

Seat No. \_\_\_\_\_

Last Name: WST

First Name: \_\_\_\_\_

There are 8 pages to this exam. Check to make sure you have a complete exam.

PLEASE ALSO PRINT YOUR NAME ON THE TOP OF  
THE **BACK** OF THE LAST PAGE OF THE EXAM

**CHEMISTRY 331**

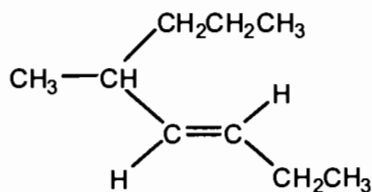
**EXAM II**

Spring 2007 (2/16/07)

I.	(15 Points)	_____
II.	(9 Points)	_____
III.	(15 Points)	_____
IV.	(6 Points)	_____
V.	(11 Points)	_____
VI.	(6 Points)	_____
VII.	(7 Points)	_____
VIII.	(14 Points)	_____
IX.	(8 Points)	_____
X.	(9 Points)	_____
TOTAL	(100 Points)	<b>_____</b>

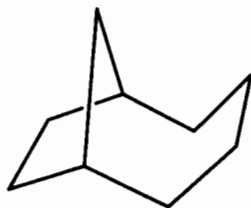
I. (15 points) Give the proper name for the following structures (including stereochemical designation when required; for stereoisomers use *E*-, *Z*-notations).

A.



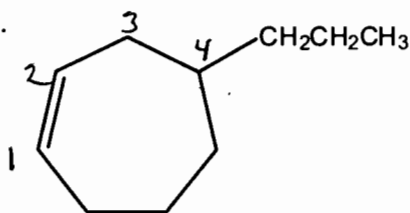
(or 3 here) or here)  
*E*-5-methyl-3-octene  
 ↑  
 1 pt.

B.



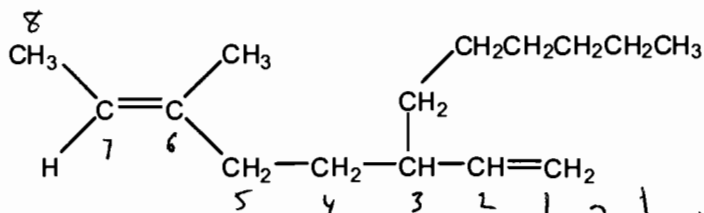
bicyclo[4.2.1]nonane  
 (1 pt) (1 pt) (1 pt)

C.



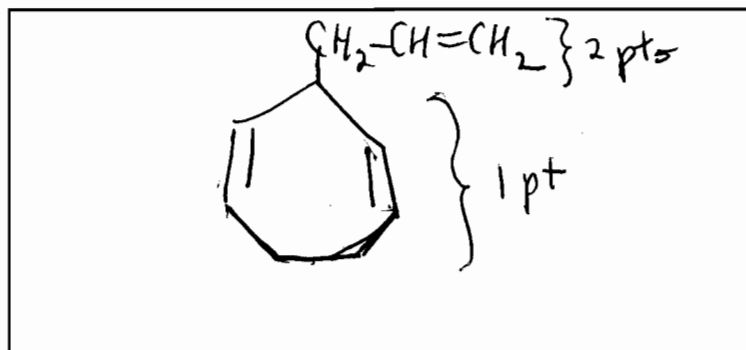
4-propylcycloheptene

D.



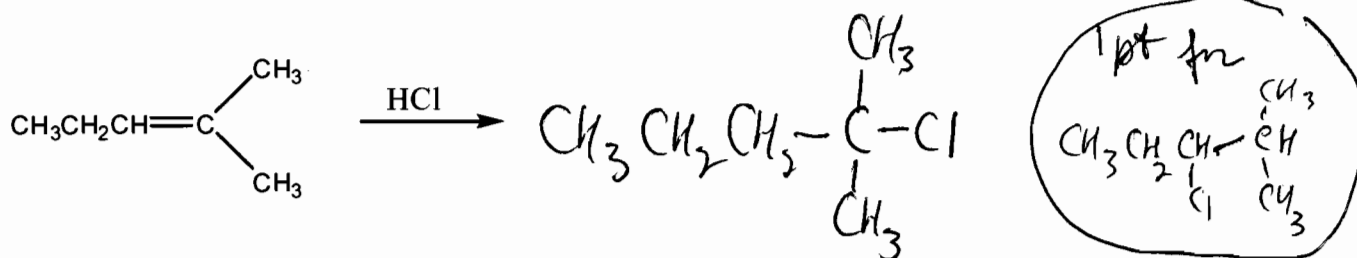
(or -1,6 here, or here)  
*E*-3-hexyl-6-methyl-1,6-octadiene

E. Give the structure of 3-allyl-1,4-cycloheptadiene.

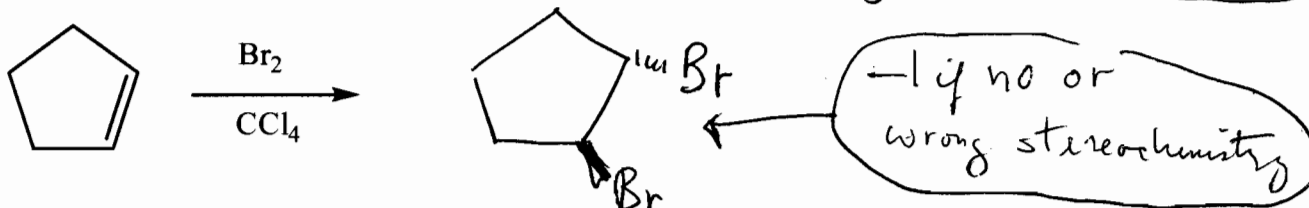


II. (9 points) Complete each of the following reactions by providing the products. Show the stereochemistry where required.

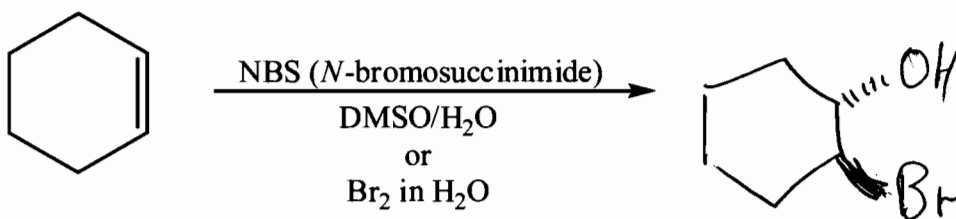
1.



2.

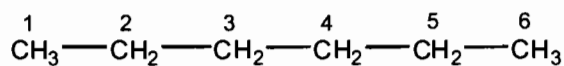


3.



III. (15 points)

A. (6 points) Consider rotation about the C<sub>3</sub>-C<sub>4</sub> bond of hydrocarbon A.

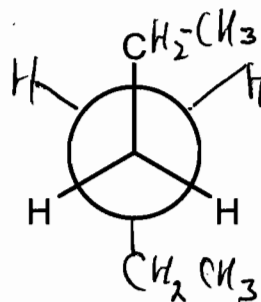


A

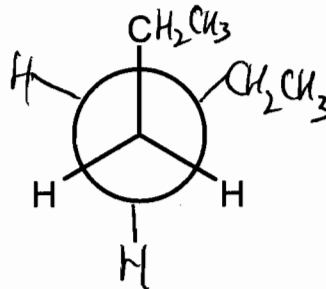
Complete the Newman projections to show conformations which fit the following descriptions.

1. The **most** stable conformation.

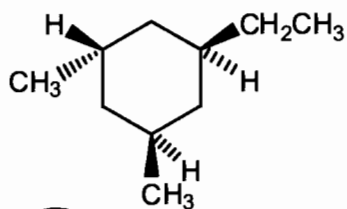
-1 if all ~~atoms~~ Hs on C<sub>2</sub>  
~~are~~ are not shown.  
 -2 if all C<sub>5</sub> are not shown



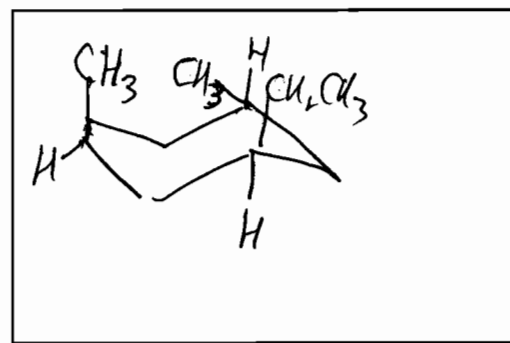
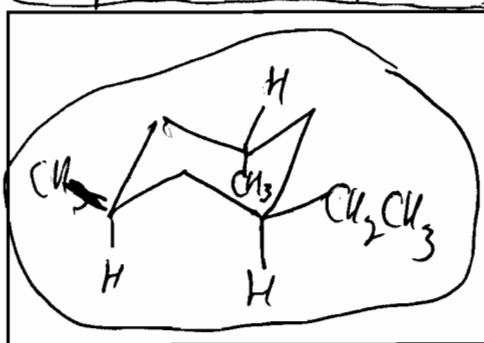
2. The **less** stable staggered conformation.



B. (6 points) Draw the two interconverting chair conformations of the following molecule and circle the more stable one.



-1 if mirror image of this is given.



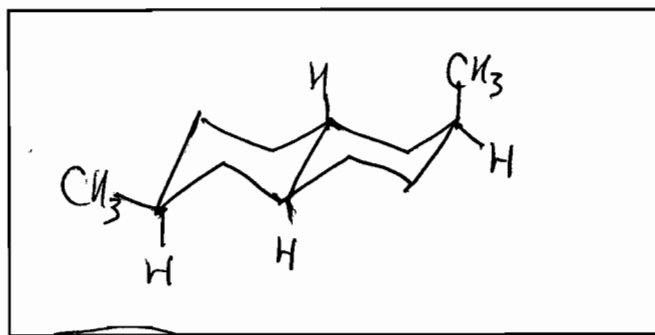
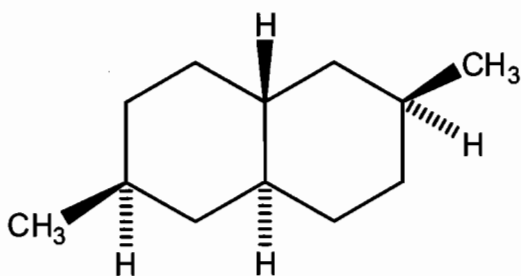
1 pt if both confs are incorrect but at least one has a chain

3 pts for one correct conf.

1 pt for correct circle

2 pts for a 2nd correct conf. (must come from inverting the chain of the 1st conf.)

C. (3 points) Draw the most stable conformation of the following molecule.



1 pt for correct trans-decalin structure  
2 pts for correct substituents

IV. (6 points) Calculate the degree of unsaturation for the following formulas.

A.  $C_{18}H_{26}Br_2Cl_2 \rightarrow C_{18}H_{(26+2+2)} = C_{18}H_{30}$  4

alkane =  $C_{18}H_{38}$

$$\begin{array}{r} 38 \\ -30 \\ \hline 8 \div 2 = 4 \end{array}$$

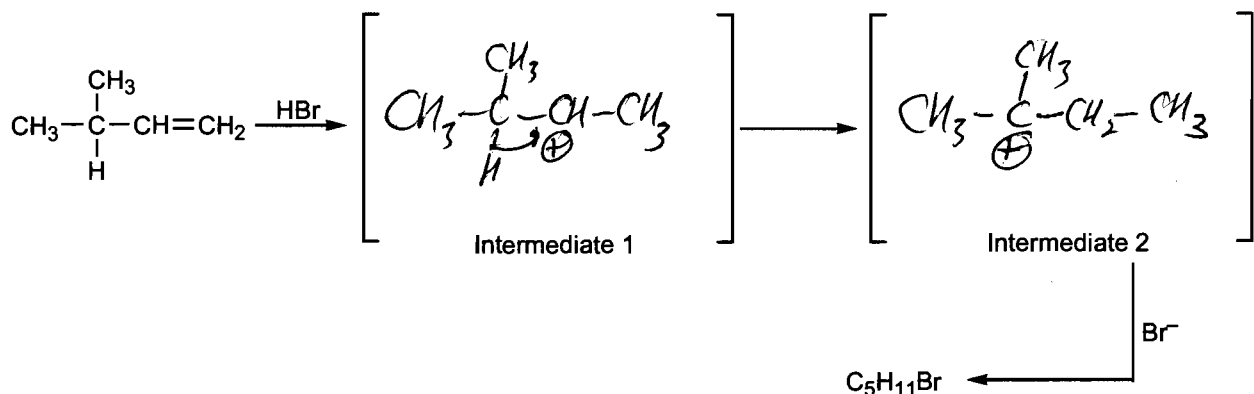
B.  $C_{11}H_{11}Cl_3N_2O_3 \rightarrow C_{11}H_{(11+3-2)} = C_{11}H_{12}$  6

alkane =  $C_{11}H_{24}$

$$\begin{array}{r} 24 \\ -12 \\ \hline 12 \div 2 = 6 \end{array}$$

V. (11 points)

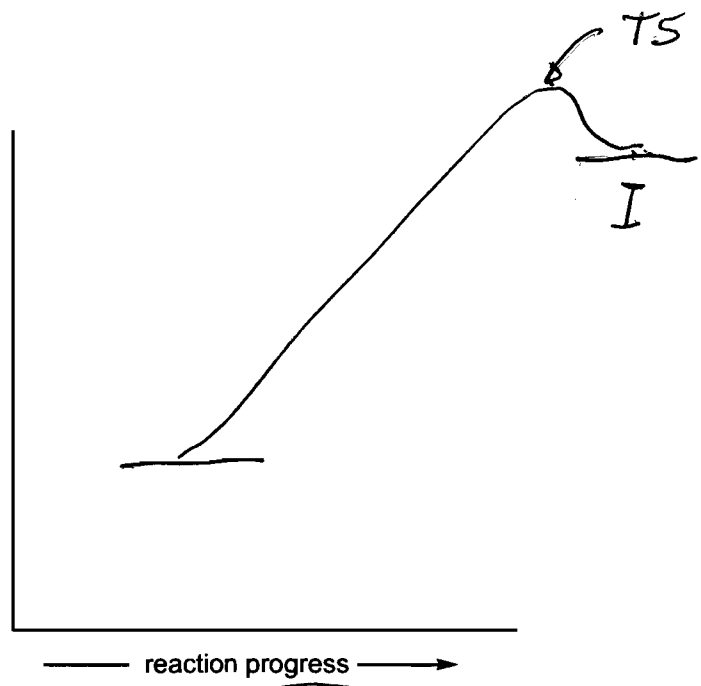
- A. (6 points) In the brackets provided draw the organic intermediates of the following 3-step reaction (two high energy intermediates are involved in this reaction).



- B. (5 points) On the following graph draw the reaction energy diagram for the **first step** of the above reaction. This diagram should be consistent with the Hammond postulate. Label the position of the transition state with "TS" and the intermediate with "I".

2 pts for correct endogonic curve

1 pt for each label



1 pt for correct position of TS (Hammond's postulate)

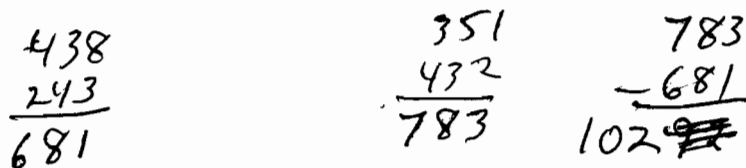
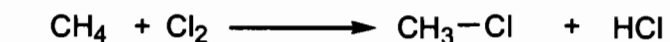
## VI. (6 points)

Table 1. Some Bond Dissociation Energies.

Bond	D (kJ/mol)
CH <sub>3</sub> -H	438
C <sub>2</sub> H <sub>5</sub> -H	420
CH <sub>3</sub> -Cl	351
C <sub>2</sub> H <sub>5</sub> -Cl	338
CH <sub>3</sub> -Br	293
C <sub>2</sub> H <sub>5</sub> -Br	285
CH <sub>3</sub> -CH <sub>3</sub>	376
H-Cl	432
H-Br	366
Cl-Cl	243
Br-Br	193

Use data presented in Table 1 to calculate  $\Delta H^\circ$  for the following reaction (show your calculations).

-1  
math  
error



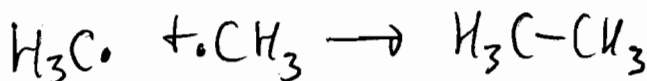
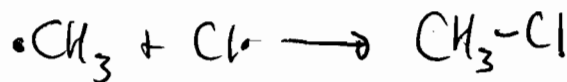
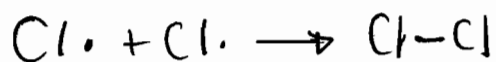
$$\Delta H^\circ = -102 \text{ kJ/mol.}$$

-1 if no  
units

-2 pts if +102

## VII. (7 points)

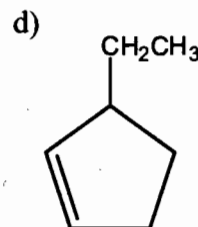
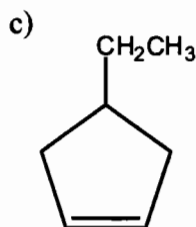
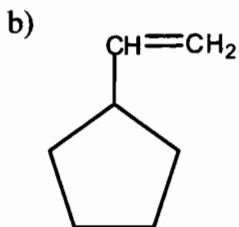
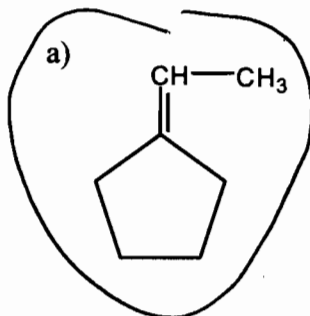
A. (4 points) Write two good termination steps for the light-induced chlorination of methane.



(any 2 of these.)

-1 for extra  
incorrect equation.

B. (3 points) The combustion (alkene + O<sub>2</sub> → CO<sub>2</sub> + H<sub>2</sub>O) of which alkene would produce the least heat?

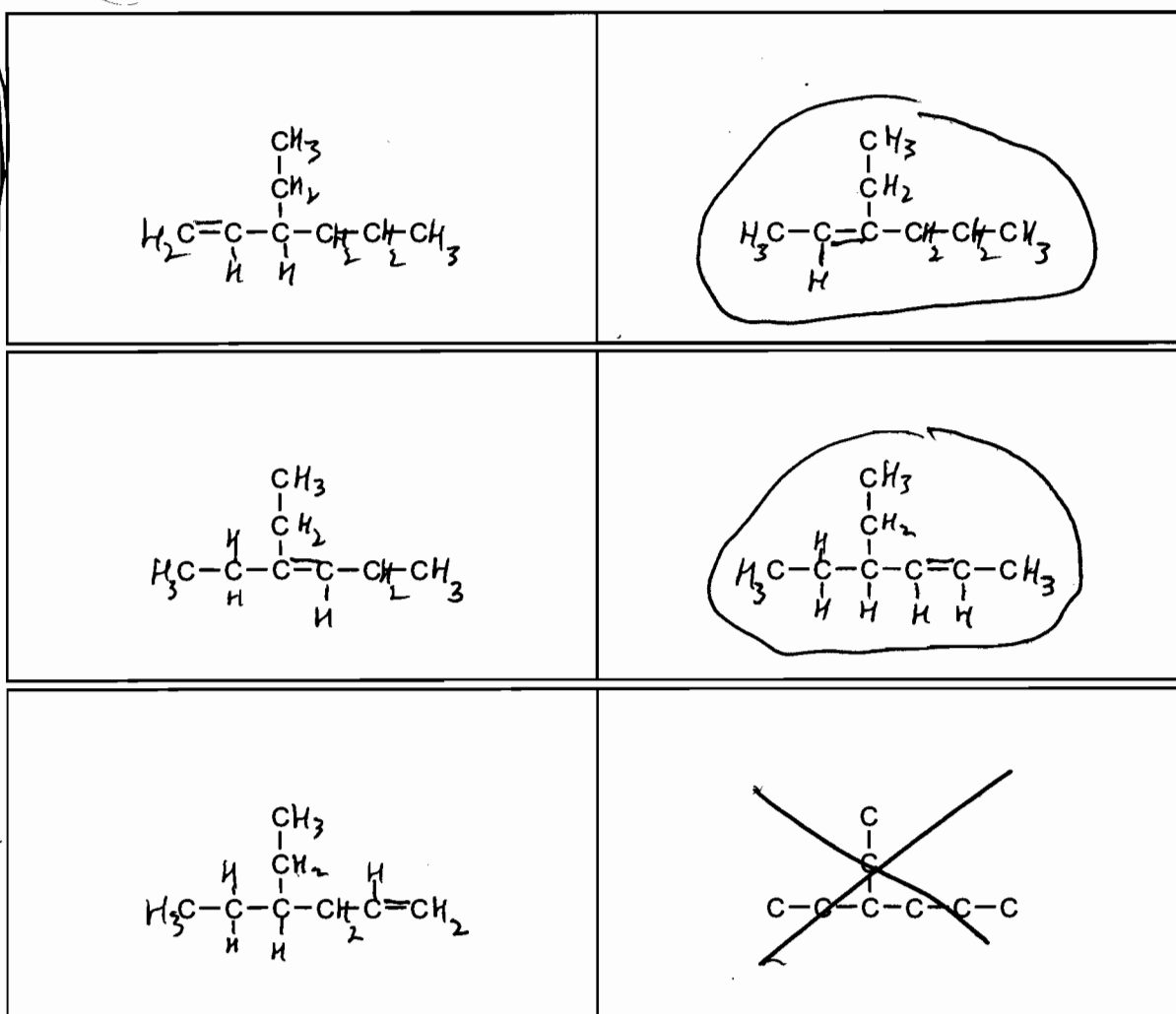


## VIII. (14 points)

- A. Complete the structures below to show ALL constitutional isomers (note: constitutional isomers only, no stereoisomers) of  $C_8H_{16}$  that have a carbon-carbon double bond and the carbon skeleton of 3-ethylhexane (this is the carbon skeleton given in the boxes; there are no more than six correct constitutional isomers and there may be fewer; DO NOT DRAW OTHER ISOMERS OF  $C_8H_{16}$ ).

**Be sure to show all hydrogens.** Cross out any boxes that are not used. Points will be deducted for duplicate or incorrect structures.

- B. Circle all the structures that can exist as cis-trans isomers (points will be deducted for circling structures that cannot exist as cis-trans isomers).



-1 pt for a major error

-2 pts for 2 major errors

-3 pts for 3 or more major errors

+2 pts for each correct isomer

-2 pts " " incorrect or duplicate isomer

+4 pts for 2 correct circles + no incorrect ones

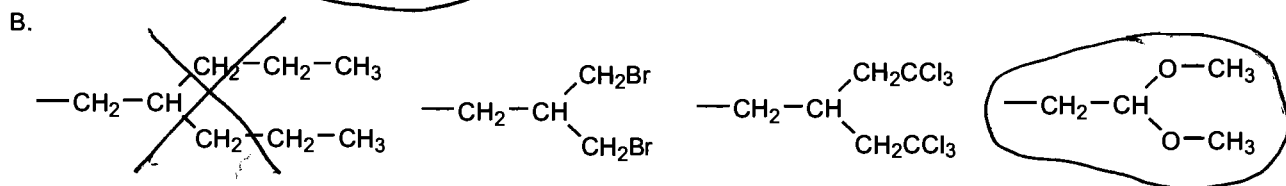
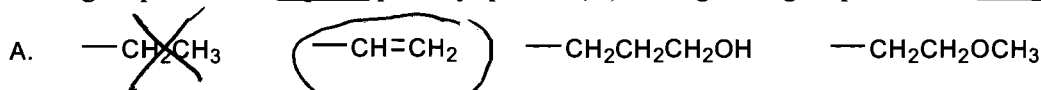
+2 pts " 1 " circle + " " "

+2 pts " 2 " circles + 1 incorrect one

0 pts " 1 " circle + 1 " circle

0 pts " 2 or more in correct circles

IX. (8 points) For each set of substituents, using the Cahn-Ingold-Prelog rules, put a circle (O) around the group with the highest priority, put an (X) through the group with the lowest priority.

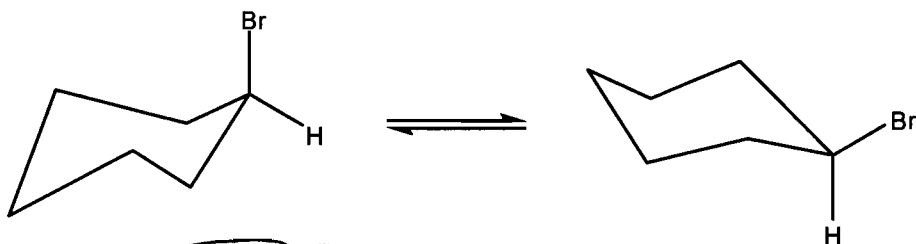


Periodic Table of the Elements

1A 1	2A 2	8B 8 9 10										3A 13	4A 14	5A 15	6A 16	7A 17	8A 18 2
1 H 1.01																	10 Ne 20.2
3 Li 6.94	4 Be 9.01											5 B 10.8	6 C 12.0	7 N 14.0	8 O 16.0	9 F 19.0	18 Ar 39.9
11 Na 23.0	12 Mg 24.3	3B 3	4B 4	5B 5	6B 6	7B 7				1B 11	2B 12	13 Al 27.0	14 Si 28.1	15 P 31.0	16 S 32.1	17 Cl 35.4	18 Ar 39.9
19 K 39.1	20 Ca 40.1	21 Sc 45.0	22 Ti 47.9	23 V 50.9	24 Cr 52.0	25 Mn 54.9	26 Fe 55.8	27 Co 58.9	28 Ni 58.7	29 Cu 63.5	30 Zn 65.4	31 Ga 69.7	32 Ge 72.6	33 As 74.9	34 Se 79.0	35 Br 79.9	36 Kr 83.8
37 Rb 85.5	38 Sr 87.6	39 Y 88.9	40 Zr 91.2	41 Nb 92.9	42 Mo 95.9	43 Tc (98)	44 Ru 101	45 Rh 103	46 Pd 106	47 Ag 108	48 Cd 112	49 In 115	50 Sn 119	51 Sb 122	52 Te 128	53 I 127	54 Xe 131
55 Cs 133	56 Ba 137	57 La 139	72 Hf 178	73 Ta 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	81 Tl 204	82 Pb 207	83 Bi 209	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226	89 Ac 227	104 Rf (261)	105 Ha (262)	106 Unh (263)	107 Uns (262)	108 Uno (265)	109 Une (266)									

X. (9 points)

A. (3 points) The energy barrier for the following interconversion is approximately how much?

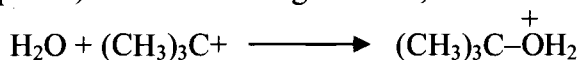


- a) 3 kcal/mol    b) 10 kcal/mol.    c) 25 kcal/mol.    d) 50 kcal/mol.

B. (3 points) How much more stable is *trans*-2-butene than *cis*-2-butene at room temperature?

- a) about 1 kcal/mol    b) about 10 kcal/mol.    c) about 25 kcal/mol.    d) about 50 kcal/mol.

C. (3 points) In the following reaction, water is functioning as



- a) an electrophile    b) an acid    c) a nucleophile    d) a carbocation