Review: Calculations for Organic II Chemistry Labs

Recall that a molecular formula tells you the mole ratio of elements in a compound. The molecular formula $C_5H_{10}O$ tells you that there are 5 moles of carbon for every 10 moles of hydrogen and one mole of oxygen.

Consider the following generic reaction:

$$A + B \rightarrow C$$

One mole of A reacts with one mole of B to form one mole of C. Yes?

What about the next equation?

$$2A + B \rightarrow C$$

Two moles of A react with one mole of B to form one mole of C. Make sense?

And one more example:

$$A + B \rightarrow 2C$$

One mole of A reacts with one mole of B but this time you form two moles of C.

The molar ratios of reagents will play a role in determining the limiting reagent.
The molar ratio between the limiting reagent and the product will affect the theoretical yield.

Determination of Molar Amounts:
Calculate the number of moles for each reagent (do not calculate for solvent or for a catalyst)
Starting from a Volume:

X moles = volume (mL) times density (g/mL) divided by molecular weight (g/mole)

Starting from a Weight:

X moles = grams (g) divided by molecular weight (g/mol)

Determine the limiting reagent (that which would produce the smallest amount of possible products): This is based on the mole ratios from the balanced chemical equation. If you have 0.500 moles of A and 0.600 moles of B, and they react in a 1:1 ratio, you have less of A. A would be the limiting reagent. If you have 0.500 moles of A and 0.600 moles of B, and they react in a 2:1 ratio, then you need to consider the ratio. 0.500 moles of A would need 0.250 moles of B. You have plenty of B! A is the limiting reagent.

To determine theoretical yield: First determine which species is the limiting reagent because the number of moles of product you will make is dependent on the molar amount of your limiting reagent. Then, multiply the possible number of moles of product by the molecular weight of the product to convert to grams.

To determine the percent yield: Divide the actual yield made in the lab by the calculated theoretical amount, and multiply by 100.

For a synthesis – to find the overall percent yield, multiply the individual percent yields of every step by each other (ex. 3 steps, all 30% yield – 0.30 x 0.30 x 0.30 = 0.27 **x 100** = 27% overall). Alternatively, you can take the limiting reagent molar amount of the first step and multiply it by the molecular weight of the FINAL product. Same answer!