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

Key

Combined Gas Law Problems

Use the combined gas law to solve the following problems:

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?

$$V_2 = \frac{P_1V_1T_2}{T_1P_2} = \frac{(12\,atm)(23L)(300K)}{(200K)(14\,atm)} = 29.57\,L$$

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?

$$V_2 = \frac{P_1V_1T_2}{T_1P_2} = \frac{(2.3\,atm)(17L)(350K)}{(299K)(1.5\,atm)} = 30.5\,L$$

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?

$$P_1 = \frac{P_2V_2T_1}{T_2V_1} = \frac{(2\,atm)(34L)(318K)}{(308K)(28L)} = 2.51\,atm$$

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?

$$V_2 = \frac{P_1V_1T_2}{T_1P_2} = \frac{(4.5L)(302K)}{287K} = 4.74L$$

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?

$V_1 = 17L \quad V_2 = 12L$
$P_1 = 88.89 atm \quad P_2 = ?$
$T_1 = 340K \quad T_2 = 367K$

$$P_2 = \frac{P_1 V_1 T_2}{T_1 V_2} = \frac{(88.89 atm)(17L)(367K)}{(340K)(12L)} = 135.93 atm$$

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?

$$V_1 = \frac{P_2 V_2 T_1}{T_2 P_1} = \frac{(1.2 atm)(48L)(325K)}{(320K)(0.5 atm)} = 117L$$

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?

$$V_2 = \frac{P_1 V_1 T_2}{T_1 P_2} = \frac{(78 atm)(21L)(750K)}{(900K)(45 atm)} = 30.33L$$

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?

$$T_2 = \frac{P_2 V_2 T_1}{P_1 V_1} = \frac{(2.4L)(3 atm)(323K)}{(5 atm)(2.9L)} = 160.41K$$

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?

$$V_1 = \frac{P_2 V_2 T_1}{T_2 P_1} = \frac{(30 atm)(29L)(115K)}{(225K)(60 atm)} = 7.41L$$