Chemical Equations
&
The Law of Conservation of Matter

A chemical equation is a symbolic representation of a chemical reaction.

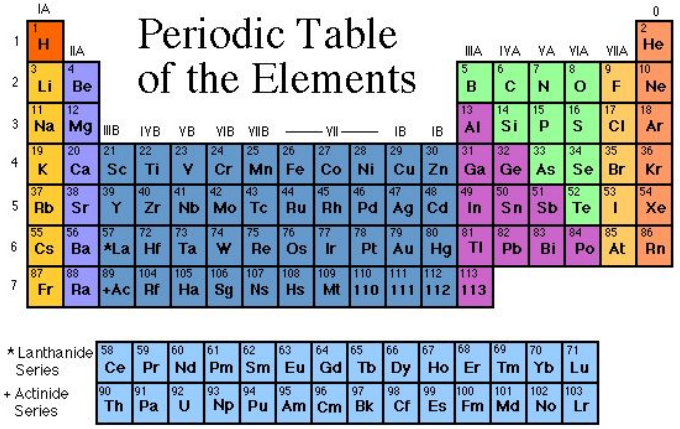
Equation Example:

The burning of methane gas in oxygen is:

$$CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$$

Review: Element Symbols

- All elements are represented by a 1 or 2 letter symbol
  - For example
    - C = Carbon
    - Ne = Neon
    - O = Oxygen
- The symbols are shown on



Review: Chemical Formulas

- Shows the elements & number of atoms of each element in a molecule
- H_2SO_4 ← Subscript
  - Elements
    - Hydrogen: 2 atoms
    - Sulfur: 1 atom
    - Oxygen: 4 atoms
  - 7 atoms total

Coefficients

- A formula may begin with a number.
- If there is no number, then “1” is understood to be in front of the formula.
  - This number is called the *coefficient*.
  - The coefficient represents the number of molecules of that compound or atom needed in the reaction.
  - For example: $2H_2SO_4$
    - The coefficient **2** indicates that there are 2 *molecules* of Sulfuric Acid (H_2SO_4)

Coefficients

- $2H_2SO_4$ ------ 2 molecules of Sulfuric Acid
  - A coefficient is distributed to ALL elements in a compound
    - 2 x H_2 (for a total of 4 H atoms)
    - 2 x S (for a total of 2 S atoms)
    - 2 x O_4 (for a total of 8 O atoms)

Practice:

- Look at each compound. How many atoms of each element are in the formula?
  - » $2NH_3$
  - » $3H_2O$
  - » CH_4
  - » $2C_6H_7O_2(OH)_3$

Now you are ready to read a chemical equation!

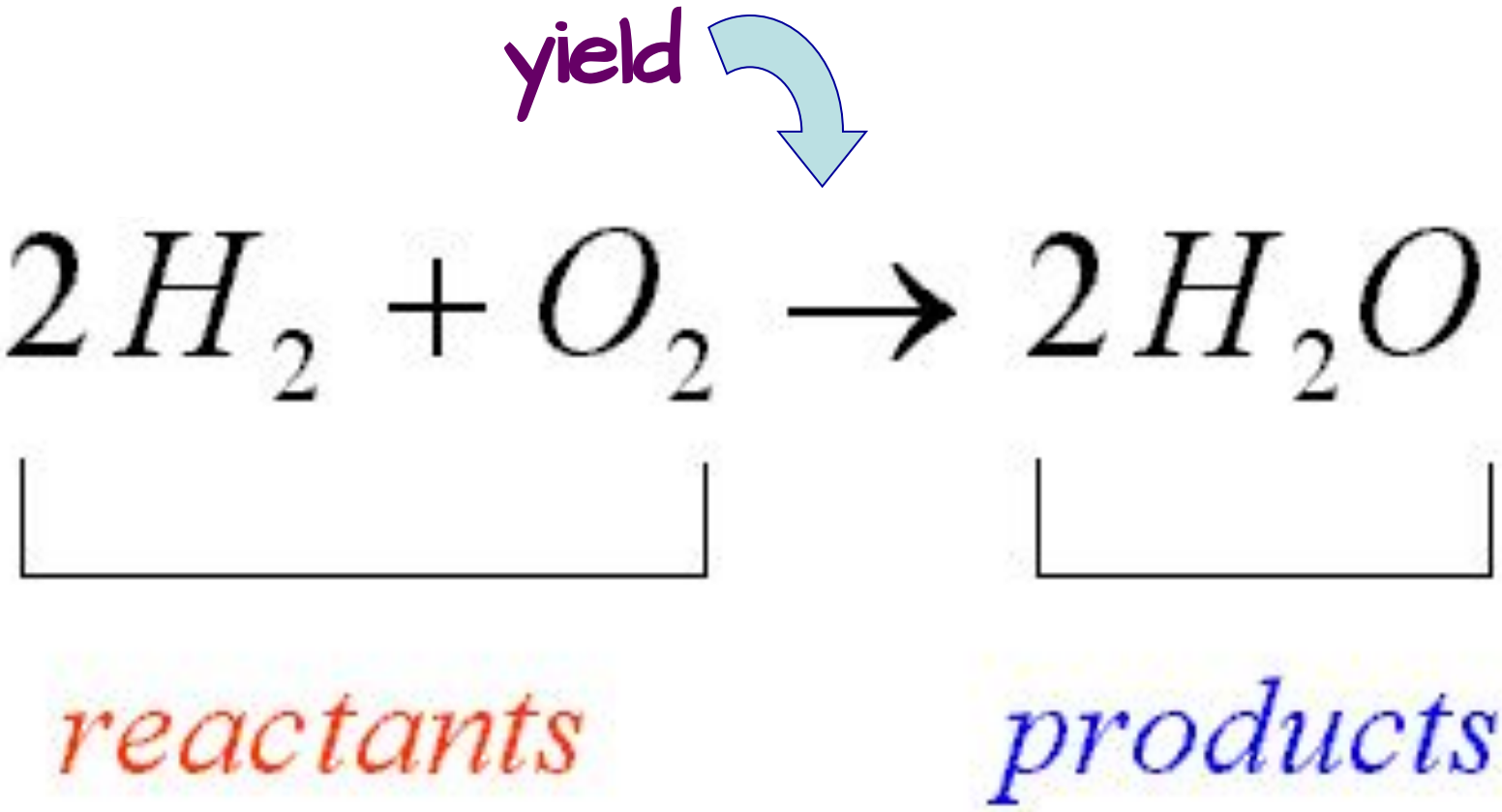
Reading Chemical Equations

- Each side of an equation represents a combination of chemicals experiencing a chemical reaction.
- The combination is written as a set of chemical formulas, separated by **+** symbols.

$$CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$$

Reading Chemical Equations

- The two sides of the equation are separated by an arrow, which stands for the word “yield” (which means *makes*).
  - The combination of chemicals *before* the reaction are on the left side of the arrow
  - The right side indicates the combination of chemicals *after* the reaction.
  - These parts have proper names.


yield
$2H_2 + O_2 \rightarrow 2H_2O$
reactants
products

Example of a chemical reaction represented by an equation:

$$4Na + O_2 \rightarrow 2Na_2O$$

- In this reaction, four sodium atoms and a molecule of oxygen (**O_2**) react to yield two molecules of **Na_2O**

Balancing Equations

- The Law of Conservation of Matter states that…

…*Matter is neither created or destroyed during a chemical reaction.*

- This means that each side of the equation must represent the same quantity of each element; in other words, each side must have the same number of each kind of atom.

Reactants Products

Amount of matter = Amount of matter

Mass of Reactants = Mass of Products

Balancing Equations

$$Na + O_2 \rightarrow Na_2O$$

- In order for this equation to be *balanced*, there must be **equal amount** of Na on the left hand side and on the right hand side.
- Right now, there is 1 Na atom on the left but 2 Na atoms on the right. We solve this problem by putting a coefficient of 2 in front of the Na on the left hand side, Like this:

$$2Na + O_2 \rightarrow Na_2O$$

Balancing Equations
$2Na + O_2 \rightarrow Na_2O$

- There are 2 Na's on the left and 2 Na's on the right. But what about the O? We now must check to see if the O's are balanced on both sides of the equation.
- On the left hand side there are 2 O's and the right hand side only has one. This is still an *unbalanced* equation. To fix this we must put a 2 in front of the Na_2O on the right hand side. Now our equation reads:

$$2Na + O_2 \rightarrow 2Na_2O$$

Balancing Equations

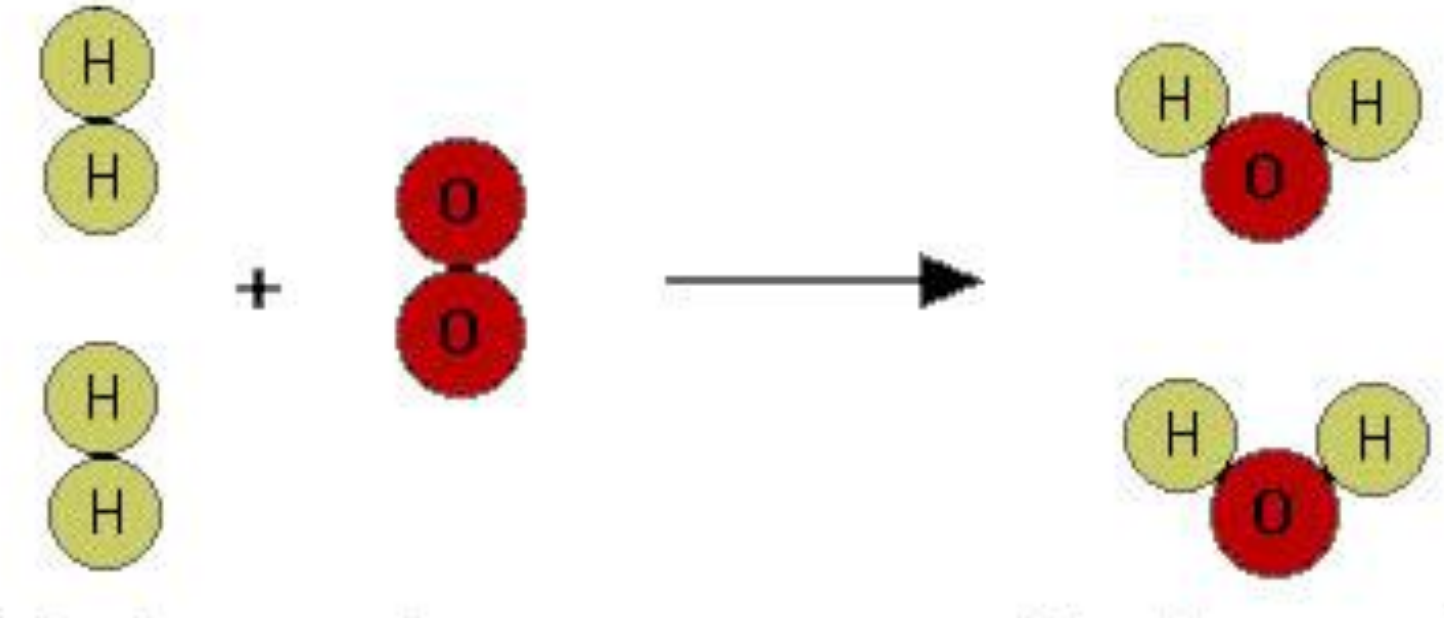
$$2Na + O_2 \rightarrow 2Na_2O$$

- Notice that the 2 on the right hand side is "distributed" to both the Na_2 and the O.
- Currently the left hand side of the equation has 2 Na's and 2O's. The right hand side has 4 Na's total and 2 O's. Again, this is a problem, there must be an equal amount of each chemical on both sides. To fix this let's add 2 more Na's on the left side. The equation will now look like this, and is now balanced:

$$4Na + O_2 \rightarrow 2Na_2O$$

Here is another example of a balanced chemical equation:

$2H_2 + O_2 \longrightarrow 2\,H_2O$

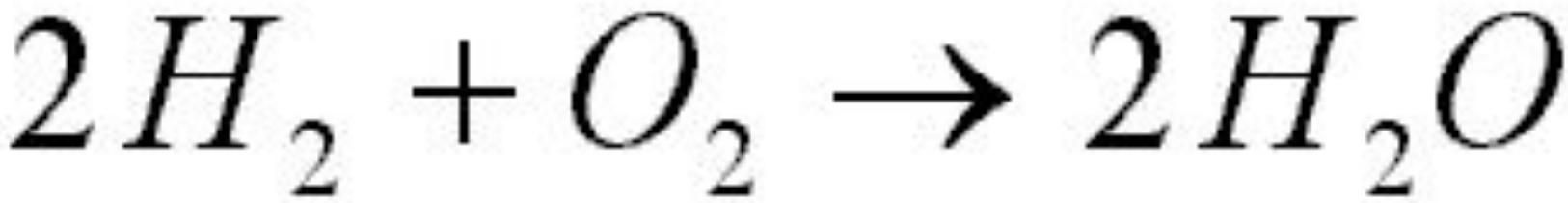


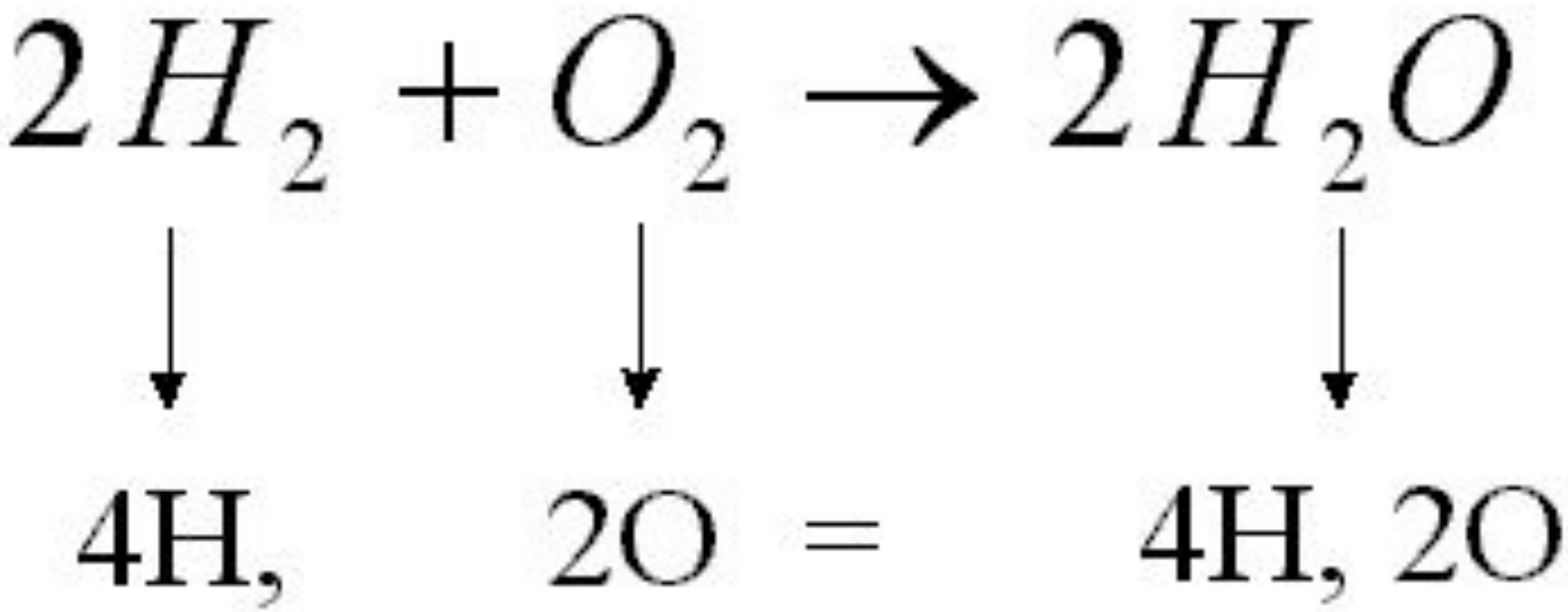
4 hydrogen atoms

+ 2 oxygen atoms

yields

2 molecules of water (each with 2 H atoms and one O atom)


$2H_2 + O_2 \rightarrow 2H_2O$


$2H_2 + O_2 \rightarrow 2H_2O$
4H, 2O = 4H, 2O

Lets try this one together:

$$CH_4 + O_2 \rightarrow CO_2 + H_2O$$

Is it balanced?

$$CH_4 + O_2 \rightarrow CO_2 + H_2O$$

C=1		**C=1**
H=4	$\neq$	**H=2**
O=2		**O=3**

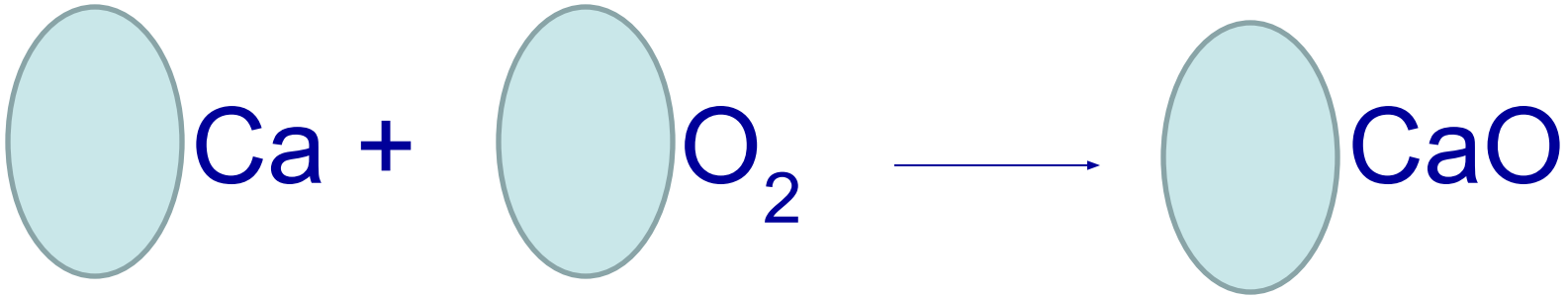
$$CH_4 + O_2 \rightarrow CO_2 + 2H_2O$$

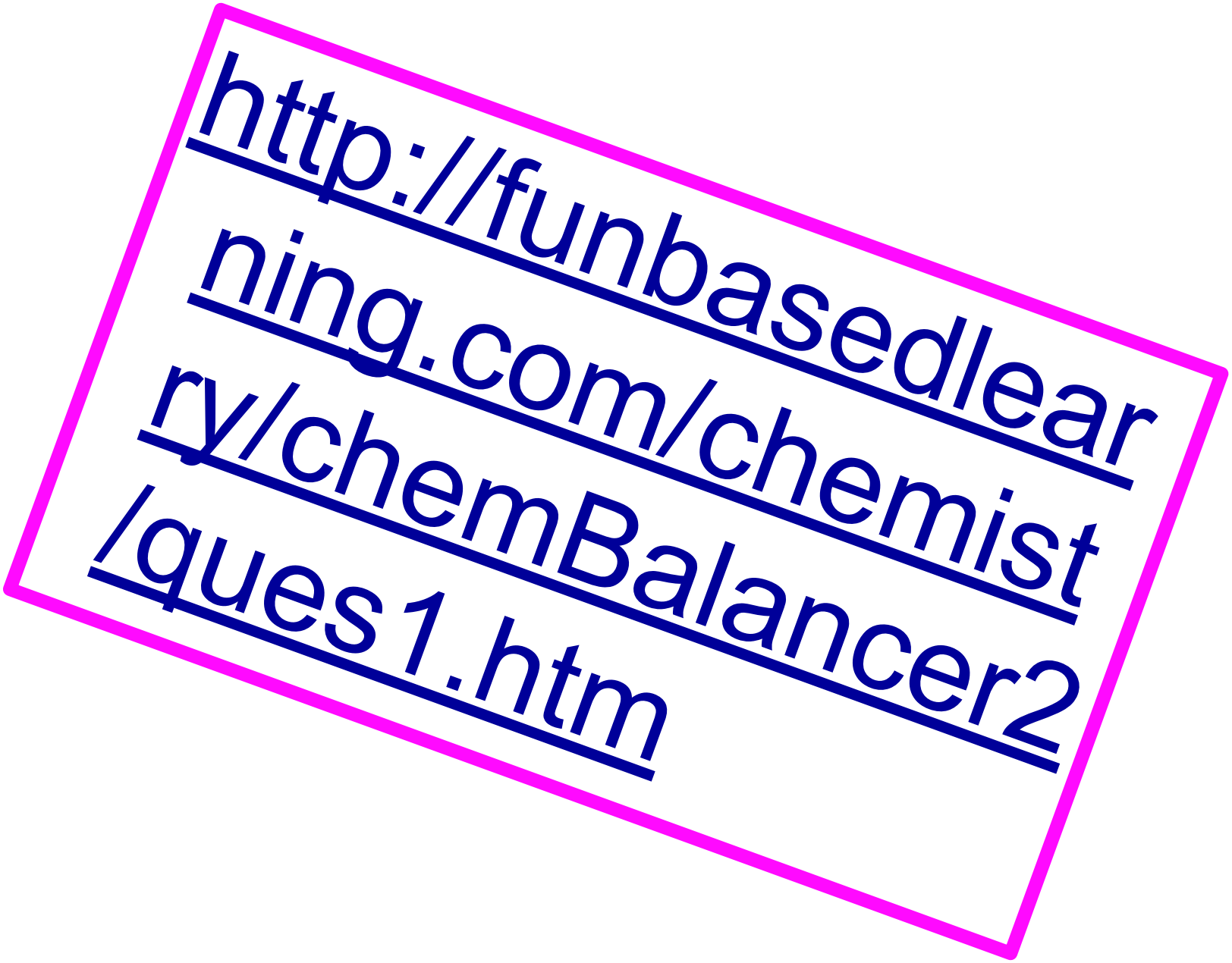
C=1		**C=1**
H=4	$\neq$	**H=4**
O=2		**O=4**

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

C=1		C=1
H=4	=	H=4
O=4		O=4

Follow along with your notes to balance this equation:




http://funbasedlearning.com/chemistry/chemBalancer2/ques1.htm