

Name:	Chemistry 105		
Signature:	Friday, December 1, 2006		
Please Circle the name of your lecture instructor			
Badger	D'Acchioli	Lawrence	Zach
Student ID Number:			

Exam 3

DO NOT OPEN THE EXAM UNTIL INSTRUCTED



Directions

Please check the exam to make sure there are 8 non-blank pages including the title page. *Read all the questions and directions carefully before entering answers!*

Sections III - V allow you to omit a problem. Please read the directions for each section write "**OMIT**" on the portion you do not want graded. If nothing is marked "**OMIT**" we will grade the first problems of that section, regardless of what work has been done. We will not attempt to interpret your desire.

When you have completed the exam please place the exam and the purple sheets neatly on the front bench. *Do not take the purple sheets with you!*

Pencils and pens down when time is called.

Good Luck!

I. Multiple Choice (30 pts) Please carefully blacken the bubble on the scantron sheet for the answer you have selected for the following multiple choice questions.

1. What color is your exam?
 - a. yellow
 - b. blue
 - c. green

2. Which one of the following is a unit of energy?
 - A) Pascal
 - B) Newton
 - C) Joule
 - D) Watt
 - E) Ampere

3. An endothermic reaction is one in which there is
 - A) a positive value for the work ($w > 0$ joules)
 - B) a negative value for the work ($w < 0$ joules)
 - C) a negative value for ΔH ($\Delta H < 0$ joules)
 - D) a positive value for ΔH ($\Delta H > 0$ joules)
 - E) a negative value for ΔE ($\Delta E > 0$ joules)

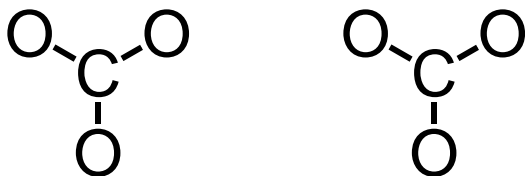
4. During an exothermic chemical reaction,
 - A) a system becomes warmer, and the chemical substances undergo an increase in potential energy
 - B) a system becomes warmer, and the chemical substances undergo a decrease in potential energy
 - C) a system becomes cooler, and the chemical substances undergo an increase in potential energy
 - D) a system becomes cooler, and the chemical substances undergo a decrease in potential energy
 - E) a system becomes warmer, and additional heat is gained from the surroundings

5. The orbital (number + letter designation) for the subshell with $n = 5$ and $l = 3$ is
 - A) 5d subshell
 - B) 5p subshell
 - C) 5f subshell
 - D) 5g subshell
 - E) 5s subshell

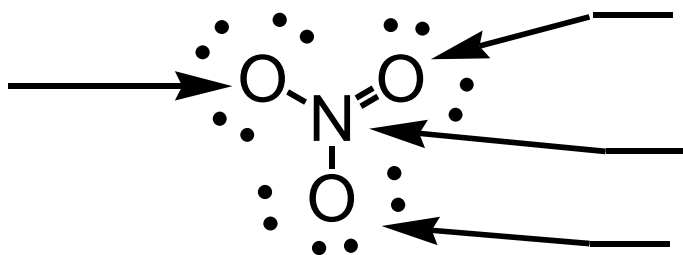
6. The frequency of an electromagnetic wave is
- A) the number of complete oscillations or cycles over a distance of one meter
 - B) the number of complete oscillations or cycles in a one second time interval
 - C) the distance between successive maxima in the wave in one complete cycle
 - D) the number of complete oscillations or cycles over a distance of one centimeter
 - E) the distance between successive nodes in the wave
7. Which one of the species below should have the smallest radius?
- A) Ar
 - B) Ca
 - C) K
 - D) Mg
 - E) Na
8. Sodium tends to form ions which have the electronic configuration of a noble gas. What is the electronic configuration of the noble gas which the sodium ion mimics?
- A) $1s^2$
 - B) $1s^2 2p^6$
 - C) $1s^2 2s^2 2p^6$
 - D) $1s^2 2s^2 2p^6 3s^2$
 - E) $1s^2 2s^2 2p^6 3s^2 3p^6$
9. Which one of the elements below has 5 valence electrons (not including d or f electrons)?
- A) Cl
 - B) Be
 - C) Te
 - D) As
 - E) Rh
10. Based on the position in the periodic table, which one of the following atoms would you expect to be the most electronegative?
- A) Cl
 - B) Ge
 - C) P
 - D) Se
 - E) Sn
11. Of the 4 quantum numbers, which one divides the subshells into orbitals?
- A) m_s
 - B) p
 - C) m_l
 - D) l
 - E) n

II. Short answer question (20 pts)

- A. (5) Draw two resonance structures for the carbonate anion (CO_3^{2-}). You must show all bonding and non-bonding electrons to receive full credit.



- B. (5) Calculate the formal charge on each atom in the following Lewis structure of the Nitrate ion:



- C. (5) Give the complete electron configuration (starting with $1s^2$) for the chlorine atom.

- D. (5) Give the electron configuration of the bromide anion using the inert gas core notation.

III. Fill in the Blank (20 pts) Solve any two (2) of the following problems and place your answer in the boxes provided. Note that very little partial credit will be given, so check your answers carefully.

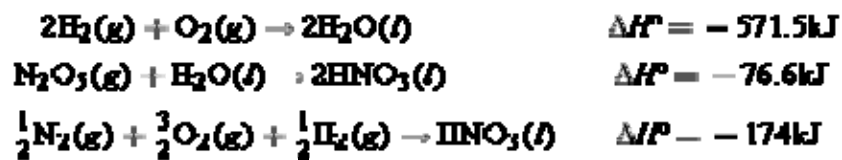
1. A calorimeter consists of metal parts with a heat capacity of $950.0 \text{ J } ^\circ\text{C}^{-1}$ and 850.0 grams of oil with a specific heat of $2.418 \text{ J g}^{-1} \text{ } ^\circ\text{C}^{-1}$. Calculate the amount of heat energy required, in kJ, to raise its temperature from $25.00 \text{ } ^\circ\text{C}$ to $31.60 \text{ } ^\circ\text{C}$.

2. Using the standard enthalpies of formation, ΔH_f° :
 $\text{H}_2\text{O}(l) = -285.9 \text{ kJ mol}^{-1}$; $\text{C}_2\text{H}_4(g) = 52.284 \text{ kJ mol}^{-1}$; $\text{C}_2\text{H}_5\text{OH}(l) = -277.63 \text{ kJ mol}^{-1}$
calculate the standard enthalpy of reaction for $\text{C}_2\text{H}_4(g) + \text{H}_2\text{O}(l) \rightarrow \text{C}_2\text{H}_5\text{OH}(l)$

3. How many resonance structures, if any, can be drawn for the nitrate ion?

VI. Thought Questions (30 pts) Answer the questions on any two (2) of the following three pages. Write "OMIT" through the page you wish omitted. Your answers must be clear and complete in order to receive complete credit. **SHOW YOUR WORK!**

1) Given the following thermochemical equations,



calculate ΔH° for the reaction



2) Junior chemist needs to heat 0.500 kg of water in a Styrofoam cup from 25°C to 35°C by inserting hot objects into the cup. The objects Junior chemist has available are a rock at 100.0 °C with a heat capacity of 200.0 J °C⁻¹; and iron ball bearings (at 100.0 °C) each with a mass of 0.344 grams. Iron has a specific heat of 0.449 J g⁻¹ °C⁻¹. In addition to the rock, how many ball bearings will Junior chemist need to get a final temperature of 35°C? Water has a specific heat of 4.18 J g⁻¹ °C⁻¹.

3) Light energy can be used to split water. The energy required for the formation of water is $\Delta H_f^\circ = -285.9 \text{ kJ/mole}$. Assuming photons are absorbed into the bonds of water with 100% efficiency, what is the wavelength — *in nm* — of the lowest energy photons that could possibly split water? Information you might need: $E = h \nu$; $c = \lambda \nu$; Planck's constant $h = 6.626069 \times 10^{-34} \text{ Js}$, $c = 3.00 \times 10^8 \text{ m/s}$, Avogadro's number 6.02×10^{23} things/mole.