

Mole & Molar Mass

Mole (mol): the amount of material counting 6.02214×10^{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 = 6.022×10^{23} atoms
- The number of particles in 1 mole is called Avogadro's Number (6.0221421×10^{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 1.1×10^{22} 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
 - 2.16×10^{24} atoms of lead
- What is the mass of each of the following?
 - 1.9×10^{24} atoms of Pb (in g)
 - 4.87×10^{25} atoms of Zn (in kg)
 - 2.33×10^{20} atoms of oxygen (in ng)
- How many molecules are in 2.50 moles of 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 2nd ed.*, Pearson

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

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

Answers