General Chemistry Chapter 5 Pre-Test

1.) (2 pts each, 16 pts total) Use your knowledge of ideal gas laws to answer each of the following. Assume all other relevant factors are constant.

a) As the pressure of an ideal gas increases, the volume must (increase or decrease)

P ↑ V ↓ $PV = nRT$

decrease

b) As the volume of an ideal gas decreases, the temperature must (increase or decrease)

V ↓ P ↑

c) As the volume of an ideal gas decreases, the pressure must (increase or decrease)

increase $PV = nRT$

d) As the temperature of an ideal gas increases, the pressure must (increase or decrease)

n ↑ P ↑

e) As the amount of an ideal gas increases, the pressure must (increase or decrease)

$PV = nRT$ increase

f) As the amount of an ideal gas decreases, the volume must (increase or decrease)

P ↑ T ↑

g) As the pressure of an ideal gas increases, the temperature must (increase or decrease)

increases $PV = nRT$

h) As the temperature of an ideal gas increases, the volume must (increase or decrease)

2.) (12 pts) A sample of argon gas has a pressure of 628 torr and a volume of 2.54 L. What is the volume of the gas if the pressure is adjusted to 846 torr?

$P_1 = 628$ torr $\quad V_1 = 2.54L \quad V_2?$

$P_2 = 846$ torr

$PV = nRT$

$\frac{PV}{nT} = \frac{nRT}{nT}$

$\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$

$\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$

$\frac{P_1V_1}{P_2} = \frac{P_2V_2}{P_2}$

$V_2 = \frac{P_1V_1}{P_2} = \frac{(628 \text{ torr})(2.54L)}{846 \text{ torr}} = \boxed{1.88 L}$

3.) (12 pts) A 7.84 L sample of carbon dioxide gas has a temperature of 38.0 °C. What is the volume of the same gas if the temperature is adjusted to 52.0 °C?

$V_1 = 7.84L \quad T_1 = 38°C + 273 = 311 K \quad V_2 = ? \quad T_2 = 52°C + 273 = 325 K$

$T_2\left(\frac{V_1}{T_1}\right) = \left(\frac{V_2}{T_2}\right)T_2$

$\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$

$V_2 = \frac{T_2V_1}{T_1} = \frac{(325 K)(7.84L)}{311 K} = \boxed{8.19L}$

4.) (12 pts) A sealed container of water vapor has a pressure of 1.00 atm and a temperature of 37 °C. What is the temperature of the sealed gas if the pressure is increased to 1.86 atm?

$P_1 = 1.00$ atm $\quad T_1 = 37°C + 273 = 310$ K

$P_2 = 1.86$ atm $\quad T_2 = ?$

$$\frac{P_1 V_1}{n_1 T_1} = \frac{P_2 V_2}{n_2 T_2}$$

$$\frac{P_1}{T_1} = \frac{P_2}{T_2} \qquad T_2 = \frac{T_1 P_2}{P_1}$$

$$\frac{T_2 P_1}{P_1} = \frac{T_1 P_2}{P_1}$$

$$= \frac{(310\ K)(1.86\ atm)}{1.00\ atm} = \boxed{576.6\ K}$$

5.) (12 pts) What is the volume of a 0.74 mol sample of oxygen gas at ~~690 torr~~ 0.88 atm at a temperature of 78.0 °C?

$V = ?$ $\quad n = 0.74$ mol $\quad P = 0.88$ atm

$T = 78.0°C + 273 = 351$ K $\quad \boxed{R = 0.0821}$

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

$$= \frac{(0.74\ mol)(0.0821)(351\ K)}{0.88\ atm}$$

$$= \boxed{24.23\ L}$$

6.) (12 pts) A 1.85 L container of 4.92 g of an unknown ideal gas is measured at 1.50 atm and 29.0 °C. What is the molar mass of the gas?

$V = 1.85 L$ | $4.92 g = mass$ | $P_1 = 1.50 atm$

$T = 29.0°C + 273 = 302$

$R = 0.0821$

molar mass $= g/mol = \frac{mass}{n}$

molar mass

$PV = nRT$

$\mathcal{M} = \frac{m}{n}$

$PV = \frac{mRT}{\mathcal{M}}$ $\quad \mathcal{M} = \frac{mRT}{PV}$ $\quad n = \frac{m}{\mathcal{M}}$

$4 = \frac{12}{3}$ $\quad 3 = \frac{12}{4}$

$= \frac{(4.92 g)(0.0821)(302 K)}{(1.50 atm)(1.85 L)} = 44 g/mol$

7.) (12 pts) What volume of carbon dioxide is produced from a reaction at 46 °C and 1.15 atm with 7.35 g of C_3H_8 and a seemingly unlimited supply of oxygen? Please balance the reaction prior to solving.

$1 C_3H_8 + 5 O_2 \rightarrow 3 CO_2 + 4 H_2O$

$T = 46°C$ $\quad V?$

$P = 1.15 atm$

1.) mol of CO_2

$R = 0.0821$

$m = 7.35 g$ C_3H_8

$46 + 273 = 319 K$

$7.35 g\ C_3H_8 * \frac{1\ mol\ C_3H_8}{\approx 44\ g/mol} * \frac{3\ mol\ CO_2}{1\ mol\ C_3H_8} = 0.50\ mol = n$

44.09

$PV = nRT$

$V = \frac{nRT}{P} = \frac{(0.50 mol)(0.0821)(319 K)}{1.15 atm} = 11.38 L$

8.) (12 pts) What is the partial pressure of nitrogen dioxide if 0.608 mol of nitrogen dioxide is combined with 1.24 mol of oxygen and 0.382 moles of hydrogen gas where the total pressure of the gas is 1.76 atm?

$P_{Tot} = 1.76$ atm

$NO_2 = 0.608$ mol

$O_2 = 1.24$ mol

$H_2 = 0.382$ mol

molar fraction of NO_2

$$\frac{\text{moles of } NO_2}{\text{tot moles}} \quad \frac{0.608 \text{ mol}}{(0.608+1.24+0.382) \text{ mol}} = \frac{0.608}{2.23} = 0.272$$

$$0.272(1.76 \text{ atm}) = \boxed{0.478 \text{ atm}}$$

Please use 0.0821 $^{L \cdot atm}/_{mol \cdot K}$ as the universal gas constant.