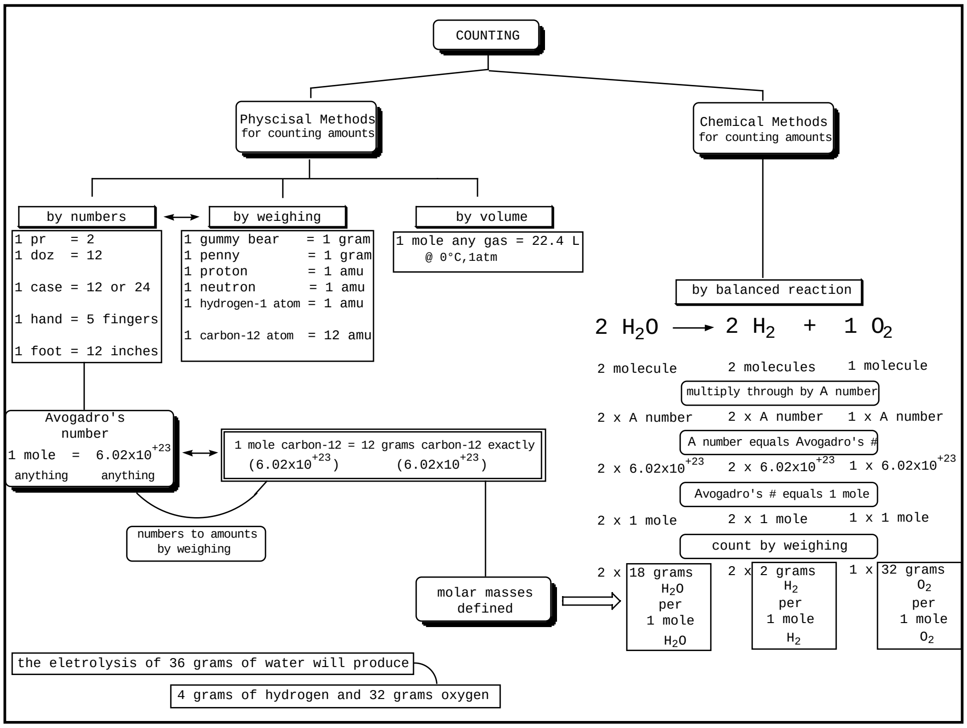
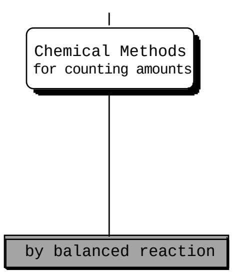




$$2\ H_2O \longrightarrow 2\ H_2 + 1\ O_2$$

2 molecule 2 molecules 1 molecule

This is a chemical recipe for the decomposition of water by electrolysis.

reactants ⟶ products

What did John Dalton in 1808 have to say about chemical reactions?

1. Chemical reactions involve the rearrangement of atoms.

In other words, atoms are not created nor destroyed in chemical reaction.

$$2\ H_2O \longrightarrow 2\ H_2 + 1\ O_2$$

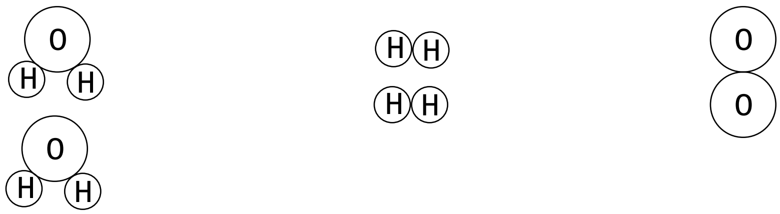
1. Chemical reactions involve just the simple rearrangement of atoms.

2. Atoms are conserved in a chemical reaction.
In other words, atoms are not created nor destroyed in chemical reaction.

Let's see if John Dalton had assumed correctly.

This ture for the above decomposition of water by electrolysis.

$$2\ H_2O \longrightarrow 2\ H_2 + 1\ O_2$$



4 hydrogen atoms 4 hydrogen atoms

2 oxygen atoms 2 oxygen atoms

The chemical equation is the shorthand notation for a chemical reaction.

Reactants —react to produce→ Products

Law of Conservation of Mass - Matter cannot be gained or lost in the process of a chemical reaction. The law of conservation of mass states that we must have a balanced equation.
List five factors involved in the construction of an equation or "chemical recipe."

1. The identity of products and reactants must be specified.
2. Reactants are written to the left of the reaction arrow (---->) and products to the ri
3. The physical state of reactants and products is shown is parentheses; (s), (l), (g), (a
4. The symbol Δ over the reaction arrow means that heat energy is necessary for the reaction to occur.
5. The equation must be balanced.

Steps for balancing a chemical equation

Step 1: Count the number of atoms of each element on both the product and reactant sid

Step 2: Determine which atoms are not balanced.

Step 3: Balance one atom at a time, using coefficients. Start with atoms that appear only once in the reactants and only once in the products. Usually leave Hydrogen atoms followed by Oxygen atoms until last.

Step 4: After you believe that you have successfully balanced the equation, repeat Step 1, to be certain that mass conservation has been achieved.

Note: DO NOT Change subscripts in a molecular formula (i.e., $2\ NaCl \not\longrightarrow Na_2Cl_2$)

Don't do this!!!!

$$2\ Mg + 1\ O_2 \longrightarrow 2\ MgO$$

In balancing, we would like the lowest whole number molar ratio. Where the number out in front is called a molar coefficient.

$$2\ Mg + 1\ O_2 \longrightarrow 2\ MgO$$

But what if an individual balanced the magnesium first?

$$2 \cdot \left(1\ Mg + \frac{1}{2}\ O_2 \longrightarrow 1\ MgO \right)$$

The reaction is balanced, BUT there is a fractional molar coefficient.
We must remove the fraction by multiplying through by 2.

$$2 \cdot 1 \qquad 2 \cdot \frac{1}{2} \qquad 2 \cdot 1$$

$$2\ Mg + 1\ O_2 \longrightarrow 2\ MgO$$

I feel this way is the easiest way to balance, if you:

1) always balance oxygens last;

2) then multiply by factor of 2, to remove any fractional molar coefficient that might be present in the balanced reaction.

$$2 \cdot \left(2\ Fe + \frac{3}{2}\ O_2 \longrightarrow 1\ Fe_2O_3 \right)$$

$$2 \cdot 2 \qquad 2 \cdot \frac{3}{2} \qquad 2 \cdot 1$$

$$4\ Fe + 3\ O_2 \longrightarrow 2\ Fe_2O_3$$

Note: We are going for the lowest whole number Molar coefficient ratio

Finally, name the compounds and give physical states.

$2\ Mg_{(s)} + 1\ O_{2(g)} \longrightarrow 2\ MgO_{(s)}$

magnesium metal solid | oxygen gas | magnesium oxide solid ionic salt

$4\ Fe_{(s)} + 3\ O_{2(g)} \longrightarrow 2\ Fe_2O_{3(s)}$

iron metal solid | oxygen gas | iron (III) oxide solid TM ionic salt

Combustion of methane gas

$1\ CH_4 + 2\ O_2 \longrightarrow 1\ CO_2 + 2\ H_2O$

Always balance oxygens last

$1 \bullet O_2 + 2 \bullet 1O$

$? \bullet O_2 = 4$

$2 + 2 = 4$

Combustion of ethane gas

$$2\left(2\,C_2H_6 + \frac{7}{2}\,O_2 \longrightarrow 2\,CO_2 + 3\,H_2O\right)$$

$2 \bullet 2$ $\quad 2 \bullet \frac{7}{2}$ $\quad 2 \bullet 2$ $\quad 2 \bullet 3$

$$4\,C_2H_6 + 7\,O_2 \longrightarrow 4\,CO_2 + 6\,H_2O$$

Combustion of methanol liquid

$$1\,CH_4O + \frac{3}{2}\,O_2 \longrightarrow 1\,CO_2 + 2\,H_2O$$

Always balance oxygens last

$1 \bullet O_2 + 2 \bullet 1O$

$2 + 2 = 4$

$1 \bullet O + ? \bullet O_2 = 4$

Now solve for "?"

$1 + ? \bullet 2 = 4$

$-1 \qquad -1$

$\frac{? \bullet 2}{2} = \frac{3}{2}$

Divide each side by 2

$? = \frac{3}{2}$

Combustion of methanol liquid

$$2\left(1\,CH_4O + \frac{3}{2}\,O_2 \longrightarrow 1\,CO_2 + 2\,H_2O\right)$$

$2 \times 1 \qquad 2 \times \frac{3}{2} \qquad 2 \times 1 \qquad 2 \times 2$

$$2\,CH_4O + 3\,O_2 \longrightarrow 2\,CO_2 + 4\,H_2O$$

Now balance the combustion of glucose (blood sugar)

$$1\,C_6H_{12}O_6 + 6\,O_2 \longrightarrow 6\,CO_2 + 6\,H_2O$$

Ionic salt transfer reactions in aqueous solution

A^+B^- (aq) + C^+D^- (aq) ⟶ AD(?) + BC(?)

Ionic salt solubility in water

All group I salts soluble, Li,Na,K
All nitrate salts soluble
All ammonium salts soluble,NH_4^+

you'll need to determine state based on some rules

Driving forces for ion transfer,
a force that makes the reaction go.

Physical state formations:
If a solid forms
If a liquid forms
If a gas forms

Evidence for chemical change, Δ
Color change (tricky)
Heat evolved (tricky)

precipitation saturation (solids)
If a liquid forms (heat evolved)
If a gas forms (bubbles, odor)

Ionic salt transfer reactions in aqueous solution

A^+B^- (aq) + C^+D^- (aq) ⟶ AD(?) + BC(?)

Use of common sense tells us that,
we will mix ionic solutions in order to have reaction occur.
(we are not going to mix for the sake of mixing)

Use of common sense tells us that,
An acids mixed with a base (antacid) causes a neutralization.

H^+A^- (aq) + M^+OH^- (aq) ⟶ H_2O (l) + MA(?)

Use of common sense tells us that,
An acids mixed with carbonate (HCO_3^-) produces CO_2 water and salt

H^+A^- (aq) + $NaHCO_3$ (aq) ⟶ H_2O(l) + NaA(aq) + CO_2 (g)