

**Chemistry 3A - Spring 2000
Midterm 2**

Professor Jean Fréchet

March 16, 2000

Your full signature _____

Print your full name _____

(Last name, First name, Middle)

Your SID _____

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

___ 161 Verdugo, Dawn

___ 171 Klopp, John

___ 181 Borths, Christopher

___ 191 Furdala, Kyle

___ 111 Watkins, Gregory

___ 121 Blackwell, Bethany

___ 131 Fox, Daniel

___ 141 Werkema, Evan

___ 261 Peterka, Darcy

___ 271 Lee, Charles

___ 211 Tripp, Jennifer

___ 221 Padilla, Omayra

___ 361 Haman, Kristina

___ 371 Hecht, Stefan

___ 311 Saxon, Eliana

___ 321 Cook, Brian

___ 461 Purdy, Matthew

___ 471 Evans, John

___ 411 Holland, Andrew

___ 421 Duncan, Andrew

___ 431 Trimble, Alexander

___ 511 Marcaurette, Lisa

521 Jen, Wendy

___ 531 Ling, Frank

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 90 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.

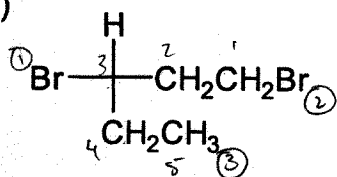
Do Not Write in this Box.

1. ___	_(9)
2. ___	_(12)
3. ___	_(10)
4. ___	_(15)
5. ___	_(12)
6. ___	_(18)
7. ___	_(12)
8. ___	_(12)
Total	(100)

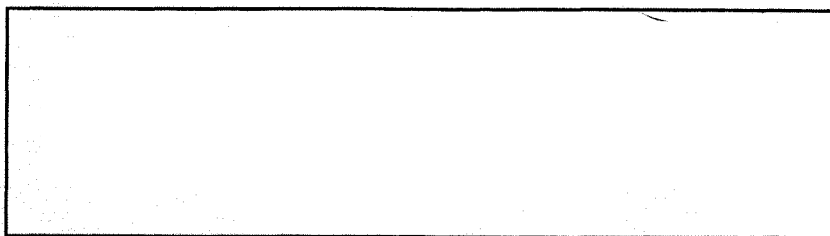
1. (9 points)

Name or draw, as appropriate, the following molecules. Do not forget stereochemistry where appropriate.

(a)

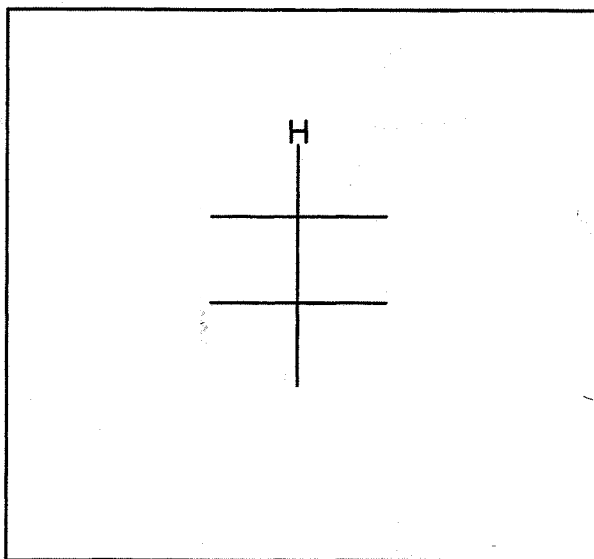
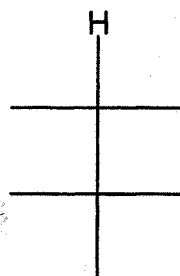


(IUPAC name)

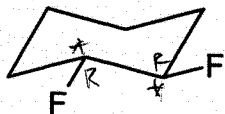


(b) (2S,3S)-2-bromo-3-methylpentane

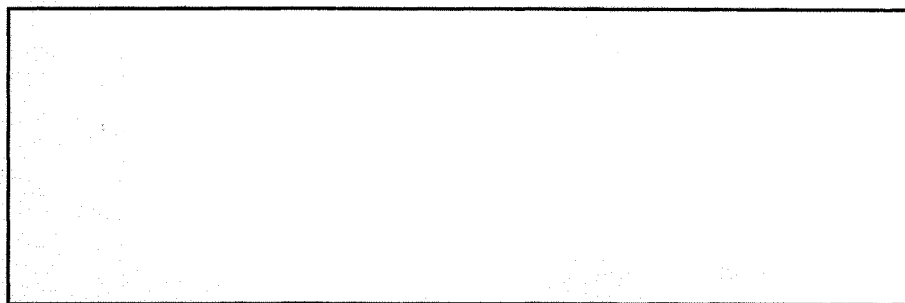
(Fischer Projection)



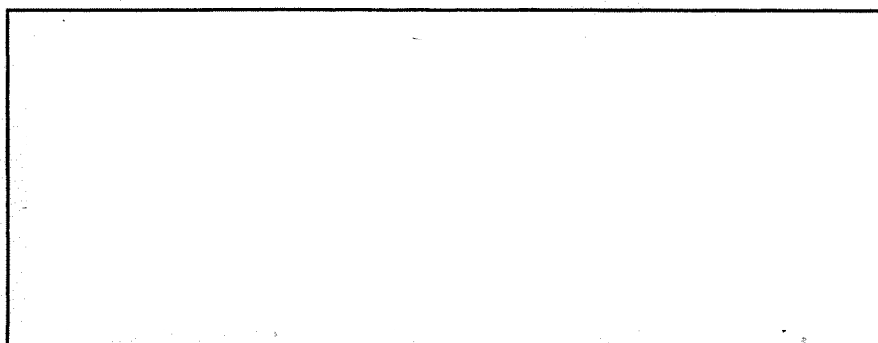
(c)



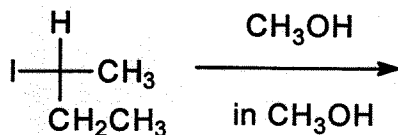
(IUPAC name)



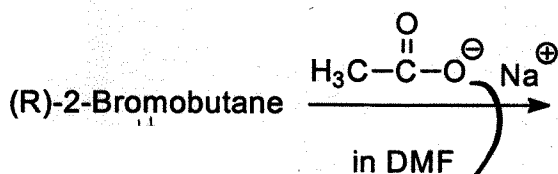
(d) Lithium diisopropylamide



2. (12 Points). (a) Consider the two different substitution reactions shown below. Assume that no elimination side-reaction takes place. Draw a clear **Fischer projection** for each product(s) obtained in each of these reactions; also write an equation showing the **RATE law** for each reaction.

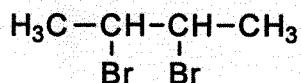


Rate =



Rate =

- (b) Draw a Newman projection and a sawhorse projection for the most stable conformation of meso-2,3-dibromobutane

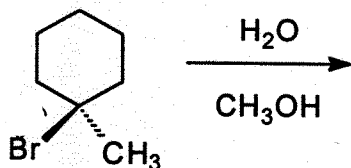


3. (11 points) (a) A partly racemized mixture of enantiomers of limonene with an optical purity of 80% has an optical rotation of $+92^\circ$. Given that (R)-limonene is known to have a positive optical rotation, calculate the percentage of (S)-limonene in the mixture and the optical rotation of pure (S)-limonene. Show the equation used and also the details of your calculation.

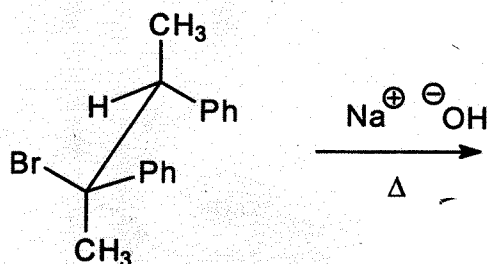
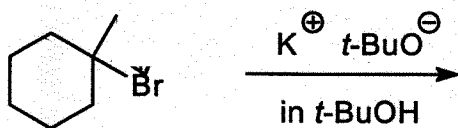
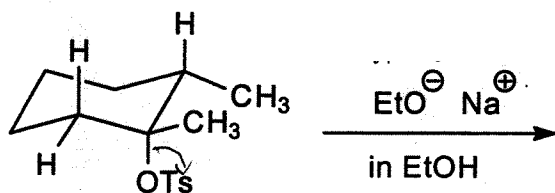
Answers. % of (S) in mixture=

Optical rotation of
pure (S)-limonene:

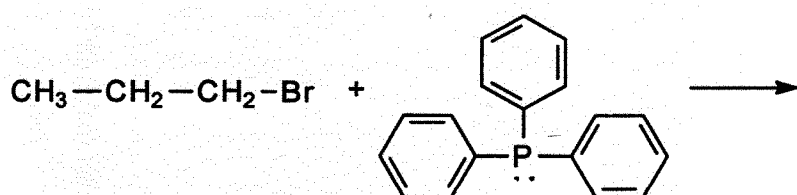
(b) Write clear structures for all of the products that may be formed when 1-bromo-1-methylcyclohexane reacts with a mixture of water and methanol. No mechanisms are needed.



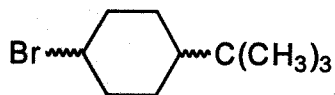
4. (15 points). (a) Complete the following reactions showing the structure of the MAJOR product. Show clear stereochemistry where appropriate. Write NR if there is no reaction.



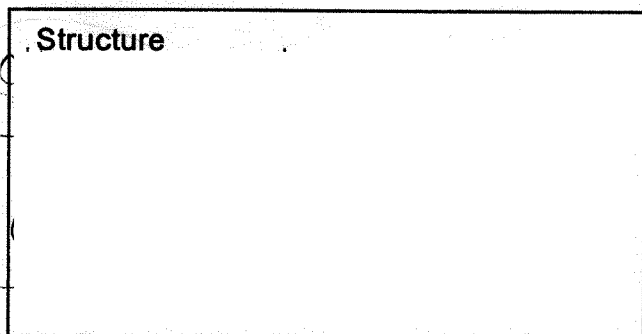
(show the product as a Fischer projection)



5. (12 Points). (a) Which of the two stereoisomers of 1-bromo-4-*t*-butylcyclohexane will react faster in an E₂ Elimination reaction with EtO[⊖] as the base? Draw clear chair structures of the two stereoisomers, circle the most reactive stereoisomer and explain briefly.

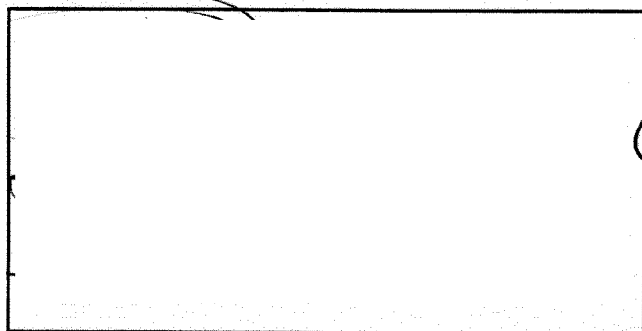


(b) Write a clear structure for a primary halide that is essentially unreactive in an S_N2 reaction and give a brief explanation of your answer



Brief explanation

(c) Write a clear structure for a primary halide that reacts easily in an S_N1 reaction and give a brief explanation of your answer

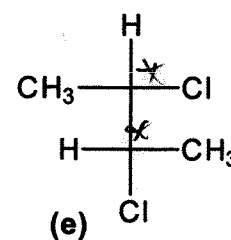
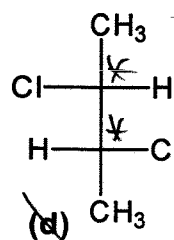
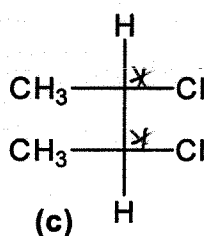
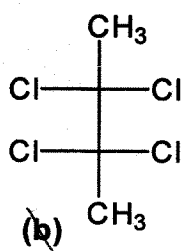
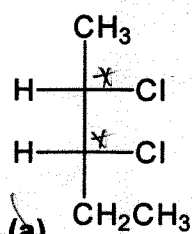


Brief explanation

6. (17 points) (a) 20 milliliters of a solution containing 2.2 grams of a compound rotate the plane of polarized light $+0.66^\circ$ in a polarimeter with a 2 decimeter long sample tube. What is the specific rotation of the sample? Show equation and calculations.

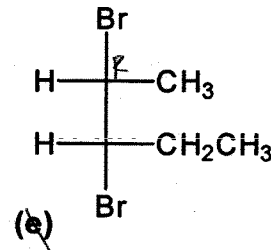
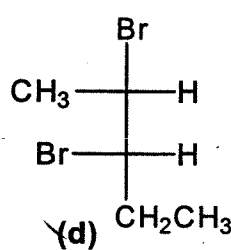
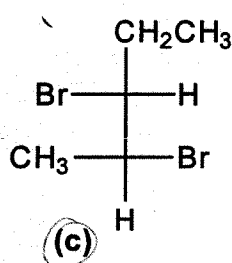
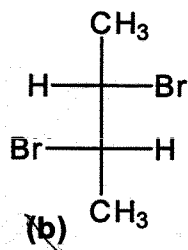
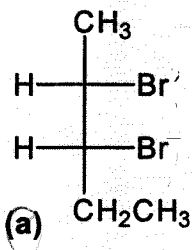
Answer:

- (b) Which of the following are meso compounds? Write the answer(s) in the box provided but do not guess as wrong answers will result in point deductions from correct answers.



Answer(s):

- (c) When (S)-2-bromopentane is brominated, several 2,3-dibromopentanes are formed. Which of the following are formed? (Note: wrong answers will result in point deductions).



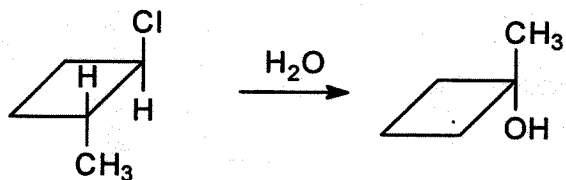
Answer(s):

- (d) Which of the following statements are **FALSE**? (Note: wrong answers will result in point deductions)

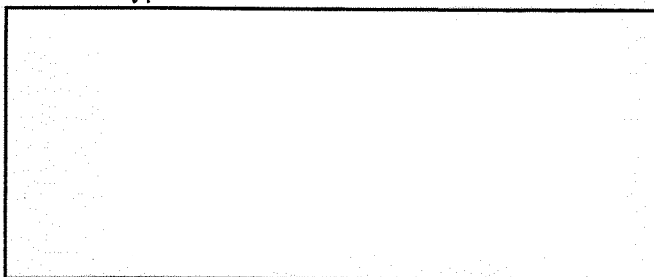
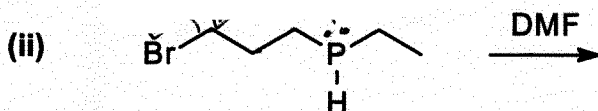
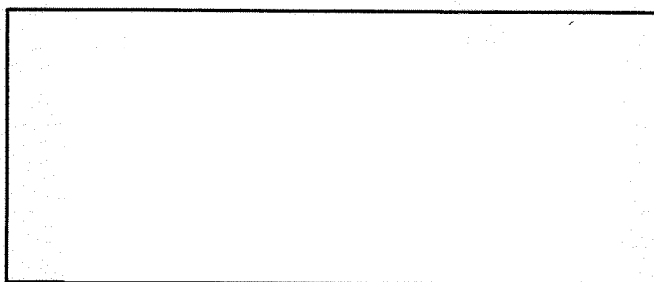
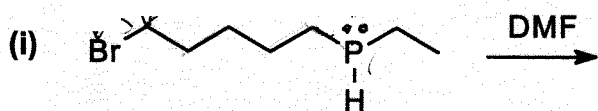
- (1) A compound with three asymmetric carbons may have up to nine stereoisomers.
- (2) The most stable conformation of cis-1,2-dimethylcyclohexane has both methyls equatorial
- (3) Meso compounds do not rotate polarized light
- (4) Diastereomers always have the same boiling points
- (5) 2,3-difluoropentane has a stereoisomer that is a meso compound.
- (6) R and S enantiomers always have the same specific rotation
- (7) S_N2 reactions are second order reactions
- (8) S_N1 reactions involve carbocationic intermediates

Answer(s):

7. (12 points). (a) Write a step-by-step mechanism (include arrows) for the reaction below:

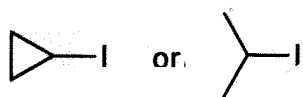


(b) The compounds shown below both react spontaneously at room temperature. Which of the two reactions is fastest and why? Show the structures of the products and explain your answer.



Fastest reaction is: Explanation:

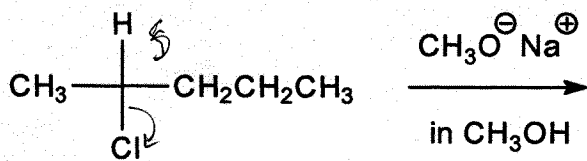
8. (12 Points) (a) Which of the following alkyl iodides will react faster in a reaction with $\text{Na}^{\oplus} \text{CN}^{\ominus}$ in DMF?



Circle your answer and provide a brief but clear explanation for the difference in reactivity.

Explanation:

- (b) Show ALL the products obtained in the following reaction (no mechanism needed):



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: $R = 2.0 \text{ cal deg}^{-1} \text{ mol}^{-1}$

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

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

Partial periodic table of the elements

GROUP	I A	II A	III B	IV B	V B	VI B	VII B	0
VALENCES	+1	+2	+3	-4 +4	-3 +5	-2 +6	-1 +7	0
PERIOD	1							2
	H 1.008							He 4.003
2	3 Li 6.941	4 Be 9.012	5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
3	11 Na 22.99	12 Mg 24.31	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
4	19 K 39.10	20 Ca 40.08	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
5	37 Rb 85.47	38 Sr 87.62	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3