Gas Laws III – The Combined Gas Law Name_____

The Combined Gas Law is a combination of both Boyle's Law and Charles's Law. Boyle's Law ($P_1V_1 = P_2V_2$) uses only pressure and volume with temperature held constant, while Charles's Law ($\frac{V_1}{T_1} = \frac{V_2}{T_2}$) uses only volume and temperature at a constant pressure. The combined gas law merges the two formulas into one equation. Like when we used pressure and volume in Boyle's and Charles's law you can use any units as long as both sides match, but when you use a temperature, you must use Kelvin as your temperature unit. The Equation for the combined gas law is below.

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

Solve the following problems and show all your work: 1) identify the variables, 2) Write the formula, 3) Plug in what you know and solve. Report your answer with the correct units. Since the answers are provided, no credit will be given if you do not show your work as instructed.

1. If I initially have a gas at a pressure of 12 atm, a volume of 23 liters, and a temperature of 200 K, and then I raise the pressure to 14 atm and increase the temperature to 300 K, what is the new volume of the gas? (Answer: 29.6 L)

2. A gas takes up a volume of 17 liters, has a pressure of 2.3 atm, and a temperature of 299 K. If I raise the temperature to 350 K and lower the pressure to 1.5 atm, what is the new volume of the gas? (Answer: 30.5 L)

3. A gas that has a volume of 28 liters, a temperature of 45 ^{0}C, and an unknown pressure has its volume increased to 34 liters and its temperature decreased to 35 ^{0}C. If I measure the pressure after the change to be 2.0 atm, what was the original pressure of the gas? (Answer: 2.51 atm)

4. A gas has a temperature of 14 ^{0}C, and a volume of 4.5 liters. If the temperature is raised to 29 ^{0}C and the pressure is not changed, what is the new volume of the gas? (Answer: 4.74 L)

5. If I have 17 liters of gas at a temperature of 67 ^{0}C and a pressure of 88.89 atm, what will be the pressure of the gas if I raise the temperature to 94 ^{0}C and decrease the volume to 12 liters? (Answer: 136 atm)

6. I have an unknown volume of gas at a pressure of 0.5 atm and a temperature of 325 K. If I raise the pressure to 1.2 atm, decrease the temperature to 320 K, and measure the final volume to be 48 liters, what was the initial volume of the gas? (Answer: 117 L)

7. If I have 21 liters of gas held at a pressure of 78 atm and a temperature of 900 K, what will be the volume of the gas if I decrease the pressure to 45 atm and decrease the temperature to 750 K? (Answer: 30.3 L)

8. If I have 2.9 L of gas at a pressure of 5 atm and a temperature of 50 ^{0}C, what will be the temperature of the gas if I decrease the volume of the gas to 2.4 L and decrease the pressure to 3 atm? (Answer: 160 K)

9. I have an unknown volume of gas held at a temperature of 115 K in a container with a pressure of 60 atm. If by increasing the temperature to 225 K and decreasing the pressure to 30 atm causes the volume of the gas to be 29 liters, how many liters of gas did I start with? (Answer: 7.41 L)

10. A toy balloon has an internal pressure of 1.05 atm and a volume of 5.0 L. If the temperature where the balloon is released is 20^0 C, what will happen to the volume when the balloon rises to an altitude where the pressure is 0.65 atm and the temperature is –15^0 C? (Answer: 7.11 L)