

## AVOGADRO'S NUMBER AND THE MOLE

Avogadro's Number ( $N_A$ ) =  $6.022 \times 10^{23}$  (to 4 sig figs)

**1 mole** (abbreviated mol) =  $6.022 \times 10^{23}$  entities

Similar to: 1 dozen = 12 entities:

**1 dozen** doughnuts = **12** doughnuts

**1 mole** of doughnuts =  $6.022 \times 10^{23}$  doughnuts

How many eggs are in 3 dozen eggs?

How many eggs are in 3 moles of eggs?

How many C atoms are in 3 moles of C atoms?

### Atomic weights and molar masses:

— The mass of **1 C atom** (on average) is **12.01 amu**

— The mass of **1 mole of C atoms** is **12.01 g (or 12.01 g/mol)**

1 mole ( $6.022 \times 10^{23}$ ) is the amount of atoms of any element that has a mass in **grams** equal to the mass of ONE atom in **amu**.

The atomic masses reported for each element in the Periodic Table gives the **atomic weight** (or **molecular/formula weight for compounds**) in **amu** and the **molar mass in g/mol**.

*Example:* What is the molar mass for each of the following?

(Use the atomic masses reported for each in the Periodic Table.)

a. Mg: \_\_\_\_\_ c. Ar: \_\_\_\_\_

b. Si: \_\_\_\_\_ d. Sn: \_\_\_\_\_

### MOLECULAR MASS (for molecules) or FORMULA MASS (for ionic compounds)

**Molar mass (MM):** Mass in grams of 1 mole of any element/compound

– To obtain, multiply the molar mass of each element by the number of each present, then add up all the constituent parts.

*Example:* Determine the molar mass of each of the following compounds:

a. **O<sub>2</sub>**: 2 (molar mass of O) = 2 (16.00 g/mol) = **32.00 g/mol**

b. **H<sub>3</sub>PO<sub>4</sub>**:

c. **Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>**:

## Mole Calculations

Ex. 1 How many moles of Ne are in 50.0 g Ne?

Ex. 2 How many Ne atoms are in 50.0 g of Ne?

Ex. 3 How many moles of CO<sub>2</sub> are in 25.0 g of CO<sub>2</sub>?

Ex. 4 How many CO<sub>2</sub> molecules are in 25.0g of CO<sub>2</sub>?

Ex. 5 How many oxygen atoms are in 25.0 g of CO<sub>2</sub>?

## Molar Volume: Volume occupied by 1 mole of any gas

Avogadro's Law: At the same temperature and pressure, equal volumes of gases contain the same number of molecules

**Standard temperature and pressure (STP): T=0°C and P=1.00 atm**  
**At STP, 1 mole of gas occupies 22.4L! (3 sig figs)**

## Molar Volume Calculations

Ex. 1 How many moles of He occupy a volume of 1.50 L at STP?

Ex. 2 What mass of SO<sub>3</sub> occupies a volume of 2.50 L at STP?

Ex. 3 What is the volume (in liters) occupied by 5.000 g of NH<sub>3</sub> at STP?

Ex. 4 How many Ne atoms are present in 50.0 L of Ne gas at STP?