

I. Mole ↔ Mole Calculations

1) Given the balanced equation, $6 \text{ AgI (aq)} + \text{Fe}_2(\text{CO}_3)_3 \text{ (aq)} \rightarrow 2 \text{ FeI}_3 \text{ (aq)} + 3 \text{ Ag}_2\text{CO}_3 \text{ (s)}$:

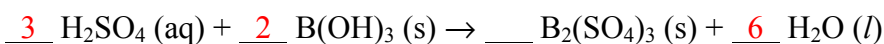
a. How many moles of AgI would be required to form 10. moles of FeI_3 ?

$$? \text{ mol AgI} = 10. \text{ mol FeI}_3 \times \frac{6 \text{ moles AgI}}{2 \text{ moles FeI}_3} = \boxed{30. \text{ mol AgI}}$$

b. How many moles of Ag_2CO_3 would be formed from the reaction of 4.0 moles of $\text{Fe}_2(\text{CO}_3)_3$ with enough AgI?

$$? \text{ mol Ag}_2\text{CO}_3 = 4.0 \text{ mol Fe}_2(\text{CO}_3)_3 \times \frac{3 \text{ mol Ag}_2\text{CO}_3}{1 \text{ mol Fe}_2(\text{CO}_3)_3} = \boxed{12 \text{ mol Ag}_2\text{CO}_3}$$

2) Given the chemical equation,



a. Balance the equation

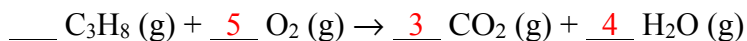
b. How many moles of B(OH)_3 would be required to completely react with 4.65 moles of H_2SO_4 ?

$$? \text{ mol B(OH)}_3 = 4.65 \text{ mol H}_2\text{SO}_4 \times \frac{2 \text{ mol B(OH)}_3}{3 \text{ mol H}_2\text{SO}_4} = \boxed{3.10 \text{ mol B(OH)}_3}$$

c. How many moles of H_2SO_4 would be needed, given enough B(OH)_3 , to produce 11.8 moles of $\text{B}_2(\text{SO}_4)_3$?

$$? \text{ mol H}_2\text{SO}_4 = 11.8 \text{ mol B}_2(\text{SO}_4)_3 \times \frac{3 \text{ mol H}_2\text{SO}_4}{1 \text{ mol B}_2(\text{SO}_4)_3} = \boxed{35.4 \text{ mol H}_2\text{SO}_4}$$

3) When propane (C_3H_8) gas burns in oxygen gas, it forms carbon dioxide gas and water vapor:



a. Write and balance the equation

b. How many moles of water would be formed in the reaction where 3.19 mol of carbon dioxide are formed?

$$? \text{ mol H}_2\text{O} = 3.19 \text{ mol CO}_2 \times \frac{4 \text{ mol H}_2\text{O}}{3 \text{ mol CO}_2} = \boxed{4.25 \text{ mol H}_2\text{O}}$$

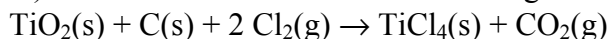
c. How many moles of carbon dioxide would be produced by the reaction of 23.4 moles of oxygen, with sufficient propane?

$$? \text{ mol CO}_2 = 23.4 \text{ mol O}_2 \times \frac{3 \text{ mol CO}_2}{5 \text{ mol O}_2} = \boxed{14.0 \text{ mol CO}_2}$$

II. Mass ↔ Mole and Mass ↔ Mass Calculations

For the following problems, use the flowchart **Mass** → **Mole** → **Mole** → **Mass**

4) Titanium is a transition metal used in many alloys because it is extremely strong and lightweight. Titanium(IV) chloride (TiCl_4) is extracted from titanium oxide using chlorine and coke (carbon):



a. If you begin with 1.25 mol TiO_2 , what mass of Cl_2 gas is needed?

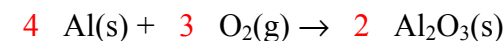
$$? \text{ g Cl}_2 = 1.25 \text{ mol TiO}_2 \times \frac{2 \text{ mol Cl}_2}{1 \text{ mol TiO}_2} \times \frac{70.90 \text{ g Cl}_2}{1 \text{ mol Cl}_2} = \boxed{177 \text{ g Cl}_2}$$

b. How many moles of C must be used in the formation of 82.5 g of TiCl_4 ?

$$? \text{ mol C} = 82.5 \text{ g TiCl}_4 \times \frac{1 \text{ mol TiCl}_4}{189.7 \text{ g TiCl}_4} \times \frac{1 \text{ mol C}}{1 \text{ mol TiCl}_4} = \boxed{0.435 \text{ mol C}}$$

$\underbrace{\hspace{10em}}_{0.435 \text{ mol TiCl}_4}$

5) Aluminum oxidizes according to the following unbalanced equation:



a. Balance the equation

b. How many grams of Al_2O_3 would be formed by the reaction of 29.75 grams of Al with enough O_2 ?

$$? \text{ g Al}_2\text{O}_3 = 29.75 \text{ g Al} \times \frac{1 \text{ mol Al}}{26.98 \text{ g Al}} \times \frac{2 \text{ mol Al}_2\text{O}_3}{4 \text{ mol Al}} \times \frac{101.96 \text{ g Al}_2\text{O}_3}{1 \text{ mol Al}_2\text{O}_3} = \boxed{56.18 \text{ g Al}_2\text{O}_3}$$

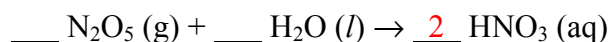
$\underbrace{\hspace{10em}}_{=1.103 \text{ mol Al}} \quad \underbrace{\hspace{10em}}_{=0.551 \text{ mol Al}_2\text{O}_3}$

c. How many grams of O_2 would be required to form 65.32 grams of Al_2O_3 ?

$$? \text{ g O}_2 = 65.32 \text{ g Al}_2\text{O}_3 \times \frac{1 \text{ mol Al}_2\text{O}_3}{101.96 \text{ g Al}_2\text{O}_3} \times \frac{3 \text{ mol O}_2}{2 \text{ mol Al}_2\text{O}_3} \times \frac{32.00 \text{ g O}_2}{1 \text{ mol O}_2} = \boxed{30.75 \text{ g O}_2}$$

$\underbrace{\hspace{10em}}_{=0.6406 \text{ mol Al}_2\text{O}_3} \quad \underbrace{\hspace{10em}}_{=0.9610 \text{ mol O}_2}$

6) Dinitrogen pentoxide, N_2O_5 , is an acidic gas that reacts with water to form aqueous nitric acid:



a. Balance the chemical equation.

b. How many grams of dinitrogen pentoxide would be required to completely react with 13.44 grams of water?

$$? \text{ g N}_2\text{O}_5 = 13.44 \text{ g H}_2\text{O} \times \frac{1 \text{ mol H}_2\text{O}}{18.02 \text{ g H}_2\text{O}} \times \frac{1 \text{ mol N}_2\text{O}_5}{1 \text{ mol H}_2\text{O}} \times \frac{108.02 \text{ g N}_2\text{O}_5}{1 \text{ mol N}_2\text{O}_5} = \boxed{80.56 \text{ g N}_2\text{O}_5}$$

$\underbrace{\hspace{10em}}_{=0.7458 \text{ mol H}_2\text{O}} \quad \underbrace{\hspace{10em}}_{=0.7458 \text{ mol N}_2\text{O}_5}$

c. How many grams of dinitrogen pentoxide would be needed, given enough water, to produce 105.65 grams of nitric acid?

$$? \text{ g N}_2\text{O}_5 = 105.65 \text{ g HNO}_3 \times \frac{1 \text{ mol HNO}_3}{63.013 \text{ g HNO}_3} \times \frac{1 \text{ mol N}_2\text{O}_5}{2 \text{ mol HNO}_3} \times \frac{108.02 \text{ g N}_2\text{O}_5}{1 \text{ mol N}_2\text{O}_5} = \boxed{90.555 \text{ g N}_2\text{O}_5}$$

$\underbrace{\hspace{10em}}_{=1.676 \text{ mol HNO}_3} \quad \underbrace{\hspace{10em}}_{=0.8382 \text{ mol N}_2\text{O}_5}$

Answers: 1a) 30. mol AgI; 1b) 12 mol Ag₂CO₃; 2a) 3.2, 1.6; 2b) 3.10 mol B(OH)₃; 2c) 35.4 mol H₂SO₄; 3a) 1.5, 3.4; 3b) 4.25 mol H₂O; 3c) 14.0 mol CO₂; 4a) 177 g Cl₂; 4b) 0.435 mol C; 5a) 4.2, 3; 5b) 56.18 g Al₂O₃; 5c) 30.75 g O₂; 6a) 1, 1, 2; 6b) 80.56 g N₂O₅; 6c) 90.55 g N₂O₅