Pre-Test 3
PHYS 0109
(Gen Chem)

Name______________________

A few equations

$PV = nRT$

$\Delta E = q + w$

$w = -P\Delta V$

$\Delta E = q_v$

$\Delta H = q_p$ (with only constant pressure PV work)

$q = \Delta T \cdot C$

$q = \Delta T \cdot n \cdot C_{mol}$

$q = \Delta T \cdot m \cdot s$

A few constants

For H_2O $s = 4.184\ J \cdot K^{-1} \cdot g^{-1}$

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

$R = 8.314\ J \cdot mol^{-1} \cdot K^{-1}$

$N_A = 6.022 \times 10^{23}\ mol^{-1}$

$1.000\ L \cdot atm = 101.3\ J$

14.7 psi = 1 atm

1 torr = 1 mm Hg

1 atm = 101,325 Pa

760 torr = 1 atm

0 °C = 273.15 K

1. 35.0 g of hot water are combined with 60.0 g of cold water. Determine the final temperature of the water if the initial temperatures of the hot and cold water samples are 89.5 and 22.3 °C respectively.

$q_{HW} = -q_{CW}$

$m_{HW} s \Delta T_{HW} = -m_{CW} s \Delta T_{CW}$

$m_{HW} s (T_{fH} - T_{iH}) = -m_c s (T_{fc} - T_{ic})$

since $T_{fH} = T_{fc}$

$m_H \cancel{s} (T_f - T_{iH}) = -m_c \cancel{s} (T_f - T_{ic})$

$35(T_f - 89.5) = -60(T_f - 22.3)$

$35T_f - 89.5(35) = -60T_f + (22.3)60$

$95T_f = 89.5(35) + 22.3(60)$

$T_f = \dfrac{89.5(35) + 22.3(60)}{95}$

$T_f = 47.1\ °C$

2. Two identical containers are charged with CH_4 and Cl_2. One container is charged with 1 atm of Cl_2 and the other container is charged with 1 atm of CH_4. The containers are at the same temperature.

a. On average, are the CH_4 molecules moving faster, slower, or the same speed as the Cl_2 molecules?

faster

b. On average, do the CH_4 molecules have more, less, or the same kinetic energy as the Cl_2 molecules?

same

c. Which gas is more dense, the CH_4, the Cl_2, or neither?

Cl_2

d. Increasing the temperature of the gases in the containers increases their pressures. What effect, if any, does the increase in temperature have on the density of the gases?

no change (density only changes if V or n changes)

3. a. A container was charged with a sample of Argon gas that is initially at 100 °C. The gas was cooled to –78 °C. Does the gas become more or less ideal.

less

b. At room temperature which gas would behave more ideally He (BP –271 °C) or CO_2 (BP –78 °C).

He both gases are at room temperature. CO_2 condenses before He condenses, so CO_2 is less ideal.

4. Determine the molar mass of a gas if 20.95 g of the gas occupies a volume of 6.075 L at 23.0 °C and 760.0 torr pressure.

$$(6.075 L)(1 atm) = n\ 0.08206 \frac{L \cdot atm}{K \cdot mol} (296.15)$$

$$n = 0.24998 \text{ mol}$$

$$MM = 20.95/0.24998 = 83.81 \text{ g/mol}$$

5. Hydrochloric acid reacts with sodium bicarbonate to produce water and carbon dioxide.

$$Cl\,(aq) + NaHCO_3(aq) \longrightarrow H_2O(l) + CO_2(g) + NaCl(aq)$$

600.0 mL of CO_2 at 23.5 °C was collected by displacing water from an inverted container. The pressure inside the container was 789 torr. How many moles of HCl were neutralized by the sodium bicarbonate?

$P_{tot} = 789$

$P_{tot} = P_{CO_2} + P_{H_2O}$

$789 = P_{CO_2} + 21.7$

$P_{CO_2} = 767.3$

$(0.6\ L)(767.3/760) = n\ 0.08206\,(273.15+23.5)$

$n = 0.0249$ mol

0.0249 mol CO_2

P_{H2O} = 21.7 torr is the vapor pressure of water at 23.5 °C. The constant was accidentally overlooked (not included).

6. 45.0 g of C_2H_6 were placed into a 1.56-L container. Determine the pressure of the gas inside the container if the temperature of the gas was 35.6 °C.

$\frac{45.0g}{30.069 g/mol} = 1.4966$ mol

$45.0g\ C_2H_6 \times \frac{1\ mol}{30.069g\ C_2H_6} = 1.4966$ mol C_2H_6

$(1.56\ L)(P) = 1.4966\ mol\ 0.08206\ \frac{L \cdot Atm}{K\ Mol}\ 308.75\ K$

$P = 24.3$ atm

7. Assuming volume and composition remain constant, does the pressure of a gas double if the temperature of a gas is increased from 50 °C to 100 °C?

NO the absolute temperature must double for the pressure to double

Assuming that the temperature and the composition of a gas remains constant, what happens to the pressure of the gas when the volume of the gas is cut in half.

the pressure doubles