The Mole:A Measurement of Matter

Mole/Mass Conversions

Percent Composition & Chemical Formulas

Chapter 10

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The Mole:A Measurement of Matter

What Is a Mole?

Name some things that we 'count' in groups, or that a specific number represents one unit?

Chemists use a specific number to represent things.

A '***mole***' of any substance contains **6.02×10^{23}** representative particles.

Converting Number of Particles to Moles

1 mol=6.02×10^{23} particles is the basis of the conversion factor

EXAMPLE:

How many moles of magnesium is 1.25×10^{23} atoms?

1 mol of Mg = 6.02×10^{23} particles

x mol of Mg = 1.25×10^{23} particles

$$\frac{1}{x} = \frac{6.02 \times 10^{23}}{1.25 \times 10^{23}}$$

$$(6.02 \times 10^{23})\, X = 1.25 \times 10^{23}$$

$$x = \frac{1.25 \times 10^{23}}{6.02 \times 10^{23}} \longrightarrow 0.208 \text{ mol}$$

Converting Moles to Number of Particles

EXAMPLE:
Propane gas is used for heating and cooking. How many ***atoms*** are in 2.12mol of propane (C_3H_8)

1 mol of propane = 6.02×10^{23} particles
2.12 mol of propane = x particles

$$\frac{1}{2.12} = \frac{6.02 \times 10^{23}}{x}$$

$$x = (6.02 \times 10^{23})(2.12)$$

1.27624×10^{24} particles of propane

but 1 particle of propane has 11 atoms therefore,

$(1.27624 \times 10^{24})(11) \longrightarrow 1.40 \times 10^{25}$ atoms

Mass of A Mole of a Substance

- The molar mass of a substance is the sum of the molar masses of each element in that substance.

The atomic mass in amu of any element is it's molar mass in grams.

EXAMPLE:

- molar mass of glucose $C_6H_{12}O_6$

6 x the molar mass of C = (6)(12amu)= 72g
12 x the molar mass of H = (12)(1amu)= 12g
6 x the molar mass of O = (6)(16amu)= 96g
Total=180g

∴ 1 mole of glucose has a mass of 180g

6.02×10^{23} particles glucose has a mass of 180g

Converting Moles to Mass

The aluminum satellite dishes in Figure 10.8 are resistant to corrosion because the aluminum reacts with oxygen in the air to form a coating of aluminum oxide (Al_2O_3). This tough, resistant coating prevents any further corrosion. What is the mass of 9.45 mol of aluminum oxide?

Known 1 mole of Al_2O_3

Al = 26.98 x 2 = 53.96g
O = 15.99 x 3 = 47.97g
101.93g

Method 1

1 mol = 101.93g
9.45 mol = *x* g

cross multiplying,

x g = (9.45)(101.93) = 963.24g

Method 2

$$\frac{9.45\ \text{mol} \mid 101.93\ \text{g}}{1\ \text{mol}} = ?\ \text{g}$$

$$= 963.24\ \text{g}$$

16. Find the mass, in grams, of 4.52×10^{-3} mol $C_{20}H_{42}$.

17. Calculate the mass, in grams, of 2.50 mol of iron(II) hydroxide.

Converting Mass to Moles

When iron is exposed to air, it corrodes to form red-brown rust. Rust is iron(III) oxide (Fe_2O_3). How many moles of iron(III) oxide are contained in 92.2 g of pure Fe_2O_3?

Known

1 mole of Fe_2O_3

Fe = 55.85 x 2 = 111.7g
O = 15.99 x 3 = 47.97g
159.67g

Method 1

1 mol = 159.67g
x mol = 92.2g

Cross Multiply,

(92.2) = (159.67)(*x*)

$\frac{92.2}{159.67}$ = x = 0.58 mol

Method 2

$$\frac{92.2\text{g} \mid 1\ \text{mol}}{159.67\text{g}} =$$

$$\frac{92.2}{159.67} = 0.58\ \text{mol}$$

18. Find the number of moles in 3.70×10^{-1} g of boron.

19. Calculate the number of moles in 75.0 g of dinitrogen trioxide.