Factor Label/Dimensional Analysis

**Purpose**: In preparation for working with chemical reactions, we need to to think about how chemists count the number of atoms, molecules or formula units in a substance. This will be done by establish some important vocabulary and mathematical methods for calculating the count, mass and volume of that substance.

# Conversion factors

1. If you are traveling at 75 mi/hr, how many miles have you travelled after 4.3 hours?
2. Convert 1 year to seconds
3. Convert 52.0 inches to cm
4. How many tires are in a parking lot with 256 cars (assuming 4 tires per car)?

**What information do you need to solve these problems?**

* **Conversion factors to relate one type of measurement to another!**
* **Make sure that all of your units cancel! This is a good method for checking your work. If your answer has more units than the question calls for, there is a problem with your equation set-up!**

# Calculating the mass of one atom, molecule or formula unit

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| --- | --- | --- |
| Representative particle | Definition | Mass units |
| Atom | Many elements can exist as neutral single atoms (particularly noble gases and metals), such as He, Na, Zn. The mass of one atom can be measured using “atomic mass units” or amu | **Atomic mass** is measured in **amu** for a single atom  Grams are used for a mole of atoms |
| ~~Ion~~ | STRIKE OUT THIS ROW. It’s not beneficial to talk about single ions. We’ll usually talk about atoms or compounds. | STRIKE OUT THIS ROW. |
| Formula unit | Ionic compounds do not exist as molecules, but rather as lattice structures. The smallest repeating pattern is called the “Formula unit”. Example: NaCl is the smallest repeating pattern in the lattice structure that makes up the table salt crystals we use in our food. | **Formula mass** is measured in **amu** for a crystal structure  Grams are used for a mole of formula units |
| Molecule | Covalently bonded compounds are molecular in nature (i.e. exist as molecules due to their lack of ionic bonding). For example, H2O is a molecule, not a repeating pattern in a larger crystal structure. | **Molecular mass** is measured in **amu** for a single molecule  Grams are used for a mole of molecules |

**Representative Particle Mass: Look at the periodic table!**

1. Find the \_atomic\_\_\_\_ mass of Cu.

**63.546 amu** (per atom of copper)

1. What is the \_\_molecular\_\_\_\_\_ mass of Cl2?
2. What is the \_atomic\_\_ mass of silicon?

**28.086 amu** (per atom of silicon)

1. Find the \_formula mass\_\_ mass of copper (II) nitrate
2. What is the \_\_molecular\_\_\_ mass of C6H12O6?

**Molar Mass**

This is the **molar mass** of Cu(NO3)2!

1. What is the mass of one mole of copper (II) nitrate?
2. What is the molar mass of C6H12O6?
3. How many moles of water are present in 42 g H2O?

**Converting between types of measurement**

1. How many atoms are present in one mole of helium, He?

1 mole He = 6.02 x 1023 atoms of He

1. How many molecules are present in 4.5 moles of CO2?
2. If you have 1.43 x 1024 grains of sand, how many moles of sand do you have?
3. If you weight 5.8x1019 formula units of potassium chloride, KCl, on a scale, what do you expect the reading on the scale to be? (i.e. How many grams of KCl are present?).