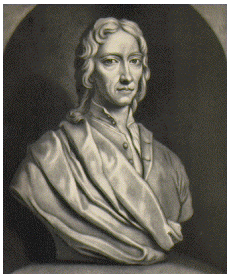
Doug Balmer

Professor Roberts

Chem 501

16 August 2007



A picture of Robert Boyle borrowed from www.english.upenn.edu/.../knarf/Gifs/boyle.html

Boyle's Law Verification

In 1662, Robert Boyle and his assistant performed an experiment where the volume of a gas was measured at varying levels of pressure. He derived his famous law from the data set he collected. He stated that the volume of a gas is indirectly proportional to its pressure, or $P_1V_1 = P_2V_2$. Based on Boyle's experiment, his independent variable was the pressure, and his dependent variable was the volume. For some reason, I always thought he designed his experiment in the reverse order. I thought that he changed the volume as he measured the resulting pressure. Figure 1 shows the inverse relationship between volume and pressure using the data he obtained in 1662.

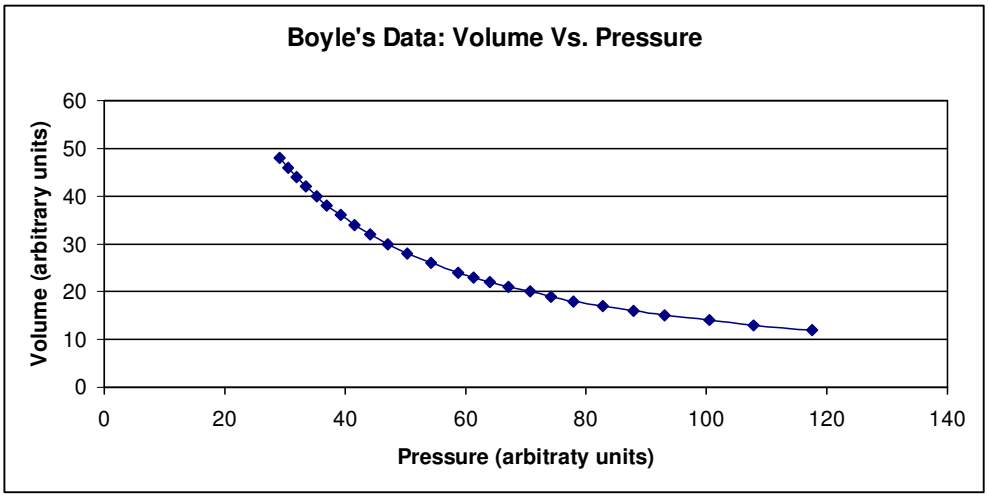


FIGURE 1 A plot of volume versus pressure shows the inverse relationship between the two variables as Robert Boyle would have seen in 1662.

Since the slope of a curve is not constant, it is much easier to see relationships between variables if they are plotted in such a way that they are linear. A plot of volume and inverse pressure reveals such a linear relationship (Fig.2). If the slope of the line is $\Delta V/ \Delta(1/P)$, then the slope simplifies to $\Delta V \Delta P$. This graph is so useful, because the slope of a line is constant. This means that $slope_1 = slope_2$, or $V_1P_1 = V_2P_2$.

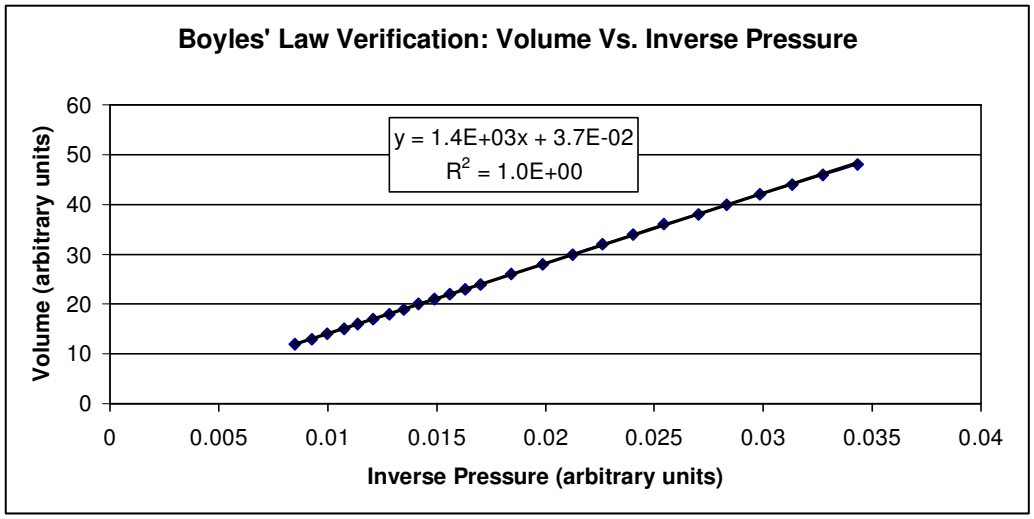


FIGURE 2 A plot of volume versus inverse pressure reveals a linear relationship.

The equation of the line in Figure 2 shows that as the inverse pressure approaches 0, or the pressure approaches infinity, the volume approaches 0.037. The volume of the gas will not be exactly zero. As the inverse pressure increases, or the pressure decreases, the volume of the gas increases proportionately. The R^2 value of 1.0 indicates that the line of best fit closely fits the set of data.

In summary, Robert Boyle discovered the law named after him by measuring the volume of a gas sample at varying pressures. His law, $P_1V_1 = P_2V_2$, works for any arbitrary units of pressure and volume as long at the temperature of the gas and the number of gas molecules remain constant.