Polytechnic Tutoring Center

Final REVIEW– CM2213, [KEY]

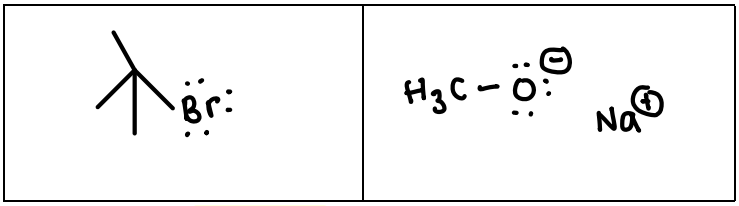
Fall 2021

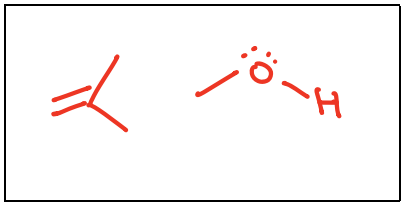
Disclaimer: This mock exam is only for practice. It was made by tutors in the Polytechnic Tutoring Center and is not representative of the actual exam given by the Academic Department.

Problem 1

Categorize each reactant, then determine which reaction type(s) will occur and draw the final, neutral organic product(s) of these reactions. Omit any iconic compounds (NaCl, KBr, etc) and acids (HCl, HBr, etc) that are formed.

a. **Reactants:** **Product(s)**





Nucleophile or Electrophile
Acid or Base

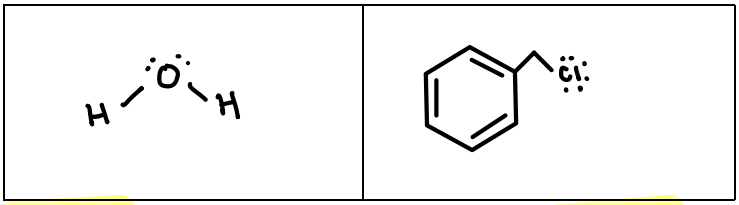
Nucleophile or Electrophile
Acid or Base

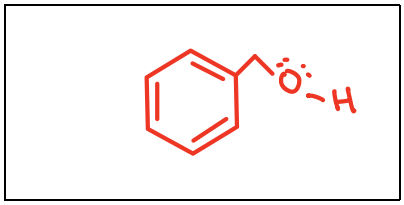
Nucleophile is: Good or Poor
Base is: Strong or weak

Electrophile is: methyl, 1°, 2°, or 3°
Acid is: Strong or weak

Mechanism that operates: Acid/Base, SN1 only, SN2 only, E1 only, E2 only, SN1 & E1 or SN2 & E2

b. **Reactants:** **Product(s)**





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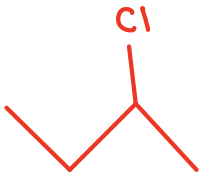
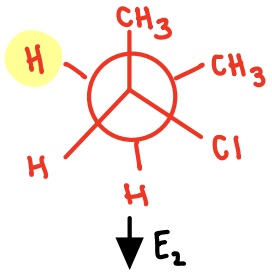
Problem 2

a. Draw the line structure of 2-chlorobutane.



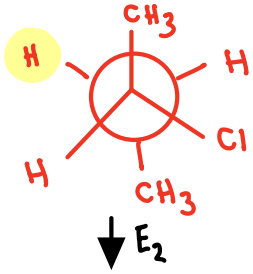
b. Draw the reactive conformations for E2 reactions and the final products of these E2 reactions. In each Newman Projection, circle the beta-hydrogen that will be attacked by the base.

Conformation 1:



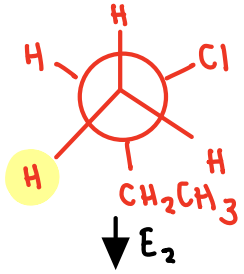
Alkene Product 1:

Conformation 2:



Alkene Product 2:

Conformation 3:



Alkene Product 3:

c. Which of the following bases would do an E2 reaction with 2-chlorobutane? Circle ALL that apply.

Methanol *methoxide* *water* *hydroxide* *methyl lithium* *tert-butoxide*

d. Which of the following bases would ONLY do E2 reactions with 2-chlorobutanee (no SN2)? Circle ALL that apply.

Methanol *methoxide* *water* *hydroxide* *methyl lithium* *tert-butoxide*

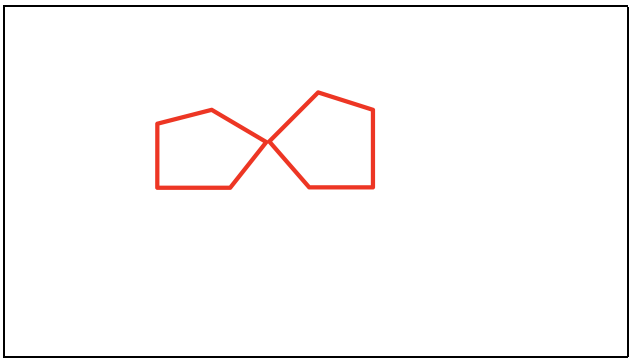
e. Which alkene product from part b) is the lowest in energy? Explain.

Product a is internal, trans, and disubstituted alkene, and thus, is the lowest in energy.

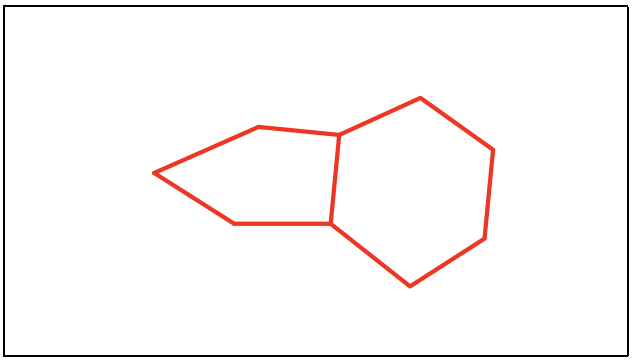
Problem 3

Draw the line structure in the box that fits each set of criteria. ALL of these compounds are hydrocarbons (C and H only).

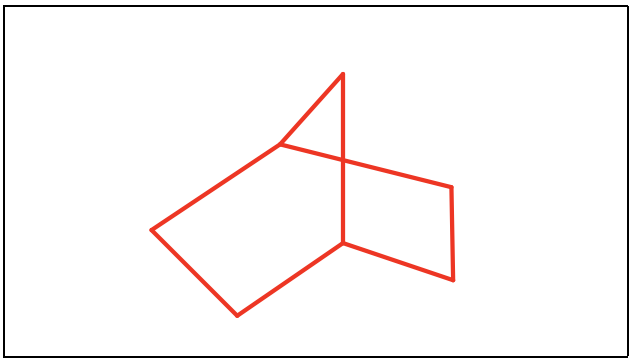
a) MS: 124 m/z (M°+)
IR: *no peaks between 1600-2200 cm-1*
Spiro ring system
Achiral
3 peaks in the 13C NMR spectrum



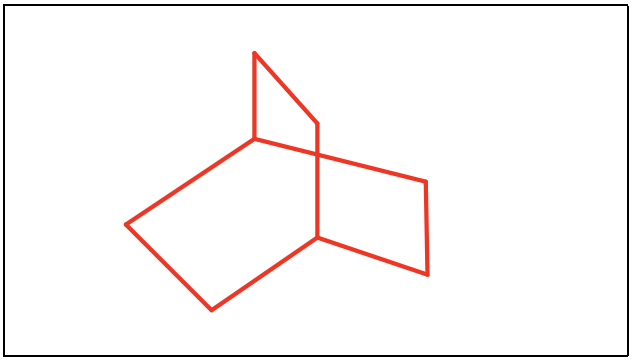
b) MS: 124 m/z (M°+)
IR: *no peaks between 1600-2200 cm-1*
Fused ring system
Achiral
5 peaks in the 13C NMR spectrum



c) MS: 96 m/z (M°+)
IR: *no peaks between 1600-2200 cm-1*
Bridged ring system
Achiral
3 peaks in the 13C NMR spectrum

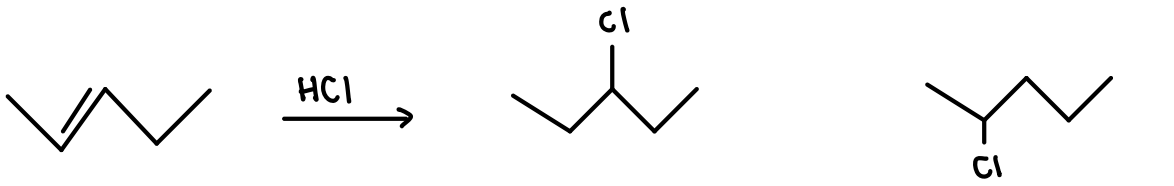


d) MS: 110 m/z (M°+)
IR: *no peaks between 1600-2200 cm-1*
Bridged ring system
Achiral
2 peaks in the 13C NMR spectrum



Problem 5

Consider the reaction of (E)-pent-2-ene with HCl:



3-chloropentane 2-chloropentane

a) Two products are possible. Write the IUPAC name of each product on the line provided.

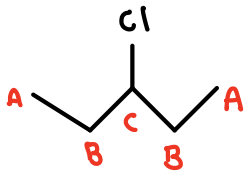
b) What is the *relationship* between these product structures? regioisomers

c) Could you readily tell apart these products by looking at their IR spectra? Explain.

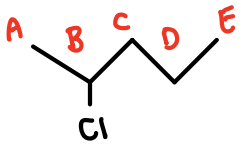
No, same functional groups.

d) Could you readily tell apart these products by looking at their 13C NMR spectra? Explain.

Yes,



3 ^{13}C NMR sets

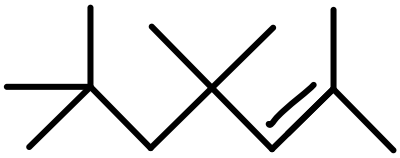


5 ^{13}C NMR sets

e) Which of these products is the Markovnikov product? Explain.

Neither/both - both intermediates are 2° carbocations, ∴ thus, both products would form.

Problem 6.
Fill the spectra tables for these molecules. For IR, focus on the most important (diagnostic) peaks.



Trimer
C12H24

Mass Spec:
M°+ = 168 m/z

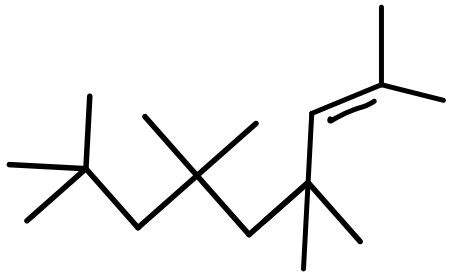
IR:
680-1620 cm-1

1H NMR:
6 peaks

Type of H	# Sets
Vinyl	1
Allylic	2
Alkyl	3

13C NMR:
9 peaks

Type of C	# Sets
Sp2	
=CH2	Ø
=CHR	1
=CR2	1
Sp3	
CH3 (1°)	4
CH2 (2°)	1
CH (3°)	Ø
C (4°)	2



Tetramer
C16H32

Mass Spec:
M°+ = 224 m/z

IR:
680-1620 cm-1

1H NMR: 8 peaks

Type of H	# Sets
Vinyl	1
Allylic	2
Alkyl	5

13C NMR:
12 peaks

Type of C	# Sets
Sp2	
=CH2	Ø
=CHR	1
=CR2	1
Sp3	
CH3 (1°)	5
CH2 (2°)	2
CH (3°)	Ø
C (4°)	3