Problem

Ethanol (C_2H_5OH) can be burned in the presence of molecular oxygen to give water and carbon dioxide gas. The chemical reaction can be written like this:

$$C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(g)$$

1) If you start with 250. g of ethanol and burn it in sufficient oxygen, how many grams of water could you produce?

2) How much ethanol would you need to burn to produce 550. g of carbon dioxide?

The first question

This is really two problems involving the same reaction. Both of the problems are solved the same way - by using dimensional analysis.

For the first question, you should start by calculating the formula weights of the two substances you are being asked about. You need formula weights every time you deal with relating masses of chemicals to a chemical reaction - which requires amounts to be given in moles.

- C_2H_5OH: 46.07 g/mol
- H_2O: 18.01 g/mol

Now, we use dimensional analysis. Remember that the formula weights are conversion factors that convert between grams and moles. The coefficients in the chemical equation also give you a conversion factor that relates moles of ethanol with moles of water. The steps:

1. Convert grams ethanol to moles ethanol.
2. Convert moles ethanol to moles water.
3. Convert moles water to grams water.

$$250.\,\text{g}\,C_2H_5OH \times \frac{\text{mol}\,C_2H_5OH}{46.07\,\text{g}\,C_2H_5OH} \times \frac{3\,\text{mol}\,H_2O}{1\,\text{mol}\,C_2H_5OH} \times \frac{18.02\,\text{g}\,H_2O}{\text{mol}\,H_2O} =$$

The answer is **293 g H_2O**

The second question

The second question is answered the same way as the first. You can relate *any two* chemical compounds in a chemical equation, as long as the .equation is balanced.

Again, we need some formula weights:

- C_2H_5OH: 46.07 g/mol
- CO_2: 44.01 g/mol

The procedure:

1. Convert grams carbon dioxide to moles carbon dioxide.
2. Convert moles carbon dioxide to moles ethanol.
3. Convert moles ethanol to grams ethanol.

$$550.\,\text{g}\,\text{CO}_2 \times \frac{\text{mol}\,\text{CO}_2}{44.01\,\text{g}\,\text{CO}_2} \times \frac{1\,\text{mol}\,\text{C}_2\text{H}_5\text{OH}}{2\,\text{mol}\,\text{CO}_2} \times \frac{46.07\,\text{g}\,\text{C}_2\text{H}_5\text{OH}}{\text{mol}\,\text{C}_2\text{H}_5\text{OH}} =$$

The answer is **288 g C_2H_5OH**