

Show all work to receive credit. $P_1V_1T_2 = P_2V_2T_1$ $PV = nRT$ $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ $P_{total} = P_1 + P_2 + \dots$

$R = 0.0821 \text{ L}\cdot\text{atm}/\text{mol}\cdot\text{K} = 62.4 \text{ L}\cdot\text{torr}/\text{mol}\cdot\text{K}$ Molar masses: C 12.01, S 32.07, H 1.008, N 14.01

1 (4 Pts) A sample of carbon monoxide gas was collected in a 2.0 L flask by displacing water at 28°C and 810 mmHg. Calculate the number of moles CO in the flask. The vapor pressure of water at 28°C is 28.3 mmHg.

$$P_{CO} = P_{total} - P_{H_2O}$$

$$P_{CO} = 810 - 28.3 = 781.7 \text{ mmHg}$$

$$n = \frac{PV}{RT}$$

$$n = \frac{(781.7 \text{ mmHg})(2.0 \text{ L})(\cancel{\text{mol}\cdot\text{K}})}{(62.4 \text{ mmHg})(301 \text{ K})}$$

$$n = 0.0832 \text{ moles CO}$$

2 (4 Pts) Calculate the density of SO₂ gas, in grams per liter, at 55°C and 1.5 atm.

$$\text{Density} = g \div L$$

$$P = 1.5 \text{ atm}$$

$$V =$$

$$n = \text{Let's assume 1 mole (64.07 g)}$$

$$R = 0.0821 \text{ L}\cdot\text{atm}/\text{mol}\cdot\text{K}$$

$$T = 328 \text{ K}$$

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

$$V = \frac{(1 \text{ mole})(0.0821 \text{ L}\cdot\text{atm})(328 \text{ K})}{(1.5 \text{ atm})}$$

$$V = 17.95 \text{ L}$$

$$\text{Density} = \frac{64.07 \text{ g}}{17.95 \text{ L}} = 3.57 \text{ g/L}$$

3 (4 Pts) The following data describes an initial and final state for an ideal gas. Given that the amount of gas does not change in the process, what was the initial volume (L) of the gas?

	P	V	T
① initial:	830 mmHg	?	35°C (308K)
② final:	720 mmHg	1.2 L	58°C (331K)

$$V_{\text{initial}} = \frac{P_2 V_2 T_1}{P_1 T_2} = \frac{(720 \text{ mmHg})(1.2 \text{ L})(308 \text{ K})}{(830 \text{ mmHg})(331 \text{ K})} = 0.97 \text{ L}$$

4 (4 Pts) Gases are sold in large cylinders for laboratory use. What pressure, in atmospheres, will be exerted by 2,500 g of oxygen gas (O₂) when stored at 22°C in a 40.0 L cylinder?

$$P = ?$$

$$V = 40.0 \text{ L}$$

$$n = \frac{2500 \text{ g O}_2}{32 \text{ g/mol}} = 78.125 \text{ mol O}_2$$

$$R = 0.0821 \text{ L}\cdot\text{atm}/\text{mol}\cdot\text{K}$$

$$T = 295 \text{ K}$$

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

$$P = \frac{(78.125 \text{ mol})(0.0821 \text{ L}\cdot\text{atm})(295 \text{ K})}{(40.0 \text{ L})}$$

$$P = 47.3 \text{ atm}$$

MORE ON BACK

Key

5 (4 Pts) Calculate the molar mass of a gaseous substance if 0.125 g of the gas occupies 93.3 mL at 298 K and 1 atm.

$$\text{molar mass} = \text{g} \div \text{moles}$$

$$P = 1 \text{ atm}$$

$$V = 0.0933 \text{ L}$$

$$R = \frac{0.0821 \text{ L} \cdot \text{atm}}{\text{mol} \cdot \text{K}}$$

$$n = ?$$

$$T = 298 \text{ K}$$

$$n = \frac{PV}{RT} = \frac{(1 \text{ atm})(0.0933 \text{ L})}{(0.0821 \text{ L} \cdot \text{atm})(298 \text{ K})}$$

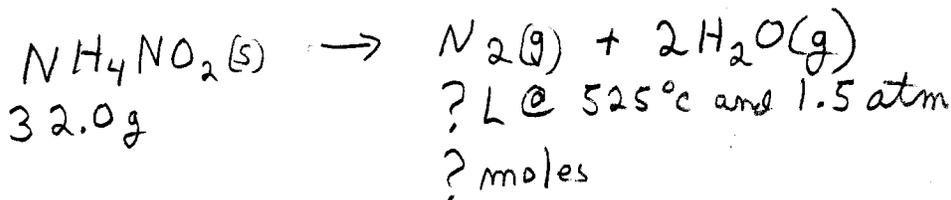
$$n = 0.00381 \text{ moles}$$

$$\text{molar mass} = \frac{0.125 \text{ g}}{0.00381 \text{ moles}} = 32.8 \text{ g/mol}$$

6 (6 Pts) Ammonium nitrite undergoes decomposition to produce only gases as shown below.



How many liters of nitrogen gas will be produced by the decomposition of 32.0 g of NH_4NO_2 at 525°C and 1.5 atm?



$$\frac{32.0 \text{ g NH}_4\text{NO}_2}{64.052 \text{ g}} \times \frac{1 \text{ mol N}_2}{1 \text{ mol NH}_4\text{NO}_2} = 0.500 \text{ mol N}_2$$

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

$$V = \frac{(0.500 \text{ mol N}_2)(0.0821 \text{ L} \cdot \text{atm})(798 \text{ K})}{(1.5 \text{ atm})}$$

$$V = 21.8 \text{ L}$$