

Stoichiometry & the mole notes

the mole concept

the mole (mol) is the SI unit for measuring the amount of a substance.

avogadro's number:

$$1 \text{ mol} = 6.022 \times 10^{23} \text{ particles}$$

(particles can be atoms, molecules, or formula units)

molar mass:

the mass of one mole of a substance in grams.

found by adding the atomic masses from the periodic table

example

$$\text{H}_2\text{O} (2 \cdot 1.008 \text{ g/mol}) + (1 \cdot 16.00 \text{ g/mol}) = 18.016 \text{ g/mol}$$

Example Problems

1. how many atoms are in 3.5 moles of Fe?

$$3.5 \text{ mol Fe} \cdot \frac{6.022 \cdot 10^{23} \text{ atoms}}{1 \text{ mol}} = 2.11 \cdot 10^{24} \text{ atoms}$$

2. what is the mass of 2.00 moles of NaCl?

find molar mass:

$$\text{Na} : 22.99 \text{ g/mol}$$

$$\text{Cl} : 35.45 \text{ g/mol}$$

$$\text{Total} : 58.44 \text{ g/mol}$$

convert

$$2.00 \text{ mol} \cdot \frac{58.44 \text{ g}}{1 \text{ mol}} = 116.88 \text{ g}$$



Conversions Involving the mole

conversion

particles \leftrightarrow moles

moles \leftrightarrow mass

moles \leftrightarrow volume (L) (at STP)

factor to use

$$1 \text{ mol} = 6.022 \cdot 10^{23} \text{ particles}$$

$$1 \text{ mol} = \text{molar mass (g)}$$

$$1 \text{ mol} = 22.4 \text{ L of gas}$$

Stoichiometry: the study of quantitative relationships in chemical reactions

Balanced chemical equations show the mole ratio of reactants & products

mole ratios come from coefficients in a balanced equation.

Stoichiometry steps:

1. Balance the equation

2. convert given quantity into moles (if necessary)

3. Use mole ratio from balanced equation.

4. Convert moles back to desired unit (grams, liters, etc.)

Example:



question: how many grams of H_2O are produced from 5.00 moles of

O_2 ? Step 1: Use mole ratio

$$5.00 \text{ mol O}_2 \cdot \frac{2 \text{ mol H}_2\text{O}}{1 \text{ mol O}_2} = 10.0 \text{ mol H}_2\text{O}$$

Step 2: Convert to grams

$$10.0 \text{ mol H}_2\text{O} \cdot \frac{18.016 \text{ g}}{1 \text{ mol}} = 180.16 \text{ g H}_2\text{O}$$

Limiting Reactant & Percent Yield

limiting reactant (LR): the reactant that runs out first, limiting product formation

excess reactant: the reactant that remains after the reaction is complete

Steps to identify LR

1. Convert reactants to moles

2. Use mole ratios to do

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