14–16 years

Key terms accessible glossary: quantitative chemistry

ROYAL SOCIETY OF CHEMISTRY

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Amount of substance

how many atoms, molecules or formula units are present in a sample of the substance, measured in moles (mol)

In other words ...
the amount of particles in a substance in moles

Example
The amount of hydrogen needed to react with one mole of oxygen was two moles

Three bricks are the same **amount** as three feathers, even though the mass will be different

Don't confuse with ...
the mass of a substance or the molar mass of a substance

Say it
A-mount ov sub-st-ens

Similar words
Quantity of a substance

Avogadro's number

the number 6.02×10^{23}, which is the number of atoms, molecules or formula units in one mole of the substance

In other words ...
one mole of any substance will have 6.02×10^{23} atoms in it. 6.02×10^{23} is the same as writing
602 000 000 000 000 000 000 000

Example
A dozen is a constant which means 12. Avogadro's number means 6.02×10^{23}

Sign it
Watch a video:
bit.ly/4rmbNt2

1 mole of carbon and 1 mole of iron both have 6.02×10^{23} atoms even though they have different masses

Don't confuse with ...
a mole which is the amount of a substance that contains 6.02×10^{23} atoms

Say it
Av-o-ga-drose num-ba

Cubic decimetre (dm^3)

a unit of volume, the same as one litre (l), which is equal to 1000 cubic centimetres (cm^3)

In other words ...
a different way to describe a litre of a substance

Example
The beaker contained one cubic decimetre (1 dm^3) of liquid

Sign it
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bit.ly/4rlKeA8

Other meanings
One cubic decimetre is the same at 1000 cubic centimetres (cm^3)

Say it
Cyue-bic des-i-mee-ta

Break it down
Cubic (relating to a cube or three-dimensional),
deci (tenth) metre (of a metre)

Empirical formula

uses chemical symbols to give the simplest ratio of atoms (or ions) of each element in a substance, such as CH_2 for ethene which has molecular formula C_2H_4

In other words ...
a way to show the simplest ratio of atoms (or ions) in a compound

Say it
Im-pir-i-cel form-ya-la

Break it down
Empirical (based on observation), formula (a way of representing something)

ethene

CH_2 empirical formula

C_2H_4 molecular formula

Example
Ionic substances have empirical formulas, such as $NaCl$, but we can also use empirical formulas to simplify for very large molecules. Glucose, for example, has the molecular formula $C_6H_{12}O_6$, and the empirical formula CH_2O

Similar words
Simplest whole number ratio

Don't confuse with ...
molecular formula – which shows the atoms in one individual molecule

Mass (*m*)

the property of matter that causes a sample of a substance to feel the force of gravity, measured in grams (g)

In other words ...
the amount of matter in an object

Example
The mass of the crucible in the image is 48.29 g

Sign it
Watch a video:
bit.ly/4rOh9wN

Don't confuse with ...
weight, which is a force due to gravity and is measured in Newtons

Say it
Mas

Similar words
Massive which means an object with a large mass or of a large size

Molar mass (*M*)

the mass of one mole of a substance, which is given by the value of its relative atomic or formula mass in grams

In other words ...
the mass in grams of one mole of a chemical

Example
The molar mass of carbon is 12 g.
The molar mass of aluminium is 27 g

Sign it
Watch a video:
bit.ly/3MgX2bL

Don't confuse with ...
relative mass, which is the average mass of the atoms in an element or compound. Molar mass in measured in grams, whereas relative mass has no units

Say it
Mo-la mas

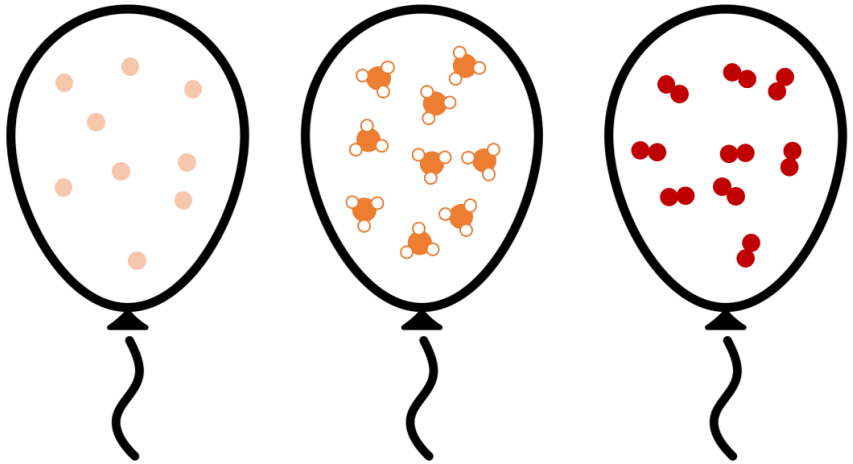
Molar volume of a gas (V_m)

the volume occupied by one mole of a gas, which is approximately 24 cubic decimetres (dm^3) at room temperature and pressure

In other words ...
the amount of space taken up by one mole of a gas

Example
The molar volume of oxygen at normal room temperature and pressure is 24 dm^3

Say it
Mo-la vol-y-eum ov a gas



These balloons all contain one mole of gas. They have different masses but the same volume

Similar words
Molar mass which is the mass of a mole of a substance

Don't confuse with ...
Remember that gases have mass

Mole (mol)

the unit of amount of substance, where one mole is the amount containing 6.02×10^{23} (Avogadro's number) atoms, molecules or formula units

In other words ...
the amount of any substance that contains 6.02×10^{23} atoms

Sign it
Watch a video:
bit.ly/4aT3cbl

Say it
Mole

One mole of carbon

Example
One mole of carbon contains 6.02×10^{23} atoms of carbon. One mole of copper contains 6.02×10^{23} atoms of copper

Don't confuse with ...
molar mass which is the mass of one mole of a substance

Volume (*V*)

how much three-dimensional space is taken up by a sample of a substance, measured in cubic centimetres (cm^3) or cubic decimetres (dm^3)

In other words ...
the amount of space an object takes up.

Sign it
Watch a video:
bit.ly/4rLu82g

Say it
vol-y-eum

Other meanings
In physics volume can also be used to describe the intensity of sound

Example
The measuring cylinder had a maximum volume of 500 cm^3

Don't confuse with ...
millilitres, 1 millilitre is the same as 1 cm^3. But in chemistry we should use cubic centimetres (cm^3) or cubic decimetres (dm^3)

Atom economy

In a balanced symbol equation, the mass of the desired product given as a percentage of the total mass of the reactants

In other words ...
the percentage of reactants that could end up as a useful product

Example
If 100 g of reactants produce 75 g of useful product, then the atom economy is 75%

$$\%\ atom\ economy = \frac{M_r\ of\ desired\ product}{M_r\ of\ total\ products} \times 100$$

Say it
At-am y-co-na-my

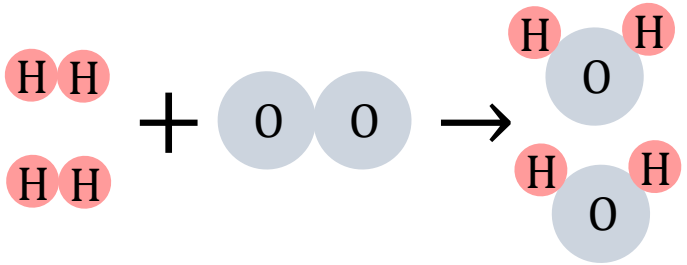
Don't confuse with ...
percentage yield which is the actual amount of product that is made in a reaction

Balanced symbol equation

for a chemical reaction this shows the chemical formulas of the reactants and products separated by an arrow. Whole numbers may be written before the formulas to balance the equation

In other words ...
when the number of atoms for each element is the same on both the left and right sides of an equation

$$2H_2 + O_2 \rightarrow 2H_2O$$



Example
This is a balanced symbol equation because there are four hydrogen atoms and two oxygen atoms in the reactants and the products

Sign it
Watch a video:
bit.ly/4azWwgO

Say it
Bal-en-st sim-bel i-cway-si-en

Similar words
Word equation, this is when we write the names of the chemicals and don't use the symbols

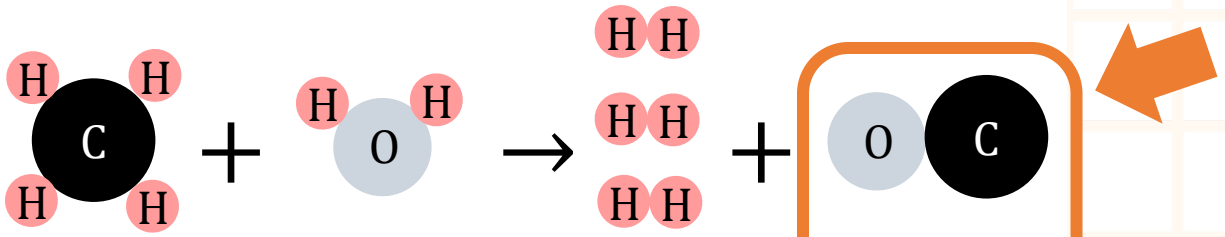
By-product

a substance produced by a chemical reaction that isn't the desired product and is often treated as waste

In other words ...
a substance made during a reaction that isn't the main product

Example
When methane reacts with steam to make hydrogen, carbon monoxide is made as a by-product

Don't confuse with ...
Not all reactions have by-products



$$CH_4 + H_2O \rightarrow 3H_2 + CO$$

Say it
B-eye prod-uct

Break it down
By (means less important) product (the thing being made)

Similar words
Waste – the by-product is not always waste and can sometimes be repurposed

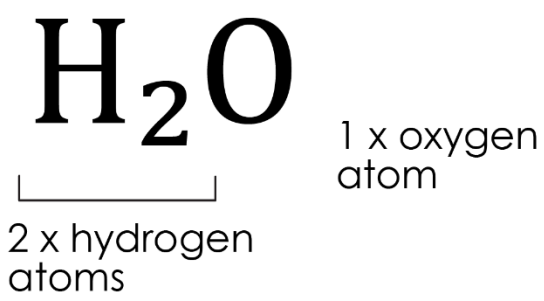
Chemical formula

uses chemical symbols to show the relative number of the atoms (or ions) of each element in a substance, such as H_2O for water or $NaCl$ for sodium chloride

In other words ...
this type of formula gives the chemical symbols of the elements whose atoms (or ions) make up the substance. The formula also shows the relative numbers of these atoms (or ions)

Example
The chemical formula for water is H_2O, which shows that each molecule has two hydrogen atoms and one oxygen atom bonded together

Say it
Cem-i-cel form-ya-la



Don't confuse with ...
balancing numbers or reacting ratios. Small, subscript numbers tell us how many atoms there are of the element whose symbol they follow

Break it down
Chemical (relating to substances), formula (a set way of writing things)

Similar words
Molecular formula (for molecules)

Other contexts
A formula can also mean a set of instructions, like a maths formula, or a recipe

Excess reactant

is not used up in a chemical reaction because another reactant has run out first

In other words ...
the substance that is left over after a reaction because there was more than needed

Example
Copper oxide is the excess reactant when making copper sulphate

Say it
eac-seas ry-act-tent

Excess copper oxide can be seen at the bottom of the tube

Don't confuse with ...
reactants, these are any chemicals reacting together.
Not all reactions will have an excess reactant

Break it down
Excess (too much) reactant (a substance you start with in a chemical reaction)

Limiting reactant

is completely used up in a chemical reaction, which therefore limits the amount of products that can be formed

In other words ...
the reactant that is used up first in a reaction and then limits how much product can be made

Example
The limiting reactant in the reaction was the sulfuric acid, when that was used up the reaction stopped

Say it
Lim-i-ting ry-act-tent

At the end of the reaction the sulfuric acid has been used up

Don't confuse with ...
The limiting reactant isn't always the one with the smallest amount

Similar words
Limiting factors which can include external factors such as temperature or light levels which affect reactions.

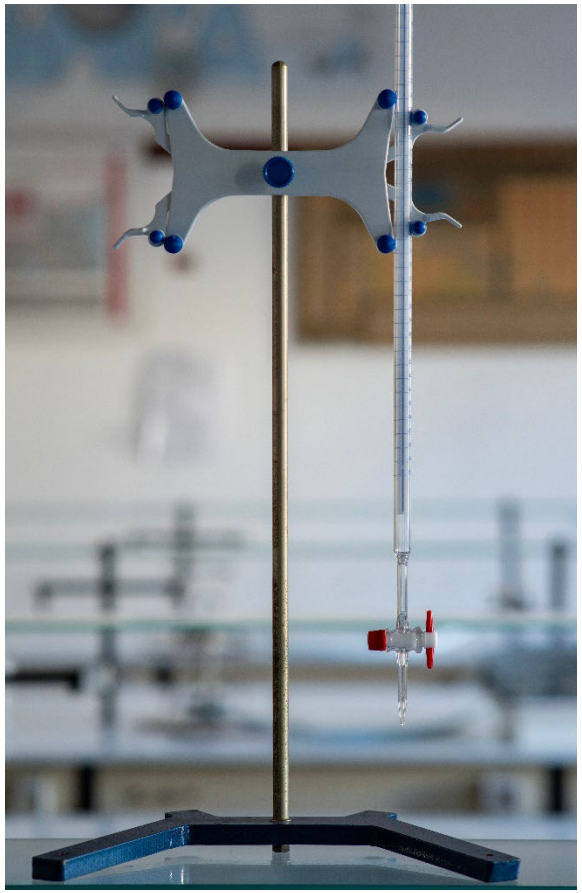
Burette

a narrow tube with a scale on the side and a tap at the bottom, used to accurately measure the volume of liquid run out of it during a titration

In other words ...
a tube used to slowly add liquids to a reaction.

Sign it
Watch a video:
bit.ly/3OKTuPB

Say it
By-ure-reat



Example
Use a burette to add the acid drop by drop to the conical flask

Don't confuse with ...
pipettes, which have a bulb at the end to draw up liquids

Similar words
Biuret which is a solution used to test for proteins

Concentration (c)

the number of grams or moles of solute present in each cubic decimetre of a solution, measured in g/dm^3 or mol/dm^3

In other words ...
the amount of substance in a specific volume of liquid

Example
The concentration of the acid was 2 mol/dm^3

Sign it
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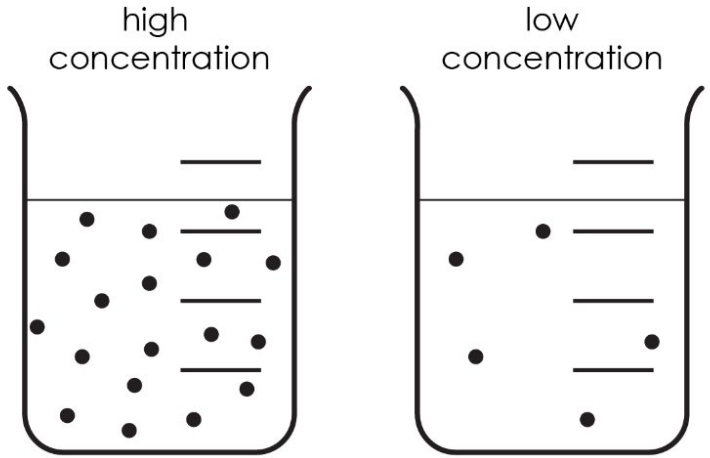
bit.ly/3MgZXkJ



Don't confuse with ...
strength of a substance, or the volume of a substance. You can have a small volume of a very concentrated solution

Say it
Con-sen-tray-shen

Concordant results

two or more results that agree closely with each other; in a titration two results are concordant if they are within 0.1 cubic centimetre (cm^3) of each other

In other words ...
results in an experiment that are very similar to each other

Example
The students repeated the experiment three times and got concordant results

	Titration 1	Titration 2	Titration 3
Volume of acid added (cm^3)	34.56	34.72	34.51

Titration 1 and 3 are concordant results

Say it
Can-cor-dent ri-zult-s

Don't confuse with ...
accurate – results can be concordant but not accurate if they are not close to the actual value

End point

in a titration, the exact volume added when the indicator changes colour

In other words ...
The point when a titration reaction is completed

Example
The end point of the titration occurred when 23 cm^3 of acid had been added.

Say it
End poynt

Don't confuse with ...
The end point does not occur when the burette is empty

Measuring cylinder

a tall tube with a scale on the side used to measure the volume of a liquid or the volume of a gas bubbling up into it through water

In other words ...
a tube used to measure volumes

Sign it
Watch a video:
bit.ly/3MyO0XF

Say it
Meas-si-ar-ing sil-in-da

Example
We used a measuring cylinder to measure 25 cm^3 of water

Don't confuse with ...
Other measuring tools like burette or pipettes

pH indicator

a substance which has a different colour above a certain pH value than below that pH value, such as methyl orange or phenolphthalein

In other words ...
a chemical that changes colour to show if a substance is acid or alkali

Example
As we added an acid to an alkali the pH indicator changed from purple to green and then red

Sign it
Watch a video:
bit.ly/46bKxVx

Don't confuse with ...
Some pH indicators have a range of colours, others have a smaller number like methyl orange

Say it
Pee-aych in-di-cay-ta

Similar words
Universal Indicator is a specific type of pH indicator

Pipette

a narrow tube filled by suction, with a mark or scale printed on the side, used to draw up a measured volume of liquid

In other words ...
a tool used to measure and transfer a small, exact volume of liquid

Example
Use a pipette to slowly add 5 drops of acid to the mixture

Sign it
Watch a video:
bit.ly/40d8bxr

Don't confuse with ...
a dropper, which looks similar but has no measurements on the side

Say it
pip-et

Solution

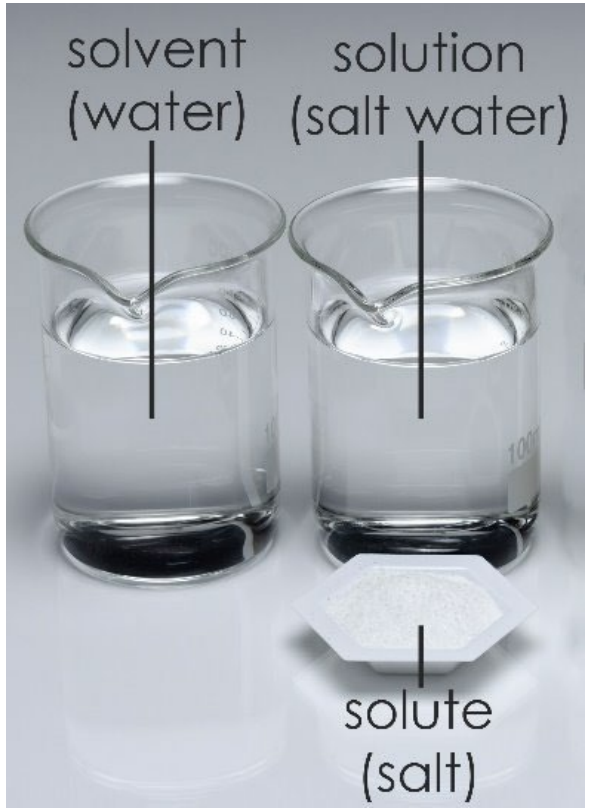
the mixture produced when a solute dissolves in a solvent

In other words ...
a mixture where one substance dissolves completely in another, such as salt in water

Sign it
Watch a video:
bit.ly/44uofhF

Say it
Sal-ue-shen

Break it down
Sol (dissolve), ution (process)



Similar words
Sometimes sterile salt solution is called 'saline'

Example
In a solution of salt water, the solute is salt and the solvent is water

Don't confuse with ...
aqueous. Solutions are often formed in water, but they can form in other liquids, too

Other contexts
The way to solve a problem, especially in mathematics

Titration

a method for finding the concentration of a solution by reaction with another solution of known concentration

In other words ...
a precise method for adding one liquid to another.

Example
The volume of acid needed to neutralise an alkali can be worked out using a titration

Sign it
Watch a video:
bit.ly/466WhIX

Say it
T-eye-tray-shen

Don't confuse with ...
Neutralisation, we can use titration to carry out neutralisation, but it can be used for other reactions as well

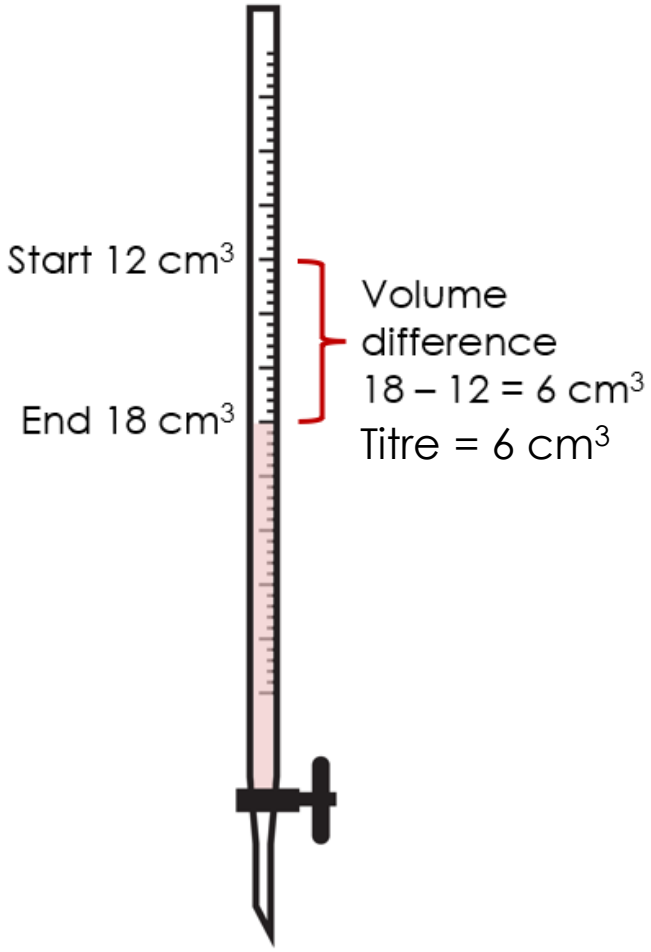
Titre

the volume of solution added from the burette that is needed to reach the end point

In other words ...
the amount of liquid that you add from the burette

Sign it
Watch a video:
bit.ly/40eZqCY

Say it
T-eye-ta



Example
The titre needed to neutralise the alkali was 24 cm^3

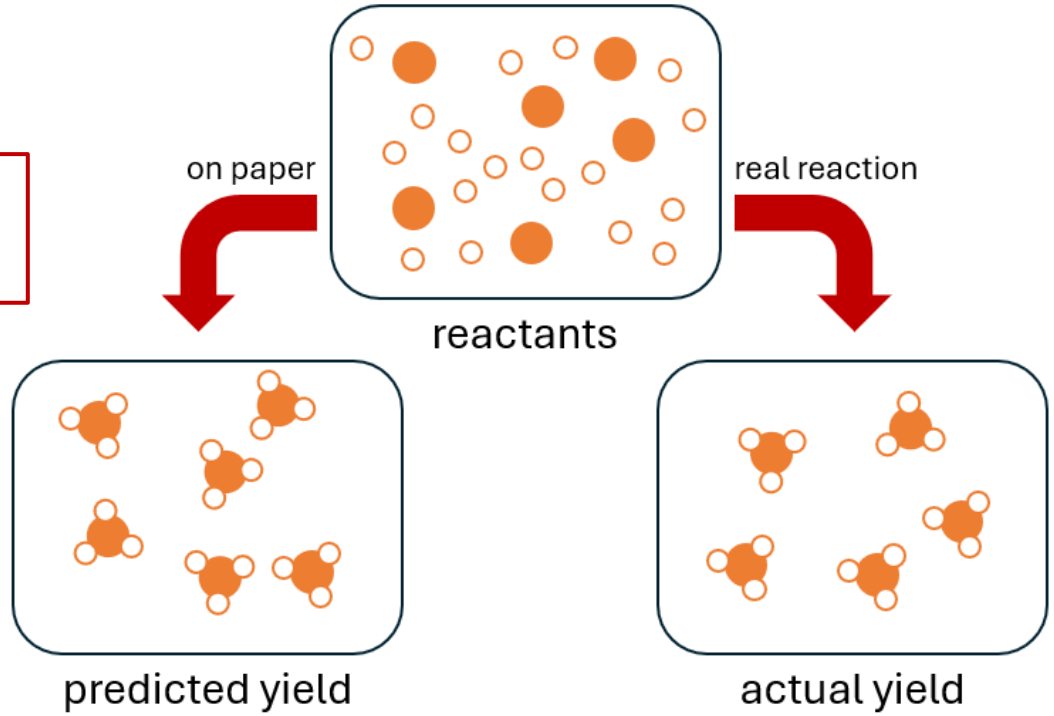
Don't confuse with ...
end point, this is when the reaction has finished and can be used to calculate the titre

Actual yield

the mass or amount of product actually made in a chemical reaction

In other words ...
the actual amount of product made

Say it
Ac-chu-al yee-ld



Example
The actual yield in an experiment is often less than what is predicted

Don't confuse with ...
Predicted/theoretical yield, which is the maximum that **could** be made in a reaction

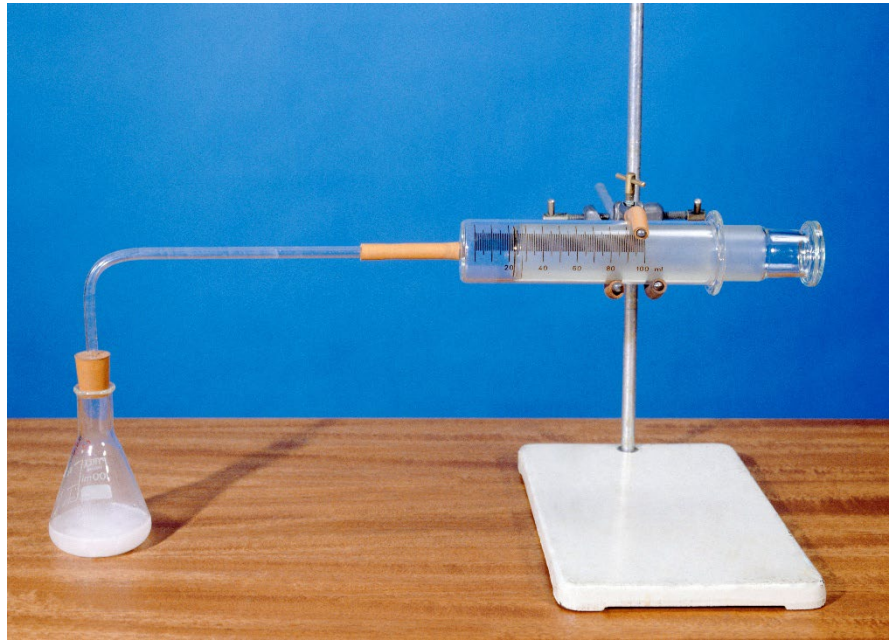
Similar words
Percentage yield and predicted/theoretical yield, they are all linked

Gas syringe

a glass tube with a scale printed on the side and a freely moving plunger, used to collect and measure the volume of a gas.

In other words ...
a piece of equipment used to measure the volume of gas

Example
A gas syringe can be used to measure the rate gas is produced in the experiment



Say it
Gas si-rinj

Don't confuse with ...
a liquid syringe which is often made of plastic

Percentage yield

the actual yield, given as a percentage of the theoretical yield

In other words ...
a way to show how much product was made compared to what was expected

Example
In an experiment the percentage yield was 75%

$$percentage\ yield = \frac{actual\ yield}{theoretical\ yield} \times 100$$

Say it
Pa-seant-ij yee-ld

Don't confuse with ...
the rate of the reaction. The yield is not linked to the speed

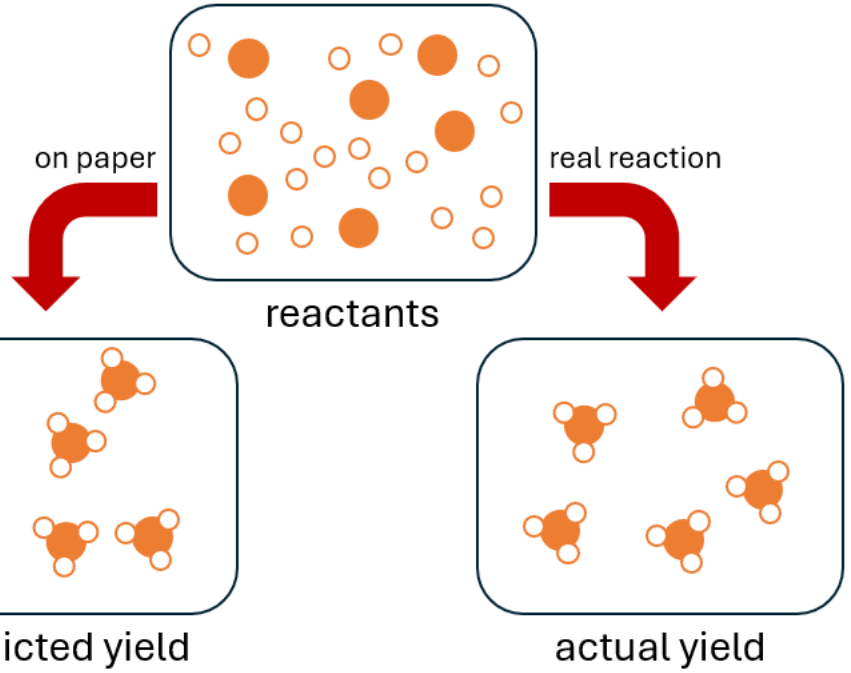
Similar words
Theoretical and actual yield, which are used to calculate percentage yield

Predicted/ theoretical yield

the maximum mass or amount of product you could make in a chemical reaction if no other reactions take place and nothing is lost

In other words ...
the maximum amount of product that could be made if everything reacted perfectly

Example
The theoretical yield was 10 g, but the students only produced 8 g



Say it
Pri-dict-ed/
th-ear-reat-ic-el
yee-ld

Similar words
Actual yield and percentage yield – they are all linked

Top pan balance

an electronic device with a metal tray and a digital readout, used to measure the mass of a sample of a substance

In other words ...
a digital device to measure mass precisely

Example
Use a top pan balance to measure out 5.2 g salt

Sign it
Watch a video:
bit.ly/4rMUHEm

Don't confuse with ...
scales – although similar to kitchen scales it is important to use the correct term in chemistry

Say it
Top pan bal-ens

Percentage composition

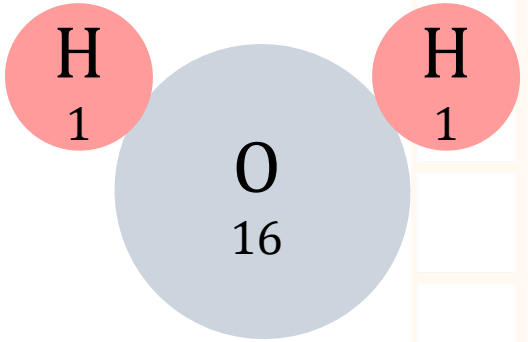
the relative mass of the atom/s of one element in a compound, given as a percentage of the relative formula mass

In other words ...
the percentage of a substance that is made up of each element

Don't confuse with ...
The number of atoms in a compound. Some atoms have more mass than others

Say it
Pa-seant-ij com-paz-i-shen

Example
The percentage composition of water is about 11% hydrogen and 89% oxygen.
Hydrogen has a relative atomic mass of **1** (×2 atoms = 2)
Oxygen has a relative atomic mass of **16**
Total mass = **18**
Composition: **Hydrogen = 11%**, **Oxygen = 89%**



Relative atomic mass (A_r)

the average mass of an atom of an element taking into account the naturally occurring percentages of its isotopes

In other words ...
the average mass of an atom of a specific element as shown on the periodic table

Example
The relative atomic mass of oxygen is 16

11	12	14	16
B	**C**	**N**	**O**
Boron	Carbon	Nitrogen	Oxygen
5	6	7	8

Sign it
Watch a video:
bit.ly/4al4ZG3

Say it
Rel-a-tiv a-tom-ic mas

Similar words
Molar mass which is the mass in grams of one mole of a substance

Don't confuse with ...
This is not the actual mass of the atom which would be a very small number

Relative formula mass (M_r)

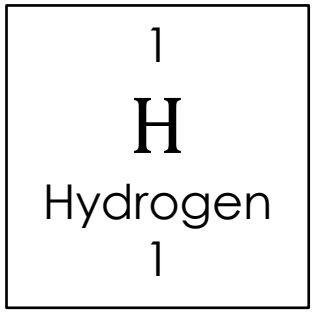
the total of the relative atomic masses of all the atoms in the chemical formula of a substance added together

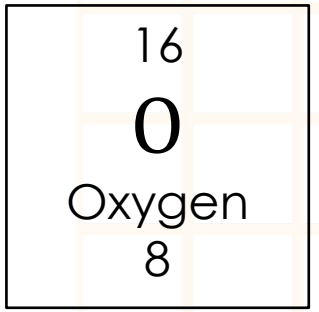
In other words ...
the total of all the relative atomic masses in a compound

Say it
Rel-a-tiv a-tom-ic mas

Don't confuse with ...
molar mass, which is the mass in grams of one mole of a substance

Example
The relative formula mass of water is 18.
A water molecule is made from two hydrogen atoms and one oxygen atom.
Hydrogen has a relative atomic mass of **1** (× 2 atoms = **2**)
Oxygen has a relative atomic mass of **16**
Total mass = **18**





Relative mass

the mass of a particle relative to $\frac{1}{12}$ of the mass of a ^{12}C atom

In other words ...
the mass of any particle, atom or molecule compared to carbon

Example
The relative mass of a proton is 1

Say it
form-ya-la

	Relative Mass
Proton	1
Neutron	1
Electron	0.000538

Don't confuse with ...
Relative mass is not measured in grams

Similar words
Relative atomic mass, which is the whole atom or relative formula mass, which is an entire molecule

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