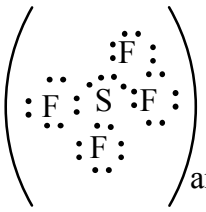
CHEM 111 Your full name (PLEASE PRINT) _____
First hour test **page 1 of 5**
September 27, 2007 Your scheduled **Tuesday** quiz section (please circle) B hr E hr

Your scheduled **Tuesday** quiz instructor:_____

Make sure your test has FIVE pages---notify us immediately if it does not. Do NOT detach pages from the staple. You may use a writing implement, hand-calculator, and your Periodic Table (unmarked, honor code) as obtained in this course. **NO** scratch paper is permitted! As requested of the faculty by the Student Executive Committee, students must sit in every other seat during the test. The PROPER METHOD (i.e., Problem Set 0) must be shown clearly on all problems, and final answers must be expressed in appropriate form. Pay attention to dimensions!! **When blanks for answers are provided, write your answer to be graded in the blank---we may not grade answers written in other locations!** *For the purposes of this test, represent hydronium ion as H_3O^+ and not as $H^+(aq)$.*

1. (7 pts) Please fill out the table below according to the method illustrated in P.S. 10.



central e^- pairs to be arranged around S,____	e^- pair shape? (sketch & name)	molec. shape? (sketch and name) formal charges?	how many π-bonds likely? resonance? drawing correction?

2. (8 pts) Use the "aufbau" and other knowledge you possess to give the *actual* array of electrons for the following species:

A. Give **SHORT-FORM ELECTRON CONFIG.** B. Give **ELECTRON DOT PICTURE**

$_{82}Pb$ _____

$_{24}Cr^+$ _____

3. (8 pts) Define the following terms briefly and accurately **ACCORDING TO YOUR LECTURE NOTES** (do **NOT** illustrate them).

(a) Brønsted acid: _____

(b) Soft Lewis base: _____

(c) Polarizability: _____

(d) Electronegativity:_____

4. (14 pts) Show by appropriate formula(s) what species are present after each of the following bulk substances are mixed (individually) with water. Clearly distinguish between ions, molecules, and solids in the final aqueous mixtures.

magnesium iodate

$(NH_4)HCO_3$

CH_3PH_2

H_2SO_3

potassium dichromate

$[Cr(SCN)_6]_2(HPO_4)_3$

$Ru(OH)_3$

5. (25 pts) The following pairs of substances were first, as separate substances, mixed with water. Then the two aqueous mixtures were combined with thorough stirring. **For each pair:**

(a) & (b) show by appropriate formula(s) what would be present **in the separate mixtures**; and then

(c) deduce and write the **balanced chemical equation for the reaction(s)** which occur(s) when the two mixtures are combined. **If no reaction occurs upon mixing, write "NR" (No reaction!)**

sodium monohydrogenphosphate and potassium hydroxide

(a)

(b)

(c)

sulfuric acid and silver chloride

(a)

(b)

(c)

5. (Continued—use same instructions as previous page)

sodium sulfite and one equivalent of HBr

(a) (b)

(c)

$CrSO_4$ and 6 equivalents of sodium cyanide

(a) (b)

(c)

$Ba(OH)_2$ and $NaHSO_4$

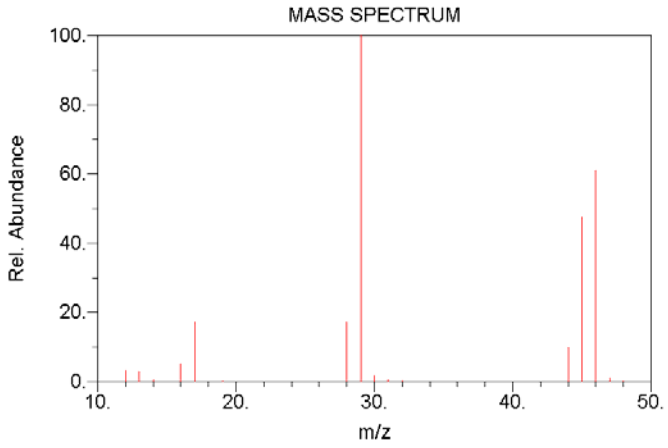
(a) (b)

(c)

6. (6 pts) (a) 0.0030 g - 0.000008 g = _____ (b) 24 kg + 76 kg = _____

(c) 273 m - 271 m = _____

7. (7 points) (a) The figure at right is a mass spectrum for (**circle one**): $C_2H_4O_2$ (acetic acid) or CH_2O_2 (formic acid). (b) Briefly and grammatically explain why.



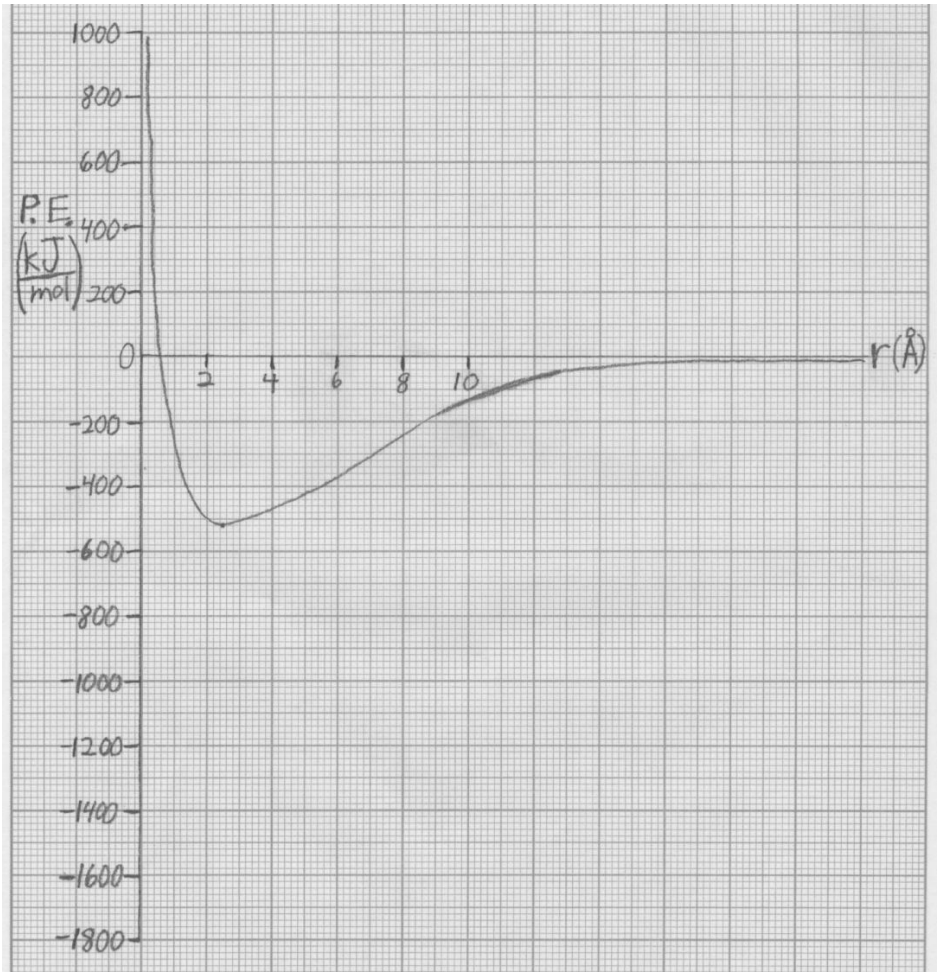
(c) What is the source of the peak with 100% Rel. Abundance?

(d) For a mixture analyzed by thin layer chromatography, the compound most strongly attracted to the stationary phase will spend the _____ time adsorbed on the stationary phase and have the _____ R_f value. (**Circle one below.**)

A. least, smallest B. least, largest C. most, largest D. most, smallest

8. (16 pts) (a) The curve shown on the graph below concerns hypothetical gas phase atoms X· and ·Y combining to form gas phase covalently-bonded molecular X-Y. What you must do is draw a curve for hypothetical gas

phase ions Y^{2+} and X^{2-} combining to form gas phase ionically-bonded $(Y^{2+})(X^{2-})$ given the following information: r_e (X-Y) = 2.50 Å; r_e $(Y^{2+})(X^{2-})$ = 3.50 Å; $IE_1(X) = 1.20 \times 10^2$ kJ/mol; $IE(X^+) = 3.00 \times 10^2$ kJ/mol; $EA(X) = -1.50 \times 10^2$ kJ/mol; $EA(X^-) = 2.40 \times 10^2$ kJ/mol; $IE(Y) = 1.00 \times 10^2$ kJ/mol; $IE(Y^+) = 2.60 \times 10^2$ kJ/mol; $EA(Y) = -0.90 \times 10^2$ kJ/mol; $EA(Y^-) = 3.50 \times 10^2$ kJ/mol; $\Delta E_{coul} \approx -1.60 \times 10^3$ kJ/mol. HINTS! Pay careful attention to the mathematical signs of the given information. If you need ΔE_∞, find it graphically; you will NOT succeed if you use the ΔE_∞ equation from the first day of class!



8. (Continued) (b) The species will prefer to be bonded (**circle one**) ionically or covalently? Use one or two succinct, legible, grammatical sentences to explain your answer.

(c) The first EA of Y to make Y^- is (**circle one**) favorable or unfavorable? Use one or two succinct, legible, grammatical sentences to explain why the EA of Y^- to make Y^{2-} has the opposite mathematical sign compared to the first EA.

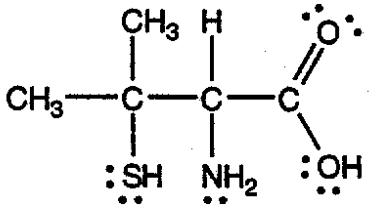
(d) Given a value of the constant "k" in the Coulomb's law equation of 2.307×10^{-28} J·m and given that by definition 1 Å = 1×10^{-10} m, calculate ΔE_{coul} to three significant figures and express your answer in kJ/mol.

answer:_____

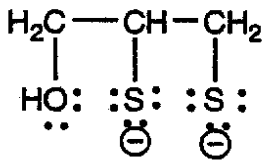
9. (9 pts) An MCAT-ish question [derived by textbooks authored by Lubert Stryer and Glen E. Rodgers]:

Parvalbumin is a 12-kd protein found in carp muscle. It is related to troponin C and calmodulin in the human body. The X-ray crystal structure of parvalbumin has revealed that the Ca^{2+} binding site of the protein consists of seven oxygen's that form a complex with the Ca^{2+}. The oxygens involved are derived from three aspartates, two glutamates, a main chain carbonyl oxygen, and a bound water molecule.

On the other hand, penicillamine and British anti-lewisite have been used to treat Wilson's disease, a metabolic disorder characterized by the buildup of Cu^{2+} in the body. One striking symptom of this disease is Kayser-Fleischer rings of the cornea that develop in the eyes of people afflicted with this malady. Since there is no known cure for Wilson's disease, penicillamine treatments must be continued throughout the lifetime of the patient. The structure of penicillamine and British anti-lewisite are shown below. Penacillamine and British anti-lewisite form complexes with copper especially through the nitrogen and sulfur sites.



penicillamine



British anti-lewisite

Which of the following statements are true:

(a) One reason penicillamine binds Cu^{2+} well is because the sulfur atom is a good soft Lewis acid.

(b) Ca^{2+} binding by parvalbumin is favored by hard-hard Lewis acid/base interactions.

(c) British anti-lewisite could be expected to form really good complexes with Na^{+}.

(d) One might anticipate that penicillamine could be a good antidote for Pb^{2+} poisoning.

(e) Bronsted acid/base definitions describe the bonding between the S atom and the Cu^{2+} ion in penacillamine complexes of copper.

(f) One could anticipate that parvalbumin might form a complex with Mg^{2+}.

(g) The parvalbumin metal ion binding site is less polarizable than the British anti-lewisite metal ion binding site.

PLEDGE: I have neither given nor received any unacknowledged aid on this test.

Signed, _____