ChemQuest 48

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Gases and Moles

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Hour: \_\_\_\_\_

### **Information: The Gas Constant**



We previously examined the fact that is a constant as long as the number of moles of a gas remains unchanged.

This means that any time you measure a gas, the pressure times the volume divided by the temperature (in Kelvin) will always equal the same number unless the amount of gas in the container changes. We are now going to explore how the pressure, volume and temperature depend on the number of moles of gas that are present.

## Table 1: Experimental Data for Three Different Samples of Gas That Contain the Same Amount of Gas (# of moles of gas is constant)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Gas** | **# of moles of Gas in container (mol)** | **Volume of Container (L)** | **Temperature of Gas (K)** | **Pressure of Gas (kPa)** |
| A | 0.3008 | 14.0 | 672.0 | 120.0 |
| B | 0.3008 | 16.0 | 1280 | 200.0 |
| C | 0.3008 | 10.0 | 340.0 | 85.0 |

## Table 2: Experimental Data for Three Different Samples of Gases That Contain Different Amounts of Gas (# of moles of gas is not constant)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Gas** | **# of moles of Gas in container** | **Volume of Container (L)** | **Temperature of Gas (K)** | **Pressure of Gas (kPa)** |
| D | 3.3485 | 40.0 | 230.0 | 160.0 |
| E | 0.7306 | 22.5 | 315 | 85 |
| F | 0.85950 | 16.0 | 280 | 125 |

## **Critical Thinking Questions**



1. Prove that is a constant for the data in Table 1, but not a constant for the data in Table 2.

2. Why is a constant in Table 1, but not in Table 2?



1. is a constant for Table 1 and Table 2. (Note that “n” means **n**umber of moles of gas in the container.). Plug in values for P, V, n, and T to discover what the numerical value of the constant is.



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1. Hopefully you got a value of about 8.31 for the constant in question 3. This constant is given a special name, “The Ideal Gas Constant” and it has the symbol “R”. Therefore, we can write:



= R

If we rearranged the above expression, which one of the following equations would be true? (The equation is known as the “Ideal Gas Law”.)

A) PT = nRV B) PV = nRT C) TV = nRP

1. At 215 kPa of pressure and a temperature of 318 K, 2.35 mol of a gas has what volume? (Use the ideal gas law and the ideal gas constant, R, to calculate V. Your answer should be 28.9 L.)
2. What is the temperature of a gas if 4.11 mol of a gas has a pressure of 315 kPa and a volume of 12.5 L?
3. Consider 1.22 mol of CO2 gas is at a temperature of 45oC and a pressure of 125 kPa. What is the volume of the container? (Hint: change 45oC to Kelvin.)
4. How many moles of gas are there in a 2.45 L container that has a pressure of 101 kPa and a temperature of 30oC?
5. What is the pressure inside of a 15.75 L container if there are 3.4 moles of gas and the temperature of the gas was 300 K?

**Review Questions**

1. Consider a sample of gas at a temperature of 65oC and a pressure of 125 kPa is in a 3.5 L container. If the container expands to 20 L and the temperature decreases to 20oC, what is the new pressure of the gas?
2. Assume that a 18.5 L container of a certain gas has a pressure of 170 kPa. To what volume would the gas need to be compressed in order to have a pressure of 650 kPa?
3. If I have 35.0 L of gas at room temperature (22.5oC) and I compress it so that the final volume is 12.0 L, what is the final temperature of the gas if the pressure is constant?
4. Gas at a temperature of 55oC and a pressure of 125 kPa is in a 4.5 L container. If the container expands to 20 L and the temperature decreases to 25oC, what is the pressure of the gas?
5. A gas is initially at a pressure of 85 kPa and a temperature of 260 K in a container that is 4.5 L. If the gas is compressed to a volume of 2.6 L and the temperature changes to 425 K, what is the new pressure?