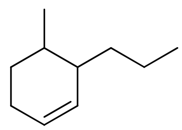
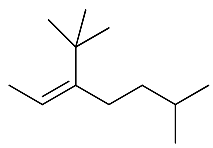
CHEMISTRY 31 **Name: ______________________________**

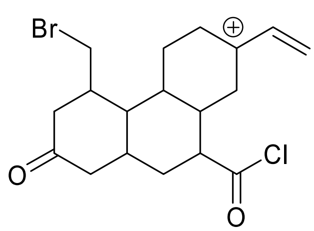
Exam #1, 100 pts

1. (4 pts) Provide the complete IUPAC name for each of the following compounds.

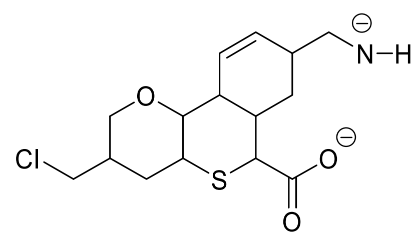




2. (6 pts) (a) Identify (by circling) all electrophilic positions in compound A and all nucleophilic positions in compound B given below:



Compound A



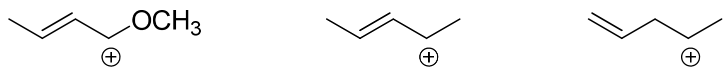
Compound B

(b) Using an arrow, point to the **most reactive** electrophile in compound A and the **most reactive** nucleophile in compound B.

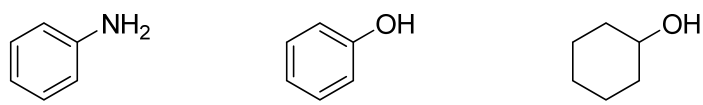
(c) Provide a brief (1-2 sentence) explanation for **one** of your answers in part b.

3. (18 pts) Evaluate each of the following sets of compounds according to the given criterion. Circle your choice and give a brief (<10 word) explanation for your reasoning.

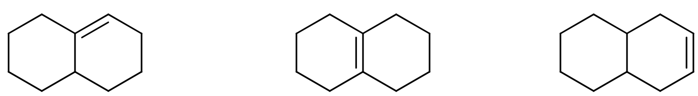
(a) Which compound is the more stable cation?



(b) Which compound is the strongest acid?

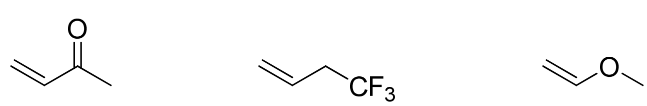


(c) Which compound is the most stable?

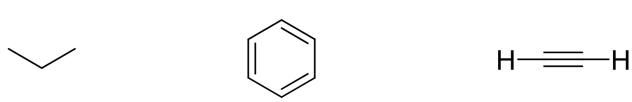


(d) Which compound is the most stable?

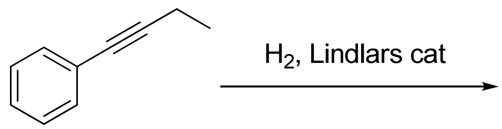
(e) Which alkene is the most reactive nucleophile?

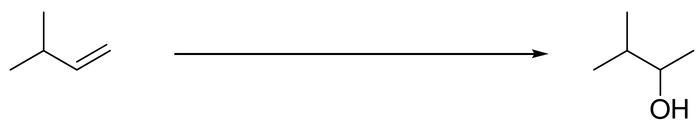


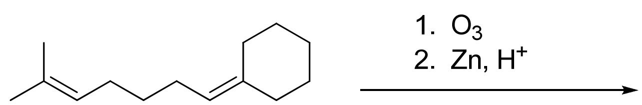
(f) Which compound has the strongest carbon-hydrogen bonds?

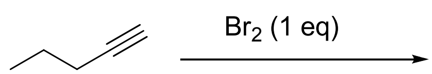


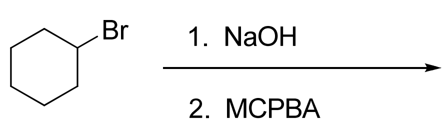
4. (26 pts) Provide the major organic product(s) or supply missing reagents for each of the following reactions.

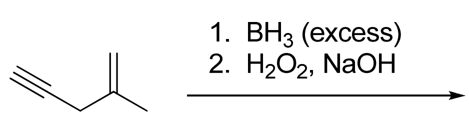


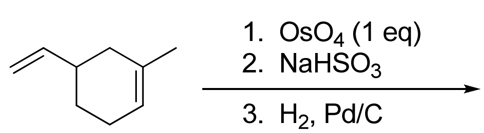


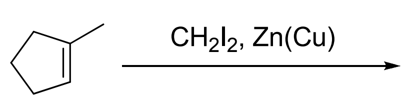




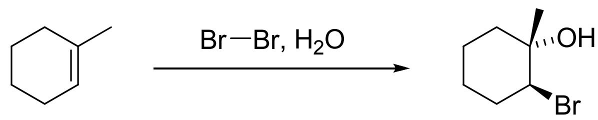




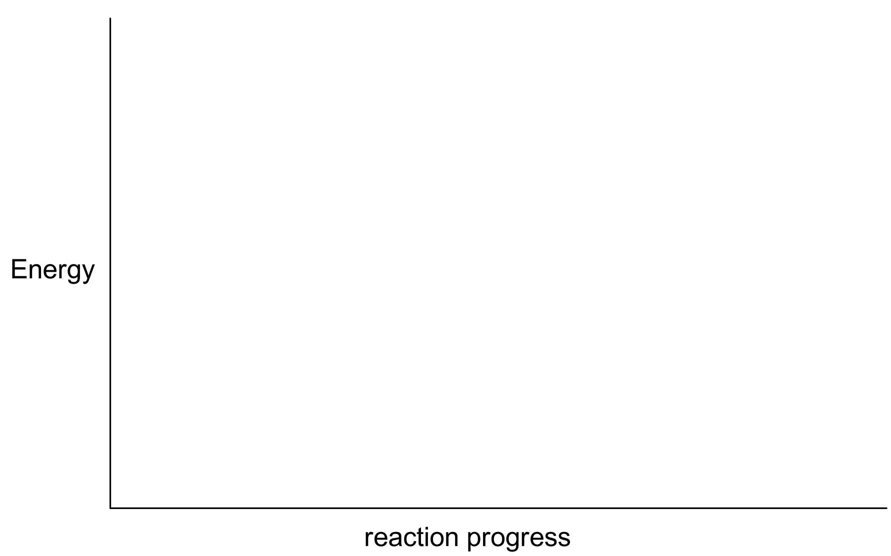




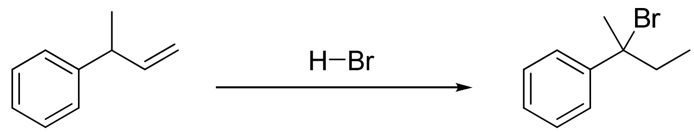
5. (10 pts) (a) Provide a detailed stepwise mechanism using curved arrows for the following reaction. Be sure to show each individual step and include the structure of each intermediate formed.



(b) Draw an energy diagram for your mechanism above and label the position of starting material, intermediates, and the product.

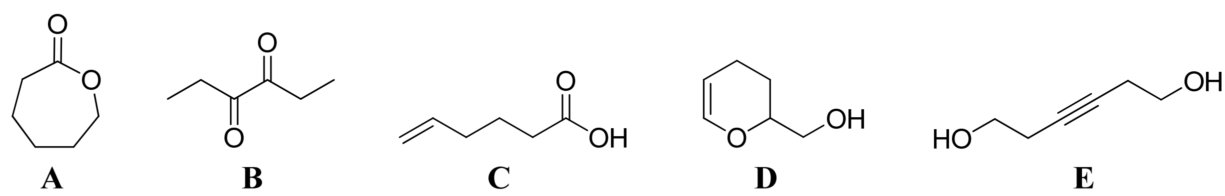


6. (10 pts) (a) Provide a detailed stepwise mechanism using curved arrows for the following reaction. Be sure to show each individual step and include the structure of each intermediate formed.



(b) Is this reaction expected to be thermodynamically favorable? Briefly explain why or why not (1-2 sentences).

7. (10 pts) Shown below are five isomers, **A-E**, all with the molecular formula $C_6H_{10}O_2$.



(a) What is the degree of unsaturation for these compounds? (show your work)

(b) Which compounds would react with exactly 2 molar equivalents of Br_2?

Provide all letter answers that apply: ________________________

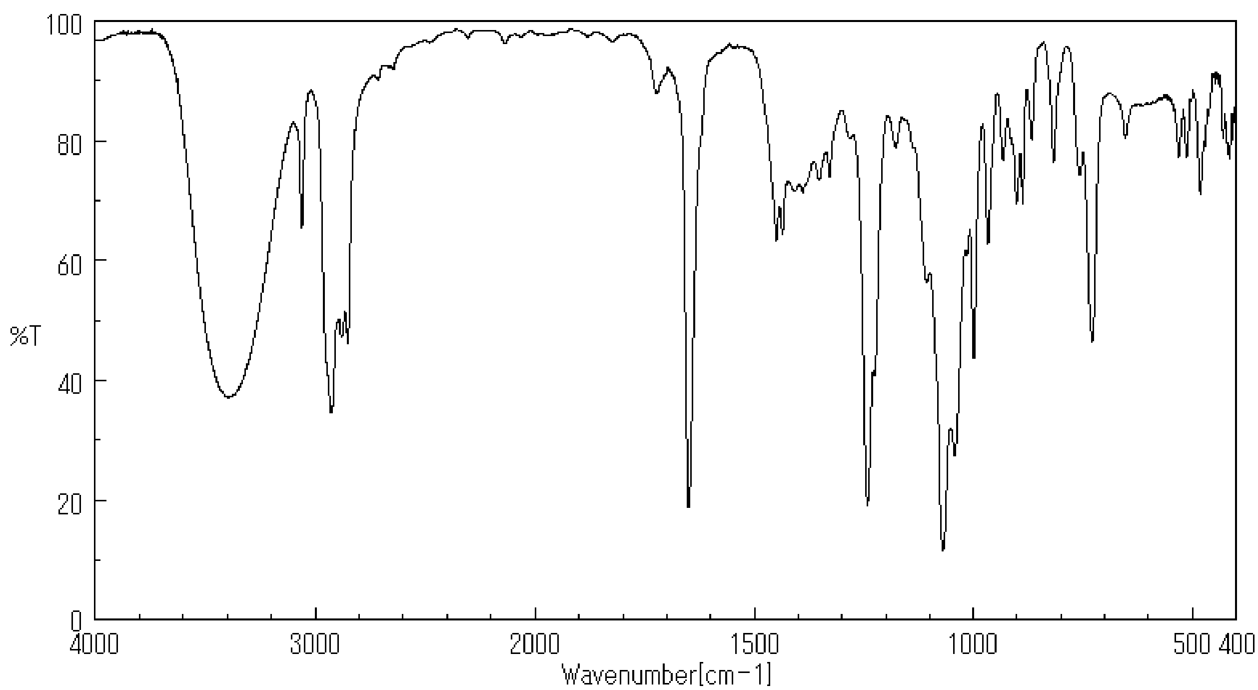
(c) Which compounds would only display three signals in ^{13}C NMR spectroscopy?

Provide all letter answers that apply: ________________________

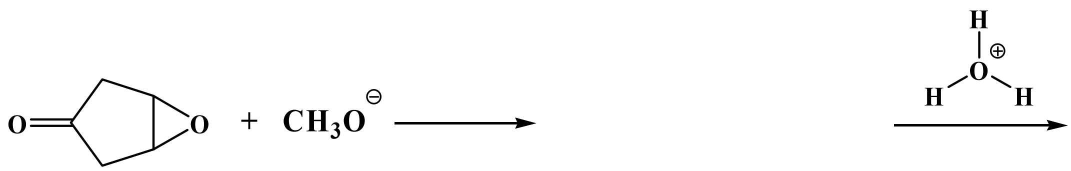
(d) Which compounds will produce CO_2 as a product upon reaction with O_3 then NaOH, H_2O_2?

Provide all letter answers that apply: ________________________

(e) Which compound matches the IR spectrum given below? ________________



8. (10 pts) Consider the two step reaction sequence shown below reacting compound A with CH_3O^- to give an intermediate, followed by reaction with H_3O^+ giving product B.



compound A intermediate product B

(a) When conducted in the lab, product B provides the spectroscopic data given below. Using this data, what is the structure of the isolated product B? Draw the structure of the intermediate, product B, and provide the curved arrows for both steps in the above reaction scheme.

^{13}CNMR: 6 peaks

IR major peaks:

3300 cm^{-1}, strong and broad

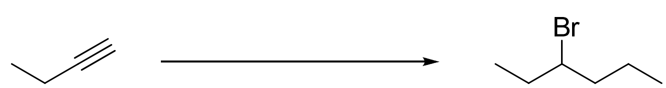
2900, 2800 cm^{-1}, strong to medium

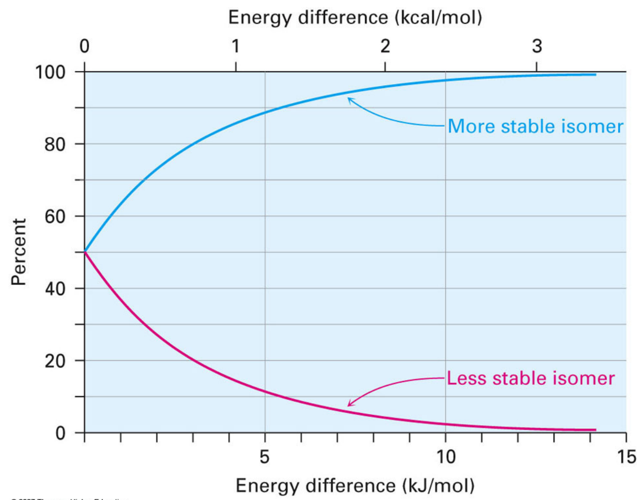
1720 cm^{-1}, strong

(b) Do you think this reaction is thermodynamically favorable? Circle YES or NO

(c) Briefly (10-20 words) explain your answer in part b.

9. (6 pts) Propose a sequence of steps to synthesize the following product from the given starting material.





Destabilizing Strain Energies

1,3-Diaxial Interactions	Gauche Interactions	Eclipsing Interactions
$CH_3 – H$ = 3.8 kJ/mol	$CH_3 – CH_3$ = 3.8 kJ/mol	H – H = 4.0 kJ/mol
$CH(CH_3)_2 – H$ = 4.6 kJ/mol	$CH(CH_3)_2 – CH_3$ = 4.6 kJ/mol	$CH_3 – H$ = 6.0 kJ/mol
$CH(CH_3)_2 – CH_3$ = 8.4 kJ/mol		$CH_3 – CH_3$ = 11.0 kJ/mol

Table 12.1 | **Characteristic IR Absorptions of Some Functional Groups**

Functional Group	Absorption (cm^{-1})	Intensity
Alkane		
C–H	2850–2960	Medium
Alkene		
=C–H	3020–3100	Medium
C=C	1640–1680	Medium
Alkyne		
≡C–H	3300	Strong
C≡C	2100–2260	Medium
Alkyl halide		
C–Cl	600–800	Strong
C–Br	500–600	Strong
Alcohol		
O–H	3400–3650	Strong, broad
C–O	1050–1150	Strong
Arene		
C–H	3030	Weak
Aromatic ring	1660–2000	Weak
	1450–1600	Medium
Amine		
N–H	3300–3500	Medium
C–N	1030–1230	Medium
Carbonyl compound		
C=O	1670–1780	Strong
Carboxylic acid		
O–H	2500–3100	Strong, broad
Nitrile		
C≡N	2210–2260	Medium
Nitro		
NO_2	1540	Strong
Aldehyde		
C-H	2800 - 2700	Medium