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.

1. For this reaction: $Fe_3O_4 + 4\ CO \rightarrow 3\ Fe + 4\ CO_2$
   a. How many grams of iron are produced from 23.2 grams of carbon monoxide?

   $\frac{23.2\,g\,CO}{1} \cdot \frac{1\ mole\ CO}{28\,g\,CO} \cdot \frac{3\ moles\ Fe}{4\ mole\ CO} \cdot \frac{56\,g\,Fe}{1\ mole\ Fe} = 34.8\,g\,Fe$

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

   $\frac{0.945\,g\,Fe_3O_4}{1} \cdot \frac{1\ mole\ Fe_3O_4}{232\,g\,Fe_3O_4} \cdot \frac{4\ moles\ CO_2}{1\ mole\ Fe_3O_4} \cdot \frac{44\,g\,CO_2}{1\ mole\ CO_2} = 0.717\,g\,CO_2$

2. For this reaction: $6\ PbO + O_2 \rightarrow 2\ Pb_3O_4$
   a. How many grams of Pb_3O_4 are produced from 7.85 grams of lead(II) oxide?

   $\frac{7.85\,g\,PbO}{1} \cdot \frac{1\ mole\ PbO}{223\,g\,PbO} \cdot \frac{2\ Pb_3O_4}{6\ mole\ PbO} \cdot \frac{685\,g\,Pb_3O_4}{1\ mole\ Pb} = 8.04\,g\,Pb_3O_4$

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

   $\frac{1.75\,g\,O_2}{1} \cdot \frac{1\ mole\ O_2}{32\,g\,O_2} \cdot \frac{6\ mole\ PbO}{1\ mole\ O_2} \cdot \frac{223\,g\,PbO}{1\ mole\ PbO} = 73.2\,g\,PbO$

3. For this reaction: $4\ Al + 3\ O_2 \rightarrow 2\ Al_2O_3$
   a. How many grams of aluminum oxide will be formed from 17 grams of aluminum reacting?

   $\frac{17\,g\,Al}{1} \cdot \frac{1\ mole\ Al}{27\,g\,Al} \cdot \frac{2\ mole\ Al_2O_3}{4\ mole\ Al} \cdot \frac{102\,g\,Al_2O_3}{1\ mole\ Al_2O_3} = 32\,g\,Al_2O_3$

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

   $\frac{12.8\,g\,Al}{1} \cdot \frac{1\ mole\ Al}{27\,g\,Al} \cdot \frac{3\ moles\ O_2}{4\ moles\ Al} \cdot \frac{32\,g\,O_2}{1\ mole\ O_2} = 11.4\,g\,O_2$

4. For this reaction: $4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O$
   a. How many grams of oxygen are needed to react with 1.24 grams of NH_3?

   $\frac{1.24\,g\,NH_3}{1} \cdot \frac{1\ mole\ NH_3}{17\,g\,NH_3} \cdot \frac{5\ moles\ O_2}{4\ mole\ NH_3} \cdot \frac{32\,g\,O_2}{1\ mole\ O_2} = 2.92\,g\,O_2$

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

   $\frac{7.65\,g\,O_2}{1} \cdot \frac{1\ mole\ O_2}{32\,g\,O_2} \cdot \frac{6\ moles\ H_2O}{5\ moles\ O_2} \cdot \frac{18\,g\,H_2O}{1\ mole\ H_2O} = 5.16\,g\,H_2O$

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