

Chemistry 333

Examination #1

March 6, 2000

Professor Charonnat

Name: _____

Be certain that your examination has six (6) pages including this one.

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

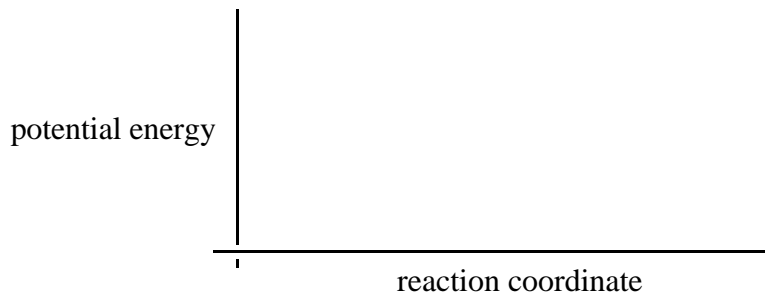
By putting your name on this examination booklet you agree to abide by California State University, Northridge policies of academic honesty and integrity.

Name: _____

1. (20 points)

Draw a reaction profile (graph of potential energy versus reaction coordinate) for both of the following two (2) examples. Label both graphs with starting material (sm), transition state(s) (ts), intermediate(s) (i) and product (p).

A. a three-step endothermic reaction with the third step being the rate-determining step

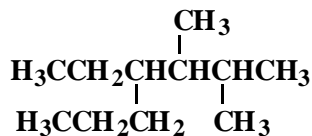


B. a two-step reaction with a late transition state in the first step and an early transition state in the second



2. (10 points)

Use IUPAC nomenclature to write the systematic name of the following branched alkane.

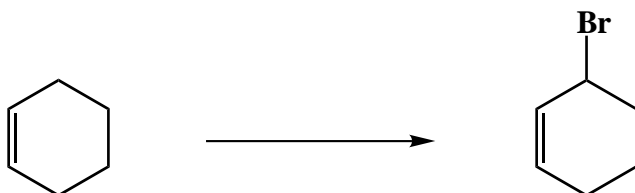


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3. (15 points)

For each of the following three (3) questions, draw the specific reagent(s) necessary to effect the transformation shown.

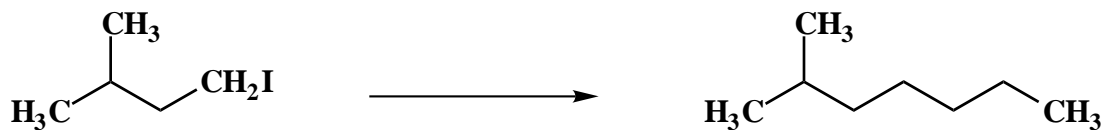
A.



B.



C.



4. (10 points)

Draw Lewis structures for both of the following two (2) compounds.

A. $\text{KOC}(\text{CH}_3)_3$

B. $\text{H}_3\text{CCO}_2\text{H}$

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5. (20 points)

For each of the following four (4) questions, circle the number that corresponds to the correct answer.

A. Alkyl radicals have an unpaired electron on a carbon that is:

1. sp hybridized
2. sp² hybridized
3. sp³ hybridized

B. A species with four hybrid orbitals will be:

1. linear
2. trigonal
3. tetrahedral

C. Resonance always involves delocalization of:

1. electron(s)
2. nuclei
3. formal charge

D. One possible termination step of the free-radical chlorination of methane is:

1. chlorine atom abstraction from molecular chlorine by a methyl radical
2. bonding of atomic hydrogen and atomic chlorine to form HCl
3. bonding of two methyl radicals to form ethane

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6. (25 points)

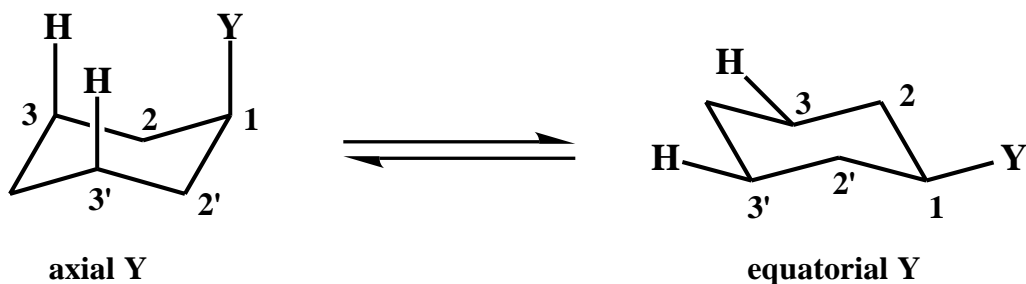
Draw the two possible chair conformations of *cis*-1-ethyl-4-methylcyclohexane. Clearly denote all 1,3-diaxial interactions for both conformations. Calculate the total strain energy for each conformation. Put a star next to the more stable conformation. Finally, determine the ratio of the two conformations at room temperature. (See tables on page 6.)

Congratulations!

1	/20
2	/10
3	/15
4	/10
5	/20
6	/25
<hr/>	
Total:	/100

Calculated Equilibrium Values at T = 298 K

<u>energy difference (kcal/mol)</u>	<u>% more stable isomer</u>	<u>% less stable isomer</u>	<u>K</u>
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



<u>substituent Y</u>	<u>steric strain due to one H-Y</u>	<u>total steric strain due to two H-Y</u>
	<u>1,3-diaxial interaction (kcal/mol)</u>	<u>1,3-diaxial interactions (kcal/mol)</u>
-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 ₂ CH ₃	0.95	1.9
-CH(CH ₃) ₂	1.1	2.2
-C(CH ₃) ₃	2.7	5.4
-C ₆ H ₅	1.5	3.0
-CO ₂ H	0.70	1.4
-C≡N	0.1	0.2