

University of Hillah

Department of Anesthesia Techniques

The first stage

Medical physics laboratory



## Experiment. Boyle's Law

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***Aim of the Experiment:***

Verify Boyle's Law by measurement the pressure of the atmosphere.

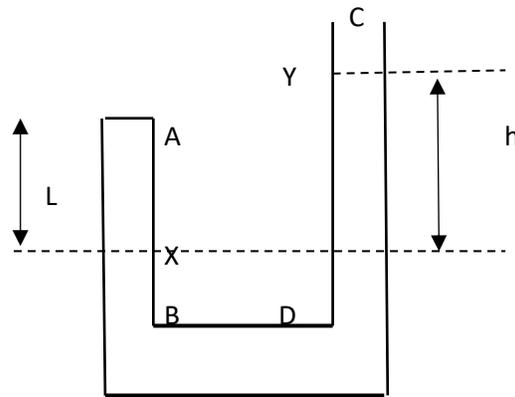
***Tools Used in the Experiment:***

Glass tube containing mercury as shown

***Procedure***

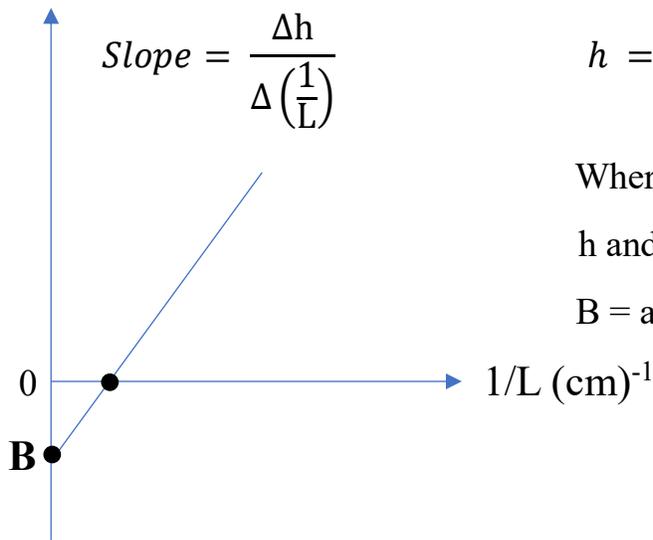
- *Keep the mercury levels X and Y in the same position ,record the scale reading of these levels and also the scale reading of ( A ), the inside of the closed end of the tube ( AB ) , this is the balance point (X=Y).*
- *Rising the tube CD ( above the balance point ) ,and recored the scale reading of X and Y levels .*
- *Take about four sets of reading over the balance point.*
- *Now, lowering the tube CD below the balance point, and record the scale reading of X and Y levels.*
- *Take about four sets of reading below the balance point.*

Open-end ( Atmospheric pressure )



A-X= L (cm)	Y-X= h ( cm)	1/L cm <sup>-1</sup>

h (cm)



$$h = \frac{C}{K} * \frac{1}{L} - B$$

Where: *C and K = constants.*

h and L the length as shown in Fig.

B = atmosphere pressure

***Theory :***

Boyle's Law, formulated by physicist Robert Boyle in the 17th century, describes the relationship between the pressure and volume of a gas at a constant temperature. It states that the pressure of a given amount of gas is inversely proportional to its volume when temperature remains constant.

Atmospheric pressure is defined as the pressure on the earth's surface due to the air column.  $P_a = 1.013 \times 10^5 \text{ Nm}^{-2}$

Mathematically, Boyle's Law can be expressed as:

$$P_1 V_1 = P_2 V_2$$

$$P \propto 1/V \quad \text{or} \quad P \cdot V = \text{constant}$$

Where:

$P_1$  and  $P_2$  are the initial and final pressures of the gas.

$V_1$  and  $V_2$  are the initial and final volumes of the gas.

### ***Medical applications:***

*1. Diving and Hyperbaric Medicine: Boyle's law plays a crucial role in understanding the physiological effects of pressure changes during diving and hyperbaric medicine. As a diver descends deeper, the increase in ambient pressure causes a reduction in the volume of gases within the lungs and other body cavities. Understanding these pressure-volume relationships helps prevent conditions like barotrauma and decompression sickness.*

*2. Mechanical Ventilation: In the field of critical care medicine, mechanical ventilators apply Boyle's law to support patients with respiratory insufficiency. By adjusting the volume of the ventilator-assisted breaths, the pressure within the lungs can be altered, helping to maintain adequate oxygenation and ventilation.*