

Chemistry 333

Examination #1

June 9, 2008

Professor Charonnat

Name: _____

Be certain that your examination has seven (7) 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.

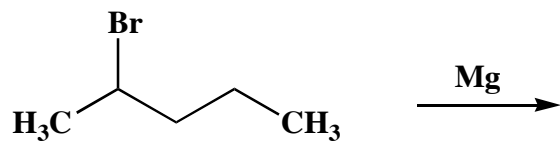
Molecular models are allowed for this examination. All electronic devices, including calculators, are unnecessary and are not allowed.

Name: _____

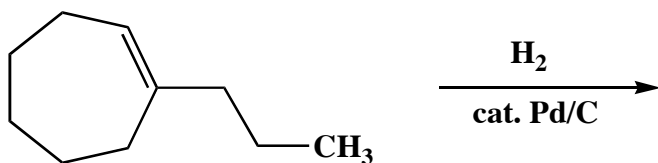
1. (25 points)

Draw the major organic product for each of the following five (5) reactions.

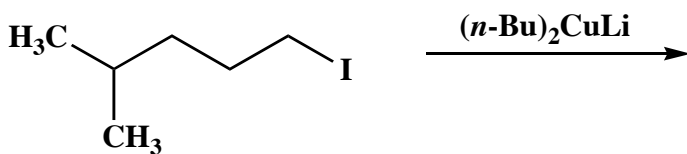
A.



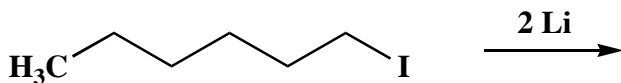
B.



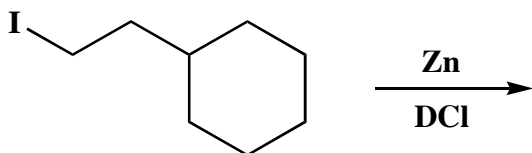
C.



D.



E.



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2. (30 points)

Circle the number that corresponds to the correct answer for each of the following six (6) questions.

A. Boron trichloride is an example of a

1. Lowry- Brønsted acid
2. Lowry- Brønsted base
3. Lewis acid

B. Which experimental result supports the idea that the free-radical chlorination of alkanes is a chain-reaction process?

1. molecular oxygen slows the reaction rate
2. several thousand product molecules are formed per photon of ultraviolet radiation
3. no reaction occurs at 25 °C in the dark

C. The bow-stern interaction of cyclohexane's boat conformation is an example of

1. steric strain
2. torsional strain
3. angle strain

D. Which of the following bonds is the most polar?

1. O-H
2. C-N
3. C-H

E. Which of the following pairs is a set of structural isomers?

1. ethane / methane
2. staggered ethane / eclipsed ethane
3. 2-methylpentane / *n*-hexane

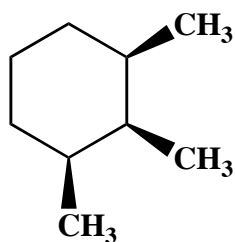
F. The envelope conformation of cyclopentane possesses

1. three carbons in a plane
2. four carbons in a plane
3. five carbons in a plane

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3. (25 points)

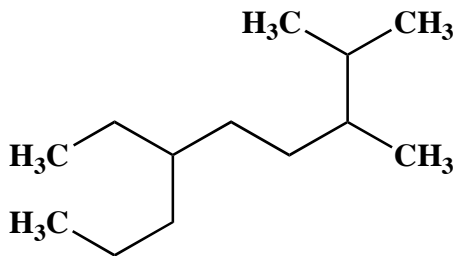
Draw the two possible chair conformations of the following trisubstituted cyclohexane. Clearly denote all 1,3-diaxial interactions for both conformations. Calculate the total strain energy for each conformation. Put a star next to the more stable conformation. Finally, use the information on page 7 to determine the approximate ratio of the two conformations at 298 K. (Reminder: a methyl/methyl 1,3-diaxial interaction is 15.5 kJ/mol.)



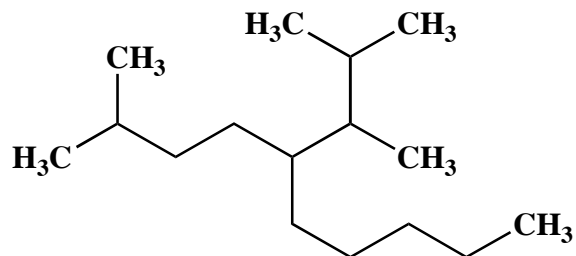
4. (20 points)

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

A.



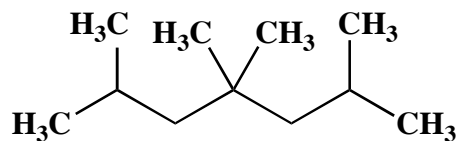
B.



Name: _____

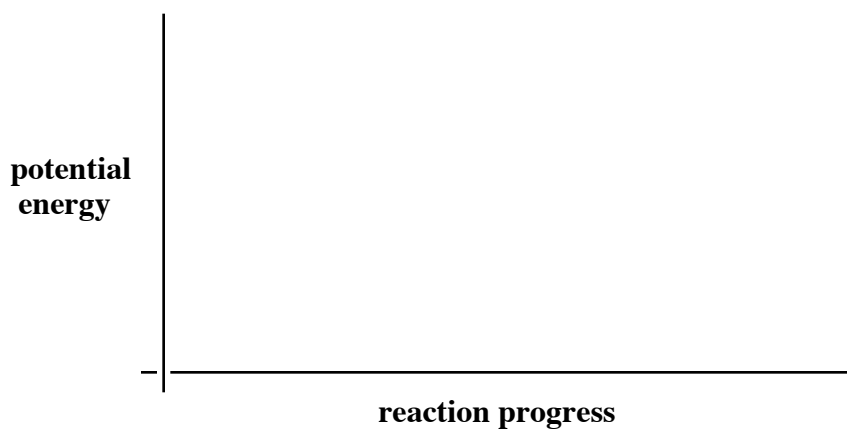
5. (20 points)

The photochemical reaction of the following alkane with molecular chlorine affords a mixture of monochlorinated alkyl halides. Draw the structures of these products and predict the molar ratio when the reaction is run at 25 °C. (Note: For these conditions, the relative rates of hydrogen atom abstraction are 5.5:4.5:1.0 for 3°:2°:1° alkane carbons.)



6. (10 points)

Draw a reaction-energy diagram (graph of reaction progress versus potential energy) for a two-step, overall exothermic reaction, with a late, first transition state. Label the graph with starting material (sm), transition states (ts_x), intermediates (int_x), product (p), activation energies (E_{a_x}) and overall standard heat of reaction (ΔH°).



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7. (10 points)

Draw a Lewis structure and use the VSEPR rules to predict the molecular shape of PBr_3 .

8. (10 points)

Why does propionic acid ($\text{H}_3\text{CCH}_2\text{CO}_2\text{H}$) have a lower pK_a than ethanol ($\text{H}_3\text{CCH}_2\text{OH}$)? Draw structures to illustrate your answer.

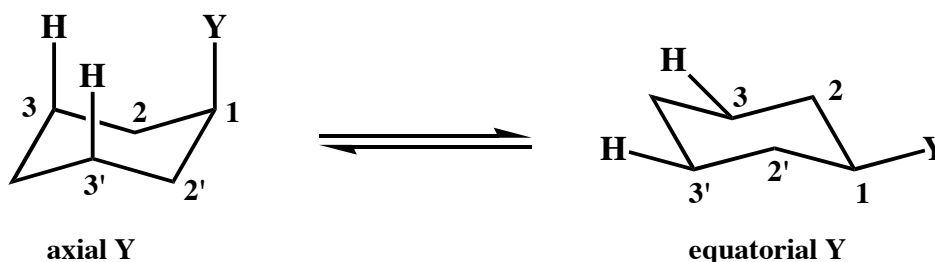
Congratulations!

1	/25
2	/30
3	/25
4	/20
5	/20
6	/10
7	/10
8	/10
Total:	/150

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Calculated Equilibrium Values at T = 298 K

<u>energy difference (kJ/mol)</u>	<u>% more stable isomer</u>	<u>% less stable isomer</u>	<u>K</u>
0.000	50	50	1.00
0.497	55	45	1.22
1.00	60	40	1.50
1.53	65	35	1.86
2.10	70	30	2.33
2.72	75	25	3.00
3.43	80	20	4.00
4.30	85	15	5.67
5.44	90	10	9.00
7.30	95	5	19.0
11.4	99	1	99.0
17.1	99.9	0.1	999



<u>substituent Y</u>	<u>total strain due to two H-Y 1,3-diaxial interactions (kJ/mol)</u>	<u>strain due to one H-Y 1,3-diaxial interaction (kJ/mol)</u>
-F	1.4	0.70
-Cl	2.4	1.2
-Br	2.4	1.2
-OH	4.4	2.2
-CH ₃	7.3	3.7
-CH ₂ CH ₃	7.5	3.8
-CH(CH ₃) ₂	9.2	4.6
-C(CH ₃) ₃	20.	10.
-Ph	12.	6.0
-CO ₂ H	5.9	3.0
-CO ₂ CH ₃	5.2	2.6
-CH=CH ₂	7.0	3.5
-C≡CH	2.0	1.0
-C≡N	0.8	0.4