EXPERIMENT PROCEDURE

- **Measuring the pressure *p* of the enclosed air at room temperature for different positions *s* of the piston.**
- **Displaying the measured values for three different quantities of air in the form of a *p*-*V* diagram.**
- **Verifying Boyle's Law.**

OBJECTIVE

Measurement at room temperature in air as an ideal gas.

SUMMARY

The experiment verifies Boyle's Law for ideal gases at room temperature, taking air as an ideal gas in this experiment. The volume of a cylindrical vessel is varied by the movement of a piston, while simultaneously measuring the pressure of the enclosed air.

REQUIRED APPARATUS

Quantity	Description	Number
1	Boyle's Law Apparatus	**1017366**

BASIC PRINCIPLES

The volume of a fixed quantity of a gas depends on the pressure acting on the gas and on the temperature of the gas. If the temperature remains unchanged, the product of the volume and the temperature remains constant in many cases. This law, discovered by Robert Boyle and Edme Mariotte, is valid for all gases in the ideal state, which is when the temperature of the gas is far above the point that is called its critical temperature.

The law discovered by Boyle and Mariotte states that:

(1) $p \cdot V = \text{const.}$

and is a special case of the more general law that applies to all ideal gases. This general law describes the relationship between the pressure *p*, the volume *V*, the temperature *T* referred to absolute zero, and the quantity *n* of the gas:

(2) $p \cdot V = n \cdot R \cdot T$

$R = 8.314 \frac{\text{J}}{\text{mol} \cdot \text{K}}$ (the universal gas constant).

From the general equation (2), the special case (1) is derived given the condition that the temperature *T* and the quantity of the gas *n* do not change.

In the experiment, the validity of Boyle's Law at room temperature is demonstrated by taking air as an ideal gas. The volume *V* of air in a cylindrical vessel is varied by the movement of a piston, while simultaneously measuring the pressure *p* of the enclosed air.

The quantity *n* of the gas depends on the initial volume V_0 into which the air is admitted through an open valve before starting the experiment.

EVALUATION

As the cross-sectional area *A* of the piston is constant, the volume *V* of the enclosed air can easily be calculated from the distance *s* travelled by the piston relative to the zero-volume position. For an exact analysis, the unavoidable dead volume V_1 of the air in the manometer should also be taken into account.

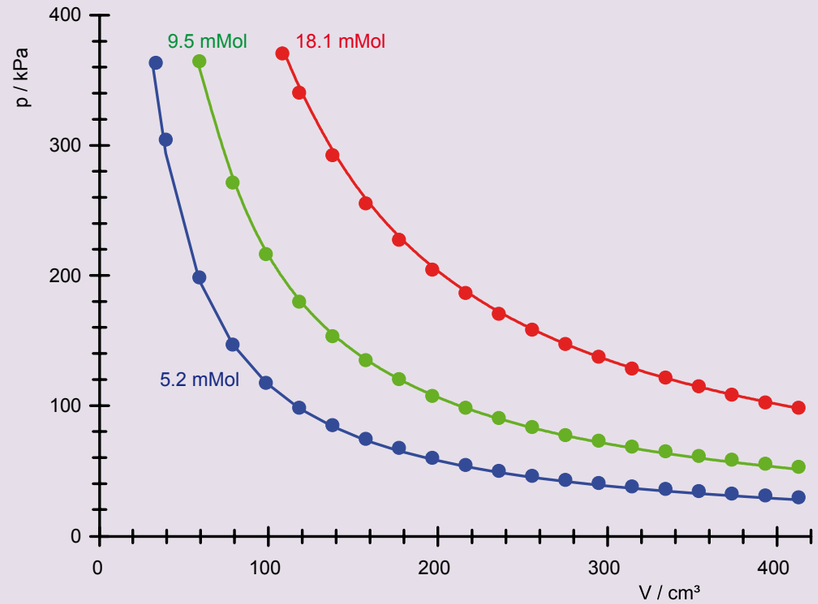

Fig. 1: Pressure/volume diagrams for three different quantities of air at room temperature.