Moles Notes

1. Atomic Mass Unit

amu – atomic mass unit, used to describe the mass of an atom

Conversion factor: **1 amu = 1.66 x 10^{-24} g**

Equivalence statement: $\frac{1 \text{ amu}}{1.66 \times 10^{-24} \text{ g}}$ or $\frac{1.66 \times 10^{-24} \text{ g}}{1 \text{ amu}}$

Example:

How many amu are in 27.0 grams of mercury?

$$27.0 \text{ g Hg} \times \frac{1 \text{ amu Hg}}{1.66 \times 10^{-24} \text{ g Hg}} = 1.63 \times 10^{25} \text{ amu Hg}$$

2. The Mole

mole (mol) – indicates a quantity of a substance that has a mass in grams numerically equal to its atomic mass.

****Round the atomic mass on the periodic table to the **TENTHS PLACE.****

Example:

1 mol of copper = 63.5 g

1 mol of calcium = 40.1 g

1 mol of chromium = 52.0 g

3. Molar Mass

molar mass (g/mol) – indicates the mass of one mole of a compound

- 1st determine type of bond and write correct formula
- 2nd add up the masses of each atom in the formula

Example:

Calculate the molar mass of sodium chloride

NaCl

Na = 1 x 23.0 = 23.0
Cl = 1 x 35.5 = 35.5

58.5 g/mol

Calculate the molar mass of silver phosphate

Ag_3PO_4

Ag = 3 x 107.9 = 323.7
P = 1 x 31.0 = 31.0
O = 4 x 16.0 = 64.0

418.7 g/mol

Calculate the molar mass of barium hydroxide

$Ba(OH)_2$

Ba = 1 x 137.3 = 137.3
H = 2 x 1.0 = 2.0
O = 2 x 16.0 = 32.0

171.3 g/mol

4. Avogadro's Number

Avogadro's number – indicates the number of atoms molecules or particles in a mole.

Conversion factor: **1 mol = 6.022 x 10^{23} units** of a substance **(atoms, molecules, particles)**

Equivalence statement: $\frac{1 \text{ amu}}{6.022 \times 10^{23} \text{ atoms}}$ or $\frac{6.022 \times 10^{23} \text{ atoms}}{1 \text{ amu}}$

Examples:

Mole → Mass

What is the mass of 5.0 mol of sulfur?

$$5.0 \text{ mol S} \times \frac{32.1 \text{ g S}}{1 \text{ mol S}} = 160 \text{ g S}$$

Mass → Mole

How many moles are in 17.0 g of bromine, Br_2?

$$17.0 \text{ g } Br_2 \times \frac{1 \text{ mol } Br_2}{159.8 \text{ g } Br_2} = 0.106 \text{ mol } Br_2$$

Br = 2 x 79.9 = 159.8 g/mol

Mole → Atoms (molecules or particles)

How many atoms are in 2.3 moles of copper?

$$2.3 \text{ mol Cu} \times \frac{6.02 \times 10^{23} \text{ atoms Cu}}{1 \text{ mol Cu}} = \boxed{1.4 \times 10^{24} \text{ atoms Cu}}$$

Atoms (molecules or particles) → Mole

How many moles are in 1.24×10^{24} molecules of carbon dioxide?

$$1.24 \times 10^{24} \text{ molecules } CO_2 \times \frac{1 \text{ mol } CO_2}{6.02 \times 10^{23} \text{ molecules } CO_2} =$$

$$\boxed{2.06 \text{ mol } CO_2}$$

Atoms (molecules or particles) → Grams

How many grams are in 2.4×10^{25} particles of KCl?

$$2.4 \times 10^{25} \text{ particles KCl} \times \frac{1 \text{ mol KCl}}{6.02 \times 10^{23} \text{ particles KCl}} \times \frac{74.6 \text{ g KCl}}{1 \text{ mol KCl}} =$$

K 1 x 39.1 = 39.1

Cl 1 x 35.5 = 35.5

74.6 g/mol

$$\boxed{3.0 \times 10^{3} \text{ g KCl}}$$

Grams → Atoms (molecules or particles)

How many atoms are in 514 g of Pb?

$$514 \text{ g Pb} \times \frac{1 \text{ mol Pb}}{207.9 \text{ g Pb}} \times \frac{6.02 \times 10^{23} \text{ atoms Pb}}{1 \text{ mol Pb}} =$$

$$\boxed{1.49 \times 10^{24} \text{ atoms Pb}}$$