The Third Experiment

THE RELATION OF GAS VOLUME AND TEMPERATURE & FINDING ABSOLUTE ZERO

The Objective of the experiment:

To find the relation of gas volume and temperature and to find the absolute zero.

The Used Equipments:

The device consists of a burette whose end is open and attached to a glass ball through a rubber tube filled with mercury. The device also contains a vertical ruler, clamps, a base and a thermal heater.

The Theoretical Part:

The scientist Charles noticed that the volume of any gas under pressure expands in the same rate to its initial volume (at zero °C) for every increase in temperature of one degree Celsius.
This observation was supported by the scientist Gay-Lussac, who found that if the temperature increases by one degree Celsius, the volume of the gas increases by 1/273 of the gas volume at zero degrees Celsius.

Therefore (1/273) is known as the volumetric expansion coefficient, which is the amount of increase in a unit volume of a gas at zero °C for every increment in temperature as one degree Celsius. It was found experimentally that the volumetric expansion coefficient (α_v) is the same for all gases; and its amount does not vary with the gas.

The reason for this is that all gases are composed of molecules as if they are free particles independent of each other, and the distance between the gas molecules greatly exceeds their radii, and this is a general characteristic of gases.
Therefore, the smallness of the forces acting between the far apart gas molecules and their small size with respect to the total volume of the gas is considered as one of the factors that have no value in the expansion of gas.

For these reasons, and with the exception of (pressure and temperature) in which the gas approaches to the state of liquidity, the gases "as a volume" behave similarly and share similar physical properties.
Charles Gay-Lussac's Law states that the volume of any amount of gas at constant pressure is directly proportional to temperature, i.e.

$V1 / V2 = T1 / T$

<u>The Procedure</u>:

1. Put a quantity of water in the bowl and put the glass ball inside it.
2. Place the bowl on a heating source and open and close the triple lock once to restore the uniform pressure.
3. Heat the bowl and wait until the temperature reaches 30 degrees Celsius and install the mercury column at a height of 19, for example, and consider it the value of the first height, which represents d_0.
4. Record the readings of the height of the mercury column in the rubber tube located to the left of the ruler for every 10 degrees and calculate the difference Δd by subtracting the value of the new height after the mercury rushes down from the value of the first height d_0.
5. Calculate the volume of the expanding air by adding the volume of the air in the glass ball plus the expanding volume in the tube, since every 1 cm in the tube equals 2 milliliters of volume.
6. Add the value of the expanding air and the volume of the original glass ball each time and write down the information as in the table below.
7. Draw a graph between air volume on the Y-axis and temperatures on the X-axis, then discuss the type of relationship and find absolute zero through the diagram.

T	D	d_0 - d	(Δd x 2) (ml)	Δd (ml) + B
