

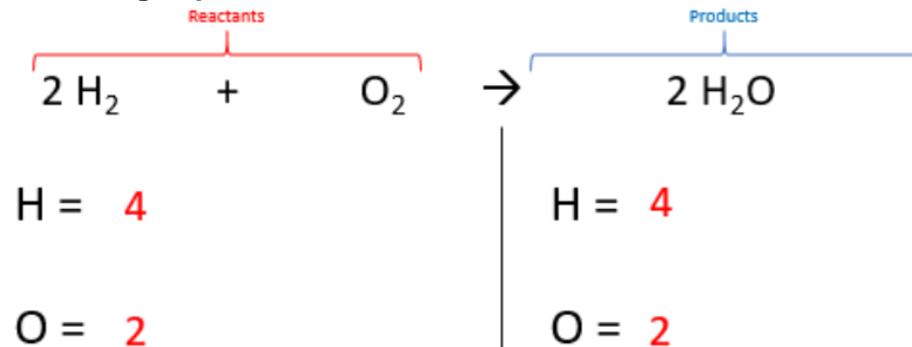
Quantitative Chemistry

Conservation of Mass

The law of conservation of mass states that **no atoms are lost or made** during a chemical reaction so the mass of the products equals the mass of the reactants.

The sum of reactants
=
The sum of products

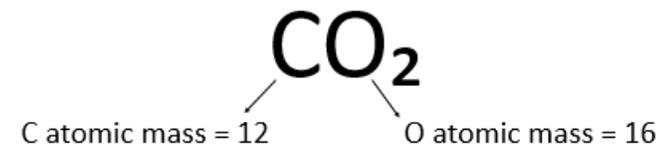
Balancing Equations: same number of atoms on both sides



Relative Formula Mass

The relative formula mass (M_r) of a compound is the sum of **the relative atomic masses** of the atoms in the numbers shown in the formula.

1		2		3		4		5		6		7		0																																																																																																	
7 Li lithium 3	9 Be beryllium 4	11 Na sodium 11	12 Mg magnesium 12	13 Al aluminium 13	14 Si silicon 14	15 P phosphorus 15	16 S sulfur 16	17 Cl chlorine 17	18 Ar argon 18	19 K potassium 19	20 Ca calcium 20	21 Sc scandium 21	22 Ti titanium 22	23 V vanadium 23	24 Cr chromium 24	25 Mn manganese 25	26 Fe iron 26	27 Co cobalt 27	28 Ni nickel 28	29 Cu copper 29	30 Zn zinc 30	31 Ga gallium 31	32 Ge germanium 32	33 As arsenic 33	34 Se selenium 34	35 Br bromine 35	36 Kr krypton 36	37 Rb rubidium 37	38 Sr strontium 38	39 Y yttrium 39	40 Zr zirconium 40	41 Nb niobium 41	42 Mo molybdenum 42	43 Tc technetium 43	44 Ru ruthenium 44	45 Rh rhodium 45	46 Pd palladium 46	47 Ag silver 47	48 Cd cadmium 48	49 In indium 49	50 Sn tin 50	51 Sb antimony 51	52 Te tellurium 52	53 I iodine 53	54 Xe xenon 54	55 Ba barium 55	56 La lanthanum 56	57 Ce cerium 57	58 Pr praseodymium 58	59 Nd neodymium 59	60 Pm promethium 60	61 Sm samarium 61	62 Eu europium 62	63 Gd gadolinium 63	64 Tb terbium 64	65 Dy dysprosium 65	66 Ho holmium 66	67 Er erbium 67	68 Tm thulium 68	69 Yb ytterbium 69	70 Lu lutetium 70	71 Hf hafnium 71	72 Ta tantalum 72	73 W tungsten 73	74 Re rhenium 74	75 Os osmium 75	76 Ir iridium 76	77 Pt platinum 77	78 Au gold 78	79 Hg mercury 79	80 Tl thallium 80	81 Pb lead 81	82 Bi bismuth 82	83 Po polonium 83	84 At astatine 84	85 Fr francium 85	86 Ra radium 86	87 Ac actinium 87	88 Th thorium 88	89 Pa protactinium 89	90 U uranium 90	91 Np neptunium 91	92 Pu plutonium 92	93 Am americium 93	94 Cm curium 94	95 Bk berkelium 95	96 Cf californium 96	97 Es einsteinium 97	98 Fm fermium 98	99 Md mendelevium 99	100 No nobelium 100	101 Lr lawrencium 101	102 Rf rutherfordium 102	103 Db dubnium 103	104 Sg seaborgium 104	105 Bh bohrium 105	106 Hs hassium 106	107 Mt meitnerium 107	108 Ds darmstadtium 108	109 Rg roentgenium 109	110 Nh nihonium 110	111 Fl flerovium 111	112 Mc moscovium 112	113 Lv livermorium 113	114 Ts tennessine 114	115 Og oganesson 115	116 Lr lawrencium 116	117 Uu ununoctium 117	118 Uu ununoctium 118	119 Uu ununoctium 119	120 Uu ununoctium 120

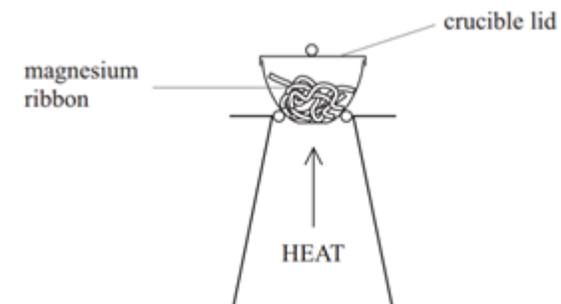
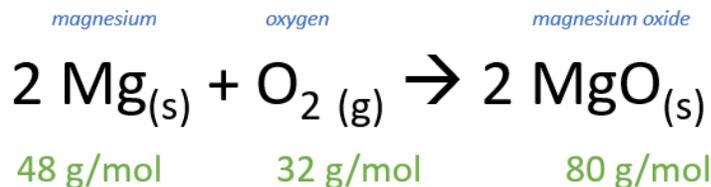


We have **TWO oxygen**
So $12 + (16 \times 2) = 44$

Use the relative atomic mass (**top number**)

Increase in mass

Some reactions may appear to involve a change in mass but this can usually be explained because **a reactant or product is a gas** and its mass has not been taken into account.



Chemical amounts are measured in **moles** (*mol*).

Moles

Important Equation

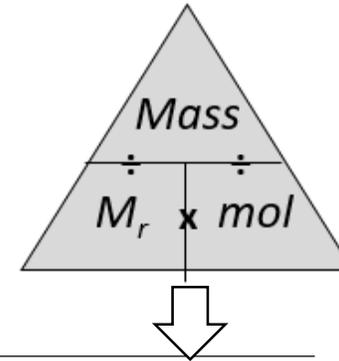
One mole of a substance contains the **same number** of the stated *particles, atoms, molecules or ions* as **one mole** of any other substance.

The number of atoms, molecules or ions in a mole of a given substance is the **Avogadro constant**. The value of the Avogadro constant is **6.02 x 10²³** per mole.

1 mol = 6.02 x 10²³ atoms, molecules or ions (Avogadro's number)

$$\text{Mass} = M_r \times \text{mol}$$

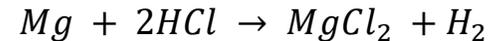
Real world mass (g) Relative formula mass (g/mol) Number of moles (mol)



Amounts of substances

The masses of reactants and products can be calculated from **balanced symbol equations**.

Chemical equations can be interpreted in terms of moles. For example:



shows that one mole of magnesium reacts with two moles of hydrochloric acid to produce one mole of magnesium chloride and one mole of hydrogen gas

The **coefficient** is the number in front of a formula. If there is no number in front, it is a 1.

Example Question

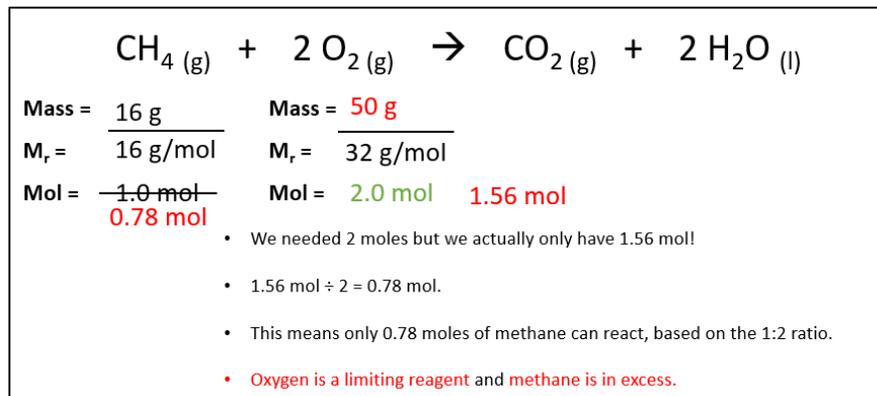


- How many moles of hydrochloric acid would you need if you started with 3 moles of Mg?
6 moles of HCl, as for every 1 mole of Mg, you need 2 moles of HCl
- How many moles of MgCl₂ would be produced if you had 10 moles of HCl?
5 moles of MgCl₂ are produced, as for every 1 mole of HCl, you produce 0.5 moles of MgCl₂
- How many moles of Mg are required to fully react with 8 moles of HCl?
4 moles of Mg are required, because for every 1 mole of HCl, you need 0.5 moles of Mg.

Limiting Reactants

In a chemical reaction involving two **reactants**, it is common to use an excess of one of the reactants to ensure that all of the other **reactant** is used. The reactant that is completely used up is called the **limiting reactant** because it limits the amount of products.

Example Question



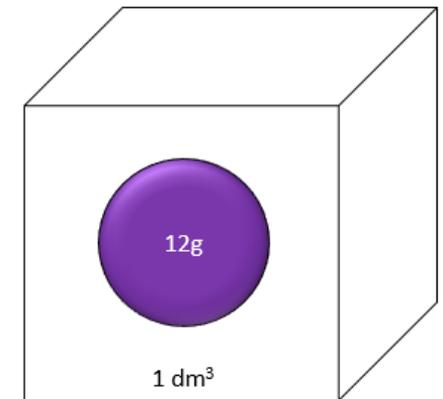
Concentrations

Chemists use a special unit called **decimetres**

1 dm³ = 1000 cm³
So to convert cm³ into dm³ you just have to divide by 1000

Example:
A solution has a volume of 500cm³, what is its volume in dm³?

$$\frac{500 \text{ cm}^3}{1000} = 0.5 \text{ dm}^3$$



12 grams per dm³ = 12 g/dm³

Concentration = Quantity of solute ÷ volume