Moles

- What particles can you think of?

- Atoms
- Ions
- Simple molecules
- Giant covalent structures

- How many particles do you think are in this beaker?
- 6.02×10^{23} particles.
- 602,000,000,000,000,000,000,000 particles
- In chemistry we say this is 1 mole

Moles

- One mole is the amount of substance that contains the same number of particles (atoms, ions, molecules etc.) as there are in 12 g of carbon-12.

- This number is called Avagadro's constant (L) or (N_a)and has the value 6.02×10^{23} mol^{-1}.

- The mole is an amount (n) and **not** a mass. You can have a mole of anything, atoms, molecules, ions, ping pong balls etc.

JUST HOW BIG IS A MOLE

- https://www.youtube.com/watch?v=1R7NiIum2TI&feature=related

- If you had a mole of paper, how tall would it be?

- If you had a mole of marshmallows, how long would it take 5 billion people to eat all of them, eating one a second?

- Why is this useful to chemists?

- We use it to make our lives easier!

What a chemical equation means

N_2 + $3\ H_2$ → $2\ NH_3$

1 molecule N_2 | 3 molecules H_2 | 2 molecules NH_3

12 molecule N_2 | 36 molecules H_2 | 24 molecules NH_3

6×10^{23} molecule N_2 | 18×10^{23} molecules H_2 | 12×10^{23} molecules NH_3

1 mole | 3 moles | 2 moles

Relative masses

- **Relative atomic mass (A_r)**
- The average of the masses of the isotopes in a naturally occuring sample of the element relative to the mass of 1/12 of an atom of carbon-12.
- *Is twelve the A_r of carbon?*
- ***NO! REMEMBER ISOTOPES!***
- **Relative formula mass (M_r)**
- This is simply the sum of the relative atomic masses of all the individual atoms in the formula.
- Note that because A_r and M_r are relative terms, they have no units.

- number of moles (mol) = mass (g) / M_r
- How do chemists use moles?
- One use is to predict what mass of products to expect from a reaction. This is what you are going to do today.

PRACTICAL

- **Baking soda**
- What is the formula of baking soda?
- $NaHCO_3$
- What do chemists call it?
- Sodium bicarbonate
- Why do cakes rise?
- When we heat sodium bicarbonate a gas is given off.
- What is the gas evolved?
- Carbon dioxide (CO_2)

http://www.almanac.com/content/household-uses-baking-soda

PRACTICAL

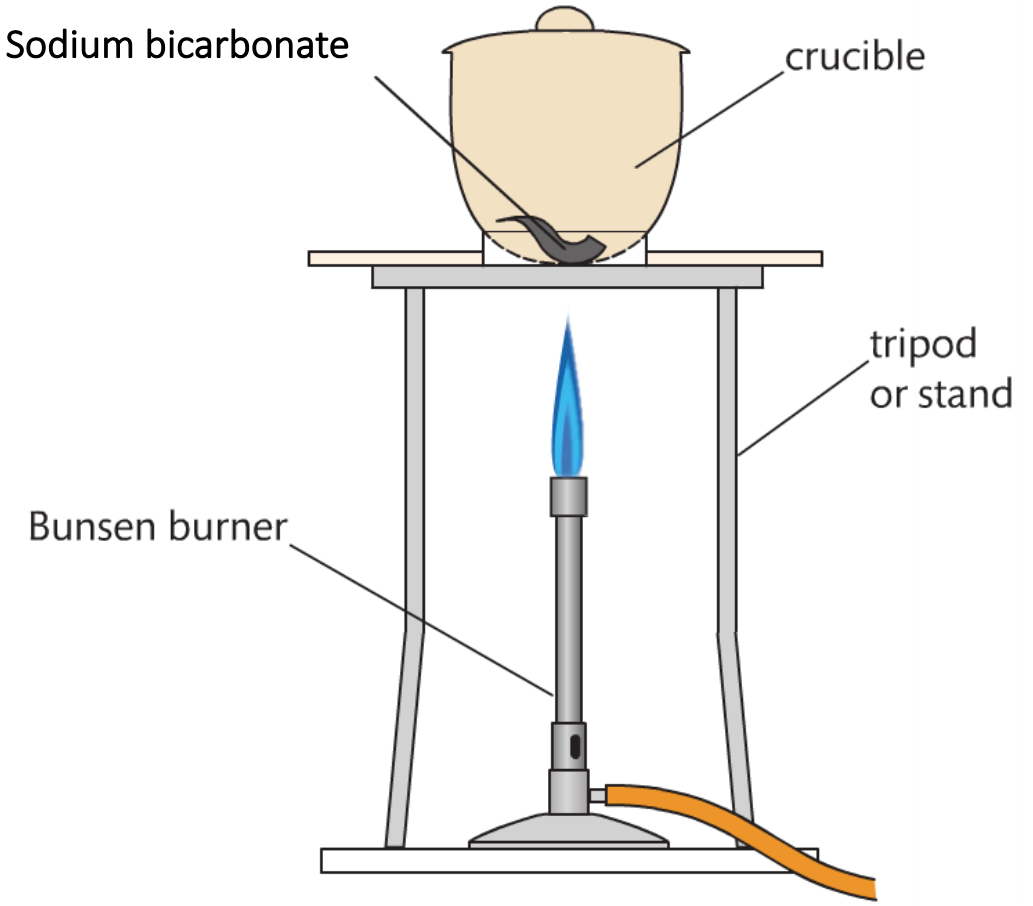
If we heat sodium bicarbonate ($NaHCO_3$), carbon dioxide (CO_2) is given off.

$$NaHCO_3(s) \rightarrow CO_2(g) + H_2O(g) + Na_2CO_3(s)$$

Is this balanced?

No

$$2NaHCO_3(s) \rightarrow CO_2(g) + H_2O(g) + Na_2CO_3$$



- If we heat 5.00 g of $NaHCO_3$ to constant mass, how much Na_2CO_3 will be left in grams?

- $2NaHCO_3(s) \rightarrow CO_2(g) + H_2O(g) + Na_2CO_3$

- number of moles (mol) = mass (g) / M_r

- M_r of $NaHCO_3$ 84.01
- M_r of CO_2 44.01
- M_r of H_2O 18.02
- M_r of Na_2CO_3 106.0

mass of $NaHCO_3$ 5.00 g

predicted mass of Na_2CO_3 = ?

Moles

- number of moles (n) = mass of substance/M_r
- Use this equation to complete the table below.

Compound	M_r	Mass (g)	Number of moles (mol)
H_2O	18.02	9.01	0.500
CO_2		5.00	
H_2S			0.100
NH_3			3.50
$Mg(NO_3)_2$		1.75	
C_3H_7OH		2500	
Fe_2O_3			5.68×10^{-5}