Answer on Question #85059 – Chemistry – Other

Task:

In an extremely explosive reaction between Glucose ($C_6H_{12}O_6$) and Oxygen, 294.7 g of water is produced when 500 grams of glucose is combusted. What is the percent yield of this reaction? (remember that the products of a combustion reaction are water and carbon dioxide).

Solution:

The equation for the combustion of glucose is:

$$C_6H_{12}O_6 + 6O_2 = 6CO_2 + 6H_2O$$

Molar Masses of Glucose and Water:

$$M(C_6H_{12}O_6) = 6 * Ar(C) + 12 * Ar(H) + 6 * Ar(O);$$

$$M(C_6H_{12}O_6) = 6*12 + 12*1 + 6*16 = 180 \,{}^{g}\!/\!{}_{mol}$$

$$M(H_2O) = 2 * Ar(H) + Ar(O) = 2*1 + 16 = 18 \,{}^{g}\!/\!{}_{mol}$$

According to the chemical reaction equation:

$$n(C_6H_{12}O_6) = \frac{n(H_2O)}{6};$$

$$\frac{m(C_6H_{12}O_6)}{M(C_6H_{12}O_6)} = \frac{m(H_2O)}{6 * M(H_2O)};$$

Then,

$$m_{theor}(H_2O) = \frac{6 * M(H_2O) * m(C_6H_{12}O_6)}{M(C_6H_{12}O_6)};$$

$$m_{theor}(H_2O) = \frac{6*18 \,{}^{g}\!/\!{}_{mol} * 500g}{180 \,{}^{g}\!/\!{}_{mol}} = 300g$$

The percentage yield is calculated by dividing the amount of the obtained desired product by the theoretical yield:

$$percent\ yield = \frac{actual\ yield}{theoretical\ yield} * 100\%$$

$$m_{theor}(H_2O) = 300g$$
$$m_{actual}(H_2O) = 294.7g$$

Since less than what was calculated was actually produced, it means that the reaction's percent yield must be *smaller* than 100%.

$$\% \, yield = \frac{m_{actual}(H_2O)}{m_{theor}(H_2O)} * 100\%$$
$$\% \, yield = \frac{294.7g}{300g} * 100\% = 98.23\%$$
$$\% \, yield = 98.23\%$$

Answer: 98.23% is the percent yield of this reaction.