

$$PV = nRT \quad P_1V_1T_2 = P_2V_2T_1 \quad \frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

atomic masses: C 12.01, H 1.008, O 16.00, N 14.01

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

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  $P_{H_2} + P_{O_2} = P_{\text{total}}$

$$P_{O_2} = \frac{n_{O_2}RT}{V} = \frac{(4.98 \text{ g}) \left( \frac{1 \text{ mol}}{32.00 \text{ g}} \right) (0.08206 \text{ L}\cdot\text{atm}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}) (338 \text{ K})}{7.75 \text{ L}}$$

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

2. Calculate the density of carbon dioxide,  $\text{CO}_2(\text{g})$ , at 100°C and 10.0 atm pressure ( $R = 0.08206 \text{ L}\cdot\text{atm}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}$ ).

Density =  $\frac{g}{L}$  so use 1 mole  $\text{CO}_2 = 44.01 \text{ g}$ , then solve for volume.

$$V = \frac{nRT}{P} = \frac{1 \text{ mol} (0.08206 \text{ L}\cdot\text{atm}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}) (373 \text{ K})}{10.0 \text{ atm}}$$

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

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

molar mass =  $\frac{g}{\text{mol}}$ , we have the grams, so solve for moles.

$$n = \frac{PV}{RT} = \frac{1000 \text{ torr} (0.100 \text{ L})}{62.3656 \text{ L}\cdot\text{torr}\cdot\text{K}^{-1}\cdot\text{mol}^{-1} (368 \text{ K})}$$

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

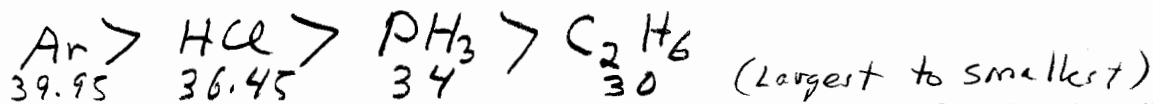
4. Calculate the volume occupied by 35.2 g of methane gas ( $\text{CH}_4$ ) at 25°C and 1.0 atm ( $R = 0.0821 \text{ L}\cdot\text{atm}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}$ ).

$$\frac{35.2 \text{ g CH}_4}{16.042 \text{ g/mol}} = 2.194 \text{ mol CH}_4$$

$$V = \frac{nRT}{P} = \frac{2.194 \text{ mol} (0.0821 \text{ L}\cdot\text{atm}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}) (298 \text{ K})}{1.0 \text{ atm}} = 53.7 \text{ L}$$

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

$C_2H_6$  Ar HCl  $PH_3$

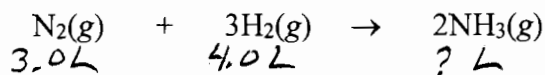


6. A sample of carbon dioxide gas at  $125^\circ\text{C}$  and 248 torr occupies a volume of 275 L. What will the gas pressure, in torr, be if the volume is increased to 321 L at  $125^\circ\text{C}$ ?

$$P_1 V_1 T_2 = P_2 V_2 T_1 \quad T \text{ is constant}$$

$$P_2 = \frac{P_1 V_1 T_2}{V_2 T_1} = \frac{(248 \text{ torr})(275 \text{ L})}{(321 \text{ L})} = 212 \text{ torr}$$

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  $H_2$ ?



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

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

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

$$n = \frac{PV}{RT} = \frac{(375 \text{ torr} \cdot \frac{1 \text{ atm}}{760 \text{ torr}})(14.0 \text{ L})}{(0.08206 \text{ L}\cdot\text{atm}\cdot\text{K}^{-1}\cdot\text{mol}^{-1})(310 \text{ K})}$$

$$n = 0.272 \text{ mol}$$