College Chemistry

Lesson: 4/7/2020

Learning Topic:

Student will be able to explain and use in calculations: Boyle's Law, Charles' Law, Gay-Lussac's Law, and Combined Gas Law

Prior Knowledge Questions

Answer the following questions:

1. Explain the movement of gas particles. Be detailed your description by including distance between particles and describe particle collisions.
2. If y = 2, then solve for x in y = 2x +3.

Answers to Prior Knowledge Questions

1. Gas molecules are ideally cylindrical in shape and have lots of space between each particle. When a gas molecule collides with another gas molecule it should ideally bounce off one another completely in an elastic manner.
2. X = -½ = -0.5

Learning Material

Watch the following video: Video on Gas Laws

As you watch the video answer the following questions:

*Hint - you can read the full transcript in the video description. Video does move quickly

1. What are the four variables that are manipulated in the different gas laws.
2. In Boyle's Law are the variables (pressure and volume) directly related or indirectly related? Directly meaning if one goes up the other goes up. Indirectly meaning if one goes up the other goes down or vice versa.
3. In Gay-Lussac's Law are the variables (pressure and volume) directly related or indirectly related?
4. In Charles' Law are the variables (pressure and volume) directly related or indirectly related?

Learning Material Continued

Negative pressure and negative volume do not exist (no such thing as removal of space). However, temperature can be negative in Fahrenheit and Celsius. Thus, all temperatures used in these calculations must be in Kelvin, which removes all negative numbers by having its 0K value as absolute zero (point which all movement of particles stops).

*Note absolute zero is a theoretical value and one scientists are still currently working to achieve.

Learning Material Continued

You may notice that Boyle's, Charles', and Gay-Lussac's laws look similar:

You can combine them to create the Combined Gas Law. If you remove the variable that is constant you achieve one of the three above, i.e. for Boyle's remove temperature, for Charles' remove pressure, and for Gay-Lussac's remove volume.

Gas Laws Summary

Name	Equation	Things that change	Things held constant
Combined	$P_1 \times V_1 \times T_2 = P_2 \times V_2 \times T_1$	Pressure, volume and temperature	Amount of gas
Boyles	$P_1 \times V_1 = P_2 \times V_2$	Pressure and Volume	Temperature Amount of gas
Charles	$V_1 \times T_2 = V_2 \times T_1$	Volume and Temperature	Pressure Amount of gas
Gay-Lussac	$P_1 \times T_2 = P_2 \times T_1$	Pressure Temperature	Volume Amount of gas

Practice Problems - Using the equations learned in the learning material, answer the following questions. Once done, check answer key in next slide.

1. A gas has a volume of 64.0 L at 300. kPa. What will the pressure be in kPa if the volume changed to 35.0 L?
2. A gas has a volume of 4.26 L at 54.0°C. What is the temperature of the gas in °C when the volume is changed to 3.52 L?
3. The gases in a hair spray can are at a temperature of 27.0 °C and a pressure of 206 kPa. If the gases in the can reach a pressure of 6.04×10^2 kPa, the can will explode. To what temperature in °C must the gases be raised in order for the can to explode?
4. A gas has a volume of 39 L at 0.0°C and 101 kPa. What will its volume be at 404 kPa and 25°C?

Answer Key to Practice Problems

1. 549 kPa
2. -2.83°C
3. 607°C
4. 10.6 L

Extensions to Learning:

Extra information:

Gas Laws and Kinetic Molecular Theory

Practice Worksheets:

Gases and Their Laws

- Based on this lesson I suggest:
  - Boyle's Law I (dd-ch)
  - Boyle's Law Worksheet
  - Charles's Law Worksheet
  - Combined Gas Law Worksheet
  - Combined Gas Law Practice worksheet
  - Combined Gas Law Practice

This worksheet has a worked out example in case you need more help.