___/72 = ___%

Name: _____

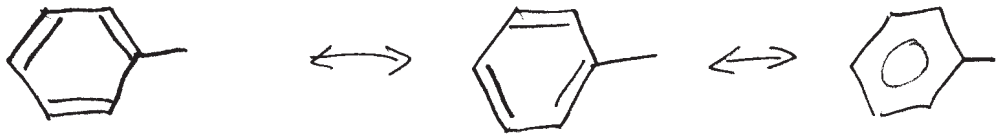
SCH 4U - Organic Chemistry Part #2

1. Aromatic compounds have chemical properties that differ from those of regular double bonds. What do each of the following terms mean with respect to aromatic compounds?

conjugate double bonds alternate double and single bonds
delocalized electrons electrons can move thaugh double bond flip
resonance stabilization lower energy due to electronic resonance, less reactive
electronic resonance flipping positions of double bond in an integrated fashion

/4

Show two different resonant structures for the hydrocarbon with a chemical formula of $C_6H_5CH_3$ (i.e. toluene, a six membered aromatic ring with one methyl attachment)



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If the bond length of a single C-C bond is 154 pm and the bond length of a double C=C bond is 134 pm, suggest a possible bond length for a the resonant bonds in the structures that you have drawn above (does not have to be the precise answer). What is your rational?

- between 134pm 154pm (140 pm)
- average of double and single bond length

/2

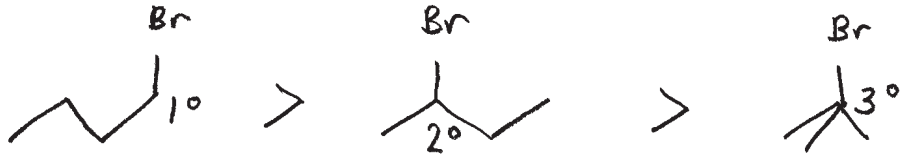
How is it possible that all six bonds that make up the ring are all the same length?

- bonds are averaged to a bond and one half ∴ all the same

/2

/10

2. Given four carbon atoms, one bromine atom and enough hydrogens to provide full saturation (i.e. C_4H_9Br), draw in order of most reactive to least reactive with respect to a substitution reaction three structures that vary from fast to moderate to slow.



/6

What is the factor at work? What is the principle? What are the details? What role does degree or reactive centre play? use point form

Steric Hindrance: non-reactive portion of a molecule blocks the reactive site (carbon chain gets in the way)

- higher degree of reactive centre → better blocking → more steric hindrance → lower reactivity
- longer chain → better blocking
- degree more important than chain length

/5

3. Identify each of the following changes as either an oxidation or a reduction. State the reason for your choice. Please note that these changes do not represent balanced chemical changes.

	Oxidation/Reduction	Rational
$C_2H_5CHO \rightarrow C_2H_5COOH$	oxidation	gains oxygen
$C_2H_4 \rightarrow C_2H_6$	reduction	gains hydrogen
$C_3H_7OH \rightarrow C_2H_5COOH$	oxidation	gains oxygen loses hydrogen
$C_6H_{10} \rightarrow C_6H_{10}(OH)_2$	oxidation	gains oxygen gains hydrogen oxygen >> hydrogen w [O] vs [R]

/8

For a mere 2 bonus marks, provide complete structures and reaction conditions for all four of the above reactions. Use a separate piece of paper and attach to the back of your test.

/19

4. An asymmetric addition will occur whenever the following conditions are met:

a) 2-butanol is treated with concentrated H_2SO_4 at high temperature
b) 1-butene is treated with H_2 and Pt catalyst
c) 2-pentene is treated with H_2O and dilute catalytic quantities of H_2SO_4
d) 2-butene is treated with HCl in water
e) 1-cyclohexene is treated with I_2 in water

½

5. Aromatic compounds:

a) undergo electronic resonance only at high temperatures
b) are more reactive than corresponding alkenes
c) are not a part of normal biological systems
d) allow for the delocalization of π electrons (the pair of electrons that produces the second bond in a double bond)
e) were never mentioned in this course

½

6. For the property of steric hindrance:

a) is identical for all first degree alcohols
b) the greater the steric hindrance, the more active the reactive site on the molecule
c) is never of concern in organic biological systems
d) depends more on length of blocking groups than the number of blocking groups (related to degree of reactive site)
e) one must consider both the length and the number of side chains adjacent to a reactive site

½

7. Sulphuric acid is used in many places in organic chemistry. Which of the following statements is true?

a) concentrated sulphuric acid at high temperature will **always** dehydrate an alcohol to form an alkene (there is a bonus mark for providing a counter example - use the margin)
b) cannot perform asymmetric additions on alkenes
c) is the acid of choice to put the flavour into french fries
d) it function will depend on concentration and temperature
e) is needed to reduce primary alcohols to ketones

½

8. Which of the follow statements is true:

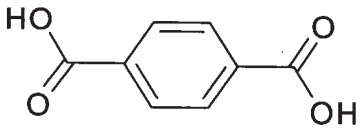
a) oxidations seldom if ever accompany a corresponding reduction
b) in order to oxidize alcohols, one must use a reducing agent such as $LiAlH_4$ in THF
c) alcohols cannot be oxidized because they have already lost electrons
d) alcohols can be oxidized but only if they are third degree alcohols
e) in a oxidation in organic chemistry, oxygen is gained and/or hydrogen is lost

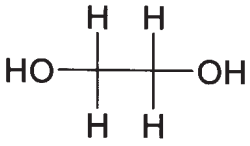
½

10

9. For the following monomers, write:
a) whether the monomer will undergo and addition of condensation polymerization
b) a polymer structure that is at least four monomer units long
c) necessary reaction condition for addition reactions
d) stable by-product for condensation reactions

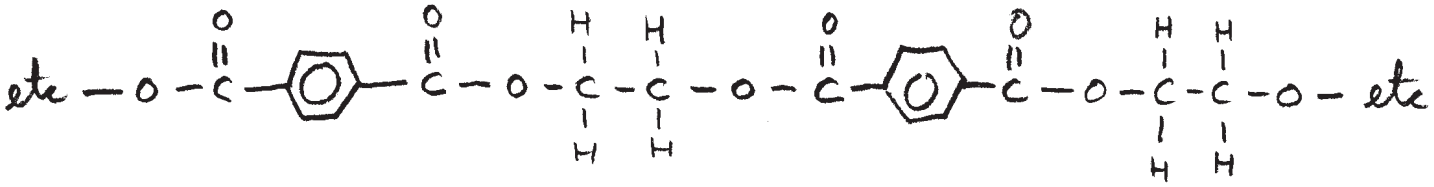
It may be helpful to show all carbons and all hydrogens





type: condensation

$+ H_2O$



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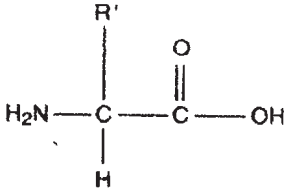
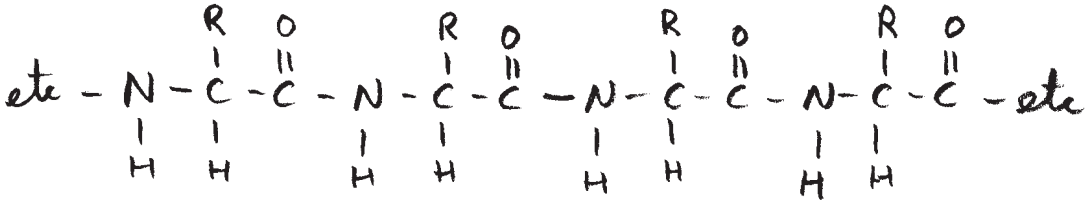


type: condensation

$+ H_2O$



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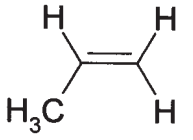
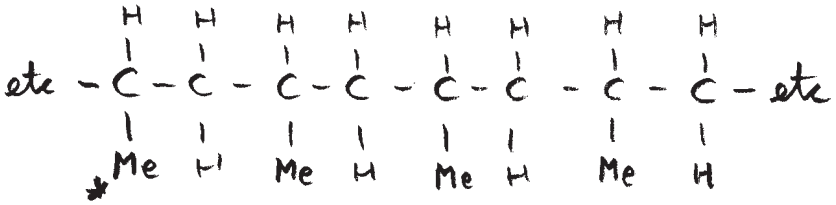


type: addition

free radical initiator

/4

* Me = methyl
= CH_3



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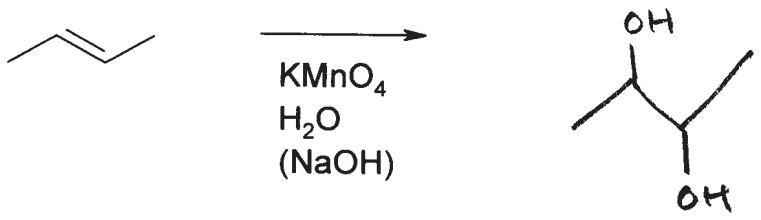
10. Complete each reaction sequence by providing reactants, product and/or conditions under the reaction arrow as required:



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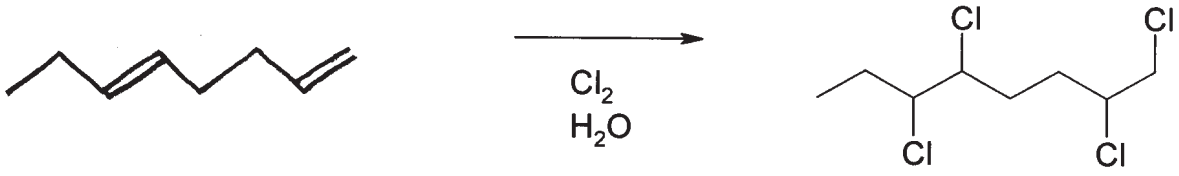

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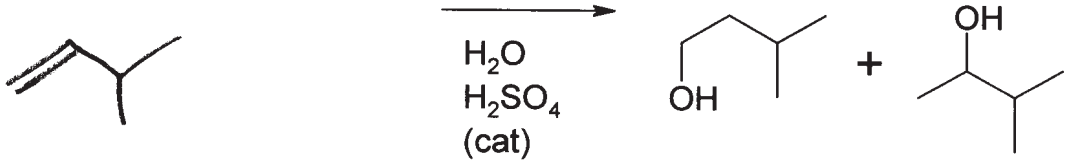

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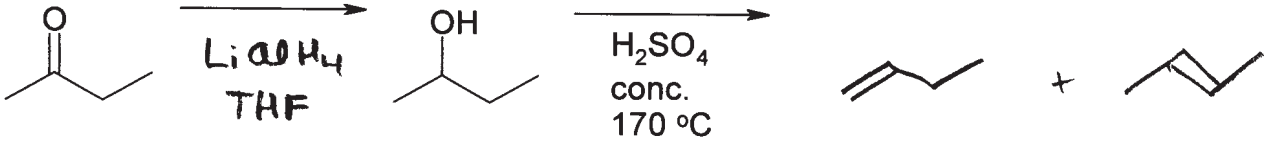

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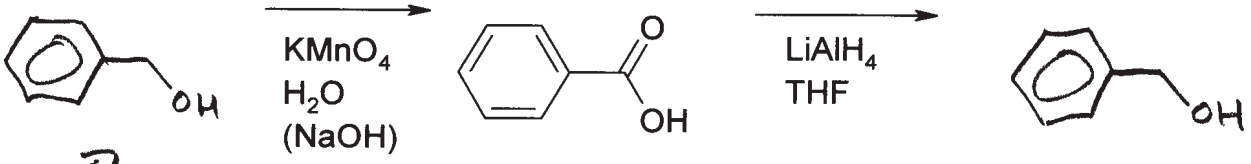

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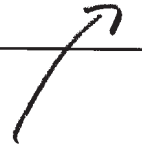
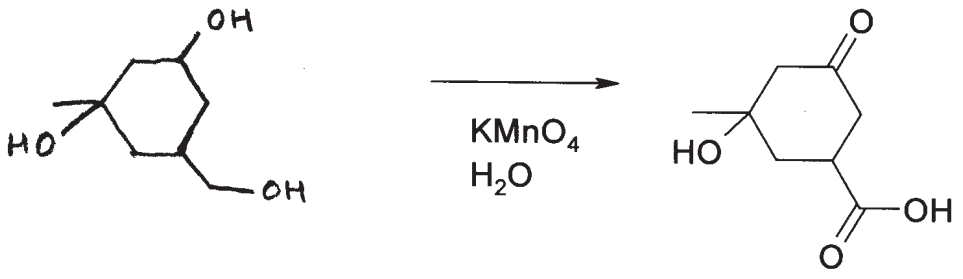


or  where R = carbon chain

/9

/3



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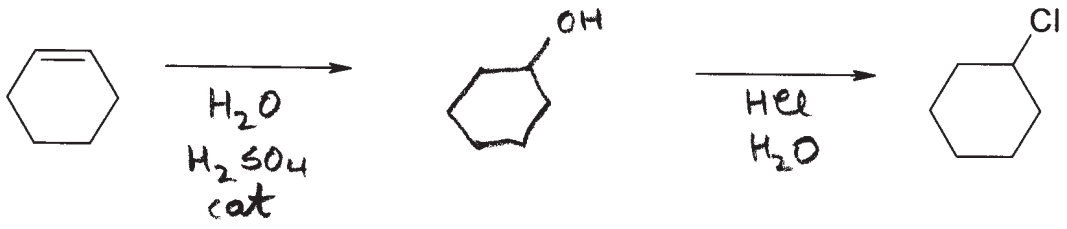
(one structure only)



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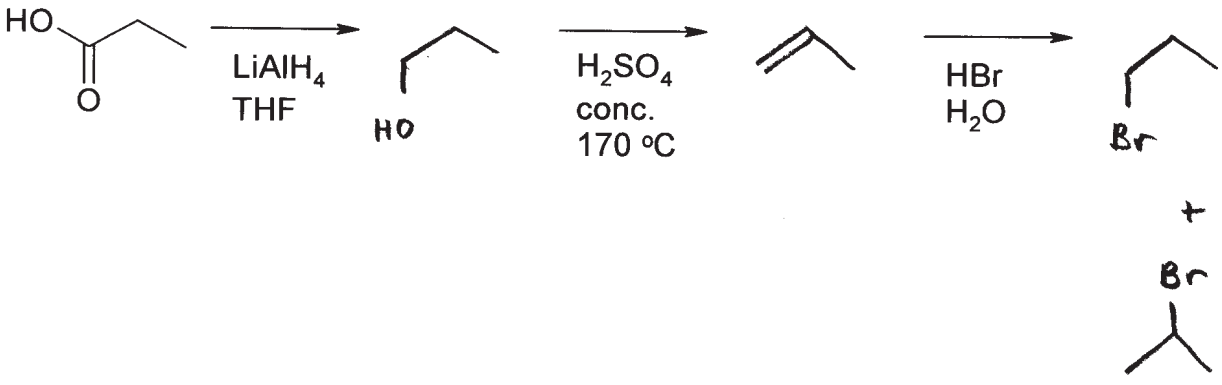

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Question #3 Bonus