## Moles, Molar Masses and Concentrations

- A **mole** is a number equal to **6.02 x $10^{23}$**
  - It is also known as **Avogadro's constant**
  - In 12g of $^{12}C$, there are 6.02 x $10^{23}$ molecules

- **One mole of any element has the same number of atoms**, therefore;
  - 1 mol of C = 6.02 x $10^{23}$ molecules
  - 1 mol of $H_2O$ = 6.02 x $10^{23}$ molecules

- One mole of 2 different elements has the **same number of atoms but different masses**
  - The mass of one mole of a substance is the **molar mass**:
    - Measured in **g $mol^{-1}$** or **grams per mole**
  - **The molar mass of an element is the same as its mass number**:
    - Potassium, for example, has mass number 39, and so has a molar mass of 39 g $mol^{-1}$
  - **The molar mass of a compound is just the sum of all the mass numbers in the molecule**
    - For example, potassium hydroxide (KOH) will be 39+16+1 = 56g $mol^{-1}$

- You can calculate the amount (mol) of a substance if you know:
  - **The mass of the sample (g)**
  - **The molar mass of the elements involved**
  - The formula is the following:

$$\boldsymbol{Amount\ (mol) = \frac{mass\ of\ sample\ (g)}{molar\ mass\ (g\ mol^{-1})}}$$



- For example, how many moles of fluorine are in 95g of this element?
  - It would be 95/19 = 5 moles

- Another example, how many molecules of glucose are in 500g of glucose ($C_6H_{12}O_6$)?
  - It would be 500/((6x12)+(1x12)+(6x16)) = 2.78 moles

- Sometimes you may need to know the amount of substance in a sample of blood or urine etc.
  - This is known as the **concentration**
  - The concentration is considered as the **number of moles of a substance per litre of solution**
    - This is known as **molarity**
      - This is measured in **mol $L^{-1}$** or **mol $dm^{-3}$** or **M**
  - The formula for concentration is:

$$\boldsymbol{Amount\ (mol) = concentration\ (mol\ L^{-1}) \times volume\ (L)}$$

  - For example, the amount of 500ml sodium chloride (NaCl) in a 2mol $L^{-1}$ concentration will be:
    - 2x0.5 = 1mol of NaCl

- **You also might need to prepare a solution; you can use the same equations**. So how do you prepare 2L of a 2M solution of NaCl?
  - The moles needed are 2 x 2 = 4
  - 4 moles = mass needed/molar mass (58)
    - Therefore, you will need 232g of NaCl to make the solution

- Areas of science require solutions made by **percentage weight calculations**
  - Therefore, a 2% glucose solution in 400ml = 400x0.02 = 8g of glucose