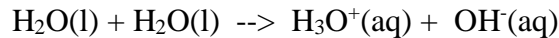


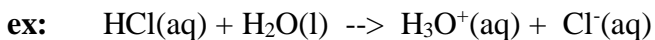
## 1. What are acids and bases?

We will cover two definitions, the Arrhenius and Bronstead definitions. First we need to look at the autoionization of water. When two water molecules bump into each other a proton can be transferred from one to the other forming hydronium and hydroxide ions.



This is a very weak reaction and in neutral water (pH=7) the concentration of hydronium and hydroxide ions both equal  $10^{-7}$  moles/liter (one mole is  $6.022 \times 10^{23}$  molecules of water). That of the undissociated water is 55.56 moles/liter. This means that about one molecule dissociates for every  $5.5 \times 10^8$  undissociated.

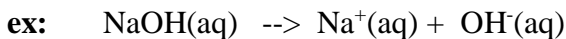
**Arrhenius Acid:** Increase hydronium concentration to that of neutral water (which also means the hydronium ion concentration is higher than the hydroxide)



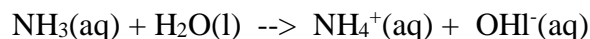
This is often written with the waters omitted, that is  $\text{H}^+(\text{aq})$  represents hydronium ion and not a proton.



**Arrhenius Base:** Increase hydroxide concentration to that of neutral water (which also means the hydroxide concentration is higher than the hydronium).



or



In the later case the ammonia took a proton from the water and this reaction is similar to the autoionization of water, except that it is an ammonia and not another water molecule that acquires the second proton.

**Bronstead Acid:** A Proton Donor. Note the HCl gave a proton to the water molecule in the above example

**Bronstead Base:** A Proton Acceptor. Note the ammonia above accepted a proton from the water.

The Bronstead definition is a more general definition and the one we will use in this class.

**Weak and Strong Electrolytes**

Solutions which contain dissolved ions conduct electricity and are called electrolytes. Soluble ionic compounds are electrolytes and insoluble ionic compounds are nonelectrolytes. Strong acids and bases are electrolytes but weak ones are not. The thing is both strong and weak acids and bases can be aqueous.

**Strong Acids:**

Heavier binary hydrogen halides: HCl, HBr and HI (HF is weak)

Some of the larger oxyacids:  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ ,  $\text{HClO}_4$ , and  $\text{HClO}_3$

Note, this is not an all inclusive list but you need to memorize these 7. All other acids will be called strong or you are to assume they are weak.

**Strong Bases:** Soluble hydroxides

Alkaline hydroxides: LiOH, .... CsOH

Heavier alkaline earth hydroxides ( $\text{Ca}(\text{OH})_2$ .... $\text{Ra}(\text{OH})_2$ ).

1. Indicate in the parenthesis if the following are aqueous or are precipitates and write E if an electrolyte and NE if a nonelectrolyte:

**A. In Class Assignment:**

a.  $\text{HNO}_3$ ( )\_\_\_\_\_      b.  $\text{HNO}_2$ ( )\_\_\_\_\_      c.  $\text{AgClO}_4$ , ( )\_\_\_\_\_

d.  $\text{AgC}_2\text{H}_3\text{O}_2$ ( )\_\_\_\_\_      e.  $\text{HC}_2\text{H}_3\text{O}_2$  ( )\_\_\_\_\_      f. HF( )\_\_\_\_\_

**B. Take Home Assignment: (write formula if needed)**

g. barium nitrate( )\_\_\_\_\_      h. hypochlorous acid ( )\_\_\_\_\_

i. hypoiodous acid ( )\_\_\_\_\_      j. iodic acid (strong) ( )\_\_\_\_\_

k. perbromic acid (strong)( )\_\_\_\_\_      l. trimethyl ammine  $\text{N}(\text{CH}_3)_3$ ( )  
(weak soluble base)

**II. Predicting products and balancing acid base neutralization reactions:**

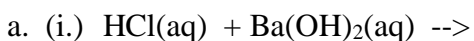
Many of these are a type of double displacement reaction and the same principle of conserving ions should be used in balancing them.

**A. Strong Acids and Strong Bases:** Write balanced

(i) molecular

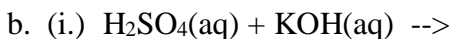
(ii) total ionic

(iii) net ionic equations for the following reactions.



(ii)

(iii)



(ii)

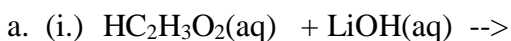
(iii)

**B. Weak Acids and Strong Bases** Write balanced molecular

(i) molecular

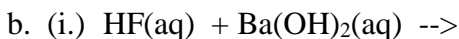
(ii) total ionic

(iii) net ionic equations for the following reactions.



(ii)

(iii)



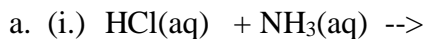
(NOTE:  $\text{BaF}_2$  forms a ppt and is no on your solubility rules)

(ii)

(iii)

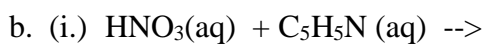
**C. Strong Acids and Weak Bases** Write balanced molecular

- (i) molecular
- (ii) total ionic
- (iii) net ionic equations for the following reactions.



(ii)

(iii)

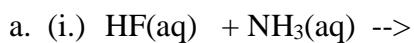
(note,  $\text{C}_5\text{H}_5\text{N}$  is pyridine, a weak base)

(ii)

(iii)

**D. Weak Acids and Weak Bases** Write balanced molecular

- (i) molecular
- (ii) total ionic
- (iii) net ionic equations for the following reactions.



(ii)

(iii)

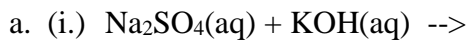
**III. Mixtures of Acids, Bases and Salts**

Predict products,

(i) molecular

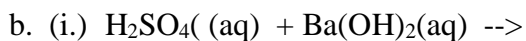
(ii) total ionic

(iii) net ionic equations for the following reactions.



(ii)

(iii)



(ii)

(iii)

Take Home Problems: Write Net Ionic Equations for the following

