Advice on balancing chemical reactions

Takes practice.

The quickest approach can vary.

General guidelines:

1. Leave the more complicated formulas "as is", and use the less complicated formulas to try to "fill in."

2. Keep polyatomic ions as intact units.

<u>Practice</u>:

$C_{12}H_{22}O_{11} + O_2 \rightarrow CO_2 + H_2O$

Review of Chapters 1-3:
Ratios within a compound

The compound CO_2 has these ratios …

1. 1 atom of C for every 2 atoms of O.

2. 6.022×10^{23} atoms of C
   for every 12.044×10^{23} atoms of O.

3. 1 mole of C atoms
   for every 2 moles of O atoms.

4. 12.0107 grams of C
   for every 32.9988 grams of O.

The chemical formula CO_2 tells us all this information.

Saying it another way, 1 CO_2 : 1 C : 2 O, or

$$\frac{1\ C}{1\ CO_2} \qquad \frac{2\ O}{1\ CO_2} \qquad \frac{1\ C}{2\ O}$$

*N_A and Molar Mass (MM) allow us to convert between atoms <--> moles <--> grams.

Chapter 4: Ratios within a reaction

Combustion (metabolism) of sucrose ($C_{12}H_{22}O_{11}$) to produce CO_2 and H_2O.

$$C_{12}H_{22}O_{11} + 12\ O_2 \rightarrow 12\ CO_2 + 11\ H_2O$$

1 mole of $C_{12}H_{22}O_{11}$ molecules produces
12 moles of CO_2 molecules and
11 moles of H_2O molecules.

1 mole of $C_{12}H_{22}O_{11}$ molecules combines with
12 moles of O_2 molecules.

Saying it another way,

$$\frac{1\ C_{12}H_{22}O_{11}}{12\ CO_2} \qquad \frac{1\ C_{12}H_{22}O_{11}}{11\ H_2O} \qquad \frac{1\ C_{12}H_{22}O_{11}}{12\ O_2}$$

Also means,

$$\frac{12\ CO_2}{11\ H_2O} \qquad \frac{12\ O_2}{12\ CO_2} \qquad \frac{12\ O_2}{11\ H_2O}$$

Must have a balanced chemical reaction!
Or else ratios will be incorrect!

$$C_{12}H_{22}O_{11} + 12\ O_2 \rightarrow 12\ CO_2 + 11\ H_2O$$

If you metabolize 2.5 moles of $C_{12}H_{22}O_{11}$,
how many moles of oxygen gas are needed?
" " " " CO_2 are produced?
" " " " H_2O are produced?

We have covered the term **stoichiometry**
(stoy-key-ahm-uh-tree, sto-key-ahm-uh-tree)
Ratios within a compound.
Ratios within a reaction.

grams <--> moles <--> moles <--> grams

$$C_{12}H_{22}O_{11} + 12\ O_2 \rightarrow 12\ CO_2 + 11\ H_2O$$

If you have 10.0 grams of $C_{12}H_{22}O_{11}$, how many
Moles O_2? Grams O_2?
Moles CO_2? Grams CO_2?
Moles H_2O? Grams H_2O?

Empirical formula from combustion analysis
(instead of directly from mass % data)

Chemists use combustion reactions and other reactions to obtain the mass % of the elements in a compound.

Combustion reactions yield data to find carbon and hydrogen only.

The combustion reaction is carried out in an apparatus that …
collects carbon (C) as carbon dioxide (CO_2) and collects hydrogen (H) as water (H_2O).

1. We convert the data from CO_2 into data that will give us C.

2. We convert the data from H_2O into data that will give us H.

Example:

A 0.438 gram sample of styrene is burned (combusted) in excess oxygen, and the combustion reaction yields 1.481 g of CO_2 and 0.303 g H_2O. What is the empirical formula of styrene?

Practice:

A 6.22 gram sample of an unknown compound with the formula Si_xH_y is burned in excess oxygen. The Si is converted to 11.64 g SiO_2, and the H is converted to 6.980 g H_2O. What is the empirical formula of the compound?