Seat No._____ Last Name WST

Lecture Section A First Name _____

PLEASE REMOVE LAST PAGE OF EXAM BEFORE PRINTING YOUR NAME ON THE BACK OF PAGE 13. THERE ARE 14 PAGES TO THIS EXAM

FINAL EXAM
CHEMISTRY 331
Fall 2007
Tuesday, December 11
7:00 to 9:00 p.m.

Course Grade

I. (24 pts) = _____

II. (72 pts)

24 pts	24 pts	24 pts
A-H	I-P	Q-X

= _____

III. (15 pts) = _____

IV. (20 pts) = _____

V. (9 pts) = _____

VI. (7 pts) = _____

VII. (15 pts) = _____

VIII. (18 pts) = _____

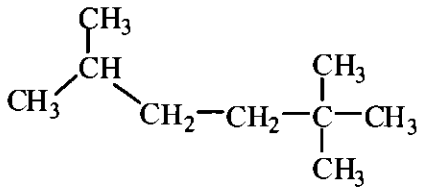
IX. (7 pts) = _____

X. (13 pts) = _____

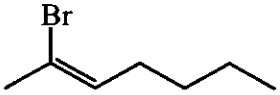
TOTAL FINAL EXAM (200 pts) = _____

Exams will be held until May 1, 2008.

I. (24 pts) Provide a proper name for each of the following compounds. (Include **R** or **S**, **cis** or **trans**, or **Z** or **E** when required).

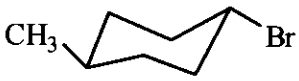
A. 

2,2,5-trimethylhexane

B. 

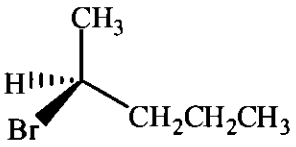
or 2 here, or here

~~Z~~-2-bromo-2-heptene

C. 

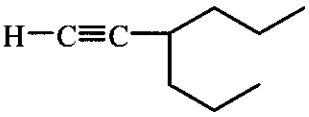
(E OK) trans-1-bromo-4-methylcyclohexane

1pt

D. 

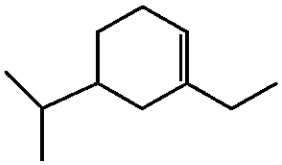
5-2-bromopentane

1pt

E. 

or 1 here, or here

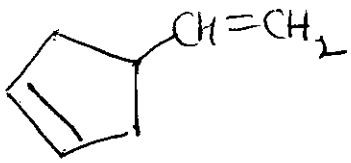
3-propyl-1-hexyne

F. 

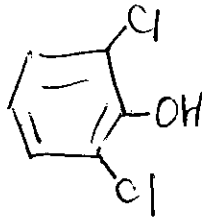
1-ethyl-5-isopropylcyclohexene

Write structural formulas for the following:

G. 4-vinylcyclopentene



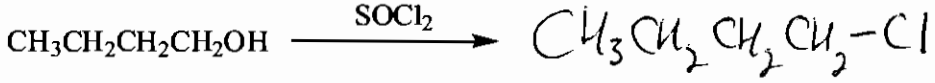
H. 2,6-dichlorophenol



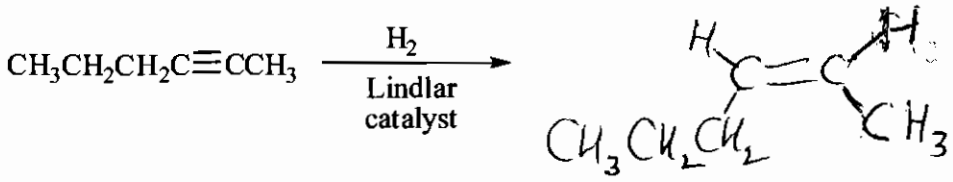
II. (72 pts) Complete the following equations giving <u>all organic</u> product(s) or reagents as required. Stereochemistry must be clearly indicated in reactions that are stereoselective.

3 pts each

A.

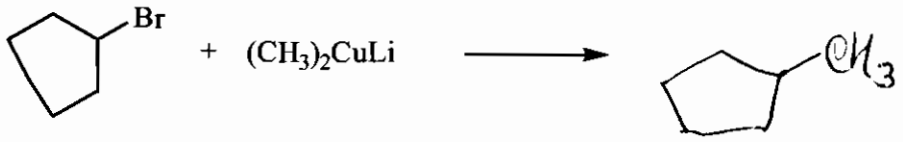


B.

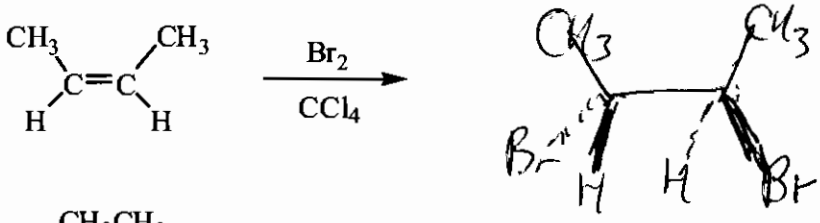


-1 if not cis

C.

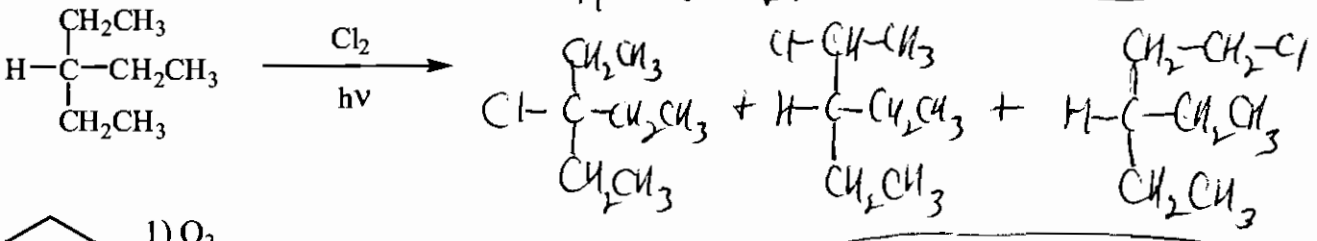


D.

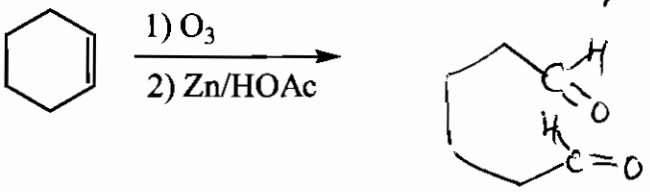


-1 if not trans addition

E.

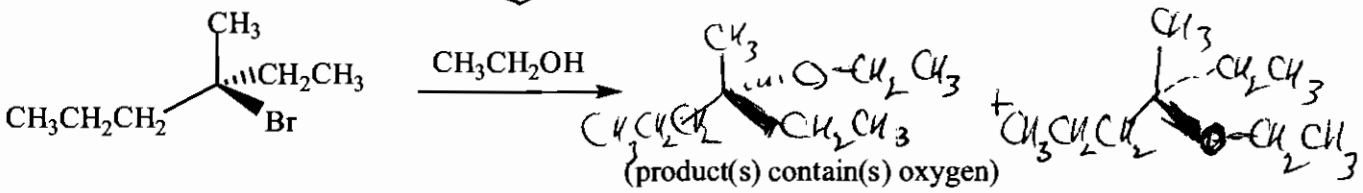


F.



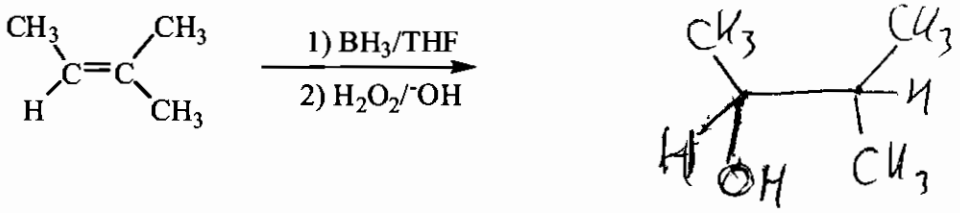
1 pt per product

G.



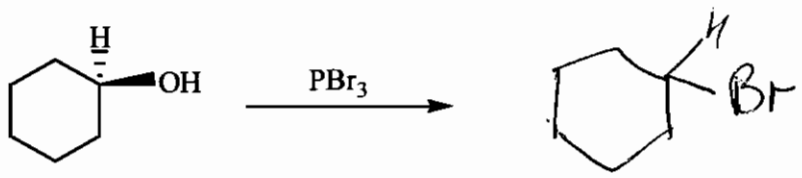
(product(s) contain(s) oxygen)

H.

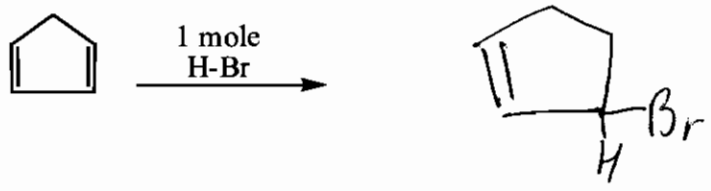


(both enantiomers)

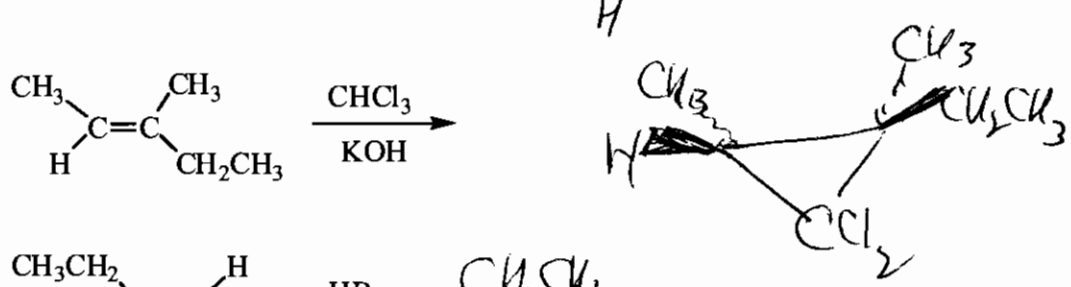
I.



J.

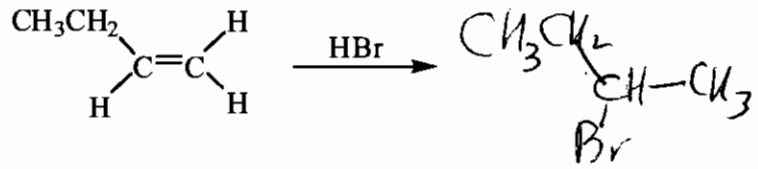


K.

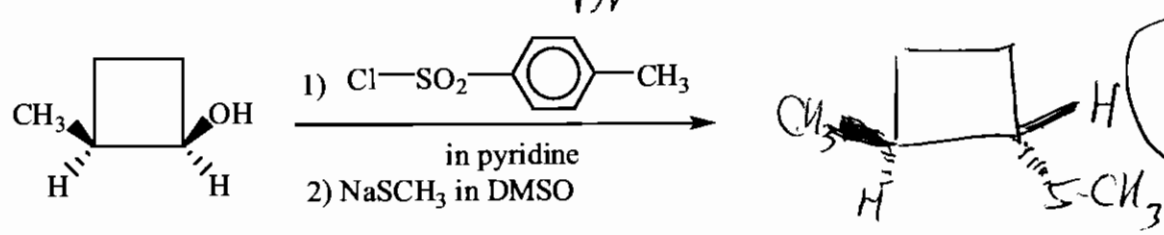


-1 y not prefer isomer

L.

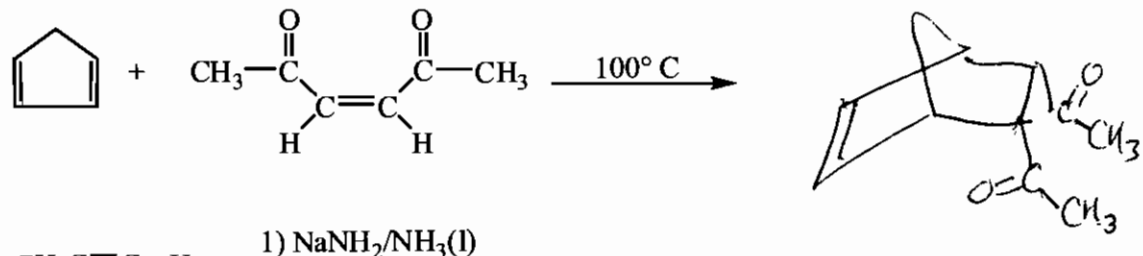


M.



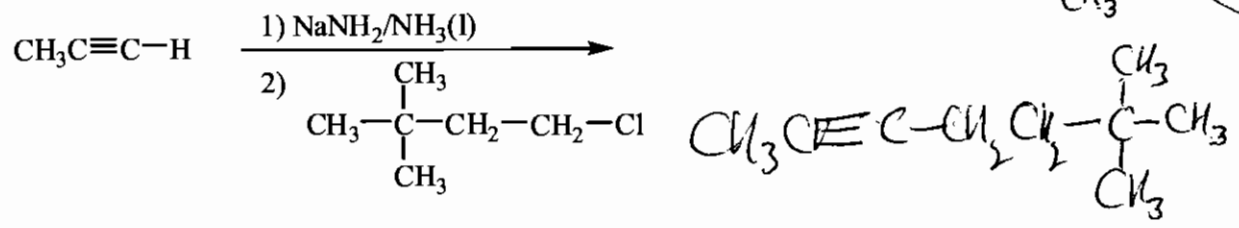
-1 y not trans

N.

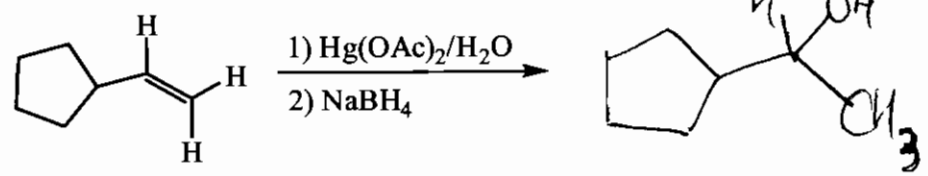


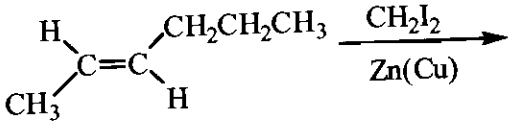
any stereo-isomer ok

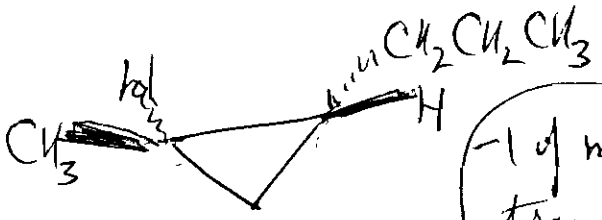
O.



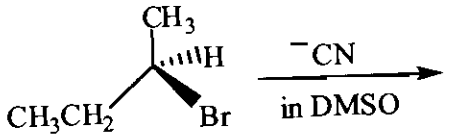
P.

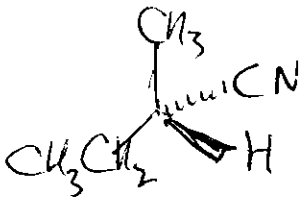


Q. 

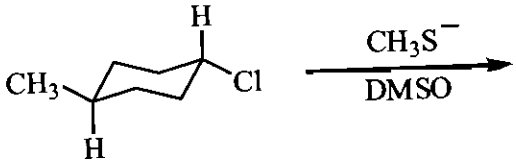


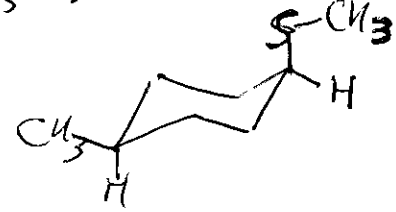
−1 if not trans

R. 



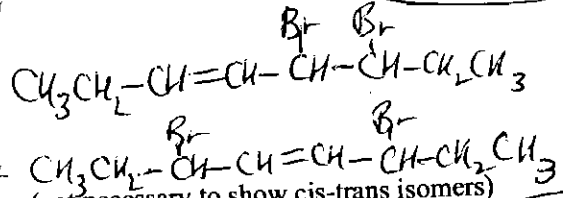
−1 if not pure isomer

S. 



−1 if not pure isomer

T. $CH_3CH_2CH{=}CHCH{=}CHCH_2CH_3$ $\xrightarrow[CCl_4]{1\text{ mole }Br_2}$

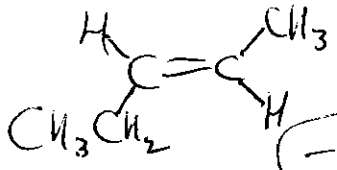


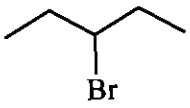
(not necessary to show cis-trans isomers)

3 pts for 2 products. 1 pt for 1

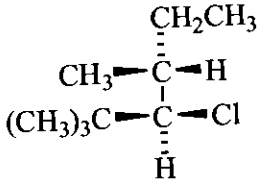
−1 if not trans

U. $CH_3CH_2C{\equiv}CCH_3$ $\xrightarrow{Na/NH_3(l)}$

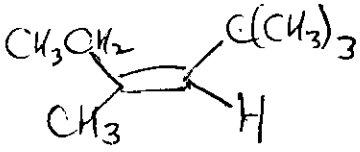


V. 

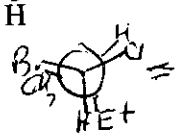
$\xrightarrow[2)\ D_2O]{1)\ Mg,\ Et_2O}$

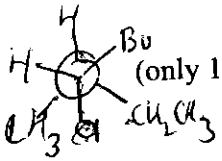
W. 

$\xrightarrow[\text{in EtOH}]{NaOEt}$

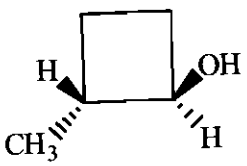


−1 if not preferred isomer.

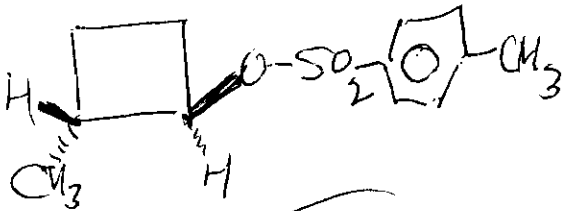




(only 1 product; no O in product)

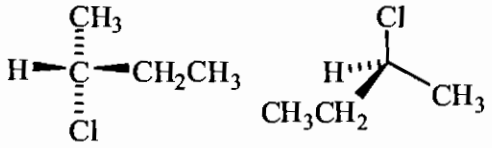
X. 

$\xrightarrow[\text{in pyridine}]{CH_3\text{-}C_6H_4\text{-}SO_2Cl\ (=TosCl)}$

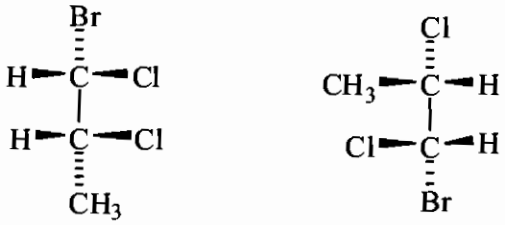


−1 if not preferred isomer.

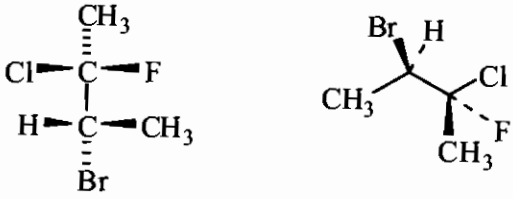
III. (15 pts) For each of the following pair of compounds, label them as enantiomers, diastereomers, or identical. These are not frozen structures. Rotation around any single bond is possible.

A. 

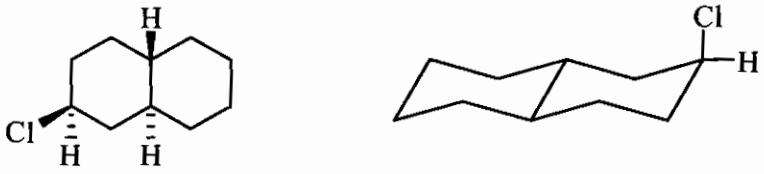
enantiomers

B. 

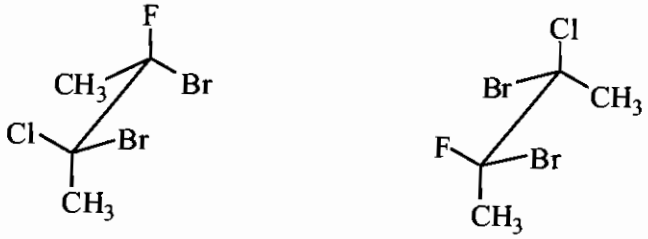
diastereomers

C. 

enantiomers

D. 

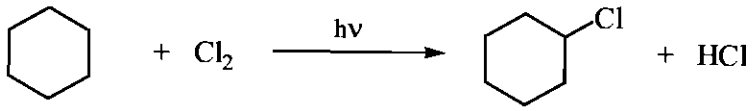
diastereomers

E. 

diastereomers

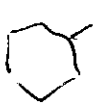
IV. (20 pts.) Draw a reasonable mechanism for **TWO** of the following three reactions. (If you do more than two, only A. and B. will be graded.)

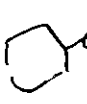
A.



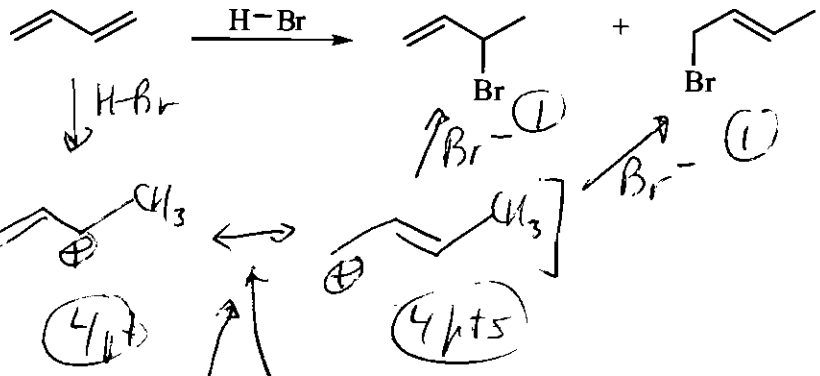
(2) $Cl_2 \xrightarrow{h\nu} Cl\cdot + Cl\cdot$

(3) $Cl\cdot +$  $\longrightarrow$  $+ HCl$

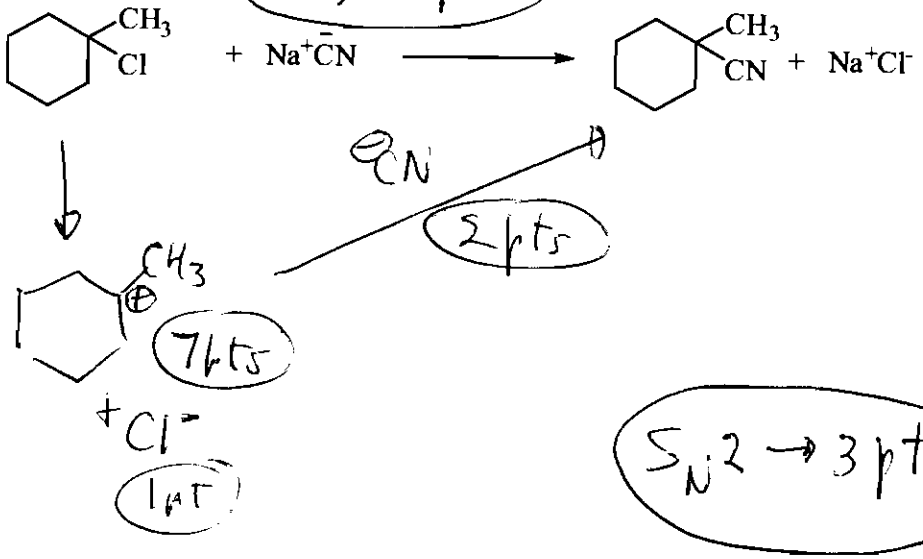
(2)  $+ Cl_2 \longrightarrow$  $+ Cl\cdot$

(3)  $+ Cl\cdot \rightarrow$  + other $Z\cdot + Z'\cdot \rightarrow Z\text{-}Z'$ reactions

B.

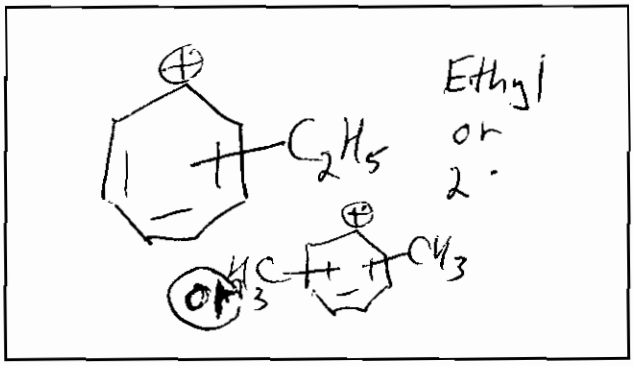


C.

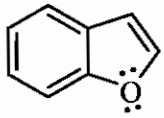


V. (9 pts.)

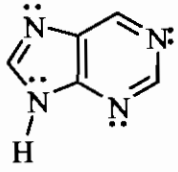
A. (5 pts) In the box provided draw the structure of an <u>aromatic</u> cation that has the formula $C_9H_{11}^+$.



B. (4 pts) How many π electrons are there for

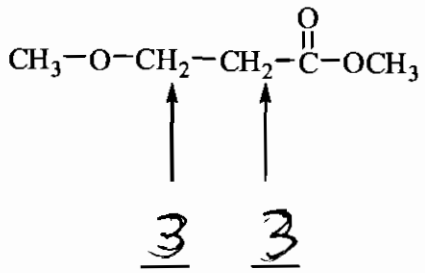
1. 

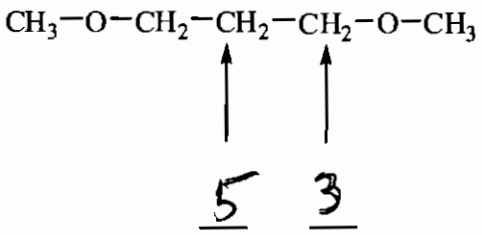
10

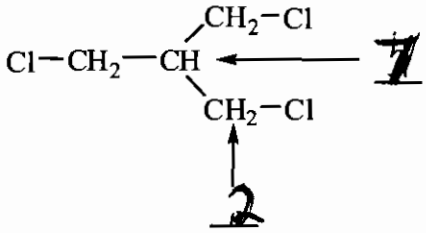
2. 

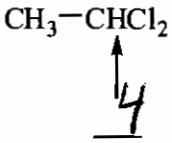
10

VI. (7 pts.) Into how many peaks will the signal for each of the indicated protons be split? (one = singlet, two = doublet, etc).



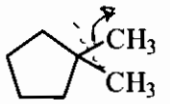




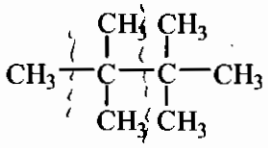


VII. (15 pts) Circle the correct answer.

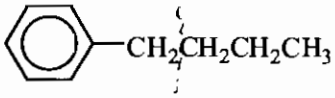
A. The compound which would be most likely to give a mass spectrum with a prominent peak at *m/e* 83 = is

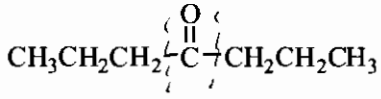
1. 

$C_6H_{11}^{\oplus}$ = 83

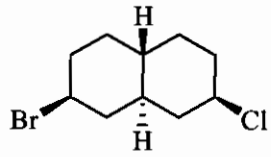
2. 

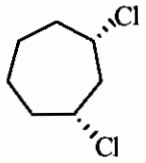
C_4H_7O 48 + 16 + 7 = 71

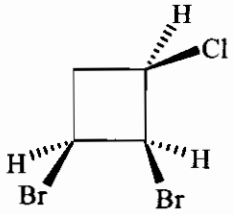
3. 

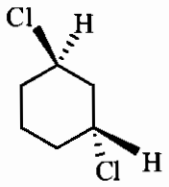
4. 

B. Which compound is a meso compound?

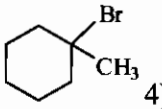
1. 

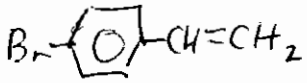
2. 

3. 

4. 

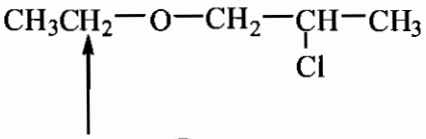
C. The most reactive alkyl halide in an S_N2 reaction is

1) $CH_3CH_2CH_2CH_2Br$ 2) $CH_3CH_2–CHBr–CH_3$ 3)  4) $(CH_3)_3C–CH_2–Br$

D. The molecular formula of *para*-bromostyrene is 

1) C_6H_5BrO 2). C_8H_7Br 3) C_8H_9Br 4) $C_7H_5BrO_2$

E. The hydrogen atoms indicated by the arrow are:



a) homotopic b) enantiotopic c) diastereotpic d) unrelated

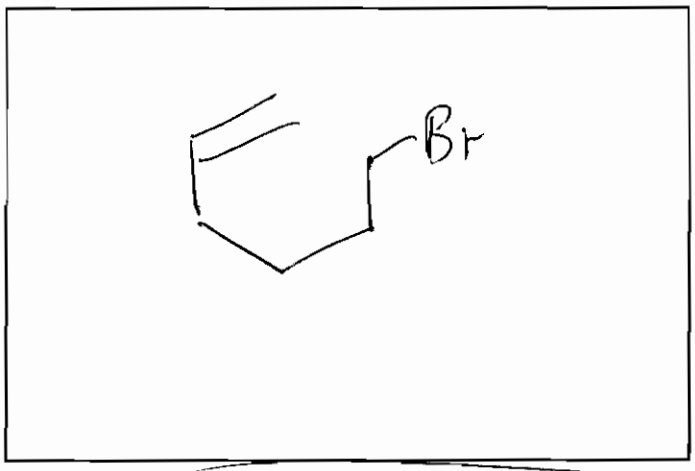
VIII. (18 pts) For each of the following compounds, propose a structure in the box provided that fits the data presented.

A. (6 pts) $C_6H_{11}Br$

^{1}H NMR:
- δ 5.8 (1,m)
- δ 5.0 (2,m)
- δ 3.4 (2,t)
- δ 2.1 (2,m)
- δ 1.9 (2,m)
- δ 1.6 (2,m)

Broadband decoupled ^{13}C NMR:
- δ138.1
- δ115.0
- δ 33.7
- δ 32.9
- δ 32.2
- δ 27.4

IR: 3000 cm^{-1}



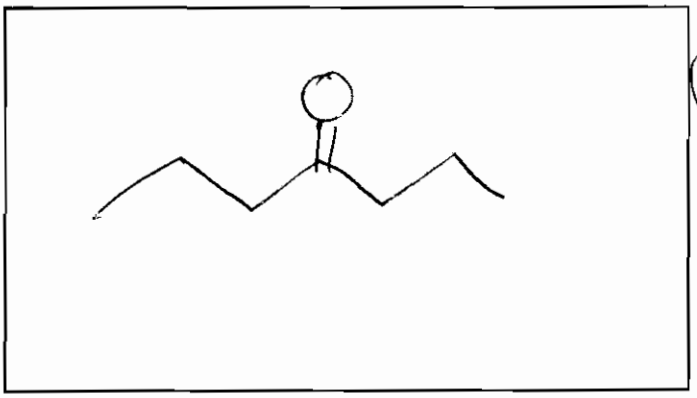
2 pts for $-CH=CH_2$

B. (6 pts) $C_7H_{14}O$

^{1}H NMR:
- δ 2.4 (4,t)
- δ 1.6 (4, m)
- δ 0.9 (6,t)

Broadband decoupled ^{13}C NMR:
- δ 211.2
- δ 45.0
- δ 17.6
- δ 14.0

IR: 1710 cm^{-1}



1 pt $C=O$

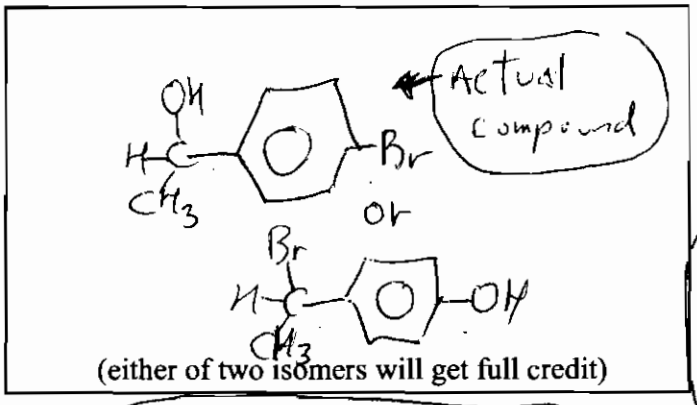
C. (6 pts) C_8H_9BrO

^{1}H NMR
- δ 7.4 (2,d)
- δ 7.2 (2,d)
- δ 4.8 (1,q)
- δ 2.5 (1,s)
- δ 1.4 (3,d)

Broadband decoupled ^{13}C NMR

δ 144.7	δ 121.0
δ 131.4	δ 69.6
δ 127.1	δ 25.2

IR: 3500 cm^{-1}, 1100 cm^{-1}



(either of two isomers will get full credit)

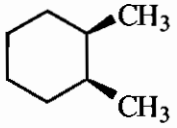
1 pt for $-OH$

1 pt for para benzene ring

meta isomer → 3 pts

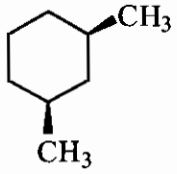
IX. (7 pts) How many ^{13}C signals would each of the following compounds show? Put your answer in the blank provided.

A.



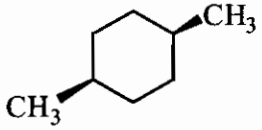
4

B.



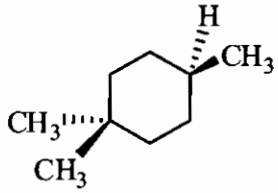
5

C.



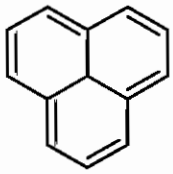
3

D.



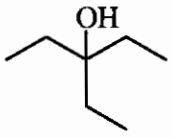
7

E.



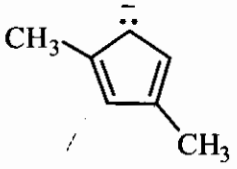
4

F.



3

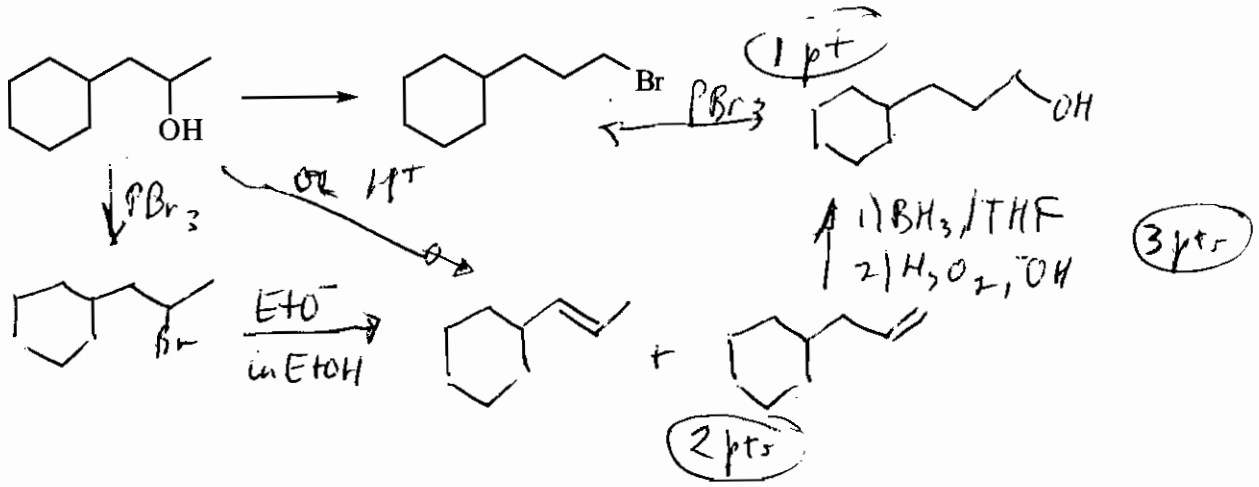
G.



4

X. (13 pts) Beginning with the starting material indicated, show how to achieve each of the following syntheses by showing all the reactions that are needed (for each reaction, give the starting material, conditions over the arrow, and the products). You may use any inorganic compound or organic compound with one or two carbon atoms.

A. (6 pts)



B. (7 pts)