

A chemical formula states how many atoms of each element are in a compound

NaCl 1 atom Na 1 atom Cl

A molecular weight is the sum of the weight of each atom in a formula

The molecular weight of Al_2O_3 is:

$2 \times 26.98 + 3 \times 16 = 102.0$ amu (atomic mass units)

When a molecular weight is expressed in grams, it is a Mole. 12g carbon = 1 mol

Molecular Formulas and Equations:

H_2	O_2	H_2O	$CaCO_3$	C_3H_8
Hydrogen	Oxygen	Water	Calcium Carbonate	Propane

The molecular weight of any compound can simply be calculated by adding up the atomic weights of the component atoms:

Compound	Molecular Weight
H_2	$1 + 1 = 2$
H_2O	$1 + 1 + 16 = 18$
C_3H_8	$(1 \times 8) + (12 \times 3) = 44$

When a **molecular weight** is expressed in grams, it is a **Mole**.

12g carbon = 1 mol of carbon

46g C₂H₆O = 1 mol of C₂H₆O

A mole is just a number like a dozen.

KEY POINT:

Equal numbers of moles contain equal numbers of particles (atoms, molecules, ions).

One mole of anything has 6.022×10^{23} particles (Avogadro's number).

Converting mass into moles:

$$\frac{\text{grams substance}}{\text{mol substance}} = \text{mol substance}$$

$$\left(\frac{\text{grams substance}}{\text{mol substance}} \right)$$

How many moles of glucose ($\text{C}_6\text{H}_{12}\text{O}_6$) in 270 g glucose?

1. find the Molecular weight of glucose:

$$6 \times 12 + 12 \times 1 + 6 \times 16 = 180.2 \text{ g/mol}$$

2. Divide the grams of glucose by the g/mol.

$$\frac{270 \text{ g glucose}}{\left(\frac{180.2 \text{ g glucose}}{\text{mol glucose}} \right)} = 1.498 \text{ mol glucose}$$

Converting moles into mass:

$$\text{mol substance} \times \left(\frac{\text{grams substance}}{\text{mol substance}} \right) = \text{g substance}$$

How many grams of CO_2 in 6.0 mol CO_2 ?

1. find the Molecular weight of CO_2 :

$$1 \times 12 + 2 \times 16 = 44.0 \text{ g/mol}$$

2. Multiply the moles of CO_2 by the g/mol.

$$6.0 \text{ mol CO}_2 \times \left(\frac{44.0 \text{ g CO}_2}{\text{mol CO}_2} \right) = 264 \text{ g CO}_2$$

How much does an atom of carbon weigh?

$$\frac{12 \text{ g C} / 1 \text{ mol C}}{6.022 \times 10^{23} \text{ atoms/mol}} = 1.99 \times 10^{-23} \text{ g/atom}$$

Since carbon has a mass of 12 amu:

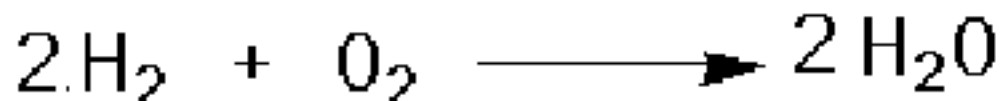
$$\frac{1.99 \times 10^{-23} \text{ g}}{12 \text{ amu}} = 1.66 \times 10^{-24} \text{ g/amu}$$

1 amu has a mass of $1.66 \times 10^{-24} \text{ g}$

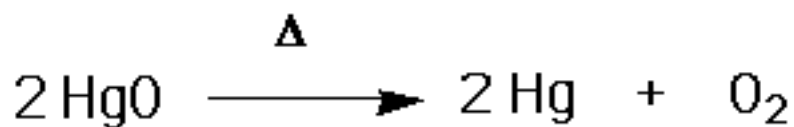
Chemical Equations

reactants

products



Reacting two hydrogen molecules with one oxygen molecule produces two molecules of water.



Heating two molecules of mercuric oxide produces two atoms of mercury and a molecule of oxygen

When methane (natural gas) is burned, one methane molecule reacts with two oxygen molecules to give one molecule of carbon dioxide and two molecules of water:



In most chemical equations, the number of atoms of a particular element in the reactants (on the left side) is always equal to the same number of atoms of that element in the products (on the right side). Thus, the four hydrogen atoms of methane (CH₄) are balanced by the four hydrogen atoms in two molecules of water. These equations are said to be balanced.

Balancing chemical equations



The combustion of propane

Combustion of hydrocarbons gives CO_2 and H_2O



balance the carbons



balance the hydrogens



balance the oxygens

