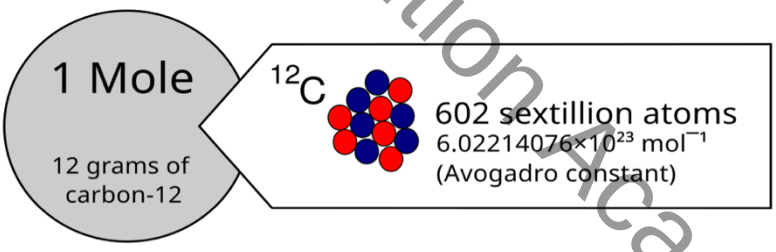
C3: Quantitative Chemistry. ASM Tuition Academy

Moles and Mass

- **Use moles for measurements.** The main measure of chemical amounts are **moles**, with mol as the unit.
- **Compare moles to relative formula mass.** The mass of one mole of a substance is equal to the **relative formula mass** in grams**.**
- For example, Boron has an A_r of 11, so one mole of Boron would weigh 11g exactly.

Avogadro's Constant

- **Definition: T**he word "mole" stands for a particular number. This is known as the **Avogadro Constant**. Just as the word"dozen" represents the number "12", the mole represents the number represented by Avogadro's constant.
- T**he Avogadro constant is a number:** The Avogadro constant is the number of atoms, molecules or ions in a mole of the given substance. We state it as **6.02 x 10$_{23}$** atoms per mole.
- **Avogadro's number and moles:** One mole of any substance contains 6.02 x 10$_{23}$ particles. To determine the number of moles in a given number of particles



- we can use the equation: –

Number of moles = (given number of particles/ 6.02 x 10$_{23}$)

Q: Calculate the number of moles of chlorine (Cl_2) in 3.01 x 10$_{25}$ particles.

Number of moles = given number of particles/ 6.02 x 10$_{23}$

Number of moles = 3.01 x 10$_{25}$/ 6.02 x 10$_{23}$ = 50 mol

Molar Mass

- The Mass of 1 mole (in grams)
- Equal to the numerical value of the average atomic mass (get from periodic table)

1 mole of C atoms	=	12.0 g
1 mole of Mg atoms	=	24.3 g
1 mole of Cu atoms	=	63.5 g

Calculations Using Moles

➤ To calculate the **number of moles** of an element or a compound, we could use this formula:

Relative Formula mass (Mr) = formula mass of any given substance

Q: Work out the number of moles in 150g of Calcium carbonate ($CaCO_3$).

1.Calculate the M_r of Calcium carbonate.

➤ First we need to calculate the relative formula mass of calcium carbonate, or ($CaCO_3$).

$M_r (CaCO_3)$

$=40 + 12 + (3 \times 16)$

$=100$

2. Now we use the formula: Moles = Mass / M_r

Moles = 150 / 100

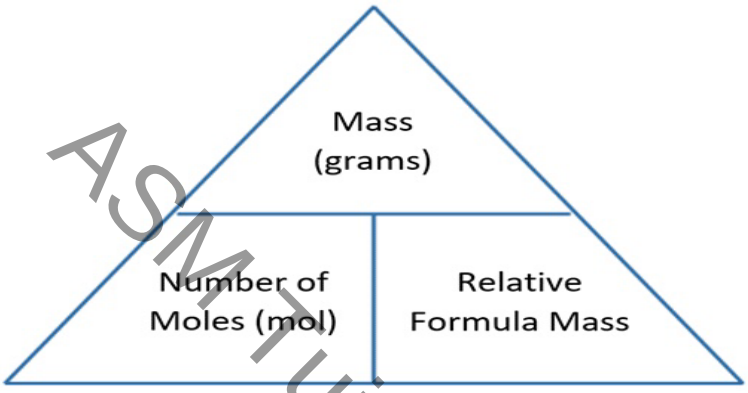
= 1.5 mol

Find the no of moles in a Given mass

- **Formula:**

  No of moles = mass (g) / relative Formula mass (Mr)

- **We can rearrange the equation to find out the mass or relative formula mass by Formula Triangle.**



- You can use the triangle to learn these three equations:

  1- mass = no of moles × Mr

  2- no of moles = mass ÷ Mr

  3- Mr = m ÷ n

  - m = Mass, which is usually measured in grams (g)
  - n = Number of moles, which is a unit used to express the amount of a substance
  - Mr = Relative formula mass, which is the sum of the atomic masses of all the atoms in a chemical formula

Q: Calculate the mass of 2 moles of sodium hydroxide (NaOH)

Solution :

- To calculate the mass, we need to rearrange the equation, which gives us:

Mass (g) = Number of moles × Relative formula mass (Mr)

- The relative formula mass of NaOH can be calculated by adding up the atomic masses of each of its atoms, which are:
  - Na (sodium) with an atomic mass of 23
  - O (oxygen) with an atomic mass of 16
  - H (hydrogen) with an atomic mass of 1
- So the relative formula mass (Mr) of NaOH is:

  Mr = 23 + 16 + 1 = 40
- Now, we can plug in the values we have to find the mass:

  Mass (g) = 2 × 40

  Mass (g) = 80 g

Therefore, the m**ass of 2 moles of NaOH is 80 grams.**

Q: Calculate the number of moles in 13g of sulfur (S)

Solution

- To calculate the number of moles, we use the formula:

  Number of moles = Mass ÷ Relative Formula mass
- The relative atomic mass of sulfur (S) is 32.
- Now we can plug in the given mass of sulfur and its relative atomic mass:

  Number of moles = 13 g ÷ 32

  Number of moles = 0.40625 = approx 0.406