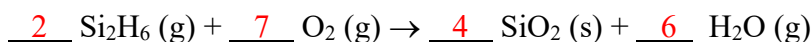


**WKS – Extra
Stoichiometry Review**

NAME Answer Key
Period _____ Date _____

- 1) Disilane (Si_2H_6) is a highly flammable gas ($D = 2.70 \text{ g/L @ } 25^\circ\text{C}$) that reacts with oxygen gas to form solid silicon dioxide (SiO_2) and water vapor:



- a. Balance the equation with the lowest whole number coefficients.
b. How many moles of oxygen would be used to completely react with 12.5 moles of disilane?

$$? \text{ mol O}_2 = 12.5 \cancel{\text{ mol Si}_2\text{H}_6} \times \frac{7 \text{ mol O}_2}{2 \cancel{\text{ mol Si}_2\text{H}_6}} = \boxed{43.8 \text{ mol O}_2}$$

- c. How many liters of disilane, at 25°C , would be needed to react with sufficient oxygen to produce 50.0 g of silicon dioxide?

$$? \text{ g Si}_2\text{H}_6 = 50.0 \cancel{\text{ g SiO}_2} \times \frac{1 \cancel{\text{ mol SiO}_2}}{60.09 \cancel{\text{ g SiO}_2}} \times \frac{2 \cancel{\text{ mol Si}_2\text{H}_6}}{4 \cancel{\text{ mol SiO}_2}} \times \frac{62.22 \text{ g Si}_2\text{H}_6}{1 \cancel{\text{ mol Si}_2\text{H}_6}} \times \frac{1 \text{ L}}{2.70 \text{ g}} = \boxed{9.59 \text{ L Si}_2\text{H}_6}$$

$\underbrace{\hspace{10em}}_{0.8321 \text{ mol SiO}_2}$
 $\underbrace{\hspace{10em}}_{0.4160 \text{ mol Si}_2\text{H}_6}$
 $\underbrace{\hspace{10em}}_{25.89}$

- d. When 27.1 L disilane @ STP (NOT 25°C) reacts with 70.1 L O_2 , also at STP, which reactant is limiting?

$$27.1 \cancel{\text{ L Si}_2\text{H}_6} \times \frac{1 \text{ mol Si}_2\text{H}_6}{22.4 \cancel{\text{ L Si}_2\text{H}_6}} = 1.21 \text{ mol Si}_2\text{H}_6; \quad 70.1 \cancel{\text{ L O}_2} \times \frac{1 \text{ mol O}_2}{22.4 \cancel{\text{ L O}_2}} = 3.13 \text{ mol O}_2$$

$$\text{equiv. Si}_2\text{H}_6 = \frac{1.21 \text{ mol Si}_2\text{H}_6}{2 \text{ mol Si}_2\text{H}_6} = 0.605; \quad \text{equiv. O}_2 = \frac{3.13 \text{ mol O}_2}{7 \text{ mol O}_2} = 0.447$$

$$0.605 > 0.447, \text{ so } \boxed{\text{O}_2 \text{ is limiting.}}$$

- e. How many L of the excess reactant remain after the reaction is complete?

$$? \text{ L Si}_2\text{H}_6 \text{ used} = 3.13 \cancel{\text{ mol O}_2} \times \frac{2 \cancel{\text{ mol Si}_2\text{H}_6}}{7 \cancel{\text{ mol O}_2}} \times \frac{22.4 \text{ L Si}_2\text{H}_6}{1 \cancel{\text{ mol Si}_2\text{H}_6}} = 20.0 \text{ L Si}_2\text{H}_6 \text{ used}$$

$\underbrace{\hspace{10em}}_{0.8941 \text{ mol Si}_2\text{H}_6}$

$$? \text{ L Si}_2\text{H}_6 \text{ remaining} = 27.1 \text{ L Si}_2\text{H}_6 \text{ present} - 20.0 \text{ L Si}_2\text{H}_6 \text{ used} = \boxed{7.1 \text{ L Si}_2\text{H}_6 \text{ remaining}}$$

- f. What is the theoretical yield of *solid* silicon dioxide from these reactants?

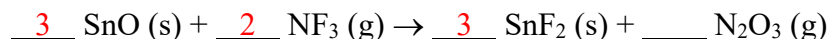
$$? \text{ g SiO}_2 = 3.13 \cancel{\text{ mol O}_2} \times \frac{4 \cancel{\text{ mol SiO}_2}}{7 \cancel{\text{ mol O}_2}} \times \frac{60.09 \text{ g SiO}_2}{1 \cancel{\text{ mol SiO}_2}} = \boxed{107 \text{ g SiO}_2}$$

$\underbrace{\hspace{10em}}_{1.79 \text{ mol SiO}_2}$

- g. After the reaction, you find that you have collected 97.8 g silicon dioxide. What is the percent yield?

$$\% \text{ Yield} = \frac{97.8 \text{ g SiO}_2}{107 \text{ g SiO}_2} \times 100\% = \boxed{91.4\%}$$

- 2) When solid tin(II) oxide reacts with nitrogen trifluoride gas, solid tin(II) fluoride and gaseous dinitrogen trioxide are produced.



- a. Balance the equation with the lowest whole number coefficients.
 b. How many moles of tin(II) oxide would be needed to form 29.4 L of N_2O_3 at STP?

$$? \text{ mol SnO} = 29.4 \text{ L N}_2\text{O}_3 \times \frac{1 \text{ mol N}_2\text{O}_3}{22.4 \text{ L N}_2\text{O}_3} \times \frac{3 \text{ mol SnO}}{1 \text{ mol N}_2\text{O}_3} = \boxed{3.94 \text{ mol SnO}}$$

1.313 mol N_2O_3

- c. How many grams of tin(II) oxide would be needed to completely react with 44.1 L of nitrogen trifluoride (D = 2.90 g/L @ 25°C)?

$$? \text{ g SnO} = 44.1 \text{ L NF}_3 \times \frac{2.90 \text{ g NF}_3}{1 \text{ L NF}_3} \times \frac{1 \text{ mol NF}_3}{71.01 \text{ g NF}_3} \times \frac{3 \text{ mol SnO}}{2 \text{ mol NF}_3} \times \frac{134.7 \text{ g SnO}}{1 \text{ mol SnO}} = \boxed{364 \text{ g SnO}}$$

127.9 g NF_3 1.801 mol NF_3 2.702 mol SnO

- d. When 158.9 g tin(II) oxide reacts with 62.5 g nitrogen trifluoride, which reactant is limiting?

$$158.9 \text{ g SnO} \times \frac{1 \text{ mol SnO}}{134.7 \text{ g SnO}} = 1.180 \text{ mol SnO}; \quad 62.5 \text{ g NF}_3 \times \frac{1 \text{ mol NF}_3}{71.01 \text{ g NF}_3} = 0.880 \text{ mol NF}_3$$

$$\text{equiv. SnO} = \frac{1.180 \text{ mol SnO}}{3 \text{ mol SnO}} = 0.3933; \quad \text{equiv. NF}_3 = \frac{0.880 \text{ mol NF}_3}{2 \text{ mol NF}_3} = 0.440$$

$$0.3933 < 0.440 \text{ so } \boxed{\text{SnO is limiting}}$$

- e. How many grams of the excess reactant remain after the reaction is complete?

$$? \text{ g NF}_3 \text{ used} = 1.180 \text{ mol SnO} \times \frac{2 \text{ mol NF}_3}{3 \text{ mol SnO}} \times \frac{71.01 \text{ g NF}_3}{1 \text{ mol NF}_3} = 55.86 \text{ g NF}_3 \text{ used}$$

0.7867 mol NF_3

$$? \text{ g NF}_3 \text{ remaining} = 62.5 \text{ g NF}_3 \text{ present} - 55.86 \text{ g NF}_3 \text{ used} = \boxed{6.6 \text{ g NF}_3 \text{ remaining}}$$

- f. What is the theoretical yield of dinitrogen trioxide from these reactants?

$$? \text{ g N}_2\text{O}_3 = 1.180 \text{ mol SnO} \times \frac{1 \text{ mol N}_2\text{O}_3}{3 \text{ mol SnO}} \times \frac{76.02 \text{ g N}_2\text{O}_3}{1 \text{ mol N}_2\text{O}_3} = \boxed{29.90 \text{ g N}_2\text{O}_3}$$

0.3933 mol N_2O_3

- g. After the reaction, you isolate 24.8 g dinitrogen trioxide. What is the percent yield?

$$\% \text{ Yield} = \frac{24.8 \text{ g N}_2\text{O}_3}{29.90 \text{ g N}_2\text{O}_3} \times 100\% = \boxed{82.9\%}$$