CHEM 120 **Name**_____
Quiz 6 **Due by 12:00 Noon Friday, Oct. 24**

Complete the following problems. You may use your book and notes, but you may not seek help from anyone other than Dr. Lamp. Failure to abide by this rule will result in a zero for the quiz and the Dean of Students office will be notified. Clearly mark your answers. (8 pts each)

1. A 15.0 g sample of nickel is heated to 100.0°C and dropped into 55.0 g water, initially at 23.0°C. Assuming that all the heat lost by the nickel is absorbed by the water, calculate the final temperature of the nickel and the water. (The specific heat capacity of nickel is 0.444 J/gK, the specific heat capacity of liquid water is 4.184 J/gK)

$$q_{Ni} = -q_{H2O}$$
$$m_{Ni}c_{ni}\Delta T_{Ni} = - m_{H2O}c_{H2O}\Delta T_{H2O}$$
$$(15.0\cancel{g})(0.444\ J/\cancel{gK})(T_f - 100.0^oC)\cancel{K} = - (55.0\cancel{g})(4.184\ J/\cancel{gK})(T_f - 23.0^oC)\cancel{K}$$
$$T_f - 100.0^oC = -34.55_3(T_f - 23.0^oC)$$
$$T_f - 100.0^oC = -34.55_3T_f + 794.7_1{}^oC$$
$$35.55_3T_f = 894.7_1{}^oC$$
$$T_f = 25.16^oC = \mathbf{25.2^oC\ (or\ 298.3K)}$$

2. Care must be taken in preparing solutions of solutes that liberate heat on dissolving. When NaOH dissolved in water, it liberates 42 kJ of energy per mole of NaOH dissolved. In other words, its *heat of solution* is -42 kJ/mol. What should be the approximate maximum temperature reached in the preparation of 500.0 mL of 6 M NaOH from solid NaOH and water at 20.0°C. The specific heat capacity of liquid water is 4.184 J/gK. Assume the density of water and the density of the final solution is ~1.0 g/mL.

$$q_{soln} = -q_{H2O}$$
$$n\Delta H_{soln} = - m_{H2O}c_{H2O}\Delta T_{H2O}$$

$$0.500\ \cancel{L} \times \frac{6.0\ mol\ NaOH}{1\ \cancel{L}} = 3.0\ mol\ NaOH\ must\ dissolve$$

$$(3.0\ mol\ NaOH)(-42000\ kJ/mol\ NaOH) = - (500.0\ g)(4.184\ J/gK)\ \Delta T_{H2O}$$

$$\Delta T_{H2O} = 60.22\ K = 60.22^oC$$
$$\Delta T_{H2O} = T_{final} - T_{initial}$$
$$60.22\ ^oC = T_{final} - 20.0^oC$$

$$\mathbf{T_{final} = 80.2^oC = 80^oC = 353K}$$

3. A biology experiment requires the preparation of a water bath at 37°C (body temperature). The temperature of cold tap water is 22.0°C and the temperature of hot tap water is 55.0°C. If a student starts with 90.0 g of cold tap water, what mass of hot water must be added to reach 37.0°C? (The specific heat capacity of liquid water is 4.184 J/gK)

$q_{hot} = -q_{cold}$

$m_{hot}c_{hot}\Delta T_{hot} = - m_{cold}c_{cold}\Delta T_{cold}$

but $c_{hot} = c_{cold} = c_{H2O,}$ so:

$m_{hot}\Delta T_{hot} = - m_{cold}\Delta T_{cold}$

$m_{hot}\ (37 - 55.0)\ ^{o}\cancel{C} = -\ (90.0g)(37 - 22.0)\ ^{o}\cancel{C}$

$m_{hot} = (-90.0\ g)(15\ ^{o}\cancel{C})/(-18\ ^{o}\cancel{C})$ = **75 g hot water is needed**.

Possibly Useful Information

$q = mc\Delta T$	$KE = \frac{1}{2}\ mv^2$
$g = 9.8\ m/s^2$	$PE = mgh$

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)