

## Precipitation Notes

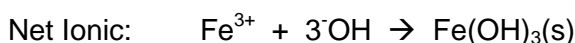
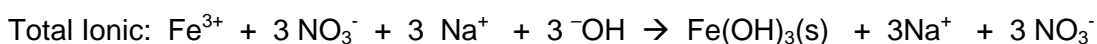
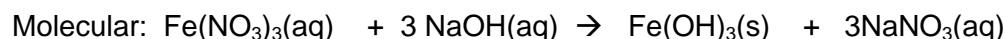
1) Using the solubility table mark with an X which ionic salts will form a precipitate and a “?” for those that might

Table1: Precipitates that should form using solubility table on page 155

|                  | Br <sup>-</sup> | OH <sup>-</sup> | SO <sub>4</sub> <sup>2-</sup> | PO <sub>4</sub> <sup>3-</sup> |
|------------------|-----------------|-----------------|-------------------------------|-------------------------------|
| K <sup>+</sup>   |                 |                 |                               |                               |
| Cu <sup>2+</sup> |                 | ppt             |                               | ppt                           |
| Ag <sup>+</sup>  | ppt             | ppt             | ppt?                          | ppt                           |
| Ba <sup>2+</sup> |                 | ppt?            | ppt                           | ppt                           |
| Fe <sup>3+</sup> |                 | ppt             |                               | ppt                           |
| Mg <sup>2+</sup> |                 | ppt             |                               | ppt                           |
| Pb <sup>2+</sup> | ppt             | ppt             | ppt                           | ppt                           |

Write Molecular, total Ionic and Net Ionic equation for all reactions that produce a precipitate

Example



2) Identifying Electrolytes, Weak Electrolytes and use of the Van't Hoff factor (i)

Electrolytes are strong acids/ strong bases and soluble ionic compounds (i = # of ions)

The Van't Hoff Factor (i) indicates the number of particles that will be found in solution

Weak electrolytes are compounds that partially dissociate like weak acids and weak bases (1 < i < 2)

Non-electrolytes are all molecular compounds and insoluble compounds (i = 1)

| Strong Acids                   | Strong Bases            |
|--------------------------------|-------------------------|
| HCl                            | All group 1 and Group 2 |
| HBr                            | Metal Hydroxides        |
| HI                             |                         |
| HNO <sub>3</sub>               |                         |
| H <sub>2</sub> SO <sub>4</sub> |                         |
| HClO <sub>3</sub>              |                         |
| HClO <sub>4</sub>              |                         |

Fill in the table below

| Compound                                      | Electrolyte (Strong/ Weak/ Non) | Van't Hoff factor      |
|---|---------------------------------|------------------------|
| BaSO <sub>4</sub>                             | <b>Non (insoluble)</b>          | <b>1</b>               |
| HCl   | <b>Strong</b>                   | <b>2</b>               |
| CH <sub>3</sub> COOH (acetic acid)            | <b>Weak</b>                     | <b>1 &lt; i &lt; 2</b> |
| NaOH  | <b>Strong</b>                   | <b>2</b>               |
| Na <sub>2</sub> SO <sub>4</sub>               | <b>Strong</b>                   | <b>3</b>               |
| Ammonia (NH <sub>3</sub> ) weak base          | <b>Weak</b>                     | <b>1 &lt; i &lt; 2</b> |
| C <sub>6</sub> H <sub>12</sub> O <sub>6</sub> | <b>Non</b>                      | <b>1</b>               |

2) Using the following equation:  $2 \text{FePO}_4 + 3 \text{Na}_2\text{SO}_4 \rightarrow \text{Fe}_2(\text{SO}_4)_3 + 2 \text{Na}_3\text{PO}_4$

- A. If 250 mL of 5.0 M iron (III) phosphate reacts with 250 mL of 5.00 M sodium sulfate, how many grams of iron (III) sulfate could be made?

$$0.417 \text{ mol} \times 399.7 \text{ g/mol} = 166.7 \text{ g}$$

- B. If a 65.0% yield is obtained, how many grams of sodium phosphate were made?

$$\frac{65}{100} = \frac{X}{136.8} \quad X = 88.92 \text{ g}$$

- C. What is the concentration of all reagents and products in solution?

0.852 mol/ L  $\text{FePO}_4$       0.834 mol/L  $\text{Fe}_2(\text{SO}_4)_3$       1.67 mol/ L  $\text{Na}_3\text{PO}_4$

|  | <b>2 <math>\text{FePO}_4</math></b>       | <b>+ 3 <math>\text{Na}_2\text{SO}_4</math></b> | <b>→</b> | <b><math>\text{Fe}_2(\text{SO}_4)_3</math></b>   | <b>+ 2 <math>\text{Na}_3\text{PO}_4</math></b>  |
|--|---|--|----------|--|---|
| Molarity or <b>MM</b>  | <b>5 mol/ L</b>                           | <b>5 mol/ L</b>                                |          | <b>399.7 g/ mol</b>  | <b>164 g/ mol</b>   |
| Amount   | <b>0.25 mL</b>                            | <b>0.25 mL</b>                                 |          |  |   |
| Moles<br>Gram/ MM or<br>Molarity x L   | <b>5 mol/ L x 0.25 L =<br/>1.25 mol</b>   | <b>5 mol/ L x 0.25 L =<br/>1.25 mol</b>        |          |  |   |
| Moles/rxn<br>(divide moles by SC)  | <b>0.625 mol</b>                          | <b>0.417 mol</b>                               |          |  |   |
| React<br>(Least Mol/ Rxn)  | <b>-0.417 mol</b>                         | <b>-0.417 mol</b>                              |          | <b>+ 0.417 mol</b>   | <b>+ 0.417 mol</b>  |
| Final Mole/ Rxn  | <b>0.208 mol</b>                          | <b>0</b>                                       |          | <b>0.417 mol</b>   | <b>0.417 mol</b>  |
| Final Moles<br>(SC x final mol/ rxn)   | <b>0.416 mol</b>                          | <b>0</b>                                       |          | <b>0.417 mol</b>   | <b>0.834 mol</b>  |
| Final Amt<br>(final moles x MM)<br>or Concentration<br>(final mols/ total<br>volume) | <b>0.426 mol/ 0.5L =<br/>0.852 mol/ L</b> | <b>0</b>                                       |          | <b>0.417 mol x 399.7<br/>g/mol =166.7 g<br/><br/>0.417mol / 0.5 L =<br/>0.834 mol/ L</b> | <b>0.834 mol x 164<br/>g/mol =136.7 g<br/><br/>0.834 mol/ 0.5 L =<br/>1.67 mol/ L</b> |

4) Using the equation:  $\text{Ca}(\text{OH})_{2(\text{aq})} + 2 \text{HCl}_{(\text{aq})} \rightarrow 2 \text{NaCl}_{(\text{aq})} + 2 \text{H}_2\text{O}_{(\text{l})}$

- A. How many liters of 0.100 M HCl would be required to react completely with 5.00 grams of calcium hydroxide?  
Information about 1 reactant to find out about the other

$$0.135 \text{ mol} \times \frac{1 \text{ L}}{0.1 \text{ mol}} = 1.35 \text{ L}$$

|  | HAVE (-)  | NEED (+)   | <b>→</b> |  |   |
|--|---|--|----------|--|---|
|  | <b><math>\text{Ca}(\text{OH})_{2(\text{aq})}</math></b> | <b>+ 2 <math>\text{HCl}_{(\text{aq})}</math></b> |          | <b><math>\text{CaCl}_{2(\text{aq})}</math></b> | <b>2 <math>\text{H}_2\text{O}_{(\text{l})}</math></b> |
| Molarity or <b>MM</b>  | <b>74 g/mol</b>   | <b>0.1 mol/ L</b>                                |          |  |   |
| Amount   | <b>5 grams</b>  |  |          |  |   |
| Moles<br>Gram/ MM or<br>Molarity x L   | <b>5g / 74 g/mol =<br/>0.0676 mol</b>                   |  |          |  |   |
| Moles/rxn<br>(divide moles by SC)  | <b>0.0676 mol</b>                                       |  |          |  |   |
| React<br>(Least Mol/ Rxn)  | <b>-0.0676 mol</b>                                      | <b>+ 0.0676<br/>mol</b>                          |          |  |   |
| Final Mole/ Rxn  | <b>0</b>  | <b>0.0676 mol</b>                                |          |  |   |
| Final Moles<br>(SC x final mol/ rxn)   | <b>0</b>  | <b>0.135 mol</b>                                 |          |  |   |
| Final Amt<br>(final moles x MM)<br>or Concentration<br>(final mols/ total<br>volume) |   |  |          |  |   |

- B. If 15.0 grams of calcium hydroxide is combined with 75.0 mL of 0.500 M HCl, how many grams of calcium chloride would be formed? **20.87g**

|  | HAVE (-)  | NEED (+)  | → |  |                                       |
|--|---|---|---|--|---------------------------------------|
| Molarity or <b>MM</b>  | <b>Ca(OH)<sub>2(aq)</sub></b><br><b>74 g/mol</b>                            | <b>+ 2 HCl<sub>(aq)</sub></b><br><b>0.5 mol/ L</b>                |   | <b>CaCl<sub>2(aq)</sub></b><br><b>111g /mol</b>                              | <b>2 H<sub>2</sub>O<sub>(l)</sub></b> |
| Amount   | <b>15 grams</b>   | <b>0.75 L</b>   |   |  |                                       |
| Moles<br>Gram/ MM or<br>Molarity x L   | $15\text{g} / 74 \text{g/mol} =$<br><b>0.2 mol</b>                          | $0.5 \text{mol/L} \times 0.75\text{L}$<br>$=$<br><b>0.375 mol</b> |   |  |                                       |
| Moles/rxn<br>(divide moles by SC)  | <b>0.2 mol</b>  | <b>0.188 mol</b>  |   |  |                                       |
| React<br>(Least Mol/ Rxn)  | <b>-0.188 mol</b>   | <b>-0.188 mol</b>   |   | <b>+0.188 mol</b>  | <b>+0.188 mol</b>                     |
| Final Mole/ Rxn  | <b>0.012 mol</b>  | <b>0</b>  |   | <b>0.188 mol</b>   |                                       |
| Final Moles<br>(SC x final mol/ rxn)   | <b>0.012 mol</b>  | <b>0</b>  |   | <b>0.188 mol</b>   |                                       |
| Final Amt<br>(final moles x MM)<br>or Concentration<br>(final mols/ total<br>volume) | $0.012 \text{ mol} \times 74 \text{ g/}$<br>$\text{mol} =$<br><b>0.89 g</b> |   |   | $0.188 \text{ mol} \times 111 \text{ g/}$<br>$\text{mol} =$<br><b>20.87g</b> |                                       |

- C. How many grams of the excess reagent will be left over after the reaction is complete?

**0.89 g**