

Chemistry 2400  
Exam #2 - KP  
Chapters 4, 5 and 6  
October 4, 2010

Name PASCOE (KEY)

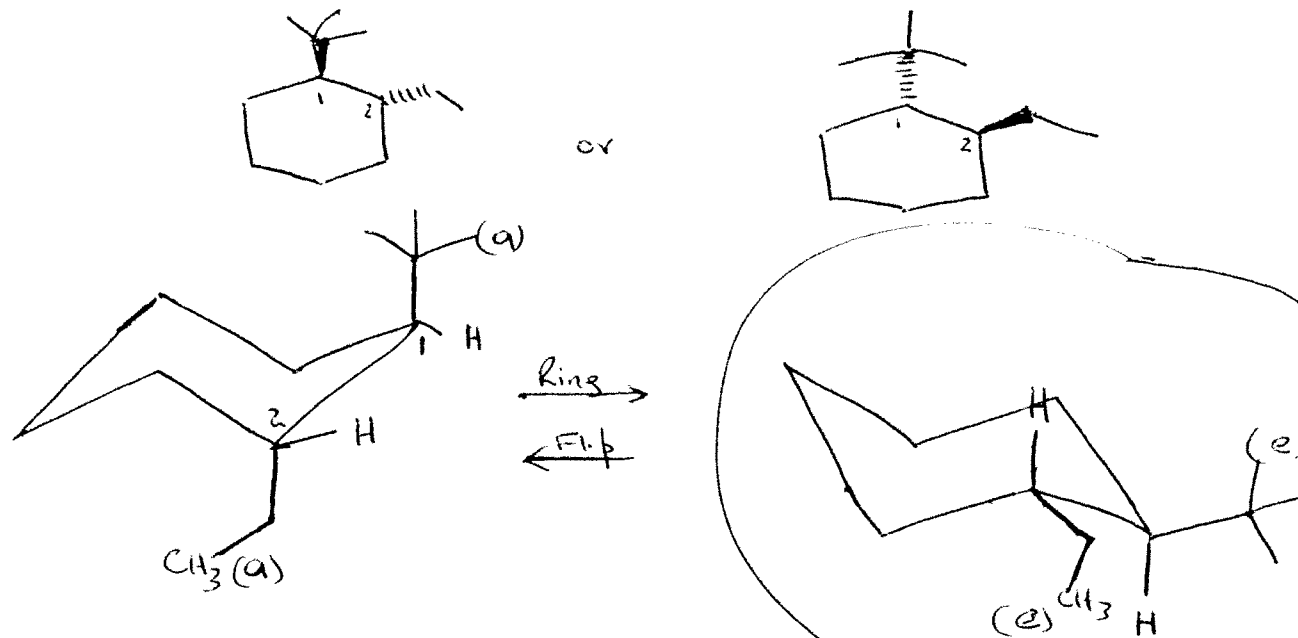
<u>Question</u>	<u>Points</u>
1	14
2	12
3	12
4	16
5	12
6	14
7	14
8	12
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Total	106

Please write your name on the BACK of the answer booklet.

1. Complete the following statements or definitions. (2 points each)
- A. When giving IUPAC names to alkyl substituted cycloalkanes if the number of carbon atoms in the chain are equal to the number in the ring the molecule is named as ...AN  
ALKYL SUBSTITUTED CYCLOALKANE.
- B. Cis- and trans- isomers are both examples of ...STEREISOMERS.
- C. As a general rule the severity of 1,3-diaxial interactions.....  
INCREASES.....with bulkier substituents.
- D. Rearrangement reactions occur when ...A SINGLE REACTANT  
UNDERGOES A REORGANIZATION OF ATOMS
- E. Reactions that have positive enthalpy changes are termed ...ENDOTHERMIC  
REACTIONS.
- F. Substituted alkenes are more stable than unsubstituted alkenes due to a phenomena known as .....HYPERCONJUGATION.
- G. Radical reactions involve .....HOMOLYTIC BOND CLEAVAGES  
and HOMOGENIC BOND FORMATIONS.

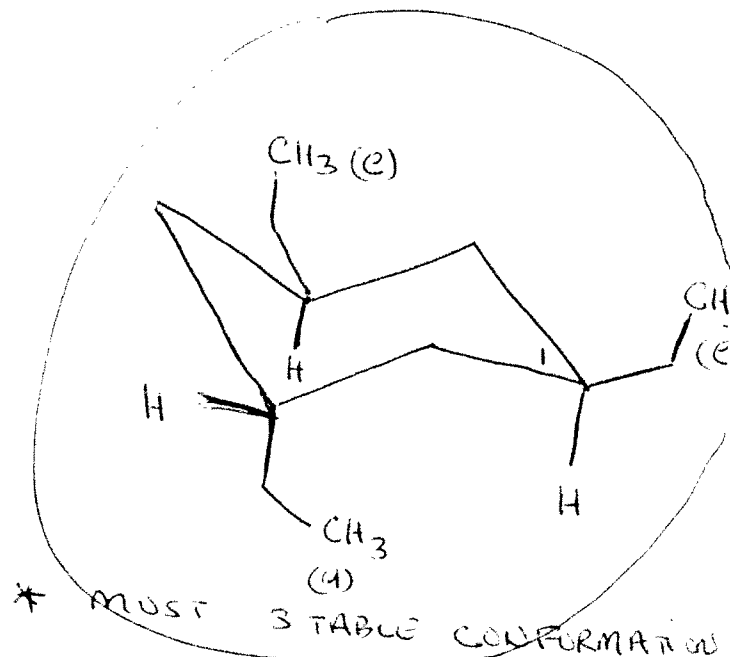
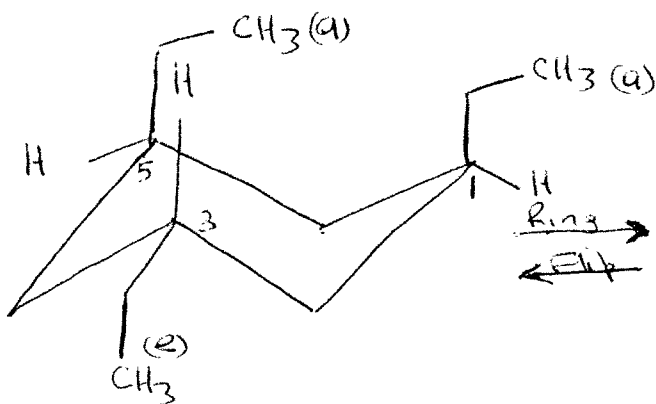
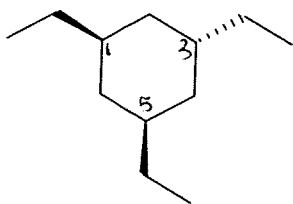
2. Draw BOTH chair conformations of the substituted cyclohexanes described below. Label the substituents as axial or equatorial by writing a- or e- beside them. Identify the MOST STABLE conformation by drawing a circle around it and state why it was chosen. (12 points)

A. Trans-1-tert-butyl-2-ethylcyclohexane



\* MOST STABLE CONFORMATION — BOTH SUBSTITUENTS EQUATORIAL

B.

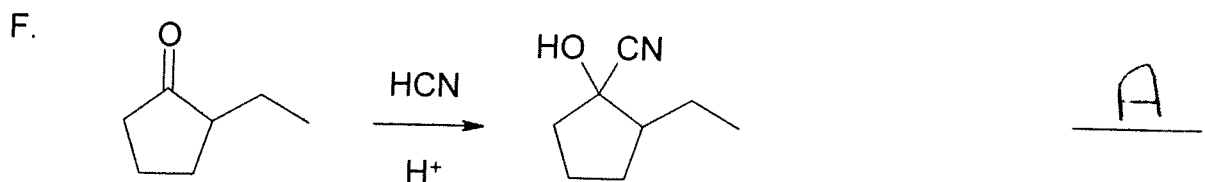
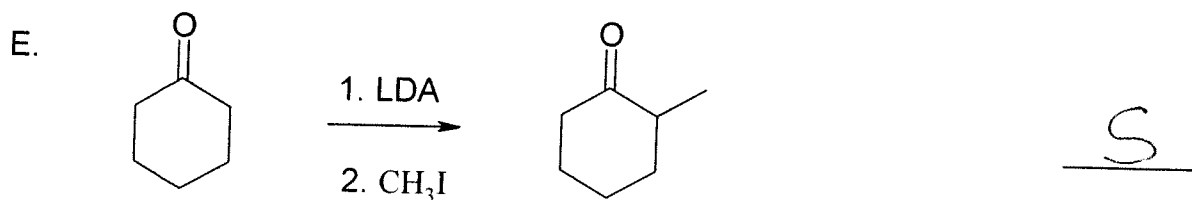
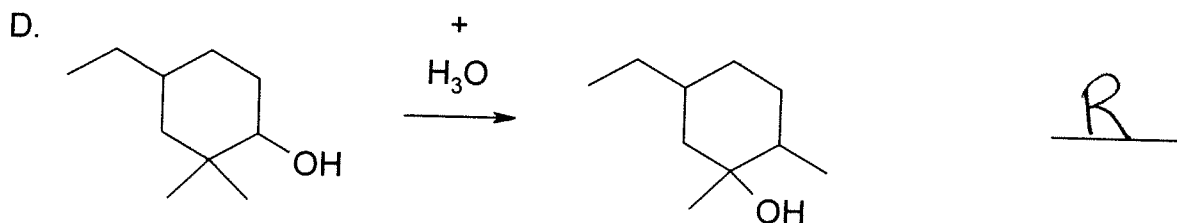
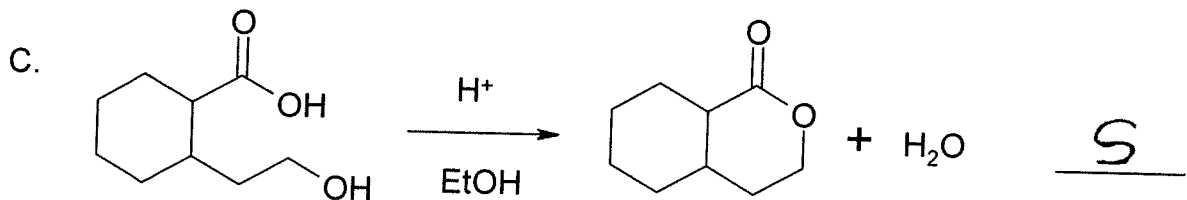
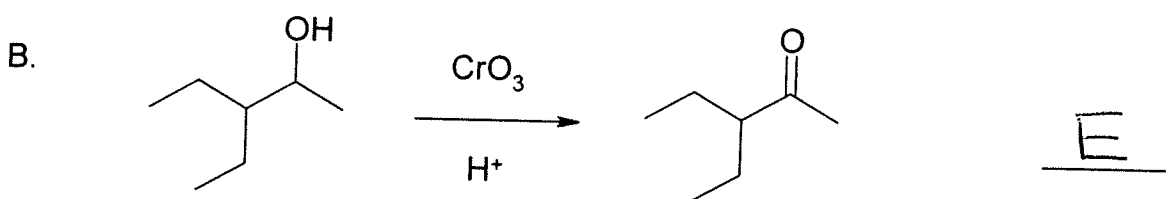
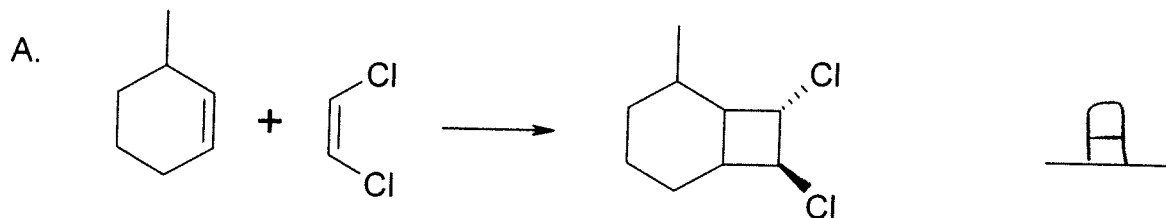


\* MOST STABLE CONFORMATION

3. Choose from the terms below the ONE that best describes the TYPE of reaction for each of the equations shown. Write the appropriate letter in the space provided. (2 points each)

A - Addition  
S - Substitution

E - Elimination  
R - Rearrangement

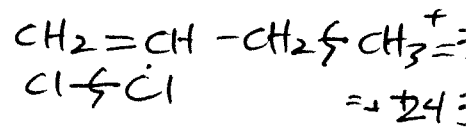


- 4A. Use the bond dissociation energy table provided to answer the following questions regarding the reaction shown in the equation.



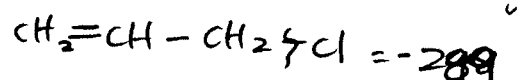
- A. How much energy is required for the bond breakages in the proposed reaction? (3 points)

+ 553 kJ/mol



- B. Calculate the enthalpy change ( $\Delta H$ ) for the proposed reaction. (4 points)

$\Delta H = -87 \text{ kJ/mol}$



- C. Will the reaction go as indicated in the equation? (2 points)

yes

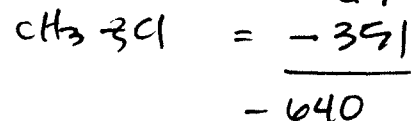
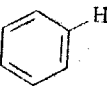
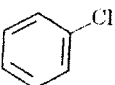
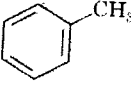
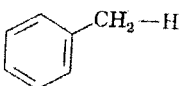
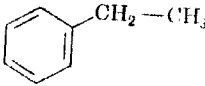
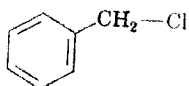
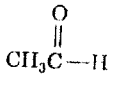
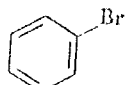
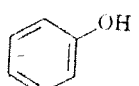
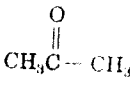


TABLE 5.3 Some Bond Dissociation Energies

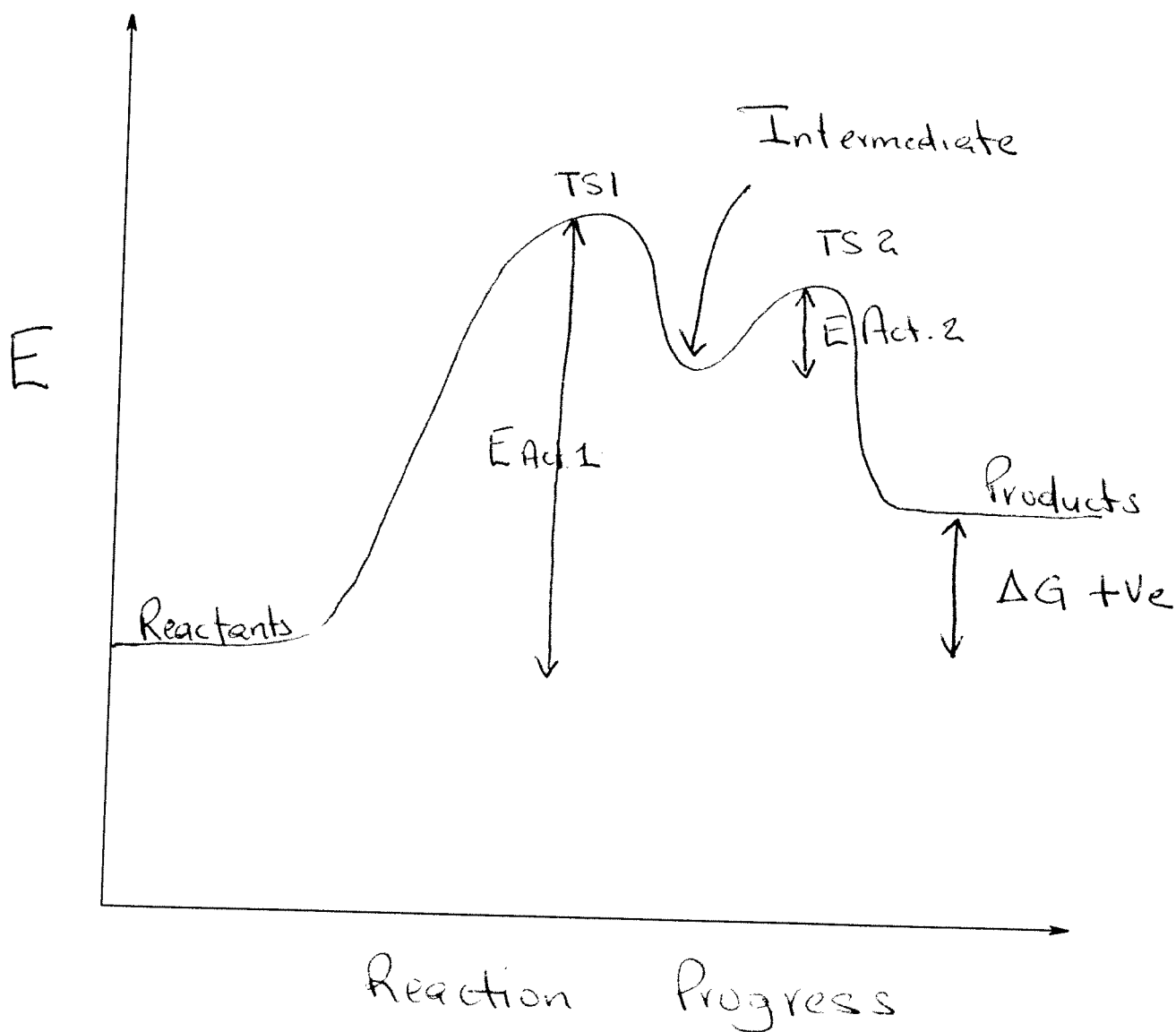
Bond	D (kJ/mol)	Bond	D (kJ/mol)	Bond	D (kJ/mol)
H-H	436	(CH <sub>3</sub> ) <sub>3</sub> C-Br	263	CH <sub>3</sub> -CH <sub>3</sub>	376
H-F	570	(CH <sub>3</sub> ) <sub>3</sub> C-I	209	C <sub>2</sub> H <sub>5</sub> -CH <sub>3</sub>	355
H-Cl	432	H <sub>2</sub> C=CH-H	444	(CH <sub>3</sub> ) <sub>2</sub> CH-CH <sub>3</sub>	351
H-Br	366	H <sub>2</sub> C=CH-Cl	368	(CH <sub>3</sub> ) <sub>3</sub> C-CH <sub>3</sub>	339
H-I	298	H <sub>2</sub> C=CHCH <sub>2</sub> -H	361	H <sub>2</sub> C=CH-CH <sub>3</sub>	406
Cl-Cl	243	H <sub>2</sub> C=CHCH <sub>2</sub> -Cl	289	H <sub>2</sub> C=CHCH <sub>2</sub> -CH <sub>3</sub>	310
Br-Br	193		464	H <sub>2</sub> C=CH <sub>2</sub>	611
I-I	151		405		427
CH <sub>3</sub> -H	438		368		332
CH <sub>3</sub> -Cl	351		293		368
CH <sub>3</sub> -Br	293		337	HO-H	498
CH <sub>3</sub> -I	234		469	HO-OH	213
CH <sub>3</sub> -OH	380	HC≡C-H	552	CH <sub>3</sub> O-H	437
CH <sub>3</sub> -NH <sub>2</sub>	335			CH <sub>3</sub> S-H	371
C <sub>2</sub> H <sub>5</sub> -H	420			C <sub>2</sub> H <sub>5</sub> O-H	436
C <sub>2</sub> H <sub>5</sub> -Cl	338				322
C <sub>2</sub> H <sub>5</sub> -Br	285			CH <sub>3</sub> CH <sub>2</sub> O-CH <sub>3</sub>	339
C <sub>2</sub> H <sub>5</sub> -I	222			NH <sub>2</sub> -H	449
C <sub>2</sub> H <sub>5</sub> -OH	380			H-CN	518
(CH <sub>3</sub> ) <sub>2</sub> CH-H	401				
(CH <sub>3</sub> ) <sub>2</sub> CH-Cl	339				
(CH <sub>3</sub> ) <sub>2</sub> CH-Br	274				
(CH <sub>3</sub> ) <sub>3</sub> C-H	390				
(CH <sub>3</sub> ) <sub>3</sub> C-Cl	330				

$$\begin{aligned} & - 640 \\ & + 553 \\ & \hline & - 87 \text{ kJ/mol} \end{aligned}$$

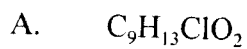
4B. Sketch the energy diagram for a TWO STEP ENDERGONIC REACTION. Be sure to clearly label the following:  
(7 points)

1.  $\Delta G$
2. Intermediate
3. Activation Energies
4. Products/Reactants
5. Axes

ENDERGONIC  $\Delta H +ve$

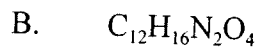


5A. Calculate the degrees of unsaturation for the following molecular formulae or structures.  
(2 points each)



3

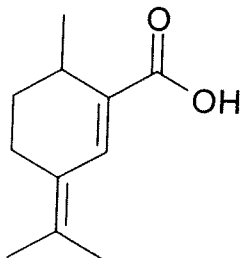
$$\begin{aligned} 2 \times 9 &= 18 + 2 = 20 \\ 13 + 1 &= 14 \\ \frac{6}{2} &= 3 \end{aligned}$$



6

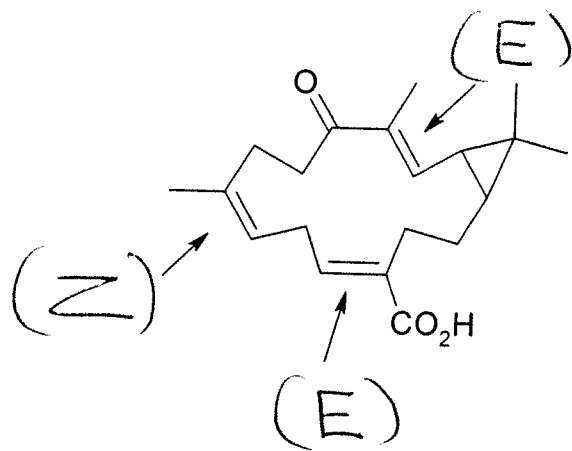
$$\begin{aligned} 2 \times 12 &= 24 + 2 = 26 \\ 16 - 2 &= 14 \\ \frac{12}{2} &= 6 \end{aligned}$$

C.

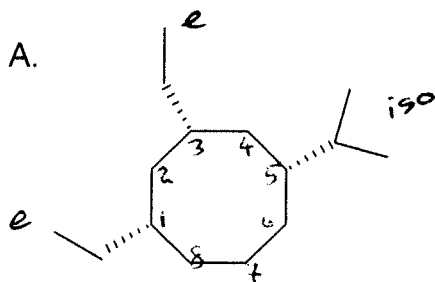


4

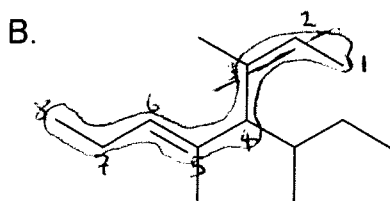
- 5B. Assign E or Z notation to the double bonds highlighted in the structure below.  
(2 points each)



6. Give IUPAC names to the following molecules. (2 points each)

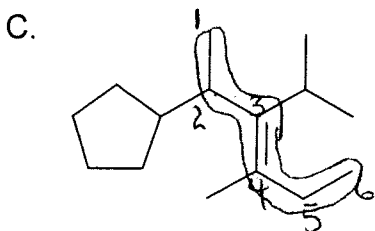


(cis) - 1,3-diethyl-5-isopropylcyclooctane

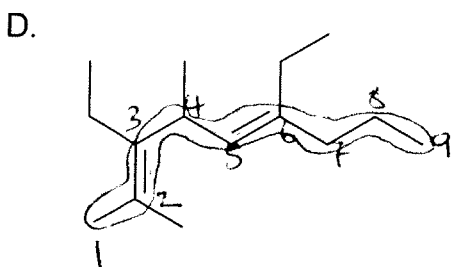


(~~2Z~~, 5E) - 4-secbutyl-3,5-dimethyl-2,5-octadiene

(~~2Z~~, 5E) - 3,5-dimethyl-4-(1-methylpropyl)-2,5-octadiene

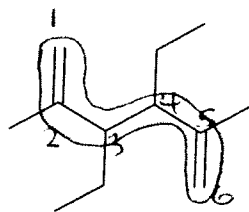


(E) - 2-cyclopentyl-3-isopropyl-4-methyl-3-hexene



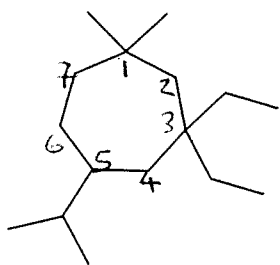
(5E) - 3,6-diethyl-2,4-dimethyl-2,5-nonadiene

E.



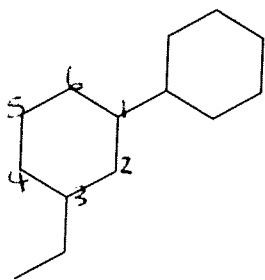
3,4-diethyl-2,5-dimethyl-1,5-hexadiene

F.



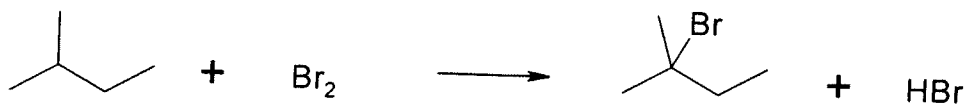
3,3-diethyl-5-isopropyl-1,1-dimethylcycloheptane

G.



1-cyclohexyl-3-ethylcyclohexane

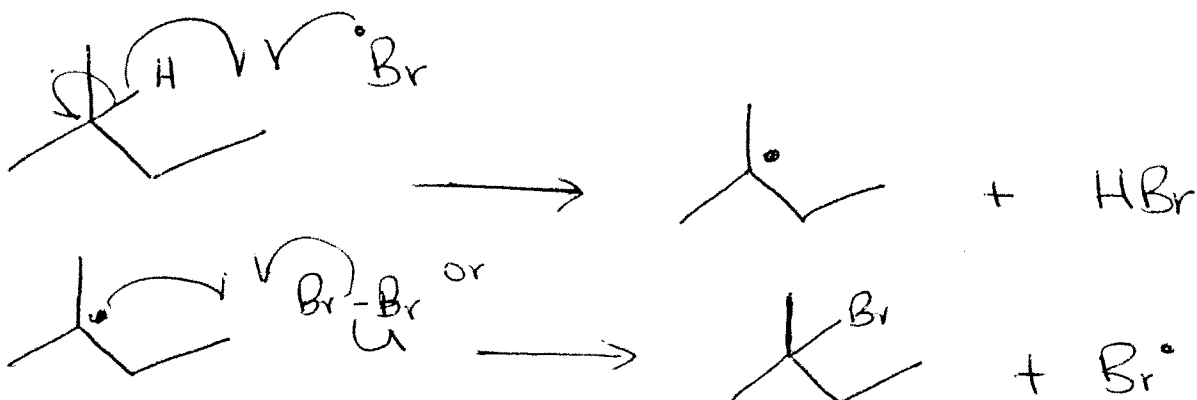
7A. The equation shown below represents the free radical bromination of 2-methylbutane. Answer the following questions regarding this reaction.



A. What type of reaction is this?

SUBSTITUTION

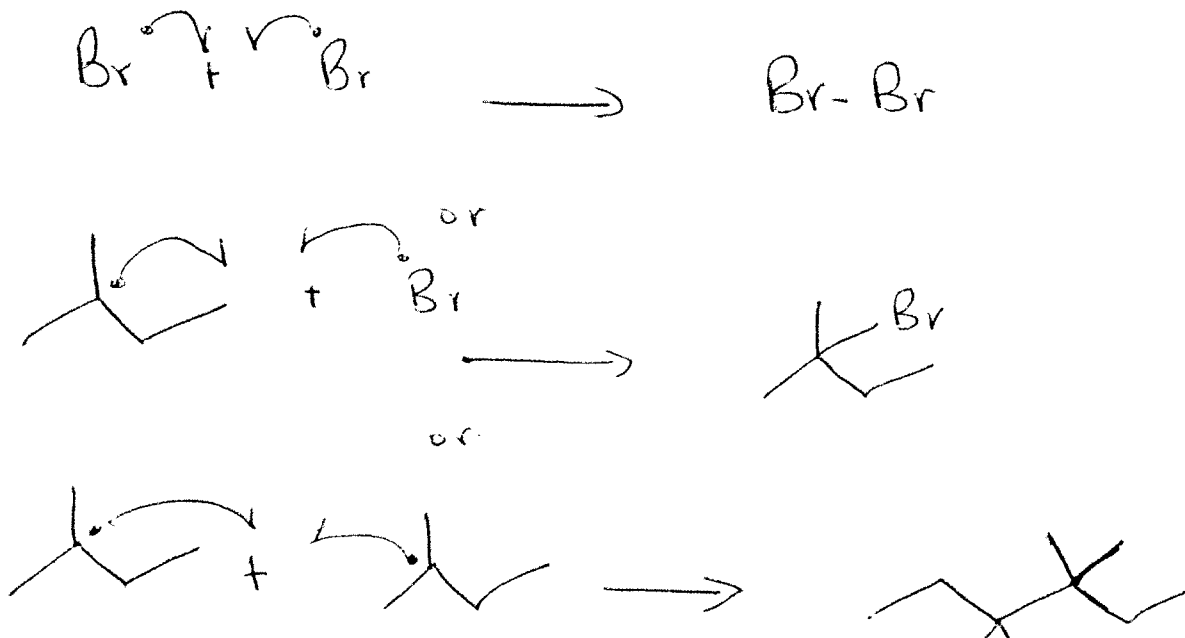
B. Write the mechanism for a propagation step:



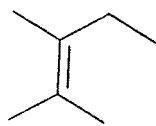
C. What is the final step of this reaction called?

TERMINATION

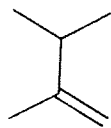
D. Write an equation (use curved arrows) to show one example of what happens in this final step:



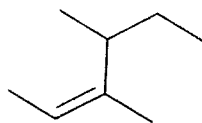
7B. Arrange the following alkenes in order of increasing stability. (Start with the least stable) (4 points)



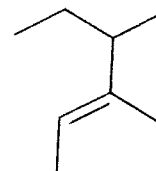
A



B



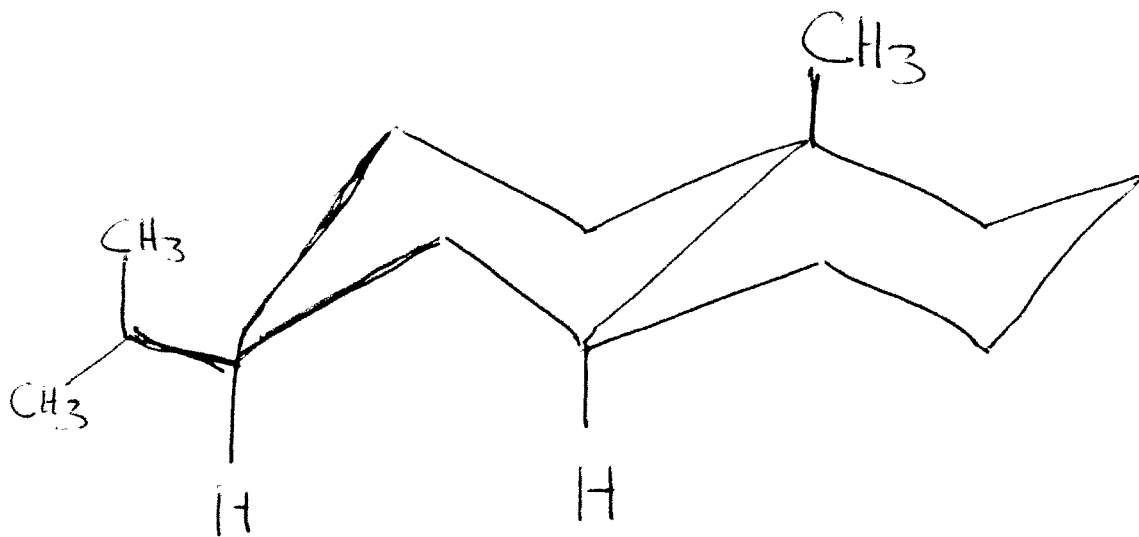
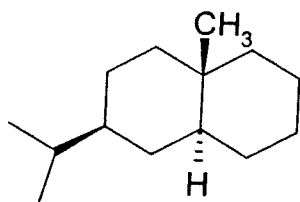
C



D

B < C < D < A

7C. Draw the most stable chair conformation for the following molecule. (2 points)



8. Complete the following equations by writing the structure of the expected product (with appropriate formal charge when needed). Use curved arrows to illustrate the movement of electrons in these reactions and describe each reactant as NUCLEOPHILE, ELECTROPHILE or RADICAL. (3 points each)

