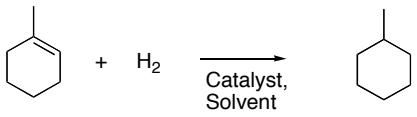
CHE 171
Fall, 2005
Exam 2

Name_____
Section: **101** **102** **103**
M W F
(circle one)

1. For the following reaction,

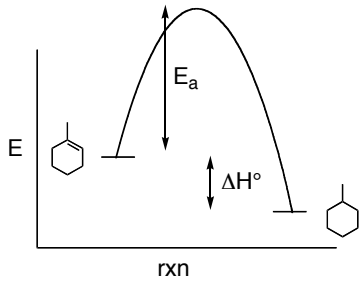


(a) What type of reaction is this? (2 pts)
Addition (or Reduction)

(b) What is the IUPAC name of the product? (3 pts)
Methylcyclohexane

(c) Is the product chiral or achiral? Explain. (5 pts)
Achiral. There are no stereogenic centers present so the compound is superimposable on its mirror image.

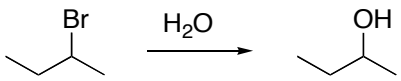
(d) If ΔH° is negative (-) show an energy level diagram for the reaction. (5 pts)



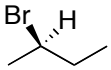
(e) Show a rate equation (or rate law) for this reaction. Is the reaction first order or second order? Is the reaction unimolecular or bimolecular? (5 pts)

second order, bimolecular

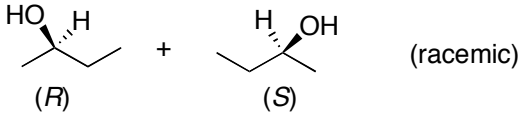
2. Treatment of (*R*)-2-bromobutane with water results in a substitution reaction that generates a racemic mixture of the corresponding alcohol products (2-butanol).



(a) Draw the starting material with the correct configuration. (4 pts)



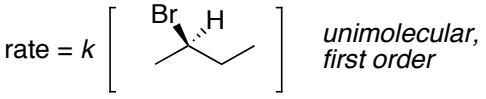
(b) Draw the products with the correct configuration (label each). (6 pts)



(c) What is the *ee* of the product mixture? Explain. (4 pts)

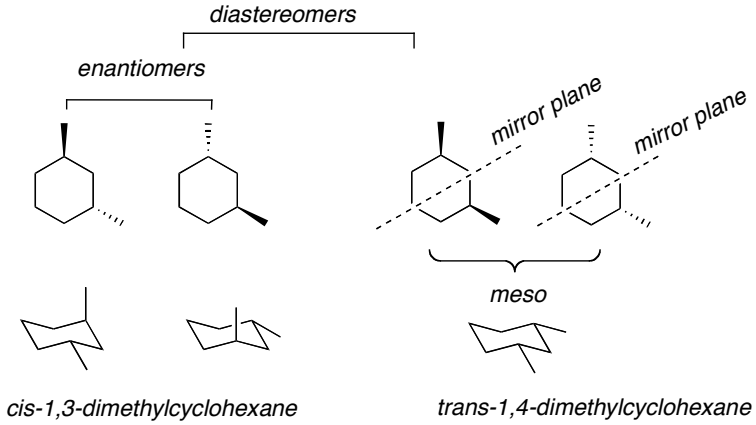
$$ee = \%R - \%S = 50 - 50 = 0\%$$

(d) Assuming that water is the solvent (and therefore in large excess), show a rate equation for this reaction. Is this a unimolecular or bimolecular reaction? Is the reaction first or second order? (6 pts)



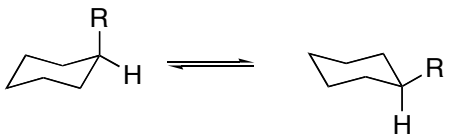
3. What is the maximum number of stereoisomers that are possible for the molecule shown below? Draw and give the full IUPAC names for all of them. What is the relationship between each pair of stereoisomers? (10 pts)

2^2 = 4 maximum, but only three exist:



4. Monosubstituted cyclohexanes exist as an equilibrium mixture of two conformers (A and B, below) having either an axial or equatorial substituent: (10 pts)

(A) (B)



R	K_{eq} = [B]/[A]
methyl	18
ethyl	23
isopropyl	38
tert-butyl	4000

(a) When R is methyl, which conformer is present in the higher concentration? *B*

(b) Which R shows the highest percentage of equatorial conformer at equilibrium? *t-butyl*

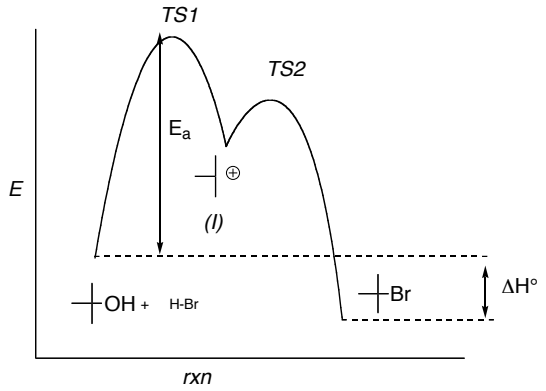
(c) Which R shows the highest percentage of axial conformer at equilibrium? *methyl*

(d) For which R is ΔG° most negative? *t-butyl*

(e) How is the size of R related to the amount of axial and equatorial conformers at equilibrium?

The larger the R group, the less amount of conformation A at equilibrium.

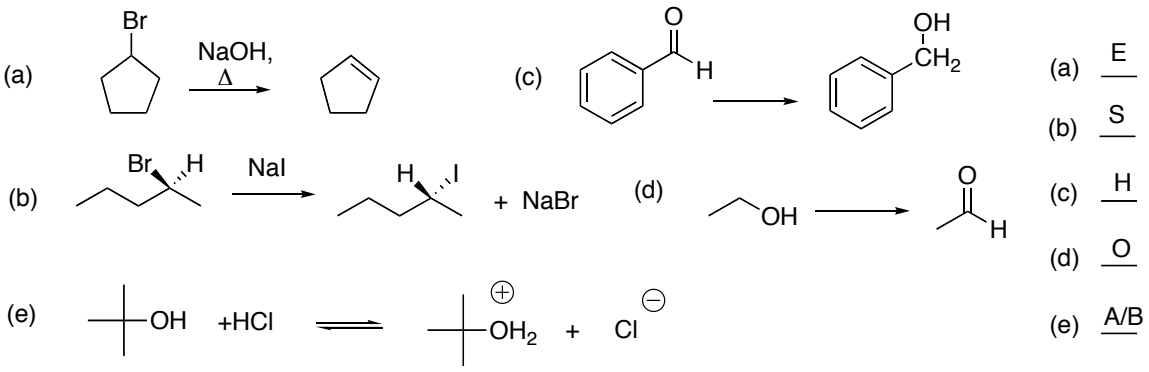
5. Show an energy level diagram for the following three-step reaction (the reaction is overall exothermic). Label the following in your diagram: intermediates (I), transition states (TS), E_a for the rate-determining step, ΔH° for the reaction. (15 pts)



6. Which of the following factors affect the rate of a reaction (circle it/them): (5 pts)

(d) temperature (g) *k*
(e) concentration (h) catalysts
(a) E_a

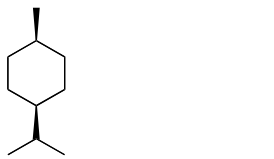
7. Label each of the following reactions as oxidation [O], reduction [H], substitution [S], addition [A], elimination [E], or Acid/Base [A/B]: (5 pts)



(a) E
(b) S
(c) H
(d) O
(e) A/B

8. For the compound shown below:
   (a) Draw representations for the cis and trans isomers using a hexagon for the 6-membered ring, and wedges and dashes for the substituents. (2 pts)
   (b) Give the full IUPAC names for each isomer. (2 pts)
   (c) Draw the two possible chair conformers for the cis isomer. Which, if either, is more stable? (3 pts)
   (d) Draw the two possible chair conformers for the trans isomer. Which, if either, is more stable? (3 pts)
   (e) Which isomer, cis or trans, is more stable and why? (2 pts)
   (f) Are either of the isomers, cis or trans, chiral? Explain. (3 pts)

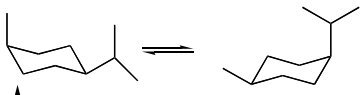
(a)



(b) cis-1-isopropyl-4-methylcyclohexane

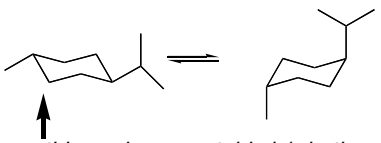
trans-1-isopropyl-4-methylcyclohexane

(c)



this one's more stable b/c larger group is equatorial

(d)



this one's more stable b/c both groups are equatorial

(e) the trans isomer is more stable because its more stable isomer has both groups equatorial

(f) neither isomer, cis or trans, is chiral; both are optically inactive compounds w/no stereogenic centers.