

atoms are only rearranged, never made or lost, and the equation must show that

Word equation

iron + water → iron
oxide + hydrogen

names only, nothing counted yet

→
make it truer

Skeletal equation

$\text{Fe} + \text{H}_2\text{O} \rightarrow \text{Fe}_3\text{O}_4 + \text{H}_2$

correct formulas in, atoms still unequal

→
make it truer

Balanced equation

$3\text{Fe} + 4\text{H}_2\text{O} \rightarrow \text{Fe}_3\text{O}_4 + 4\text{H}_2$

every element counts the same on both sides

reading it back: 3 iron atoms, 8 hydrogen atoms and 4 oxygen atoms stand on each side, which is what conservation of mass means on paper

Signs that a chemical change has happened

- a change in state, such as wax melting and then burning to gas and vapour
- a change in colour, iron nails turning brown in copper sulphate solution
- evolution of a gas, bubbles rising when zinc meets dilute acid
- a change in temperature, the beaker turning warm or cold to the touch
- formation of a precipitate, an insoluble solid appearing in a clear solution

hit and trial, but in an order

Balancing a chemical equation, step by step

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write the skeletal equation and box every formula so you never change what is inside a box

count atoms of each element on both sides, listing them in a small table beside the equation

start with the compound carrying the most atoms, and balance the element that appears in the fewest places

leave hydrogen and oxygen for last, since they turn up in the most formulas and shift as you go

multiply through if a fraction appears: $\frac{1}{2} \text{O}_2$ becomes O_2

once the whole equation is doubled

finish by adding state symbols and the conditions written over the arrow

State symbols and conditions

solid, liquid, gas, and dissolved in water (s) (l) (g) (aq)

heating, shown by Δ written over the arrow

$\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$

a reaction run in solution, both sides marked aq

$\text{Zn}(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{ZnCl}_2(\text{aq}) + \text{H}_2(\text{g})$

water written as a reactant and water written as (aq) are different things: (aq) says the substance is dissolved in water, not that water took part