# Chem 111

Lecture 8

### Announcements

- Oct 4<sup>th</sup> is your first exam. Less than 2 weeks.
- Practice Exams:

http://courses.umass.edu/chem111-bbotch/ExamInfo.html

Our TA: Breanne Holmes
 →Office Hours Monday,1:00-2:30pm in the CRC



## Homework

- Continue Reading Chapter 3
- OWL online homework.



## Recap

- Hydrates  $Coll_2 \cdot bH_2O$
- Practiced a few problems
- Chemical Equations  $A + B \rightarrow C$
- Balancing Chemical Equations
- Combustion Reactions



## Let's Practice

Write the balanced chemical equation for the reaction that occurs when ethanol,  $C_2H_5OH(I)$ , is burned in air.

$$C_2 H_5 OH(k) + 30_2(2) \longrightarrow 2(0_2(2)) + 3H_2 O(k)$$

C: 
$$2$$
  
H: 6  
O:  $1 \times 2 = 2$   
 $2 \times 3 = 5$   
 $4 + 3 = 7$   
 $1 \times 2 = 3$   
 $4 + 3 = 7$   
 $1 \times 2 = 7$ 

### **Chemical Equilibrium**

**Chemical Equilibrium –** occurs when opposing reactions are proceeding at the same rate.



#### **Solutions**

**Solution** – is a homogeneous mixture of two or more substances.

**Solvent -** is the component that is present in greater quantity.

**Solute -** is the component that is present in lesser quantity. It is said to be dissolved in the solvent.

Aqueous Solutions – Solutions where water is the solvent.



#### **Aqueous Solutions**

**Electrolyte** – a substance whose aqueous solutions contains ions and hence conduct electricity.

Non electrolyte - a substance that does not form ions in solution.



| **b** | **b** | **c** | **4** 

## **Ionic Compounds in Water**

Water is a polar solvent.



## Ionic Compounds in Water





### **Metathesis Reactions**

From the Greek, "To Transpose"

$$AX + BY \rightarrow AY + BX$$

$$AgNO_{3}(aq) + KCI(aq) \rightarrow (AgCI(s)) + KNO_{3}(aq)$$

$$AgNO_{3}(aq) \rightarrow Agt(aq) + NO_{3}(aq)$$

$$KCI(aq) \rightarrow Kt(aq) + CI(aq)$$

For a metathesis reaction to occur, ions must be removed from the solution.

- 1. The formation of an insoluble solid (a precipitate).
- 2. The formation of either a soluble weak electrolyte or soluble nonelectrolyte. Acid Base  $R \times NS$
- 3. The formation of a gas.



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#### **Complete Ionic Equation**

 $Mg(NO_3)_2(aq) + 2NaOH(aq) \rightarrow Mg(OH)_2(s) + 2NaNO_3(aq)$ 

 $Mg^{2+}(aq) + 2NO_3^{-}(aq) + 2Na^{+}(aq) + 2OH^{-}(aq)$ 

 $\rightarrow$  Mg(OH)<sub>2</sub>(s) + 2Na + (aq) + 2NO<sub>3</sub> - (aq)

**Spectator lons** – Are ions that appear in identical forms among both the reactants and the products.



## **Net Ionic Equation**

When spectator ions are omitted from the complete ionic equation, we are left with the net ionic equation.

Complete:  $Mg^{2+}(aq) + 2NO_3^{-}(aq) + 2Na^{+}(aq) + 2OH^{-}(aq)$   $\rightarrow Mg(OH)_2(s) + 2Na^{+}(aq) + 2NO_3^{-}(aq)$ Net Ionic:

 $Mg^{2+}(aq) + 2OH^{-}(aq) \rightarrow Mg(OH)_{2}(s)$ 



#### Let's Practice

Write the net ionic equations for the reactions that occur when solutions of the following compounds are mixed.

a) KOH and  $Co(NO_3)_2$ 

b) NaCl and  $(NH_4)_2SO_4$ 



#### Acids

Arrhenius's definition: when dissolved in water increases H<sup>+</sup> concentration of water.

Brønsted's definition: proton donor

Examples: HCI, HNO<sub>3</sub>, H<sub>2</sub>SO<sub>4</sub>, CH<sub>3</sub>CO<sub>2</sub>H

 $\begin{array}{rcl} \mathsf{HCI}(aq) + \mathsf{H}_2\mathsf{O}(l) \rightarrow \mathsf{H}_3\mathsf{O}^+(aq) + & \mathsf{CI}^-(aq) \\ \mathsf{HCI}(aq) & \rightarrow \mathsf{H}^+(aq) + & \mathsf{CI}^-(aq) \end{array}$ 

**Monoprotic** – yield one H atom per molecule of acid. **Diprotic** - yield two H atoms per molecule of acid.

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\begin{array}{rl} \mathsf{H}_2\mathsf{SO}_4(aq) \rightarrow \mathsf{H}^+(aq) &+ & \mathsf{HSO}_4^-(aq) \\ \mathsf{HSO}_4^-(aq) &\leftrightarrows \mathsf{H}^+(aq) &+ & \mathsf{SO}_4^{-2-}(aq) \end{array}
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#### Bases

Arrhenius's definition: when dissolved in water increases OHconcentration of water.

Brønsted's definition: proton acceptor

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Examples: NaOH, KOH, NH<sub>3</sub>
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NaOH  $(aq) \rightarrow Na^+(aq) + OH^-(aq)$ 

 $NH_3(aq) + H_2O(l) \rightarrow NH_4^+(aq) + OH^-(aq)$ 

Amphiprotic – can react as either an acid or a base.

