

## 2 Balancing chemical equations

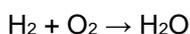
### 2.1 Conservation of mass

When new substances are made during chemical reactions, atoms are not created or destroyed – they just become rearranged in new ways. So, there is always the same number of each type of atom before and after the reaction, and the total mass before the reaction is the same as the total mass after the reaction. This is known as the conservation of mass.

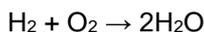
You need to be able to use the principle of conservation of mass to write formulae, and balanced chemical equations and half equations.

### 2.2 Balancing an equation

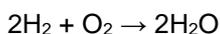
The equation below shows the correct formulae but it is not balanced.



While there are two hydrogen atoms on both sides of the equation, there is only one oxygen atom on the right-hand side of the equation against two oxygen atoms on the left-hand side. Therefore, a two must be placed before the  $\text{H}_2\text{O}$ .



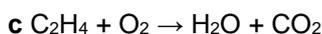
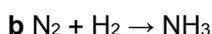
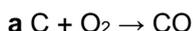
Now the oxygen atoms are balanced but the hydrogen atoms are no longer balanced. A two must be placed in front of the  $\text{H}_2$ .



The number of hydrogen and oxygen atoms is the same on both sides, so the equation is balanced.

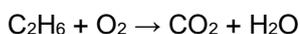
### Practice question

1 Balance the following equations.

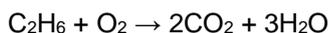


### 2.3 Balancing an equation with fractions

To balance the equation below:

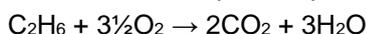


- Place a two before the  $\text{CO}_2$  to balance the carbon atoms.
- Place a three in front of the  $\text{H}_2\text{O}$  to balance the hydrogen atoms.



There are now four oxygen atoms in the carbon dioxide molecules plus three oxygen atoms in the water molecules, giving a total of seven oxygen atoms on the product side.

- To balance the equation, place three and a half in front of the  $\text{O}_2$ .

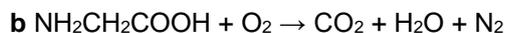
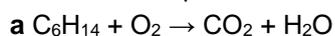
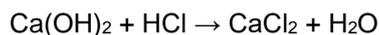


- Finally, multiply the equation by 2 to get whole numbers.



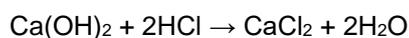
**Practice question**

2 Balance the equations below.

**2.4 Balancing an equation with brackets**

Here the brackets around the hydroxide ( $\text{OH}^-$ ) group show that the  $\text{Ca}(\text{OH})_2$  unit contains one calcium atom, two oxygen atoms, and two hydrogen atoms.

To balance the equation, place a two before the HCl and another before the  $\text{H}_2\text{O}$ .

**Practice question**

3 Balance the equations below.

