



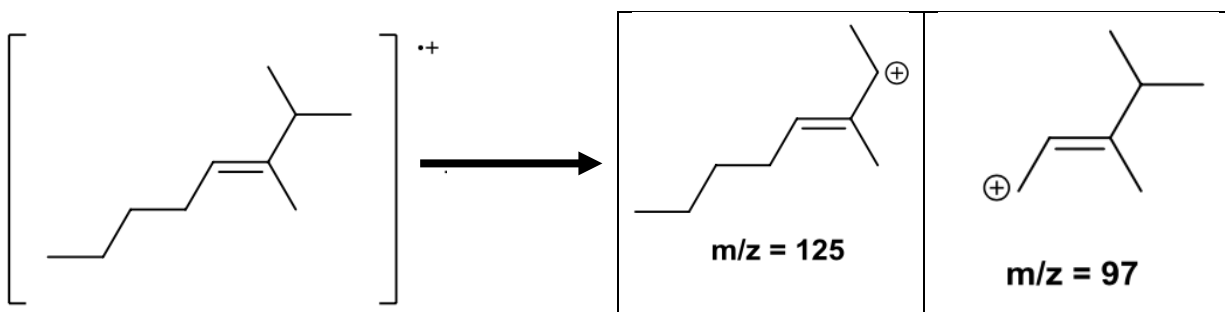
Polytechnic Tutoring Center

Midterm I KEY – CM 2223, Spring 2022

Disclaimer: This mock exam is only for practice. It was made by tutors in the Polytechnic Tutoring Center and is not representative of the actual exam given by the Academic Department.

Problem 1:

- a. Draw in two of the major fragmentation products of the radical cation of this alkene in the boxes. Clearly indicate if each compound is a radical, cation, or radical cation.

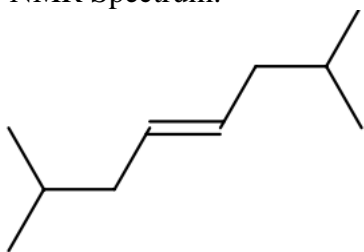


- b. Briefly describe the diagnostic peaks for the alkene from part a) in the IR spectrum including where you would look (cm⁻¹ region) and what you would see. Ignore the fingerprint region.

There would be a vinyl C-H stretch around 3000-3150 cm⁻¹

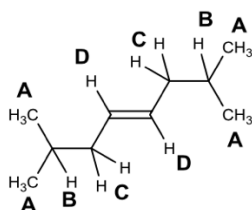
There would be an alkene C=C stretch around 1620-1680 cm⁻¹

- c. Draw an alkene isomer with the formula C₁₀H₂₀ that would have 4 peaks in the ¹³C NMR Spectrum.



The cis isomer would also work

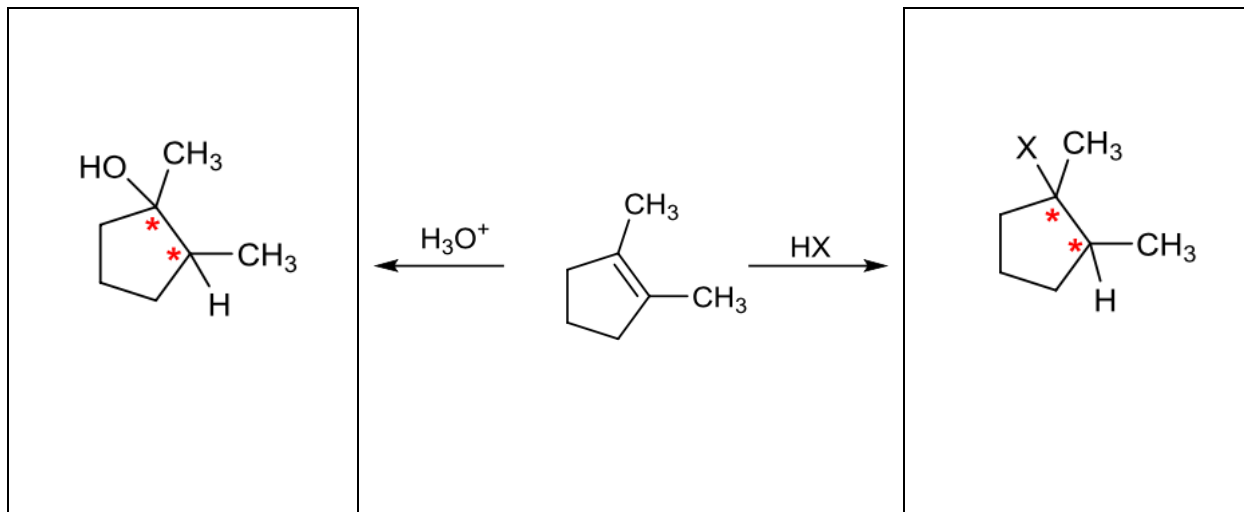
- d. Predict the ¹H NMR data of your alkene from part c). Include chemical shift multiplicity and integrations.



H	ppm	Mult	Int
A	0.8-1.0	d	12 → 6
B	1.4-1.7	mult.	2 → 1
C	1.7-2.3	dd or t	4 → 2
D	4.5-7.5	t	2 → 1

Problem 2:

- A) Draw the major product of each reaction in the box provided. Indicate the relative stereochemistry (with dashes/wedges) if the reaction is stereoselective. Write “racemic” if the product is racemic.

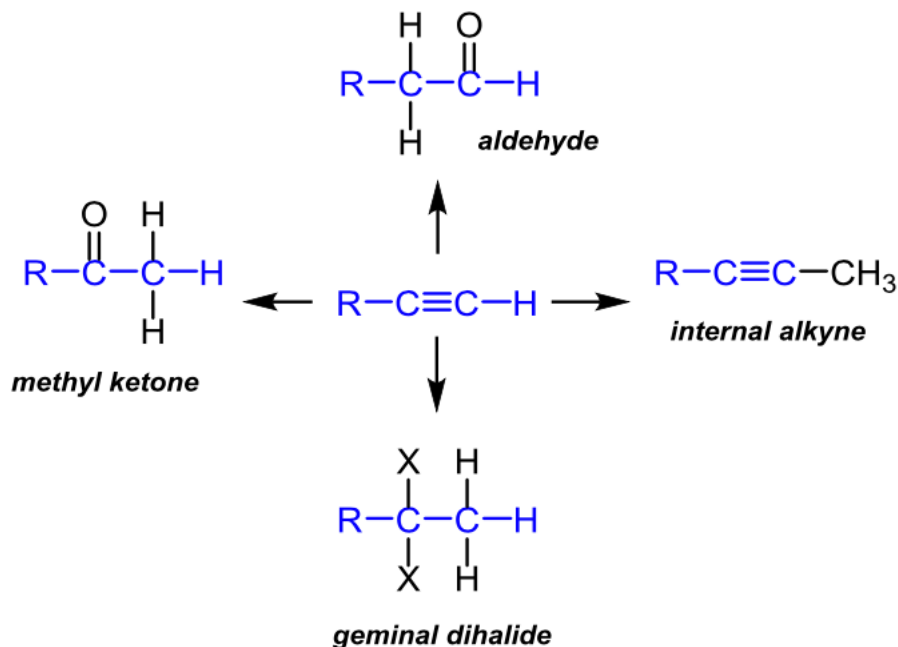


Mixture of 4 stereoisomers

Mixture of 4 stereoisomers

- B) Please explain the stereoselectivity from part A).

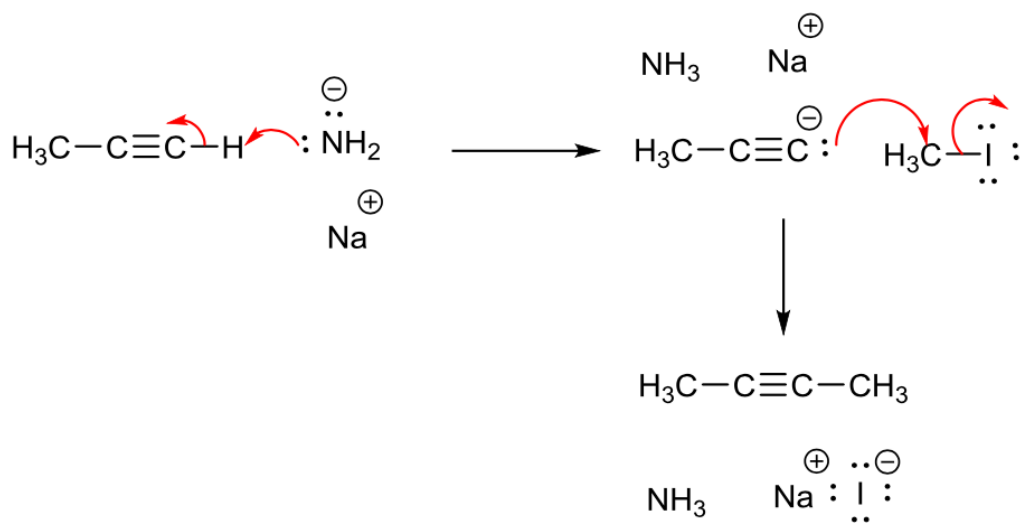
These two reactions are NOT stereoselective. Their mechanisms involve TRUE carbocations. While there may be a preference for a stereoisomer due to steric hindrance, there will be a mixture of cis and trans isomers, which will be racemic!

Problem 3:

- A) To produce the aldehyde, you would do a hydroboration-oxidation reaction. To produce the methyl ketone, you would do a mercury-catalyzed hydration reaction. Which of these reactions proceeds with Markovnikov regioselectivity? Explain.

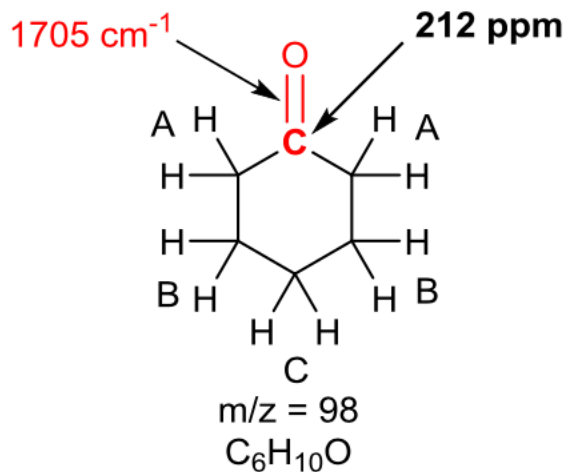
The mercury-catalyzed hydration reaction is Markovnikov. The oxygen becomes bonded to the more-substituted carbon from the alkyne.

- B) To convert propyne into but-2-yne, you would treat propyne with $NaNH_2$, followed by CH_3I . The first reaction is acid-base. The second reaction is S_N2 . Draw the mechanisms for both reactions. Include all lone pairs and non-zero formal charges.



Problem 4:

A) What is the structure of Product X?

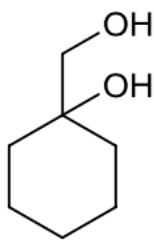


B) What reagents must have been used in this transformation?

The reagents that are needed to convert methylene cyclohexane into cyclohexanone are ozone, followed by zinc and water.

Problem 5:

A) What is the structure of Product Y?



B) What reagents must have been used in this transformation?

This is a dihydroxylation reaction. Either KMnO_4 , NaOH , H_2O OR 1) OsO_4 , 2) Na_2SO_3 , H_2O