

Investigation of Ideal Gas Laws by Using the Pressure Sensor and Thermistor Sensors

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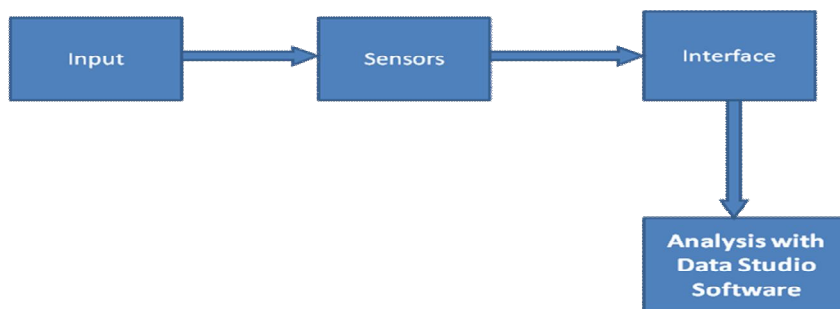
Abstract

This paper describes the investigation techniques of Ideal Gas Laws by connecting a Pressure sensor and a Thermistor sensor to the Ideal Gas syringe, and analysis with data acquisition software. The result of this experiment provides high percentage accuracy; importance of sensors to analyze the pressure and temperature in order to obtain accurate results.

Keywords: Gas laws, Thermistor sensor, Pressure sensor, Interface-750, Data acquisition Software

Introduction

The conventional way to verify the Ideal gas laws is that we are heating a water or liquid and then dip the thermometer in boiled water and then find the values of Temperature and Pressure. But this method gives a lot of difficulties for Physicists and Chemists in experimental work. These difficulties are mitigate by adopting a modern experimental technique i.e) using Sensors, Syringe and Interface.



Thermistor Sensor

The change of temperature is measured by using the Thermistor Sensor. It has a unique quality to read the resistance and convert it into the temperature. The data studio software displays the temperature in degree celsius.



Figure: 1 Thermistor Sensor

Pressure Sensor

In the experiment the pressure sensor is used to find out the pressure exerted on air that is filled inside the ideal gas syringe. The pressure sensor contains two ports; one port is for measuring the internal pressure and the other is for measuring the external pressure.

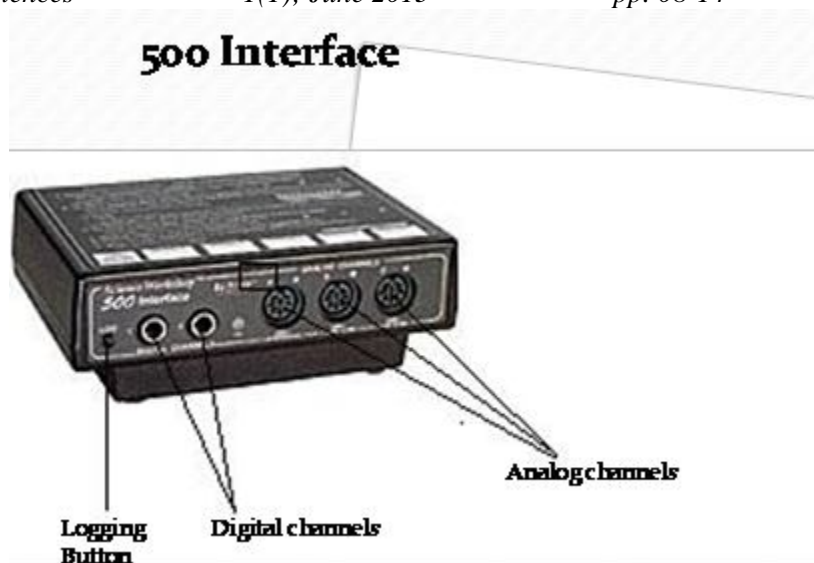


Figure:2 Pressure Sensor

**Table 1
Pressure range comparison**

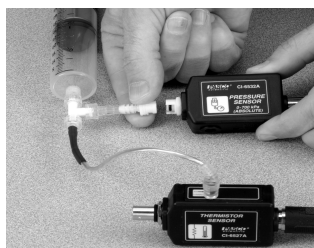
kiloPascals	inches of Hg	mm of Hg	Bar	pounds/sq in	atmospheres
700.00	207.25	5250.4	6.999	101.48	6.908
101.32	30.00	760.0	1.013	14.69	1.000

Science Workshop 500 Interface



Experimental Setup

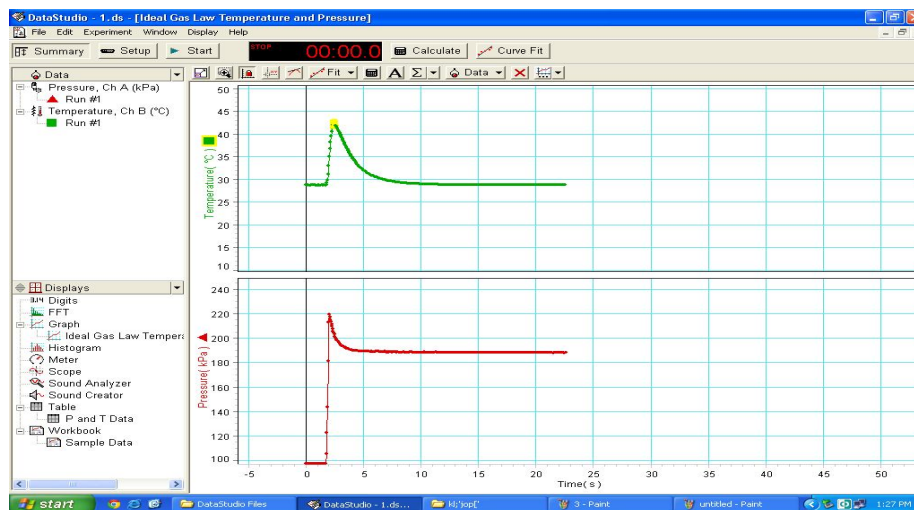
Traditional experiments in this area involve creates many confusions. The traditional approach is difficult to execute and data is rarely sufficient for an understanding of relationship of Boyles and charles. This remove these difficulties by using sensors .



Experiment 1: (Ideal Gas Law Syringe)

Procedure The ideal Gas law Syringe allows simultaneously measurements of temperature and pressure of a gas as it is compressed. The mini stereo jack is connected to a low thermal mass thermistor build into the end of a syringe to measure temperature changes. The white plastic tubing coupler attaches to the port to the pressure sensor. Disconnect the white plastic pressure coupler and press the plunger of the syringe all the way in, the min volume should be 20 cc. set the plunger at 40 cc and reconnect the sensor. Press start from the data studio software and quickly press the plunger. Wait until the pressure vs temperature graph is constant. Release the plunger till it stops gradually.



Graph:**Experimental Values:**

Temperature 1	28.757 centigrade
Temperature 2	42.000 centigrade
Pressure 1	102.37 KPa
Pressure 2	202.82 KPa

$$V_1/V_2 = 1.898$$

Calculated Value:

$$V_1/V_2 = 2.0$$

Analysis:

$$\% \text{age error} = [((\text{experimental value} - \text{calculated value}) / (\text{calculated value})) * 100]$$

$$\% \text{age error} = 5 \%$$

Hence this experiment proves the given theory.

Experiment 2 (Constant Temperature)

Procedure: The ideal Gas law Syringe allows simultaneously measurements of temperature and pressure of a gas as it is compressed. The mini stereo jack is connected to a low thermal mass thermistor build into the end of a syringe to measure temperature changes. The white plastic tubing coupler attaches to the port to the pressure sensor. Disconnect the white coupler and set the plunger at 45 cc and reconnect the coupler. Press start from the data studio software and compress the plunger at 40 cc hold it till the temperature is constant. Repeat this procedure until the plunger is at 20 cc.

Graph:

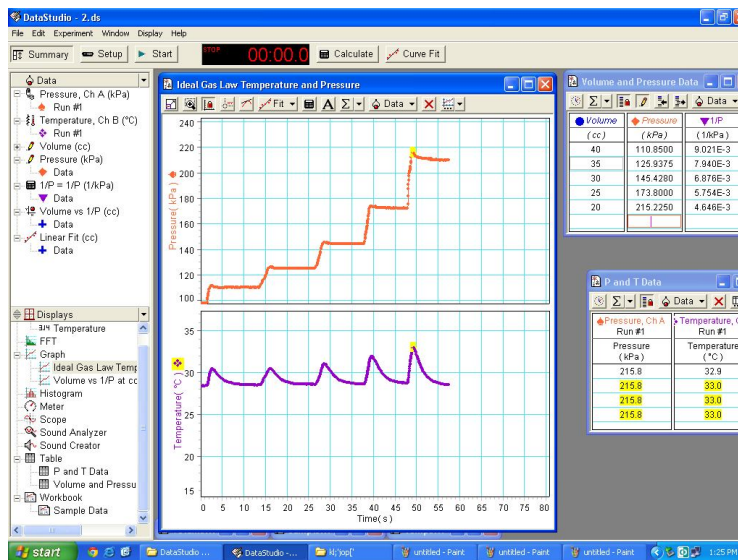
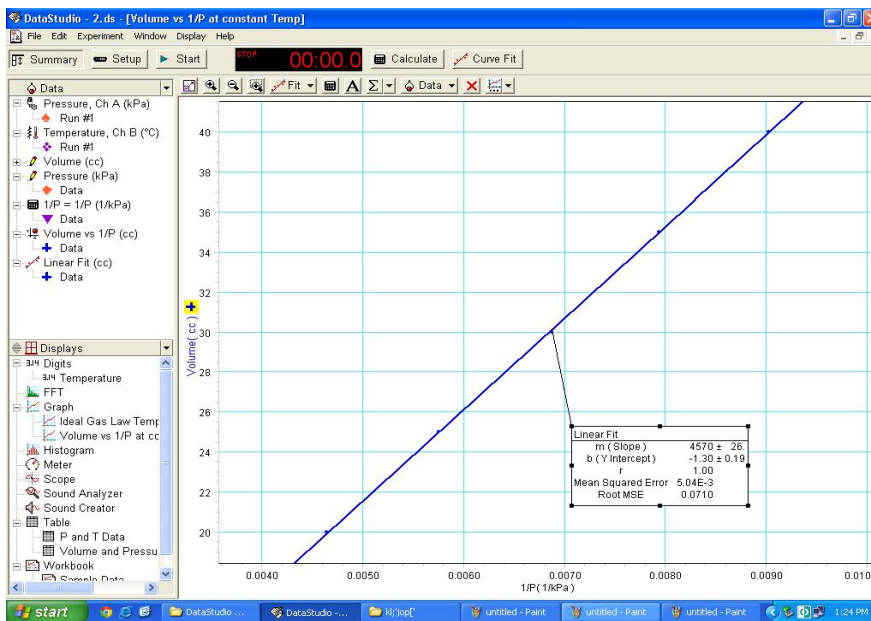


Table:2

Volume(cc)	Pressure(KPa)	Temperature(centigrade)
40	110.85	30.38
35	125.94	30.50
30	145.42	30.98
25	173.80	31.9
20	215.22	32.9

Graph (Volume Vs.1/Pressure):



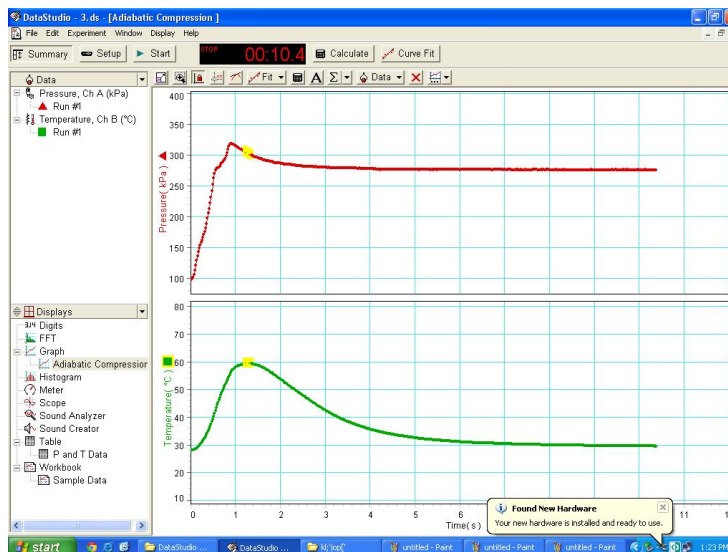
ANALYSIS:

It is a linear graph. The slope is represented by $nRT = 4570$.

Experiment 3(Adiabatic Compression):

Procedure: The ideal gas law syringe contains a sensing needle inside the syringe. As it is compressed from 60cc to 20cc .The temperature changes and measured by the thermistor sensor

Graph:



Equation:

$$P_1 V_1^\gamma = P_2 V_2^\gamma$$

Table:

V₁	60 cc
V₂	20 cc
P₁	109.03 KPa
P₂	507.59 KPa

$\gamma = 1.40$

Analysis:

Hence the above relation is proved

References

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