

Chem 20 - Unit B - Gases

Boyle's Law

Hey good looking...learn about my law!



Nov 14-7:55 PM



Dr. Martyn Poliakoff
Proudly Presents:

The Periodic Table Movie of the Day!!!

Oct 4-12:12 PM

POS Checklist

- illustrate how Boyle's and Charles's laws, individually and combined, are related to the ideal gas law ($PV = nRT$)

Oct 4-1:26 PM

What's the Deal with:
volume and pressure?



From our discussions last day (and the Cartesian divers lab) we found that the volume of a gas and the pressure it exerts on it's container are related.

What is this relationship?

Nov 14-8:47 PM

Relationships b/t P and V

- as the volume of a gas is increased, the pressure the gas exerts is decreased

- as the volume of a gas is decreased, the pressure is increased

(Note: we assume the temperature of the gas and amount of gas remains constant.)

Oct 4-1:27 PM

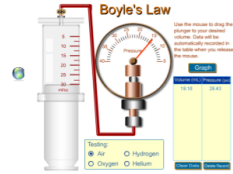
The first person to observe this trait was Robert Boyle (1627 - 1691).



Relationships b/t P and V

Nov 14-8:51 PM

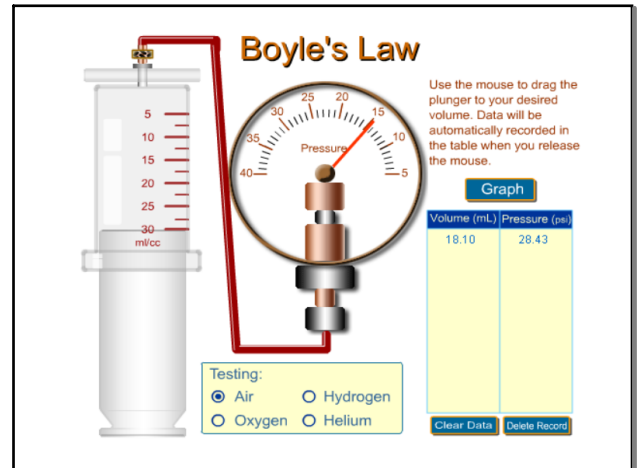
We can investigate this relationship further by using an applet like this one.



In this applet, we will look at two relationships between data:

- qualitative (quality, without numbers)
- quantitative (quantity, with numbers)

Oct 4-1:29 PM



Oct 8-8:36 AM

Boyle's Law Applet Investigation

Problem: What is the mathematical relationship between pressure and volume (when temperature is constant)?

Design: Pressure is the manipulated variable.
Volume is the responding variable.
Temperature is the controlled variable.

Evidence: Collect data from 5 trials for each kind of gas.

Analysis: What relationship is there between the measurements?

Evaluation: Answer the problem.

Nov 14-9:08 PM

From the applet, we can deduce Boyle's Law:

Boyle's Law

For any gas, the product of the pressure and the volume is a constant. (When temperature is kept the same.)

$$PV = k$$

Oct 4-2:09 PM

...another way of stating this, if we compare the same gas with the same k value, is:

Boyle's Law

Pressure is inversely proportional to volume of a gas when temperature is constant.

$$P_1V_1 = P_2V_2$$

Oct 4-2:14 PM

Boyle's Law

$$P_1V_1 = P_2V_2$$

Some things to keep in mind about my law:



- You can use any unit for pressure or volume. The units you put in will just be the same as those you get out.

Recall the units for pressure:

$$1 \text{ atm} = 760 \text{ Torr} = 760 \text{ mmHg} = 101.3 \text{ kPa}$$

*Note: the Torr is the same unit as mmHg, just with a different symbol.

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- You may only use this equation if temperature stays the same! If the temperature of the gas changes, this equation no longer applies.

- Likewise, you may only use this equation if the amount of gas (in moles) stays the same! If some gas escapes or is added to the container, this equation no longer applies.



Oct 12-2:32 PM

- When answering questions, you must write the beginning formula, show your substitution WITH units and record your final answer to the correct number of sig digs.

ex) Evaluate.

a) $4.657 + 1.25 = \underline{\hspace{2cm}}$

b) $7.6 \times 0.0015 = \underline{\hspace{2cm}}$

c) $15.000 / 5.00 = \underline{\hspace{2cm}}$

Remember the rules of Sig Digs!

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Using Boyle's Law (Number Crunching)

(pg 152 # 6)

6) A bicycle pump contains 0.650 L of air at 101 kPa. If the pump is closed, what pressure is required to change the volume to 0.250 L?

Oct 4-2:16 PM

ex) A balloon contains 1.5 L of air under 3.00 atm. If the pressure of the balloon changes to 5.00 atm, what is the new volume of the balloon?

Oct 12-2:43 PM

ex) LD is attempting to determine the pressure of the gas inside of a unopened can of pop. LD opens the 355 mL can and pours out the pop, measuring the volume of the pop to actually be 350 mL.

a) What is the pressure of the gas inside the empty can?

b) If we assume the amount of gas in the can was the same after pouring, what is the initial pressure of the gas in the can?

Oct 12-2:36 PM

ex) A balloon has a volume of x mL. What happens to the volume of the balloon if:

a) the pressure is halved.

b) the pressure is doubled.

c) the pressure decreases by a factor of 5.

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