

The Mole – part 3

In our last worksheet we learnt how to convert between mass (grams) and number of moles. In this worksheet we will learn how to convert between number of moles and number of particles (either atoms or molecules). Remember that we said 1 mole of any substance contains Avogadro's number (N_A) of particles. So 2 moles will contain $2 \times N_A$, etc.

The formula that we use for these calculations is:

$$n = \frac{N_0}{N_A}$$

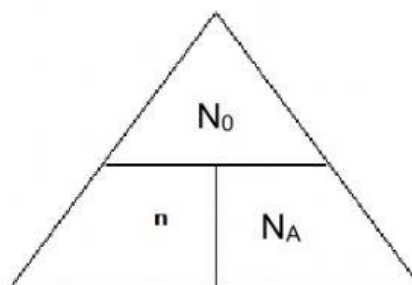
Where:

n = number of moles (unit: mol)

N_0 = number of particles (atoms/molecules)

N_A = Avogadro's number ($6,02 \times 10^{23}$)

We can also write this as a triangle:



Watch the following video to help you understand this section before you attempt the calculations that follow:

<https://www.youtube.com/watch?v=HMAOrGpkTsQ>

Calculating the number of particles (atoms or molecules):

Remember: 1 mole = $6,02 \times 10^{23}$ particles

Examples:

1) 1 mole of Al = $6,02 \times 10^{23}$ atoms

2) 1 mole of Zn = $\quad \times 10^{23}$ atoms

3) 2 moles of Mg = $1,20 \times 10^{24}$ atoms

4) 2 moles of C = $\quad \times 10^{24}$ atoms

5) 3 moles of Na = $\quad \times 10 \quad$ atoms

6) 6 moles of Chlorine gas (Cl_2) = $\quad \times 10$ molecules
= $\quad \times 10$ atoms

7) 4 moles of nitrogen gas (N_2) = $\quad \times 10$ molecules
= $\quad \times 10$ atoms

Always use 2 decimal places unless told otherwise

Remember every diatomic molecule is made up of TWO atoms!

Examples:

1) Calculate the number of atoms in 3 moles of Calcium metal

$$N_o = n \times N_A$$

$$= 3 \times 6,02 \times 10^{23}$$

$$= \quad \times 10^{24} \text{ atoms}$$

2) Calculate the number of moles in $2,41 \times 10^{23}$ atoms of Cu metal

$$n = N_o / N_A$$

$$= \frac{2,41 \times 10^{23}}{6,02 \times 10^{23}}$$

$$= \quad \text{mol}$$

3) Calculate the number of moles in $1,51 \times 10^{24}$ molecules of NaOH

$$n = N_o / N_A$$

$$= \frac{\quad \times 10^{24}}{\quad \times 10^{23}}$$

$$= \quad \text{mol}$$

4) Calculate the number of molecules in 12 moles of MgSO_4

$$N_o = n \times N_A$$

$$= \quad \times 6,02 \times 10^{23}$$

$$= \quad \times 10^{24} \text{ molecules}$$

Hint: Count how many atoms are in ONE molecule of MgSO_4

4.2 Calculate the number of atoms in the above example

$$\text{No. of atoms} = \quad \times 10^{24} \text{ molecules} \times$$

$$= \quad \times 10^{25} \text{ atoms}$$

5) Calculate the number of atoms in 2 moles of Fluorine gas

$$N_o = n \times N_A$$

$$= 2 \times 6,02 \times 10^{23}$$

$$= \quad \times 10^{24} \text{ molecules}$$

$$\text{Thus no. of atoms} = \quad \times 10^{24} \times 2$$

$$= \quad \times 10^{23} \text{ atoms}$$

Now we will do calculations where we combine the two triangles we have learnt. If we are given grams and asked to calculate number of atoms, we first change grams to moles, then moles to number of particles.

6) Calculate the number of molecules in 38g of Fluorine gas

$$n = \frac{m}{M}$$

$$n = \frac{38}{38}$$

$$= 1 \text{ mol}$$

$$N_o = n \times N_A$$

$$= \quad \times 6,02 \times 10^{23}$$

$$= \quad \times 10^{23} \text{ molecules}$$

7) Calculate the number of atoms in 36 g of H₂O

$$n = \frac{m}{M}$$

$$n = \quad /$$

$$= \quad \text{mol}$$

$$N_o = n \times N_A$$

$$= \quad \times 6,02 \times 10^{23}$$

$$= \quad \times 10^{24} \text{ molecules}$$

$$\text{Thus no of atoms} = \quad \times 10^{24} \text{ molecules} \times$$

$$= \quad \times 10^{24} \text{ atoms}$$

8) Calculate the number of atoms in 1 mol of hydrogen gas

$$N_O = n \times N_A = \quad \times 6,02 \times 10^{23}$$

$$= \quad \times 10^{23} \text{ molecules}$$

$$\text{Thus no of atoms} = \quad \times 10^{23} \text{ molecules} \times$$

$$= \quad \times 10^{24} \text{ atoms}$$

Question 6

Calculate:

6.1) the number of atoms in 1,5 moles of Carbon

$$N_O = n \times N_A$$

$$= \quad \times 6,02 \times 10^{23}$$

$$= \quad \times 10 \quad \text{atoms}$$

6.2 the number of atoms in 100 g of CaCO_3

$$n = m/M$$

$$n = \quad /$$

$$= \quad \text{mol}$$

$$N_O = n \times N_A$$

$$= \quad \times 6,02 \times 10^{23}$$

$$= \quad \times 10 \quad \text{molecules}$$

$$\text{Thus no of atoms} = \quad \times 10 \quad \times$$

$$= \quad \times 10 \quad \text{atoms}$$

6.3) the number of moles in $3,01 \times 10^{23}$ atoms of Ca metal

$$n = N_o / N_A$$

$$= \frac{\quad \times 10^{23}}{\quad \times 10^{23}}$$

$$= \quad \text{mol}$$

6.4) the number of atoms in 186,25 g of KCl

$$n = m / M$$

$$n = \quad /$$

$$= \quad \text{mol}$$

$$N_o = n \times N_A$$

$$= \quad \times 6,02 \times 10^{23}$$

$$= \quad \times 10 \quad \text{molecules}$$

$$\text{Thus no of atoms} = \quad \times 10 \quad \times$$

$$= \quad \times 10 \quad \text{atoms}$$

6.5) the number of molecules in 50 g of CaCO_3

$$n = m/M$$

$$n = \quad /$$

$$= \quad \text{mol}$$

$$N_o = n \times N_A$$

$$= \quad \times 6,02 \times 10^{23}$$

$$= \quad \times 10 \quad \text{molecules}$$

6.6) the mass of $1,2 \times 10^{24}$ atoms of Al metal

$$n = N_o/N_A$$

$$= \frac{\quad \times 10}{\quad \times 10}$$

$$= \quad \text{mol}$$

$$m = n \times M$$

$$= \quad \times$$

$$= \quad \text{g}$$