Went over TEAM QUIZ 1 results (see key)

ex. what mass of propane, \( \text{C}_3\text{H}_8 \), would contain the same mass of carbon as is contained in 1.35 grams of barium carbonate, \( \text{BaCO}_3 \)?

\[
g \text{BaCO}_3 \rightarrow \text{mol BaCO}_3 \rightarrow \text{mol C} \rightarrow \text{mol C}_3\text{H}_8 \rightarrow g \text{C}_3\text{H}_8
\]

molar mass \( \text{BaCO}_3 \) = 137.33 + 12.01 + 3(16.00) = 197.34 g/mol
1 mol \( \text{BaCO}_3 \) has 1 mol C per formula unit

\[
1.35 \text{ g BaCO}_3 \times \frac{1 \text{ mol BaCO}_3}{197.34 \text{ g}} \times \frac{1 \text{ mol C}}{1 \text{ mol BaCO}_3} = 6.84 \times 10^{-3} \text{ mol C}
\]

1 mol \( \text{C}_3\text{H}_8 \) has 3 mol C per formula unit
molar mass \( \text{C}_3\text{H}_8 \) = 44.09 g/mol (see previous example)

\[
6.84 \times 10^{-3} \text{ mol C} \times \frac{1 \text{ mol C}_3\text{H}_8}{3 \text{ mol C}} \times \frac{44.09 \text{ g}}{1 \text{ mol C}_3\text{H}_8} = 0.100 \text{ g C}_3\text{H}_8
\]
Chapter 2:

Composition stoichiometry – the relative ratios of different elements within one particular compound or molecule

Chapter 3:

Reaction stoichiometry – the relative ratios between different substances as they react with each other

<table>
<thead>
<tr>
<th>Reactants</th>
<th>change</th>
<th>products</th>
</tr>
</thead>
<tbody>
<tr>
<td>NaOH + HCl</td>
<td>not?</td>
<td>NaCl + H₂O</td>
</tr>
</tbody>
</table>

Law of conservation of matter – a balanced chemical equation must always include the same # of each kind of atom on both sides of the equation.
Ex. 1)

\[
\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}
\]

Ex. 2)

\[
\text{Fe}_2\text{O}_3 + \text{CO} \rightarrow 2\text{Fe} + 2\text{CO}_2
\]

But now, wrong # C atoms

\[
\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2
\]

Ex. 3) The combustion of propane (‘burning’)

\[
\text{C}_3\text{H}_8 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}
\]

\[
\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}
\]

Ex. 4) The combustion of methanol

\[
\text{CH}_3\text{OH} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}
\]

\[
\text{CH}_3\text{OH} + \text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}
\]

\[
2\text{CH}_3\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 4\text{H}_2\text{O}
\]
What if we write

\[ 2\text{C}_3\text{H}_8 + 10\text{O}_2 \rightarrow 6\text{CO}_2 + 8\text{H}_2\text{O} \]

-does this equation obey the law of conservation of matter? Yes.
-is this a ‘correct’ chemical equation for propane combustion? No. can divide through by 2.

Balancing equations is usually a ‘trial and error’ process, so the best way to learn is from lots of practice.

Some helpful hints:

1) look for elements that are only in one component on each side of the iron (Fe in previous example)
2) if ‘free’ elements occur on either side (O\(_2\) in combustion reactions), balance last
3) check to see if coefficients are all ‘divisible’ by 2 or 3 to give whole numbers

Chemical equations are a powerful ‘planning’ tool:
If I want to make NaCl, I now have a recipe!

\[ \text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O} \]

If I want to make 27 formula units of NaCl, how many units of the following ingredients do I need?

\[ \begin{align*}
\text{NaOH} & \quad 27 \\
\text{HCl} & \quad 27
\end{align*} \]
If I want to make 10 Fe atoms, how many Fe\textsubscript{2}O\textsubscript{3} units do I need? CO molecules?

\[ \text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2 \]

\[
\begin{align*}
10 \text{ Fe atoms} & \times \frac{1 \text{ Fe}_2\text{O}_3 \text{ units}}{2 \text{ Fe atoms}} = 5 \text{ Fe}_2\text{O}_3 \text{ units} \\
10 \text{ Fe atoms} & \times \frac{3 \text{ CO molecules}}{2 \text{ Fe atoms}} = 15 \text{ CO molecules}
\end{align*}
\]

but chemists work with large amounts – use moles.

If I have 3.20 moles of C\textsubscript{3}H\textsubscript{8}, how many moles of CO\textsubscript{2} are produced? H\textsubscript{2}O?

\[ \text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O} \]

\[
\begin{align*}
3.20 \text{ mol C}_3\text{H}_8 & \times \frac{3 \text{ mol CO}_2}{1 \text{ mol C}_3\text{H}_8} = 9.60 \text{ mol CO}_2 \\
3.20 \text{ mol C}_3\text{H}_8 & \times \frac{4 \text{ mol H}_2\text{O}}{1 \text{ mol C}_3\text{H}_8} = 12.8 \text{ mol CO}_2
\end{align*}
\]

chemical demonstration: combustion of methanol in a 5 gallon water jug