Al- mustaqbal University College
Anesthesia Techniques Department
First stage /medical physics
Third lecture by Asst. Lecturer Fatema Sattar

Lecture 4:

Boyle's Law

Purpose of the experiment

To verify Boyle's law and the relation between volume and pressure.

Apparatus

Air column with measuring scale, pressure gauge, oil reservoir, hand air pump.

Theory

Boyle's law is a famous gas law studied in physics and chemistry. It relates pressure and volume of gas keeping other parameters (amount of gas and temperature) constant. To verify the law by studying the relation between pressure and volume.

Gaseous state is a state of matter in which the substance does not have any specific shape or volume. It adopts the form and size of its container. The fundamental macroscopic properties of gases are pressure, volume, temperature and mass of the gas. These can be explained by kinetic theory by considering their molecular composition and motion. Scientific observation has determined that these variables are related to one another, and the values of these properties determine the state of the gas.

These relationships among pressure, temperature and volume of a gas lead to Gas laws. Boyle's Law tells us that the volume of gas increases as the pressure decreases. Charles' Law tells us that the volume of gas increases as the temperature increases and Avogadro's Law tells us that the volume of gas increases as the amount of gas increases. The ideal gas law is the combination of the three simple gas laws.

According to Boyle's Law, the pressure (P) of a given mass of gas is inversely proportional to its volume (V), provided that the temperature of the gas remains constant. For an enclosed gas, at constant temperature (T):

$$P \alpha \frac{1}{V}$$

Or

$$P * V = constant$$

$$P_1V_1=P_2V_2$$

Procedure

1. Connect the apparatus as shown in the down diagram.

2. The hand air pump is attached to the oil reservoir.

3. Now open the air tap and start pumping air through the air pump.

4. Keep pumping the air until the oil is reached in the upper part of the column. This can be observed in the pressure gauge.

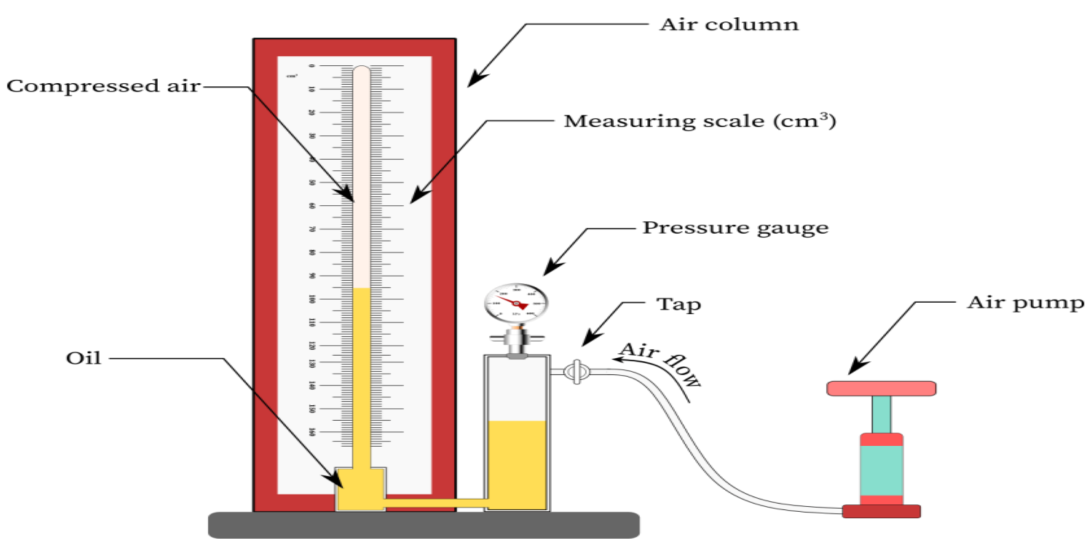
5. Close the air tap once the oil no longer rises and the pressure gauge reading is constant (i.e. reached its peak).

6. Now record both pressure and volume readings.

7. Now we reduce the pressure value by the pressure gauge and record the resulting volume reading by measuring scale.

8. We continue the process of reducing pressure and measuring the volume corresponding to this pressure for several readings until we obtain several values of pressure and volume, and we note the inverse relationship between them, as in the table below.

9. Finally, conclude the experiment based on the graphs.



Pressure reading (kPa)	Volume reading (cm3 or ml)
650	25
450	33
290	48
230	57
195	64
160	72
110	89

Result

The graph of pressure vs volume and pressure vs inverse volume are plotted.

Pressure vs volume