ANSWER KEY.

R = 0.08206 L·atm/(mol·K) = 62.36 L·torr/(mol·K). K = °C + 273. Show all work with units and correct significant figures.

1. A 4.00 L tank holds 0.500 mol of CH_4 gas at 35 °C. What is the pressure of the gas in atm?

T = 35 + 273 = 308 K
P = nRT/V = (0.500 mol)(0.08206 L·atm/(mol·K))(308 K) ÷ 4.00 L
P = 3.16 atm

2. What volume does 12.0 g of oxygen gas occupy at 745 torr and 22 °C?

Oxygen gas is O_2, 32.00 g/mol: n = 12.0 g ÷ 32.00 g/mol = 0.375 mol. T = 22 + 273 = 295 K
V = nRT/P = (0.375 mol)(62.36 L·torr/(mol·K))(295 K) ÷ 745 torr
V = 9.26 L

3. A 1.17 g sample of an unknown gas fills a 0.500 L flask at 27 °C and 0.812 atm.
(a) Calculate the molar mass of the gas.
(b) Is the gas Ar, SO_2, or Cl_2? Explain.

(a) T = 300 K. n = PV/RT = (0.812 atm)(0.500 L) ÷ [(0.08206 L·atm/(mol·K))(300 K)] = 0.01649 mol
M = 1.17 g ÷ 0.01649 mol = 70.9 g/mol
(b) Cl_2. Its molar mass is 70.90 g/mol (Ar is 39.95, SO_2 is 64.07).

4. A sealed, rigid steel can of helium is at 1.50 atm and 20 °C. It is left in a hot car and warms to 120 °C. What is the new pressure?

Rigid can: V and n constant, so $P_1/T_1 = P_2/T_2$. T_1 = 293 K, T_2 = 393 K
P_2 = 1.50 atm × (393 K ÷ 293 K) = 2.01 atm

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5. Use $P_1V_1/(n_1T_1) = P_2V_2/(n_2T_2)$ to predict each change. Give the factor and a one-sentence reason.

(a) The volume of a gas is cut in half at constant n and T. What happens to P?

(b) The moles of gas are tripled at constant P and T. What happens to V?

(c) The kelvin temperature is doubled and the volume is doubled at constant n. What happens to P?

(a) P doubles. P and V are inversely related, so half the space means twice as many wall collisions.

(b) V triples. V is directly proportional to n.

(c) P stays the same. Doubling T doubles P, but doubling V halves it: $P_2 = P_1 \times (2/2)$.

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6. A 10.0 L container at 25 °C holds 0.300 mol N_2, 0.100 mol O_2, and 0.0500 mol CO_2.

(a) What is the total pressure in atm?

(b) What is the mole fraction of O_2?

(c) What is the partial pressure of O_2?

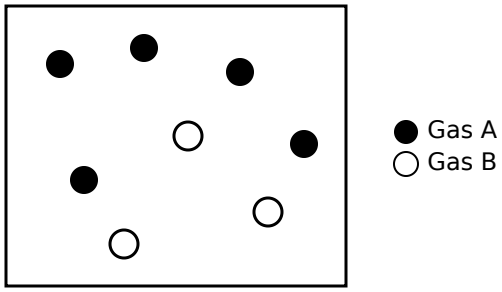
(a) n_{total} = 0.450 mol. P_{total} = (0.450 mol)(0.08206 L·atm/(mol·K))(298 K) ÷ 10.0 L = 1.10 atm

(b) X_{O2} = 0.100 mol ÷ 0.450 mol = 0.222

(c) P_{O2} = 0.222 × 1.10 atm = 0.244 atm

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7. The container below holds a mixture of Gas A and Gas B at a total pressure of 2.40 atm.



(a) What is the partial pressure of each gas?

(b) Four more particles of Gas B are added at constant volume and temperature. What is the new total pressure? Does the partial pressure of Gas A change? Explain.

(a) X_A = 5/8 = 0.625, so P_A = 0.625 × 2.40 atm = 1.50 atm. P_B = 3/8 × 2.40 atm = 0.900 atm

(b) 12 particles instead of 8: P_{total} = 2.40 atm × 12/8 = 3.60 atm. P_A stays 1.50 atm, because each gas acts as if it were alone in the container. The number of A particles, V, and T did not change.

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