

CHAPTER 4	Thought Lab 4.1: Molar Volumes of Gases	BLM 4.1.7
HANDOUT		

Two students decided to calculate the molar volume of carbon dioxide, oxygen, and methane gases. First, they measured the mass of an empty 150 mL syringe with the entire syringe and balance in a vacuum. This ensured that the syringe did not contain any air. Next, they filled the syringe with 150 mL of carbon dioxide gas. They measured and recorded the mass of the syringe plus the gas. The students repeated their procedure for oxygen gas and for methane gas. Finally, a thermometer in the room registered 23.0 °C (296.15 K) and the barometer registered 98.7 kPa. The students used these values for the temperature and pressure of the three gases. The students' results are given in the table below.

Three Gases at 296 K and 98.7 kPa

Gas	Carbon dioxide	Oxygen	Methane
Volume of gas (<i>V</i>)	150 mL	150 mL	150 mL
Mass of empty syringe	25.08 g	25.08 g	25.08 g
Mass of gas + syringe	25.34 g	25.27 g	25.18 g
Mass of gas (<i>m</i>)			
Molar mass of the gas (<i>M</i>)			
Number of moles of gas $\left(n = \frac{m}{M}\right)$			
Calculations for STP			
Volume of gas at STP (273.15 K and 101.325 kPa)			
at STP $v = \frac{V}{n}$			
Calculations for SATP			
Volume of gas at SATP (298.15 K and 100 kPa)			
at SATP $v = \frac{V}{n}$			

Procedure

1. Calculate the molar volume for the carbon dioxide, oxygen, and methane gases at STP. Write your calculations and answers in the rows indicated.
2. Calculate the molar volume for the carbon dioxide, oxygen, and methane gases at SATP. Write your calculations and answers in the rows indicated.

CHAPTER 4	Thought Lab 4.1: Molar Volumes of Gases (continued)	BLM 4.1.7
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Analysis

1. Compare the three molar volumes at STP. What do you observe?
2. The accepted molar volume of a gas at STP is 22.4 L/mol. Use this value to calculate the percentage experimental error in the data for each gas.
3. Compare the three molar volumes at SATP. What do you observe?
4. The accepted molar volume of a gas at SATP is 24.8 L/mol. Use this value to calculate the percentage experimental error in the data for each gas.