**Gas Laws**

**Kinetic Molecular Theory**

What is the Kinetic Molecular Theory?

What are the properties of gases?

1.

2.

3.

4.

5.

What is diffusion?

How can you increase the pressure of a gas?

1.

2.

3.

Definition of volume –

Unit for volume?

**Temperature**

How is temperature related to gas molecules?

Unit for temperature?

Conversion for temperature (Celsius/Kelvin).

Practice Problems

1. Convert 15.0 K to degrees Fahrenheit
2. Convert 32 K to degrees Fahrenheit
3. What is 400ºF in Kelvin?

**Pressure**

What is gas pressure?

What is a barometer?

1 atm = = = =

What is STP?

**Conversion practice**

1. 658 mm Hg to atm

2. 8431 torr to atm

3. 345 Pa to kPa to atm

4. 745 mm Hg to kPa

**Gas Laws**

What 4 variables do to the gas laws related to each other?

**Gas Intro Homework**

1. Explain what causes gas pressure.
2. How does temperature affect the energy of gas molecules?
3. How can the pressure of a gas in a container be decreased?
4. Convert the following temperatures:

|  |  |  |
| --- | --- | --- |
| a) 250 Kelvin to Celsius | b) 339 Kelvin to Celsius | c) 17 Celsius to Kelvin |
| d) 55 Celsius to Kelvin | e) 89.5 Fahrenheit to Celsius | f) 383 Kelvin to Fahrenheit |

1. Convert the following pressures:

|  |  |  |
| --- | --- | --- |
| a) convert 1.5 atm to mm Hg | b) convert 580 torr to mm Hg | c) 170 mm Hg to atm |
| d) 550.54 kPa to mm Hg | e) 300 torr to kPa | f) 383 torr to atm |

**Boyles’ and Charles’ Laws**

**Boyle’s Law**

What is the definition of Boyle’s Law?

What is the equation for Boyle’s Law?

In words this means…..

**Practice Problems**

1. Atmospheric pressure suddenly decreases from 750 mm Hg to 680 mm Hg. What will the new volume of a balloon be if the original volume was 0.50 L?
2. 3.0 L of nitrogen gas at a pressure of 1.0 atm is allowed to expand until the pressure drops to 0.5 atm. What is the new volume of the nitrogen after the pressure drops?
3. Oxygen is transferred from a 15 L tank to an 18 L tank. The original pressure was found to be 2.0 atm. What was the final pressure of the tank?

**Charles’ Law**

What is the equation for Charles’ Law?

In words this means……

**Practice Problems**

1. The volume of gas in a soda can is 250 mL. The can is placed on a hot plate with a temperature of 100ºC and then transferred to an ice bath with a temperature of 5ºC
2. A gas occupies a volume of 60.0 ml at 36º C. What volume will this gas occupy at standard temperature if the pressure is constant?
3. A gas is heated to 50.0º C until it occupies a volume of 3.8 L. If the original temperature was 35.0 ºC, what was the original volume?

**Boyle’s/Charles Law Practice Problems**

1. A sample of hydrogen at 1.5 atm had its pressure decrease to 0.5 atm producing a new volume of 750 mL. What was its original volume?
2. A gas is heated to 150.0º C until it occupies a volume of 12.8 L. If the original temperature was 85.0 ºC, what was the original volume?
3. Ammonia gas occupies a volume of 450 ml at a pressure of 720 mmHg. What volume would it occupy at the pressure, 760 mm Hg?
4. A 2.0-liter container of nitrogen had a pressure of 3.2 atm. What volume would be necessary to decrease the pressure to 1.0 atm?
5. What temperature is needed to change 39 mL of a dry gas at the temperature, 273 K to 35 mL?

6. A gas has a volume of 300 mL at 0ºC. What happens to the volume if the temperature increases to 100 º C?

1. oA fixed amount of helium gas is compressed from 4 L to 2.5 L at a constant temperature. If the pressure of a gas in the 4.0 L volume is 210 kPa, what will the pressure be at 2.5 L?
2. The pressure of a fixed amount of gas in a tank is 3.20 atm at 22.0 ºC. If the temperature rises to 60 ºC, what is the new gas pressure in the tank if the volume is constant?
3. A fixed mass of gas at 40ºC occupies a volume of 2.32 L. If the temperature is raised to 75ºC, what is the new volume if the pressure remains constant?
4. A gas at 110 kPa and 30C fills a flexible container with an initial volume of 2 L. If the temperature is raised to 80ºC, and the pressure is increased to 440 kPa, what is the new volume?
5. The volume of a sample of gas is 200 mL at 275 K and 92.1 kPa. What is the temperature of the gas if the volume increases to 450 mL and the pressure increases to 98.5 kPa?

**Gay-Lussac’s Law**

What is the definition of Gay-Lussac’s Law?

What is the equation for Gay-Lussac’s Law?

In words this means…..

**Practice Problems**

1. The temperature of 200.0 mL of a gas originally at STP is changed to -25°C at constant volume. Calculate the pressure of the gas in atm.
2. Oxygen is stored at a temperature of 20.0º C in a university lab. The initial pressure of the gas is 0.85 atm. If the gas is transferred to a lab with a temperature of 35º C, what will be the new pressure of the gas?
3. A gas has a pressure of 85.0 mm Hg at 6870 K. What is the new pressure at 300.0 K if volume is constant?

**Combined Gas Law**

What is the definition of the Combined Gas Law?

What is the equation for the Combined Gas Law?

What must be the same for pressure and volume?

**Practice Problems**

1. A quantity of helium occupies a volume of 16.5 L at 78 C and 45.6 atm. What is the new volume at STP?

1. A pocket of gas is discovered in a drilling operation. The temperature of the gas is 480 ºC and its pressure is 12.8 atm. At the surface, the same gas has a volume of l8.0 L at 22 ºC and l.00 atm. How large was the pocket of gas?
2. A gas has a volume of 240.0mL at 45.0°C and 700.0 mmHg. Calculate its volume at STP.

**Gay-Lusscas/Combined Homework**

# Gay-Lussac’s Law

1. A sample of gas has a pressure of 100.0 torr and a temperature of 27.00C. Calculate the

pressure if the temperature is changed to 127.0C while the volume remains constant.

2. The temperature of 2.0 L of a gas originally at STP is changed to -25C at constant volume. Calculate the pressure of the gas in atm.

3. A gas occupies a volume of 5.00 L at 27C and 630 mm Hg. At what temperature would the pressure be 760 mm Hg if the volume remains constant?

4. The pressure of a tank of gas is 2.0 atm and the temperature is 40°C. If the volume remains constant, what will the new pressure be if the temperature is lowered to 20°C?

# Combined Gas Law

1. A certain gas occupies a volume of 5.55 L at STP. What would its volume be at 27C and 12 atm?

2. A 0.280 L sample of neon exerts a pressure of 660.0 torr at 26.0C. At what temperature, C, would it exert a pressure of 940.0 torr in a volume of 0.440 L?

3. A certain gas has a volume of 0.500 L at 77C and 6.00 atm. Calculate the new temperature if the volume decreased to 0.400 L an the pressure is increased to 1.00 atm.

4. A gas has a volume of 0.240 L at 25C and 600.0 mmHg. Calculate its volume at STP.

**Ideal Gas Law**

What is the definition for the Ideal Gas Law?

What does n stand for?

What does R stand for?

List the different values of R.

**Practice Problems**

1. What is the volume in liters of 0.250 mol of oxygen gas at 20.0 ºC and 0.974 atm?
2. What is the temperature of 1.67 moles of helium gas at a pressure of 760 mm Hg that occupies a 1.00 L container?
3. How many moles of argon gas occupies a 4.23 L container at a temperature of 27º C and a pressure of 742 mm Hg?

**Ideal Gas Homework**

1. What is the volume in liters of 0.250 mol of oxygen gas at 20.0 C and 0.974 atm?
2. How many moles of oxygen will occupy a volume of 2.50 L at 1.20 atm and 25.0°C?
3. What volume will 2.00 moles of nitrogen occupy at 720. mm Hg at 20.0°C?
4. How many moles of nitrogen gas will occupy a volume of 3.47 L at 6680 mm Hg and 27.0°C?
5. At what temperature (in °C) will 5.00 g of chlorine gas exert a pressure of 900. mm Hg at a volume of 750 mL?

**Review**

1. What happens to the pressure when you raise the temperature inside a closed container?
2. What does the constant collision of gas molecules against the inside walls of a container produce?
3. What instrument measures atmospheric pressure?
4. What is STP?
5. List the parts of PV=nRT
6. Explain diffusion of a gas.
7. At constant temperature, pressure and volume are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ related. (inversely / directly)
   1. How about pressure and temperature?
   2. How about temperature and volume?
8. Name three ways the pressure of a gas can be decreased using the gas laws.
9. A teacher inserts a balloon into a container of liquid nitrogen. The balloon initially has a volume of 8.0 L and a temperature of 21.5⁰C. If pressure stays constant, what will the volume of the balloon be after it cools to a temperature of -100⁰C?
10. A gas occupies a volume of 1.0 L at 1.0 atm of pressure. What is the pressure when the gas expands to fill 5.0 L?
11. On a cold winter morning when the temperature is -13⁰C, the air pressure in an automobile tire is 3.0 atm. If the volume does not change, what is the pressure after the tire has warmed to 18⁰C?
12. A 12 L balloon at 2.0 atm and 30 ⁰C rises to an elevation where the pressure is 0.92 atm and the temperature is 9.5 ⁰C. What is the new volume of the balloon?
13. A 245 L sample of 2.0 moles of gas is at a pressure of 2.14 atm and a temperature of 156 ⁰C. What volume does the same sample occupy when the temperature is decreased to 98 ⁰C and 0.86 atm and the amount of gas has decreased to 1.5 moles?
14. One day a chemist collected 25.7 mL of a gas when the temperature was 28 ⁰C and the pressure was 105.5 kPa. The next day the pressure increased to 109.6 kPa, but the volume of the gas had decreased to 15.3 mL. Find the new temperature of the gas.
15. How many moles of nitrogen gas will occupy a volume of 0.15 L at 6680 mmHg and 37.0⁰C?
16. What is the pressure in atmospheres exerted by a 0.7 mole sample of nitrogen in a 10.0 L container at 2.0⁰C?