CHM151 Quiz 5A 25 Pts Fall 2019 Name: Key

SHOW ALL WORK TO RECEIVE CREDIT.

$PV = nRT$ $\quad P_1V_1T_2 = P_2V_2T_1$ $\quad \frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ atomic masses: C 12.01, H 1.008, O 16.00, N 14.01

$R = 0.08206\ L\cdot atm\cdot K^{-1}\cdot mol^{-1} = 62.3656\ L\cdot$**torr**$\cdot K^{-1}\cdot mol^{-1}$

1. Hydrogen and oxygen gas are mixed in a 7.75 L flask at 65°C and contains 0.482 g of hydrogen and 4.98 g of oxygen. What is the partial pressure of oxygen in the flask?

Dalton's law of partial pressure $P_{H_2} + P_{O_2} = P_{total}$

$P_{O_2} = \frac{n_{O_2}RT}{V} = \frac{4.98\text{ g} \mid \text{mol} \mid 0.08206\text{ L·atm} \mid 338\text{ K}}{32.00\text{ g} \mid \text{mol·K} \mid 7.75\text{ L}}$

$P_{O_2} = 0.557$ atm or 423 torr

2. Calculate the density of carbon dioxide, $CO_2(g)$, at 100°C and 10.0 atm pressure ($R = 0.08206$ $L\cdot atm\cdot K^{-1}\cdot mol^{-1}$).

Density = g ÷ L so use 1 mole CO_2 = 44.01 g, Then solve for volume.

$V = \frac{nRT}{P} = \frac{1\text{ mol} \mid 0.08206\text{ L·atm} \mid 373\text{ K}}{\text{mol·K} \mid 10.0\text{ atm}}$

$V = 3.06$ L so density $= \frac{44.01\text{ g}}{3.06\text{ L}} = 14.4$ g/L

3. Determine the molar mass of Freon–11 gas if a sample weighing 0.597 g occupies 100 cm³ at 95°C, and 1000 mmHg ($R = 0.08206$ $L\cdot atm\cdot K^{-1}\cdot mol^{-1}$, 1 atm = 760 mmHg).

molar mass = g/mol, we have the grams, so solve for moles.

$n = \frac{PV}{RT} = \frac{1000\text{ torr} \mid 0.100\text{ L} \mid \text{mol·K}}{62.3656\text{ L·torr} \mid 368\text{ K}}$

$n = 0.00436$ mol $\quad$ molar mass $= \frac{0.597\text{ g}}{0.00436\text{ mol}} = 137$ g/mol

4. Calculate the volume occupied by 35.2 g of methane gas (CH_4) at 25°C and 1.0 atm ($R = 0.0821$ $L\cdot atm\cdot K^{-1}\cdot mol^{-1}$).

$\frac{35.2\text{ g } CH_4 \mid \text{mol}}{16.042\text{ g}} = 2.194$ mol CH_4

$V = \frac{nRT}{P}$

$V = \frac{2.194\text{ mol} \mid 0.0821\text{ L·atm} \mid 298\text{ K}}{\text{mol·K} \mid 1.0\text{ atm}} = 53.7$ L

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Key

5. Arrange the following gases in order of increasing rate of effusion. (List from slowest to fastest)
C_2H_6 Ar HCl PH_3

Ar > HCl > PH_3 > C_2H_6
39.95 36.45 34 30 (Largest to smallest)

6. A sample of carbon dioxide gas at 125°C and 248 torr occupies a volume of 275 L. What will the gas pressure, in torr, be if the volume is increased to 321 L at 125°C?

$P_1V_1T_2 = P_2V_2T_1$ T is constant

$$P_2 = \frac{P_1V_1T_2}{V_2T_1} = \frac{(248\text{ torr})(275\text{ L})}{(321\text{ L})} = 212\text{ torr}$$

7. What is the volume of NH_3 produced in the following reaction when 3.0 L of N_2 reacts with 4.0 L of H_2?

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$$
3.0 L 4.0 L ? L

Based on N_2: $\frac{3.0\text{ L }N_2 \mid 2\text{ L }NH_3}{\mid 1\text{ L }N_2} = 6.0\text{ L }NH_3$

Based on H_2: $\frac{4.0\text{ L }H_2 \mid 2\text{ L }NH_3}{\mid 3\text{ L }H_2} = 2.67\text{ L }NH_3$

8. A sample of nitrogen gas is confined to a 14.0 L container at 375 torr and 37.0°C. How many moles of nitrogen are in the container (R = 0.08206 L·atm·K^{-1}·mol^{-1}, 1 atm = 760 torr)?

$$n = \frac{PV}{RT} = \left(\frac{375\text{ torr} \mid \text{atm}}{\mid 760\text{ torr}}\right)(14.0\text{ L})\left(\frac{\text{mol}\cdot\text{K}}{0.08206\text{ L}\cdot\text{atm}}\right)(310\text{ K})$$

$n = 0.272$ mol