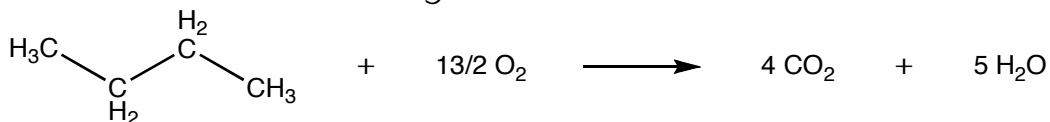


## MiniChem 5: The Chemical Sentence

A sample chemical "sentence" is given below:



This "sentence" describes the reaction of butane with oxygen to give carbon dioxide and water. This type of reaction is called a combustion reaction. This sentence stipulates that 1 mole of  $\text{C}_4\text{H}_{10}$  will react with  $13/2$  moles of  $\text{O}_2$  to give 4 moles of  $\text{CO}_2$  and 5 moles of water. Note that the equation is balanced, i.e. the number of moles of each element is the same on both sides of the arrow. The chemical substances on the right-hand side of the arrow are called reactants while those on the left-hand side of the arrow are called products. This kind of sentence is a lot simpler and more useful than this other sentence: "58 g of butane react with 208 g of oxygen to produce 176 g of carbon dioxide and 90 g of water". Note that the total mass of the reactants equals the total mass of the products (266 g).

In order to use a chemical sentence you need first to convert whatever extensive property is used to measure quantities of reactants or products into the corresponding number of moles. Thus:

If one is measuring a mass: ( $m$ )

- $m \rightarrow n$  by  $n = m / M$  where  $M$  is the molecular weight of the substance and  $n$  is the number of moles.

If one is measuring a volume ( $V$ )

- $V \rightarrow m$  by  $m = d \times V$  where  $d$  is the density of the substance and then  $m \rightarrow n$  as above.
- Alternatively  $V \rightarrow n$  if the concentration (molarity),  $c$  in mol/L, of the substance is known by  $n = c \times V$

Note a substance may also be taken out from a bottle in which its concentration is expressed in % by mass or % by volume of solution rather than in moles per liter of solution.

Related concepts: limiting reagent, excess reagent, yield of reaction.

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