This is an open-book, open notes exam. No electronic devices are allowed.

1. (5 points each) Fill in the missing reagent, product or starting material.

a.

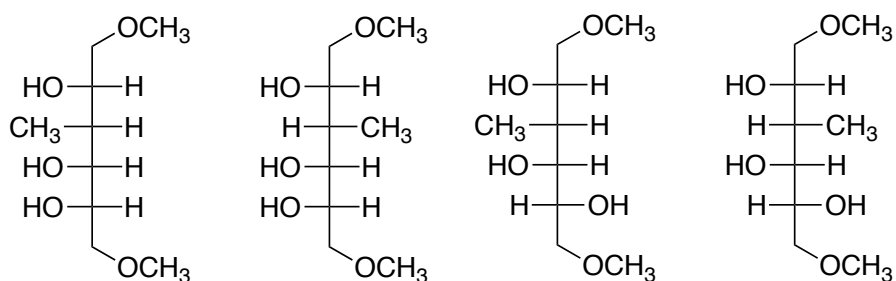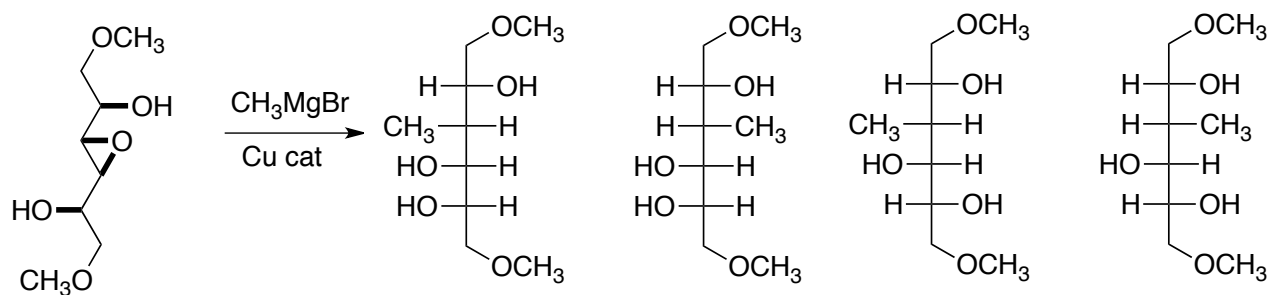1. NBS

2. NaCN/DMSO

?

C_8H_7N

b.   ?

Na / Liq NH_3

EtOH

   OCH_3

c.

$\overset{O}{\underset{O}{Cl}}\overset{}{\underset{}{}}$Cl / $AlCl_3$;

?

   OCH_3

d.

   Br

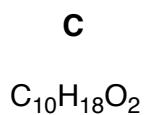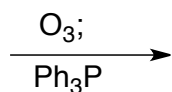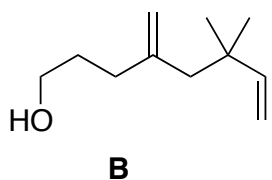$CH_2=O$

HCl

?

C_8H_8BrCl
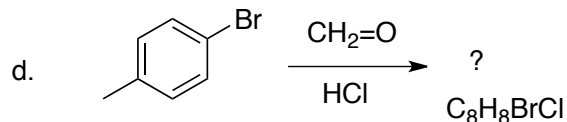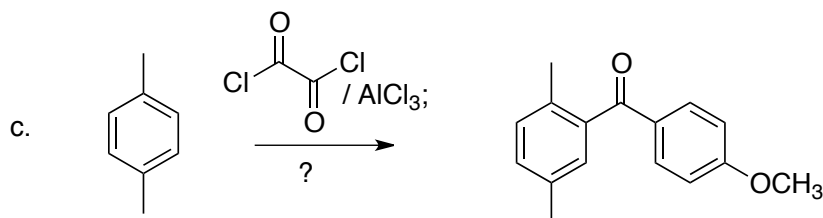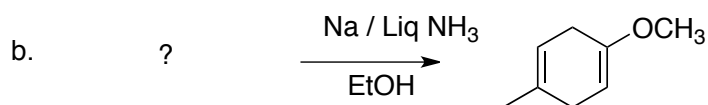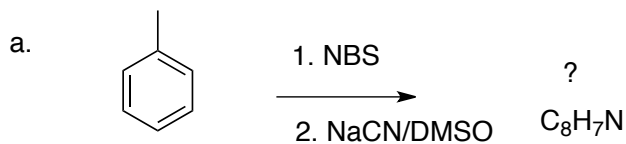
2. (20 points) Which product would be formed, and why? Explain in detail.

CH_3MgBr

Cu cat

3. (20 points) Using any monosubstituted benzene that contributes six carbons to the final product, and any other pieces that contribute three or fewer carbons to the final product, outline a synthesis of **A**.

A
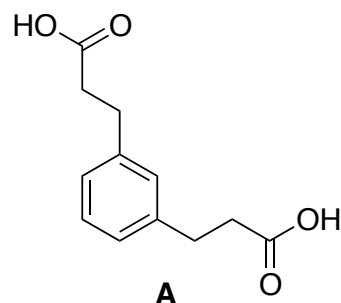
4. (20 points) Deduce the structure of **C**, and draw an arrow-pushing mechanism for the conversion of **B** to **C**.

B

$$\xrightarrow[\text{Ph}_3\text{P}]{\text{O}_3;}$$ **C**

$C_{10}H_{18}O_2$

IR: 3397, 2966, 1710 cm^{-1}

^{13}C NMR:	^{1}H NMR:
210.8, s	1.10, s, 6H
147.3, d	1.8, m, 2H
111.1, t	2.02, bs, 1H (exchanges)
62.4, t	2.42, s, 2H
54.5, t	2.50, t, J = 7.2 Hz, 2H
41.8, t	3.59, t, J = 7.4 Hz, 2H
36.6, s	4.90, d, J = 10.5 Hz, 1H
27.2, q (2)	5.02, d, J = 17.6 Hz, 1H
26.5, t	5.89, dd, J = 10.5, 17.6 Hz, 1H

5. (20 points) Outline a mechanism for the transformation of **D** to **E**.

bb | bf