Experiment: Charles' Law Experiment

Purpose

To verify Charles' Law- when a given mass of a gas is heated at constant pressure, the volume V of given mass of a gas is directly proportional to its absolute temperature.

Theory

Charles 'law, also known as Charlie - Lussac's law (Charles-Gaylussac's Law) (Charles - Gaylussac's Law) discovered by Charles and Gaylussac respectively in 1787 and 1802 AD. Charles-Gay-Lussac's Law tells us that at conditions of constant pressure and constant amount of gas, the change of volume is proportional to the change of temperature.

So

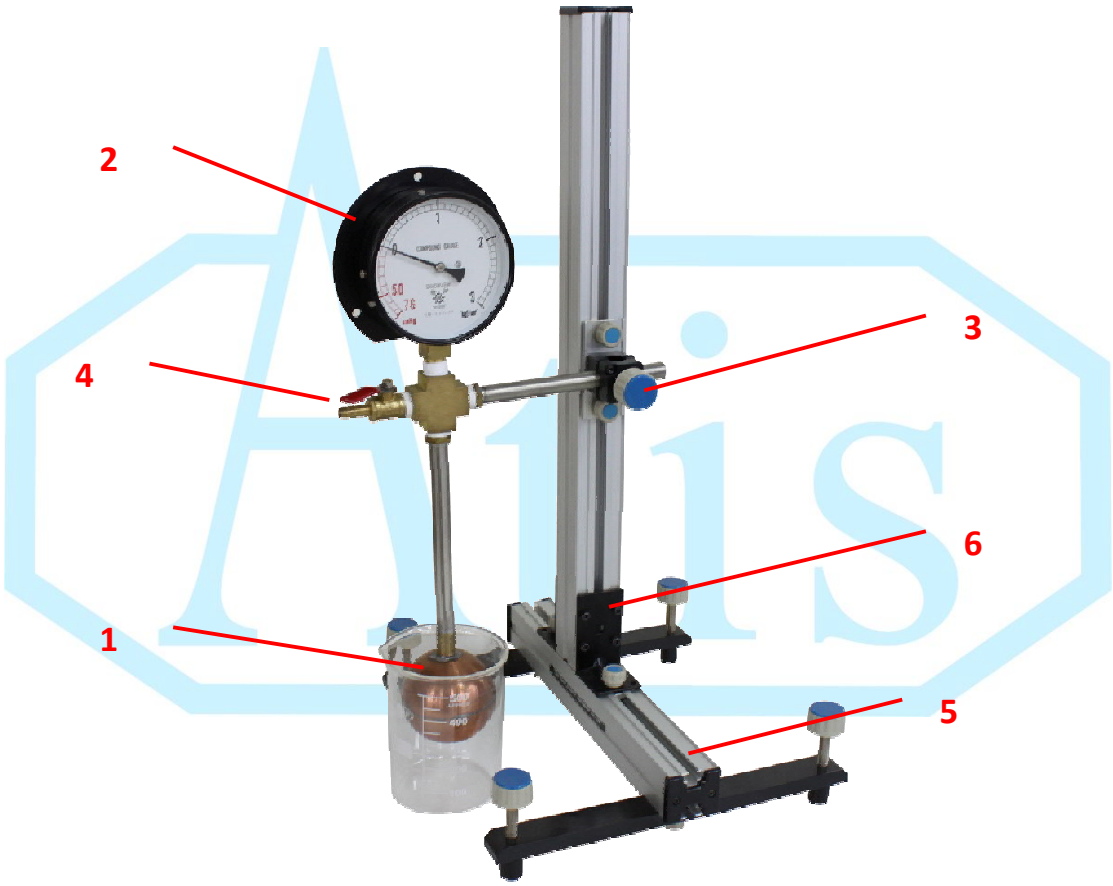
$$P / T = \text{const} \tag{1}$$

Quantitative low-density gas volume remains constant; the pressure of a gas changes by 1/273.15(= 1/273) of the pressure at 0 ° C.

$$P = P_0(1 + \frac{1}{273.15}T) \tag{2}$$

Instrument

NO	Accessory	Qty	NO	Accessory	Qty
1	Metal Ball	1	2	Manometer	1
3	Removable Connector	1	4	Valve	1
5	Base	1	6	Removable Bracket	1
7	Thermometer	1			



Procedure

1. Set up the base and the bracket.

2. Put the metal ball in the ice bucket to lower the temperature to 0℃, and close the valve, the reading on the manometer is zero. (The reading of the manometer is relative pressure, should convert it into absolute pressure.)

3. Heat up the beaker, then wait for the temperature to rise at 0 ° C, 25 ℃, 50 ℃, 70℃, and 90 ℃, and record the pressure change.

4. According to the equation 1 to calculate the K value of the const, obtain the error%, and plot the p-T experimental data diagram in order to verify that the constant volume of Charles- Lussac's law.

Note:

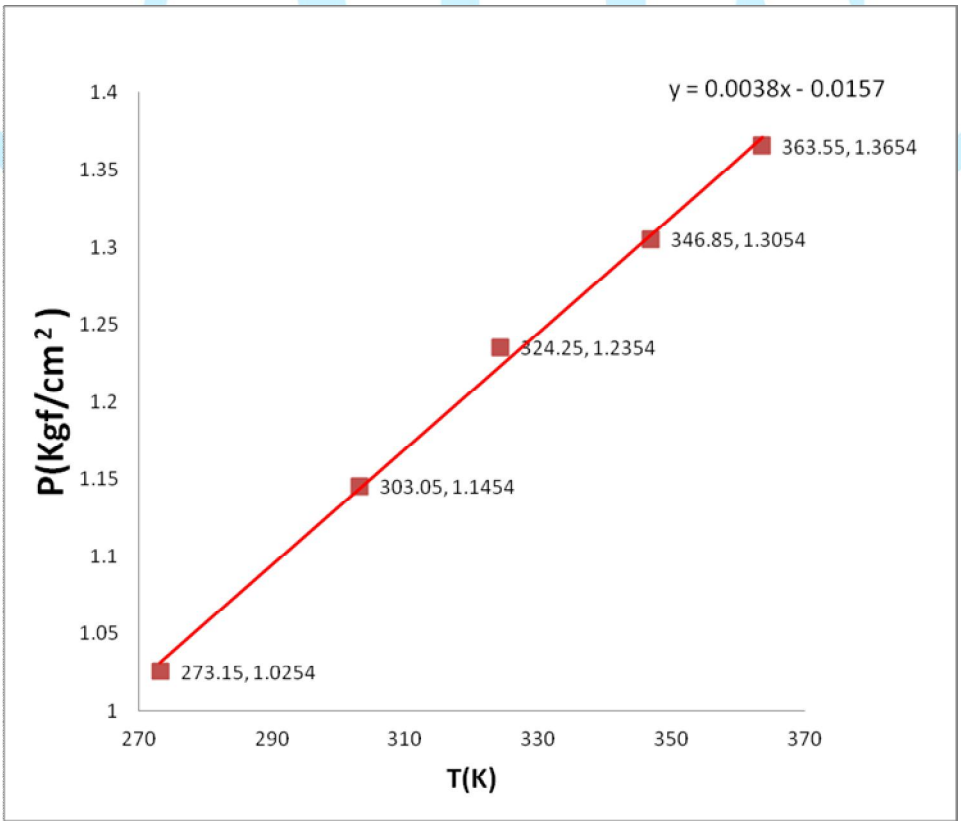
1. Make sure the beaker completely immersed in water.
2. Mix the water and write down the data while the experimental system is in equilibrium.
3. Do not ceaselessly heat up the system.

Note: experimental data calculation reference:

Average const value K $\bar{x} = \frac{\sum_i x_i}{n}$; Deviation $d_i = x_i - \bar{x}$; average standard deviation $\bar{\sigma} = \sqrt{\frac{\sum_i d_i}{n(n-1)}}$;

Experimental Record

Charles-Gaylussac's Law experimental data Form					
Room temperature=31.4℃ Room pressure= 1005.3 KPa=1.02540 Kgf/cm^2					
temperature(℃)	0℃	29.9℃	51.1℃	73.7℃	90.4℃
Absolute temperature (K)	273.15	303.05	324.25	346.85	363.55
Pressure(Kgf/cm^2)	1.0254	1.1454	1.2354	1.3054	1.3654
Const K value	0.376×10^{-2}	0.378×10^{-2}	0.381×10^{-2}	0.376×10^{-2}	0.376×10^{-2}
Const K value	$\bar{x}=\frac{\sum_i x_i}{n}=0.377\times10^{-2}$				
Deviation	-0.186×10^{-4}	-0.0699×10^{-4}	0.374×10^{-4}	-0.0899×10^{-4}	-0.168×10^{-4}
Average standard deviation	$\bar{\sigma}=\sqrt{\frac{\sum_i d_i}{n(n-1)}}=0.416\times10^{-4}$				
Result $\bar{x}\pm\bar{\sigma}$	$0.377\times10^{-2}\pm0.416\times10^{-4}$				
Percentage error %	1.1%				



Charles-Gaylussac's Law experimental data Form					
Room temperature=_____℃ Room pressure= _____KPa=_____ Kgf/cm^2					
temperature(℃)					
Absolute temperature (K)					
Pressure(Kgf/cm^2)					
Const K value					
Const K value					
Deviation					
Average standard deviation					
Result $\bar{x} \pm \bar{\sigma}$					
Percentage error %					