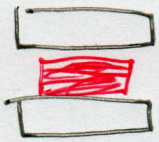
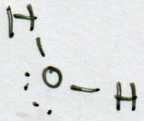
4/30/19





Chemical reactions occur on the basis of numbers, not mass.

$$\underbrace{2\,H_2(g) + O_2(g)}_{\text{reactants}} \longrightarrow \underbrace{2\,H_2O(\ell)}_{\text{products}}$$

Suppose you were given the task of making grilled cheese sandwiches, and you were given 100g of bread and 50g of cheese. You know there is a ratio of two pieces of bread per one piece of cheese, but unless you knew how much mass there was in each slice of bread or each slice of cheese, you wouldn't be able to determine how many sandwiches could be made.

Similarly, if you knew two molecules of H_2 reacted with one molecule of O_2 to make water, if you were given 20g of H_2 and 20g of O_2, you wouldn't be able to determine how much water could be made unless you knew how many molecules of H_2 there were and how many molecules of O_2 there were. In other words, you have to convert from mass to a number.

combustion – a reaction of oxygen

complete combustion – oxygen reacts completely and as efficiently as possible; if it reacts with carbon, it only forms CO_2.

$$C_3H_{8(g)} + 5O_{2(g)} \longrightarrow 3CO_{2(g)} + 4H_2O_{(\ell)}$$

↙ State symbol – indicates whether a substance is in solid (s), liquid (ℓ), or gas (g) form.

Imagine 10.0 g of propane (C_3H_8) under complete combustion in oxygen, How many grams of CO_2 are produced?

To answer this question, there are three conversions that must be done!

mass of propane ⟶ moles of propane ⟶ moles of CO_2 ⟶ mass of CO_2

molar mass of C_3H_8 = $3 \times 12.01\ g_C + 8 \times 1.01\ g = 44.11\ \frac{g\ C_3H_8}{mol}$

molar mass of CO_2 = $1 \times 12.01_C + 2 \times 16.00_O = 44.01\ \frac{g\ CO_2}{mol}$

$$\frac{10.0\ g\ C_3H_8}{1} \times \frac{1\ mol\ C_3H_8}{44.11\ g\ C_3H_8} \times \frac{3\ mol\ CO_2}{1\ mol\ C_3H_8} \times \frac{44.01\ g\ CO_2}{1\ mol\ CO_2} = 29.93\ g\ CO_2$$

mass propane → moles propane → moles CO_2 → mass CO_2