Do Now ...

Date: February 9, 2015

Obj: Experimentally confirm (or disconfirm) Boyle's Law for the behavior of gases.

Choose and answer **one** of the following:

- Why do divers get the "bends"?
- Why do your ears "pop" going up a mountain?
- Why can't you crush an "empty" water bottle with the cap on?

Monday, February 9, 2015

Today:

Warm-Up: Kinetic Molecular Theory

Lab: Boyle's Law

Homework: Work on Lab Write-Up

Do Now ...

Date: February 10, 2015

Obj: Describe and predict the relationship b/t P, T, and V with the combined gas law.

Copy and Complete: **K = °C + 273**

Convert 25°C to degrees Kelvin: _____

Convert 25 degrees Kelvin to Celsius: _____

Convert 373°C to degrees Kelvin: _____

Tuesday, February 10, 2015

Today:

W-Up: KMT

Work on Labs, Intro to Combined Gas Laws

HW: Finish First Draft of Lab

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http://www.youtube.com/watch?v=-Ba8YrcAbpE&NR=1

Quick Activity:

Describe the motion of atoms or molecules in a gas.

What effect does temperature have on these particles (the atoms or molecules)?

Include diagrams to support your explanation.

Vortex Rings

https://www.youtube.com/watch?v=72LWr7BU8Ao

Kinetic Molecular Theory

Three basic assumptions about gasses:

- A gas is composed of tiny particles (atoms or molecules).
- These particles are in constant random motion.
- Their collisions are perfectly elastic.

These assumptions are the basis for our understanding of the behavior of gasses.

What happens ...

... to volume when we increase the pressure?

... to temperature when we increase the pressure?

... to pressure when we decrease the volume?

... to temperature when we increase the pressure?

Temperature and Volume

What happens to volume when we increase the temperature?

Demo: Temperature and Volume

What is the relationship between temperature and volume?

What is happen kinetically?

What caused the gas to expand according to Kinetic Theory?

Temperature and Volume

At constant pressure, if we:

Increase Temperature ⇨ Increase Volume

Decrease Temperature ⇨ Decrease Volume

Temperature and Volume are ***directly proportional***.

Effect of Heating/Cooling a Gas

Image from http://www.soames.com/myweb3/Saved%20As%20WEB%20Adbe%20Scan/Additional%20Pics%201%2022%2003/Hot-Air-

Kinetic Theory

Three basic assumptions about gasses:

- A gas is composed of tiny particles (atoms or molecules).
- These particles are in constant random motion.
- Their collisions are perfectly elastic.

These assumptions are the basis for our understanding of the behavior of gasses.

Temperature and Volume

What happens to the volume of a balloon if we decrease the temperature?

https://www.youtube.com/watch?v=OpajW3fkNKo

Combined Gas Law

We can relate initial and final differences using the Combined Gas Law.

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

Combined Gas Law

Temperature (T)

You **MUST** use degrees Kelvin in your calculations!

$$K = °C + 273$$

$$°C = K - 273$$

Practice

Convert 15°C to Kelvin. 288K

Convert –10°C to Kelvin. 263K

Combined Gas Law: Practice

If I initially have a gas at a pressure of 22 atm, a volume of 22 liters, and a temperature of 100 K, and then I raise the pressure to 14 atm and increase the temperature to 300 K, what is the new volume of the gas?

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$P_1 = 22\text{atm}$
$V_1 = 22\ \text{L}$
$T_1 = 100\text{K}$
$P_2 = 14\text{atm}$
$V_2 = ?\ \text{L}$
$T_2 = 300\text{K}$

Combined Gas Law: Practice

If no pressure (or volume or temperature) is given in the problem, don't include that variable in your calculations!

e.g. – The initial pressure is 22atm and the final pressure is 14atm. If the initial volume is 22L, what is the final volume?

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$P_1 = 22\text{atm}$
$V_1 = 22\ \text{L}$

$P_2 = 14\text{atm}$
$V_2 = ?\ \text{L}$

Combined Gas Law: Practice

A gas at STP occupies 28 cm^3 of space. If the pressure changes to 3.8 atm and the temperature increases to 203^oC, find the new volume.

STP =
Standard Temperature (0 ^oC or 273 K)
and
Pressure (1 atm).

Big Ideas – Gas Laws

Remember kinetic theory!

Gas pressure is created when molecules gain energy or have less space in which to move.

Gas molecules constantly and randomly move independently of each other and are mostly far apart.

Do Now ...

Date: February 11, 2015

Obj: Describe and predict the relationship b/t P, T, and V with the combined gas law.

Copy and Complete:

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

What do P_1, V_1, T_1, P_2, V_2 and T_2 stand for?

Wednesday, February 11, 2015

Today:

Warm-Up, Demo + Activity: Pressure and Volume, Combined Gas Law Practice

Homework: - Complete Combined Gas Law Worksheet

Combined Gas Law: Practice

- A gas takes up a volume of 17 liters, has a pressure of 2.3 atm, and a temperature of 299K. If I raise the temperature to 350K and lower the pressure to 1.5 atm, what is the new volume of the gas?

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

Combined Gas Law: Practice

A sample of sulfur dioxide (SO_2) is initially at a temperature of 133°C, a volume of 20 L, and a pressure of 850 mm Hg.

If the volume changes to 25 L and the temperature increases to 181°C, find the new pressure.

Combined Gas Law: Practice

- A gas has a temperature of 14°C, and a volume of 4.5 liters. If the temperature is increased to 43°C and the pressure is not changed, what is the new volume of the gas?

Combined Gas Law: Practice

A gas at STP occupies 28 mL (1L=1000mL) of space. If the pressure changes to 3.8 atm and the temperature increases to 203°C, find the new volume.

STP =
Standard Temperature (0 ^{o}C or 273 K)
and
Pressure (1 atm).

Do Now ...

Date: February 17, 2011

Obj: Describe and predict the relationship b/t P, T, and V with the combined gas law.

Copy and solve:

A balloon has a volume of 2.0 L at a pressure of 1.0 atm and a temperature of 30°C. What happens to the volume if the temperature is lowered to 3°C and the pressure stays the same?

(Hint: use the equation from yesterday.)

Thursday, February 11, 2015

Today:

Warm-Up
Demo
Notes & Practice: Combined Gas Law

HW: Finish Lab

Warm-Up

Use kinetic theory to explain why the volume of a balloon decreases when liquid nitrogen is poured over it.

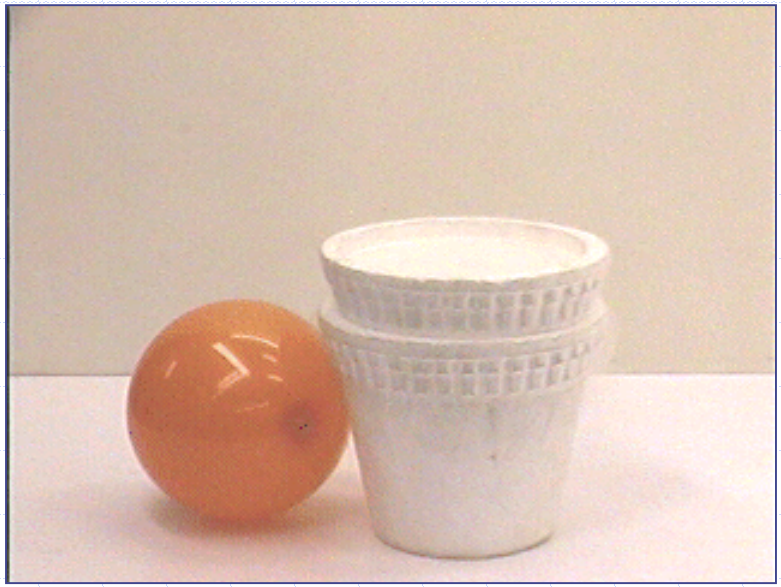


Image from http://www.physics.umd.edu/lecdem/services/demos/demosi4/i4-17.htm

Pressure and Volume

At constant temperature, if we:

Increase Pressure ⇨ Decrease Volume

Decrease Pressure ⇨ Increase Volume

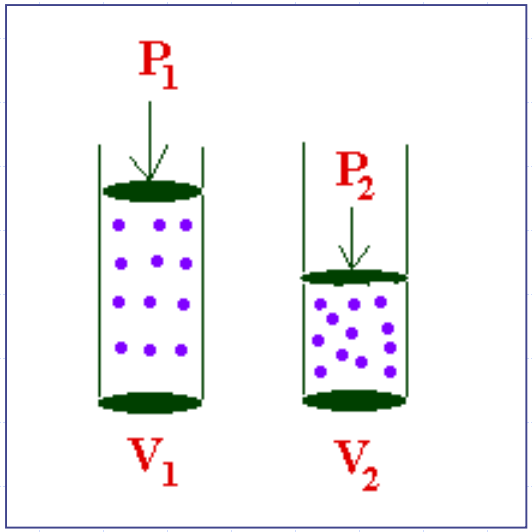
Pressure and Volume are ***indirectly proportional***.

Boyle's Law

The volume of a gas varies inversely with pressure (at constant mass and temperature).

We can compare any two sets of conditions with:

$$P_1V_1 = P_2V_2$$



Temperature and Volume

What happens to volume when we increase the temperature?

Animation: http://www.learnerstv.com/animation/animation.php?ani=123&cat=chemistry

Boyle's Law: $P_1V_1 = P_2V_2$

A balloon contains 30L of helium gas at 100kPa. What is the volume when the balloon rises to an altitude where the pressure is only 25kPa?

(Assuming constant temperature.)

Boyle's Law: $P_1V_1 = P_2V_2$

Practice

A given mass of air has a volume of 6L at 100kPa. What volume will it occupy at a pressure of 25kPa if the temperature does not change?

Boyle's Law Animation

- Explain what is happening in the animation.

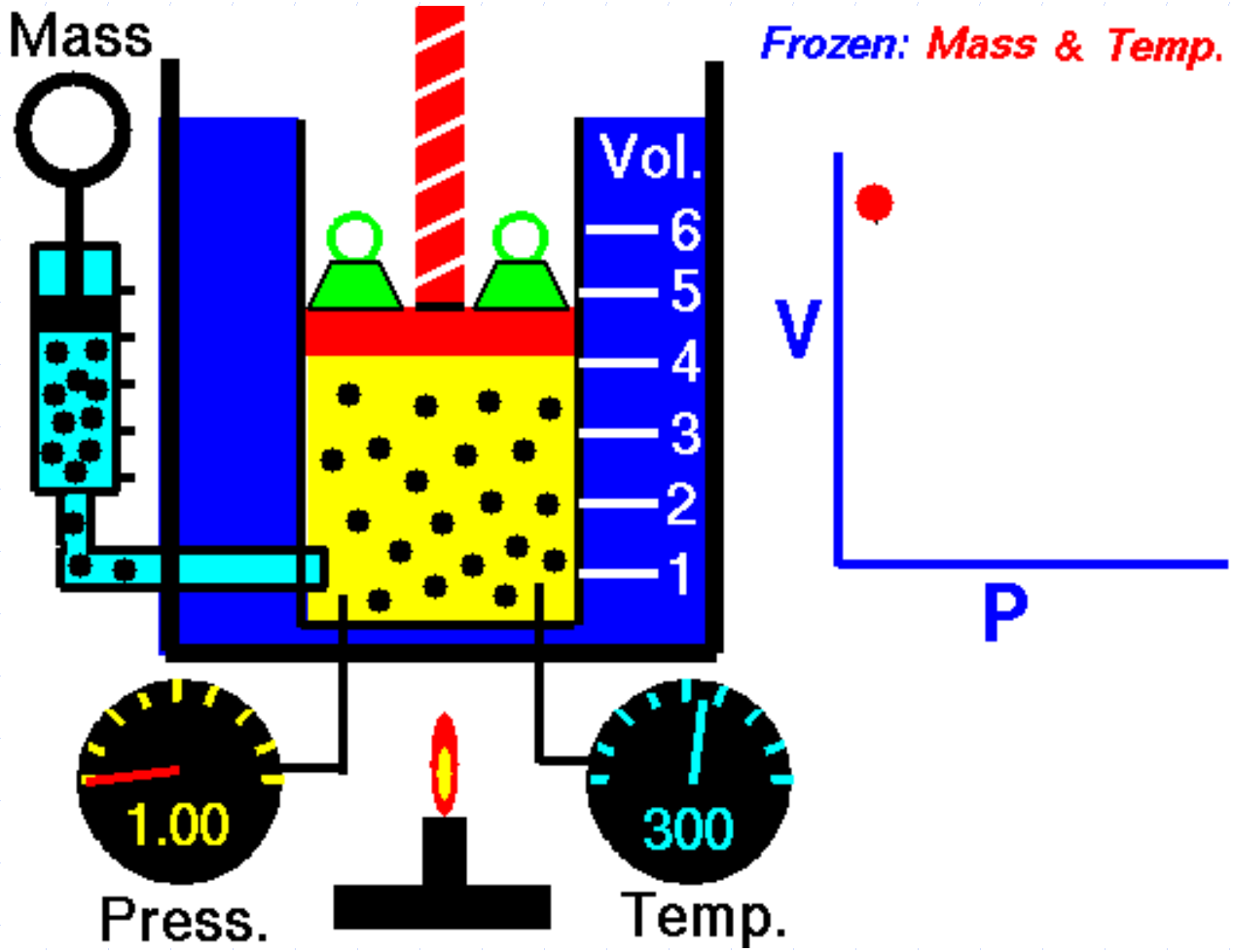
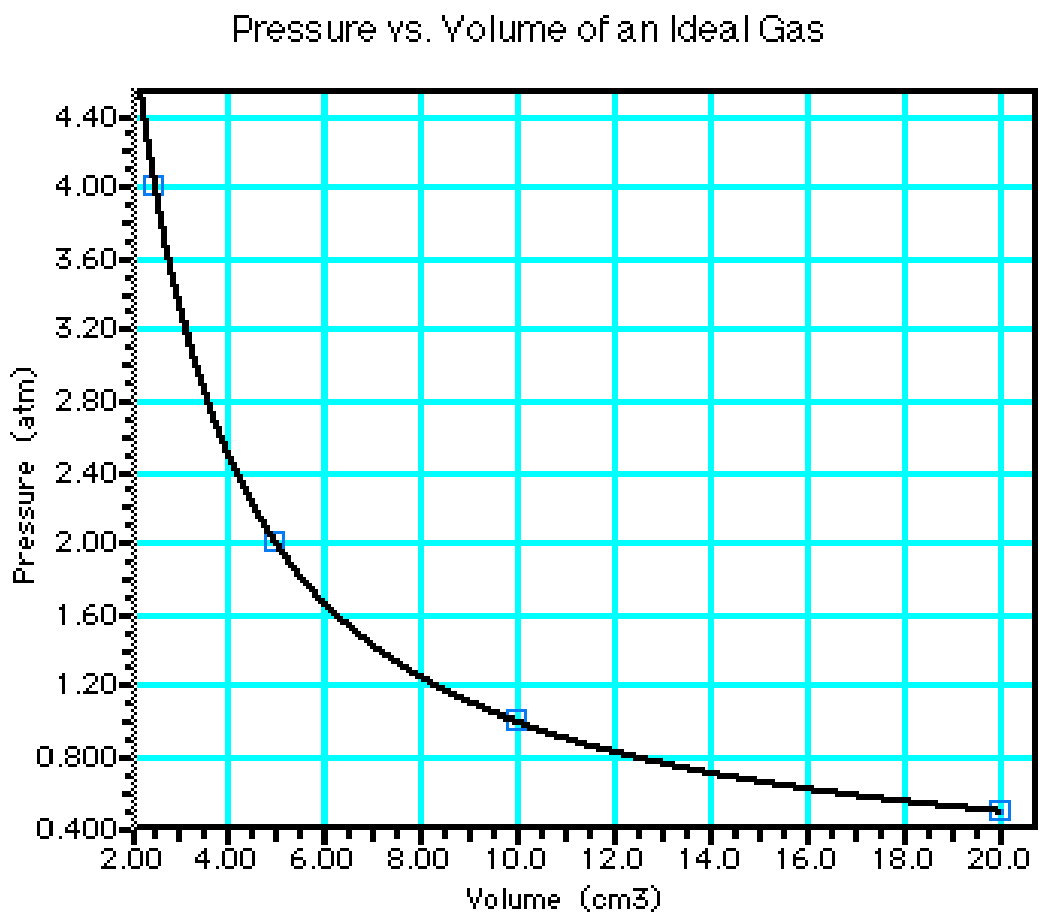


Image from http://www.grc.nasa.gov/WWW/K-12/airplane/aglussac.html

Graph of Boyle's Law

The volume of a gas varies inversely with pressure (at constant temperature).



P (atm)	V (cm^3)
4	2.5
2	5
1	10
0.5	20

Temperature and Volume

At constant pressure, if we:

Increase Temperature ⇨ Increase Volume

Decrease Temperature ⇨ Decrease Volume

Temperature and Volume are ***directly proportional***.

Charles's Law

Charles' Law: the volume of a gas is directly proportional to the temperature (if pressure and mass are constant).

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

Temperature (T)

Temperature is the average kinetic energy of the system.

$$\text{Kelvin} = {}^\circ\text{Celsius} + 273$$

or

$${}^\circ\text{Celsius} = \text{K} - 273$$

Practice

Convert 15°C to Kelvin.

Convert –10°C to Kelvin.

Temperature (T)

Always use the Kelvin scale when working with gases!

Charles' Law

Charles's Law: the volume of a gas is directly proportional to the temperature (if pressure and mass are constant).

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

Charles' Law: Practice

A balloon inflated in an air-conditioned room at 27°C, has a volume of 4.0L. The balloon is then heated to a temperature of 57 °C. What is the new volume of the balloon if the pressure remains constant?

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

Charles' Law Animation

Explain what is happening in the animation.

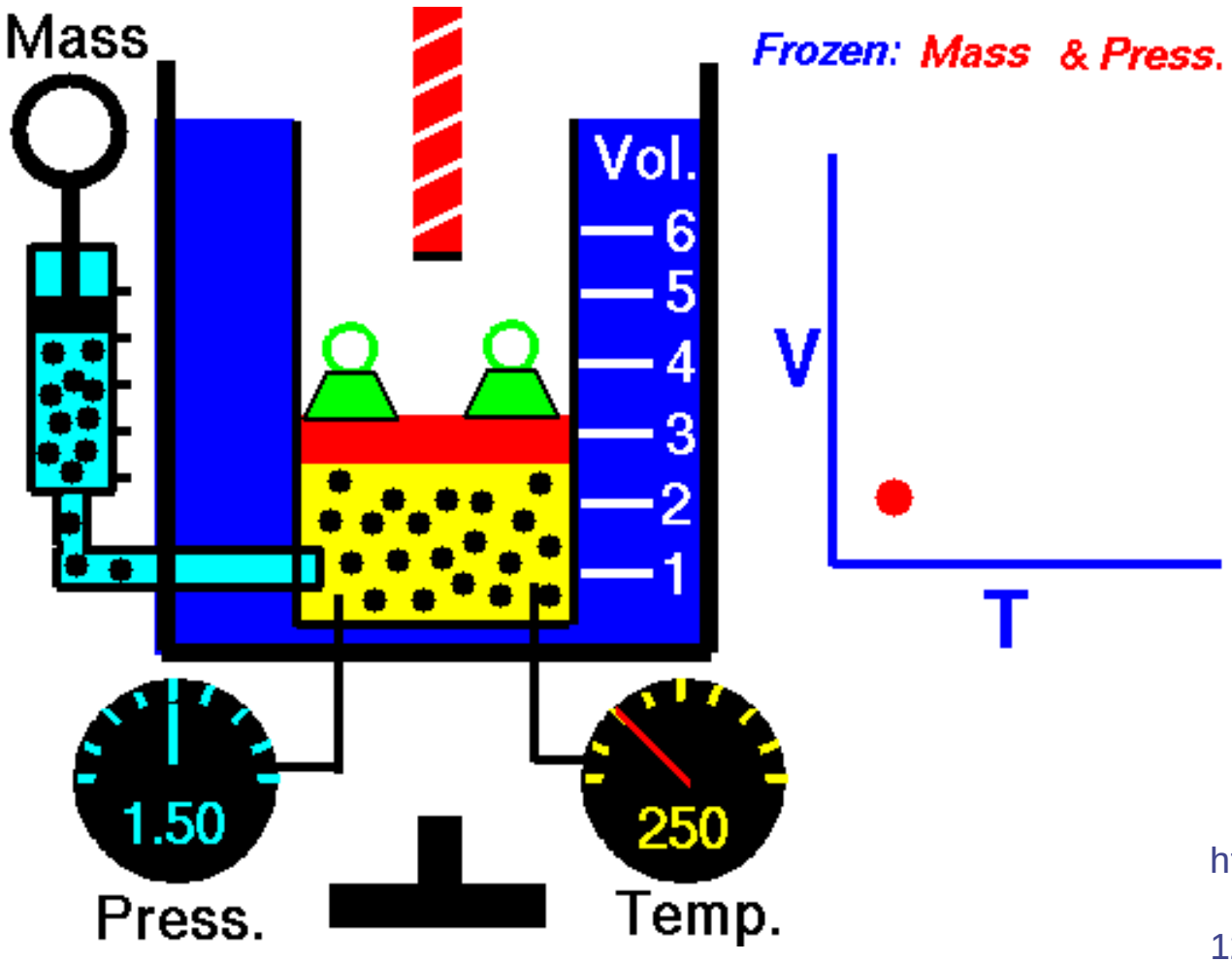


Image from http://www.grc.nasa.gov/WWW/K-12/airplane/aglussac.html

Charles's Law

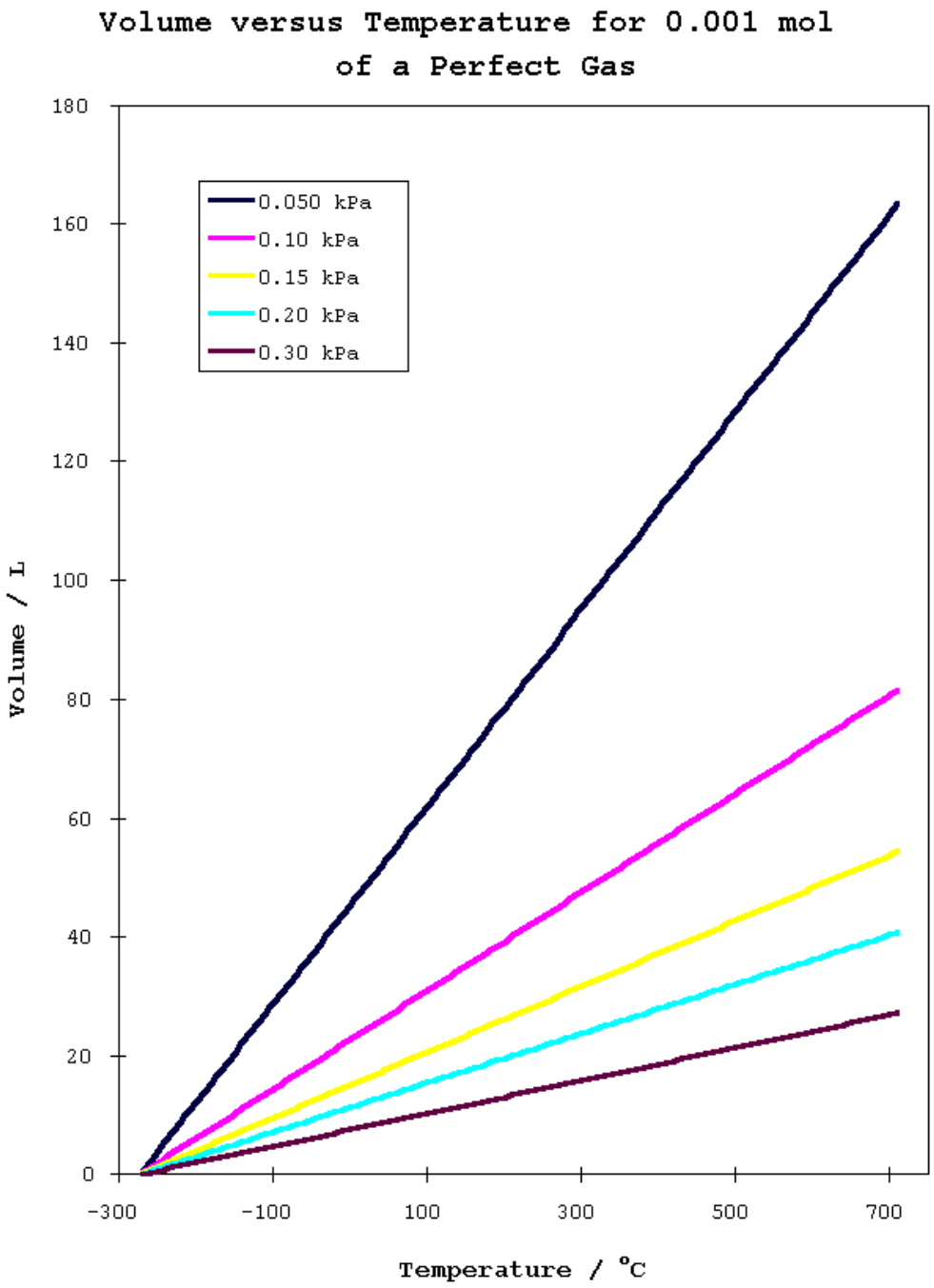


Image from http://faculty.uccb.ns.ca/~dkeefe/chem251/figures/charles.gif

Practice

Complete Charles' Law problems on the back of your notes.

Practice

Complete Combined Gas Law problems on the back of your notes.

Try to see if you can do the PV=nRT problems.

Do Now ...

Date: February 12, 2015

Obj: Describe and predict the relationship between P, T, and V using the combined gas law.

Copy and do **two** of the following:

Convert 32°C to Kelvin (K).

As pressure rises, what happens to volume?

As temperature rises what happens to volume?

Friday, February 12, 2015

Today:

Warm-Up
Lab: Boyle's Law

HW: Finish Lab – Final Draft Due Tuesday

Combined Gas Law: Practice

A gas has a temperature of 14°C, and a volume of 4.5 liters. If the temperature is increased to 43°C and the pressure is not changed, what is the new volume of the gas?

Combined Gas Law: Practice

A sample of sulfur dioxide (SO_2) is initially at a temperature of 133°C, a volume of 20 L, and a pressure of 850 mm Hg.

If the volume changes to 25 L and the temperature increases to 181°C, find the new pressure.

Demo: Pressure and Volume

What is the relationship between pressure and volume?

Demo: Pressure and Volume

What caused the balloon to expand?