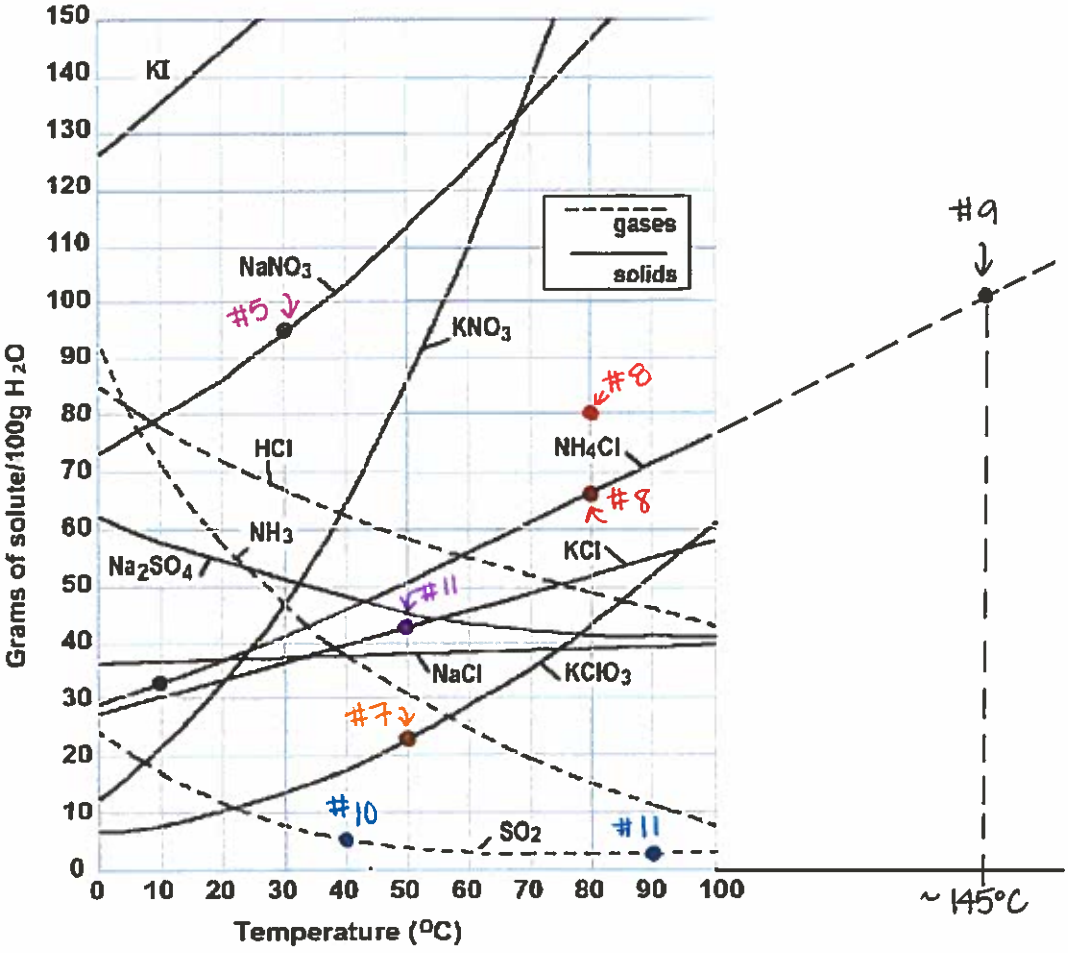
Lesson 6.5 Review

One way to distinguish between saturated, supersaturated and unsaturated solutions is by the interpretation of a **solubility curve.**

- The solubility of most solids increases (that is, more mass of solid dissolves successfully) as temperature increases. This is true if the enthalpy of solvation is positive – that is, if dissolving in water is an endothermic process. Their solubility curve will increase with temperature.

- Some solids and most gases will have decreasing solubility curves with temperature.



Based on the solubility curve, decide whether each of the following (1-4) is A: unsaturated, B: saturated, C: supersaturated, or whether D: not enough information is given. * assume it's dissolved *

1) 50 g KCl in 100 g of water at 90°C. A

2) 50 g KCl in 100 g of water at 60°C. C

(200g KNO_3 in 100g H_2O)

3) 50 g KNO_3 in 25 g of water at 60°C. C

4) 65 g KNO_3 in 400 g of water at 70°C. A

(16.25g KNO_3 in 100g H_2O)

5) If a saturated sodium nitrate solution at 30°C is evaporated to dryness, how many grams will crystallize out? saturated @ 30°C when 95g $NaNO_3$ dissolved / 100g H_2O
∴ when the H_2O is gone, [95g] will crystallize

6) Which solid salt has the greatest increase in solubility from 20°C to 70°C?
Steepest curve - so KNO_3

7) You have a potassium chlorate solution containing 10 g of solute in 100 g of water at 50°C. What mass of solute do you have to add to make this solution saturated?

saturated when 23g $KClO_3$ added / 100g H_2O

so: add (23g − 10g) = **13 g extra $KClO_3$**

8) You have 80 g ammonium chloride in 100 g of water at 80°C. How many grams of solute must crystallize out of the solution for it to become saturated at the same temperature?

saturated when 67g NH_4Cl dissolved / 100g H_2O

∴ 80g − 67g = 13g NH_4Cl crystals will form

9) You have 100 g ammonium chloride in 100 g of water at 10°C. What temperature do you have to heat this to in order for the solution to become saturated?

@ 10°C, saturated when 33g NH_4Cl dissolved / 100g H_2O

Extrapolate the NH_4Cl curve; saturated at approx. 145°C

10) How much ammonia gas escapes out as a saturated solution originally held at 40°C is warmed to 90°C? 5g NH_3 / 100mL H_2O @ 40°C 2g NH_3 / 100mL H_2O @ 90°C

∴ 5 − 2 = **3g**

11) What are the steps needed to make a saturated solution of potassium chloride in 300 g of water at 50°C?

43g KCl in 100g H_2O @ 50°C (when saturated)

= 129g KCl in 300g H_2O @ 50°C (" ")

∴ #1) Heat 300g H_2O to 50°C and maintain this temperature

#2) Crush 129g $KCl_{(s)}$, add to H_2O and stir constantly until dissolved. Maintain temperature.

Homework assigned on M4/11 - T4/12

Lesson 6.5

Key

1. Describe the properties of, and distinguish between:

a) Solutions, colloids, and suspensions

- < 1nm in diameter
- transparent
- cannot be filtered
- no light scattering

- 1-1000nm diameter
- cloudy/homogeneous

- >1000nm diameter
- cloudy + heterogeneous
- may be filtered
- solute may settle

show Tyndall effect

b) Electrolytes and nonelectrolytes

↳ undissociated (dissolved) solute in aqueous solution → ex. alcohols, sugar in H_2O

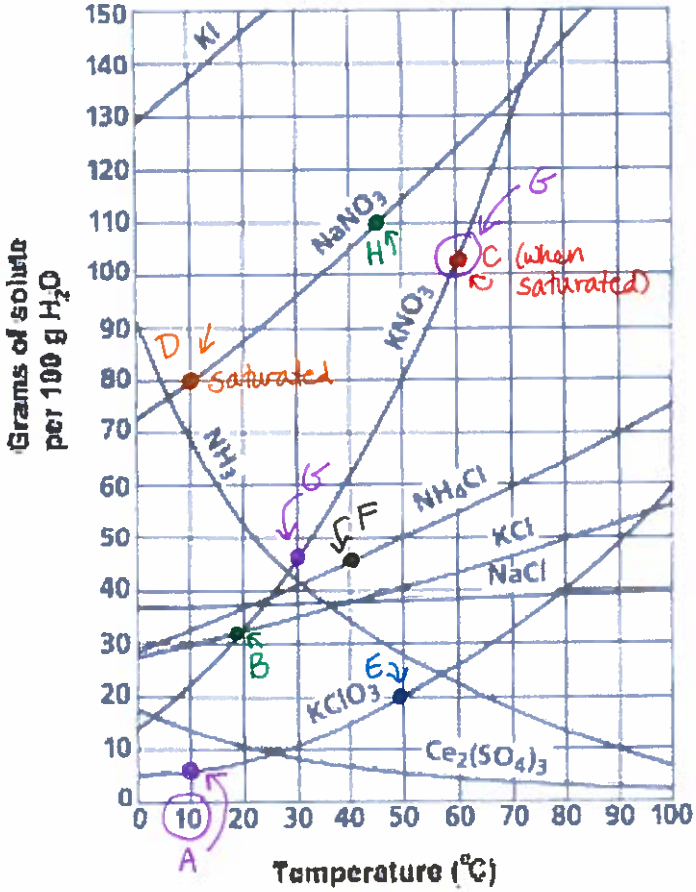
↳ str. acids/bases, soluble ionic compounds ↳ dissolved ions in aqueous solution ↳ conduct electricity in solution

c) Strong electrolytes and weak electrolytes

↳ v. high concentrations of dissolved ions ↳ conduct electricity v. well ex. str acids/bases

↳ mod. high concentrations of dissolved ions ↳ conduct electricity OK but not as brightly ↳ some ions form but dissociation is not 100% complete

2. Answer the questions using the given solubility curve



A. Which of the salts is the least soluble in water at 10°C?

$KClO_3$ (potassium chlorate)

B. What two salts have the same solubility at 19°C?

KCl (potassium chloride) + KNO_3 potassium nitrate

C. 120. g of potassium nitrate is put in 200 mL of water at 60°C. Is this solution saturated, unsaturated or supersaturated?

120 g / 200 mL = 60 g / 100 mL @ 60°C

* unsaturated

D. 80. g of sodium nitrate is put in 50 mL of water at 10°C. Is this solution saturated, unsaturated or supersaturated? 80. g $NaNO_3$ / 50 mL = 160. g $NaNO_3$ / 100 mL @ 10°C

* supersaturated

E. What mass of potassium chlorate must be added to 500. g water to produce a saturated solution at 50°C? saturated when 20 g / 100 g H_2O @ 50.°C

∴ 20 g x 5 = 100 g to add to 500 mL H_2O

F. What are the steps needed to make a saturated solution of ammonium chloride in 50 g water at 40°C? @ 40°C, need 46 g / 100 mL H_2O

∴ heat 50 g H_2O to 40°C and maintain temp. while adding 23 g NH_4Cl and stirring constantly.

G. A saturated potassium nitrate solution is prepared at 60°C using 100. mL of water. How many grams of solute will crystallize if the temperature is suddenly cooled to 30°C?

@ 60°C, need 102 g KNO_3 in 100. mL H_2O to be saturated

@ 30°C, need 47 g KNO_3 in 100 mL H_2O to be saturated

∴ solid that crystallizes out = 102 g − 47 g = 55 g comes out of solution

H. 30. grams of sodium nitrate are dissolved in 200. mL of water at 45°C. How many grams should be added to this to make the solution saturated at 45°C? @ 45°C, need 110 g $NaNO_3$ / 100 mL H_2O for saturation (or 220 g $NaNO_3$ / 200 mL H_2O)

To make this solution saturated, add (220 g − 30 g) = 180 g more $NaNO_3$ to saturate the solution