Chemistry 3A - Fall 1998
Midterm Exam 2

Professor Jean Fréchet

October 20, 1998

Your full signature_____

Print your full name_____
(Last name, First name, Middle)

Your SID_____

Please check the section number and name of your GSI/TA.

___**111 Turculet,Laura**
___**121 Klei,Steven**
___**131 Krumper,Jennifer**
___**141 Downey,Karen**
___**211 Eng,Christina**
___**221 Shiau,Timothy**
___**311 Kita,Ryoko**
___**321 Davis,Anna**
___**331 Yeh,Robert**
___**341 Mork,Benjamin**
___**361 Fischer,Fabian**
___**371 Bennett,Miriam**
___**381 Fujdala,Kyle**
___**411 Hodges,Alan**
___**421 Ahrendt,Kateri**
___**431 Borths,Christopher**
___**511 Saxon,Eliana**
___**521 Wiener,John**
___**531 de Graffenried,Christopher**
___**541 Dosa,Peter**

If you are making up an I-grade, indicate the semester you took 3A_____ and the Professor_____.

This exam has **10** pages; **make sure that you have them all.** We will only grade answers that are in the designated spaces. Please do your scratch work on the backs of the exam pages. Write only **one** answer to each problem; multiple answers will receive **no** credit, even if one of them is correct.

Note: This examination runs for a total of 80 minutes. No questions will be answered by proctors after the exam begins. Please write legibly; ambiguous or messy answers will receive **no credit**.

A partial periodic table and data needed for calculations can be found on page **10** of the exam.

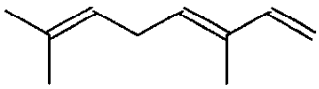
Do Not Write in this Box.
1._____(8)
2._____(8)
3._____(9)
4._____(10)
5._____(12)
6._____(8)
7._____(9)
8._____(11)
Total_____(75)

1. (8 points)

1. Name or draw, as appropriate, the following molecules according to IUPAC rules. Do not forget stereochemistry where appropriate.

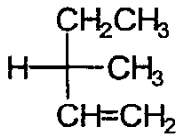
a. (2E,4E)-5-ethyl-6-methyl-2,4-heptadiene

b.



c. Fischer projection of (3R,4S)-3,4-dimethylhexane

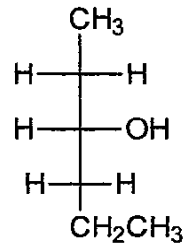
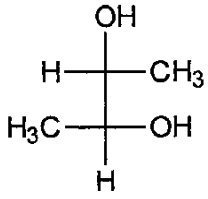
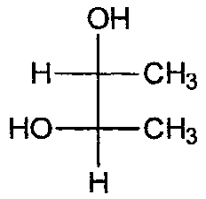
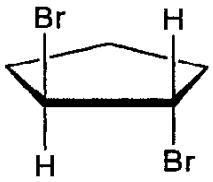
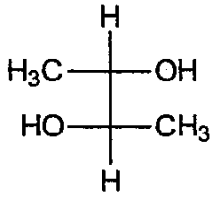
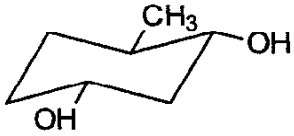
d.



2. (8 points)

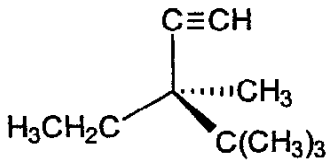
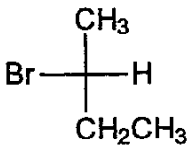
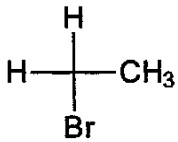
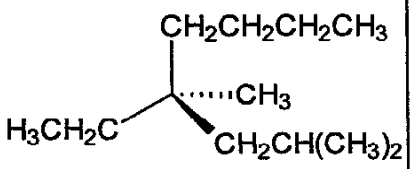
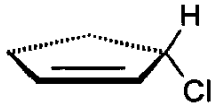
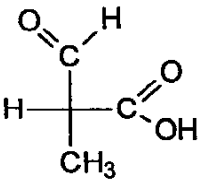
(2a) Consider the eight compounds below and write the number(s) of all MESO compounds in the answer box.

Answer:

1 	**2** 	**3** 
4 	**5** 	**6** 
7 	**8** 	

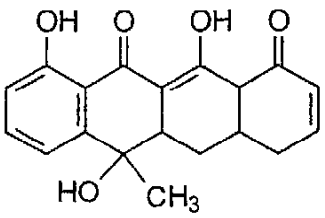
(2b) Consider the six compounds below and write the number(s) of all those shown in the S configuration in the answer box

Answer:

9 	**10** 	**11** 
12 	**13** 	**14** 

3. (9 points)

3a. The molecule below is a precusor of several members of the powerful family of tetracycline antibiotics. What is the maximum number of stereoisomers possible for this molecule? **Explain your answer**.



Answer:

Explanation:

3b. (R)-epinephrine is a powerful hormone that acts as a stimulator of the cardiac muscle. The pure R isomer of epinephrine has $[\alpha]_D = -50°$. A synthetic sample of of epinephrine with both R and S isomers in unequal amounts has $[\alpha]_D = -45°$.
What is the percent optical purity (also called enantiomeric excess) and the percentage of pure R isomer in the synthetic sample? Explain briefly and show your calculation.

Answers: Percent optical purity = % R isomer =

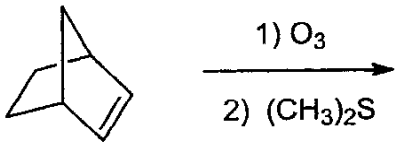
3c. Rank the following substituents in order of decreasing priority (Cahn-Ingold-Prelog)

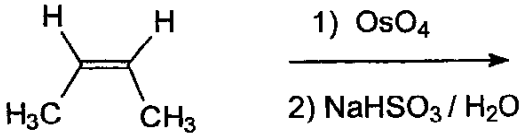
$-CH=CH_2$ $-CH_2NH_2$ $-CH(CH_3)_2$

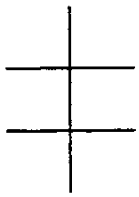
Answer: _____ > _____ > _____

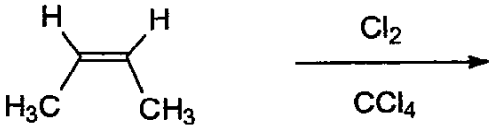
highest priority *lowest priority*

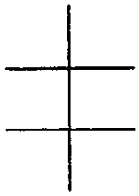
4. (10 points). Show the structure of the major product(s) obtained in each of the following reactions. Your answers must show clear stereochemistry where applicable. If no reaction occurs, write NR. Do not show any mechanisms.

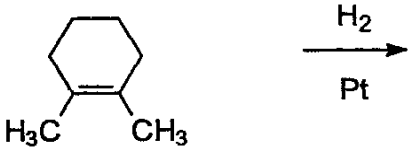






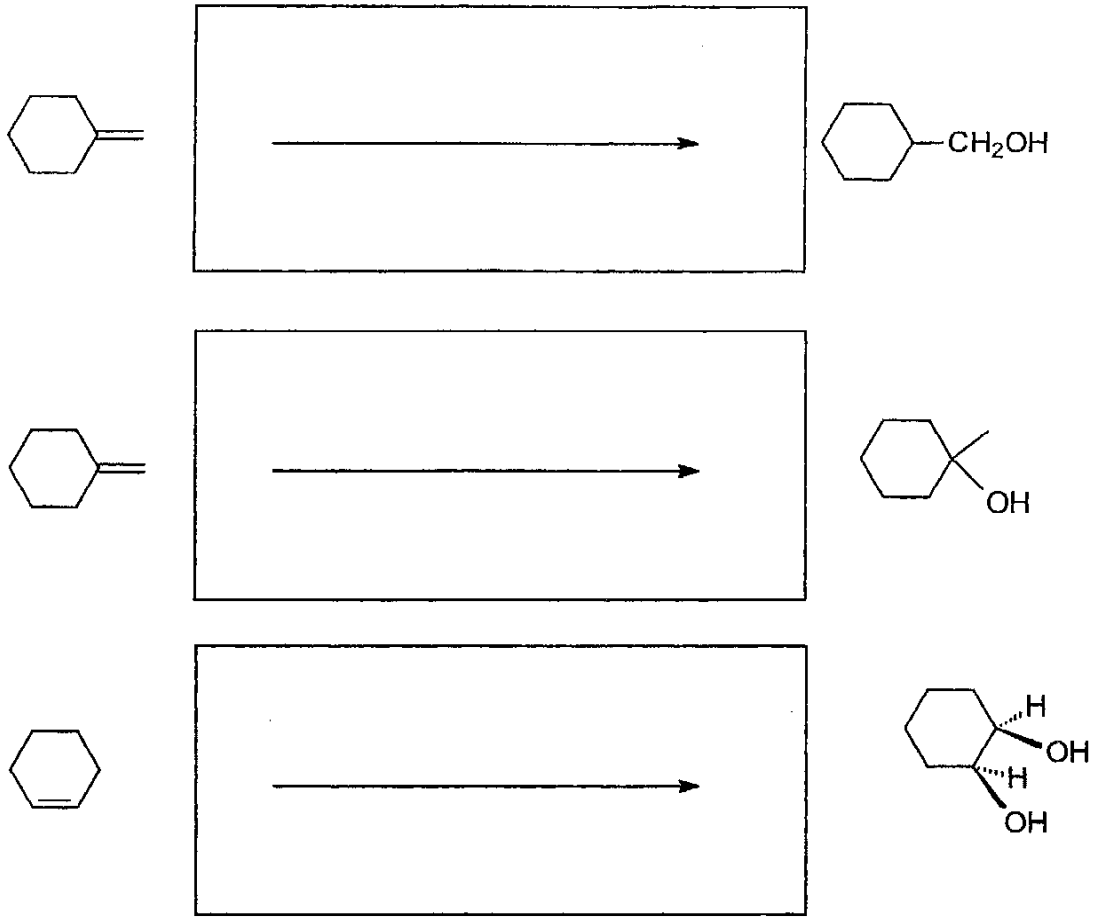






5. (12 points)

5a. Complete the following reactions showing the missing reagents.



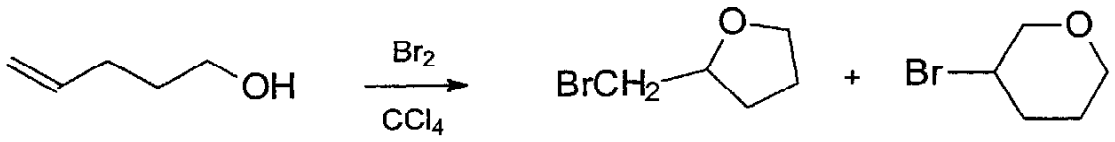
5b. Assuming that the specific rotation of (2R,3R)-2,3-dibromobutane is $[\alpha]_D = -10°$, what is the value of $[\alpha]_D$ for (2R,3S)-2,3-dibromobutane? Explain your answer in one sentence.

Answer: $[\alpha]_D =$

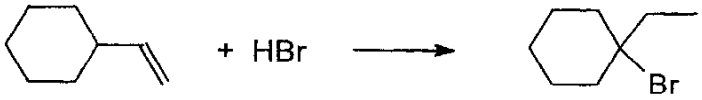
Explanation:

6. (8 points)

The reaction below might lead to the two products shown , in fact, only one is actually obtained. Circle it and show a detailed mechanism to explain why it is formed exclusively. Your mechanism must show all steps and relevant transition states, and include curved arrows to depict the movement of electrons.



7. (9 points) (a) Write a step by step mechanism accounting for all steps in the following reaction. Explain briefly why the bromine atom becomes attached to the ring.



(b) a second product is obtained in reasonable yield in the above reaction, write a clear structure for this second product (no mechanism needed).

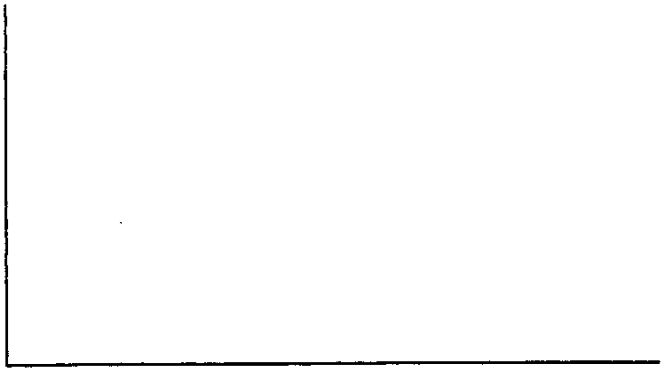
Answer:

8. (11 points)

Consider the reaction below for which $\Delta H° = +28$ kcal mol^{-1} and $\Delta S° = +0.03$ kcal mol^{-1}

$$H_3C-CH_2-CH_2-CH_3 \longrightarrow H_3C-CH=CH-CH_3 + H_2$$

(a) Given that no intermediate is involved in this reaction draw an energy diagram showing all labels.



(b) This reaction is actually an equilibrium, explain in one sentence why the entropy term favors the formation of butene and hydrogen from butane

$$H_3C-CH_2-CH_2-CH_3 \rightleftharpoons H_3C-CH=CH-CH_3 + H_2$$

(c) Using the values of $\Delta H°$ and $\Delta S°$ given above, calculate the temperature at which the equilibrium constant will be equal to 1. Show the equation you use and your detailed calculation.

Answer: Temperature =

Note: **There are no questions to be answered on this page**, it only contains data that may be of use in solving the questions contained in this exam. Not all of the data given is needed.

Value of gas constant: R = 2.0 cal deg^{-1} mol^{-1}

Value of e (base for natural logarithms) e = 2.718

Value of absolute zero (kelvin) = -273°C

Partial periodic table of the elements

1 H 1.00794																	2
3 Li 6.941	4 Be 9.01218											5 B 10.811	6 C 12.011	7 N 14.0067	8 O 15.9994	9 F 18.9984	10
11 Na 22.9898	12 Mg 24.3050	IIIB								IIB		13 Al 26.9815	14 Si 28.0855	15 P 30.9738	16 S 32.066	17 Cl 35.4527	18
19 K 39.0983	20 Ca 40.078	21 Sc 44.9559								30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.9216	34 Se 78.96	35 Br 79.904	36	
37 Rb 85.4678	38 Sr 87.62	39 Y 88.9059								48 Cd 112.411	49 In 114.82	50 Sn 118.710	51 Sb 121.75	52 Te 127.60	53 I 126.904	54	