

4.S: The Mole and Measurements in Chemistry (Summary)

- The **mole** is defined as the number of atoms contained in *exactly* 12 grams of carbon-12 (the isotope ^{12}C). There are 6.0221415×10^{23} particles in a mole. Remember, a *mole* is just a number (like *dozen*) and you can have a mole of *anything*.
- The concept of a mole is based on **Avogadro's Hypothesis** (*equal volumes of all gases at the same temperature and pressure contained the same number of molecules*) and the number of particles in a mole (6.0221415×10^{23}) is commonly referred to as **Avogadro's number** (typically rounded to 6.02×10^{23} for most calculations).
- Because atomic masses, and the number of particles in a mole, are both based on the isotopic atomic mass of the isotope carbon-12, **the mass of any substance expressed in atomic mass units is numerically equal to the molar mass of the substance in grams per mole**. Thus, *exactly* 12 grams of carbon-12 contains *exactly* a mole of carbon atoms; likewise, 31.9988 grams of O_2 contains 6.02214×10^{23} oxygen molecules (note, *six* significant figures), etc.
- To convert the number of **moles** of a substance into the **mass** of a substance, you simply need to multiply (**moles \times molar mass**).
- To convert the **mass** of a substance into the number of **moles**, you simply need to *divide* the **mass** by the **molar mass**.
- To convert the number of **moles** of a substance into the number of **particles** of that substance, you simply need to multiply (**moles \times Avogadro's number**).
- The **percentage composition** of a compound, simply tells us what *percent* of the total mass arises from each element in the compound. To do the calculation, simply take the atomic mass of the element in question and divide it by the molar mass of the molecule.
- The **empirical formula** for a compound is the *lowest whole-number ratio* of the elements in that compound. For example, the molecular formula for glucose is $\text{C}_6\text{H}_{12}\text{O}_6$, but the simplest whole-number ratio of the elements in glucose is CH_2O .

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