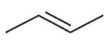
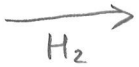
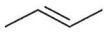
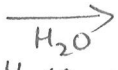
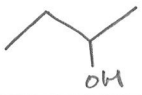
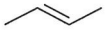
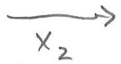
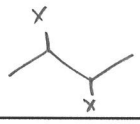
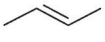
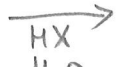
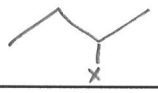
/86 = %

Name:_____

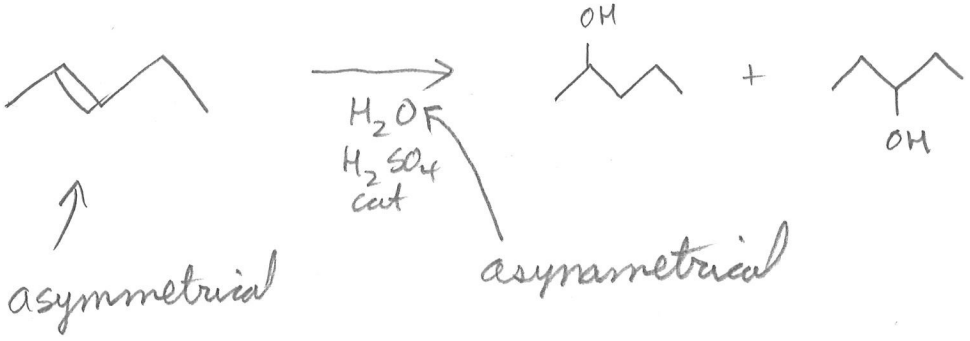
SCH 4U – Organic Chemistry Test #2

1. Common uses of alkenes in organic synthesis may involve addition reactions. There were four different types of addition reactions studies in this course. Using the table, list the four different types of addition reactions, provide reaction conditions and give the structure for the product that you would expect. Use X to represent halogens as necessary.

Name of Type of Addition Reaction	Starting Material	Conditions Under Reaction Arrow	Product Structure
hydrogenation			
hydration			
halogenation			
hydrohalogenation			

/12

All of the above examples should result in only one possible product. There is however the possibility that addition reactions can lead to more than one possible product. Provide a clear example reaction that illustrates this point using a hydration addition reaction. What must be true about the alkene reactant and what must be true about the molecule being added in order for more than one product to occur?



/4

/16

2. 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 then single bonds
delocalized electrons e⁻ that can change location
resonance stabilization stability that results from alternate resonance structures
electronic resonance ability of e⁻ to move position through change of double bond location

/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)

/2

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?

134pm < bond length < 154 pm /2

compromise between single & double bond length (average)

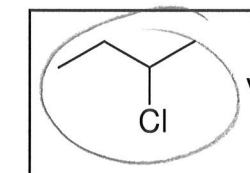
How is it possible that all six bonds that make up the ring are all the same length?

can be thought of as six bond and a halfs /1

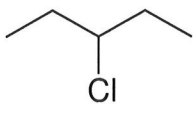
(not

/9

3. For each pair of compounds, which compound would react faster in a substitution reaction and why. Circle the faster reacting substance. What is the name of the concept at work here? steric hindrance
Give details to the reasons behind your choice.

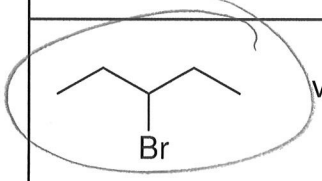


vs

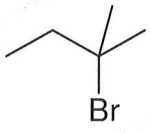


2° 2°

- shorter chain
- less S.H.
- less blocking ∴ faster reaction



vs



2° 3°

- lower degree
- less S.H.
- less blocking therfore faster reaction

/5

4. Write an esterification reaction for the reaction between butanoic acid and pentyl alcohol. Write the name of the ester product. Include reaction conditions.

pentyl butanoate

/5

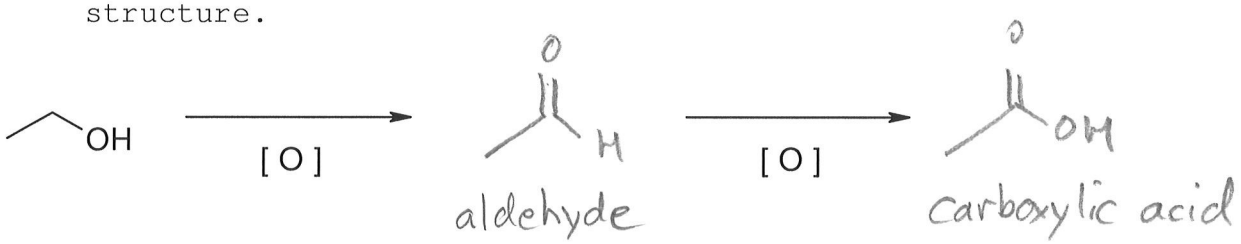
/10

5. Oxidations and Reductions are common reactions in organic chemistry. These reactions do not involve complete loss or gain of electrons, instead the loss or gain is partial. This partial loss of gain is achieved through the shifts in electronegativity that occur when oxygen or hydrogen is added or removed. Fill in the following table with the words "added" or "removed" to indicate your knowledge of oxidation or reduction. Use capitol letters to indicate the more important changes.

	oxygen	hydrogen
oxidation →	ADDED	removed
reduction →	REMOVED	added

/3

Complete the reaction sequence for the oxidation of the primary two carbon alcohol. Include the intermediate. Write the name of the class of organic compound under each structure.



aldehyde carboxylic acid

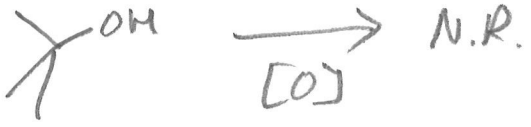
/4

Repeat the above instructions for the oxidation of a three carbon second degree alcohol.

ketone

/3

Repeat the above instructions for the oxidation of a four carbon third degree alcohol. Make a comment about this reactions



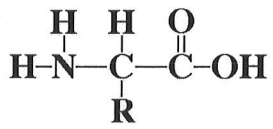
/3

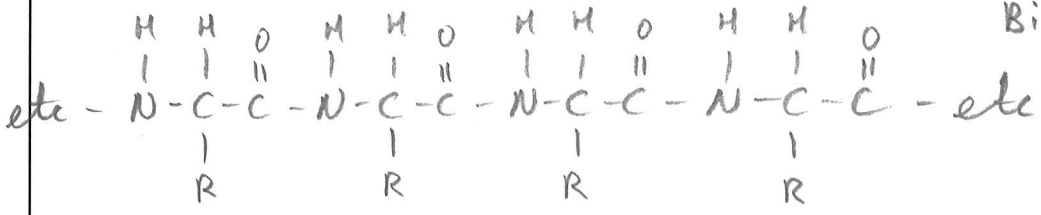
- without a hydrogen to remove from the alcohol carbon, no reaction can occur (i.e. carbonyl group cannot form)

/13

6. For each monomers undergoing a polymerization reaction, write:
   - the type of polymerization reaction you would expect
   - the formula of a stable by-product if applicable
   - any special reaction conditions that are necessary to make the polymerization reaction work
   - a good diagram of the product polymer that includes four or more monomer units linked together

TYPE: condensation



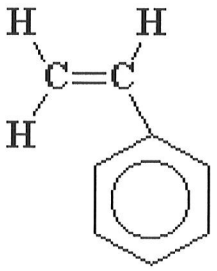


+ H_2O

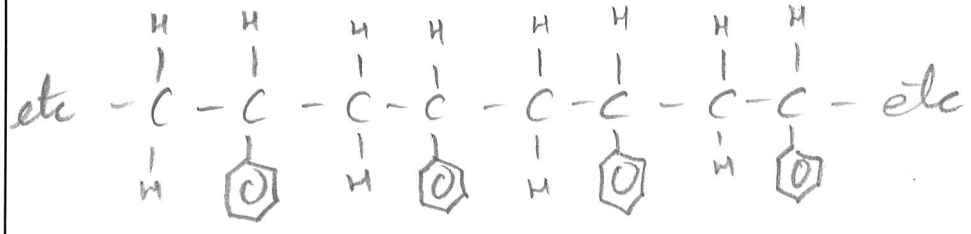
Bi-Product

/4

TYPE: addition

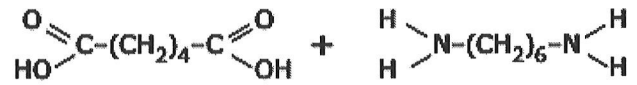


free radical initiator

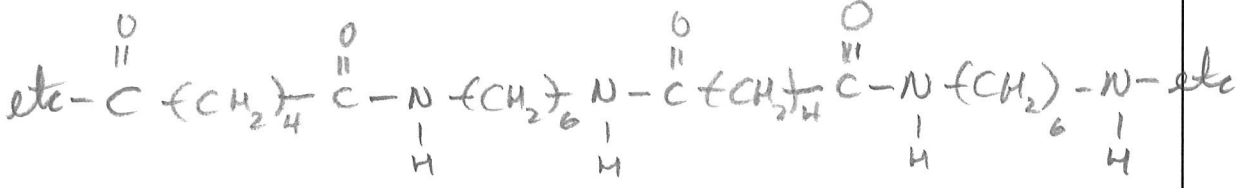


/4

/8



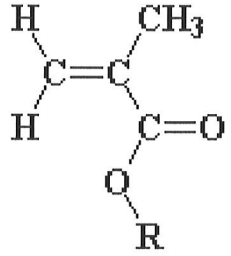
TYPE: condensation



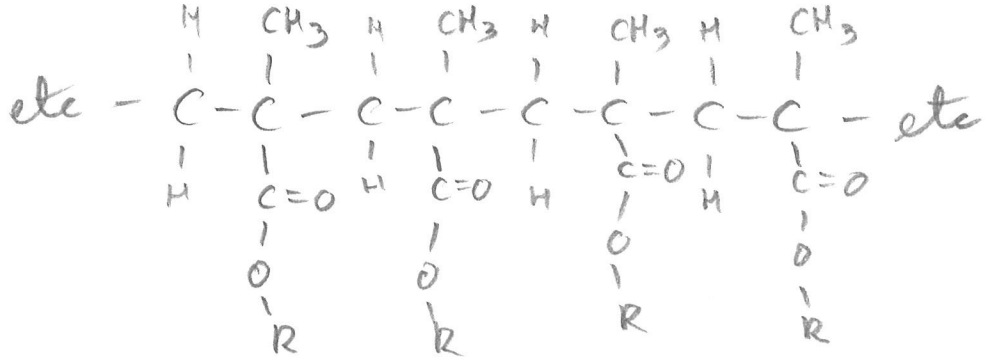
+ H_2O Bi-Product

/4

TYPE: addition



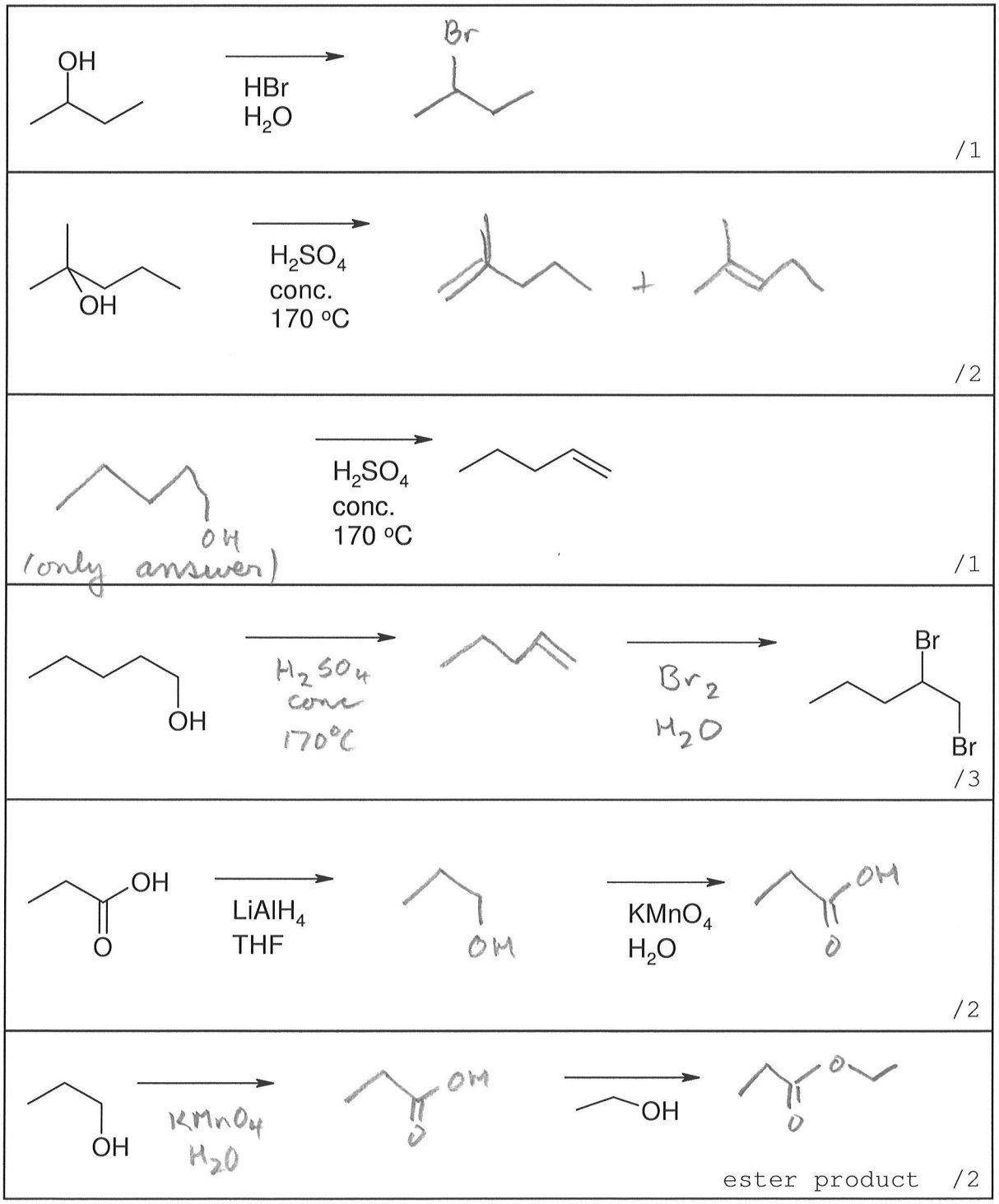
free radical initiator



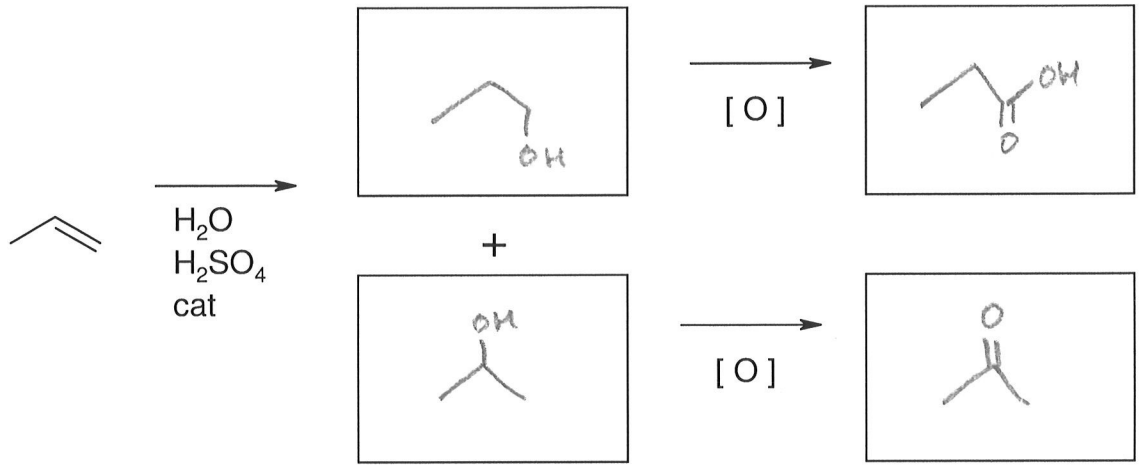
/4

/8

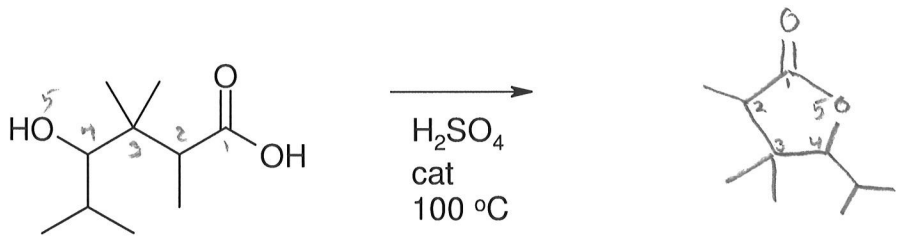
6. Complete each of the following reactions as fully as possible. Show products, reactants and/or reaction conditions as required. Pay attention to the possibility of multiple products or reactants. The marking scheme may be of assistance.



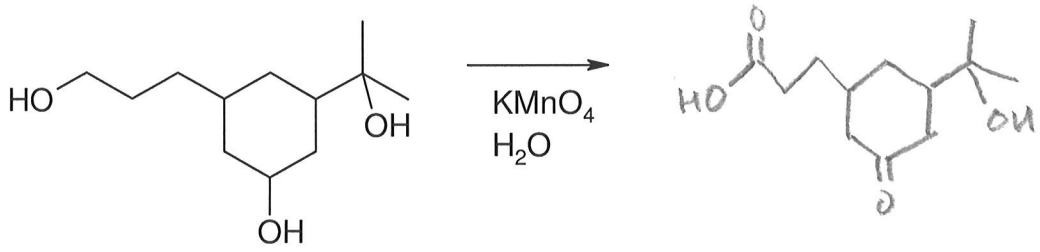
/11



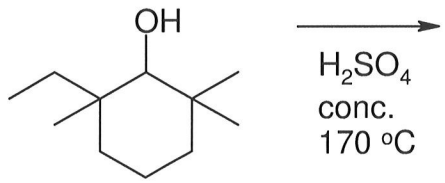
/4



one difficult answer worth /2

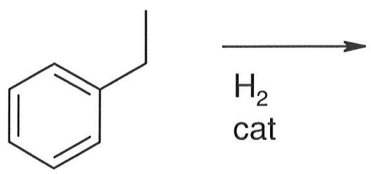


one answer multiple considerations /3



N.R.

/1



N.R.

/1

/11