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 x N_A, etc.

The formula that we use for these calculations is:

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

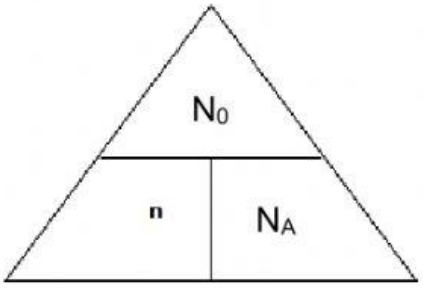
Where:

n = number of moles (unit: mol)

N_o = 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 = $\quad \times 10$ atoms

Always use 2 decimal places unless told otherwise

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

Remember every diatomic molecule is made up of TWO atoms!

Examples:

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

$N_O = n \times N_A$

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

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

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

$n = {}^{N_O}/_{N_A}$

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

$=$ $\quad$ mol

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

$n = {}^{N_O}/_{N_A}$

= _____ x 10^{24} / x 10^{23}

= mol

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

$N_O = n \times N_A$

= x 6,02 x 10^{23}

= x 10^{24} molecules

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

4.2 Calculate the number of atoms in the above example

No. of atoms = x 10^{24} molecules x

= x 10^{25} atoms

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

$N_O = n \times N_A$

= 2 x 6,02 x 10^{23}

= x 10^{24} molecules

Thus no. of atoms = x 10^{24} x 2

= x 10^{23} 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

$n = {}^{m}/_{M}$

$n = {}^{38}/_{38}$

= 1 mol

N_O = n x N_A

= x 6,02 x 10^{23}

= x 10^{23} molecules

7) Calculate the number of atoms in 36 g of H_2O

$n = {}^{m}/_{M}$

$n = \quad /$

= mol

N_O = n x N_A

= x 6,02 x 10^{23}

= x 10^{24} molecules

Thus no of atoms = x 10^{24} molecules x

= x 10^{24} atoms

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

N_O = n x N_A = x 6,02 x 10^{23}

= x 10^{23} molecules

Thus no of atoms = x 10^{23} molecules x

= x 10^{24} atoms

Question 6

Calculate:

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

N_O = n x N_A

= x 6,02 x 10^{23}

= x 10 atoms

6.2 the number of atoms in 100 g of $CaCO_3$

$n = {}^{m}/_{M}$

$n =$ /

= mol

N_O = n x N_A

= x 6,02 x 10^{23}

= x 10 molecules

Thus no of atoms = x 10 x

= x 10 atoms

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

$n = {}^{N_O}/_{N_A}$

= $\frac{\text{x } 10^{23}}{\text{x } 10^{23}}$

= mol

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

$n = {}^{m}/_{M}$

$n = \quad /$

= mol

$N_O = n \times N_A$

= x 6,02 x 10^{23}

= x 10 molecules

Thus no of atoms = x 10 x

= x 10 atoms

6.5) the number of molecules in 50 g of $CaCO_3$

$n = {}^{m}/_{M}$

$n =$ /

= mol

N_O = n x N_A

= x 6,02 x 10^{23}

= x 10 molecules

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

$n = {}^{N_O}/_{N_A}$

= $\frac{\text{x 10}}{\text{x 10}}$

= mol

m = n x M

= x

= g