Stoichiometry Practice 2
"Theoretical Yield"
"Percent Yield"

4.97 Various members of a class of compounds called alkenes (Chapter 11), react with hydrogen to produce a corresponding alkane (Chapter 10). Termed hydrogenation, this type of

reaction is used to produce products such as margarine. A typical hydrogenation reaction is

$$\underset{\text{Decene}}{C_{10}H_{20}(l)} + H_2(g) \longrightarrow \underset{\text{Decane}}{C_{10}H_{22}(s)}$$

How much decane can be produced in a reaction of excess decene with 1.00 g hydrogen?

4.98 A Human Perspective: Alcohol Consumption and the Breathalyzer Test (Chapter 12), describes the reaction between the dichromate ion and ethanol to produce acetic acid. How much acetic acid can be produced from a mixture containing excess of dichromate ion and 1.00×10^{-1} g of ethanol?

4.99 A rocket can be powered by the reaction between dinitrogen tetroxide and hydrazine:

$$N_2O_4(l) + 2N_2H_4(l) \longrightarrow 3N_2(g) + 4H_2O(g)$$

An engineer designed the rocket to hold 1.00 kg N_2O_4 and excess N_2H_4. How much N_2 would be produced according to the engineer's design?

4.100 A 4.00-g sample of Fe_3O_4 reacts with O_2 to produce Fe_2O_3:

$$4Fe_3O_4(s) + O_2(g) \longrightarrow 6Fe_2O_3(s)$$

Determine the number of g of Fe_2O_3 produced.

4.101 If the actual yield of decane in Problem 4.97 is 65.4 g, what is the % yield?

4.102 If the actual yield of acetic acid in Problem 4.98 is 0.110 g, what is the % yield?

4.103 If the % yield of nitrogen gas in Problem 4.99 is 75.0%, what is the actual yield of nitrogen?

4.104 If the % yield of Fe_2O_3 in Problem 4.100 is 90.0%, what is the actual yield of Fe_2O_3?

Stoichiometry 2 - Theoretical Yield

4.97 $C_{10}H_{20}(l) + H_2(g) \longrightarrow C_{10}H_{22}(s)$

$$\frac{1.00\,g\,H_2}{} \left|\, \frac{1\,mol\,H_2}{2.02\,g\,H_2} \,\right|\, \frac{1\,mol\,C_{10}H_{22}}{1\,mol\,H_2} \,\left|\, \frac{142.32\,g\,C_{10}H_{22}}{1\,mol\,C_{10}H_{22}} \right. = \boxed{70.5\,g\,C_{10}H_{22}}$$

4.98 $16H^+ + 2Cr_2O_7^{2-} + \underset{\text{ethanol}}{3CH_3CH_2OH} \longrightarrow 3CH_3COOH + 4Cr^{3+} + 11H_2O$

$$\frac{0.100\text{ ethanol}}{} \left|\, \frac{1\text{ mol ethanol}}{46.08\text{ g ethanol}} \,\right|\, \frac{3\text{ mol acetic acid}}{3\text{ mol ethanol}} \,\left|\, \frac{60.06\text{ g acetic acid}}{1\text{ mol acetic acid}} \right.$$

$$= \boxed{0.130\text{ g acetic acid}}$$

4.99 $N_2O_4(l) + 2N_2H_4(l) \longrightarrow 3N_2(g) + 4H_2O(g)$

$$1.00\,kg\,N_2O_4 \rightarrow \frac{1\bar{0}00\,g\,N_2O_4}{} \left|\, \frac{1\,mol\,N_2O_4}{92.02\,g\,N_2O_4} \,\right|\, \frac{3\,mol\,N_2}{1\,mol\,N_2O_4} \,\left|\, \frac{28.02\,g\,N_2}{1\,mol\,N_2} \right.$$

$$= \boxed{913\,g\,N_2}$$

4.100 $4Fe_3O_4(s) + O_2(g) \longrightarrow 6Fe_2O_3(s)$

Fe: 55.845

$$\frac{4.00\,g\,Fe_3O_4}{} \left|\, \frac{1\,mol\,Fe_3O_4}{231.535\,g\,Fe_3O_4} \,\right|\, \frac{6\,mol\,Fe_2O_3}{4\,mol\,Fe_3O_4} \,\left|\, \frac{159.69\,g\,Fe_2O_3}{1\,mol\,Fe_2O_3} \right. = \boxed{4.14\,g\,Fe_2O_3}$$

4.101 $C_{10}H_{22}$

$AY = 65.4\,g$

$TY = 70.5\,g$

$$\frac{AY}{TY} \times 100\% = \frac{65.4\,g}{70.5\,g} \times 100 = \boxed{92.8\%}$$

4.102 Acetic acid

$AY = 0.110g$

$TY = 0.130g$

$$\frac{AY}{TY} \times 100\% = \frac{0.110g}{0.130g} \times 100\% = \boxed{84.6\%}$$

4.103 N_2

$AY = ?$

$TY = 913g\ N_2$

$$\frac{AY}{TY} \times 100\% = 75.0\%$$

$$\frac{AY}{913\ g} = 0.75$$

$$\boxed{AY = 685g\ N_2}$$

4.104 Fe_2O_3

$AY = ?$

$TY = 4.14g$

$$\frac{AY}{4.14g} \times 100 = 90.0\%$$

$$AY = \boxed{3.73g\ Fe_2O_3}$$