The Mole

In chemistry a mole is a number.

A convenient number that is used when working with elements and compounds.

Other people use number names on a regular basis:

- a dozen is twelve "things" or particles

- a gross is 144 particles

- a ream is 500 particles

a mole is 6.022×10^{23} particles

Representative Particles

A representative particle is a general term to indicate one of something.

The chair you are sitting in is a "representative particle" of all chairs.

Representative particles in chemistry:

- an atom is a representative particle of an element
- a formula unit is a representative particle of an ionic compound
- a molecule is a representative particle of a covalent compound

Lazy Vocabulary

When your chem text refers to a mole of aluminum what they **really** mean is a mole of aluminum atoms.

When your chem text refers to a mole of magnesium chloride they **really** mean a mole of magnesium chloride formula units.

When you chem text refers to a mole of carbon dioxide they **really** mean a mole of carbon dioxide molecules.

A mole is a number, a unit

one mole is defined to be

602,200,000,000,000,000,000,000 (6.022 x 10^{23}) of any kind of particle.

While it is possible to discuss (even calculate) with moles of chairs or people or cars or shoes, this is not practical because that many of any of these objects don't exist in the world.

It makes more sense to discuss a mole of atoms or formula units or molecules or electrons, etc.

Why this number for a Mole?

This number is also known as Avogadro's number.

This number is chosen so that the **average atomic mass** in u (or amu) as often recorded in the periodic table will result in the mass in grams of one mole of atoms.

Examples:

one mole of carbon (6.022×10^{23} atoms) = 12.011 g

one mole of iron (6.022×10^{23} atoms) = 55.845 g

Molar Mass

The mass in grams of one mole (6.022×10^{23} particles) of any substance is called the **molar mass**.

Molar mass is for all practical purposes the same as formula mass, molecular mass, gram atomic mass, and others.

The average atomic mass listed on the periodic table measured in grams is equal to one mole of atoms of that element.

Examples

How many atoms are in 52.32 grams of calcium?

$$52.32 \text{ g Ca} \times \frac{1 \text{ mole Ca atoms}}{40.08 \text{ g Ca}} \times \frac{6.022 \times 10^{23} \text{ atoms Ca}}{1 \text{ mole Ca atoms}}$$

7.861×10^{23} atoms of calcium

Examples

What is the mass of 7.26×10^{25} atoms of sulfur?

7.26×10^{25} S atoms X $\dfrac{1 \text{ mole S atoms}}{6.022 \times 10^{23} \text{ S atoms}}$ X $\dfrac{32.066 \text{ g sulfur}}{1 \text{ mole S atoms}}$

3870 g of sulfur

Examples:

How many moles of aluminum are in 43.26 grams?

$$43.26 \text{ g Al} \times \frac{1 \text{ mole Al}}{26.981538 \text{ g Al}} = 1.603 \text{ mole of Al}$$