

## Mixed Gas Laws Worksheet

- 1) How many moles of gas occupy 98 L at a pressure of 2.8 atmospheres and a temperature of 292 K?
- 2) If 5.0 moles of  $O_2$  and 3.0 moles of  $N_2$  are placed in a 30.0 L tank at a temperature of  $25^{\circ}C$ , what will the pressure of the resulting mixture of gases be?
- 3) A balloon is filled with 35.0 L of helium in the morning when the temperature is  $20.0^{\circ}C$ . By noon the temperature has risen to  $45.0^{\circ}C$ . What is the new volume of the balloon?
- 4) A 35 L tank of oxygen is at 315 K with an internal pressure of 190 atmospheres. How many moles of gas does the tank contain?

- 5) A balloon that can hold 85 L of air is inflated with 3.5 moles of gas at a pressure of 1.0 atmosphere. What is the temperature in  $^{\circ}\text{C}$  of the balloon?
- 6)  $\text{CaCO}_3$  decomposes at  $1200^{\circ}\text{C}$  to form  $\text{CO}_2$  gas and  $\text{CaO}$ . If 25 L of  $\text{CO}_2$  are collected at  $1200^{\circ}\text{C}$ , what will the volume of this gas be after it cools to  $25^{\circ}\text{C}$ ?
- 7) A helium balloon with an internal pressure of 1.00 atm and a volume of 4.50 L at  $20.0^{\circ}\text{C}$  is released. What volume will the balloon occupy at an altitude where the pressure is 0.600 atm and the temperature is  $-20.0^{\circ}\text{C}$ ?
- 8) There are 135 L of gas in a container at a temperature of  $260^{\circ}\text{C}$ . If the gas was cooled until the volume decreased to 75 L, what would the temperature of the gas be?

- 9) A 75 L container holds 62 moles of gas at a temperature of  $215^{\circ}\text{C}$ . What is the pressure in atmospheres inside the container?
- 10) 6.0 L of gas in a piston at a pressure of 1.0 atm are compressed until the volume is 3.5 L. What is the new pressure inside the piston?
- 11) A gas canister can tolerate internal pressures up to 210 atmospheres. If a 2.0 L canister holding 3.5 moles of gas is heated to  $1350^{\circ}\text{C}$ , will the canister explode?
- 12) The initial volume of a gas at a pressure of 3.2 atm is 2.9 L. What will the volume be if the pressure is increased to 4.0 atm?

- 13) An airtight container with a volume of  $4.25 \times 10^4$  L, an internal pressure of 1.00 atm, and an internal temperature of  $15.0^\circ$  C is washed off the deck of a ship and sinks to a depth where the pressure is 175 atm and the temperature is  $3.00^\circ$  C. What will the volume of the gas inside be when the container breaks under the pressure at this depth?
- 14) Two flasks are connected with a stopcock. Flask #1 has a volume of 2.5 L and contains oxygen gas at a pressure of 0.70 atm. Flask #2 has a volume of 3.8 L and contains hydrogen gas at a pressure of 1.25 atm. When the stopcock between the two flasks is opened and the gases are allowed to mix, what will the resulting pressure of the gas mixture be?
- 15) A weather balloon has a volume of 35 L at sea level (1.0 atm). After the balloon is released it rises to where the air pressure is 0.75 atm. What will the new volume of the weather balloon be?

## Mixed Gas Laws Worksheet - Solutions

- 1) How many moles of gas occupy 98 L at a pressure of 2.8 atmospheres and a temperature of 292 K?

$$n = \frac{PV}{RT} = \frac{(2.8 \text{ atm})(98 \text{ L})}{(0.0821 \text{ L}\cdot\text{atm}/\text{mol}\cdot\text{K})(292 \text{ K})} = 11 \text{ moles of gas}$$

- 2) If 5.0 moles of O<sub>2</sub> and 3.0 moles of N<sub>2</sub> are placed in a 30.0 L tank at a temperature of 25<sup>o</sup> C, what will the pressure of the resulting mixture of gases be? 25<sup>o</sup> C = 298 K

$$\text{O}_2: P = \frac{nRT}{V} = \frac{(5.0 \text{ mol})(0.0821 \text{ L}\cdot\text{atm}/\text{mol}\cdot\text{K})(298 \text{ K})}{(30.0 \text{ L})} = 4.1 \text{ atm}$$

$$\text{N}_2: P = \frac{nRT}{V} = \frac{(3.0 \text{ mol})(0.0821 \text{ L}\cdot\text{atm}/\text{mol}\cdot\text{K})(298 \text{ K})}{(30.0 \text{ L})} = 2.4 \text{ atm}$$

$$P_{\text{Tot}} = P_{\text{O}_2} + P_{\text{N}_2} = 4.1 \text{ atm} + 2.4 \text{ atm} = 6.5 \text{ atm}$$

- 3) A balloon is filled with 35.0 L of helium in the morning when the temperature is 20.0<sup>o</sup> C. By noon the temperature has risen to 45.0<sup>o</sup> C. What is the new volume of the balloon?

$$T_1 = 20.0^{\circ} \text{ C} = 293 \text{ K}, V_1 = 35.0 \text{ L}, T_2 = 45.0^{\circ} \text{ C} = 318 \text{ K}, V_2 = ?$$

$$V_2 = \frac{V_1 T_2}{T_1} = \frac{(35.0 \text{ L})(318 \text{ K})}{(293 \text{ K})} = 38.0 \text{ L}$$

- 4) A 35 L tank of oxygen is at 315 K with an internal pressure of 190 atmospheres. How many moles of gas does the tank contain?

$$n = \frac{PV}{RT} = \frac{(190 \text{ atm})(35 \text{ L})}{(0.0821 \text{ L}\cdot\text{atm}/\text{mol}\cdot\text{K})(315 \text{ K})} = 260 \text{ moles of gas}$$

- 5) A balloon that can hold 85 L of air is inflated with 3.5 moles of gas at a pressure of 1.0 atmosphere. What is the temperature in <sup>o</sup>C of the balloon?

$$T = \frac{PV}{nR} = \frac{(1 \text{ atm})(85 \text{ L})}{(3.5 \text{ mol})(0.0821 \text{ L}\cdot\text{atm}/\text{mol}\cdot\text{K})} = 296 \text{ K} = 23^{\circ} \text{ C}$$

- 6) CaCO<sub>3</sub> decomposes at 1200<sup>o</sup> C to form CO<sub>2</sub> gas and CaO. If 25 L of CO<sub>2</sub> are collected at 1200<sup>o</sup> C, what will the volume of this gas be after it cools to 25<sup>o</sup> C?

$$T_1 = 1200^{\circ} \text{ C} = 1473 \text{ K}, V_1 = 25 \text{ L}, T_2 = 25^{\circ} \text{ C} = 298 \text{ K}, V_2 = ?$$

$$V_2 = \frac{V_1 T_2}{T_1} = \frac{(25 \text{ L})(298 \text{ K})}{(1473 \text{ K})} = 5.1 \text{ L}$$

- 7) A helium balloon with an internal pressure of 1.00 atm and a volume of 4.50 L at 20.0<sup>o</sup> C is released. What volume will the balloon occupy at an altitude where the pressure is 0.600 atm and the temperature is -20.0<sup>o</sup> C?

$$P_1 = 1.00 \text{ atm}, V_1 = 4.50 \text{ L}, T_1 = 20.0^{\circ} \text{ C} = 293 \text{ K}, P_2 = 0.600 \text{ atm}, V_2 = ?, T_2 = -20.0^{\circ} \text{ C} = 253 \text{ K}$$

$$V_2 = \frac{P_1 V_1 T_2}{T_1 P_2} = \frac{(1.00 \text{ atm})(4.50 \text{ L})(253 \text{ K})}{(293 \text{ K})(0.600 \text{ atm})} = 6.48 \text{ L}$$

- 8) There are 135 L of gas in a container at a temperature of 260<sup>o</sup> C. If the gas was cooled until the volume decreased to 75 L, what would the temperature of the gas be?

$$T_1 = 260^{\circ} \text{ C} = 533 \text{ K}, V_1 = 135 \text{ L}, T_2 = ?, V_2 = 75 \text{ L}$$

$$T_2 = \frac{V_2 T_1}{V_1} = \frac{(75 \text{ L})(533 \text{ K})}{(135 \text{ L})} = 296 \text{ K} = 23^{\circ} \text{ C}$$

- 9) A 75 L container holds 62 moles of gas at a temperature of 215<sup>0</sup> C. What is the pressure in atmospheres inside the container? **215<sup>0</sup> C = 488 K**
- $$P = \frac{nRT}{V} = \frac{(62 \text{ mol})(0.0821 \text{ L}\cdot\text{atm}/\text{mol}\cdot\text{K})(488 \text{ K})}{(75 \text{ L})} = 33 \text{ atm}$$
- 10) 6.0 L of gas in a piston at a pressure of 1.0 atm are compressed until the volume is 3.5 L. What is the new pressure inside the piston?
- P<sub>1</sub> = 1.0 atm, V<sub>1</sub> = 6.0 L, P<sub>2</sub> = ?, V<sub>2</sub> = 3.5 L**
- $$P_2 = \frac{P_1 V_1}{V_2} = \frac{(1.0 \text{ atm})(6.0 \text{ L})}{(3.5 \text{ L})} = 1.7 \text{ atm}$$
- 11) A gas canister can tolerate internal pressures up to 210 atmospheres. If a 2.0 L canister holding 3.5 moles of gas is heated to 1350<sup>0</sup> C, will the canister explode? **1350<sup>0</sup> C = 1623 K**
- $$P = \frac{nRT}{V} = \frac{(3.5 \text{ mol})(0.0821 \text{ L}\cdot\text{atm}/\text{mol}\cdot\text{K})(1623 \text{ K})}{(2.0 \text{ L})} = 230 \text{ atm}$$
- Yes, the canister will explode.**
- 12) The initial volume of a gas at a pressure of 3.2 atm is 2.9 L. What will the volume be if the pressure is increased to 4.0 atm?
- P<sub>1</sub> = 3.2 atm, V<sub>1</sub> = 2.9 L, P<sub>2</sub> = 4.0 atm, V<sub>2</sub> = ?**
- $$V_2 = \frac{P_1 V_1}{P_2} = \frac{(3.2 \text{ atm})(2.9 \text{ L})}{(4.0 \text{ atm})} = 2.3 \text{ L}$$
- 13) An airtight container with a volume of 4.25 x 10<sup>4</sup> L, an internal pressure of 1.00 atm, and an internal temperature of 15.0<sup>0</sup> C is washed off the deck of a ship and sinks to a depth where the pressure is 175 atm and the temperature is 3.00<sup>0</sup> C. What will the volume of the gas inside be when the container breaks under the pressure at this depth?
- P<sub>1</sub> = 1.00 atm, V<sub>1</sub> = 4.25 x 10<sup>4</sup> L, T<sub>1</sub> = 15.0<sup>0</sup> C = 288 K, P<sub>2</sub> = 175 atm, V<sub>2</sub> = ?, T<sub>2</sub> = 3.00<sup>0</sup> C = 276 K**
- $$V_2 = \frac{P_1 V_1 T_2}{T_1 P_2} = \frac{(1.00 \text{ atm})(4.25 \times 10^4 \text{ L})(276 \text{ K})}{(288 \text{ K})(175 \text{ atm})} = 233 \text{ L}$$
- 14) Two flasks are connected with a stopcock. Flask #1 has a volume of 2.5 L and contains oxygen gas at a pressure of 0.70 atm. Flask #2 has a volume of 3.8 L and contains hydrogen gas at a pressure of 1.25 atm. When the stopcock between the two flasks is opened and the gases are allowed to mix, what will the resulting pressure of the gas mixture be? (**P' & V' are initial conditions before mixing**)
- P'<sub>O2</sub> = 0.70 atm, P'<sub>H2</sub> = 1.25 atm, V'<sub>O2</sub> = 2.5 L, V'<sub>H2</sub> = 3.8 L, V = 6.3 L**
- O<sub>2</sub>: P<sub>2</sub> =  $\frac{P'_{O2} V'_{O2}}{V} = \frac{(0.70 \text{ atm})(2.5 \text{ L})}{(6.3 \text{ L})} = 0.28 \text{ atm}$**
- H<sub>2</sub>: P<sub>2</sub> =  $\frac{P'_{H2} V'_{H2}}{V} = \frac{(1.25 \text{ atm})(3.8 \text{ L})}{(6.3 \text{ L})} = 0.75 \text{ atm}$**
- P<sub>Tot</sub> = P<sub>O2</sub> + P<sub>H2</sub> = 0.28 atm + 0.75 atm = 1.0 atm**
- 15) A weather balloon has a volume of 35 L at sea level (1.0 atm). After the balloon is released it rises to where the air pressure is 0.75 atm. What will the new volume of the weather balloon be?
- P<sub>1</sub> = 1.0 atm, V<sub>1</sub> = 35 L, P<sub>2</sub> = 0.75 atm, V<sub>2</sub> = ?**
- $$V_2 = \frac{P_1 V_1}{P_2} = \frac{(1.0 \text{ atm})(35 \text{ L})}{(0.75 \text{ atm})} = 47 \text{ L}$$