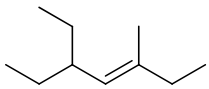
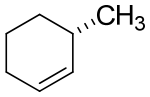
CHEMISTRY 31 **Name:** _____

Summer 2010 Final Exam

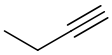
200 pts

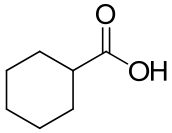
1. (6 pts) Provide the complete IUPAC name for each of the following compounds:

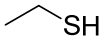


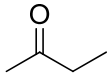


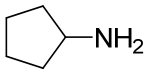
2. (10 pts) For each of the following compounds provide the functional group and the corresponding pKa value for the most acidic hydrogen.



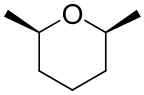


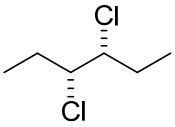






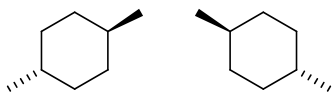
3. (6 pts) For each compound given below determine if it is chiral or achiral (give answer below structure).



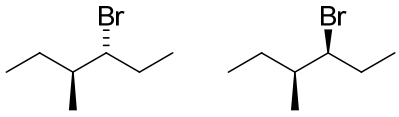


4. (12 pts) What is the relationship between each set of compounds below; identical, constitutional isomers, enantiomers, or diastereomers (give answers below structures).

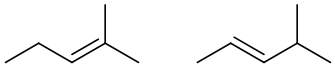
(a)



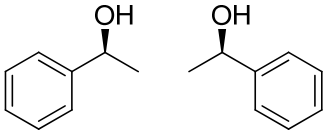
(b)



(c)

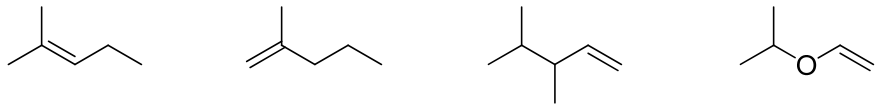


(d)

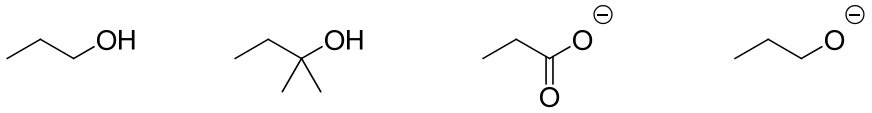


5. (30 pts) Answer each of the following questions by circling your answers:

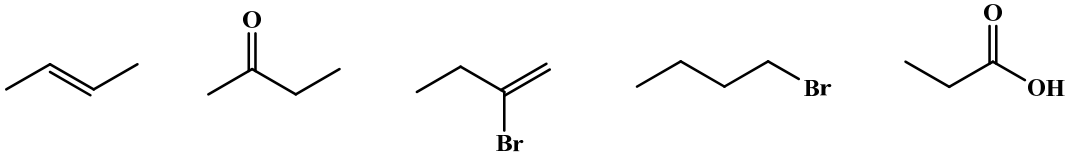
(a) Which of the following alkenes will isomerize to a new alkene with H_3PO_4? (circle all that apply)



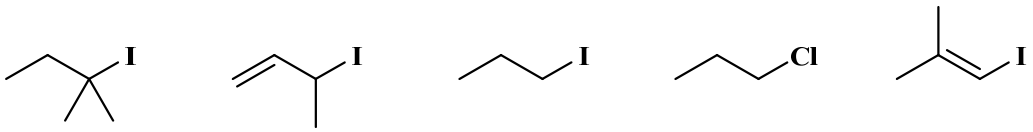
(b) Circle the strongest nucleophile and cross-out the weakest nucleophile from choices below:



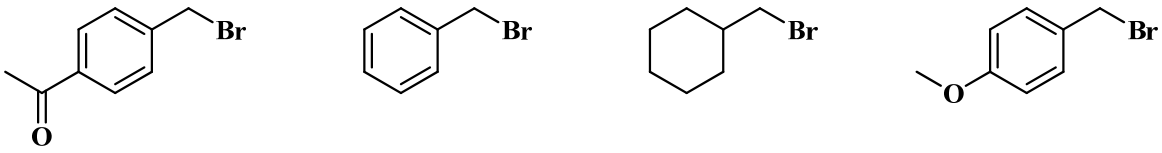
(c) Which of the following compounds cannot be prepared directly from an alkyne? (circle all that apply)



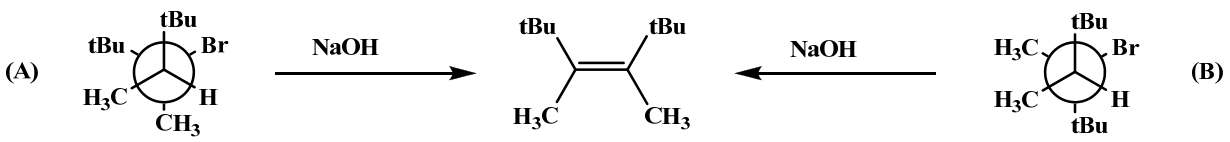
(d) Which substrate will react the fastest with hydroxide ($^-$OH) in DMSO to give a substitution product? (circle one answer)



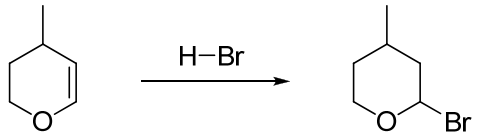
(e) Which substrate will undergo the fastest S_N1 reaction? (circle one choice)



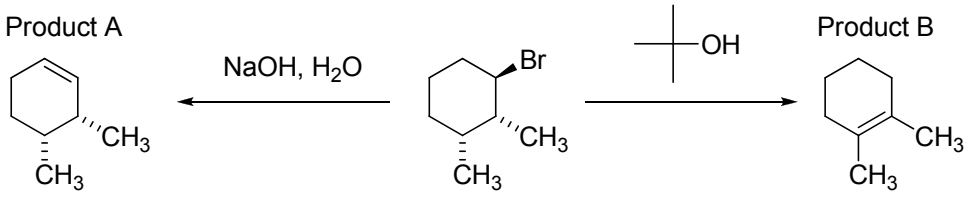
(f) Which starting material, **A** or **B**, will give the following alkene in the *highest yield* when reacted with NaOH? (circle one choice from **A** or **B**)



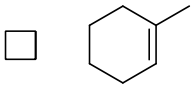
6. (10 pts) Addition of HBr to the alkene shown below gives only the product provided. Explain why this is the only product generated. Note, a picture is worth a thousand words!



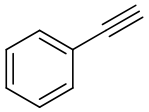
7. (12 pts) When the following alkyl halide is reacted with NaOH product A is produced. However, when it is reacted with $(CH_3)_3COH$ product B is produced. How do you explain the difference in product formation?



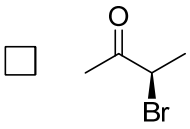
8. (28 pts) Provide the major product(s) for each of the following reactions. Be sure to include appropriate stereochemistry where necessary. For reactions with a box in front, check the box if the product is predicted to be optically active.

☐ 

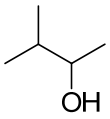
1. OsO_4
2. $NaHSO_3$



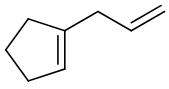
$HgSO_4$
H_2SO_4, H_2O

☐ 

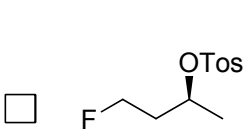
NaCN, DMSO

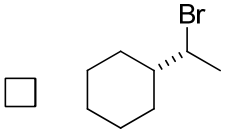


HBr



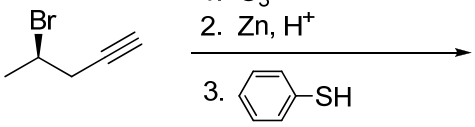
1. O_3 (1 eq)
2. NaOH, H_2O_2

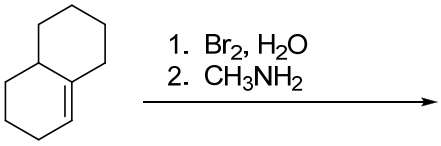
☐ 

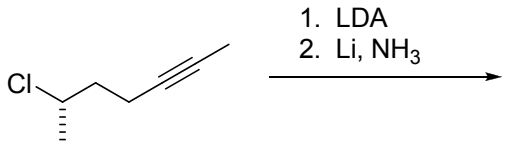


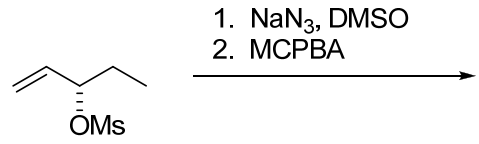
NaNH$_2$, NH$_3$

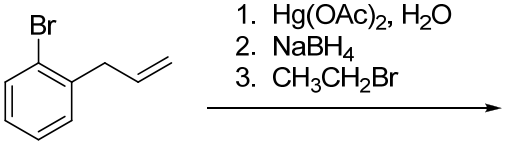
9. (30 pts) Provide the major product(s) for each of the following reactions. Be sure to include appropriate stereochemistry where necessary. For reactions with a box in front, check the box if the product is predicted to be optically active.

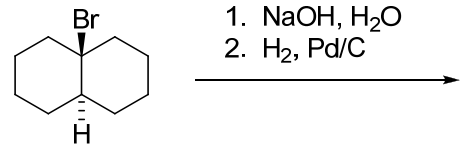
☐ 



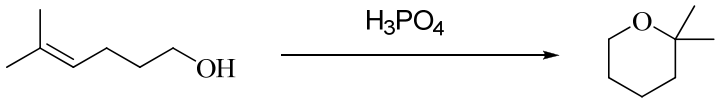
☐ 

☐ 



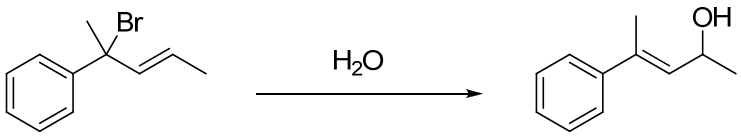
☐ 

10. (14 pts) (a) In an attempt to dehydrate the following alcohol, the cyclic product shown below was obtained. Propose a mechanism to explain how this product is produced.



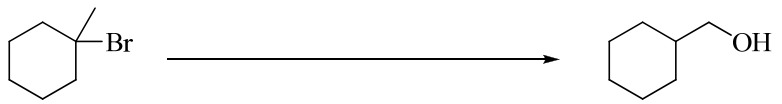
(b) Why did the initially planned alcohol dehydration not work (1-2 sentences)?

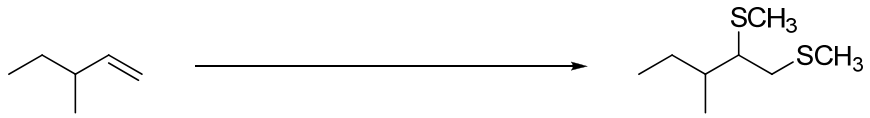
11. (14 pts) (a) Propose a mechanism for the following reaction.



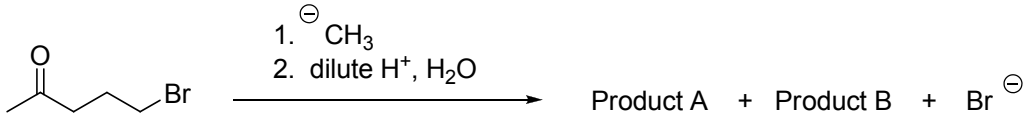
(b) Why is the given product thermodynamically favored (1-2 sentences)?

12. (14 pts) Propose a sequence of steps to synthesize the following product from the given starting material.





13. (14 pts) The following reaction produces two organic products, product A and B, along with a bromide anion (note step 2 just neutralizes charge). Using the following data for product A and B, along with your understanding of organic reactions, what are the structures of A and B?



Product A: Degree of unsaturation = 1 — Draw Product A Below

^{13}C spectrum = 6 signals
(one above 200 ppm)

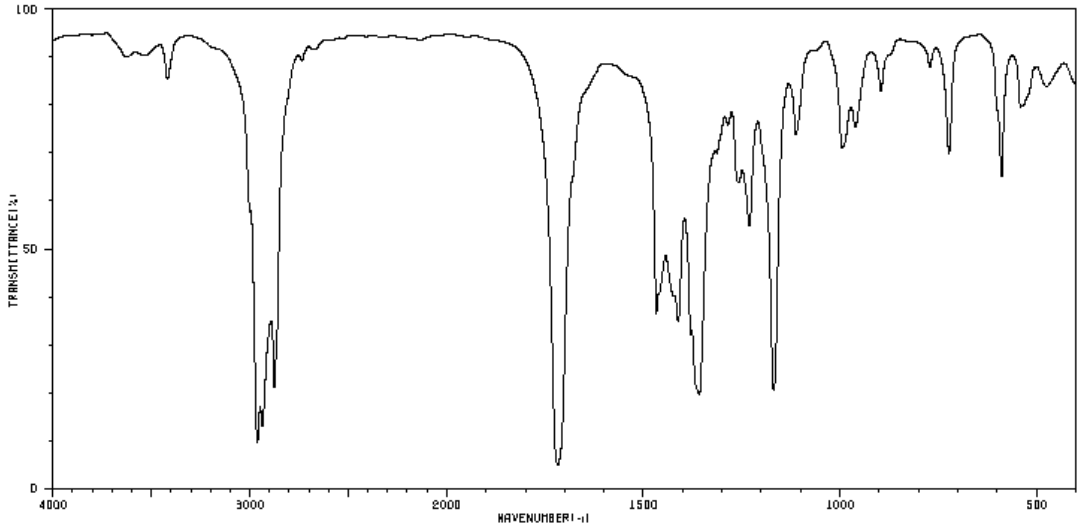
IR spectrum on following page:

Product B: Degree of unsaturation = 0 — Draw Product B Below

^{13}C spectrum = 5 signals
(all below 90 ppm)

IR spectrum on following page:

Product A Key absorptions 2962, 2936, 2875, 1718 cm^{-1}



Product B Key absorptions 3373, 2963, 2936, 2875 cm^{-1}

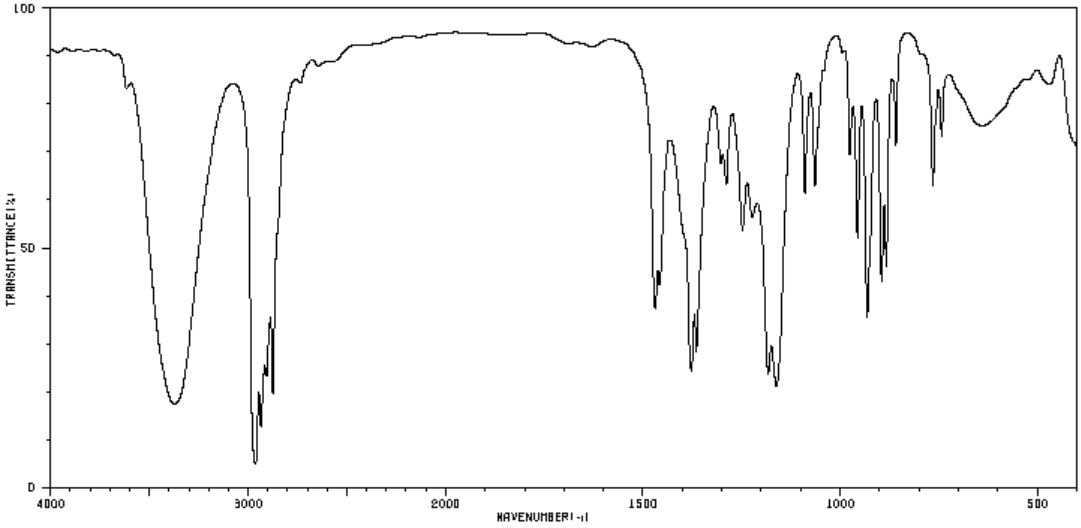


Table 12.1 Characteristic IR Absorptions of Some Functional Groups

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

Functional Group	Absorption (cm^{-1})	Intensity
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

© 2007 Thomson Higher Education