

**I. Big Idea-**

I can take a solid chemical and throw it into a solution, and it will either dissolve or not dissolve. If the solid dissolves, then it will either make  
or

**Electrolytes –****Non-electrolytes –**

The unit we use to describe the concentration of a solution is called

(        ). .

1. A 12.0-g sample of HF is dissolved in water to give  $3.1 \times 10^2$  mL of solution. The concentration of the solution is
2. The concentration of a 293.0-mL sample of a calcium chloride solution is 0.422 M. What is the mass of the solute?
3. To calculate the concentration in molarity of a salt solution, you need to know
  - (A) the mass of the salt added to the solution and the volume of water added to the solution.
  - (B) the mass of the salt added to the solution and the total volume of the solution.
  - (C) the mass of the salt added, the molar mass of the salt, and the total volume of the solution.
  - (D) the molar mass of the salt and the total volume of the solution.
  - (E) the mass of the salt added, the molar mass of the salt, the volume of water added, and the total volume of the solution.

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**II. Molarity & Dilution Problems**

1. How much 9.0 M HCl is needed to prepare 10.0 L of 0.50 M HCl?
2. A 10.00 mL sample of 2.05 M KNO<sub>3</sub> is diluted to a volume of 250.0 mL. What is the concentration of the diluted solution?

Dilutions –

*\*\*Do not use this formula for titrations!\*\**

3. What volume of 0.460 M barium nitrate solution is needed to prepare 213.0 mL of 0.268 M nitrate ion solution?
4. Calculate the molarity of the resulting solution prepared by diluting 25.0 ml of 18.0% by mass ammonium chloride (density = 1.05 g/mL) to a final volume of 80.0 ml.  
 (A) 0.059 M            (B) 0.0536 M            (C) 1.11 M            (D) 0.292 M            (E) None of the above
5. A 230.-mL sample of a 0.275 M solution is left on a hot plate overnight (please don't do this without your TA's supervision); the following morning the solution is 1.10 M. What volume of solvent has evaporated from the 0.275 M solution? (Assume volumes are additive.)  
 (A) 58.0 mL    (B) 63.3 mL    (C) 172 mL    (D) 230. mL    (E) 288 mL

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**III. Solubility Rules**

1. . Which pair of ions would *not* be expected to form a precipitate when dilute solutions of each are mixed?  
 (A)  $\text{Cu}^{2+}$ ,  $\text{S}^{2-}$     (B)  $\text{Ag}^+$ ,  $\text{Cl}^-$     (C)  $\text{Ca}^{2+}$ ,  $\text{PO}_4^{3-}$   
 (D)  $\text{Mn}^{2+}$ ,  $\text{OH}^-$     (E)  $\text{Mg}^{2+}$ ,  $\text{SO}_4^{2-}$
2. Which of the following solutions contains the greatest total ion concentration in aqueous solution?  
 (A) One mole of potassium chloride dissolved in 1.0 L of aqueous solution.  
 (B) One mole of iron(II) nitrate dissolved in 1.0 L of aqueous solution.  
 (C) One mole of potassium hydroxide dissolved in 1.0 L of aqueous solution.  
 (D) One mole of calcium phosphate dissolved in 1.0 L of aqueous solution.  
 (E) At least two of these solutions have an equal number of ions, and these contain the greatest total ion concentration.

**Precipitate –**

If a substance dissolves significantly in a solvent (usually water), it is called \_\_\_\_\_. If a substance does not dissolve more than 0.1M in a solvent, it is called \_\_\_\_\_.

**Solubility & Precipitation Rules -**

#### IV. Precipitation Reactions

Imagine that I have a beaker where I mix the following solutions together. What are the (a) molecular, (b) complete ionic, and (c) net ionic reactions when the following are mixed? If no reaction occurs write no reaction. Do not forget to include states.

1.  $\text{Fe}(\text{NO}_3)_3(\text{aq})$  and  $(\text{NH}_4)_2\text{SO}_4$

Molecular

Complete Ionic:

Net Ionic:

Draw a beaker with ions in it below:

2.  $\text{CaCl}_2(\text{aq})$  and  $\text{K}_2\text{SO}_4(\text{aq})$

Molecular:

Complete Ionic:

Net Ionic:

3. An aqueous solution of silver nitrate is added to an aqueous solution of potassium chromate, and this reaction produces a solid. What is the formula for the solid?

(A) AgK            (B)  $\text{AgCrO}_4$             (C)  $\text{KNO}_3$             (D)  $\text{K}_2\text{NO}_3$             (E)  $\text{Ag}_2\text{CrO}_4$

4. An aqueous solution of barium nitrate reacts with an aqueous solution of sodium sulfate. Identify the solid and indicate its coefficient in the balanced equation.

(A)  $\text{NaNO}_3$ , 1            (B)  $\text{BaSO}_4$ , 1            (C)  $\text{NaNO}_3$ , 2            (D)  $\text{BaSO}_2$ , 2  
(E) none of these

5. Reacting 42.8 mL of 0.320 M  $\text{AgNO}_3$  with 55.8 mL of 0.580 M  $\text{K}_2\text{CrO}_4$  results in what mass of solid formed?

## V. Extra section - A couple ways precipitation reactions help us out in the lab:

We're starting to get to some cool stuff in the lab, so I included a little extra page here at the bottom about how we use precipitation reactions in the lab. You will be trying these out in Exp. 3 Weeks 1 & 2!

- a) Maybe I want to make a certain compound and I know it is insoluble in water. If I mix different solutions together We might have a problem where we want to make a certain compound, and we can do it by precipitating it from solution:

*“Kevin is trying to synthesize isoamericanol again, and he needs some silver chromate this time around to use as an oxidizing agent. He looks in his lab cabinets and finds 0.320M silver nitrate and 0.580M potassium chromate. What volumes of each should Kevin add to make 2.27 g of  $\text{Ag}_2\text{CrO}_4$ ?”*

- b) Maybe I have an unknown chemical solution and I want to find out what's inside of it. Precipitation and metal flame tests are some qualitative methods we could use to help us find out. (I put an infographic about flames tests up under “Chemistry Web Resources” for anyone interested!)

*“Nichrome wire was dipped in the solution and held over a Bunsen burner. Without a didymium glass filter, you observe a bright yellow flame color, and with the filter, you observe a light purple flame color. Addition of silver nitrate yielded a precipitate. When HCl is added, bubbles are observed to form. What ions are present in the solution?”*

- c) Maybe I want to find out quantitatively how much of a certain ion or substance is dissolved in solution, so we can precipitate it out (and you'll learn all the purification nuances if you take Chem 1CL).

*“One year when Kevin was in high school, swim league finals were at the rival high school's pool, which was notorious for burning swimmers' eyes. (The eye-burning and pool smell is actually caused by reactions between ammonia and ammonia-like compounds from human sweat and urine with hypochlorous acid in the pool to make chloramines – there's an infographic about this too). Kevin's back and this time he's trying to use silver nitrate to figure out how much chlorine is in that pool. Plan an experiment that would help Kevin do this without spending all his money on silver nitrate. The pool is 50m x 25.0m x 3.0m in volume, and for reference the average balance of chlorine to water in a swimming pool is 0.00013 ounces of chlorine per gallon.*