

Pressure, Volume, and Temperature: Discovery of the Gas Laws

Experiment 3

This experiment will explore the relationship between pressure, volume, and temperature. Data will be collected and used to make mathematical equations relating to pressure, volume, and temperature. The characteristics of gases will be unfolded and understanding will come from conducting this experiment. To understand how the gas law works in mathematical aspects, learning about the gas law in experimentation practices is essential to grasping the subject. In Part A of this experiment, the relationship of pressure and volume were tested. Air was confined in a syringe and multiple data points of pressure were taken by moving the piston to various volumes. The piston started at 5mL and rose to 20mL in one to three intervals. To reassure that results were reliable, volume points were tested again at 15mL, 10mL, and 5mL. The pressure at the end of the experiment was almost identical to the first pressure points collected. In Part B of this experiment, the relationship of pressure and temperature were tested. A beaker was filled with water and set on a hot plate to boil. Once water reached boiling point, temperature and pressure data points were collected. As temperature dropped in 5-7 degrees Celsius, data was collect to determine the pressure. Ice water was added to water to cool the temperature of water faster. Ice was added to reach zero degrees Celsius and pressure was collected. This experiment showed the relation between pressure and volume are as pressure increases, volume decreases and showed the relation between pressure and temperature are as pressure increases, temperature increases. Pressure and volume are indirectly proportional and pressure and temperature are directly proportional.

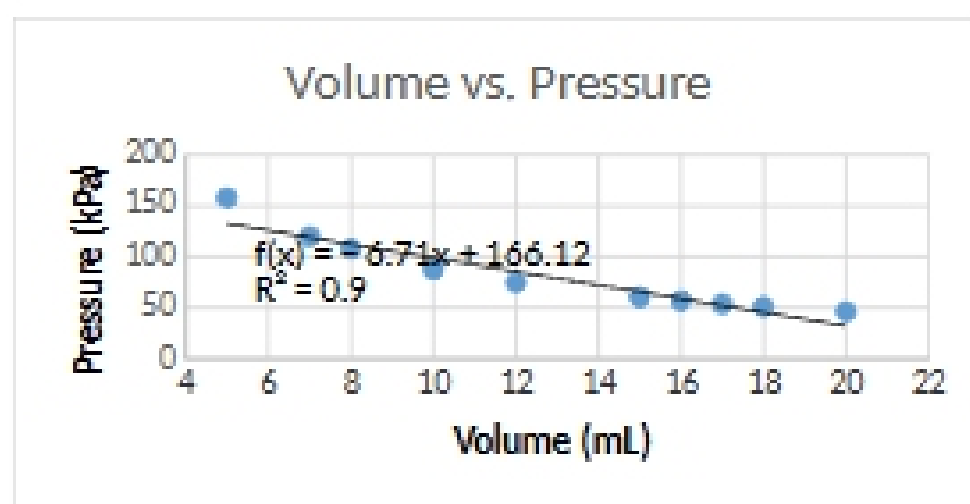
Results of this experiment were taken by using a syringe and pressure sensor in Part A and by using a pressure sensor and temperature probe in Part B. LoggerPro was the software used in taking data points during this experiment. After the experiment, graphs and math calculations were taken to determine which graphs displayed the best relationship between volume vs. pressure and volume vs. temperature.

Part A: Pressure-Volume Relationships

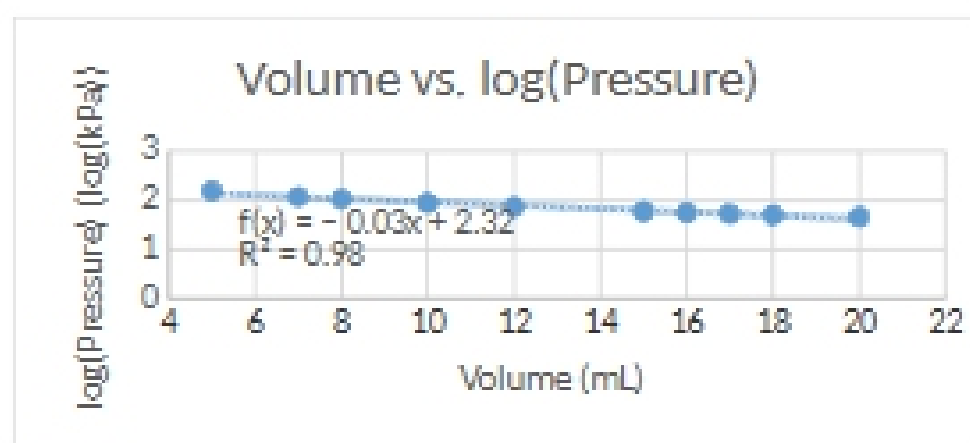
Latest: Volume (mL)	Latest: Pressure (kPa)	1/Pressure (1/kPa)	log(Pressure) (log(kPa))
5.0	158.08	0.006	2.19

7.0	119.99	0.008	2.08
8.0	107.60	0.009	2.03
10.0	89.31	0.01	1.95
12.0	74.79	0.01	1.87
15.0	60.45	0.02	1.78
16.0	56.90	0.02	1.76
17.0	53.76	0.02	1.73
18.0	50.78	0.02	1.71
20.0	46.32	0.02	1.67
15.0	60.78	0.02	1.78
10.0	87.55	0.01	1.94

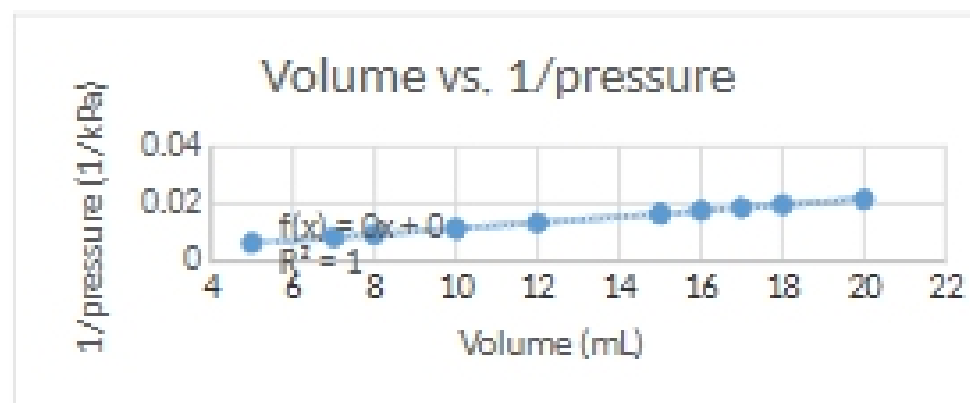
Volume (mL)	k
5.0	790
7.0	840
8.0	860
10.0	890
12.0	890
15.0	910
16.0	910
17.0	910
18.0	910
20.0	930
15.0	910
10.0	880



$R^2 = 0.089607$
This is not the best relationship between Volume and Pressure.



$R^2 = 0.97569$
This is not the best relationship between Volume and Pressure.



$R^2 = 0.99974$
This is the best relationship between Volume and Pressure.

Part A of this experiment focuses on the relationship of pressure and volume. Volume and pressure are normally indirectly proportional, until 1/pressure comes into the picture. In the graphs above the normal trend line in decreases, but volume vs. 1/pressure has an increases trend

line. The equations used are $1/\text{pressure} = 1/\text{kPa}$, and $\log(\text{pressure}) = \log(\text{kPa})$. Examples are: $1/(\text{pressure (kPa)}) = 1/(158.08 \text{ kPa}) = 0.0006 \text{ kPa}$ and $\log(\text{pressure (kPa)}) = \log(158.08 \text{ kPa}) = 2.19$ kPa and k (constant) = Pressure (kPa) * Volume (mL) = 158.08 kPa * 5.0 mL = 790.

Part B: Pressure-Temperature Relationships

Event Number	Pressure (kPa)	Temperature (°C)	Temperature (K)	1/Pressure (1/kPa)	log(Pressure) (log(kPa))
1	114.08	81.3	354.45	0.00877	2.08
2	115.46	86.6	359.75	0.00866	2.06
3	115.36	80.3	353.45	0.00867	2.06
4	115.37	80.3	353.45	0.00867	2.06
5	113.17	75.3	348.45	0.00884	2.05
6	113.16	75.3	348.45	0.00884	2.05
7	111.20	70.1	343.25	0.00899	2.05
8	109.59	66.0	339.15	0.00912	2.04
9	107.60	61.0	334.15	0.00929	2.03
10	106.29	56.3	329.45	0.00941	2.03
11	105.29	51.2	324.35	0.00949	2.02
12	103.50	46.6	319.75	0.00966	2.01
13	101.92	42.2	315.35	0.00981	2.01
14	101.02	37.6	310.75	0.00989	2.00
15	99.74	32.6	305.75	0.0100	1.99
16	99.35	27.7	300.85	0.0101	1.99
17	97.02	21.8	294.95	0.0103	1.99
18	96.05	16.7	289.85	0.0104	1.98
19	92.86	11.0	284.15	0.0108	1.97
20	91.28	6.60	279.75	0.0109	1.96
21	90.61	0.00	273.15	0.0110	1.96
22	96.74	24.2	297.35	0.0103	1.99
23	108.53	98.1	371.25	0.00921	2.04
24	114.50	97.3	370.45	0.00873	2.06
25	114.91	92.4	365.55	0.00870	2.06

