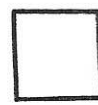
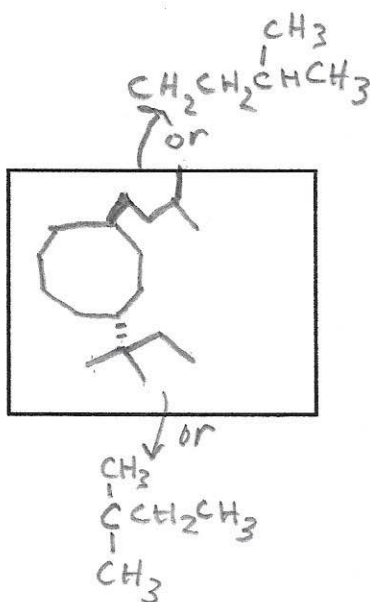
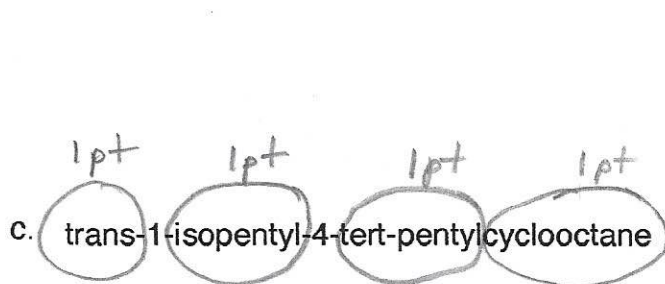
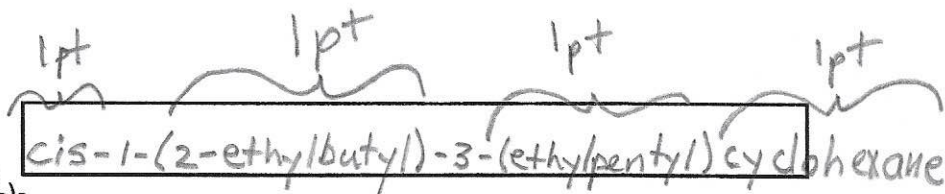
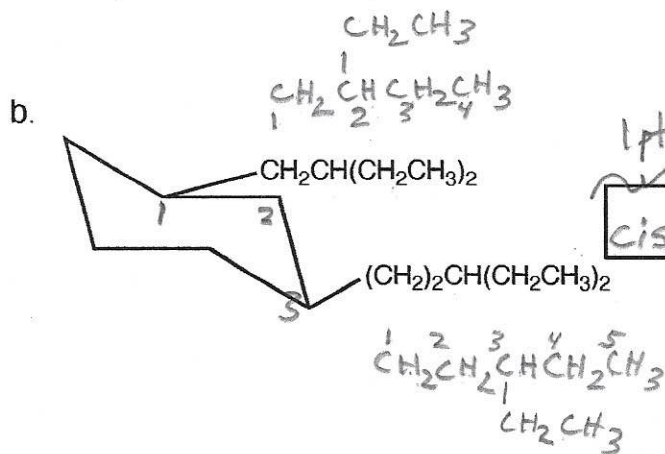
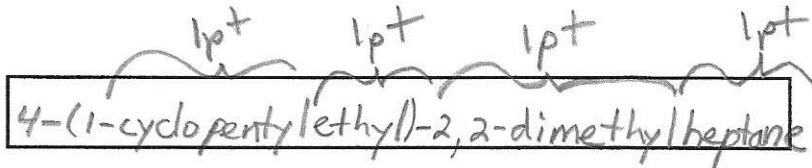
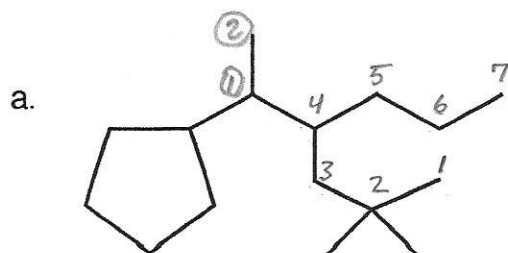


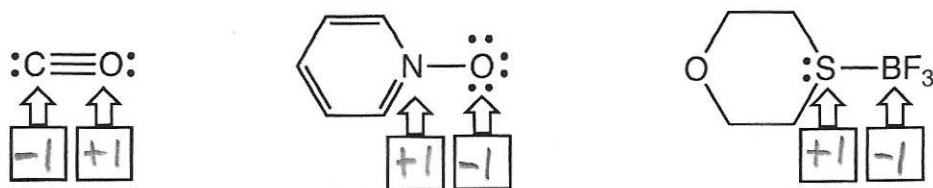
# Exam 1, F2024

1. Give an acceptable IUPAC name for each of the compounds in **a** and **b**. Draw the structure of the compound in **c**. Be sure to indicate the **stereochemistry** where appropriate. (12 points)

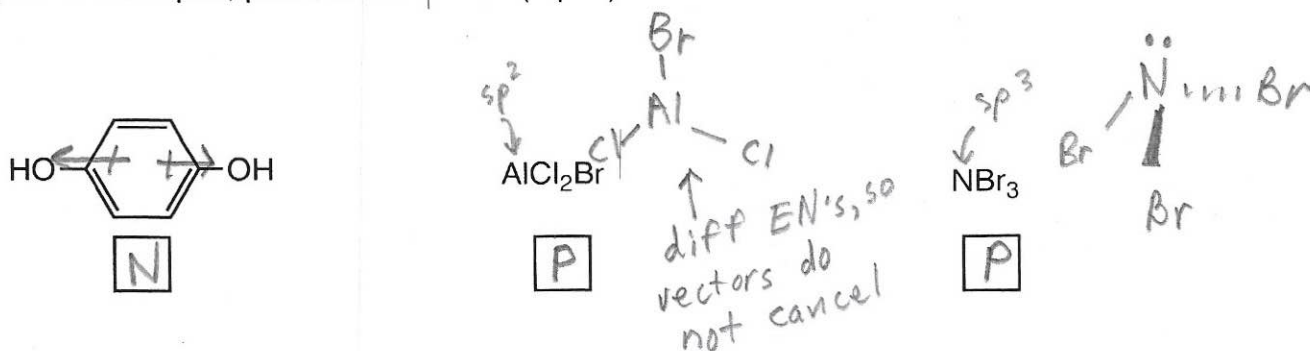
-1 for incorrect numbers



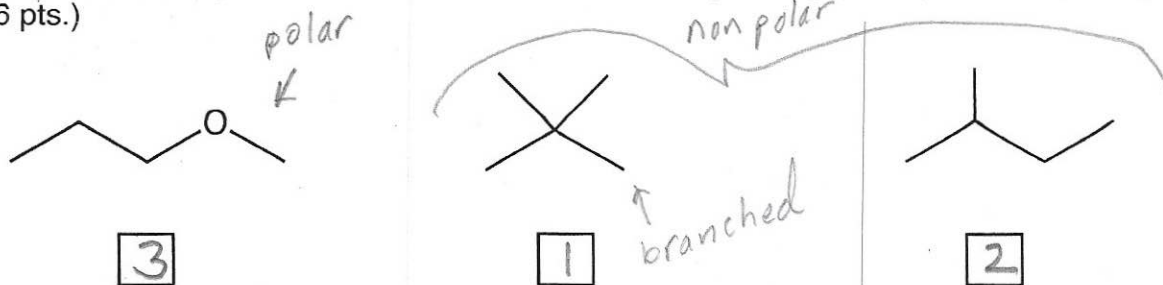
2. Calculate the formal charge of the indicated atoms. (6 pts.)



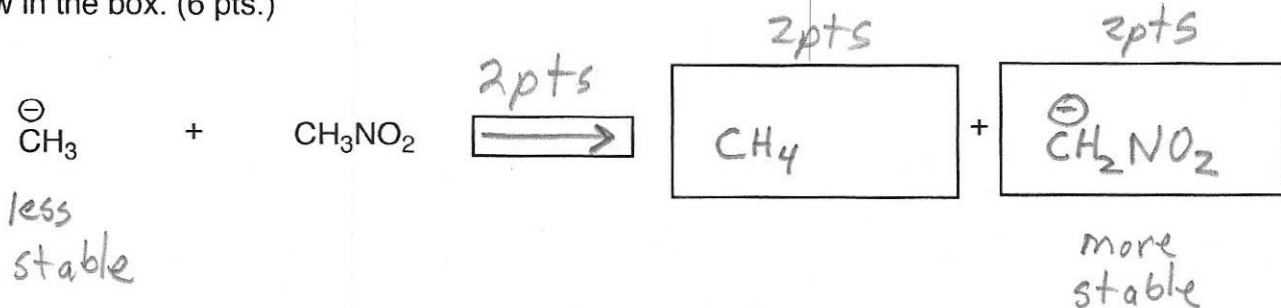
3. Consider the polarity of the compounds below. If the compound is polar, place **P** in the box. If the compound is nonpolar, place **N** in the box. (6 pts.)



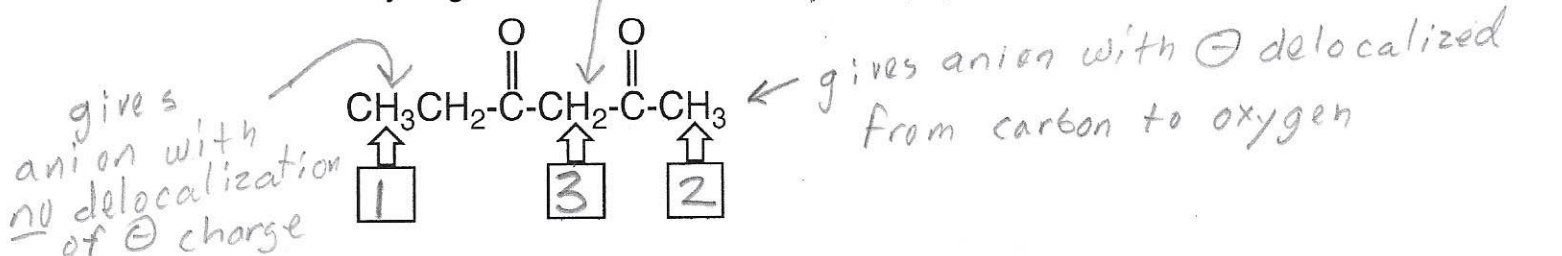
4. Place the compounds below in order of increasing boiling point. (1=lowest, 3=highest boiling point) (6 pts.)



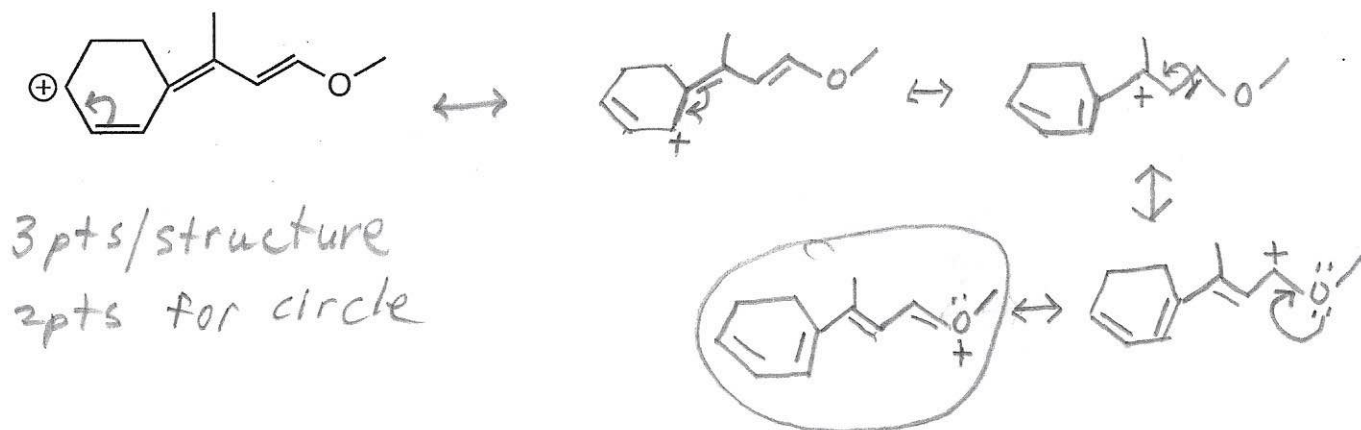
5. Predict the products that would result from an acid/base reaction between the compounds below, and place the answers in the boxes provided. Indicate the direction of the equilibrium by placing an arrow in the box. (6 pts.)



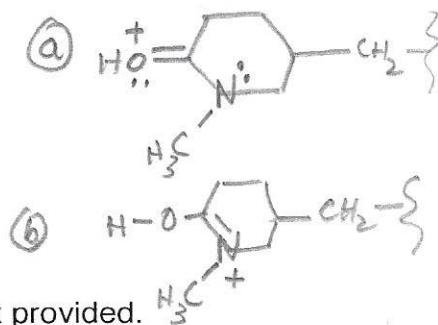
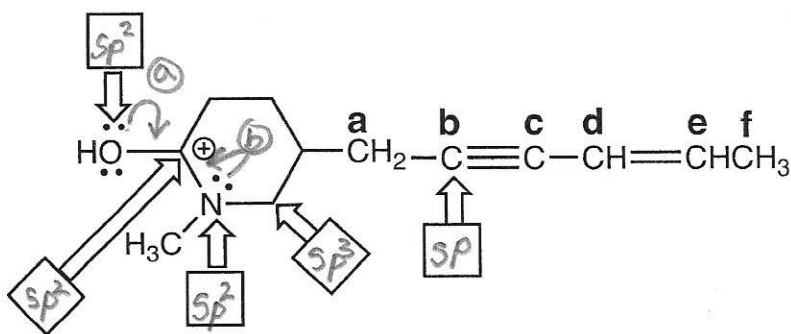
6. Rank the indicated hydrogens in order of increasing acidity. (1=least acidic, 3=most acidic) (6 pts.)



7. For the structure given below, draw the important resonance contributors. Circle the major contributor. (14 pts.)



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



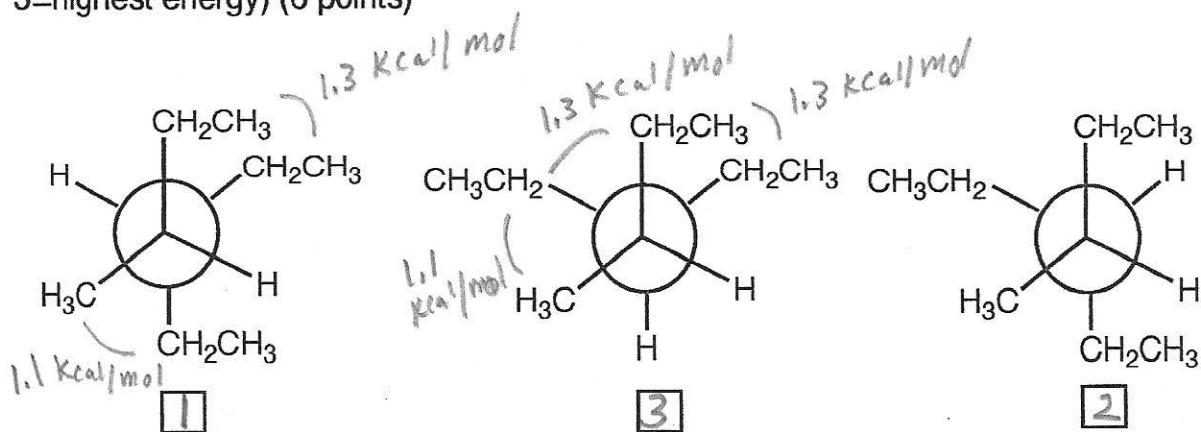
a. Write the hybridization of each atom indicated by an arrow in the box provided. (10 pts.)

b. What is the  $C_b - C_c - C_d$  bond angle? (2 pts.)  $180^\circ$

c. The sigma bond between the carbon atoms labeled e and f is formed by the overlap of what types of orbitals. Be specific. (2 pts.)  $sp^2 - sp^3$



9. a. Arrange the Newman projections below in order of increasing strain energy. (1=lowest energy, 3=highest energy) (6 points)



b. Using the strain energies below, calculate the energy difference between the most stable and least stable conformation. You must show your work in the box provided to receive credit. (2 points)

Strain Energies:

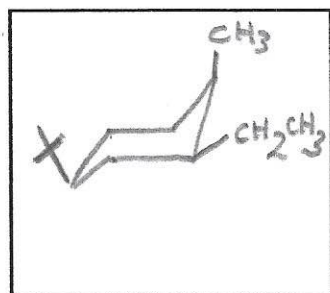
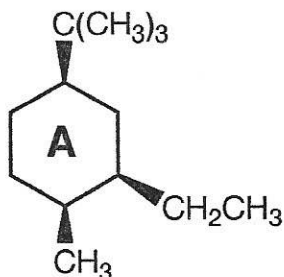
$\text{CH}_3 - \text{CH}_3$  gauche = 0.9 kcal/mol

$\text{CH}_3 - \text{CH}_2\text{CH}_3$  gauche = 1.1 kcal/mol

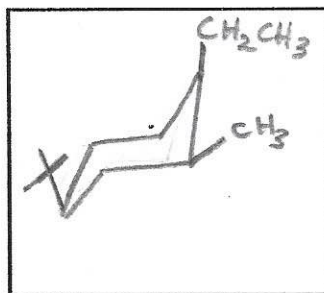
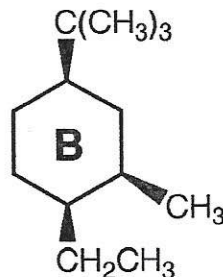
$\text{CH}_3\text{CH}_2 - \text{CH}_3\text{CH}_2$  gauche = 1.3 kcal/mol

1.3	1.3
1.3	1.1
1.1	2.4
3.7	3.7
	-2.4
	1.3 kcal/mol

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



4pts



4pts

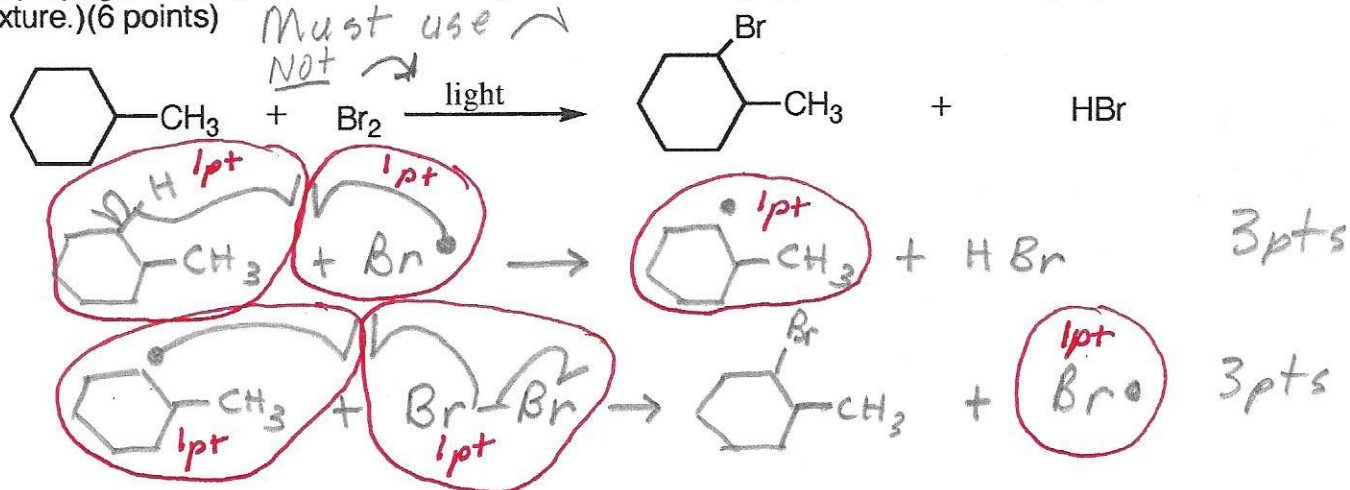
b. Which isomer is more stable, A or B? (2 points)

less crowding (steric strain)  
because smaller group is  
axial

A



11. The bromination of the compound below gives a mixture of products. a) Provide a mechanism for the propagation steps that lead to the products shown. (Fyi, this is not the major product in the mixture.) (6 points)



b) Given the bond dissociation energies (BDE) below, calculate the overall  $\Delta H^\circ$  for the reaction in the box provided. You must show your work in the box below to receive credit. (4 points)

$$\Delta H^\circ = (95 + 46) - (68 + 88) = -15 \text{ Kcal/mol}$$

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

products

to get credit, the sign of  $\Delta H$  must match

Bond-Dissociation Energy		Bond-Dissociation Energy	
Bond	kcal/mol	Bond	kcal/mol
<b>H—X bonds and X—X bonds</b>		<b>Bonds to secondary carbons</b>	
H—H	104	(CH <sub>3</sub> ) <sub>2</sub> CH—H	95
D—D	106	(CH <sub>3</sub> ) <sub>2</sub> CH—F	106
F—F	38	(CH <sub>3</sub> ) <sub>2</sub> CH—Cl	80
Cl—Cl	58	(CH <sub>3</sub> ) <sub>2</sub> CH—Br	68
Br—Br	46	(CH <sub>3</sub> ) <sub>2</sub> CH—I	53
I—I	36	(CH <sub>3</sub> ) <sub>2</sub> CH—OH	91
H—F	136	<b>Bonds to tertiary carbons</b>	
H—Cl	103	(CH <sub>3</sub> ) <sub>3</sub> C—H	91
H—Br	88	(CH <sub>3</sub> ) <sub>3</sub> C—F	106
H—I	71	(CH <sub>3</sub> ) <sub>3</sub> C—Cl	79
HO—H	119	(CH <sub>3</sub> ) <sub>3</sub> C—Br	65
HO—OH	51	(CH <sub>3</sub> ) <sub>3</sub> C—I	50
<b>Methyl bonds</b>		(CH <sub>3</sub> ) <sub>3</sub> C—OH	91
CH <sub>3</sub> —H	104	<b>Other C—H bonds</b>	
CH <sub>3</sub> —F	109	PhCH <sub>2</sub> —H (benzylic)	85
CH <sub>3</sub> —Cl	84	CH <sub>2</sub> =CHCH <sub>2</sub> —H (allylic)	87
CH <sub>3</sub> —Br	70	CH <sub>2</sub> =CH—H (vinyl)	108
CH <sub>3</sub> —I	56	Ph—H (aromatic)	110
CH <sub>3</sub> —OH	91	<b>C—C bonds</b>	
<b>Bonds to primary carbons</b>		CH <sub>3</sub> —CH <sub>3</sub>	88
CH <sub>3</sub> CH <sub>2</sub> —H	98	CH <sub>3</sub> CH <sub>2</sub> —CH <sub>3</sub>	85
CH <sub>3</sub> CH <sub>2</sub> —F	107	CH <sub>3</sub> CH <sub>2</sub> —CH <sub>2</sub> CH <sub>3</sub>	82
CH <sub>3</sub> CH <sub>2</sub> —Cl	81	(CH <sub>3</sub> ) <sub>2</sub> CH—CH <sub>3</sub>	84
CH <sub>3</sub> CH <sub>2</sub> —Br	68	(CH <sub>3</sub> ) <sub>3</sub> C—CH <sub>3</sub>	81
CH <sub>3</sub> CH <sub>2</sub> —I	53		
CH <sub>3</sub> CH <sub>2</sub> —OH	91		
CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> —H	98		
CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> —F	107		
CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> —Cl	81		
CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> —Br	68		
CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> —I	53		
CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> —OH	91		

