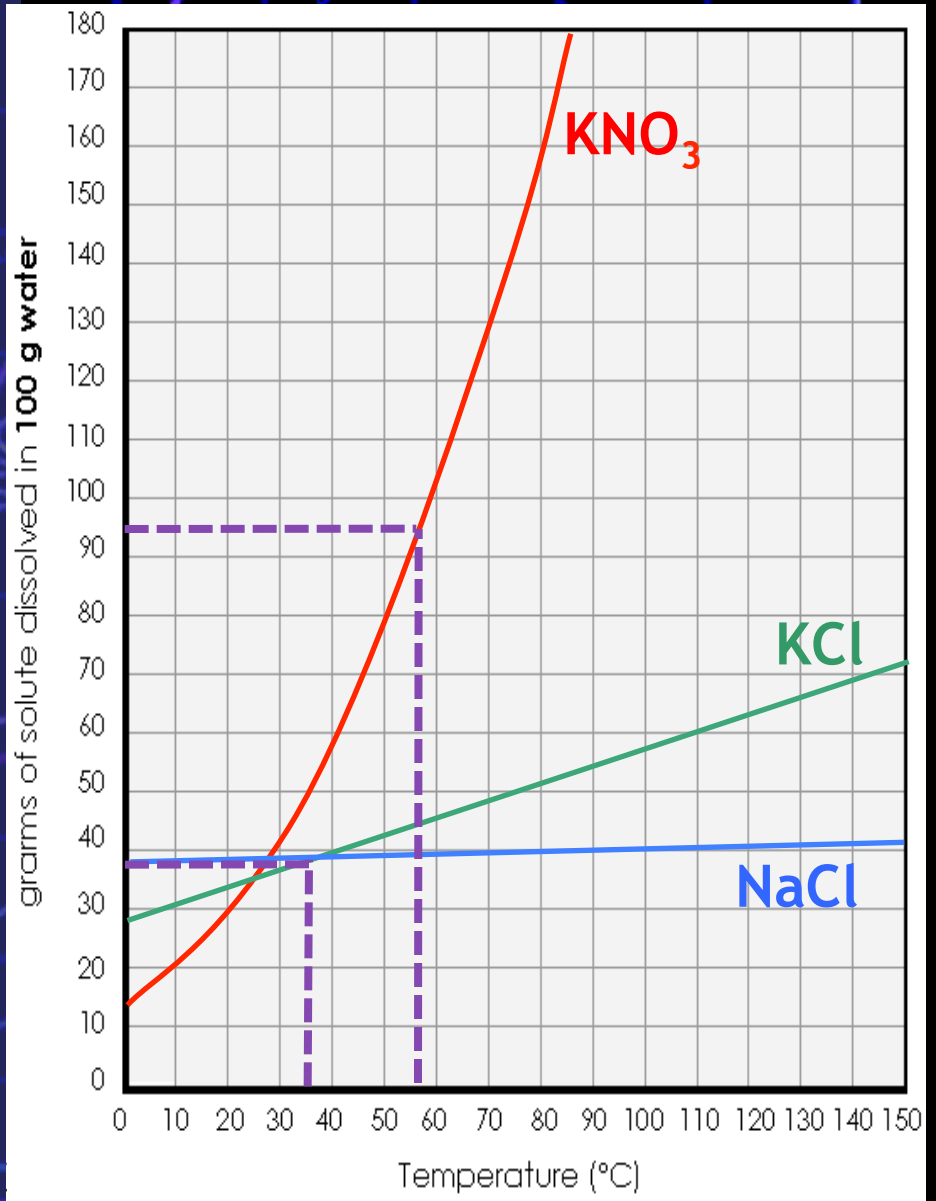**Ex2**: *How many grams of KCl will dissolve in 100g H$_2$O at 82 °C?*

___52___ g

**Ex3**: *At what temp will 95g of KNO$_3$ dissolve in 100g H$_2$O?*

___57___ °C

**Ex4**: *At what temp will 38g of KCl dissolve in 100g H$_2$O?*

___35___ °C

## Part II: Calculating from the Graph

- sometimes a question can be asked that **cannot** be answered solely from reading the graph. But **information** can be obtained from the graph to help answer the question.

- **Ex5**: *Dissolving 25 g of NaCl in 100g $H_2O$ at 75°C produces an **unsaturated** sol'n. How many more grams of NaCl must be added to saturate the sol'n?*

  1. find the **maximum** amount of NaCl that will dissolve at the **given temp**.  _____**40**_____ g
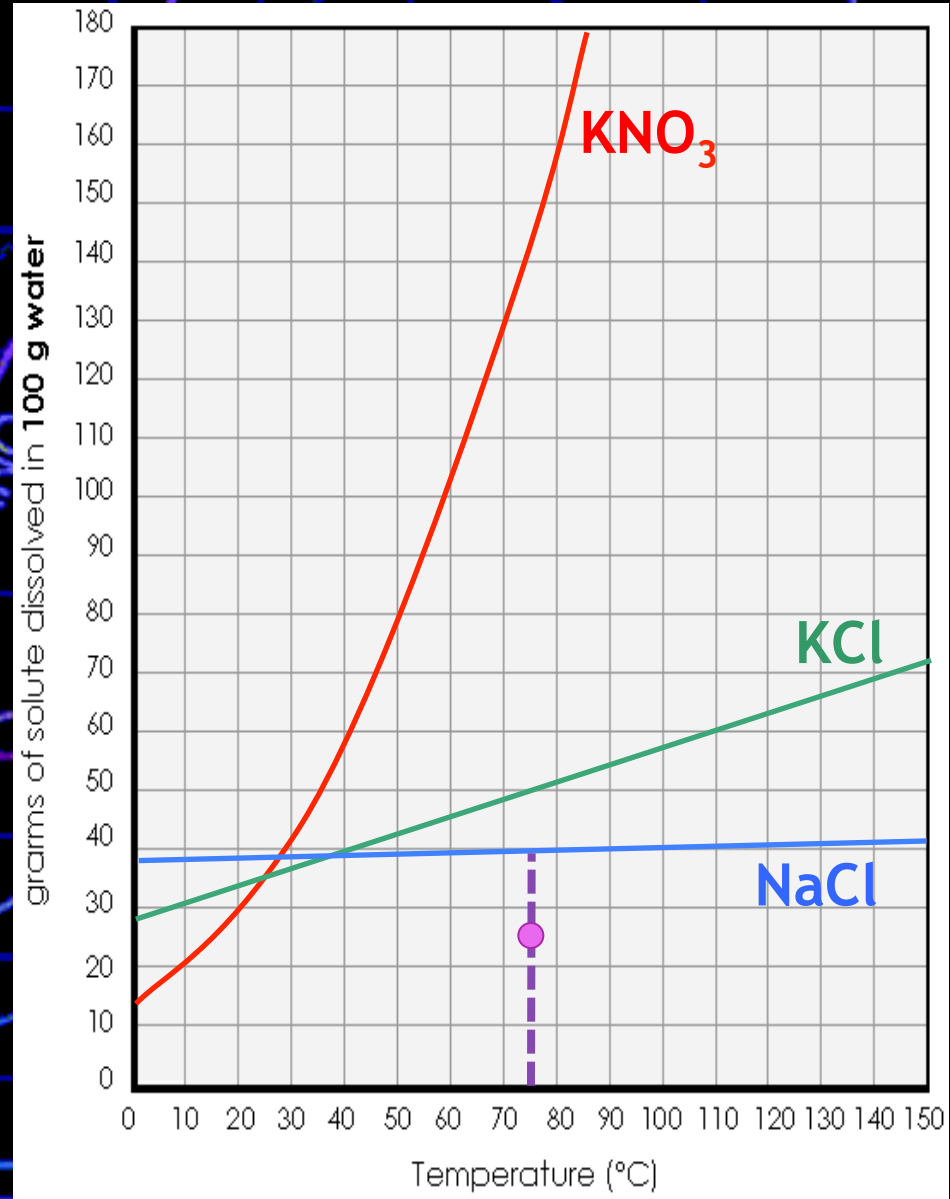
- **Ex5**: *Dissolving 25 g of NaCl in 100g $H_2O$ at 75°C produces an unsaturated sol'n. How many more grams of NaCl must be added to saturate the sol'n?*
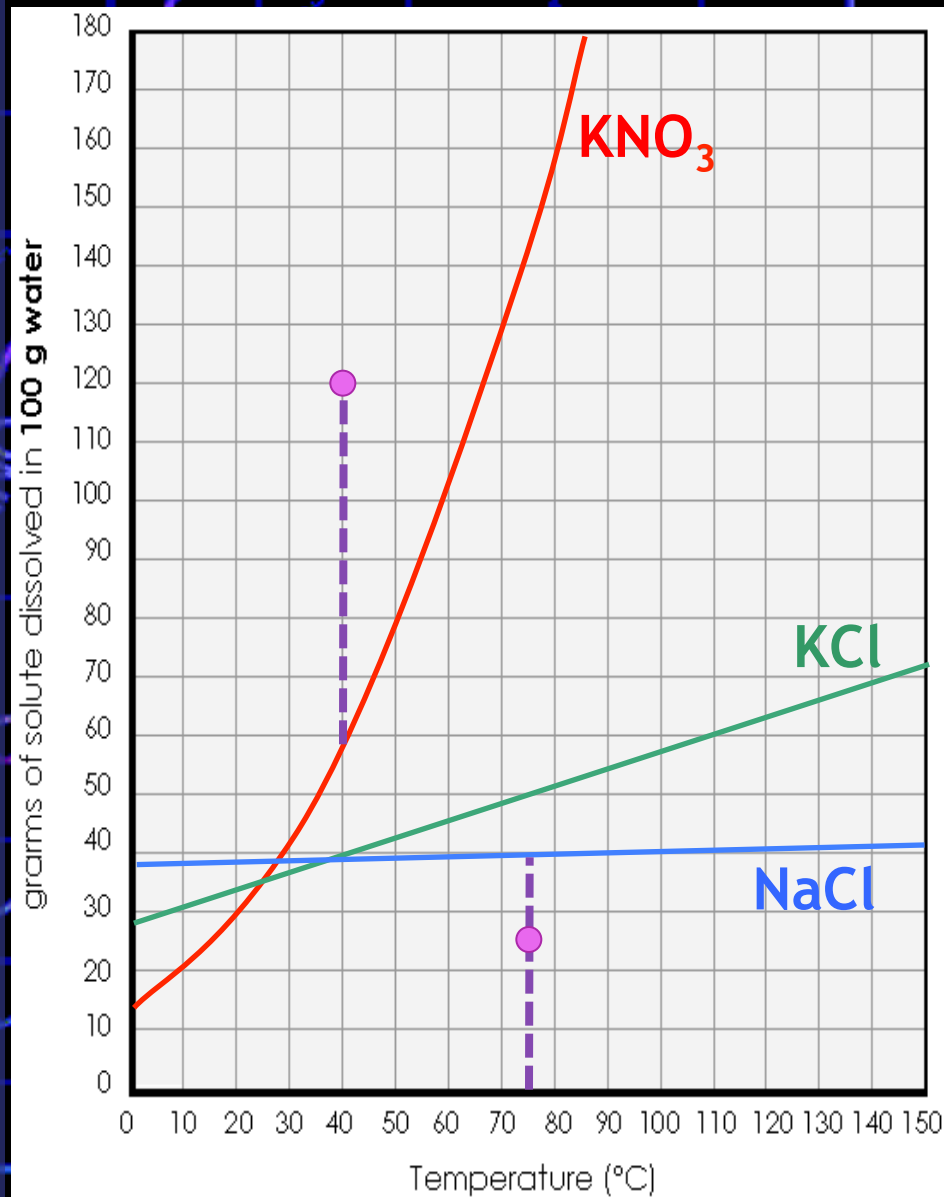  1. find the **maximum** amount of NaCl that will dissolve at the **given temp**. ____40____ g
  2. subtract the **given** amount from the **maximum** amount.
     **40 g – 25 g = 15 g needed**

**Ex6**: *If 120g of $KNO_3$ is dissolved in 100g $H_2O$ at a high temp and then allowed to cool to 40°C, how many grams of $KNO_3$ will crystallize out of the sol'n?*

- **Ex6**: *If 120g of $KNO_3$ is dissolved in 100g $H_2O$ at a high temp and then allowed to cool to 40°C, how many grams of $KNO_3$ will crystallize out of the sol'n?*
  1. find the **maximum** amount of $KNO_3$ that will dissolve at the given **temp**. ___57___ g
  2. subtract the **maximum** amount from the **given** amount.

  **120 g – 57 g = 63 g crystallize**

- **Ex7**: *What is the minimum mass (in grams) of 90°C water needed to dissolve 70 grams of KCl?*

grams of solute dissolved in 100 g water

KNO₃

KCl

NaCl

Temperature (°C)
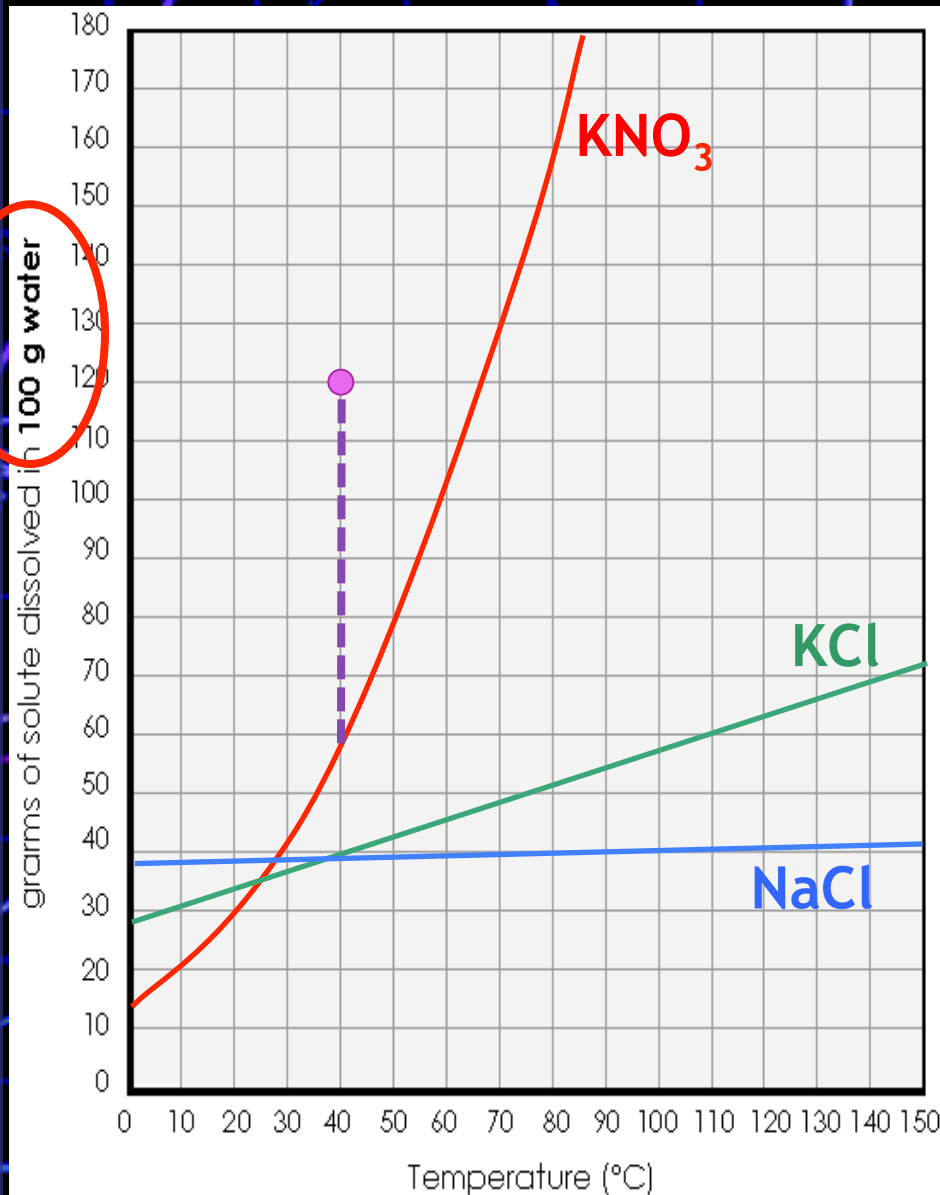
- **Ex7**: *What is the minimum mass (in grams) of 90°C water needed to dissolve 70 grams of KCl?*
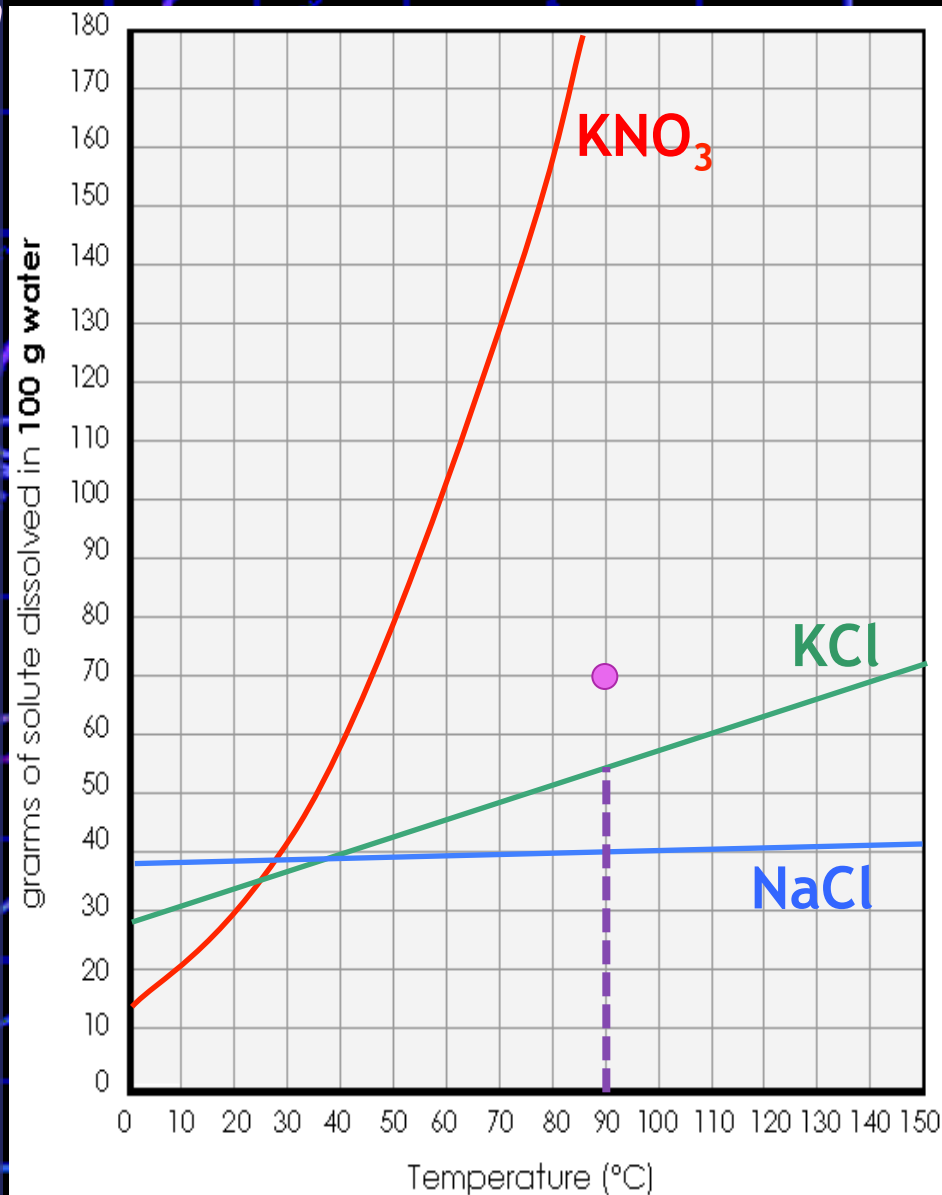
  1. find the **maximum** amount of KCl that will dissolve at the **given temp.** ___55___ g

  2. set up an **inequality** that shows the info you have at that temp
     a. on the **left**, write what you see on the graph

     $$\frac{55 \text{ g KCl}}{100 \text{ g H}_2\text{O}} = \frac{70 \text{ g KCl}}{X \text{ g H}_2\text{O}}$$

     b. on the **right**, write what you want to do.

  3. **cross multiply** to solve for X

$$\frac{55 \text{ g KCl}}{100 \text{ g H}_2\text{O}} = \frac{70 \text{ g KCl}}{\text{X g H}_2\text{O}}$$

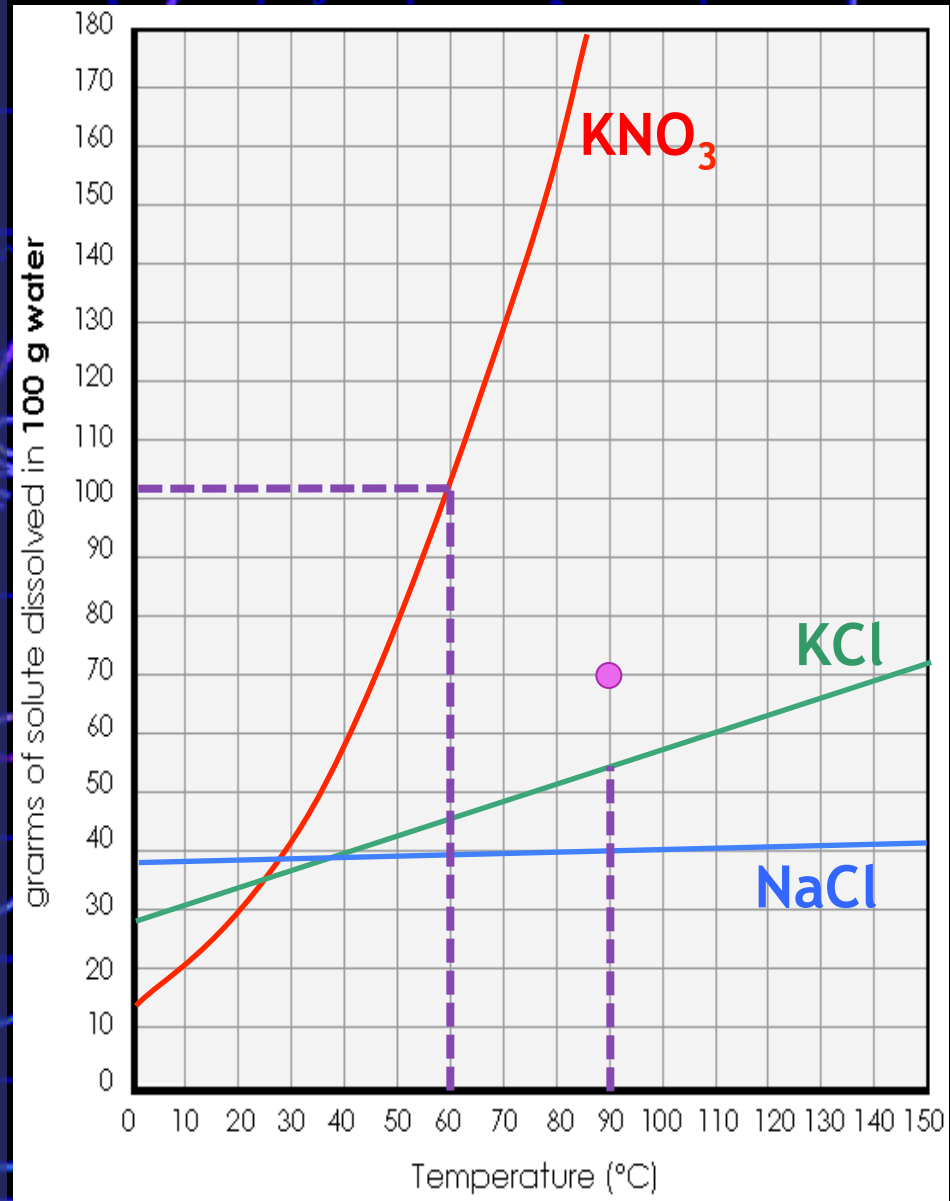**3. cross multiply** to solve for X

$$(55\text{g KCl})(\text{X}) = (100\text{g H}_2\text{O})(70\text{g KCl})$$

$$\text{X} = \frac{(100\text{g H}_2\text{O})(70\text{g KCl})}{(55\text{g KCl})} = \boxed{127.27\text{g H}_2\text{O}}$$

- **Ex8**: *How much 60°C water would have to be added (to the original 100g) to dissolve all the KNO$_3$ from Ex6?*

  1. find the maximum amount of KNO$_3$ that will dissolve at the given temp. ___**103**___ g

  2. find the amount of KNO$_3$ in Ex6.
  
  **amount of KNO$_3$ in Ex6 = 120 g**



grams of solute dissolved in 100 g water vs Temperature (°C)

KNO$_3$ — KCl — NaCl

**Ex8**: *How much 60°C water would have to be added (to the original 100g) to dissolve all the $KNO_3$ from Ex6?*

1. find the maximum amount of $KNO_3$ that will dissolve at the given temp.  __103__ g

2. find the amount of $KNO_3$ in Ex6.

   **amount of $KNO_3$ in Ex6 = 120 g**

3. set up an inequality that shows the info you have at that temp
   a. on the **left**, write what you see on the graph

$$\frac{103 \text{ g } KNO_3}{100 \text{ g } H_2O} = \frac{120 \text{ g } KNO_3}{X \text{ g } H_2O}$$

   b. on the **right**, write what you want to do.

4. **cross multiply** to solve for X
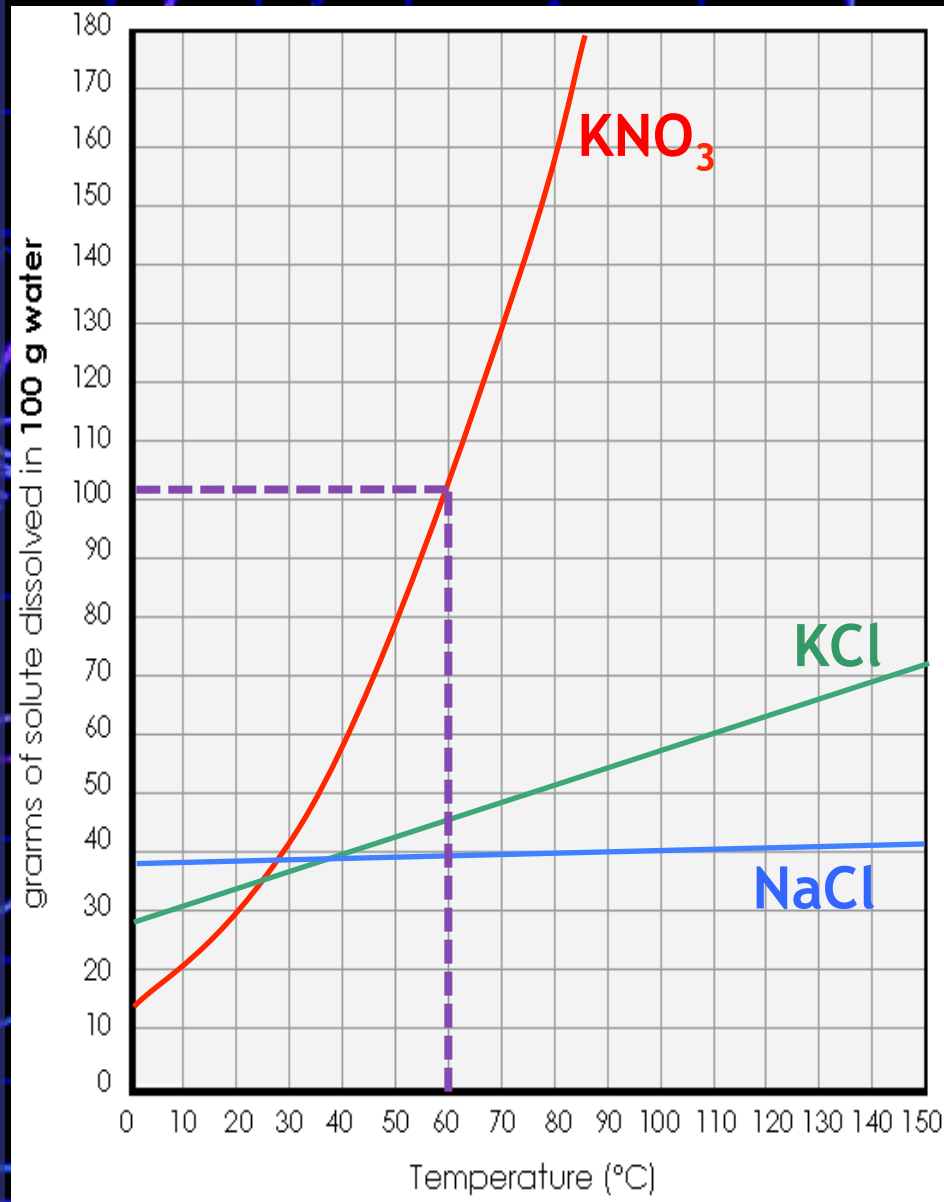
$$\frac{103 \text{ g KNO}_3}{100 \text{ g H}_2\text{O}} = \frac{120 \text{ g KNO}_3}{X \text{ g H}_2\text{O}}$$

- **cross multiply** to solve for X
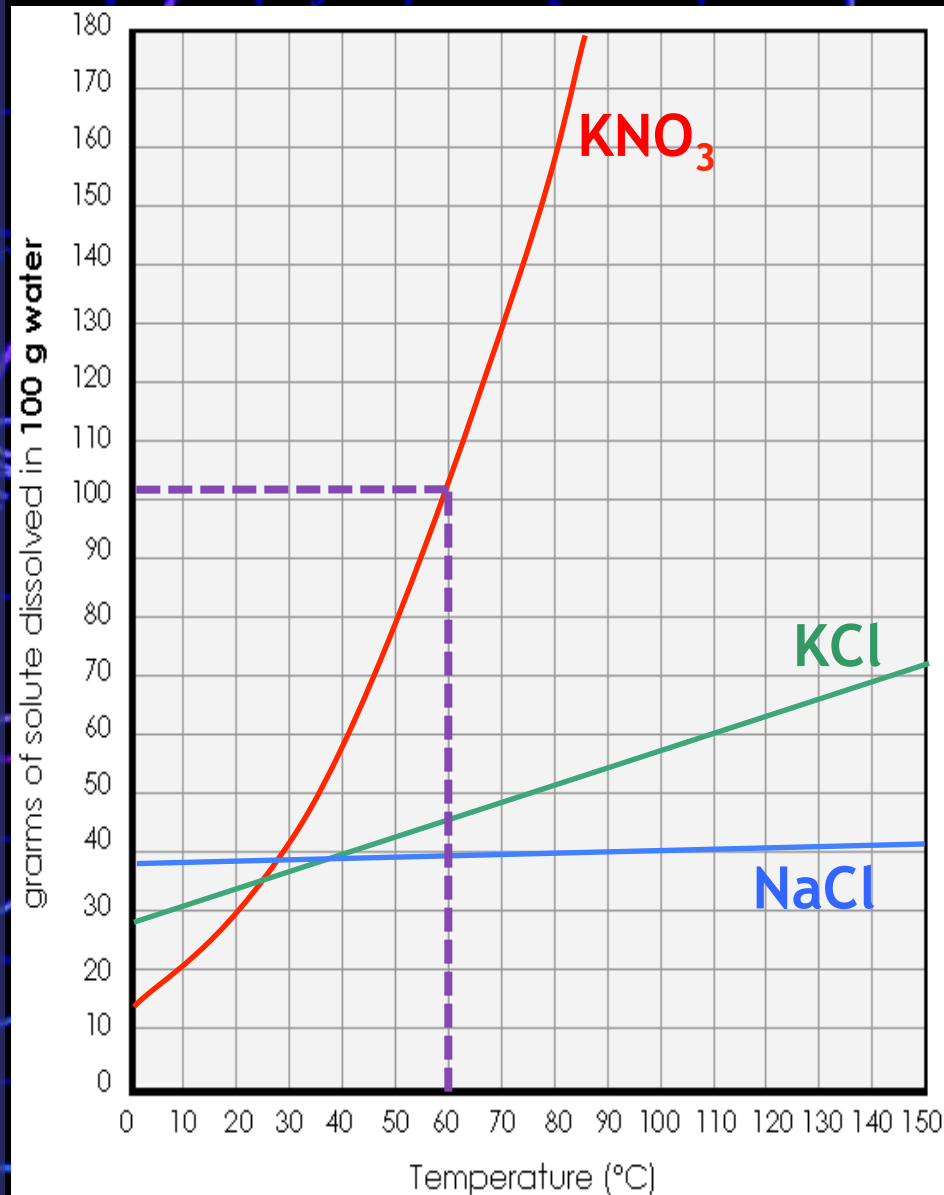
$(103\text{g KNO}_3)(X) =$

$\qquad (100\text{g H}_2\text{O})(120\text{g KNO}_3)$

$X = \dfrac{(100\text{g H}_2\text{O})(120\text{g KNO}_3)}{(103\text{g KNO}_3)} = \textbf{116.5g H}_2\textbf{O}$

5. subtract the original 100 g of $H_2O$ from the amount calculated.

$116.5 \text{ g H}_2\text{O} - 100 \text{ g H}_2\text{O} =$

$\boxed{16.5 \text{ g H}_2\text{O}}$

## Part III:  Solution Concentration

- the concentration of a solution can be expressed as a percentage in a similar way to how we calculated percent composition before.

- **Ex9**:  *What is the concentration of a sugar solution consisting of 23 g of sugar dissolved in 134 g of water?*

  1. add the weights of the sugar and the water together. This is the total weight

     **23 g sugar + 134 g water  = 157 g total**

  2. then divide the sugar's weight    $\dfrac{\text{23 g sugar}}{\text{157 g total}}$  **=**  **14.65% sugar**    by the total weight.
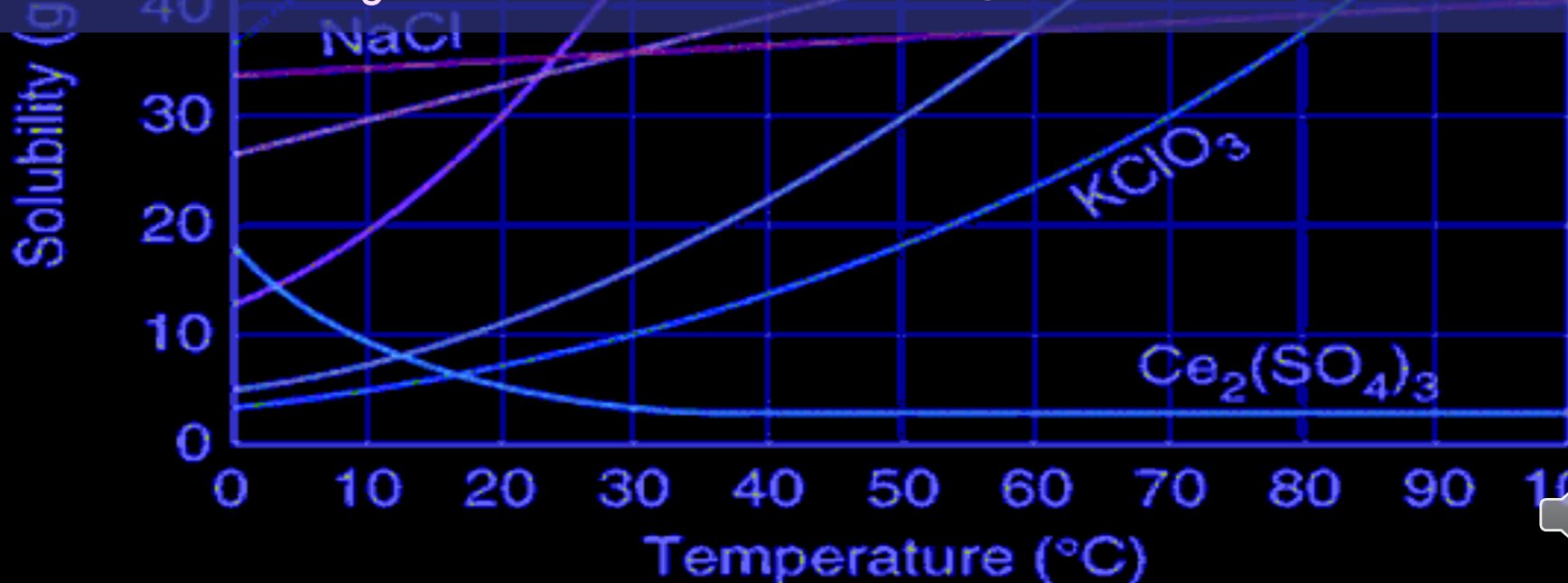
- Make sure notesheet is **completely filled in**
- Preview the **funsheet** (7.2)
- **Rewind and review** any parts that were not clear
- Bring both **notesheet** and **funsheet packets** to class