Name: KEY

Chemistry 111
Test 3
November 24, 2004

Instructions before starting the test:

1. Your exam booklet should have **six** pages total, with questions on pages 2-5 and a periodic table on p. 6. Check to see you have six pages now. If you do not, ask for another copy of the exam.
2. Write your name in the space above and on the backs of pages 2-5.
3. You may use one side of an 8.5" by 11" sheet of paper filled with reference information.
4. You may use programmable calculators, but chemical data should not be stored in them.
5. You may start work on this test at 8:00 a.m. You must turn in this test by 9:30 a.m. (The test should take you only 60 minutes.)

Question (Possible Points)	Your Score
Question 1 (20)	
Question 2 (16)	
Question 3 (8)	
Question 4 (12)	
Question 5 (15)	
Question 6 (29)	
Total (100)	

Average of First 3 Tests	
Estimated Grade	

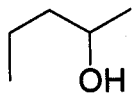
1. (20 points total) Circle the best answer to each of the following five questions. Your answers need not be justified, and no partial credit will be awarded.

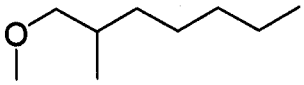
A. At equilibrium, a system contains 0.0763 M $H_2(g)$, 0.0932 M $I_2(g)$, and 0.577 M HI(g). What is the value of K for the reaction

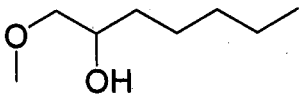
$$2\ HI(g) \rightleftharpoons H_2(g) + I_2(g)\ ?$$

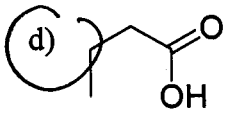
(a) 0.00534 (b) 0.0123 (c) 0.0214 (d) 46.8 (e) 187

B. Which of the following molecules is not optically active?

a) 

b) 

c) 

d) 

e) Molecules a, b, c, and d are all optically active

C. How many sp^2-hybridized atoms are in the molecule adenine (shown below)?

(a) 0 (b) 4 (c) 8 (d) 9 (e) 10

D. Aqueous solutions of $K_3[Fe(CN)_6]$ are red. What color of light do these solutions most strongly absorb?

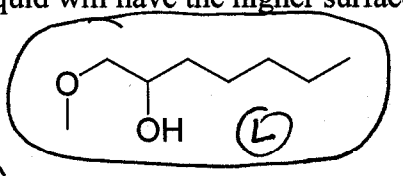
(a) yellow (b) green (c) orange (d) red (e) violet

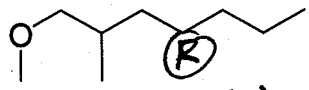
E. Which of the following species can function as a hydrogen bond donor?

(a) H_2S (b) LiH (c) $N(CH_3)_3$ (d) BeH_2 (e) NH_4^+

2. (16 points total) For each of the following comparisons, circle your choice and justify it below. Your justifications may be aided by drawing structures of the molecules you are discussing.

(a) Which liquid will have the higher surface tension (at the same temperature)?

4 pts 

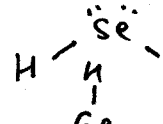
or 

Has an H-bond donors (OH) and acceptor (:Ö:). This H-bonding
4pts holds the molecule together more strongly, which means it requires more energy to pull them apart.

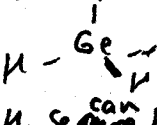
-4 (R) can H-bond better
-4 (L) being an alcohol weakens intermol forces
-3 (L) has higher surface tension due to mass only
-4 (R) forms fewer H-bonds
-1 (R) has dipole-dipole
-4 begs question, or random reason

(b) Which liquid will have the higher boiling point?

4pts (81 g mol^{-1}) H_2Se or GeH_4 (77 g mol^{-1}) same # of e$^-$'s.



is polar ⇒ dipole-dipole + dispersion.

4pts 

is non-polar ⇒ dispersion only

(-4) H_2Se can H-bond (or GeH_4)
(-3) $\Delta\chi$ of H-Se vs. H-Ge
(-3) mass/dispersion only
(-4) GeH_4 weighs more

(-4) GeH_4 is smaller
(-2) GeH_4 has more bonds (∴ ● $T_b(GeH_4)$ greater)
(-2) Ge atom is bigger than Se
(-4) GeH_4 ionic
(-4) lone pair creates more $\vec{E}$

3. (8 points) The endothermic "water gas" reaction

$$H_2O(g) + CH_4(g) \rightarrow CO(g) + 3\,H_2(g)$$

is commonly used in chemical plants to generate hydrogen gas. State and briefly explain two ways one can increase the yield of hydrogen gas in this reaction besides increasing the number of moles of $H_2O(g)$ or $CH_4(g)$.

(1) ↓ system P (more moles of gas on right)
(2) ↑ system V (ditto)
(3) Remove CO and H_2 (more right to restore product concentrations)
(4) ↑T (forward rxn is endothermic)

2 per means, 2 per explanation