

The Origin of the Mole

- Dalton believed that molecules are made up of “atoms”
- Atoms combine in proportion to their atomic masses
 - 2.0 g of hydrogen gas combines with 159.8 g of bromine gas
 - the bromine gas atom is $159.8 \text{ g} / 2.0 \text{ g} = 79.9$ times heavier than hydrogen
- Avogadro's Hypothesis: Equal volumes of different gases, at the same temperature and pressure, and contain the same number of particles.

Example:

If 500 mL of nitrogen gas combines with 1000 mL of oxygen gas, how many nitrogen molecules are present for every oxygen molecule? Suggest a formula for the compound formed.

3. What is the molar mass of a substance if 2.5×10^{-3} moles are found to have a mass of 0.30 g?

4. How many atoms are there in 5.2 mol of HNO_3 ?

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5. How many moles are present in 3.8×10^{27} molecules of $\text{Pb}(\text{NO}_3)_2$?

- The molar volume of a gas is the volume occupied by one mole of the gas
- At 0°C and 101.3 kPa, 1 mol of a gas occupies 22.4 L
- These conditions are known as Standard Temperature and Pressure (STP)
- $\frac{1 \text{ mol}}{22.4 \text{ L}}$ or $\frac{22.4 \text{ L}}{1 \text{ mol}}$

Example:

1. At STP, what is the volume of 2.5 mol of O₂?

2. How many molecules are there in 0.750 mol of Cl₂?