WKS 3-7 – Chem H
Stoichiometry

NAME Answer Key
Period _____ **Date** _____

I. Mole ⟷ Mole Calculations

1) Given the balanced equation, 6 AgI (aq) + $Fe_2(CO_3)_3$ (aq) → 2 FeI_3 (aq) + 3 Ag_2CO_3 (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 $Fe_2(CO_3)_3$ with enough AgI?

$$?\ \text{mol } Ag_2CO_3 = 4.0\ \text{mol } Fe_2(CO_3)_3 \times \frac{3\ \text{mol } Ag_2CO_3}{1\ \text{mol } Fe_2(CO_3)_3} = \boxed{12\ \text{mol } Ag_2CO_3}$$

2) Given the chemical equation,

__3__ H_2SO_4 (aq) + __2__ $B(OH)_3$ (s) → ___ $B_2(SO_4)_3$ (s) + __6__ H_2O (*l*)

   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?

$$?\ \text{mol } B(OH)_3 = 4.65\ \text{mol } H_2SO_4 \times \frac{2\ \text{mol } B(OH)_3}{3\ \text{mol } H_2SO_4} = \boxed{3.10\ \text{mol } B(OH)_3}$$

   c. How many moles of H_2SO_4 would be needed, given enough $B(OH)_3$, to produce 11.8 moles of $B_2(SO_4)_3$?

$$?\ \text{mol } H_2SO_4 = 11.8\ \text{mol } B_2(SO_4)_3 \times \frac{3\ \text{mol } H_2SO_4}{1\ \text{mol } B_2(SO_4)_3} = \boxed{35.4\ \text{mol } H_2SO_4}$$

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

___ C_3H_8 (g) + __5__ O_2 (g) → __3__ CO_2 (g) + __4__ H_2O (g)

   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?

$$?\ \text{mol } H_2O = 3.19\ \text{mol } CO_2 \times \frac{4\ \text{mol } H_2O}{3\ \text{mol } CO_2} = \boxed{4.25\ \text{mol } H_2O}$$

   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):

$$TiO_2(s) + C(s) + 2\ Cl_2(g) \rightarrow TiCl_4(s) + CO_2(g)$$

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

$$MM\ (Cl_2) = 2 \times 35.45\ \text{g} = 70.90\ \text{g/mol}$$

$$?\ \text{g } Cl_2 = 1.25\ \cancel{\text{mol } TiO_2} \times \frac{2\ \cancel{\text{mol } Cl_2}}{1\ \cancel{\text{mol } TiO_2}} \times \frac{70.90\ \text{g } Cl_2}{1\ \cancel{\text{mol } Cl_2}} = \boxed{177\ \text{g } Cl_2}$$

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

$MM\ (TiCl_4) = 47.87\ g + 4(35.45\ g) = 189.7\ g/mol$

$$?\ mol\ C = 82.5\ g\ TiCl_4 \times \frac{1\ mol\ TiCl_4}{189.7\ g\ TiCl_4} \times \frac{1\ mol\ C}{1\ mol\ TiCl_4} = \boxed{0.435\ mol\ C}$$

5) Aluminum oxidizes according the following unbalanced equation:

$$\_4\_\ Al(s) + \_3\_\ O_2(g) \rightarrow \_2\_\ Al_2O_3(s)$$

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?

$MM\ (Al_2O_3) = 2(26.98\ g) + 3(16.00\ g) = 101.96\ g/mol$

$$?\ g\ Al_2O_3 = 29.75\ g\ Al \times \frac{1\ mol\ Al}{26.98\ g\ Al} \times \frac{2\ mol\ Al_2O_3}{4\ mol\ Al} \times \frac{101.96\ g\ Al_2O_3}{1\ mol\ Al_2O_3} = \boxed{56.18\ g\ Al_2O_3}$$

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

$MM\ (Al_2O_3)$ above; $MM\ (O_2) = 2(16.00\ g) = 32.00\ g/mol$

$$?\ g\ O_2 = 65.32\ g\ Al_2O_3 \times \frac{1\ mol\ Al_2O_3}{101.96\ g\ Al_2O_3} \times \frac{3\ mol\ O_2}{2\ mol\ Al_2O_3} \times \frac{32.00\ g\ O_2}{1\ mol\ O_2} = \boxed{30.75\ g\ O_2}$$

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

$$\_\_\_\ N_2O_5\ (g) + \_\_\_\ H_2O\ (l) \rightarrow \_2\_\ HNO_3\ (aq)$$

a. Balance the chemical equation.

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

$MM\ (H_2O) = 2(1.008\ g) + 16.00\ g = 18.02\ g/mol$; $MM\ (N_2O_5) = 2(14.01\ g) + 5(16.00\ g) = 108.02\ g/mol$

$$?\ g\ N_2O_5 = 13.44\ g\ H_2O \times \frac{1\ mol\ H_2O}{18.02\ g\ H_2O} \times \frac{1\ mol\ N_2O_5}{1\ mol\ H_2O} \times \frac{108.02\ g\ N_2O_5}{1\ mol\ N_2O_5} = \boxed{80.56\ g\ N_2O_5}$$

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

$MM\ (HNO_3) = 1.008\ g + 14.007\ g + 3(15.999\ g) = 63.012\ g/mol$; $MM\ (N_2O_5)$ above

$$?\ g\ N_2O_5 = \underbrace{105.65\ g\ HNO_3 \times \frac{1\ mol\ HNO_3}{63.012\ g\ HNO_3} \times \frac{1\ mol\ N_2O_5}{2\ mol\ HNO_3} \times \frac{108.02\ g\ N_2O_5}{1\ mol\ N_2O_5}}_{\text{Note use of 5 SF in MM due to 5 SF in given amount.}} = \boxed{90.557\ g\ N_2O_5}$$