Chem101 2017 Discussion #7 Chapter 6

TF's name:_____ Discussion Time: _____

Things you should know when you leave Discussion today:

1. Dissolving ionic, polar, and non-polar compounds in water
2. Precipitation Reaction & Solubility (writing balanced net ionic reactions)
3. Solubility of Ionic compounds.
4. Concentration calculation (Molarity)

1. The molarity is a unit of concentration and is defined as the moles of a solute in a L of solvent $\left(\frac{\text{moles of solute}}{\text{L of solvent}}\right)$. Using dimensional analysis and the density of water (1.00 g/mL), calculate the molarity of water in water.(Answer:55.5M)

2. A computer simulation at 25 °C of $BaCl_2(s)$ dissolved in water. A cubical region will containing on average 110 water molecules, three Ba^{2+} ions and six Cl^- ions. What is the concentration (in *M*) of the chloride ion in the solution? Assume that the density of water is 1 g/mL. (Answer: 3M)

3. You are given 300 mL of a 0.2 M aqueous solution of calcium chloride ($CaCl_2$; 111g/mol) and 300 mL of a 0.2 M aqueous solution of sodium phosphate (Na_3PO_4; 164 g/mol). These solutions are mixed and a precipitate forms.

    a. List all the species in each of the solutions and the amount of each species. (always write the phase/state of the compound next to the chemical symbol, e.g. H_2O (l) for liquid water)(hint: drawing beakers may help)

    b. List all the species in the combine solution before reaction :

    c. What are the spectator ions for this process?

d. Write the net-ionic reaction for this process.

e. What is the limiting reactant (hint: ion)?

f. How many moles of the solid precipitate are formed Assume 100% yield? What is the mass of this precipitate?

g. What reactant, if any, is in excess, and how many moles are there in excess?

h. What are the final concentrations (M) for each of the ions **in solution** after precipitation? Assume that the final volume of the solution is 600 mL.

Starting Ions	Number of moles f ions still in the solution.	Concentration of Ions in the solution: [Ion]$= \frac{\#moles}{V_{new}(L)}$

i. **Show that final solution electrically neutral by calculating that it contains as many moles of positive charge as it does negative charge.**

4. Sea water contains 35 g NaCl per liter. If we have cubical sample of 1000 molecules of sea water, how many sodium ions will be in that cube? How many chloride ions?(Treat sea water as pure water.)(Answer:11)

Solubility Rules

When determining if an ionic compound will be soluble in water, break it into its ions. Read through the rules in numerical order. As soon as your ions meet a criterion, stop reading the chart and use that rule. For example, $(NH_4)_3PO_4$ is soluble. Rule #1 supersedes Rule #7.

Soluble:

1. **Group 1 and NH_4^+ compounds**
2. **Acetate (CH_3COO^-), Nitrate (NO_3^-), Perchlorate(ClO_4^-), Chlorate(ClO_3^-)**
3. **Halide compounds (Cl^-, Br^-, I^-) [Except: Ag^+, Pb^{2+}, Hg_2^{2+}]**
4. **Compound containing F^-. [Except: Mg^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Pb^{2+}]**
5. **Sulfate compounds (SO_4^{2-}) [Except: Pb^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}]**

Insoluble:

6. **Sulfide compounds (S^{2-})**
7. **Carbonate(CO_3^{2-})**
8. **Oxalate($C_2O_4^{2-}$),**
9. **Phosphate(PO_4^{3-}),**
10. **Chromate(CrO_4^{2-})compounds**
11. **Most metal Oxides**
12. **Metal Hydroxide compounds (OH^-) [Except: Ba^{2+}]**

5. If you take 35.0 g AgCl and added to one liter of water. If we then take a cubical sample of 1000 water molecules of that solution, how many ions of silver will be in that cube? How many chloride ions?

6. How would you check the presence of Ag^+ ions in a liquid sample with a chemical you always have in your kitchen?

7. How would you check the presence of Pb^{2+} ions in a liquid sample with a chemical you always have in your kitchen?

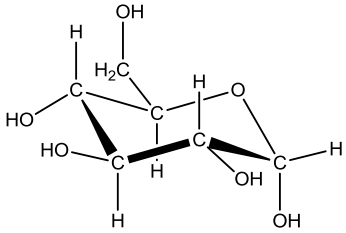
8. What is present in the solution when the following compounds are placed in water (continue on next page)?

a) $Ba(OH)_2(s) \xrightarrow{H_2O}$

b) $(NH_4)_3PO_4(s) \xrightarrow{H_2O}$

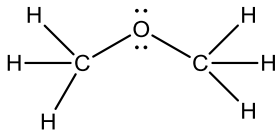
c) $Ni_2O_3(s) \xrightarrow{H_2O}$

d) $C_6H_{12}O_6\,(s) \xrightarrow{H_2O}$

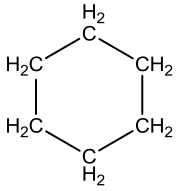


Please note that I have water above the arrows. Is that water necessary? Is that redounded? What should you use in the balanced chemical reaction to indicate that water is a solvent not a reactant?

e) $CH_3OCH_3\,(l) \longrightarrow$



f) $C_6H_{12}\,(l) \longrightarrow$



g) $Na_3PO_4(s) + BaCl_2(s) \longrightarrow$

h) Predict the relative water solubility (from most soluble to least soluble) for the following molecules. Remember to consider both the polar and non-polar parts of the molecule.

- $CH_3CH_2CH_2CH_2OH$
- $CH_3CH_2CH_2CH_2CH_2OH$
- $HOCH_2CH_2CH_2CH_2OH$
- $HOCH_2CH_2CH_2OH$

a. **Which one has the highest dispersion force? Does dispersion force contribute to solubility in water?**

9. If 2 moles of calcium chloride are dissolved in 500. mL of water, what is the molarity of calcium ion? If 500. mL of water is added to the existing solution. What would be the new molarity of calcium ion? (Answer:2.0M)

10. How many grams of $CaCl_2$ (*s*) has to be added to 1.00 L of water to get 0.0400 M solution of Cl^- (*aq*)? (Answer:2.22g)

11. To analyze the alcohol content of a certain wine, a chemist needs 1.00 L of an aqueous 0.200 M $K_2Cr_2O_7$ (294 g/mol) solution. How much solid $K_2Cr_2O_7$ must be weighed out to make this solution? (Answer:58.8g)

12. An average human has about 5.0 L of blood in their body. If an average person were to eat 34.2 g of sugar ($C_{12}H_{22}O_{11}$; 342 g/mol) and all the sugar dissolves into the bloodstream, what would the person's blood sugar be in units of molarity? (Answer:$2.0*10^{-2}$M)

13. A standard solution is prepared for the analysis of fluoxymesterone ($C_{20}H_{29}FO_3$; 336 g/mol), an anabolic steroid. A stock solution is first prepared by dissolving 16.8 mg of fluoxymesterone in enough water to give a total volume of 500.0 mL. A 1.0 µL aliquot (portion) of this stock solution is taken out and then diluted to a final volume of 1.0 mL. Calculate the final concentration of this new solution in M. (Answer: $1.0*10^{-7}$M)

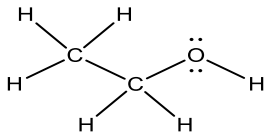
14. What is present in the solution when the following compounds are placed in water:

a) $Fe(OH)_2(s) \longrightarrow$

b) $K_3PO_4(s)$ ⟶

c) $BaS(s)$ ⟶

d) $C_2H_5OH\ (l)$ ⟶



15. Write the net ionic reaction when $Pb^{2+}(aq)$ reacts with the yellow transparent solution of $CrO_4^{2-}(aq)$.

16. If you take 3.00 moles of potassium sulfate and added to one liter of water. If we then take a cubical sample of 1000 water molecules of that solution, how many ions of potassium will be in that cube? How many sulfate ions will be in that cube? How many of both ions will be in that cube? (Answer: 108, 54, 162)

17. You are given 150 mL of a 0.20 M aqueous solution of ammonium carbonate and 150 mL of 0.40 M aqueous solution of barium iodide. These solutions are mixed and a precipitate forms.

a. Write the net-ionic equation for this process.
b. In terms of the net-ionic equation, what is the limiting reactant?
c. How many moles of the solid precipitate are formed?
d. What are the spectator ions for this process?
e. What are the final concentrations (M) for each of the ions in solution after precipitation?
f. Show that final solution electrically neutral by calculating that it contains as many moles of positive charge as it does negative charge.