Chemistry 333

Examination #1

June 16, 2003 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.

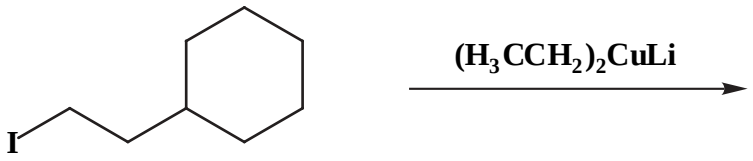
Molecular models are allowed for this examination. Calculators are unnecessary and are not allowed.

Name:_____

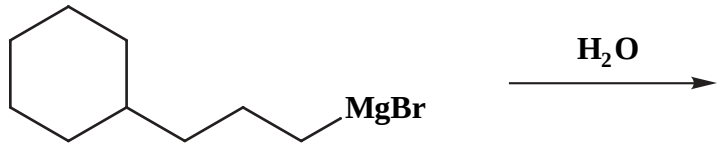
1. (20 points)

Draw the major organic product for each of the following four (4) reactions.

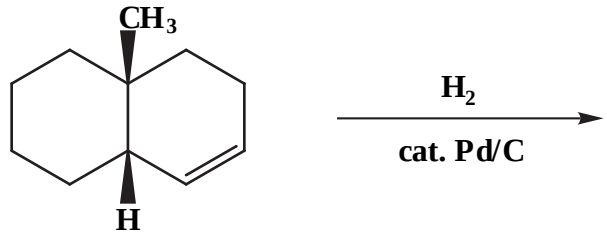
A.



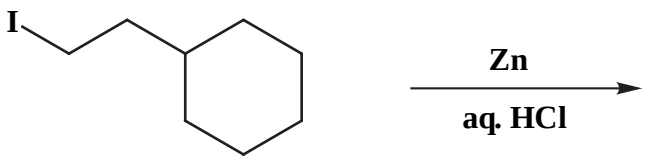
B.



C.



D.

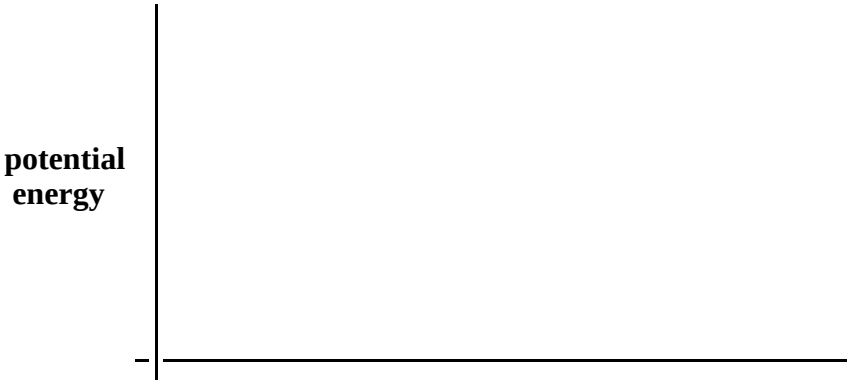


Name:_____

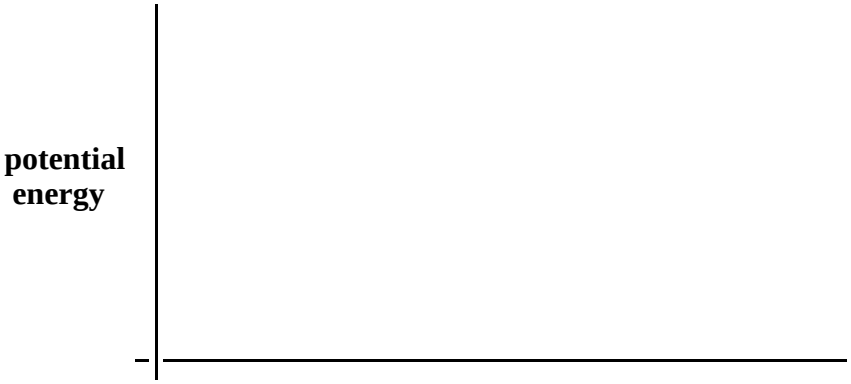
2. (30 points)

Draw a reaction profile (graph of potential energy versus reaction progress) for each of the following three (3) examples. Label each curve with the following, as appropriate: starting material (sm), transition states (ts_X), intermediates (int_X), product (p), activation energies (Ea_X) and overall standard heat of reaction (ΔH^o).

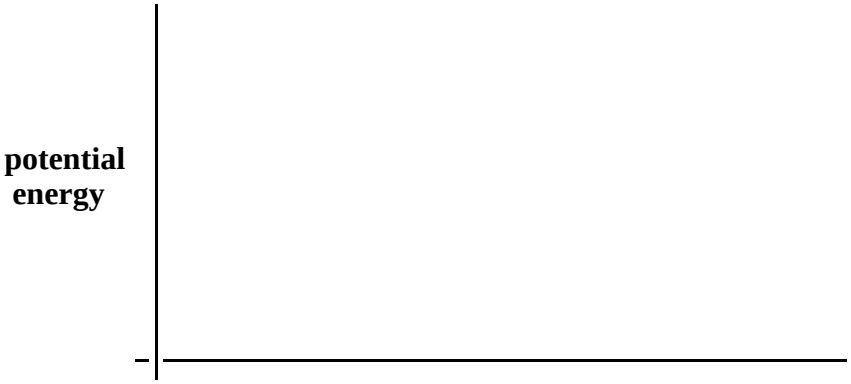
A. A one-step reaction with an early transition state.



B. A one-step reaction with a late transition state.



C. An overall exothermic, three-step process with a rate-determining second step.



Name:_____

3. (25 points)

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

A. Which of the following anions is resonance stabilized?

1. bromide
2. nitrate
3. hydroxide

B. The nitrogen atom of ammonia is:

1. sp hybridized
2. sp^2 hybridized
3. sp^3 hybridized

C. Which of the following species is a Lewis base?

1. water
2. boron trifluoride
3. aluminum tribromide

D. Ionic bonding involves electrostatic attraction of:

1. anions with anions
2. anions with cations
3. cations with cations

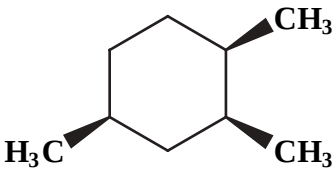
E. Organic compounds always contain:

1. hydrogen
2. carbon
3. hydrogen and carbon

Name:_____

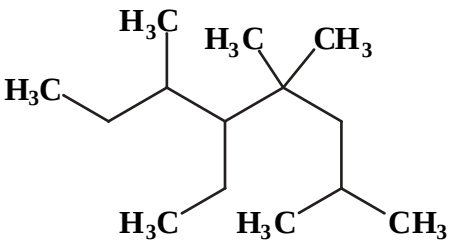
4. (25 points)

Draw the two possible chair conformations of the following 1,2,4-trisubstituted cyclohexane. Clearly denote all 1,3-diaxial and gauche interactions for both conformations. Calculate the total strain energy for each conformation. Put a star next to the more stable conformation. Finally, determine the ratio of the two conformations at 298 K. (See the tables on page 8. Additional note: a methyl/methyl 1,3-diaxial interaction is worth 3.7 kcal/mole.)



5. (10 points)

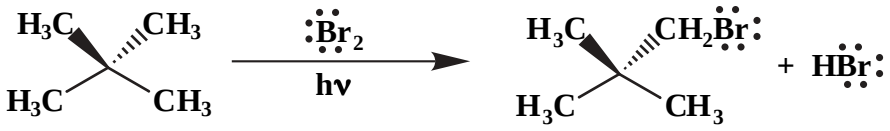
Use IUPAC nomenclature to write the systematic name of the following alkane. Denote each carbon of the alkane as primary (1°), secondary (2°), tertiary (3°) or quaternary (4°).



Name:_____

6. (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:_____

7. (10 points)

Draw a Lewis structure for both of the following two (2) compounds. Show all covalent bonds and nonzero formal charges clearly.

A. HCN

B. NH_4Cl

8. (10 points)

Write the electronic configuration for both of the following two (2) elements. Denote each orbital's occupancy clearly.

A. nitrogen

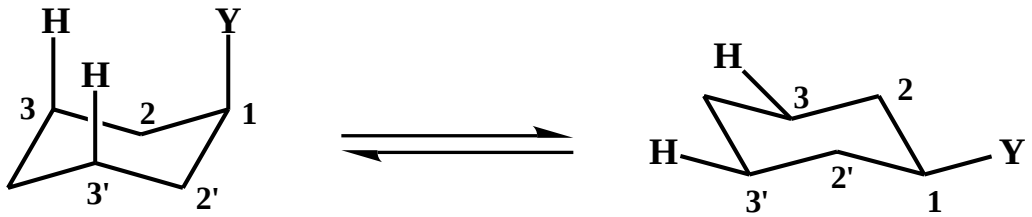
B. sodium

Congratulations!

1	/20
2	/30
3	/25
4	/25
5	/10
6	/20
7	/10
8	/10
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