

Products of Combustion Reactions

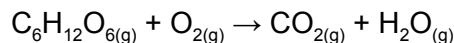
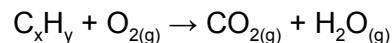
combustion: a chemical reaction that occurs in the presence of oxygen and results in the release of energy

cellular respiration: the process by which cells convert the chemical energy stored in organic molecules (sugars) into energy that cells can use

hydrocarbon: an organic compound containing only carbon and hydrogen atoms

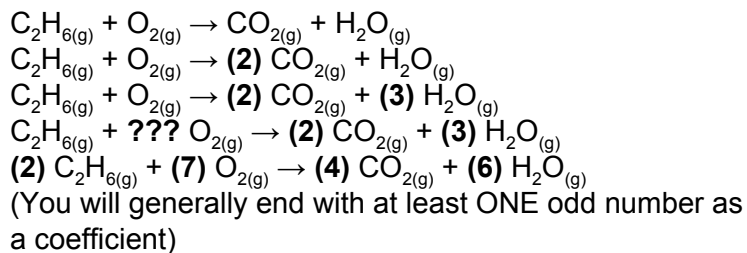
fuel: a substance that releases energy when involved in a chemical reaction (often combustion) or a nuclear reaction

emission: a substance discharged into the atmosphere or into surface water

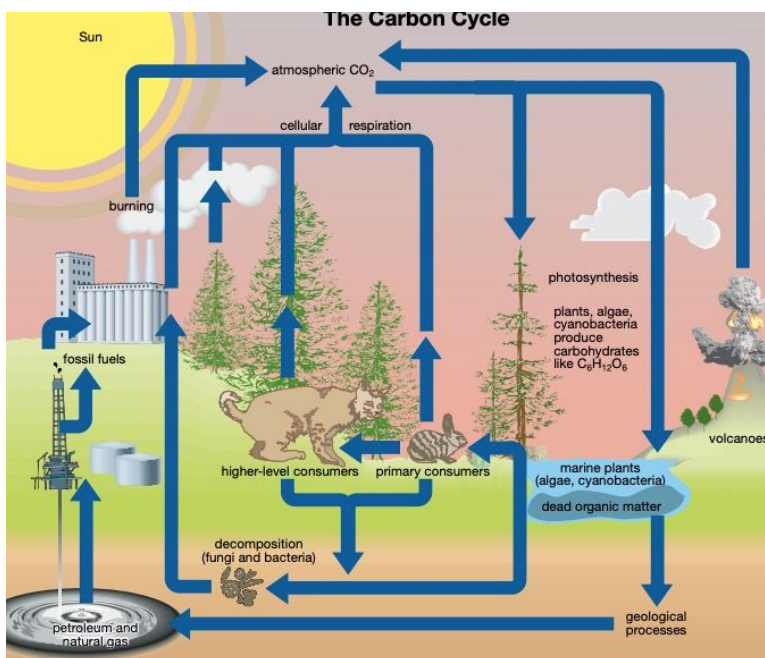


Balancing Combustion Reactions (Really... any chemical reaction)

- 1) Write the unbalanced equation
- 2) Balance the first Element on both sides
- 3) Balance the Second Element on both sides
- 4) Continue till done... leave oxygen til last
 - a) If you can't balance oxygen with a whole number then DOUBLE EVERYTHING you've done, then try again



Carbon Cycle



Carbon Sink and Carbon Sequestering

<p>Carbon Sink</p> <ul style="list-style-type: none"> - CO₂ being transformed and stored in a new substance <ul style="list-style-type: none"> - CO₂ in the ocean becomes carbonic acid - CO₂ is picked up by plants and converted into sugars 	<p>Carbon Sequestering</p> <ul style="list-style-type: none"> - Injecting CO₂ into the earth to store it
--	---

Other Forms of Combustion

<p>Incomplete Combustion of Carbons</p> <ul style="list-style-type: none"> - Produces CO_(g) instead of CO_{2(g)} <p>Combustion of Sulphurs</p> <ul style="list-style-type: none"> - Production of SO₂ and SO₃ from the combustions of sulphur <p>Combustion of Nitrogens</p> <ul style="list-style-type: none"> - Production of NO_x from the combustions of sulphur - Happens at higher temperatures (650°C) <p>Combustion of Metals</p> <ul style="list-style-type: none"> - Trace amounts of Mercury and Lead can be released when coal and other hydrocarbons are burned <p>Production of Soot and Particulates</p> <ul style="list-style-type: none"> - Causes breathing problems 	$2 \text{CH}_{4(g)} + 3 \text{O}_{2(g)} \rightarrow 2 \text{CO}_{(g)} + 4 \text{H}_2\text{O}_{(g)}$ $\text{H}_2\text{S}_{(g)} + \text{O}_{2(g)} \rightarrow \text{SO}_{2(g)} + \text{H}_2\text{O}_{(g)} \text{ (combustion of Sour Gas)}$ $\text{SO}_{2(g)} + \text{O}_{2(g)} \rightarrow \text{SO}_{3(g)}$ $\text{N}_{2(g)} + \text{O}_{2(g)} \rightarrow 2 \text{NO}_{(g)}$ $2 \text{NO}_{(g)} + \text{O}_{2(g)} \rightarrow 2 \text{NO}_{2(g)}$
--	--

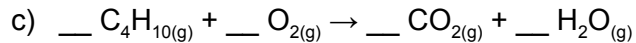
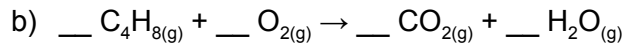
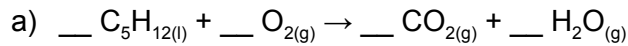
Sources of SO₂ and NO_x

<p>Natural</p> <ul style="list-style-type: none"> - Hot springs - Volcanic outgasing 	<p>Natural</p> <p>Forest Fires</p>
<p>Man Made emissions from:</p> <ul style="list-style-type: none"> ● coal-fired power plants ● pulp and paper mills ● refining crude oil ● refining oil sands ● refining metals and smelting ● automobiles 	<p>Man Made emissions from:</p> <ul style="list-style-type: none"> ● fossil fuel power plants ● industrial and domestic furnaces ● production of fertilizers ● burning of crops ● automobiles

Science 30 - Lesson 15 - Products of Combustion Reactions

Name: _____

1) Balance the following combustion reactions.



d) combustion of octane _____

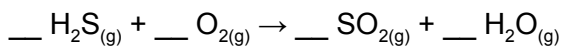
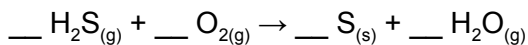
2) Describe, at the atomic level, what happens to the molecules in a fuel during combustion.

3) "The products of a combustion reaction are dependent on the substance being combusted." Explain the meaning of this statement, and include an example.

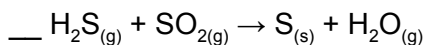
4) Gasoline is a mixture of hydrocarbons, none of which contain nitrogen. Explain how the combustion of gasoline in automobiles can be considered to be a major source of the production of NO_x compounds.

5) The Claus process can be used to remove hydrogen sulfide from sour natural gas. The Claus process occurs in two steps:

a) Thermal Step (This step occurs in a furnace at high temperatures.)



b) Catalytic Step



c) Balance the three reactions in the Claus process.

d) Identify one emission, other than those listed in the equations, that is produced by the Claus process.

e) Improvements to the Claus process focus on reducing emissions. One improvement requires the use of pure oxygen rather than atmospheric air in the furnace. Explain how the use of pure oxygen could result in a reduction to emissions from the Claus process.

6) In 2000, emissions of SO_2 in Canada were estimated to be 2.4×10^6 t (tonnes). Prepare a table that shows the mass of sulfur dioxide emissions from each of the sources shown in the figure below.

