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Stoichiometry Worksheet 3 – Gram-to-Gram Calculations

Learning Target: Students will calculate the theoretical yield in moles and grams

Textbook Section: 9.2

Directions: You must solve each of the following problems using dimensional analysis. EVERY number in your work should be followed by a unit and a formula.

12+16

1. For this reaction: $\text{Fe}_3\text{O}_4 + 4 \text{CO} \rightarrow 3 \text{Fe} + 4 \text{CO}_2$

a. How many grams of iron are produced from 23.2 grams of carbon monoxide?

$$\frac{23.2 \text{ g CO}}{1} \cdot \frac{1 \text{ mole CO}}{28 \text{ g CO}} \cdot \frac{3 \text{ mole Fe}}{4 \text{ mole CO}} \cdot \frac{56 \text{ g Fe}}{1 \text{ mole Fe}} = \frac{3897.6 \text{ g Fe}}{112} = \boxed{34.8 \text{ g Fe}}$$

b. How many grams of carbon dioxide are produced to react with 0.945 grams of Fe_3O_4 ?

$$\frac{0.945 \text{ g Fe}_3\text{O}_4}{1} \cdot \frac{1 \text{ mole Fe}_3\text{O}_4}{232 \text{ g Fe}_3\text{O}_4} \cdot \frac{4 \text{ mole CO}_2}{1 \text{ mole Fe}_3\text{O}_4} \cdot \frac{44 \text{ g CO}_2}{1 \text{ mole CO}_2} = \frac{166.32 \text{ g CO}_2}{232} = \boxed{0.718 \text{ g CO}_2}$$

(56x3)+(16x4) = 232

2. For this reaction: $6 \text{PbO} + \text{O}_2 \rightarrow 2 \text{Pb}_3\text{O}_4$

a. How many grams of Pb_3O_4 are produced from 7.85 grams of lead(II) oxide?

$$\frac{7.85 \text{ g PbO}}{1} \cdot \frac{1 \text{ mole PbO}}{223 \text{ g PbO}} \cdot \frac{2 \text{ mole Pb}_3\text{O}_4}{6 \text{ mole PbO}} \cdot \frac{685 \text{ g Pb}_3\text{O}_4}{1 \text{ mole Pb}_3\text{O}_4} = \frac{10,754.5 \text{ g Pb}_3\text{O}_4}{1,338} = \boxed{8.04 \text{ g Pb}_3\text{O}_4}$$

16+207=223

b. How many grams of lead(II) oxide must react with 1.75 grams of oxygen?

$$\frac{1.75 \text{ g O}_2}{1} \cdot \frac{1 \text{ mole O}_2}{32 \text{ g O}_2} \cdot \frac{6 \text{ mole PbO}}{1 \text{ mole O}_2} \cdot \frac{223 \text{ g PbO}}{1 \text{ mole PbO}} = \frac{2341.5 \text{ g PbO}}{32} = \boxed{73.2 \text{ g PbO}}$$

16+16=32

3. For this reaction: $4 \text{Al} + 3 \text{O}_2 \rightarrow 2 \text{Al}_2\text{O}_3$

a. How many grams of aluminum oxide will be formed from 17 grams of aluminum reacting?

$$\frac{17 \text{ g Al}}{1} \cdot \frac{1 \text{ mole Al}}{27 \text{ g Al}} \cdot \frac{2 \text{ mole Al}_2\text{O}_3}{4 \text{ mole Al}} \cdot \frac{102 \text{ g Al}_2\text{O}_3}{1 \text{ mole Al}_2\text{O}_3} = \frac{3,468 \text{ g Al}_2\text{O}_3}{108} = \boxed{32 \text{ g Al}_2\text{O}_3}$$

(27x2)+(16x3) = 102

b. How many grams of oxygen are needed to react with 12.8 grams of aluminum?

$$\frac{12.8 \text{ g Al}}{1} \cdot \frac{1 \text{ mole Al}}{27 \text{ g Al}} \cdot \frac{3 \text{ mole O}_2}{4 \text{ mole Al}} \cdot \frac{32 \text{ g O}_2}{1 \text{ mole O}_2} = \frac{1228.8 \text{ g O}_2}{108} = \boxed{11.4 \text{ g O}_2}$$

4. For this reaction: $4 \text{NH}_3 + 5 \text{O}_2 \rightarrow 4 \text{NO} + 6 \text{H}_2\text{O}$

a. How many grams of oxygen are needed to react with 1.24 grams of NH_3 ?

$$\frac{1.24 \text{ g NH}_3}{1} \cdot \frac{1 \text{ mole NH}_3}{17 \text{ g NH}_3} \cdot \frac{5 \text{ mole O}_2}{4 \text{ mole NH}_3} \cdot \frac{32 \text{ g O}_2}{1 \text{ mole O}_2} = \frac{198.4 \text{ g O}_2}{68} = \boxed{2.91 \text{ g O}_2}$$

14+(1x3) = 17

b. How many grams of water are produced from 7.65 grams of oxygen?

$$\frac{7.65 \text{ g O}_2}{1} \cdot \frac{1 \text{ mole O}_2}{32 \text{ g O}_2} \cdot \frac{6 \text{ mole H}_2\text{O}}{5 \text{ mole O}_2} \cdot \frac{18 \text{ g H}_2\text{O}}{1 \text{ mole H}_2\text{O}} = \frac{826.2 \text{ g H}_2\text{O}}{160} = \boxed{5.17 \text{ g H}_2\text{O}}$$

1a) 34.7 g iron

1b) 0.718 g carbon dioxide

2a) 8.04 g Pb_3O_4

2b) 73.2 g lead(II) oxide

3a) 32 g aluminum oxide

3b) 11.4 g oxygen

4a) 2.91 g oxygen

4b) 5.17 g water