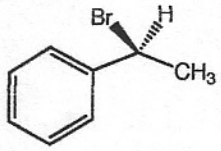
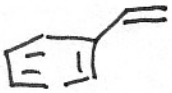
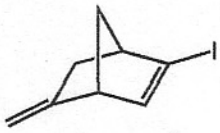
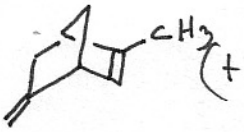
Problem 1. (30 points) Give the **final** products for the following reactions. If no reaction occurs, state so. Be sure to show the correct stereochemistry. **Circle Your Answer**

A) 

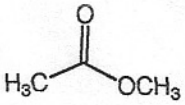
$\xrightarrow[(CH_3)_3COH]{(CH_3)_3CO^-K^+}$  (+3)

B) $CH_3^-Li^+ + CH_2{=}CH{-}CH_2OH \xrightarrow{\text{ether}}$ CH_4 (+1) + $CH_2{=}CH{-}CH_2O^-Li^+$ (+2)

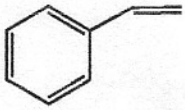
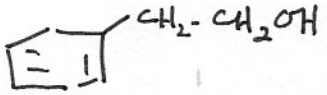
C) 

$+ LiCu(CH_3)_2 \xrightarrow{\text{ether}}$ 

(+3)

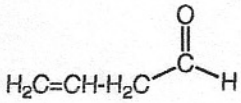
D) 

$\xrightarrow[\text{2) } H_3O^+]{\text{1) } CH_3CH_2MgBr \text{ (excess)/ether}}$ $CH_3{-}C(OH)(CH_2CH_3){-}CH_2{-}CH_3$ (+3)

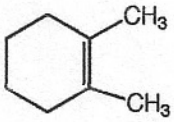
E) 
$\xrightarrow[\text{2) } H_2O_2/NaOH]{\text{1) } B_2H_6\text{, diglyme}}$ 

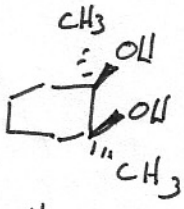
(+3)

F) $CH_3MgBr + H_3CC{\equiv}CH \xrightarrow{\text{ether}}$ CH_4 (+1) + $CH_3{-}C{\equiv}C^-Mg^+Br$ (+2)

G) 

$\xrightarrow[CH_3OD]{NaBH_4}$ $CH_2{=}CH{-}CH_2{-}C(OD)(H){-}H$ (+3) ← if H instead D (+1)

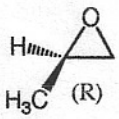
H) 

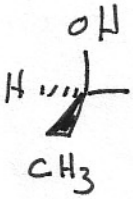
$\xrightarrow[\text{tBuOOH, }^-OH]{OsO_4\text{, tBuOH}}$ 

(+3) must show correct stereo - if no stereo (+1)

I)
$\xrightarrow[\text{2) } H_2O\text{, NaOH}]{\text{1) } Br_2\text{, } H_2O}$

(+3)

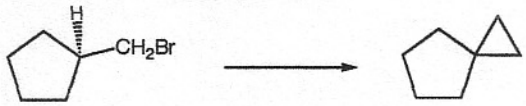
J) 

$\xrightarrow[CH_3CH_2OH]{CH_3CH_2O^-K^+}$ show stereochem 

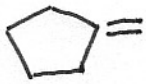
(+3)

Problem 2. (40 points) Give the reagents that you would use to carry out the following reactions. **Circle Your Answers**

A)

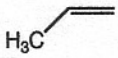


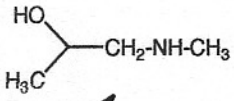
(+4) $t\text{-}O^-$ or CH_3O^-



CH_2I_2 / Zn (Cu) (+4)
ether

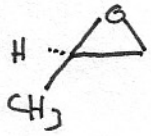
B)





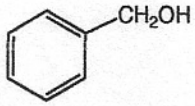
(+4) 1) Br_2/H_2O
2) NaOH

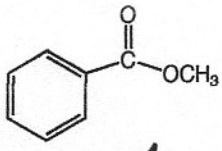
or $CH_3\text{-}\overset{O}{\overset{\|}{C}}Cl$



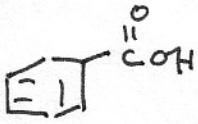
CH_3NH_2 / CH_3OH
(+4)

C)





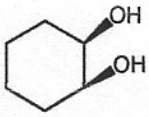
(+4) $K_2Cr_2O_7$
H_2SO_4

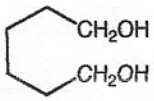


CH_3OH / H_2SO_4
(+4)

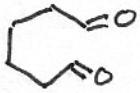
if no acid then only +3

D)



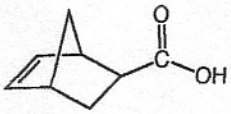


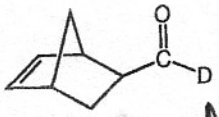
(+4) HIO_4



$NaBH_4$ / CH_3OH (+4)
or
1) $LiAlH_4$ / ether
2) H_3O^+

E)



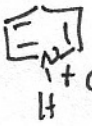


+4

1) LiAlD4
ether
2) H_3O^+

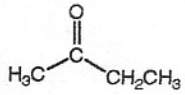
+4

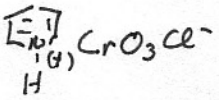
must show structure



$+CrO_3Cl^-$ in CH_2Cl_2

Problem 3. (10 points) Starting with ethanol as your only source of carbon, develop a synthesis for the following compound.



PCC = 

(+3) $CH_3-CH_2OH \xrightarrow{PCC} CH_3\overset{O}{\overset{\|}{C}}H$

(+4) $CH_3CH_2OH \xrightarrow{PBr_3} CH_3CH_2Br \xrightarrow[\text{ether}]{Mg} CH_3CH_2MgBr$

1) ether
2) H_3O^+

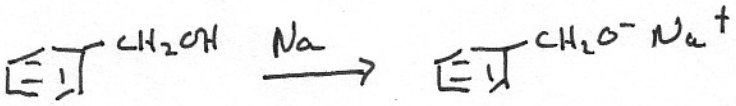
$CH_3-\overset{O}{\overset{\|}{C}}-CH_2CH_3 \xleftarrow[H_2SO_4]{K_2Cr_2O_7} CH_3-\overset{OH}{\overset{|}{\underset{H}{\underset{|}{C}}}}-CH_2-CH_3$

(+3)

Problem 4. (10 points) Show how you would carry out the following transformation with the given starting material and any necessary organic or inorganic reagents.

(+4) 1) $LiAlH_4$ ether
2) H_3O^+

CH_3Br (+3)



(+3)

Problem 5. (10 points) Determine the structure of the compound that has the molecular formula $C_9H_{12}O$ whose NMR spectrum has the following resonances.

δ1.2 (triplet, 3H) δ 2.5 (quartet, 2H) δ 2.0 (broad, 1H)
δ 4.8 (singlet, 2H) δ 7.2 (doublet, 2H) δ 7.4 (doublet, 2H)

+10

if wrong sub. pattern, ortho or meta (+5)

Chemical Shifts: alkane (δ 0.9 – 1.8), allylic (H-C-C=C ,δ 1.5-2.6),
C-H adjacent to C=O (δ 2.0-2.5), alkyne (δ 2.5), benzylic (H-C-Ar, δ 2.3-2.8),
alcohol or ether (H-C-O, δ 3.3-3.7), Vinylic (H-C=C, δ 4.5-6.5), aryl (H-Ar, δ 6.5-8.5),
aldehyde (H-C=O, δ 9-10), alcohol (H-OR, δ 0.5 – 5.0)