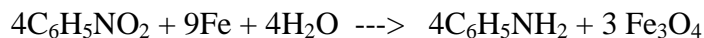


**1. Mole to Mole Conversions:**

**Objective:** Given the moles or number of atoms of one species be able to predict the moles or atoms of another species consumed or produced from a balanced chemical equation.

(in class)

Aniline, ( $C_6H_5NH_2$ ) can be formed from nitro benzene ( $C_6H_5NO_2$ ) by the following equation:



1.a. Write the conversion factor converting moles iron to moles aniline

$$\left( \frac{4 \text{ mol } C_6H_5NH_2}{9 \text{ mol } Fe} \right)$$

1.b. How many moles of aniline would be formed if 3.78 moles of iron was consumed?

$$3.78 \text{ mol } Fe \left( \frac{4 \text{ mol } C_6H_5NH_2}{9 \text{ mol } Fe} \right) = 1.68 \text{ mol } C_6H_5NH_2$$

(take home)

1.c. Write the conversion factor converting moles nitrobenzene to moles  $Fe_3O_4$ .

$$\left( \frac{3 \text{ mol } Fe_3O_4}{4 \text{ mol } C_6H_5NO_2} \right)$$

1.d. Write the conversion factor describing the ratio of the consumption of iron to the consumption of nitrobenzene.

$$\left( \frac{9 \text{ mol } Fe}{4 \text{ mol } C_6H_5NO_2} \right)$$

1.e. How many moles of nitrobenzene would be needed to produce 4.678 Mmoles of  $Fe_3O_4$ ?

$$4.678 \text{ Mmol } Fe_3O_4 \left( \frac{10^6 \text{ mol } Fe_3O_4}{\text{Mmol } Fe_3O_4} \right) \left( \frac{4 \text{ mol } C_6H_5NO_2}{3 \text{ mol } Fe_3O_4} \right) \\ = 6.237 \times 10^6 \text{ mol } C_6H_5NO_2 \text{ or } 6.237 \text{ Mmol } C_6H_5NO_2$$

1.f. How many moles of iron would be needed to consume  $3.56 \times 10^{22}$  molecules of nitrobenzene?

$$3.56 \times 10^{22} \text{ molecule } C_6H_5NO_2 \left( \frac{\text{mol } C_6H_5NO_2}{6.022 \times 10^{23} \text{ molecule}} \right) \left( \frac{9 \text{ mol } Fe}{4 \text{ mol } C_6H_5NO_2} \right) = 0.133 \text{ mol } Fe$$

1.g. How many atoms of iron are consumed if 3.59 nmoles of water are consumed?

$$3.59 \text{ nmol } H_2O \left( \frac{10^{-9} \text{ mol } H_2O}{\text{nmol}} \right) \left( \frac{9 \text{ mol } Fe}{4 \text{ mol } H_2O} \right) \left( \frac{6.022 \times 10^{23} \text{ atom } Fe}{\text{mol } Fe} \right) = 4.86 \times 10^{15} \text{ atom } Fe$$

## 2. Mass to Mass or Mass to Mole Conversions

**Objective:** Given the mass one species be able to predict the mass another species consumed or produced from a balanced chemical equation.

**Technique:** This is a three step process which should be done in one equation which uses three conversion factors.

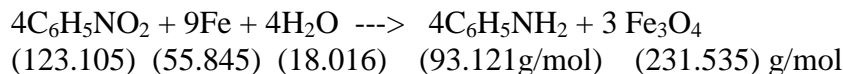
Conversion Factor #1: Use molar mass to convert mass of known material to moles.

Conversion Factor #2: Use coefficients of balanced reaction equation to convert moles of known material to moles of desired material.

Conversion Factor # 3: Use molar mass to convert moles of desired material to mass of desired material.

(in class)

Aniline, ( $C_6H_5NH_2$ ) can be formed from nitro benzene ( $C_6H_5NO_2$ ) by the following equation:



2.a. How many grams of aniline would be formed if 3.78 moles of iron was consumed?

$$3.78 \text{ mol Fe} \left( \frac{4 \text{ mol } C_6H_5NH_2}{9 \text{ mol Fe}} \right) \left( \frac{93.121 \text{ g } C_6H_5NH_2}{\text{mol}} \right) = 156 \text{ g } C_6H_5NH_2$$

2.b. How many grams of nitrobenzene would be needed to produce 4.678 kg of  $Fe_3O_4$ ?

$$4.678 \text{ kg } Fe_3O_4 \left( \frac{10^3 \text{ g } Fe_3O_4}{\text{kg}} \right) \left( \frac{\text{mol } Fe_3O_4}{231.535 \text{ g } Fe_3O_4} \right) \left( \frac{4 \text{ mol } C_6H_5NO_2}{3 \text{ mol } Fe_3O_4} \right) \left( \frac{123.105 \text{ g } C_6H_5NO_2}{\text{mol}} \right)$$

$$= 3.316 \times 10^3 \text{ g } C_6H_5NO_2 \text{ or } 3.316 \text{ kg } C_6H_5NO_2$$

(take home)

2.c. How many grams of iron would be needed to consume  $3.56 \times 10^{22}$  molecules of nitrobenzene?

$$3.56 \times 10^{22} \text{ molecule } C_6H_5NO_2 \left( \frac{\text{mol } C_6H_5NO_2}{6.022 \times 10^{23} \text{ molecule}} \right) \left( \frac{9 \text{ mol Fe}}{4 \text{ mol } C_6H_5NO_2} \right) \left( \frac{55.845 \text{ g Fe}}{\text{mol}} \right) = 7.43 \text{ g Fe}$$

2.d. How many grams of iron are consumed if 3.59 ng of water are consumed?

$$3.59 \text{ ng } H_2O \left( \frac{10^{-9} \text{ g } H_2O}{\text{ng}} \right) \left( \frac{\text{mol } H_2O}{18.016 \text{ g } H_2O} \right) \left( \frac{9 \text{ mol Fe}}{4 \text{ mol } H_2O} \right) \left( \frac{55.845 \text{ g atom Fe}}{\text{mol Fe}} \right) = 2.50 \times 10^{-8} \text{ g Fe or } 25.0 \text{ ng Fe}$$

2.e. How many grams of aniline are produced if 22.45 g of  $Fe_3O_4$  are also produced?

$$22.45 \text{ g } Fe_3O_4 \left( \frac{\text{mol } Fe_3O_4}{231.535 \text{ g } Fe_3O_4} \right) \left( \frac{4 \text{ mol } C_6H_5NH_2}{3 \text{ mol } Fe_3O_4} \right) \left( \frac{93.121 \text{ g } C_6H_5NH_2}{\text{mol}} \right) = 12.04 \text{ g } C_6H_5NH_2$$