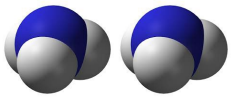
Conservation of mass

Chemical equations obey the law of conservation of mass.

This is because chemical equations **balance** the **number of atoms** present in the beginning of a chemical reaction (reactants) with those that are present at the end of a chemical reaction (products).

Cracking the code

Ammonia has the chemical formula NH_3.  It has N = 1 and H = 3 atoms

Writing $2NH_3$ means two molecules of ammonia 

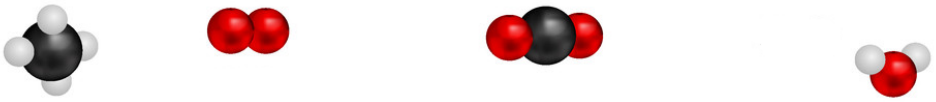
So $2NH_3$ means N = 2 and H = 6 atoms

Unbalanced chemical equation

Here the fuel is methane, CH_4

fuel + oxygen ⟶ carbon dioxide + water

$CH_4 + O_2 \longrightarrow CO_2 + H_2O$

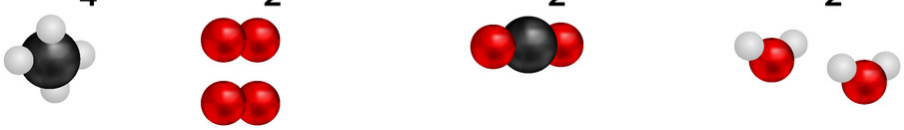


REACTANTS	PRODUCTS
C = 1	C = 1
H = 4	H = 2
O = 2	O = 3

Balanced chemical equation

fuel + oxygen ⟶ carbon dioxide + water

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



REACTANTS	PRODUCTS
C = 1	C = 1
H = 4	H = 4
O = 4	O = 4

When fuels burn they react with the oxygen in the air.

If there is an abundance of air, then complete combustion will take place. This means carbon dioxide and water are produced.

If there is not enough oxygen in the air available, then incomplete combustion happens and carbon monoxide and water are made.

Complete combustion

fuel + oxygen (abundant) → carbon dioxide + water

Incomplete combustion

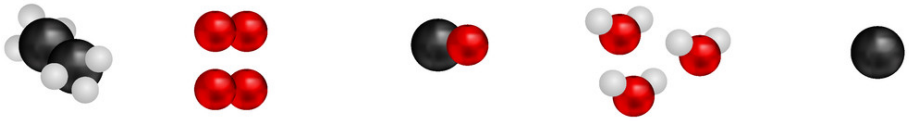
fuel + oxygen (low levels) → carbon dioxide + carbon monoxide + water + carbon

It is hard to balance an equation for incomplete combustion as the amount of carbon dioxide and/or carbon monoxide and/or carbon produced depends on the fuel and the amount of oxygen. *However*, the equation will still obey the conservation of mass.

Here the fuel is ethane, C_2H_6

fuel + oxygen ⟶ carbon monoxide + water + carbon

C_2H_6 + $2O_2$ ⟶ CO + $3H_2O$ + C



REACTANTS	PRODUCTS
C = 2	C = 2
H = 6	H = 6
O = 4	O = 4

Decide whether these reactions are balanced or not? Do they show conservation of mass?

Count the atoms on each side of the →

Tick only those that show conservation of mass.

- ❒ $C_3H_6 + O_2 \rightarrow 3CO_2 + H_2O$
- ❒ $C_2H_5OH + 2O_2 \rightarrow 2CO + 3H_2O$
- ❒ $C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$
- ❒ $C_6H_{14} + 5O_2 \rightarrow 3CO + 3C + 7H_2O$
- ❒ $CH_4 + 2O_2 \rightarrow CO_2 + H_2O + CO$
- ❒ $2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$
- ❒ $H_2 + O_2 \rightarrow H_2O$
- ❒ $Cu(OH)_2 \rightarrow CuO + H_2O$
- ❒ $CaCO_3 \rightarrow CaO + CO_2$
- ❒ $Mg + HCl \rightarrow MgCl_2 + H_2$