CHEM 130 **Name** ________________________________

Quiz 6 – Oct. 28, 2011

Complete the following problems. You must show your work to receive full credit. Show your answers to the correct number of significant figures with the correct units.

1. Brass has a density of 8.40 g/cm^3 and a specific heat of 0.385 J g^{-1} $^oC^{-1}$. A 11.6 cm^3 piece of brass, initially at 198^{o}C is dropped into an insulated container with 150.0 g water, initially at 23.5^{o}C. What will be the final temperature of the water-brass mixture? . (8 pts)

$$q_{brass} = -q_{water}$$
$$m_{brass}c_{brass}\Delta T_{brass} = -m_{water}C_{water}\Delta T_{water}$$
$$(11.6cm^3 \times 8.40g/cm^3)(0.385\ J/g^oC)(T_f - 198^oC) = -(150.0g)(4.1848\ J/g^oC)(T_f - 23.5^oC)$$
$$(37.51_4 J/^oC)(T_f - 198^oC) = -(627.6\ J/^oC)(T_f - 23.5^oC)$$
$$T_f - 198^oC = -16.73T_f + 393.1_5{}^oC$$
$$17.73T_f = 591.1_5{}^oC$$
$$\mathbf{T_f = 33.3_4{}^oC}$$

Problems 7-7, 7-8

2. Oxygen-acetylene flames are used to produce very high temperatures for a variety of applications, including welding. What is the quantity of heat evolved, in kilojoules, when 124 gram mixture containing equal parts of C_2H_2 (molar mass 21.213 g/mol) O_2 by mass is burned? Assume the reaction below: (8 pts)

$$2C_2H_2(g) + 5O_2(g) \rightarrow 4CO_2(g) + 2H_2O(g) \qquad \Delta H^o = -2610\ kJ$$

Based on the limiting reagent, how much energy will be released as heat? We need to find the limiting reagent!

First, if C_2H_2 is the limiting reagent,

$$62\ \cancel{g\ C_2H_2} \times \frac{1\ \cancel{mol\ C_2H_2}}{21.213\ \cancel{g\ C_2H_2}} \times \frac{2610\ kJ}{2\ \cancel{mol\ C_2H_2}} = 3814\ kJ \text{ of heat will be released}$$

NOTE: I actually gave you the wrong molar mass for C_2H_2! The correct molar mass is 26.038 g/mol. If you use this value, you get an energy release of 3107 kJ.

Now, if O_2 is the limiting reagent,

$$62\ \cancel{g\ O_2} \times \frac{1\ \cancel{mol\ O_2}}{31.9988\ \cancel{g\ O_2}} \times \frac{2610\ kJ}{5\ \cancel{mol\ O_2}} = 1011\ kJ \text{ of heat will be released}$$

Therefore, O_2 must be the limiting reagent and 1010 kJ of heat will be evolved.

Problem 7-17, just a different reaction

3. Determine ΔH^o for the reaction $N_2H_4(\ell) + 2H_2O_2(\ell) \rightarrow N_2(g) + 4H_2O(\ell)$ from the data below: (9 pts)

$$N_2H_4(\ell) + O_2(g) \rightarrow N_2(g) + 2H_2O(\ell) \qquad \Delta H^o = -622.2 \text{ kJ}$$
$$H_2(g) + \tfrac{1}{2} O_2(g) \rightarrow H_2O(\ell) \qquad \Delta H^o = -285.8 \text{ kJ}$$
$$H_2(g) + O_2(g) \rightarrow H_2O_2(\ell) \qquad \Delta H^o = -187.8 \text{ kJ}$$

We need to re-write the reactions so that we end up with the appropriate reactants and products, with the correct stoichiometry, and do the same things to the ΔH's that we do to the reactions.

Leave 1st reaction alone	$N_2H_4(\ell) + O_2(g) \rightarrow N_2(g) + 2H_2O(\ell)$	$\Delta H^o = -622.2$ kJ
Multiply 2nd reaction by 2	$2[H_2(g) + \tfrac{1}{2} O_2(g) \rightarrow H_2O(\ell)]$	$\Delta H^o = 2(-285.8$ kJ)
Reverse 3rd reaction and multiply by 2	$2[H_2O_2(\ell) \rightarrow H_2(g) + O_2(g)]$	$\Delta H^o = (-2)(-187.8$ kJ)

Now our overall reaction is:

$$N_2H_4(\ell) + \cancel{O_2(g)} + \cancel{2H_2(g)} + \cancel{O_2(g)} + 2H_2O_2(\ell) \rightarrow N_2(g) + 2H_2O(\ell) + 2H_2O(\ell) + \cancel{2H_2(g)} + \cancel{2O_2(g)}$$
$$N_2H_4(\ell) + 2H_2O_2(\ell) \rightarrow N_2(g) + 4H_2O(\ell)$$

And the ΔH^o = -622.2 kJ + 2(-285.8 kJ) + (-2)(-187.8 kJ) = -818.2 kJ

Problems 7-59, <u>7-60</u>

Possibly Useful Information

$q = mc\Delta T$	$K = {}^oC + 273.15$
$q_{rxn} = n\Delta H_{rxn}$	Specific heat of H_2O (l) = 4.184 J/gK

1 1A	2 2A	3 3B	4 4B	5 5B	6 6B	7 7B	8	9 8B	10	11 1B	12 2B	13 3A	14 4A	15 5A	16 6A	17 7A	18 8A
1 H 1.00794																	2 He 4.00260
3 Li 6.941	4 Be 9.01218											5 B 10.811	6 C 12.011	7 N 14.0067	8 O 15.9994	9 F 18.9984	10 Ne 20.1797
11 Na 22.9898	12 Mg 24.3050											13 Al 26.9815	14 Si 28.0855	15 P 30.9738	16 S 32.066	17 Cl 35.4527	18 Ar 39.948
19 K 39.0983	20 Ca 40.078	21 Sc 44.9559	22 Ti 47.88	23 V 50.9415	24 Cr 51.9961	25 Mn 54.9381	26 Fe 55.847	27 Co 58.9332	28 Ni 58.693	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.9216	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.4678	38 Sr 87.62	39 Y 88.9059	40 Zr 91.224	41 Nb 92.9064	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.906	46 Pd 106.42	47 Ag 107.868	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.757	52 Te 127.60	53 I 126.904	54 Xe 131.29
55 Cs 132.905	56 Ba 137.327	57 *La 138.906	72 Hf 178.49	73 Ta 180.948	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.967	80 Hg 200.59	81 Tl 204.383	82 Pb 207.2	83 Bi 208.980	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.025	89 †Ac 227.028	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (277)	109 Mt (268)	110 Ds (271)	111 Rg (272)							

*Lanthanide series	58 Ce 140.115	59 Pr 140.908	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.965	64 Gd 157.25	65 Tb 158.925	66 Dy 162.50	67 Ho 164.930	68 Er 167.26	69 Tm 168.934	70 Yb 173.04	71 Lu 174.967
†Actinide series	90 Th 232.038	91 Pa 231.036	92 U 238.029	93 Np 237.048	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)