Chemistry 333

Examination #1

June 17, 2002 Professor Charonnat

Name: _____

Be certain that your examination has eight (8) pages including this one.

Put your name on **each** page of this examination booklet.

By putting your name on this examination booklet you agree to abide by
California State University, Northridge policies of academic honesty and integrity.

Molecular models are allowed for this examination. Calculators are unnecessary and are not allowed.

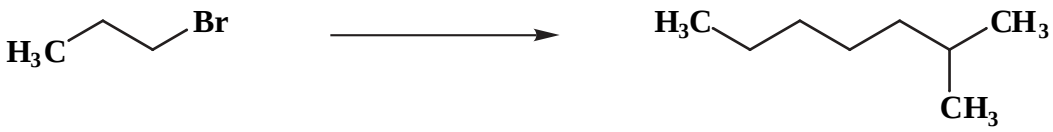
Name:_____

1. (15 points)

Draw the specific reagent(s) necessary to effect the transformation shown for each of the following three (3) questions.

A.

B.

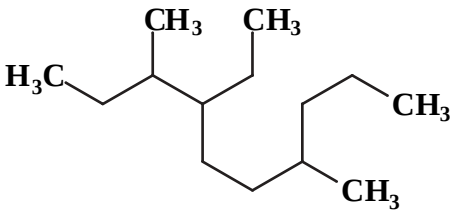


C.

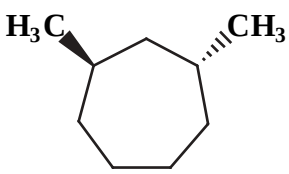
2. (20 points)

Use IUPAC nomenclature to write the systematic names of the following two (2) alkanes.

A.



B.



Name:_____

3. (25 points)

Circle the number that corresponds to the correct answer for each of the following five (5) questions.

A. An orbital is the volume where:

1. a nucleus resides
2. an electron resides
3. an atom resides
4. a molecule resides

B. A Lewis acid is:

1. an electron pair donor
2. an electron pair acceptor
3. a proton donor
4. a proton acceptor

C. Alkanes dissolve in:

1. water
2. polar organic solvents
3. mixtures of water and polar organic solvents
4. nonpolar organic solvents

D. Degenerate orbitals have:

1. very different energies
2. moderately different energies
3. slightly different energies
4. identical energies

E. According to the VSEPR rules, a species with three hybrid orbitals is:

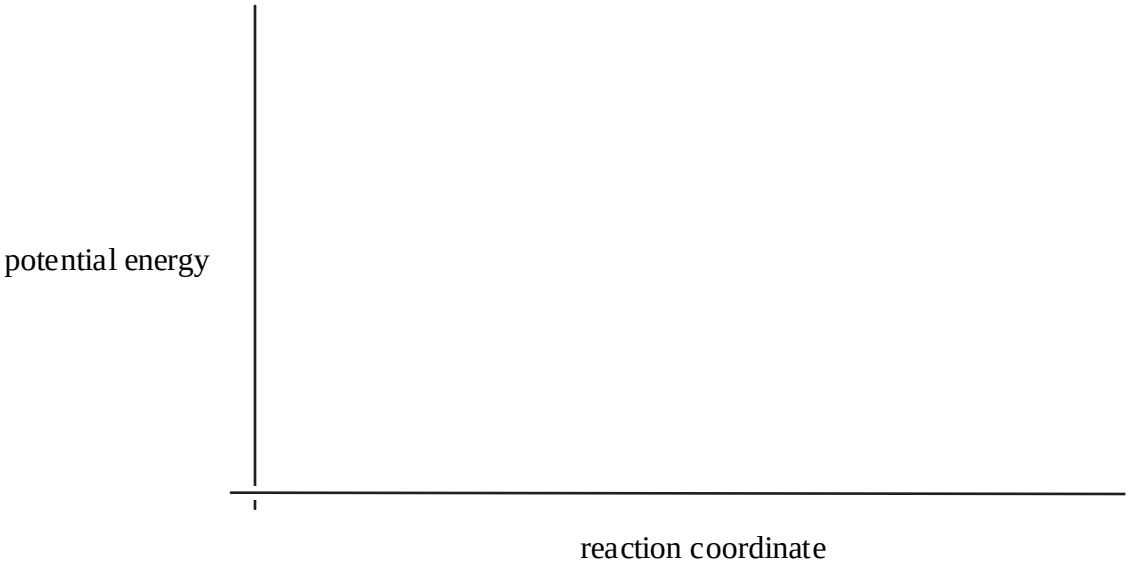
1. linear
2. trigonal
3. tetrahedral
4. octahedral

Name:_____

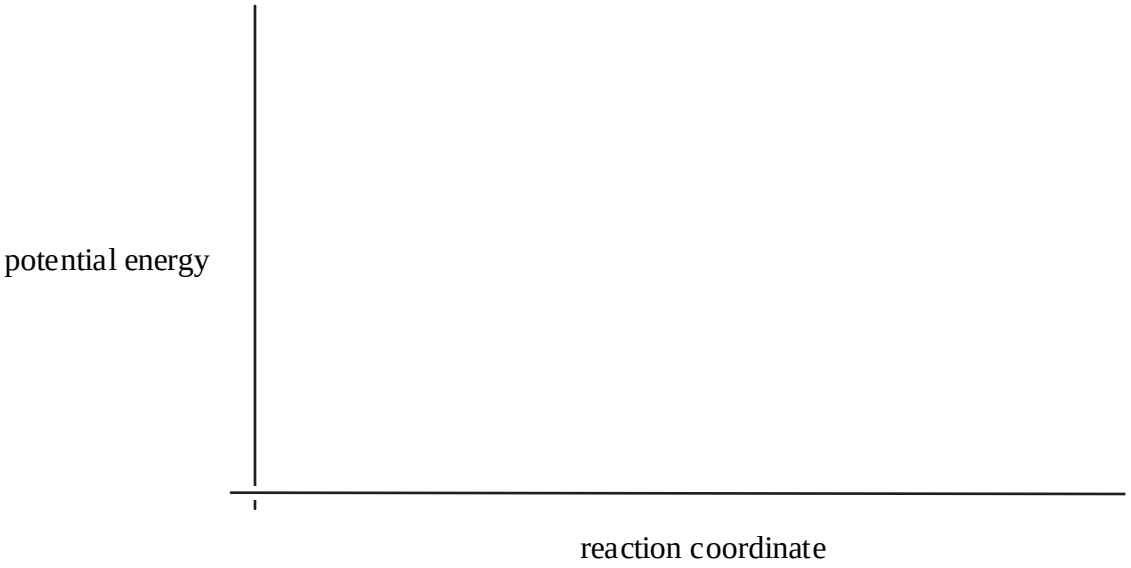
4. (20 points)

Draw reaction profiles (graphs of potential energy versus reaction coordinate) for the following two (2) questions. Label both graphs with starting material (sm), transition states (ts_x), intermediates (i_x), product (p), activation energies (Ea_x) and overall standard heat of reaction (ΔH^o).

A. a five-step, overall exothermic reaction, with the fourth step being the rate-determining step



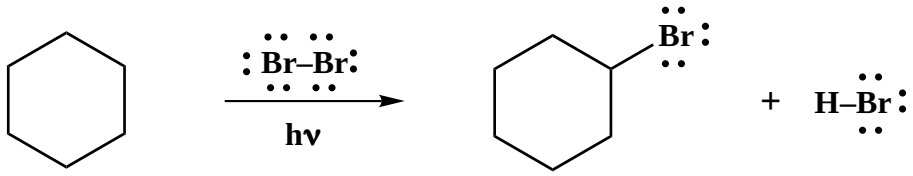
B. a three-step reaction with an early, first-step transition state and a late, third-step transition state



Name:_____

5. (20 points)

Draw the mechanism of the following reaction, using the curved-arrow notation to indicate the reorganization of electron density. Show **all** intermediates and denote **all** lone pairs and unpaired electrons. Write at least one termination step.



Name:_____

6. (25 points)

Define each of the following five (5) terms precisely, succinctly and with correct grammar. Draw a specific example to illustrate each answer.

A. staggered conformation

B. homolytic bond cleavage

C. heterolytic bond cleavage

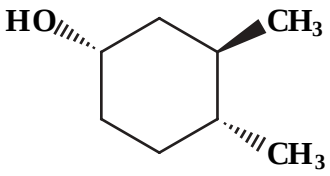
D. spirocyclic alkane

E. bridged, bicyclic alkane

Name:_____

7. (25 points)

Draw the two possible chair conformations of the following trisubstituted cyclohexane. Clearly denote all 1,3-diaxial interactions for both conformations. Calculate the total strain energy for each conformation. Put a star next to the more stable conformation. Finally, use the information on page 8 to determine the approximate ratio of the two conformations at 298 K.

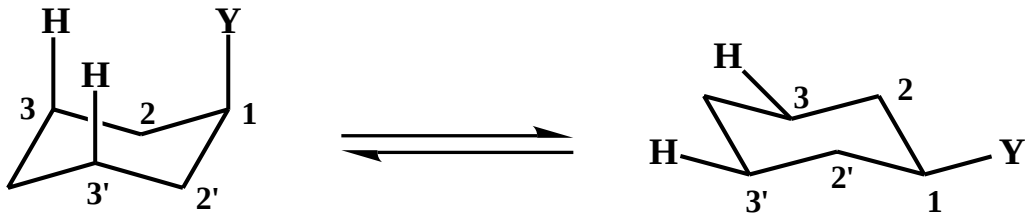


Congratulations!

1	/15
2	/20
3	/25
4	/20
5	/20
6	/25
7	/25
Total:	/150

Calculated Equilibrium Values at T = 298 K

energy difference (kcal/mol)	% more stable isomer	% less stable isomer	K
0.000	50	50	1.00
0.119	55	45	1.22
0.240	60	40	1.50
0.367	65	35	1.86
0.502	70	30	2.33
0.651	75	25	3.00
0.821	80	20	4.00
1.028	85	15	5.67
1.302	90	10	9.00
1.745	95	5	19.0
2.723	99	1	99.0
4.092	99.9	0.1	999



axial Y **equatorial Y**

substituent Y	steric strain due to one H-Y 1,3-diaxial interaction (kcal/mol)	total steric strain due to two H-Y 1,3-diaxial interactions (kcal/mol)
-F	0.12	0.24
-Cl	0.25	0.50
-Br	0.25	0.50
-OH	0.50	1.0
$-CH_3$	0.90	1.8
$-CH_2CH_3$	0.95	1.9
$-CH(CH_3)_2$	1.1	2.2
$-C(CH_3)_3$	2.7	5.4
$-C_6H_5$	1.5	3.0
$-CO_2H$	0.70	1.4
-CN	0.1	0.2