Chemistry 113 – Chemistry and the Environment
Take-Home Quiz 2 (February 8, 2002)
Due at the beginning of class Monday, February 11, 2002

Name:_____

My signature is my pledge that I neither received nor provided aid from/to another individual. I understand the plagiarism policy on page 142 of the student handbook and its' consequences on page 125.

Signature:_____

Show your work on all problems!

There are no 'trick' questions here. However, many questions require substantial thought. Please read CAREFULLY before answering. To receive full credit on the problems with mathematical calculations, you must show all work. Do not include irrelevant answers.

1. (12 pts) Aluminum burns in elemental bromine, producing aluminum bromide. In an experiment, 6.0 g of aluminum was reacted with 51.6 g of bromine to yield 50.3 g of aluminum bromide. Determine the limiting reagent and calculate the theoretical and percent yields for this experiment.

2. (8 pts) Draw a Lewis structure of NO_2^- and determine its electronic and molecular geometries. Based on electronegativities, show the bond dipoles as seen in Figure 9.9b for water.

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3. (15 pts) Given:

Table 1: Heat of formation at 25°C*	
$C_6H_{12}O_6$ (*s*)	$\Delta H_f°$ = -1273.02 kJ/mol
CO_2 (*g*)	$\Delta H_f°$ = -393.5 kJ/mol
H_2O (*g*)	$\Delta H_f°$ = -241.83 kJ/mol
H_2O (*l*)	$\Delta H_f°$ = -285.83 kJ/mol
C_2H_5OH (*l*)	$\Delta H_f°$ = -277.7 kJ/mol

*Constants taken from Brown, LeMay and Bursten (1997). CTCS

Dr. Steve Johnston (Prof of Biology) has boldly claimed that *Saccharomyces cerevisiae* or yeast is the coolest organism. One "cool" thing about yeast is that it can perform either aerobic or anaerobic metabolism. In aerobic metabolism, glucose ($C_6H_{12}O_6$) goes through combustion. However, in anaerobic metabolism, yeast would breakdown glucose WITHOUT using oxygen. The products in anaerobic metabolism are ethanol (C_2H_5OH) and CO_2.

(a) Write a balanced chemical equation for the anaerobic metabolism of glucose in yeast (3 pts).

(b) Write a balanced chemical equation for the combustion of glucose (2 pts).

(c) Calculate the change in enthalpy (ΔH) for the reaction in part b. (5 pts).

(d) In the presence of a lot of oxygen (assume unlimited amount) and glucose, would yeast most likely perform aerobic or anaerobic metabolism? Explain and support your answer. (3 pts).

(e) According to previous studies, for every 1 mole of glucose broken down by aerobic metabolism, a yeast cell will store about 1900 kJ for later use. Is this number (1900 kJ/mol) and the enthalpy calculated in part b similar? If yes, why would they be the same? If no, why would they be different? (2 pts).

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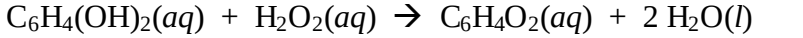
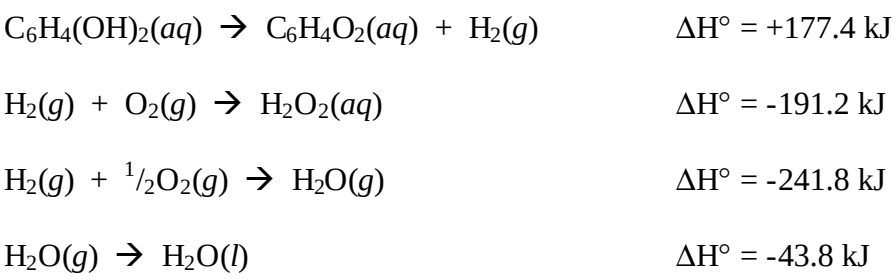
4. (10 pts) The bombardier beetle uses an explosive discharge as a defensive measure. The chemical reaction involved is the oxidation of hydroquinone by hydrogen peroxide to produce quinone and water:



$$C_6H_4(OH)_2(aq) + H_2O_2(aq) \rightarrow C_6H_4O_2(aq) + 2\,H_2O(l)$$

Calculate $\Delta H°$ for this reaction from the following data:



$C_6H_4(OH)_2(aq) \rightarrow C_6H_4O_2(aq) + H_2(g)$ $\Delta H° = +177.4$ kJ

$H_2(g) + O_2(g) \rightarrow H_2O_2(aq)$ $\Delta H° = -191.2$ kJ

$H_2(g) + {}^1/_2O_2(g) \rightarrow H_2O(g)$ $\Delta H° = -241.8$ kJ

$H_2O(g) \rightarrow H_2O(l)$ $\Delta H° = -43.8$ kJ

5. (8 pts) Disodium aurothiomalate ($Na_2C_4H_3O_4SAu$) has the trade name Myocrisin and is used in the treatment of rheumatoid arthritis. Patients receive weekly intramuscular injections consisting of 50.0 mg Myocrisin in 0.500 mL of solution. Calculate the concentration of Myocrisin in terms of molarity. During treatment, blood serum levels of gold can reach levels as high as 300.0 μg gold per 100.0 mL serum. Calculate the concentration of gold in the serum in molarity and then determine the molarity of the Myocrisin in the serum.

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6. (8 pts) **Describe** how would you prepare 1.00 L of a 0.50 M solution of H_2SO_4 from concentrated (18 M) sulfuric acid?

7. (12 pts) When nitroglycerin, $NO_2OCH(CH_2ONO_2)_2$, decomposes a lot of heat is released. Calculate the ΔH_{rxn}**/mol** nitroglycerin us ing bond energies. If you need help seeing what this molecule looks like, see me.

8. (9 pts) Predict the empirical formulas of the ionic compounds formed from the following pairs of elements. Name each compound.
   a) Al and Cl

   b) Ba and S

   c) Ga and O

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9. (8 pts) Notice the Lattice energy for LiF using Table 8.2. Based on that information, determine a rough estimate for the Lattice energy of MgO using Figure 8.5. (Hint: What is lattice energy based on?)

10. (10 pts) Predict the products and write the balanced molecular equation, complete ionic equation, and the net ionic equation for the following.

a) $AgNO_3(aq) + Na_3PO_4(aq) \rightarrow$

b) $FeSO_4(aq) + K_2S(aq) \rightarrow$