% Yield

$$\%\ \text{yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100$$

- actual yield (AY) - actual amount of product made if you really did the reaction
- theoretical yield (TY) - amount of product you get by doing stoichiometry, what you would get if everything were perfect

Examples

1) Ethanol (C_2H_5OH) is produced from the fermentation of sugar ($C_{12}H_{22}O_{11}$) in the presence of enzymes.

$$C_{12}H_{22}O_{11}(aq) + H_2O(g) \rightarrow 4\,C_2H_5OH(l) + 4\,CO_2(g)$$

Determine the theoretical yield of ethanol if 684 g (GIVEN) of sugar undergoes fermentation. What is the % yield if 349 g of ethanol are actually produced? (GIVEN AY)

$$684\text{ g } C_{12}H_{22}O_{11} \left|\frac{1\text{ mol } C_{12}H_{22}O_{11}}{342.34\text{ g } C_{12}H_{22}O_{11}}\right| \frac{4\text{ mol } C_2H_5OH}{1\text{ mol } C_{12}H_{22}O_{11}} \left|\frac{46.08\text{ g } C_2H_5OH}{1\text{ mol } C_2H_5OH}\right| = 368\text{ g } C_2H_5OH \text{ (TY)}$$

MM $C_{12}H_{22}O_{11}$: C 12 × 12.01 g = 144.12 g; H 22 × 1.01 g = 22.22 g; O 11 × 16.00 g = 176.00 g; 342.34 g

MM C_2H_5OH: C 2 × 12.01 g; H 6 × 1.01 g; O 1 × 16.00 g

24.02
6.06
16.00
46.08 g

$$\%\ \text{yield} = \frac{AY}{TY} \times 100 = \frac{349\text{ g}}{368\text{ g}} \times 100 = 94.8\%$$

2. Lead (II) oxide is obtained by roasting galena (lead (II) sulfide), in air. The unbalanced equation is:

$$2\,PbS(s) + O_2(g) \rightarrow 2\,PbO(s) + 2\,SO_2(g)$$

A. Balance the equation and determine the theoretical yield of lead (II) oxide if 200.0g of lead (II) sulfide is heated.

GIVEN

B. What is the % yield if 170.0g of lead (II) oxide is obtained?

AY

$$200.0\,g\,PbS \times \frac{1\,mol\,PbS}{239.27\,g\,PbS} \times \frac{2\,mol\,PbO}{2\,mol\,PbS} \times \frac{223.20\,g\,PbO}{1\,mol\,PbO} = 186.6\,g\,PbO$$

TY

MM Pb 207.20g
S + 32.07g
239.27g

Pb 207.20g
O + 16.00g
223.20g

$$\%\,yield = \frac{AY}{TY} \times 100$$

$$= \frac{170.0\,g}{186.6\,g} \times 100$$

$$= 91.10\,\%$$

3. Upon heating, calcium carbonate decomposes to calcium oxide and carbon dioxide.

A. Write the balanced equation and determine the theoretical yield of CO_2 when 235.0g of calcium carbonate is heated.

B. What is the % yield if 97.5g of carbon dioxide is collected?