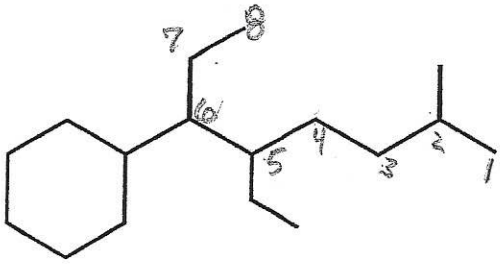
Exam 1, Fall 2023

1. Give an acceptable IUPAC name for each of the compounds below. Be sure to indicate the **stereochemistry** where appropriate. **(12 points)**

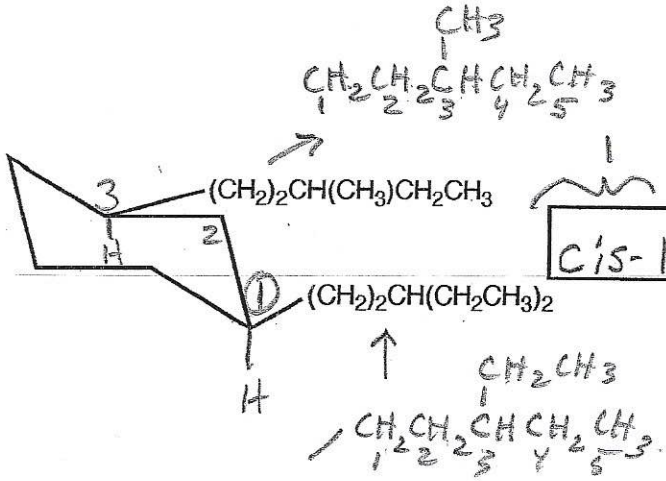
(-1) for incorrect numbers or alpha order

a.



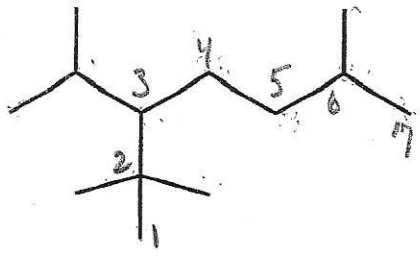
6-cyclohexyl-5-ethyl-2-methyloctane

b.



cis-1-(3-ethylpentyl)-3-(3-methylpentyl) cyclohexane

c.

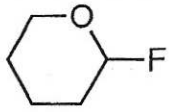


3-isopropyl-2,2,6-trimethylheptane

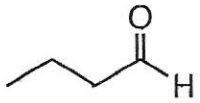
or

2,2,6-trimethyl-3-methylethylheptane

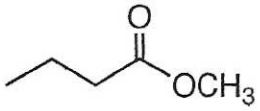
2. If the compound can form hydrogen bonds in the pure state, place **Y** for yes in the box. If it cannot, place **N** for no in the box. (6 pts.)



N



N



N

2pts each

3. Place the compounds in order of increasing solubility in heptane. (1=least soluble, 3=most soluble) (6 pts.)

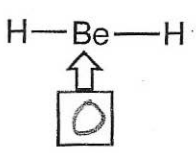
CCl_4 — 3

$CH_3CH_2OCH_3$ — 2

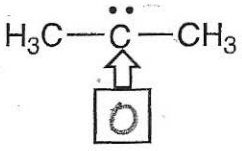
$CH_3CH_2NHCH_3$ — 1

2pts each

4. Calculate the formal charge of the indicated atoms. (6 pts.)



0



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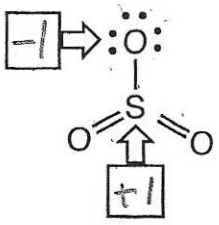
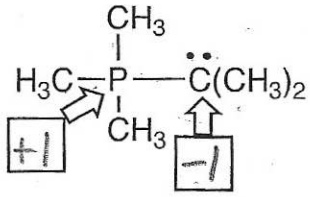


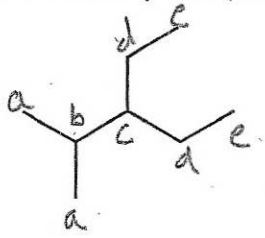
−1 and +1

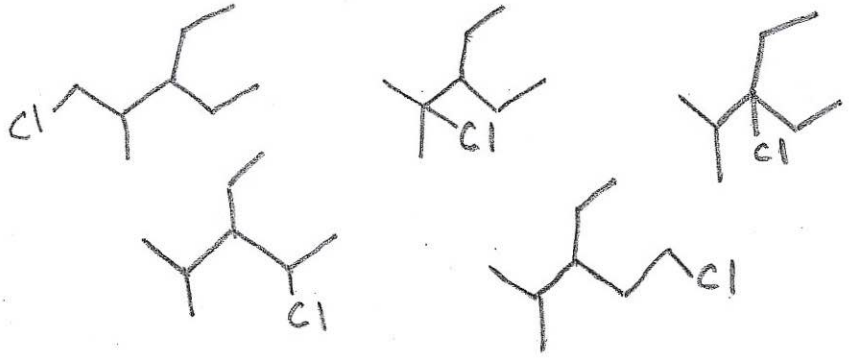


+1 and −1

1pt each

5. Draw all structural isomers resulting from the monochlorination of the compound shown below. You will be penalized for duplicate and incorrect structures. (10 pts.)

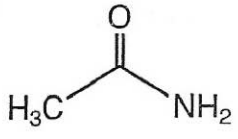




(+2) correct structure

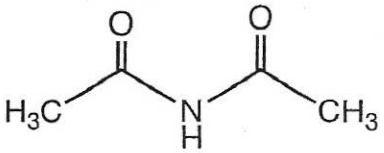
(−1) for duplicate or incorrect structure

6. Rank the following compounds in order of increasing acidity. (1=least acidic, 3=most acidic) (6 pts.)



2

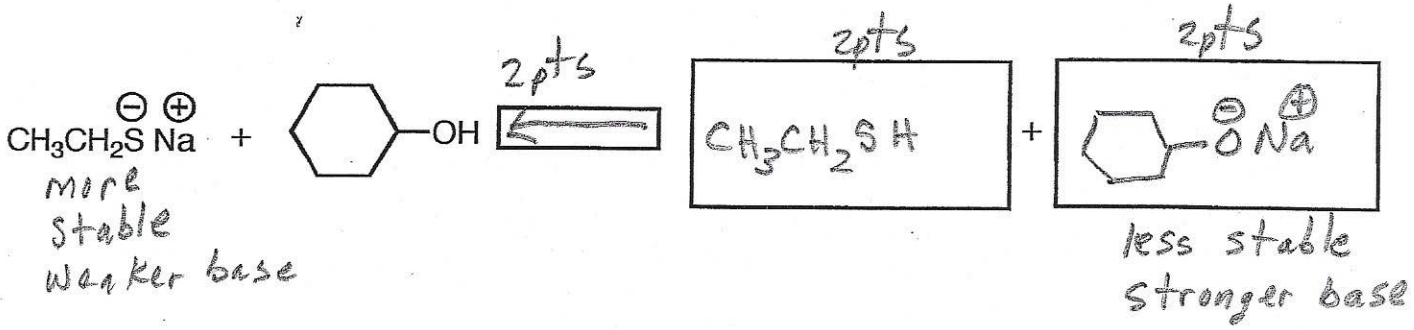
1



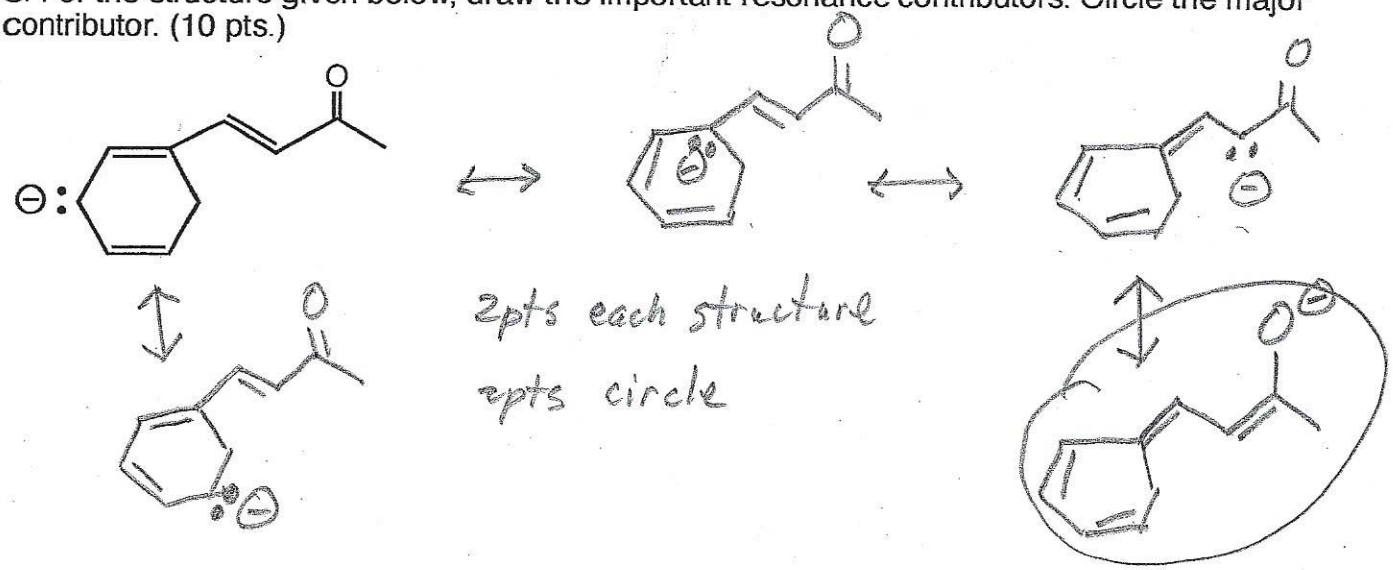
3

2pts each

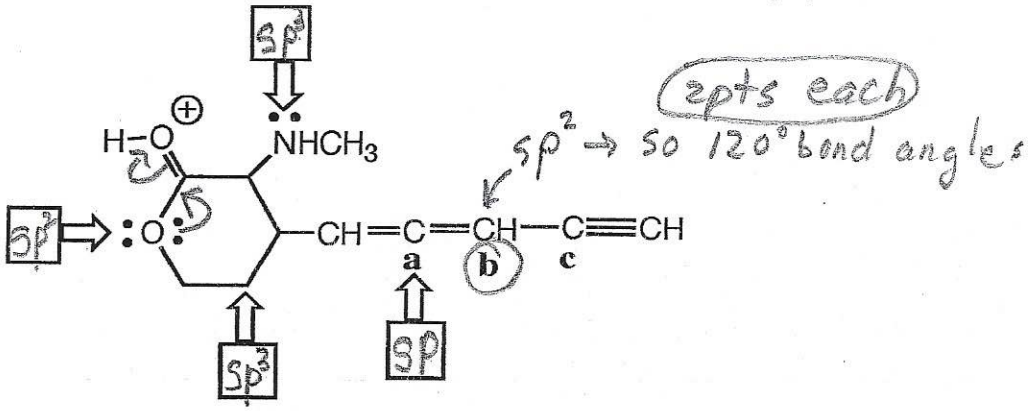
7. Predict the products that would result from an acid/base reaction between the compounds below, and place the answers in the boxes provided. Indicate the direction of the equilibrium by placing an arrow in the box. (6 pts.)



8. For the structure given below, draw the important resonance contributors. Circle the major contributor. (10 pts.)



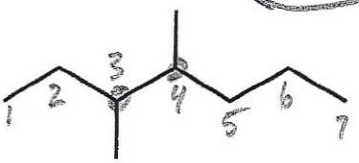
9. Consider the structure below and answer the following questions.

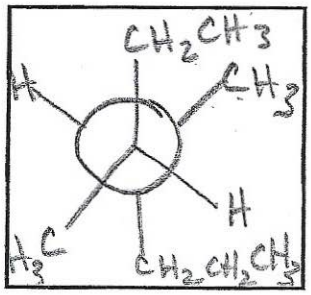


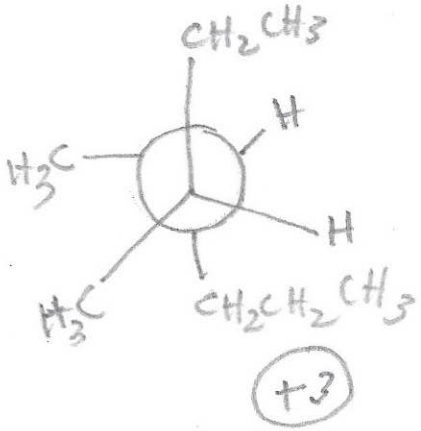
a. Write the hybridization of each atom indicated by an arrow in the box provided. (8 pts.)

b. What is the C_a-C_b-C_c bond angle? (2 pts.) 120°

10. Viewing the structure below along the C3-C4 bond, construct the Newman projection of the most stable conformation. (6 points)

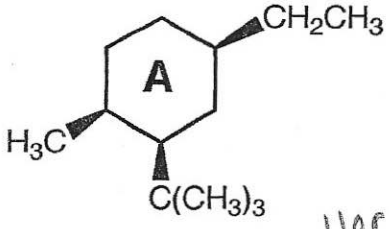


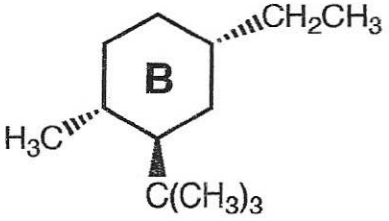




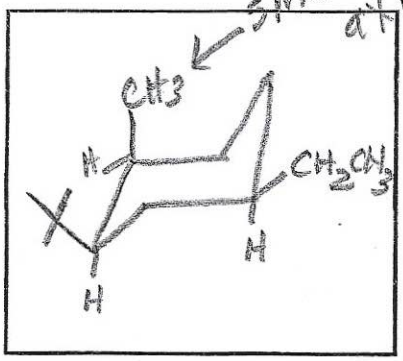
+3

11. a. Draw the more stable chair conformation for each of the substituted cyclohexanes shown below. (8 points)

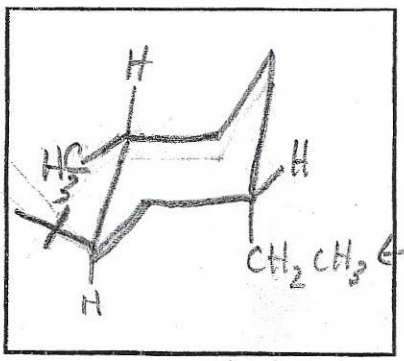




smaller group axial



4pts

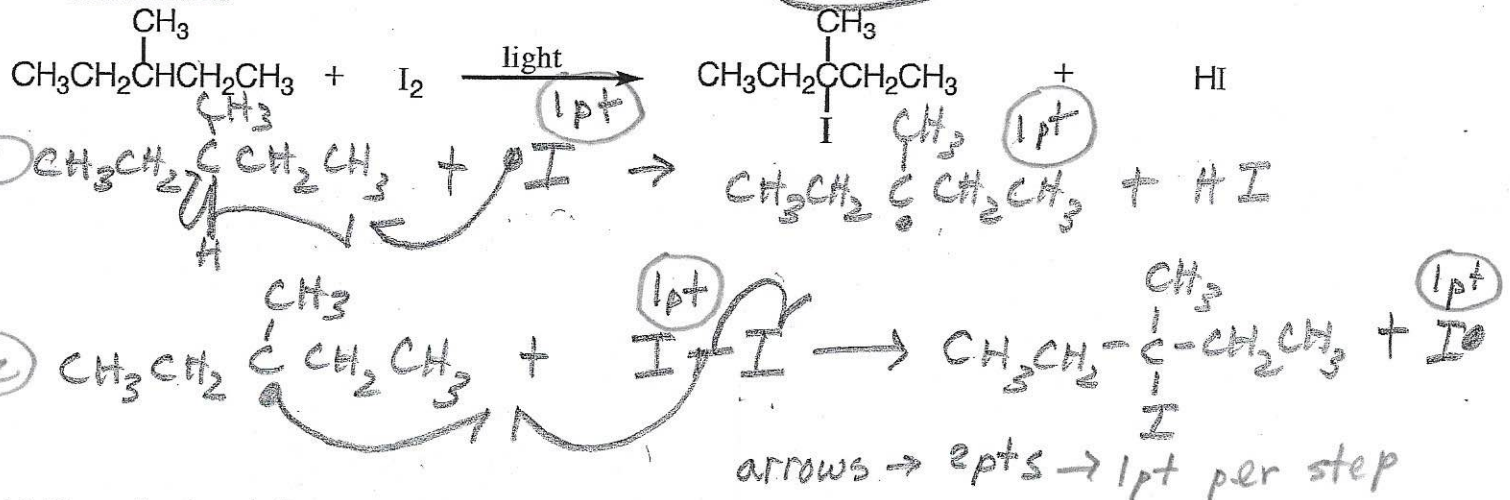


larger group axial

4pts

b. Which isomer is more stable, A or B? (2 points) A

12. The iodination of the compound below gives a mixture of products. a) Provide a mechanism for the propagation steps that lead to the products shown. (6 points)



b) Given the bond dissociation energies (BDE) below, calculate the overall Δ H°for the reaction in the box provided. **You must show your work in the box below to receive credit.** (4 points)

$\Delta H = (91 + 36) - (50 + 71) = +6$ kcal/mol

127 − 121

c) Are the products or reactants favored at equilibrium? (2 points) reactants

Bond	Bond-Dissociation Energy, kcal/mol
H—X bonds and X—X bonds	
H—H	104
D—D	106
F—F	38
Cl—Cl	58
Br—Br	46
I—I	36
H—F	136
H—Cl	103
H—Br	88
H—I	71
HO—H	119
HO—OH	51
Methyl bonds	
CH_3—H	104
CH_3—F	109
CH_3—Cl	84
CH_3—Br	70
CH_3—I	56
CH_3—OH	91
Bonds to primary carbons	
CH_3CH_2—H	98
CH_3CH_2—F	107
CH_3CH_2—Cl	81
CH_3CH_2—Br	68
CH_3CH_2—I	53
CH_3CH_2—OH	91
$CH_3CH_2CH_2$—H	98
$CH_3CH_2CH_2$—F	107
$CH_3CH_2CH_2$—Cl	81
$CH_3CH_2CH_2$—Br	68
$CH_3CH_2CH_2$—I	53
$CH_3CH_2CH_2$—OH	91

Bond		Bond-Dissociation Energy, kcal/mol
Bonds to secondary carbons		
$(CH_3)_2CH$—H		95
$(CH_3)_2CH$—F		106
$(CH_3)_2CH$—Cl		80
$(CH_3)_2CH$—Br		68
$(CH_3)_2CH$—I		53
$(CH_3)_2CH$—OH		91
Bonds to tertiary carbons		
$(CH_3)_3C$—H		91
$(CH_3)_3C$—F		106
$(CH_3)_3C$—Cl		79
$(CH_3)_3C$—Br		65
$(CH_3)_3C$—I		50
$(CH_3)_3C$—OH		91
Other C—H bonds		
$PhCH_2$—H	(benzylic)	85
CH_2=$CHCH_2$—H	(allylic)	87
CH_2=CH—H	(vinyl)	108
Ph—H	(aromatic)	110
C—C bonds		
CH_3—CH_3		88
CH_3CH_2—CH_3		85
CH_3CH_2—CH_2CH_3		82
$(CH_3)_2CH$—CH_3		84
$(CH_3)_3C$—CH_3		81