

## Dougherty Valley HS Chemistry

Gay-Lussac's Law, Combined Gas Law,  
and Ideal Gas Law

Name:

Date:

Period:

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Gay-Lussac's Law, the Combined Gas Law, and the Ideal Gas Law are the remaining three gas laws we are going to use.

Use them just like Boyle's Law or Charles' Law.

- Read the entire problem
- Write down what the variables are (are we dealing with temp, or volume, or pressure, etc?)
- Pick the equation that has those variables in them.
- Plug the numbers into the equation and solve for the unknown value.

P = pressure

V = volume

T = temperature

n = # of moles

R = the ideal gas constant =  $8.31 \frac{\text{L} \cdot \text{kPa}}{\text{K} \cdot \text{mol}}$  ← (those are the units. The dot is just a multiplication sign)

### Gay-Lussac's Law

$$\frac{P_1}{T_1} = \frac{P_2}{T_2} \quad \text{Pressure increases as temperature increases. Directly proportional.}$$

### Combined Gas Law

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

### Ideal Gas Law

$$PV = nRT \quad * \text{ Make sure to convert your pressure to kPa, volume to Liters, and temperature to Kelvin!}$$

If you don't do this then your units in your ideal gas constant (R) won't cancel out right and you won't get the right answer!!

### Practice Problems

Answer the following problems.

SHOW YOUR WORK!

Don't forget to **convert all temperatures to Kelvins** before you start the calculations!

PUT A BOX AROUND YOUR FINAL ANSWER!

### Gay-Lussac's Law Problems:

1) At 120 °C, the pressure of a sample of nitrogen is 1.07 atm. What will the pressure be at 205 °C?

2) A sample of oxygen gas is at 27 °C and 1.00 atm. What will the pressure be at -70 °C?

3) A sample of gas is at  $-73\text{ }^{\circ}\text{C}$  and  $1.4\text{ atm}$ . What will the final temperature be if the pressure is doubled?

### Combined Gas Law

4) The volume of a gas-filled balloon is  $30.0\text{ L}$  at  $313\text{ K}$  and  $153\text{ kPa}$ . What would the volume be at  $273\text{ K}$  and  $101.3\text{ kPa}$ ? ( $273\text{ K}$  and  $101.3\text{ kPa}$  is called "standard temperature and pressure" which is usually abbreviated as STP)

5) A gas at  $155\text{ kPa}$  and  $25^{\circ}\text{C}$  has an initial volume of  $1.00\text{ L}$ . The pressure of the gas increases to  $605\text{ kPa}$  as the temperature is raised to  $125\text{ }^{\circ}\text{C}$ . What is the new volume?

6) A  $5.00\text{ L}$  air sample has a pressure of  $107\text{ kPa}$  at a temperature of  $-50\text{ }^{\circ}\text{C}$ . If the temperature is raised to  $102\text{ }^{\circ}\text{C}$  and the volume expands to  $7.00\text{ L}$ , what will the new pressure be?

**Ideal Gas Law Problems:** don't forget to use the ideal gas constant ( $R$ ) !

7) Determine the volume occupied by  $0.582\text{ mol}$  of a gas at  $15\text{ }^{\circ}\text{C}$  if the pressure is  $81.8\text{ kPa}$ .

8) What pressure is exerted by  $0.450\text{ mol}$  of a gas at  $25\text{ }^{\circ}\text{C}$  if the gas is in a  $0.650\text{ L}$  container?

9) A  $1.5\text{ L}$  flask contains  $5\text{ moles}$  of a gas at  $27\text{ }^{\circ}\text{C}$ . What is the pressure of the gas?

**Mixed Gas Law Problems:**

These problems require you to use either Boyle's Law, Charles' Law, Gay-Lussac's Law, the Combined Gas Law, or the Ideal Gas Law. Write down the name of the gas law you need to use for each problem and then solve the problem.

10) A gas occupies 30.5 L at 1 atm. At what pressure will the gas occupy at 45.9 L? Temperature is held constant.

Name of Gas Law Used: \_\_\_\_\_

11) At 84 °C a gas in a container exerts a pressure of 0.503 atm. Assuming the size of the container has not changed, at what temperature would the pressure be 1.20 atm?

Name of Gas Law Used: \_\_\_\_\_

12) A 14.2 L sample of gas is at 42 °C. What temperature will the gas exert if its volume is reduced to 8.53 L?

Name of Gas Law Used: \_\_\_\_\_

13) When the temperature of a rigid hollow sphere containing 658 L of helium gas is held at 621 K, the pressure of the gas is  $1.89 \times 10^3$  kPa. How many moles of helium does the sphere contain?

Name of Gas Law Used: \_\_\_\_\_

14) A given mass of air is at 37 °C, has a volume of 6.00 L, and is at 101 kPa. What volume will the gas occupy if you increase the pressure to 162 kPa, and the temperature to 50°C?

Name of Gas Law Used: \_\_\_\_\_

15) A child's lungs can hold 2.20 L. How many moles of air do her lungs hold at a pressure of 102 kPa and a body temperature of 37 °C?

Name of Gas Law Used: \_\_\_\_\_