WORKSHOP

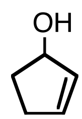
Alkyl Halides and Alcohols: Synthesis

1. Disconnect the alcohol shown below into three "Grignard-carbonyl" pairs that when combined would give the alcohol.

$$(CH_3)_2C(OH)CH_2CH_3$$

2. Show how to carry out the following synthetic transformations. You may use methanol and ethanol as reactants, any inorganic reagents, and any necessary solvents. If more than one synthetic step is required, show the product for each step.

a. cyclopentane ⟶ deuteriocyclopentane (C_5H_9D)

b. cyclopentene ⟶ 

c. 1-chloropentane ⟶ 1-heptanol

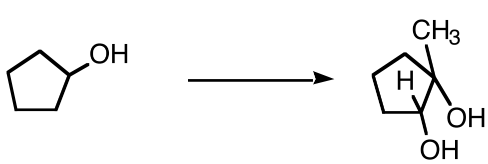
d. 2–methyl–1–propanol ⟶ 3–methylbutanenitrile

e. cyclopentanone ⟶ cyclopentyl bromide

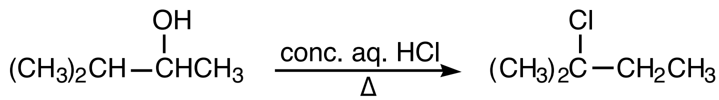
f. cyclohexanol ⟶ 1–methylcyclohexene ⟶ *trans*–2–methylcyclohexanol

g. 1–propanol ⟶ 3–pentanone
1–propanol ⟶ 2–methyl–2–butanol

h. isopropyl bromide (only carbon source) ⟶ $(CH_3)_2CHC(=O)CH_2CH_3$

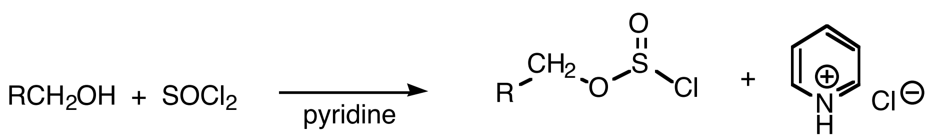
i. 

2. Consider the following observations:

a. 

Explain (give a reasonable mechanism) for this reaction

b. When an alcohol reacts with $SOCl_2$/pyridine, the following derivative is formed. If the reactant alcohol is (*S*)-1-deuterioethanol, the product is (*R*)-1-deuterioethyl chloride. Clearly explain how the formation of this intermediate facilitates the conversion of the alcohol to the corresponding alkyl chloride.



c. The reaction of THF with concentrated HBr gives a new compound, C_4H_9OBr. This new compound shows a broad absorption in the IR at 3400 cm^{-1}. When the new compound is treated with aqueous NaOH solution, THF is re-formed. Propose a structure for C_4H_9OBr, and explain (give a mechanism) for the interconversion.

d. Compounds **A** and **B** both have a molecular formula of C_7H_7Br. When either is reacted with Mg/Et_2O followed by treatment with H_2O, toluene ($C_6H_5CH_3$) is obtained. When **A** is added to $AgNO_3$/EtOH, an immediate precipitate occurs. However, when **B** is added to $AgNO_3$/EtOH, even heating for extended periods of time yields no precipitate. Give structures for **A** and **B**, and explain the reasoning behind your assignments.

Observation **Deduction**