Pressure-Temperature Relationship

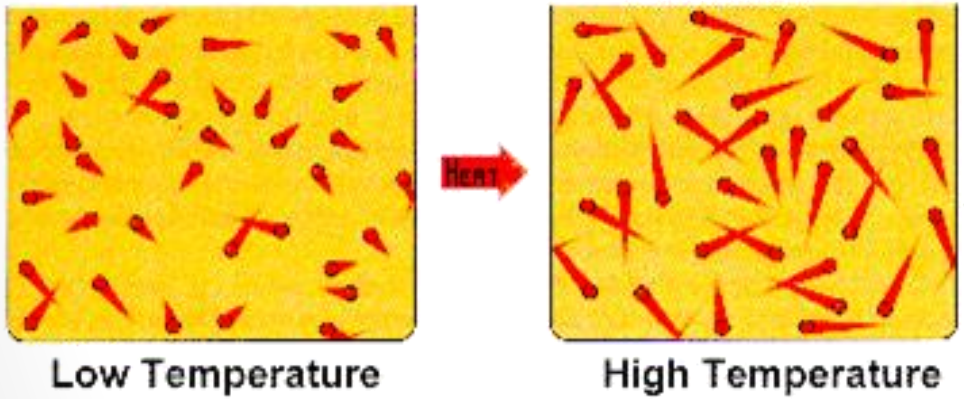
Outcomes:

- Experiment to develop the relationship between pressure and temperature of a gas using visual, numerical and graphical representations. *Include: contribution of Gay-Lussac*

Back to the KMT…

Kinetic Molecular Theory:

- When the **TEMPERATURE** of a gas is **INCREASED**, the kinetic energy (**SPEED**) of the particles also **INCREASES**.
- This leads to **MORE COLLISIONS** between particles and the container.
- Therefore more collisions should equal **HIGHER PRESSURE**.



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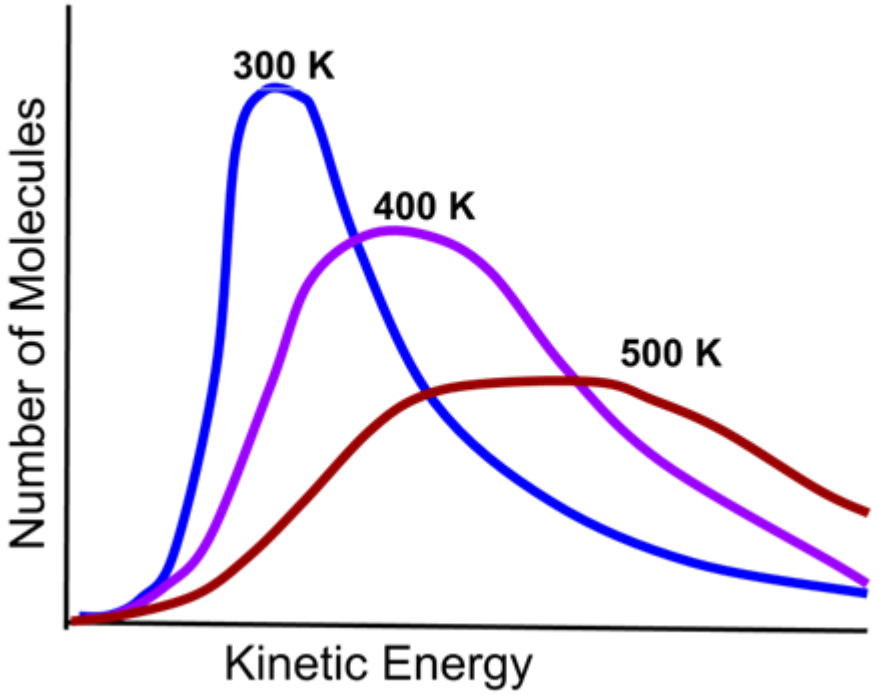
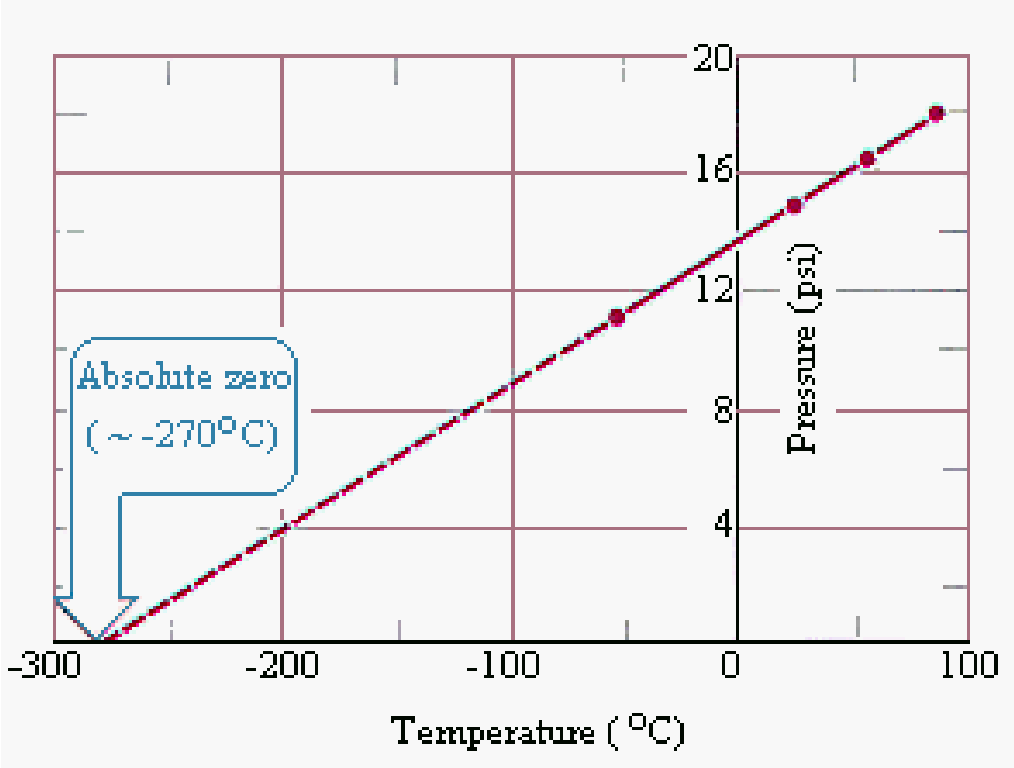


http://www.softschools.com/notes/ap_chemistry/images/temparature_img_1.png

Joseph Gay-Lussac…

http://www.nndb.com/people/885/000100585/

- Followed Charles' and Boyle's work, and investigated the temperature-pressure relationship.
- Found that the ***pressure of a gas varies directly with the temperature of the gas.*** (with constant **VOLUME** and **AMOUNT** of gas)
- A graph of this relationship would look like the volume-temperature relationship.



http://intranet.micds.org/upper/science/text/chemistry_textbook/ch10/Chap10gases/ptgraph.GIF

Joseph Gay-Lussac…

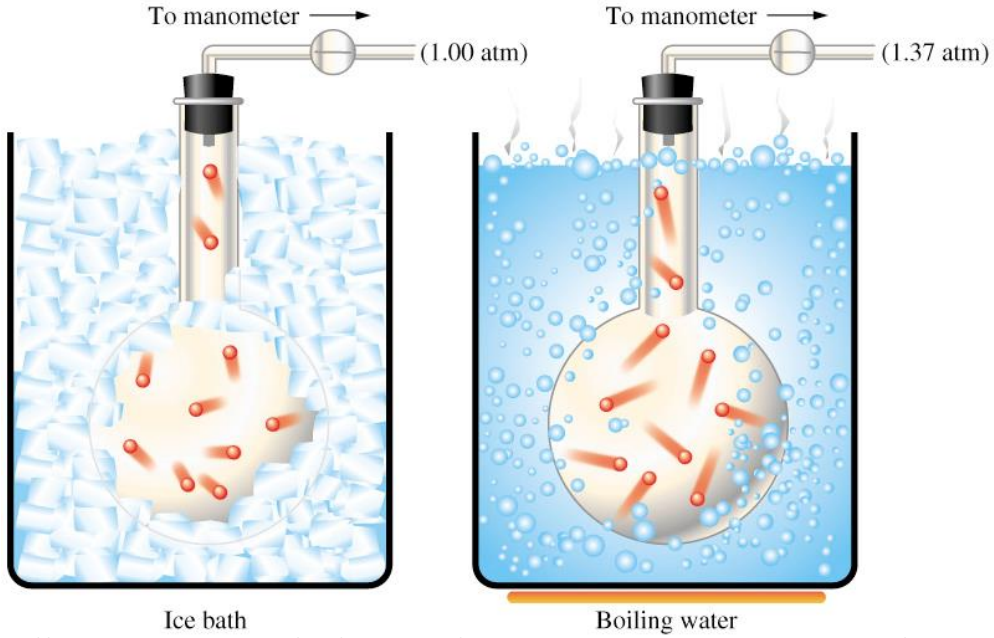
So,

$$\frac{P_1}{T_1} = k \qquad OR \qquad \frac{P_2}{T_2} = k$$

Therefore:

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

**Remember that temperature must be in Kelvin.

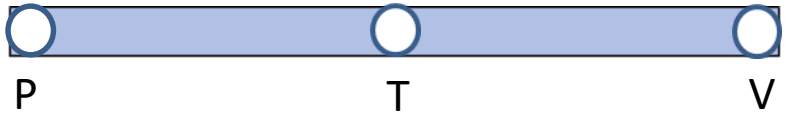


https://www.coursehero.com/file/13139540/3-Gay-Lussacs-Law-and-temperaturepdf/

Symbolic Relationships:

We can visualize the relationship between pressure, temperature and volume, using the following analogy:

Three holes are drilled into a piece of wood as shown:



If ***P*** is fixed (constant), ***T*** and ***V*** move up/down together.

→ They are ***Directly Proportional*** to each other

→ i.e. ***T α V***

If ***V*** is fixed (constant), ***P*** and ***T*** move up/down together.

→ They are also ***Directly Proportional*** to each other

→ i.e. ***P α T***

If ***T*** is fixed (constant), ***P*** and ***V*** act like a see-saw.

→ They are ***Inversely Proportional*** to each other

→ i.e.

******The symbol 'α' means "proportional to"***

Gay-Lussac's Law Examples:

Examples:

A sealed storage tank contains Argon gas at 18°C and 875kPa. What is the pressure if the temperature changes to 32°C?

Gay-Lussac's Law Examples:

Try these ones…

A closed "empty" tank containing air at 97kPa and 22°C survives intact in a fire. If the tank is able to withstand a maximum pressure of 350kPa, what is the maximum temperature it could have reached in the fire?

Gay-Lussac's Law Examples:

Try these ones…

A sample of Neon gas in a cylinder has a pressure of 125kPa at 300K. The cylinder is heated to 400K. Predict the new pressure at 400K.