Assignment : Ideal and Combined Gas Law

Show all your work, formula, units and evaluate for significant figures in questions 1, 2 and 5.

1. Two identical gas bottles contain different gases under the same conditions of temperature and pressure. One contains 16 g of SO_2. What mass of He is contained in the other bottle? ① $n = 16g \times \frac{1 mol SO_2}{64.07g SO_2} = 0.2497 mol SO_2$ ② $n_{SO_2} = n_{He}$ ③ $m_{He} = 0.2497 mol \times \frac{4.00 g}{1 mol He}$ $= 1.0 g_{He}$

2. What is the molecular mass of a gas if 2.82 g of the gas occupies 3.16 L at STP? ① $PV = nRT$ $n = (101.3 kPa)(3.16 L) / (8.31 \frac{kPa \cdot L}{K mol})(273 K) = 0.1411 mol$ ② $mm = \frac{m}{n} = \frac{2.82g}{0.1411 mol} = 20.0 g/mol$ OR $2.00 \times 10^1 g/mol$

3. A sample of carbon tetrachloride vapour (CCl_4) was obtained at 95.2 kPa and a temperature of 125°C. ① $P mm = dRT$, $d = \frac{P mm}{RT}$

   Determine the density of that sample in g/L under the given conditions. ② $\frac{(95.2 kPa)(153.81 \frac{g}{mol})}{(8.31 \frac{kPa \cdot L}{K mol})(398 K)} = 4.43 \frac{g}{L}$

4. A balloon is filled with an ideal gas and the initial volume is recorded. Then, its temperature is doubled, pressure is tripled and gas is allowed to leak from the balloon until there are only ¼ of the number of moles remaining. How many times bigger or smaller is the original volume compared to the final volume. ① $T_2 = 2T_1$, $P_2 = 3P_1$, $n_2 = \frac{1}{4} n_1$, $\frac{P_1 V_1}{T_1 n_1} = \frac{P_2 V_2}{T_2 n_2}$ ② $\frac{P_1 V_1}{T_1 n_1} = \frac{3 P_1 V_2}{2 T_1 \frac{1}{4} n_1}$ $V_1 = \frac{3 V_2}{0.5}$ ③ $V_1 = 6 V_2$

5. Mark is given a sample of gas in the laboratory. He assumes that this gas behaves like an ideal gas. To test his assumption, he conducts an experiment and makes the following observations :

Number of moles of gas	2.0 mol
Volume of gas	10.0 L
Temperature	−73°C
Pressure	404 kPa

① $R = \frac{PV}{nT}$ ② $R = \frac{(404 kPa)(10.0 L)}{(2.0 mol)(200 K)}$ $R = 10 \frac{kPa \cdot L}{K \cdot mol}$

Given the above information, is his assumption correct?
Explain your answer.

6. Gas is stored in a reservoir which is 1000 L, at a pressure of 612 kPa and a temperature of 20°C. A stopcock connects the first reservoir that contains the gas, with the second reservoir, which is initially empty. The stopcock is then opened.

   At equilibrium (once the gas has distributed itself among the two reservoirs), the temperature of the gas remains at 20°C and the pressure in the two reservoirs is 204 kPa. What volume is the second reservoir?

① $\frac{P_1 V_1}{T_1 n_1} = \frac{P_2 V_2}{T_2 n_2}$ moles/Temp const. ② $(612 kPa)(1000 L) = 204 kPa V_2$ $V_2 = 3000 L$ ③ $3000 L - 1000 L = 2000 L$