**Name** _____ **AP Chemistry**

**HW 1: Due 2/6/15 Complete both free response questions. One will be graded. Show all work. Box and clearly label all final answers**

1. A rigid 11.06 L cylinder contains 19.73 g of $Cl_2(g)$ and 19.73 g of $F_2(g)$.
(a) Calculate the total pressure, in atm, of the gas mixture in the cylinder at 298 K.
(b) The temperature of the gas mixture in the cylinder is increased to 370 K. Calculate each of the following.
    (i) The mole fraction of $F_2(g)$ in the cylinder
    (ii) The partial pressure, in atm, of $F_2(g)$ in the cylinder
(c) If the chlorine molecules travel at a rate of 361 m/s at 370 K, at what rate will the fluorine molecules travel?

A different rigid 3.70 L cylinder contains 0.973 mol of NO(g) at 298 K. A 0.973 mol sample of $O_2(g)$ is added to the cylinder, where a reaction occurs to produce $NO_2(g)$.
(d) Write the balanced equation for the reaction.
(e) Calculate the total pressure, in atm, in the cylinder at 298 K after the reaction is complete.

a. $19.73\ g\ Cl_2 \div 70.90 = 0.2783$ moles $Cl_2$

$19.73\ g\ F_2 \div 38.00 = 0.5192$ moles $F_2$

$0.2783 + 0.5192 = 0.7975$ total moles

$PV = nRT \quad P = \frac{nRT}{V} = \frac{(0.7975)(0.08206)(298)}{11.06}$

$P = 1.763$ atm

bi. $\frac{0.5192}{0.7975} = 0.6510$ 2 sig figs

bii. $P = \frac{(0.5192)(0.08206)(370)}{11.06} = 1.4$ atm

c. $\frac{361}{x} = \frac{38.00}{70.90}$ $x = 493$ m/s

d. $2NO + O_2 \rightarrow 2NO_2$

| | 0.973 | 0.973 | ∅ |
|---|---|---|---|
| | $-2x$ | $-x$ | $+2x$ |
| ∅ | | 0.4865 | 0.973 |

$0.4865 + 0.973 = 1.460$ moles

$P = \frac{(1.460)(0.08206)(298)}{3.70}$

$P = 9.65$ atm

2. Butane, $C_4H_{10}$, is a hydrocarbon that is commonly used as fuel for in lighters.

(a) Write a balanced equation for the complete combustion of butane gas, which yields $CO_2(g)$ and $H_2O(l)$.
(b) Calculate the volume of air at 73°C and 1.00 atmospheres that is needed to burn completely 37.0 grams of butane. Assume that air is 21.0 percent $O_2$ by volume.
(c) The heat of combustion of butane is -2,881.9 kJ/mol. Calculate the heat of formation, $\Delta H°_f$, of butane given that $\Delta H°_f$ of $H_2O(l)$ = -285.3 kJ/mol and $\Delta H°_f$ of $CO_2(g)$ = -393.5 kJ/mol.
(d) If the enthalpy of vaporization for $H_2O(l)$ is 44.0 kJ/mol, what is $\Delta H°$ for the combustion reaction above if $H_2O(g)$ is formed instead of $H_2O(l)$?
(e) Assuming that all of the heat evolved in burning 73.0 grams of butane is transferred to 11.06 kilograms of water (specific heat = 4.184 J/g · K), calculate the increase in temperature of the water.

a. $2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O(l)$ $\Delta H = -5763.8$ KJ

b. $37.0 \div 58.0 = 0.638$ moles $\times \frac{13}{2} = 4.147$ moles $O_2$

$V = nRT/P$

$V = \frac{(4.147)(0.08206)(346)}{1.0} = 117.7$ L

$117 \div 0.21 =$ **560. L air**

c. $2(-2881.9) = [8(-393.5) + 10(-285.3)] - 2x$

$-5763.8 = -6001 - 2x$

$237.2 = -2x$

**$x = -118.6$ KJ/mol**

d. $10H_2O(l) \rightarrow 10H_2O(g)$ $\Delta H = 440$ KJ

**$\Delta H = -5323.8$**

e. $73 \div 58 = 1.26$ moles

$\frac{2 \text{ moles}}{-5763.8} = \frac{1.26 \text{ moles}}{x}$

$x = 3631$ KJ

$q = mC\Delta T$

$\Delta T = \frac{(3631)}{(11.06)(4.184)}$

**$\Delta T = 78.5$ K**