1) Name three factors that affect how fast a substance dissolves. 
- agitation, temperature, particle size of solute

2) Define saturated solution and explain **dynamic equilibrium** in a saturated solution.
- Maximum amount of solute for a given quantity of solvent.
- Dynamic equilibrium is reached because the rate of solvation (dissolving) equals the rate of crystallization.

3) What is solubility and what units is solubility measured in?
- amount of a substance that dissolves in a given quantity of a solvent at a specified temperature and pressure.

4) What is an unsaturated solution?
- a solution that contains less solute than a saturated solution

5) Define the terms miscible and immiscible and give an example of both scenarios.
- Miscible - 2 liquids dissolve in each other
  - ex. water and ethanol
- Immiscible - 2 liquids that are insoluble in one another
  - ex. water and oil

6) Look at the graph on page 521 and answer the following questions:

   a. What is the solubility of sodium nitrate at 70°C? Solubility will in units of ___g/100g H₂O.
      - \[ 120 \text{ g/100 g H}_2\text{O} \]

   b. Using the solubility you determined above, how much sodium nitrate would dissolve in 350.0g of water at 70°C? (Set it up algebraically.)
      - \[ \frac{x \text{ g NaNO}_3}{350 \text{ g H}_2\text{O}} = \frac{120 \text{ g NaNO}_3}{100 \text{ g H}_2\text{O}} \]
      - \[ x = 420 \text{ g NaNO}_3 \]

   c. Which common chemical does temperature have little to no effect on solubility? How can you tell?
      - \[ \text{NaCl} \] - no change in solubility (g/100g H₂O) as temperature changes
7) Look at the table on page 522 and answer the following questions:
   a. Global warming has serious effects on life in rivers, streams, ponds, etc. This has to do with dissolved oxygen in the water. Will there be more oxygen at higher or lower temperatures? How do you know?
      \[
      \begin{array}{c|c|c|c|c}
      \hline
      \text{Temperature} & 0^\circ C & 20^\circ C & 50^\circ C & 100^\circ C \\
      \hline
      \text{Amount of dissolved O}_2 & 0.0070 g & 0.0043 g & 0.0013 g & 0.0 g \\
      \hline
      \end{array}
      \]

   b. How much more sugar will dissolve in 100\(^\circ\)C compared to 0\(^\circ\)C water?
      \[
      0^\circ C \quad 100^\circ C \\
      17.9 g \quad 4.97 g \\
      4.97 g - 17.9 g = 308 g more in 100^\circ C water
      \]

8) What is a supersaturated solution? Explain how this process is used to make rock candy.
   
9) Concentration is measured in units of molarity.
   a. Define concentration. Explain what it means to be dilute or concentrated.
      Concentration is measured in units of molarity.
      a. Define concentration. Explain what it means to be dilute or concentrated.

   b. What is the formula for molarity?
      \[
      \text{Molarity (M)} = \frac{\text{moles of solute}}{\text{liters of solution}}
      \]
      \[
      M = \frac{\text{mol}}{L}
      \]

   c. A solution is made by mixing 4.5 mol of NaCl in 2.5 L of water. Determine the molarity using the equation you wrote above. Use the example below the equation in the book as a guide.
      \[
      \frac{4.5 \text{ mol NaCl}}{2.5 \text{ L H}_2\text{O}} = (1.8 \text{ M NaCl})
      \]

   d. If 45 g of HCl is combined with 345 mL of water, what is the molarity of HCl? (You need to convert grams to moles and milliliters to liters first. Use sample problem 16.2 for help.)
      \[
      \frac{45 \text{ g HCl}}{36.46 g \text{ HCl}} = 1.2 \text{ mol HCl}
      \]
      \[
      \frac{345 \text{ mL}}{1000 \text{ mL}} = 0.345 L
      \]
      \[
      \frac{1.2 \text{ mol HCl}}{0.345 L} = 3.5 \text{ M HCl}
      \]
10) Dilutions are used to make different concentrations of solutions from using a stock (original) solution.
   a. Write the formula for dilutions. \( M_1 V_1 = M_2 V_2 \)

b. A 220mL solution of 3.00M HCl is diluted with water until the final volume reaches 450mL. What is the new concentration of this solution? See sample problem 16.4. \( p528-9 \)
   \[
   \frac{220\text{mL} \cdot 3.00\text{M}}{450\text{mL}} = \frac{450\text{mL} \cdot M_2}{450\text{mL}}
   \]
   \[ M_2 = \boxed{1.5 \text{M}} \]

c. A solution of 4.5M NaCl is left uncovered in the lab with the initial volume of 85.0mL. If 16mL of water is evaporated, what is the new concentration? (be careful to calculate final volume correctly) \( p529-9 \)
   \[
   \frac{85.0\text{mL}}{-16.0\text{mL}} = \frac{1.5 \text{M} \cdot 85.0\text{mL}}{69\text{mL}} = \boxed{5.5 \text{M}}
   \]

11) Write the formula for the percent by mass formula. \( p530 \)
   \[
   \text{Percent by mass} = \frac{\text{mass of solute}}{\text{mass of solution}} \times 100
   \]

12) If there is 4.5 grams of NaCl dissolved in 120mL of water, what is the percent by mass if the density of water is 1.00g/mL?
   \[
   \frac{4.5 \text{g NaCl}}{120 \text{g H}_2\text{O}} \times 100 = \boxed{3.8\% \text{ by mass}}
   \]

13) Determine the mass of NaCl needed to create 320mL of a 4.50% solution.
   \[
   \frac{x \text{g NaCl}}{320 \text{g H}_2\text{O}} \times 4.50\% = \boxed{14.4 \text{g NaCl}}
   \]
Molarity Worksheet #1

Calculate the molarities of the following solutions:

1) 2.3 moles of sodium chloride in 0.45 liters of solution.
\[
\frac{2.3 \text{ mol NaCl}}{0.45 \text{ L}} = 5.1 \text{ M NaCl}
\]

2) 1.2 moles of calcium carbonate in 1.22 liters of solution.
\[
\frac{1.2 \text{ mol CaCO}_3}{1.22 \text{ L}} = 0.98 \text{ M CaCO}_3
\]

3) 0.090 moles of sodium sulfate in 12 mL of solution.
\[
\frac{0.090 \text{ mol Na}_2\text{SO}_4}{0.012 \text{ L}} = 7.5 \text{ M Na}_2\text{SO}_4
\]

4) 0.75 grams of LiF in 65 mL of solution.
\[
\frac{0.75 \text{ g LiF}}{25.94 \text{ g LiF}} = 0.029 \text{ mol LiF}
\]
\[
\frac{0.029 \text{ mol LiF}}{0.065 \text{ L}} = 0.45 \text{ M LiF}
\]

5) 4.8 grams of Mg(C_2H_3O_2)_2 in 5 liters of solution.
\[
\frac{4.8 \text{ g Mg(C_2H_3O_2)_2}}{142.419 \text{ g Mg(C_2H_3O_2)_2}} = 0.034 \text{ mol Mg(C_2H_3O_2)_2}
\]
\[
\frac{0.034 \text{ mol Mg(C_2H_3O_2)_2}}{5 \text{ L}} = 0.007 \text{ M Mg(C_2H_3O_2)_2}
\]

6) 120 grams of Ca(NO_3)_2 in 240 mL of solution.
\[
\frac{120 \text{ g Ca(NO}_3\text{)_2}}{164.109 \text{ g Ca(NO}_3\text{)_2}} = 0.73 \text{ mol Ca(NO}_3\text{)_2}
\]
\[
\frac{0.73 \text{ mol Ca(NO}_3\text{)_2}}{0.24 \text{ L}} = 3.0 \text{ M Ca(NO}_3\text{)_2}
\]

7) 98 grams of sodium hydroxide in 2.2 liters of solution.
\[
\frac{98 \text{ g NaOH}}{40.00 \text{ g NaOH}} = 2.5 \text{ mol NaOH}
\]
\[
\frac{2.5 \text{ mol NaOH}}{2.2 \text{ L}} = 1.1 \text{ M NaOH}
\]
Molarity Worksheet #2

1) Sea water contains roughly 28.0 g of NaCl per 1.00 liter. What is the molarity of sodium chloride in sea water?

\[
\frac{28.0\, \text{g NaCl}}{58.44\, \text{g NaCl}} \times 0.479\, \text{mol NaCl} = 0.479\, \text{mol NaCl}
\]

\[
\frac{0.479\, \text{mol NaCl}}{1.00\, \text{L}} = 0.479\, \text{M NaCl}
\]

2) What is the molarity of 245.0 g of H₂SO₄ dissolved in 1.00 L of solution?

\[
\frac{245.0\, \text{g H}_2\text{SO}_4}{98.09\, \text{g H}_2\text{SO}_4} \times 2.498\, \text{mol H}_2\text{SO}_4 = 2.50\, \text{M H}_2\text{SO}_4
\]

3) What is the molarity of 5.30 g of Na₂CO₃ dissolved in 400.0 mL solution?

\[
\frac{5.30\, \text{g Na}_2\text{CO}_3}{105.99\, \text{g Na}_2\text{CO}_3} \times 0.0500\, \text{mol Na}_2\text{CO}_3 = 0.125\, \text{M Na}_2\text{CO}_3
\]

4) What is the molarity of 5.00 g of NaOH in 750.0 mL of solution?

\[
\frac{5.00\, \text{g NaOH}}{40.00\, \text{g NaOH}} \times 0.125\, \text{mol NaOH} = 0.167\, \text{M NaOH}
\]

5) How many moles of Na₂CO₃ are there in 10.0 L of 2.0 M solution?

\[
\frac{M\, \text{mol}}{L} \times M \times L = \text{mol}
\]

\[
2.0\, \text{M Na}_2\text{CO}_3 \times 10.0\, \text{L} = 20.\, \text{mol Na}_2\text{CO}_3
\]

6) How many moles of Na₂CO₃ are in 10.0 mL of a 2.0 M solution?

\[
2.0\, \text{M Na}_2\text{CO}_3 \times 0.0100\, \text{L} = 0.020\, \text{mol Na}_2\text{CO}_3
\]
7) How many moles of NaCl are contained in 100.0 mL of a 0.20 M solution?

\[
0.20 \text{ M NaCl} \times 0.1000 \text{ L} = 0.020 \text{ mol NaCl}
\]

8) What weight (in grams) of NaCl would be contained in problem 7?

\[
0.020 \text{ mol NaCl} \times 58.44 \text{ g NaCl/mmol NaCl} = 1.2 \text{ g NaCl}
\]

9) What weight (in grams) of H₂SO₄ would be needed to make 750.0 mL of 2.00 M solution?

\[
2.00 \text{ M H₂SO₄} \times 0.7500 \text{ L} = 1.50 \text{ mol H₂SO₄} \times \frac{98.09 \text{ g H₂SO₄}}{1 \text{ mol H₂SO₄}} = 147 \text{ g H₂SO₄}
\]

10) What volume (in mL) of 18.0 M H₂SO₄ is needed to contain 2.45 g H₂SO₄?

\[
\frac{2.45 \text{ g H₂SO₄}}{98.09 \text{ g H₂SO₄/mmol H₂SO₄}} = 0.0250 \text{ mol H₂SO₄}
\]

\[
M = \frac{\text{mol}}{L} \quad L = \frac{\text{mol}}{M} = \frac{0.0250 \text{ mol H₂SO₄}}{18.0 \text{ M}} = 0.00139 \text{ L} = 1.39 \text{ mL}
\]

11) What volume (in mL) of 12.0 M HCl is needed to contain 3.00 moles of HCl?

\[
L = \frac{\text{mol}}{M} = \frac{3.00 \text{ mol HCl}}{12.0 \text{ M HCl}} = 0.250 \text{ L} = 250 \text{ mL}
\]

12) How many grams of Ca(OH)₂ are needed to make 100.0 mL of 0.250 M solution?

\[
0.1000 \text{ L} \times 0.250 \text{ M Ca(OH)₂} = 0.0250 \text{ mol Ca(OH)₂} \times \frac{74.10 \text{ g Ca(OH)₂}}{1 \text{ mol Ca(OH)₂}} = 1.85 \text{ g Ca(OH)₂}
\]
1) If I add 25 mL of water to 125 mL of a 0.15 M NaOH solution, what will the molarity of the diluted solution be?

\[
\frac{125 \text{ mL} \cdot 0.15 \text{ M}}{150 \text{ mL}} = 0.13 \text{ M NaOH}
\]

2) If I add water to 100 mL of a 0.15 M NaOH solution until the final volume is 150 mL, what will the molarity of the diluted solution be?

\[
\frac{100 \text{ mL} \cdot 0.15 \text{ M}}{150 \text{ mL}} = 0.10 \text{ M NaOH}
\]

3) How much 0.0500 M HCl solution can be made by diluting 250 mL of 10.0 M HCl?

\[
\frac{250 \text{ mL} \cdot 10.0 \text{ M}}{0.0500 \text{ M}} = 50000 \text{ mL} = 5.0 \times 10^4 \text{ mL}
\]

4) I have 345 mL of a 1.50 M NaCl solution. If I boil the water until the volume of the solution is 250.0 mL, what will the molarity of the solution be?

\[
\frac{345 \text{ mL} \cdot 1.50 \text{ M}}{250.0 \text{ mL}} = 2.07 \text{ M NaCl}
\]

5) How much water would I need to add to 500.0 mL of a 2.4 M KCl solution to make a 1.0 M solution?

\[
\frac{500.0 \text{ mL} \cdot 2.4 \text{ M}}{1.0 \text{ M}} = 1200 \text{ mL}
\]

\[
1200 \text{ mL} - 500.0 \text{ mL} = 700 \text{ mL of water must be added}
\]
Dilutions Worksheet #2

1) A stock solution of 1.00 M NaCl is available. How many milliliters are needed to make 100.0 mL of 0.750 M:\n\[
\frac{100.0 \text{ mL} \times 0.750 \text{ M}}{1.00 \text{ M}} = 75.0 \text{ mL}
\]

2) What volume of 0.250 M KCl is needed to make 100.0 mL of 0.100 M solution?:\n\[
\frac{100.0 \text{ mL} \times 0.100 \text{ M}}{0.250 \text{ M}} = 40.0 \text{ mL}
\]

3) Concentrated H₂SO₄ is 18.0 M. What volume is needed to make 2.00 L of 1.00 M solution?:\n\[
\frac{2.00 \text{ L} \times 1.00 \text{ M}}{18.0 \text{ M}} = 0.111 \text{ L}
\]

4) Concentrated HCl is 12.0 M. What volume is needed to make 2.00 L of 1.00 M solution?:\n\[
\frac{2.00 \text{ L} \times 1.00 \text{ M}}{12.0 \text{ M}} = 0.167 \text{ L}
\]

5) A 0.500 M solution is to be diluted to 500.0 mL of a 0.150 M solution. How many mL of the 0.500 M solution are required?:\n\[
\frac{500.0 \text{ mL} \times 0.150 \text{ M}}{0.500 \text{ M}} = 150. \text{ mL}
\]

6) A stock solution of 10.0 M NaOH is prepared. From this solution, you need to make 250.0 mL of 0.375 M solution. How many mL will be required?:\n\[
\frac{250.0 \text{ mL} \times 0.375 \text{ M}}{10.0 \text{ M}} = 9.38 \text{ mL}
\]
Calculating percent by mass/volume

The concentration of a solution can be expressed as a percent – the ratio of solute to solution. This calculation is commonly performed based on the mass of a substance (m/m) or on the volume of substances (v/v). A solution that is composed of 5 g of salt for every 95 g of water will have a mass percent of 5%.

\[
\frac{5 \text{ g NaCl}}{(5 \text{ g} + 95 \text{ g}) \text{ solution}} \times 100 = 5\%
\]

A solution made from 35 mL of ethanol and 65 mL of water will have a percent by volume of 35%.

\[
\frac{35 \text{ mL ethanol}}{(35 \text{ mL} + 65 \text{ mL}) \text{ solution}} \times 100 = 35\%
\]

Answer the following questions. Show all work and report answers with units.

1) What is the percent by mass of 5.0 g of iron (II) sulfate dissolved in 75.0 g of water?

\[
\frac{5.0 \text{ g } \text{FeSO}_4}{(5.0 \text{ g } \text{FeSO}_4 + 75.0 \text{ g } \text{H}_2\text{O})} \times 100 = 6.3\% \text{ FeSO}_4
\]

2) A solution is made by adding 25 mL of benzene to 80.0 mL of toluene. What is the percent by volume of benzene?

\[
\frac{25 \text{ mL benzene}}{(25 \text{ mL benzene} + 80 \text{ mL toluene})} \times 100 = 24\% \text{ benzene}
\]

3) A solution is formed by adding 35 g of ammonium nitrate to 250 g of water. What is the percent by mass of ammonium nitrate?

\[
\frac{35 \text{ g } \text{NH}_4\text{NO}_3}{(35 \text{ g } \text{NH}_4\text{NO}_3 + 250 \text{ g } \text{H}_2\text{O})} \times 100 = 12\% \text{ NH}_4\text{NO}_3
\]
4) What is the percent by volume of a solution formed by mixing 25 mL of isopropanol with 45 mL of water?

\[
\frac{25 \text{ mL isopropanol}}{25\text{ mL isopropanol} + 45\text{ mL H}_2\text{O}} \times 100 = 36\% \text{ isopropanol}
\]

5) A solution is made by dissolving 125 g of sodium chloride in 1.5 kg of water. What is the percent by mass?

\[
\frac{125 \text{ g NaCl}}{125\text{ g NaCl} + 1500\text{ g H}_2\text{O}} \times 100 = 7.69\% \text{ NaCl}
\]

6) What is the percent by volume of a solution formed by added 15 L of acetone to 28 L of water?

\[
\frac{15 \text{ L acetone}}{15\text{ L acetone} + 28\text{ L H}_2\text{O}} \times 100 = 35\% \text{ acetone}
\]

7) What mass of NaOH is found in 40.0 g of a 10.0% by mass solution? How many moles of NaOH is this?

\[
\frac{X \text{ g NaOH}}{40.0\text{ g}} \times 100 = 10.0\% = 4.00 \text{ g NaOH}
\]

8) What mass of lithium chloride is found in 85 g of a 25% by mass solution?

\[
\frac{X \text{ g LiCl}}{85\text{ g}} \times 100 = 25\% = 21\text{ g LiCl}
\]
1) The reaction of zinc metal and hydrochloric acid produces hydrogen gas and zinc chloride.
   a. Write the balanced chemical equation

   \[ \text{Zn(s)} + 2\text{HCl(aq)} \rightarrow \text{H}_2(\text{g}) + \text{ZnCl}_2(\text{aq}) \]

   b. 25g of Zn metal was reacted in excess HCl, what amount of hydrogen gas will be produced in grams?

   \[
   \frac{25 \text{g Zn}}{65.39 \text{g Zn}} = \frac{1 \text{mol Zn}}{1 \text{mol Zn}} = \frac{2.02 \text{g H}_2}{1 \text{mol H}_2} = 0.77 \text{g H}_2
   \]

   c. 0.200L of 1.00M HCl was reacted with excess zinc metal, what mass of zinc chloride will be produced?

   \[
   \frac{0.200 \text{L HCl}}{1 \text{L HCl}} \frac{1 \text{mol ZnCl}_2}{2 \text{mol HCl}} \frac{136.28 \text{g ZnCl}_2}{1 \text{mol ZnCl}_2} = 13.6 \text{g ZnCl}_2
   \]

   d. Another reaction produces 0.850mol of ZnCl₂ and the compound is dissolved in 450mL of water. What is the final concentration of zinc chloride?

   \[
   \frac{0.850 \text{mol ZnCl}_2}{0.45 \text{L}} = 1.9 \text{ M ZnCl}_2
   \]

2) The reaction of HCl and Ca(OH)_2 produces H₂O and CaCl₂.
   a. Write the balanced equation for this reaction.

   \[ 2\text{HCl(aq)} + \text{Ca(OH)}_2(\text{aq}) \rightarrow 2\text{H}_2\text{O(l)} + \text{CaCl}_2(\text{aq}) \]

   b. 388mL of 2.5M HCl is reacted with excess calcium hydroxide. What amount of water will be produced in grams?

   \[
   \frac{0.388 \text{L HCl}}{2.5 \text{L HCl}} \frac{2 \text{mol H}_2\text{O}}{1 \text{mol HCl}} \frac{18.02 \text{g H}_2\text{O}}{1 \text{mol H}_2\text{O}} = 17 \text{g H}_2\text{O}
   \]

   c. How many liters of 3.00M Ca(OH)_2 will react with 388mL of 2.5M HCl?

   \[
   \frac{0.388 \text{L HCl}}{2.5 \text{L HCl}} \frac{1 \text{mol Ca(OH)}_2}{2 \text{mol HCl}} \frac{1 \text{L Ca(OH)}_2}{3.00 \text{mol Ca(OH)}_2} = 0.16 \text{L Ca(OH)}_2
   \]
1. How many milliliters of 0.75 M sodium hydroxide are needed to neutralize 275 mL of 0.50 M sulfuric acid?

\[ 2 \text{NaOH(aq)} + \text{H}_2\text{SO}_4(aq) \rightarrow \text{Na}_2\text{SO}_4(aq) + 2 \text{H}_2\text{O}(l) \]

\[
\begin{array}{c}
0.275 \text{L H}_2\text{SO}_4 \times 0.50 \text{ mol H}_2\text{SO}_4/1 \text{L H}_2\text{SO}_4 \times 1 \text{ mol NaOH}/1 \text{ mol H}_2\text{SO}_4 \times 1 \text{ L NaOH}/1000 \text{ mL NaOH} = 370 \text{ mL NaOH}
\end{array}
\]

2. How many grams of lead (II) nitrate are needed to fully react 23.5 mL of 0.55 M sodium chloride in the precipitation of lead (II) chloride?

\[ \text{Pb(NO}_3\text{)}_2(aq) + 2\text{NaCl}(aq) \rightarrow \text{PbCl}_2(s) + 2\text{NaNO}_3(aq) \]

\[
\begin{array}{c}
0.0235 \text{ L NaCl} \times 0.55 \text{ mol NaCl}/1 \text{ L NaCl} \times 1 \text{ mol Pb(NO}_3\text{)}_2/2 \text{ mol NaCl} = 2.19 \text{ g Pb(NO}_3\text{)}_2
\end{array}
\]

3. How many mL of 0.40 M barium chloride are needed to react 175 mL of 1.50 M ammonium phosphate in the precipitation of barium phosphate?

\[ 2(\text{NH}_4)_3\text{PO}_4(aq) + 3\text{BaCl}_2(aq) \rightarrow 3\text{Ba}(\text{PO}_4)_2(s) + 6\text{NH}_4\text{Cl} \]

\[
\begin{array}{c}
0.175 \text{ L (NH}_4\text{)}_3\text{PO}_4 \times 1.50 \text{ mol (NH}_4\text{)}_3\text{PO}_4/1 \text{ L (NH}_4\text{)}_3\text{PO}_4 \times 1 \text{ mol BaCl}_2/2 \text{ mol (NH}_4\text{)}_3\text{PO}_4 \times 1 \text{ L BaCl}_2/1000 \text{ mL BaCl}_2 = 9.90 \text{ mL BaCl}_2
\end{array}
\]

4. When 53 mL of 0.75 M cobalt (III) nitrate are added to a sodium sulfide solution, how many grams of cobalt (III) sulfide can be precipitated?

\[ 2(\text{Co(NO}_3\text{)}_3(aq)) + 3\text{Na}_2\text{S}(aq) \rightarrow 2\text{Co}_2\text{S}_3(s) + 6\text{NaNO}_3(aq) \]

\[
\begin{array}{c}
0.053 \text{ L Co(NO}_3\text{)}_3 \times 0.75 \text{ mol Co(NO}_3\text{)}_3/1 \text{ L Co(NO}_3\text{)}_3 \times 2 \text{ mol Co}_2\text{S}_3/3 \text{ mol Co(NO}_3\text{)}_3 \times 144 \text{ g Co}_2\text{S}_3 = 4.39 \text{ g Co}_2\text{S}_3
\end{array}
\]

5. How many grams of aluminum hydroxide will be neutralized by 45.3 mL of 0.55 M HCl?

\[ \text{Al(OH)}_3(s) + 3\text{HCl}(aq) \rightarrow 3\text{H}_2\text{O}(l) + \text{AlCl}_3(aq) \]

\[
\begin{array}{c}
0.0453 \text{ L HCl} \times 0.55 \text{ mol HCl}/1 \text{ L HCl} \times 1 \text{ mol Al(OH)}_3/3 \text{ mol HCl} \times 78.019 \text{ g Al(OH)}_3 = 0.65 \text{ g Al(OH)}_3
\end{array}
\]
6. What concentration of Zinc bromide is required if 75.0 mL of Zinc bromide is used to completely react with 75.0 mL of 0.350 M silver chlorate?

\[
2\text{ZnBr}_2(aq) + 2\text{AgClO}_3(aq) \rightarrow \text{Zn(ClO}_3)_{2}(aq) + 2\text{AgBr}_2(s)
\]

\[
\frac{0.0750\text{L AgClO}_3}{0.350\text{mol AgClO}_3} = \frac{1\text{L AgClO}_3}{2\text{mol AgClO}_3} = \frac{0.0131\text{mol ZnBr}_2}{0.0750\text{L}} = 0.175\text{M ZnBr}_2
\]

7. How many mL of 3.15 M HCl is needed to neutralize 1.86 grams of Strontium hydroxide?

\[
2\text{HCl(aq)} + \text{Sr(OH)}_{2}(aq) \rightarrow 2\text{H}_2\text{O}(l) + \text{SrCl}_2(aq)
\]

\[
\frac{1.86\text{g Sr(OH)}_2}{121.64\text{g Sr(OH)}_2} = \frac{1\text{mol Sr(OH)}_2}{2\text{mol HCl}} = \frac{1\text{L HCl}}{3.15\text{mol HCl}} = \frac{100\text{mL HCl}}{1\text{L HCl}} = 9.71\text{mL HCl}
\]

8. How many grams of NO(g) are produced when 0.85L of 2.00 M HNO\text{ }_3 solution is added to 216 g of Ag according to the equation. Which reactant is the limiting reactant?

\[
3\text{ Ag(s)} + 4\text{ HNO}_3(aq) \rightarrow 3\text{ AgNO}_3(aq) + \text{NO(g)} + 2\text{ H}_2\text{O(l)}
\]

\[
\frac{0.85\text{L HNO}_3}{2.00\text{mol HNO}_3} = \frac{1\text{L HNO}_3}{4\text{mol HNO}_3} = \frac{30.09\text{g Ag}}{1\text{mol Ag}} = 13\text{g NO}
\]

\[
\frac{216\text{g Ag}}{107.87\text{g Ag}} = \frac{1\text{mol Ag}}{3\text{mol Ag}} = \frac{30.01\text{g NO}}{1\text{mol NO}} = 20.09\text{g NO}
\]
9. Calculate the mass of water produced when 0.333 L of 0.500 M NaOH is added to 3.0 grams of acetic acid. The equation is:

\[
\text{NaOH(aq)} + \text{HC}_2\text{H}_3\text{O}_2(aq) \rightarrow \text{NaC}_2\text{H}_3\text{O}_2(aq) + \text{H}_2\text{O(l)}
\]

\[
\begin{array}{c|c|c|c|c|c}
0.333 \text{ L NaOH} & 0.500 \text{ mol NaOH} & 1 \text{ mol H}_2\text{O} & 18.02 \text{ g H}_2\text{O} & 3.00 \text{ g H}_2\text{O} \\
1 \text{ L NaOH} & 1 \text{ mol NaOH} & 1 \text{ mol H}_2\text{O} & 18.02 \text{ g H}_2\text{O} \end{array}
\]

10. Calculate the mass of AgCl formed when 0.250 L of 0.100 M solution of NaCl is added to 0.100 L of 0.200 M AgNO₃.

\[
\text{AgNO}_3(aq) + \text{NaCl(aq)} \rightarrow \text{AgCl(s)} + \text{NaNO}_3(aq)
\]

\[
\begin{array}{c|c|c|c|c|c|c|c|c}
0.250 \text{ L NaCl} & 0.100 \text{ mol NaCl} & 1 \text{ mol AgCl} & 143.32 \text{ g AgCl} & 3.59 \text{ g AgCl} \\
1 \text{ L NaCl} & 1 \text{ mol NaCl} & 1 \text{ mol AgCl} & 143.32 \text{ g AgCl} \\
0.100 \text{ L AgNO}_3 & 0.200 \text{ mol AgNO}_3 & 1 \text{ mol AgCl} & 143.32 \text{ g AgCl} & 2.87 \text{ g AgCl} \\
1 \text{ L AgNO}_3 & 1 \text{ mol AgNO}_3 & 1 \text{ mol AgCl} & 143.32 \text{ g AgCl} \end{array}
\]
Solubility Curve Practice Problems

Directions: Use the graph to answer the questions below. If the question requires a calculation, SHOW ALL WORK TO RECEIVE CREDIT FOR THE ANSWER!

1. What is the solubility of potassium chloride at 10°C? 30 g/100 g H₂O
2. What is the solubility of potassium chloride at 80°C? 52 g/100 g H₂O
3. Is potassium chloride a solid or a gas? solid
What happens to the solubility of solids as temperature increases? Solubility increases
4. What is the solubility of NH₃ at 10°C? 70 g/100 g H₂O
5. What is the solubility of NH₃ at 50°C? 30 g/100 g H₂O
6. Is ammonia a solid or gas? gas
What happens to the solubility of gases as temperature increases? Solubility decreases
7. What is the mass of potassium chlorate that will dissolve in 50 g of water at 20°C? 5 g KClO₃
8. What is the mass of sodium sulfate that will dissolve in 250 g of water at 30°C? 125 g Na₂SO₄
9. At 80°C, 30 g of sodium chloride is dissolved in 100 g of water. Is this solution saturated, unsaturated, or supersaturated? unsaturated
10. At 20°C, 90 g of sodium nitrate is dissolved in 100 g of water. Is this solution saturated, unsaturated, or supersaturated? supersaturated
11. A saturated solution of potassium iodide is dissolved in 100 g of water. If the saturated solution is cooled from 20°C to 0°C, how many grams of precipitate will be formed? 20.9 g KI

@20°C 145 g KI 100 g H₂O
@0°C 125 g KI 100 g H₂O
145 g KI 125 g KI 20.9 g KI
12. Which substance below is least soluble at 40°C? \( \text{SO}_2 \) (g)

13. Which substance below is the most soluble at 20°C? \( \text{KI} \) (s)

14. Which substance below shows the least change in solubility from 0°C to 100°C? \( \text{NaCl} \)

15. What mass of 30°C water will dissolve 225 g of potassium chloride to form a saturated solution?

\[
\frac{25 \text{ g KCl}}{100 \text{ g H}_2\text{O}} = \frac{225 \text{ g KCl}}{x \text{ g H}_2\text{O}} \Rightarrow x = \frac{225 \times 100}{25} = 900 \text{ g H}_2\text{O}
\]

16. A solution of sodium nitrate is saturated at 10°C. How much more of the salt would need to be added to the solution so it remains saturated as the temperature is increased to 50°C?

\[
\frac{79 \text{ g NaNO}_3}{100 \text{ g H}_2\text{O}} \quad \frac{112 \text{ g NaNO}_3}{100 \text{ g H}_2\text{O}} = \frac{33 \text{ g NaNO}_3}{x \text{ g H}_2\text{O}}
\]