Chapter 3 Part 1

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Formula Mass

- Formula mass is the mass of one formula mass of something.
- Formula mass has units of atomic mass units (amu)
- Atomic units (amu) are an exceptionally small unit of mass used to represent the mass of approximately one proton or neutron ($1\ \text{g} = 6.022 \times 10^{23}\ \text{amu}$)

$$\text{Formula mass of } H_2O = 2(\text{atomic mass H}) + (\text{atomic mass O})$$

$$= 2(1.008\ \text{amu}) + 16.00\ \text{amu}$$

$$= 18.02\ \text{amu}$$

Formula Mass

Calculate the formula mass of $MgCl_2$.

Formula Mass

Calculate the formula mass of $Mg(NO_3)_2$.

Expressing Amount

- People generally use terms to describe the number of something
  - A pair of shoes means 2 shoes
  - A quartet of singers means 4 singers
  - A dozen eggs means 12 eggs

Moles

- A mole is 6.022×10^{23} of something
  - A mole of carbon is 6.022×10^{23} carbon atoms
  - A mole of water is 6.022×10^{23} water molecules
  - A mole of ammonia is 6.022×10^{23} ammonia molecules
  - A mole of hamburgers is 6.022×10^{23} hamburgers
- The value 6.022×10^{23} is called Avogadro's number
- Moles are the SI unit for amount
- A mole contains Avogadro's number of formula units

Avogadro's Number

Avogadro's number is used as the conversion factor between

A. formula units and grams.
B. formula units and moles.
C. moles and grams.
D. formula mass and molecular mass.
E. molecular mass and atomic mass.

Amount vs. Mass

Amount

- How many of something there are
- Expressed in units of moles, dozens, pairs, etc.
- SI unit is moles

Mass

- How much matter is in something
- Expressed in units of grams, pounds, kilograms, short tons, etc.
- SI unit is kilograms

Moles

How many Fe atoms are in 4.390 moles of Fe?

Molar Mass

- Molar mass is the mass of one mole of something in grams
- The molar mass of Mg is the mass of 6.022×10^{23} magnesium atoms in grams
- The molar mass of OH^- is the mass of 6.022×10^{23} hydroxide ions in grams
- The molar mass of CO_2 is the mass of 6.022×10^{23} carbon dioxide molecules in grams

Molar Mass

Molar mass is used as the conversion factor between

A. formula units and grams.
B. formula units and moles.
C. moles and grams.
D. formula mass and molecular mass.
E. molecular mass and atomic mass.

Relating Atomic Mass Units to Grams

$$1\ \text{g} = 6.022 \times 10^{23}\ \text{amu}$$

Atomic mass units

What is the mass in amu of 10.0 billion SO_2 molecules?

Moles

An analytical balance can detect a mass of 0.1 mg. What is the total number of $MgCl_2$ molecules present in this minimally detectable quantity of $MgCl_2$?

Moles

How many molecules of liquid ethyl mercaptan, C_2H_6S, are contained in a 1.0 μL sample? The density of ethyl mercaptan is 0.84 g/mL.

Mass

Which of the following contains the most mass?

A. 1 formula unit of carbon
B. 1 gram of carbon
C. 1 mole of carbon
D. 1 atomic mass unit of carbon

Elemental Composition

Given 2500 millimoles of H_2SO_4, how many atoms of hydrogen are present?

Percent Composition (Mass Percent)

Determine the percent composition of oxygen in HNO_3 to four significant figures?