Chem 150 – Exam 3b *Name:* _____
Fall 2009

Chemistry 150 Exam 3

Be sure to put your name on each page. This page can be removed from your exam so that you will have a Periodic Table handy throughout the exam, it does not need to be turned in. Show all your work for problems which require any sort of calculation, no credit will be given for answers without work shown. If you have shown a significant amount of work or multiple drawings for a problem, draw a box around what you consider your final answer.

Avogadro's Number = 6.022×10^{23} units/mol
$32.00^{o}F = 0.000^{o}C = 273.15K$
1 foot = 12 inches
1 inch = 2.54cm (exactly)
1 pound = 453.6 g = 16 ounces
1 amu = 1.6605×10^{-24} g
Masses of subatomic particles:
Proton 1.00728amu = 1.6726×10^{-24} g
Neutron 1.00866amu = 1.6749×10^{-24} g
Electron 0.000549amu = 9.1094×10^{-28} g
Density of Water = 1.000 g/mL
R = 0.08206 L•atm/mol•K
PV=nRT
1 calorie = 4.184 J = 0.001Calorie

1 **H** 1.0079																	2 **He** 4.0026
3 **Li** 6.941	4 **Be** 9.0122											5 **B** 10.811	6 **C** 12.011	7 **N** 14.007	8 **O** 15.999	9 **F** 18.998	10 **Ne** 20.180
11 **Na** 22.990	12 **Mg** 24.305											13 **Al** 26.982	14 **Si** 28.086	15 **P** 30.974	16 **S** 32.066	17 **Cl** 35.453	18 **Ar** 39.948
19 **K** 39.098	20 **Ca** 40.078	21 **Sc** 44.956	22 **Ti** 47.88	23 **V** 50.942	24 **Cr** 51.996	25 **Mn** 54.938	26 **Fe** 55.847	27 **Co** 58.933	28 **Ni** 58.69	29 **Cu** 63.546	30 **Zn** 65.39	31 **Ga** 69.723	32 **Ge** 72.61	33 **As** 74.922	34 **Se** 78.96	35 **Br** 79.904	36 **Kr** 83.80
37 **Rb** 85.468	38 **Sr** 87.62	39 **Y** 88.906	40 **Zr** 91.224	41 **Nb** 92.906	42 **Mo** 95.94	43 **Tc** (98)	44 **Ru** 101.07	45 **Rh** 102.91	46 **Pd** 106.42	47 **Ag** 107.87	48 **Cd** 112.41	49 **In** 114.82	50 **Sn** 118.71	51 **Sb** 121.76	52 **Te** 127.60	53 **I** 126.90	54 **Xe** 131.29
55 **Cs** 132.91	56 **Ba** 137.33	57 **La** 138.91	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.84	75 **Re** 186.21	76 **Os** 190.23	77 **Ir** 192.22	78 **Pt** 195.08	79 **Au** 196.97	80 **Hg** 200.59	81 **Tl** 204.38	82 **Pb** 207.2	83 **Bi** 208.98	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** 226.03	89 **Ac** 227.03	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (263)	107 **Bh** (262)	108 **Hs** (265)	109 **Mt** (266)	110 (269)	111 (272)	112 (277)		114		116		

58 **Ce** 140.12	59 **Pr** 140.91	60 **Nd** 144.24	61 **Pm** (145)	62 **Sm** 150.36	63 **Eu** 151.97	64 **Gd** 157.25	65 **Tb** 158.93	66 **Dy** 162.50	67 **Ho** 164.93	68 **Er** 167.26	69 **Tm** 168.94	70 **Yb** 173.04	71 **Lu** 174.97
90 **Th** 232.04	91 **Pa** 231.04	92 **U** 238.03	93 **Np** 237.05	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (258)	101 **Md** (258)	102 **No** (259)	103 **Lr** (260)

Score

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Multiple Choice: Circle the letter of the most correct response. (6pts. per question)

1. The First Law of Thermodynamics states that:
   a. Kinetic energy is stored in chemical bonds
   b. Electrostatic energy is another name for electricity
   c. An element in its "normal" state has no energy
   d. Energy cannot be created or destroyed
   e. Potential energy is a measure of the speed of molecular movement

2. The specific heat capacity of a substance is:
   a. The amount of energy required to increase the temperature of one mole of the substance 1°C
   b. The amount of energy required to increase the temperature of one gram of the substance 1°C
   c. $4.184\ ^{J}/_{g\bullet^{o}C}$
   d. The amount of energy required to increase the temperature of one pound of the substance 1°C
   e. The amount of energy required to increase the temperature of one gram of the substance 1°F

3. Each of the following describes an ***exothermic*** process *except*:
   a. Chemical bonds are formed
   b. The reactants have a higher energy than the products of a reaction
   c. The system absorbs heat from the surroundings
   d. ΔH is negative
   e. The system liberates heat to the surroundings

4. Is each of the following processes endothermic or exothermic? (3pts each)

Splitting water to form $H_2(g)$ and $O_2(g)$	*Endothermic*	*Exothermic*
Burning propane in air	*Endothermic*	*Exothermic*
Freezing apple juice	*Endothermic*	*Exothermic*
Boiling water	*Endothermic*	*Exothermic*

Single Calculations: (15pts each)

5. Strontium oxide (SrO) can be converted to strontium metal by the following reaction:

$$2\ SrO(s) \rightarrow 2\ Sr(s) + O_2(g)$$

What is $\Delta H^{o}_{reaction}$ for this process? ($\Delta H_f^{o} = -592.0\ ^{kJ}/_{mol}$ for SrO.)

Score

6. The specific heat capacity of liquid water is $4.184^{J}/_{g\bullet^{o}C}$. How much energy is released by cooling 650.0g of liquid water from 37.16ºC to 19.65ºC?

7. How much energy is required to boil 825.0g of water at its boiling point (100ºC)?
($\Delta H^{o}_{vaporization} = 40.64\ ^{kJ}/_{mol}$ for water)

8. You have determined that $\Delta H^{o}_{reaction}$ for the reaction of calcium metal with oxygen gas is $-1270^{kJ}/_{mol}$.

$$2\ Ca(s) + O_2(g) \rightarrow 2\ CaO(s)$$

What is $\Delta H^{o}_{reaction}$ for the following reaction? Explain your answer.

$$6\ CaO(s) \rightarrow 6\ Ca(s) + 3\ O_2(g)$$

Problems: (20pts each)

9. Acetaldehyde burns according to the following equation:

$$2\ C_2H_4O(g) + 5\ O_2(g) \rightarrow 4\ CO_2(g) + 4\ H_2O(g)$$

You perform an experiment in which you burn 13.753g of acetaldehyde and determine that the reaction generated 344.82kJ of heat. Based upon this experiment, what is the value of ΔH_f^{o} for acetaldehyde?

Material	**ΔH_f^{o} ($^{kJ}/_{mol}$)**
$CO_2(g)$	-393.509
$H_2O(g)$	-241.818

Score

10. The specific heat capacity of graphite is $0.715\,^{J}/_{g\bullet ^{o}C}$ and the specific heat capacity of ethylene glycol (a component of antifreeze) is $2.38\,^{J}/_{g\bullet ^{o}C}$. You have heated a block of graphite to 61.13ºC and dropped it into a beaker containing 450.0g ethylene glycol at 20.19ºC. When the system reaches thermal equilibrium, the temperature of the graphite and ethylene glycol is 21.84ºC. If the system is perfectly insulated, what was the mass of the graphite block?

11. You have been studying a series of reactions:

$$A \rightarrow B \rightarrow C \rightarrow D$$

So far, you have determined the following ΔH^{o}_{rxn} values:

A → B	$+4.28\,^{kJ}/_{mol}$
C → B	$-7.13\,^{kJ}/_{mol}$
C → D	$-9.51\,^{kJ}/_{mol}$

What is ΔH^{o}_{rxn} for the overall reaction, A → D? Is A → D endothermic or exothermic? Draw a qualitatively correct reaction coordinate diagram for the entire stepwise process, A → B → C → D.

Score