

## Mole & Molar Mass

**Mole (mol):** the amount of material counting  $6.02214 \times 10^{23}$  particles

The value of the mole is equal to the number of atoms in exactly 12 grams of pure carbon-12.

- 12.00 g C-12 = 1 mol C-12 atoms =  $6.022 \times 10^{23}$  atoms
- The number of particles in 1 mole is called Avogadro's Number ( $6.0221421 \times 10^{23}$ ).

$$\frac{6.022 \times 10^{23} \text{ atoms}}{1 \text{ mol}} \quad \text{or} \quad \frac{1 \text{ mol}}{6.022 \times 10^{23} \text{ atoms}}$$

<i>Converting between Number of Moles and Number of Atoms</i>	
<i>Calculate the number of atoms in 2.45 mol of copper.</i>	<i>A silver ring contains <math>1.1 \times 10^{22}</math> silver atoms. How many moles of silver are in the ring?</i>
<div style="text-align: center;"> </div> $2.45 \text{ mol Cu} \times \frac{6.022 \times 10^{23} \text{ atoms}}{1 \text{ mol}}$ $= 1.48 \times 10^{24} \text{ atoms Cu}$	<div style="text-align: center;"> </div> $1.1 \times 10^{22} \text{ atoms Ag} \times \frac{1 \text{ mol}}{6.022 \times 10^{23} \text{ atoms}}$ $= 1.8 \times 10^{-2} \text{ mol Ag}$

**Molar Mass:** the mass of 1 mol of atoms of an element

An element's molar mass in g/mol is numerically equal to the element's atomic mass in amu.

$$\frac{1 \text{ mol C}}{12.01 \text{ g C}} \quad \text{or} \quad \frac{12.01 \text{ g C}}{1 \text{ mol C}}$$

<i>Converting between Mass and Number of Moles</i>	<i>Converting between Mass and Number of Atoms</i>
<i>Calculate the moles of carbon in 0.0265 g of pencil lead.</i>	<i>How many aluminum atoms are in a can weighing 16.2 g?</i>
<div style="text-align: center;"> </div> $0.0265 \text{ g C} \times \frac{1 \text{ mol C}}{12.01 \text{ g C}}$ $= 2.21 \times 10^{-3} \text{ mol C}$	<div style="text-align: center;"> </div> $16.2 \text{ g Al} \times \frac{1 \text{ mol Al}}{26.98 \text{ g Al}} \times \frac{6.022 \times 10^{23} \text{ atoms}}{1 \text{ mol}}$ $= 3.62 \times 10^{23} \text{ atoms Al}$



## Practice Problems

- How many atoms are there in each of following?
  - 3.75 moles of silver
  - 2.36 moles of xenon
  - 158 kg of phosphorus
- What is the amount, in moles, of each of the following?
  - 449 g of potassium
  - 11.8 g of Ar
  - $2.16 \times 10^{24}$  atoms of lead
- What is the mass of each of the following?
  - $1.9 \times 10^{24}$  atoms of Pb (in g)
  - $4.87 \times 10^{25}$  atoms of Zn (in kg)
  - $2.33 \times 10^{20}$  atoms of oxygen (in ng)
- How many molecules are in 2.50 moles of  $\text{CO}_2$ ?
- Calculate the mass, in grams, of 0.433 mol of calcium nitrate.  
*Hint: Formula Weight of  $\text{Ca}(\text{NO}_3)_2 = (\text{AW of Ca}) + 2(\text{AW of N}) + 6(\text{AW of O})$*
- Calculate the number of H atoms in 0.350 mol of  $\text{C}_6\text{H}_{12}\text{O}_6$

### References:

*Tro, Chemistry: A Molecular Approach 2<sup>nd</sup> ed., Pearson*

*Brown/LeMay/Bursten, Chemistry: The Central Science, 12<sup>th</sup> ed., Pearson*

1. (a)  $2.26 \times 10^{24}$  silver atoms; (b)  $1.42 \times 10^{24}$  xenon atoms (c)  $3.07 \times 10^{27}$  phosphorus atoms  
 2. (a) 11.5 moles; (b) 0.295 moles Ar; (c) 3.59 moles  
 3. (a)  $6.5 \times 10^2$  g; (b) 5.29 kg; (c)  $6.19 \times 10^6$  ng  
 4.  $1.51 \times 10^{24}$  atoms; 5. 71.1 g  $\text{Ca}(\text{NO}_3)_2$ ; 6.  $2.53 \times 10^{24}$  H atoms

Answers