

Lab: To determine the Molar volume of a Gas

Two students decided to calculate the molar volumes of carbon dioxide, $\text{CO}_{2(g)}$, oxygen, $\text{O}_{2(g)}$, and methane, $\text{CH}_{4(g)}$.

In order to determine the molar volume of these gases the students first measured the mass of an empty 150 mL gas syringe under vacuum conditions. This ensured that the syringe did not contain any air. Next they filled the syringe with 150 mL of carbon dioxide gas, recording the mass of the syringe plus the carbon dioxide gas.

The students repeated their procedure for oxygen gas and for methane gas.

Finally the students measured the temperature of the room to be 23.0 °C and the pressure was determined to be 98.70 kPa. These values of the temperature and pressure of the three gases were recorded to be identical for the three gases.

The data is recorded below.

Data Collected to Determine the Molar Volume of a Gas

Gas	carbon dioxide	oxygen	methane
Volume of gas (± 2 mL)	150	150	150
Mass of empty syringe (± 0.01 g)	25.08	25.08	25.08
Mass of gas + syringe (± 0.01 g)	25.34	25.27	25.18

Data Analysis: (You are only required to complete the analysis for your assigned gas)

1. Calculate the mass of the gas.
2. Calculate the number of moles for the gas.
3. Calculate the volume of the gas at STP using the Combined Gas Law.
4. Calculate the molar volume, mol L^{-1} of the gas at STP, (using volume at STP from (3) above and the number of moles of gas from (2) above.

Table of Data Processing:

Mass of Gas			
Number of Moles of Gas			
Volume of Gas at STP			
Molar Volume at STP			

Summary Table: Calculations of Molar Volume of a Gas

Gas	carbon dioxide	oxygen	methane
Mass of Gas (g)			
Number of Moles of Gas (mol)			
Volume of Gas at STP (mL)			
Molar Volume at STP (L)			

Conclusion:

Compare the three molar volumes to the accepted value of 22.4 mol L^{-1} by calculating percent error for each. Interpret the results with respect to errors and improvements in the experiment.

Sample Calculations: