☆ Use 3 s.d.

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Combined Gas Law Problems

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

Use the combined gas law to solve the following problems:

1) If I initially have a gas at a pressure of 12 (P_1) atm, a volume of 23 (V_1) liters, and a temperature of 200 (T_1) K, and then I raise the pressure to 14 (P_2) atm and increase the temperature to 300 (T_2) K, what is the new volume of the gas? (V_2)

$$\frac{(12\text{ atm})(23\text{ L})}{200\text{ K}} = \frac{(14\text{ atm})(V_2)}{300\text{ K}}$$

$V_2 = 29.6\text{ L}$

2) A gas takes up a volume of 17 (V_1) liters, has a pressure of 2.3 (P_1) atm, and a temperature of 299 K (T_1). If I raise the temperature to 350 (T_2) K and lower the pressure to 1.5 atm, what is the new volume of the gas? (P_2, V_2)

$$\frac{(2.3\text{ atm})(17\text{ L})}{299\text{ K}} = \frac{(1.5\text{ atm})(V_2)}{350\text{ K}}$$

$V_2 = 30.5\text{ L}$

3) A gas that has a volume of 28 (V_1) liters, a temperature of 45 (T_1) °C, and an unknown pressure (P_1) has its volume increased to 34 (V_2) liters and its temperature decreased to 35 (T_2) °C. If I measure the pressure after the change to be 2.0 atm, what was the original pressure of the gas? (P_2)

$T_1 = 45°C + 273.15 = 318.15\text{ K}$

$T_2 = 35°C + 273.15 = 308.15\text{ K}$

$$\frac{(P_1)(28\text{ L})}{318.15\text{ K}} = \frac{(2.0\text{ atm})(34\text{ L})}{308.15\text{ K}}$$

$P_1 = 2.51\text{ atm}$

4) A gas has a temperature of 14 (T_1) °C, and a volume of 4.5 (V_1) liters. If the temperature is raised to 29 (T_2) °C and the pressure is not changed, what is the new volume of the gas? (V_2)

$T_1 = 14°C + 273.15 = 287.15\text{ K}$

$T_2 = 29°C + 273.15 = 302.15$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \qquad \frac{4.5\text{ L}}{287.15\text{ K}} = \frac{V_2}{302.15\text{ K}}$$

$V_2 = 4.74\text{ L}$

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

5) If I have 17 liters of gas at a temperature of 67 °C and a pressure of 88.89 atm, what will be the pressure of the gas if I raise the temperature to 94 °C and decrease the volume to 12 liters?

$T_1 = 67°C + 273.15 = 340.15K$

$T_2 = 94°C + 273.15 = 367.15K$

$$\frac{(88.89atm)(17L)}{340.15K} = \frac{(P_2)(12L)}{367.15K}$$

$$\boxed{P_2 = 136\ atm}$$

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?

$$\frac{(0.5atm)(V_1)}{325K} = \frac{(1.2atm)(48L)}{320K}$$

$$\boxed{V_1 = 117\ L}$$

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?

$$\frac{(78atm)(21L)}{900K} = \frac{(45atm)(V_2)}{750K}$$

$$\boxed{V_2 = 30.3\ L}$$

8) If I have 2.9 L of gas at a pressure of 5 atm and a temperature of 50 °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?

$T_1 = 50°C + 273.15 = 323.15K$

$T_2 = ?$

$$\frac{(5atm)(2.9L)}{323.15K} = \frac{(3atm)(2.4L)}{T_2}$$

$$\boxed{T_2 = 160\ K}$$

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?

$$\frac{(60atm)(V_1)}{115K} = \frac{(30atm)(29L)}{225K}$$

$$\boxed{V_1 = 7.41\ L}$$