

# Chemical Quantities Outline

## (The Molar Mass)

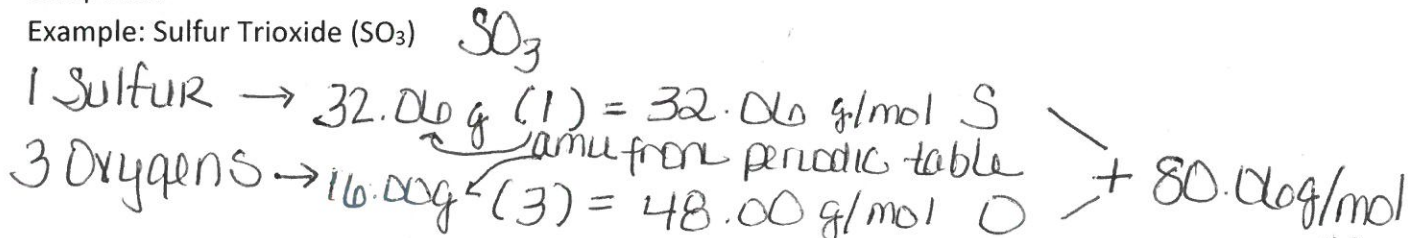
### Molar Mass

- Atomic Mass is the mass of a single atom expressed in amu; relative values based on the isotopes; (decimals) on the periodic table
- Molar mass is the mass of a mole of an element/compound/molecule; equal to the atomic mass  
Units are g/mole (grams per mole)
- Example:

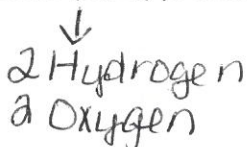
Carbon's atomic mass 12.01 amu and its molar mass is 12.01 g/mol

### How to find the mass of a mole of a compound

- You must know the chemical formula
- Then add the atomic masses of the atoms that make up that compound
- Example: Sulfur Trioxide ( $\text{SO}_3$ )

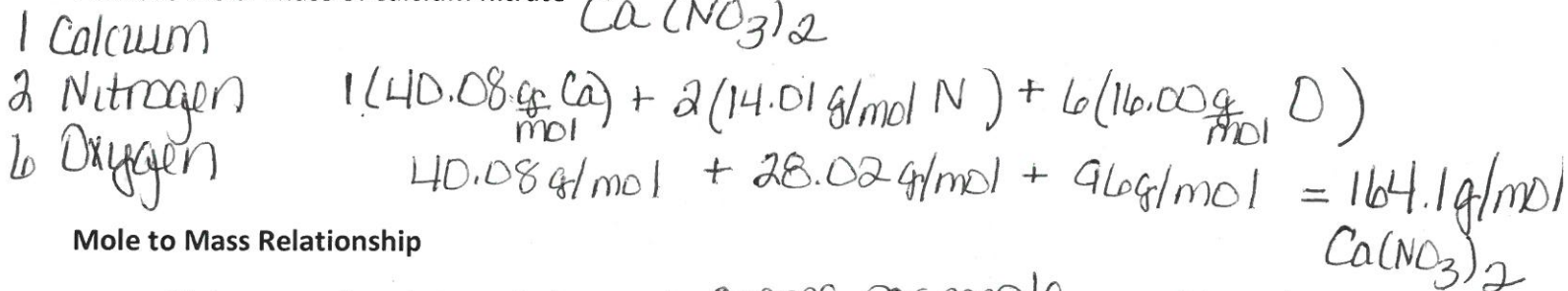


The decomposition of hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) provides sufficient energy to launch a rocket. What is the molar mass of hydrogen peroxide?



$$2(1.008 \text{ g/mol}) \text{ H} = 2.016 \text{ g/mol H}$$
$$2(16.00 \text{ g/mol}) \text{ O} = 32.00 \text{ g/mol O}$$
$$= 34.02 \text{ g/mol H}_2\text{O}_2$$

Find the molar mass of calcium nitrate



### Mole to Mass Relationship

- Molar mass of a substance is the mass in grams per mole of that substance
- Use the molar mass of an element or compound to convert between mass and the mole

Conversion factors:  $\text{molar mass} = \frac{\text{g}}{\text{mol}}$  or  $\frac{\text{mol}}{\text{g}}$

Items made out of aluminum, such as aircraft parts and cookware, are resistant to corrosion because the aluminum reacts with oxygen in the air to form a coating of aluminum oxide ( $\text{Al}_2\text{O}_3$ ). This tough, resistant coating prevents any further corrosion. What is the mass, in grams, of 9.45 moles of aluminum oxide?

9.45 moles  $\left( \frac{101.96 \text{ g}}{1 \text{ mol}} \right) = 963.53 \text{ g}$  molar mass is used in conversion

$2(26.98 \frac{\text{g}}{\text{mol}} \text{ Al}) + 3(16.00 \frac{\text{g}}{\text{mol}} \text{ O})$

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

2.50 mol  $\text{Fe}(\text{OH})_2 \left( \frac{89.87 \text{ g}}{1 \text{ mol}} \right) = 225 \text{ g}$

$53.96 \text{ g/mol Al} + 48.00 \text{ g/mol O}$   
 $101.96 \text{ g/mol Al}_2\text{O}_3$   
 $55.85 \text{ g Fe} + 32.00 \text{ g O} + 2.016 \text{ g H}$   
 $89.87 \text{ g Fe}(\text{OH})_2$

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

92.2 g  $\left( \frac{1 \text{ mol}}{159.70 \text{ g}} \right) = 0.577 \text{ mol Fe}_2\text{O}_3$

$\text{Fe}_2\text{O}_3 \quad 2(55.85 \frac{\text{g}}{\text{mol}}) + 3(16.00 \frac{\text{g}}{\text{mol}}) = 159.70 \frac{\text{g}}{\text{mol}}$

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

75.0g  $\text{N}_2\text{O}_3 \left( \frac{1 \text{ mol}}{76.02 \text{ g}} \right) = 0.987 \text{ mol N}_2\text{O}_3$

$\text{N}_2\text{O}_3 \quad 2(14.01) + 3(16.00)$   
 $28.02 + 48.00$   
 $76.02 \text{ g/mol}$

### 2-step Problems

\*\*\*If you do not see moles in the problem, it is a 2 step problem.\*\*\*

Calculate the number of formula units in 78.4g of sodium chloride.

78.4g  $\text{NaCl} \left( \frac{1 \text{ mol NaCl}}{58.44 \text{ g NaCl}} \right) \left( \frac{6.022 \times 10^{23} \text{ f.u.}}{1 \text{ mol NaCl}} \right) = 8.34 \times 10^{23} \text{ f.u.}$

$\text{NaCl} \rightarrow 22.99 \text{ g/mol} + 35.45 \text{ g/mol} = 58.44 \text{ g/mol}$

How many grams are in 94.8 molecules of  $\text{SO}_2$ ?  $\rightarrow 32.06 \frac{\text{g}}{\text{mol}} + 2(16.00) \text{ g/mol} = 64.06 \text{ g/mol}$

94.8 molecules  $\left( \frac{1 \text{ mol SO}_2}{6.02 \times 10^{23} \text{ molecules}} \right) \left( \frac{64.06 \text{ g}}{1 \text{ mol SO}_2} \right) = 1.009 \times 10^{-20} \text{ g}$