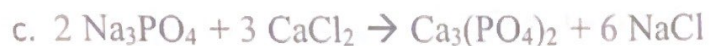
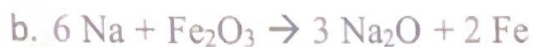
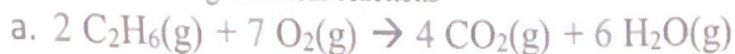


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Chapter 3

1. Balance the following chemical reactions



2. A compound is found to contain 26.56% potassium, 35.41% chromium, and the remainder oxygen. Find its empirical formula.

$$26.56 \text{ g K} \times \frac{1 \text{ mol K}}{39.10 \text{ g}} = 0.679 \text{ mol K} / 0.679 = 1 \times 2 = 2$$

$$36.48 \text{ g Cr} \times \frac{1 \text{ mol Cr}}{52.00 \text{ g}} = 0.702 \text{ mol Cr} / 0.679 = 1.033 \times 2 = 2.066$$

$$36.96 \text{ g O} \times \frac{1 \text{ mol O}}{16.00 \text{ g}} = 2.31 \text{ mol O} / 0.679 = 3.402 \times 2 = 6.802$$

3. A sample of a compound with a formula mass of 34.00 amu is found to consist of 0.44 g H and 6.92 g O. Find its molecular formula.

$$0.44 \text{ g H} \times \frac{1 \text{ mol}}{1.01 \text{ g H}} = 0.4356 \text{ mol} / 0.4325 = 1.01$$

empirical formula = OH

$$6.92 \text{ g O} \times \frac{1 \text{ mol}}{16.00 \text{ g}} = 0.4325 \text{ mol} / 0.4325 = 1$$

molecular formula = O<sub>2</sub>H<sub>2</sub>

$$\frac{\text{molecular formula}}{\text{empirical formula}} = \frac{34.00}{17.01} = 1.999$$

4. 12.915 g of a biochemical substance containing only carbon, hydrogen, and oxygen was burned in an atmosphere of excess oxygen. Subsequent analysis of the gaseous result yielded 18.942 g carbon dioxide and 7.749 g of water. Determine the empirical formula of the substance.

$$\text{mass of C} = 18.942 \text{ g CO}_2 \times \frac{1 \text{ mol CO}_2}{44.01 \text{ g}} \times \frac{1 \text{ mol C}}{1 \text{ mol CO}_2} \times \frac{12.01 \text{ g C}}{1 \text{ mol C}} = 5.169 \text{ g C} \rightarrow \frac{0.4303 \text{ mol}}{0.4298}$$

$$\text{mass of H} = 7.749 \text{ g H}_2\text{O} \times \frac{1 \text{ mol H}_2\text{O}}{18.01 \text{ g}} \times \frac{2 \text{ mol H}}{1 \text{ mol H}_2\text{O}} \times \frac{1.01 \text{ g H}}{1 \text{ mol H}} = 0.869 \text{ g H} \rightarrow \frac{0.8604 \text{ mol}}{0.4298}$$

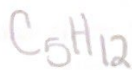
$$\text{mass of O} = 12.915 - 5.169 - 0.869 = 6.877 \text{ g O} \rightarrow 0.4298 \text{ mol} / 0.4298$$



5. After combustion with excess oxygen, a 12.501 g of a petroleum compound produced 38.196 g of carbon dioxide and 18.752 g of water. A previous analysis determined that the compound does not contain oxygen. Establish the empirical formula of the compound.

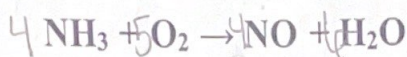
$$38.196 \text{ g CO}_2 \times \frac{1 \text{ mol CO}_2}{44.01 \text{ g}} \times \frac{1 \text{ mol C}}{1 \text{ mol CO}_2} = 0.8679 \text{ mol C} / 0.8679 = 1 \times 5$$

$$18.752 \text{ g H}_2\text{O} \times \frac{1 \text{ mol H}_2\text{O}}{18.01 \text{ g}} \times \frac{2 \text{ mol H}}{1 \text{ mol H}_2\text{O}} = 2.0824 \text{ mol H} / 0.8679 = 2.3996 \times 5$$



## Chapter 4

6. Take the reaction:



In an experiment, 3.25 g of  $\text{NH}_3$  are allowed to react with 3.50 g of  $\text{O}_2$ .

a. Which reactant is the limiting reagent?

$$3.25 \text{ g NH}_3 \times \frac{1 \text{ mol NH}_3}{17.04 \text{ g}} \times \frac{4 \text{ mol NO}}{4 \text{ mol NH}_3} \times \frac{30.01 \text{ g}}{1 \text{ mol NO}} = 5.724 \text{ g NO}$$

$$3.50 \text{ g O}_2 \times \frac{1 \text{ mol O}_2}{32.00 \text{ g}} \times \frac{4 \text{ mol NO}}{5 \text{ mol O}_2} \times \frac{30.01 \text{ g}}{1 \text{ mol NO}} = 2.63 \text{ g NO} \leftarrow \text{O}_2 \text{ is limiting}$$

b. How many grams of NO are formed?

$$2.63 \text{ g NO}$$

c. How much of the excess reactant remains after the reaction?

$$2.63 \text{ g NO} \times \frac{1 \text{ mol NO}}{30.01 \text{ g NO}} \times \frac{4 \text{ mol NH}_3}{4 \text{ mol NO}} \times \frac{17.04 \text{ g}}{1 \text{ mol NH}_3} = 1.493 \text{ g of NH}_3 \text{ is used}$$

$$3.25 \text{ g} - 1.493 \text{ g} = 1.76 \text{ g NH}_3 \text{ excess}$$

7. Given the following reaction to produce Iodine gas:



What is the percent yield of  $I_2$  if the actual grams produced is 39.78 grams of  $I_2$  from 62.55 grams of NaI and excess of all the other reactants?

$$62.55 \text{ g NaI} \times \frac{1 \text{ mol NaI}}{149.89 \text{ g}} \times \frac{1 \text{ mol } I_2}{2 \text{ mol NaI}} \times \frac{253.8 \text{ g}}{1 \text{ mol } I_2} = 52.96 \text{ g } I_2$$

↑  
theoretical yield

$$\% \text{ yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100\% = \frac{39.78 \text{ g}}{52.96 \text{ g}} \times 100\% = 75.11\%$$

8. If the typical yield is 86.78%, how much  $SO_2$  should be expected if 4897 grams of ZnS are used? (2803 of  $SO_2$ )



$$4897 \text{ g ZnS} \times \frac{1 \text{ mol ZnS}}{97.48 \text{ g}} \times \frac{2 \text{ mol } SO_2}{2 \text{ mol ZnS}} \times \frac{64.07 \text{ g}}{1 \text{ mol } SO_2} = 3218.62 \text{ g } SO_2$$

↑  
theoretical yield

$$\% \text{ yield} = \frac{\text{actual yield}}{\text{theoretical yield}}$$

$$86.78 = \frac{\text{actual yield}}{3218.62 \text{ g}} \quad \text{actual yield} = 2793.1 \text{ g}$$

#### Chapter 5

9. For the reaction below what volume of 0.45 M  $FeCl_2$  is needed to react with 35.0 g Al?



$$35.0 \text{ g Al} \times \frac{1 \text{ mol Al}}{26.98 \text{ g}} \times \frac{3 \text{ mol } FeCl_2}{2 \text{ mol Al}} \times \frac{1 \text{ L}}{0.45 \text{ mol } FeCl_2} = 4.32 \text{ L}$$

10. I have 345 mL of a 1.5 M NaCl solution. If I boil the water until the volume of the solution is 250 mL, what will the molarity of the solution be?

$$M = \frac{\text{mol}}{V}$$

$$M_1 V_1 = M_2 V_2$$

$$MV = \text{mol}$$

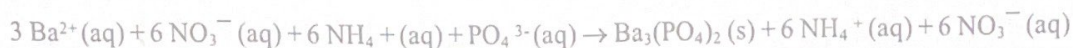
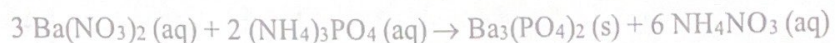
$$V = \frac{\text{mol}}{M}$$

$$(1.5 \text{ M})(345\text{mL}) = x (250 \text{ mL})$$

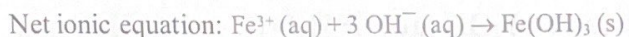
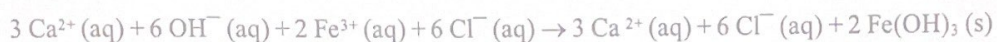
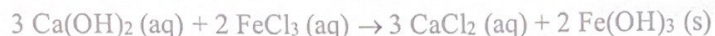
$$x = 2.07 \text{ M}$$

11. Finish the precipitation reactions below and write the net ionic reactions:

a. barium nitrate + ammonium phosphate  $\rightarrow$



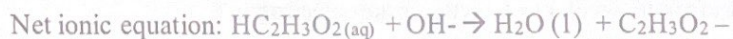
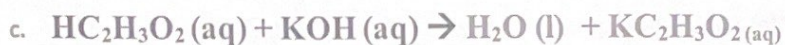
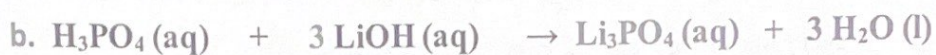
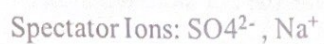
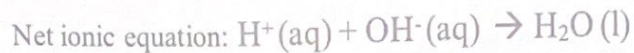
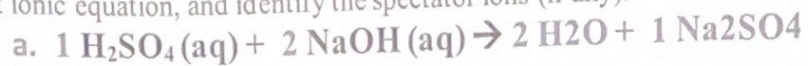
b. calcium hydroxide + iron(III)chloride  $\rightarrow$



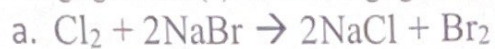
12. Strong electrolyte, weak electrolyte, or non-electrolyte?

|                            |                    |                          |                    |
|----------------------------|--------------------|--------------------------|--------------------|
| $\text{Ca}(\text{NO}_3)_2$ | Strong electrolyte | $\text{Fe}(\text{OH})_3$ | Non-electrolyte    |
| $\text{KClO}_4$            | Strong electrolyte | $\text{H}_3\text{PO}_4$  | Weak electrolyte   |
| $\text{NaOH}$              | Strong electrolyte | $\text{MgCl}_2$          | Strong electrolyte |
| $\text{HF}$                | Weak electrolyte   | $\text{CH}_3\text{OH}$   | Non-electrolyte    |

13. For the following neutralization reactions complete and balance the equations, write the net ionic equation, and identify the spectator ions (if any).



14. In each equation determine what is (1) being oxidized, (2) being reduced, (3) the oxidizing agent and (4) the reducing agent



$\text{Cl}^0$  to  $\text{Cl}^{1-}$ ; reduced/ox. ag.

$\text{Br}^{1-}$  to  $\text{Br}^0$ ; oxidized/red. ag.



$\text{C}^0$  to  $\text{C}^{4+}$ ; oxidized/red. ag

$\text{S}^{6+}$  to  $\text{S}^{4+}$ ; reduced/ox. agent



$\text{N}^{5+}$  to  $\text{N}^{2+}$ ; reduced/ox. agent

$\text{I}^{1-}$  to  $\text{I}^0$ ; oxidized/red. Agent