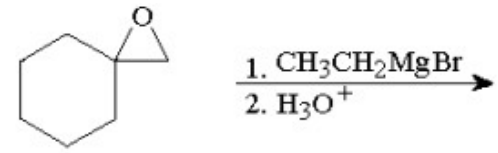
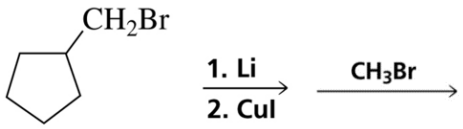
Organic Chemistry 2 EXAM 1 Oct 2018 Student # Name .

1. [12 pts] What is the product of the following reactions?

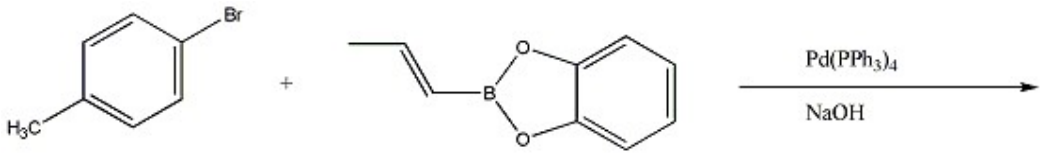
(a)



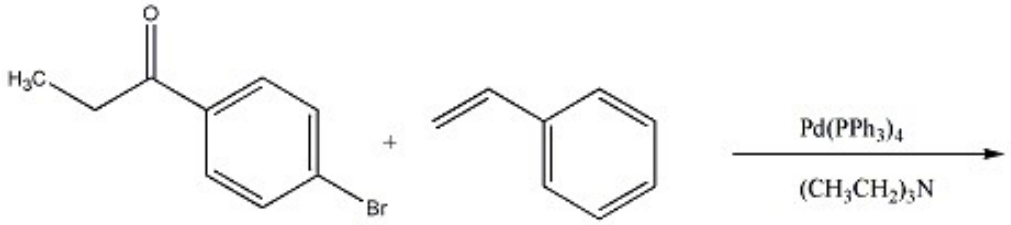
(b)



(c)

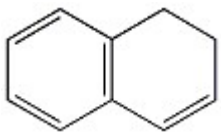


(d)

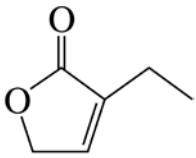


2. [6 pts] Provide the structure of the alkene that will undergo metathesis to generate the following compounds.

(a)

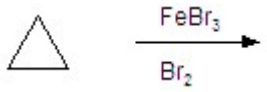


(b)

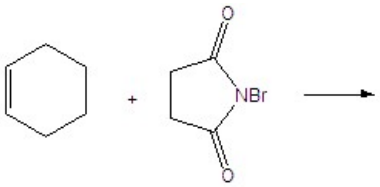


3. [9 pts] What is the major product of the following reactions.

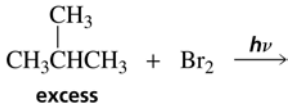
(a)



(b)



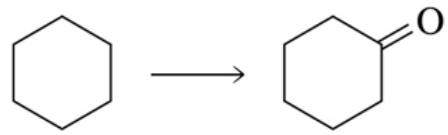
(c)



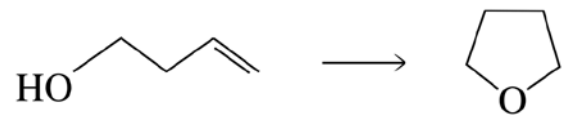
4. [6 pts] When 3,3-dimethyl-1-butene is treated with HBr alone, the major product is 2-bromo-2,3-dimethylbutane. When the same alkene is treated with HBr and peroxide, the product is 1-bromo-3,3-dimethylbutane. Explain these results by referring to the mechanism.

5. [10 pts] Using the given starting material and any necessary organic or inorganic reagent, indicate how the desired product could be obtained.

(a)



(b)



6. [4 pts] Show the m/z values of the molecular ion and 5 likely fragments for the compound ethyl ether, $CH_3CH_2OCH_2CH_3$

7. [12 pts] Propose structures of the following there compounds consistent with each set of the corresponding data. Assume each compound has an sp3 hybridized C-H absorption in IR spectrum, and other major IR absorptions above 1500 cm^{-1} are listed as follows.

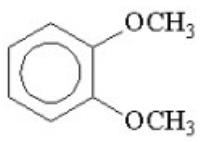
(a) A compound having a molecular ion at 72 and an IR absorption at 1725 cm^{-1}.

(b) A compound having a molecular ion at 55 and an IR absorption at 2250 cm^{-1}.

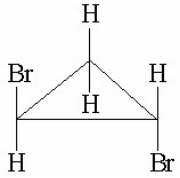
(c) A compound having a molecular ion at 74 and an IR absorption at 3200-3600 cm^{-1}.

8. [5 pts] Is the λ_{max} of phenol in aqueous solution affected by the pH of the solution? If so, explain how and why λ_{max} changes.

9. [6 pts]) How many signals would you expect to see in the ^1H NMR spectrum of the following compounds?



A



B

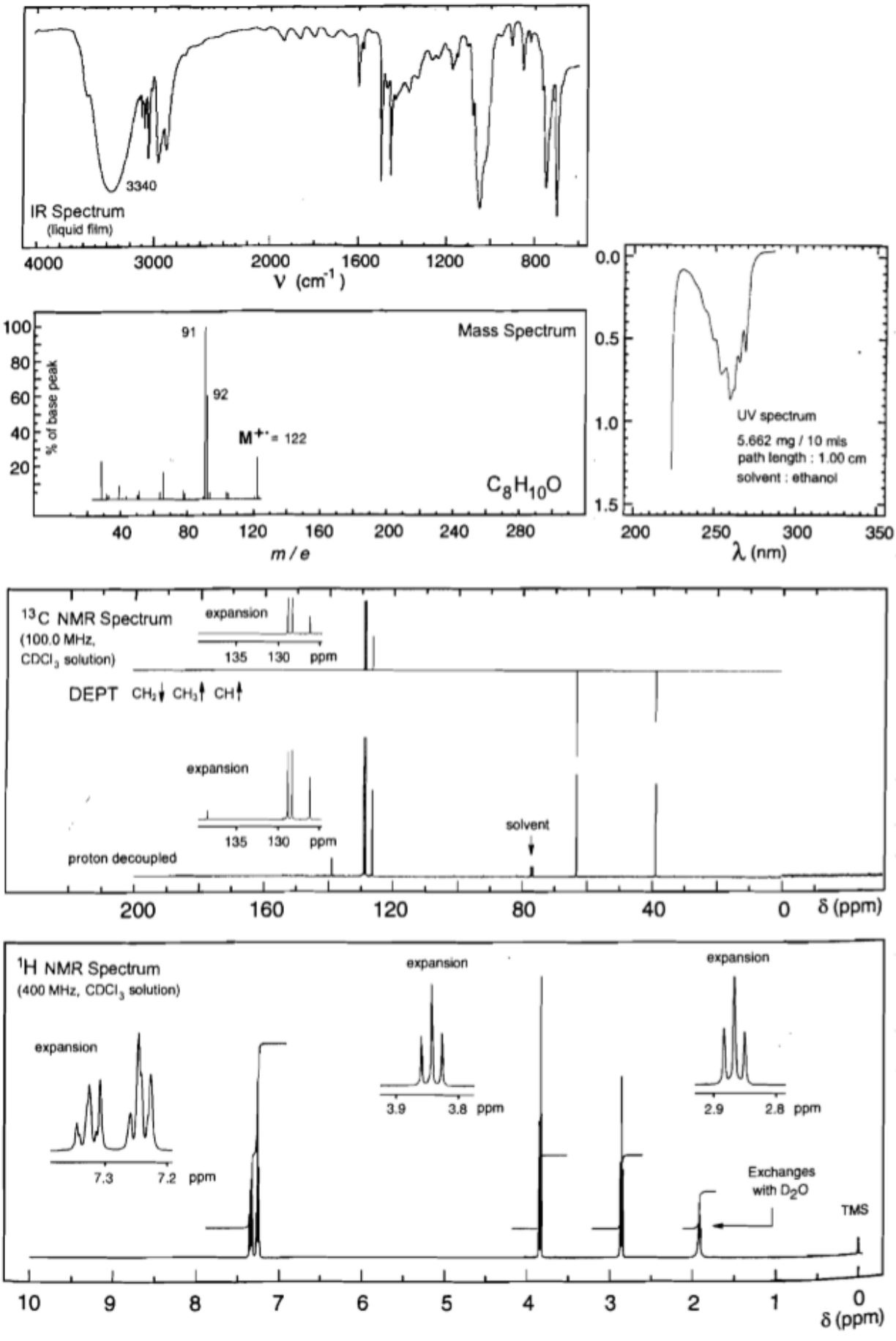
10. [15 points × 2] Identify the structure of the following compounds, **A**, and **B** based on the spectral data provided on the following pages, respectively.

- Try to assign as many peaks in the spectra as possible for the full credit and you should show your peak assignments directly on top of the spectra.
- Write down the proposed structure and your reasoning process on this page.

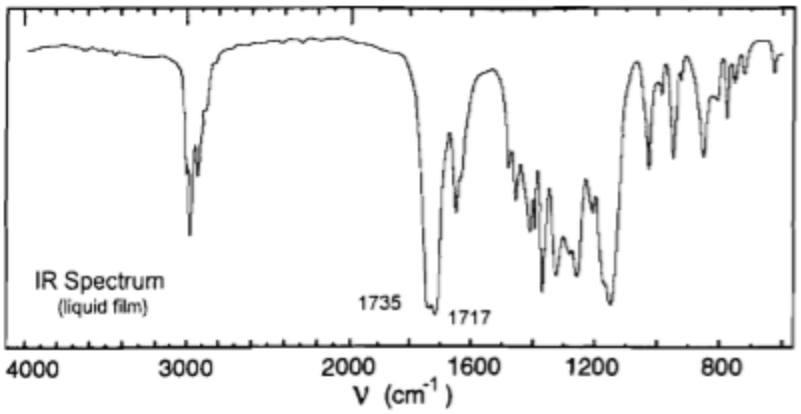
(A)

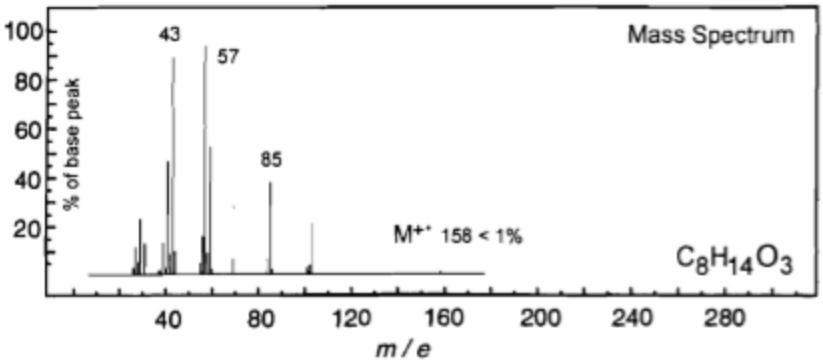
(B)

(A)

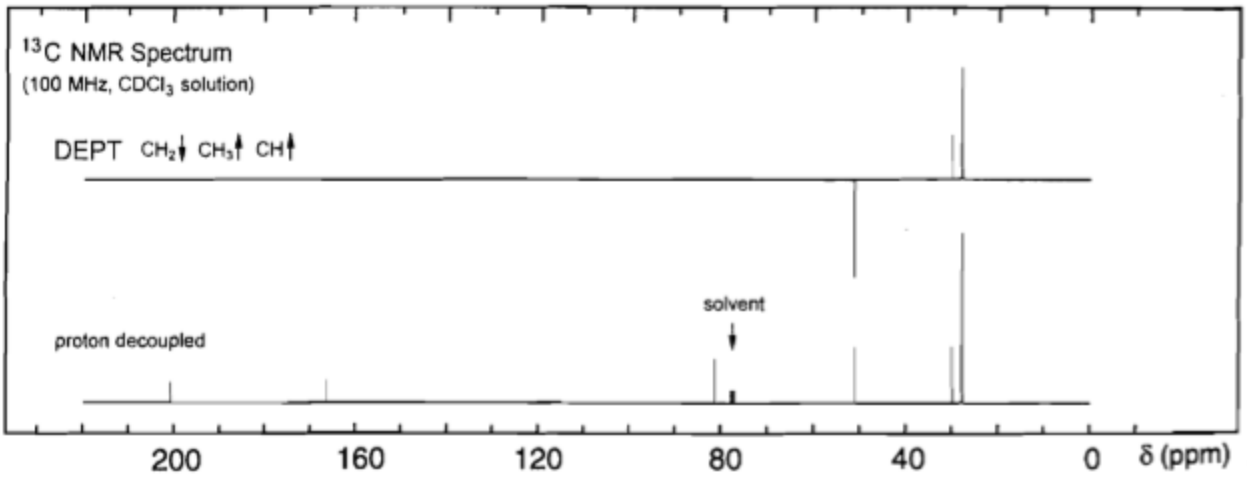

IR Spectrum
(liquid film)
3340
4000
3000
2000
1600
1200
800
ν (cm⁻¹)
Mass Spectrum
91
92
M+· = 122
% of base peak
C8H10O
40
80
120
160
200
240
280
m/e
UV spectrum
5.662 mg / 10 mls
path length : 1.00 cm
solvent : ethanol
0.0
0.5
1.0
1.5
200
250
300
350
λ (nm)
13C NMR Spectrum
(100.0 MHz,
CDCl3 solution)
expansion
135 130 ppm
DEPT CH2 CH3 CH
expansion
135 130 ppm
solvent
proton decoupled
200
160
120
80
40
0
δ (ppm)
1H NMR Spectrum
(400 MHz, CDCl3 solution)
expansion
7.3 7.2 ppm
expansion
3.9 3.8 ppm
expansion
2.9 2.8 ppm
Exchanges
with D2O
TMS
10
9
8
7
6
5
4
3
2
1
0
δ (ppm)

(B)





No significant UV absorption above 220 nm



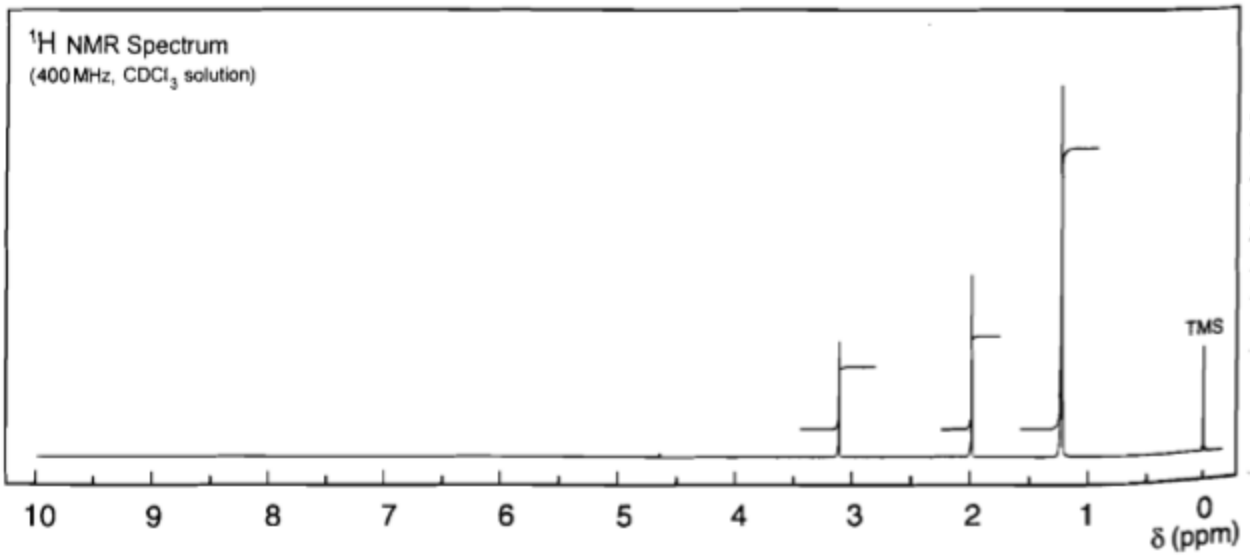
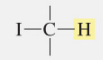
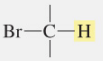
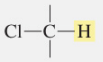
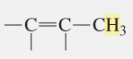
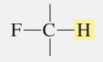
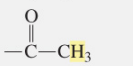
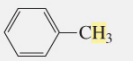
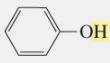
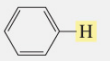
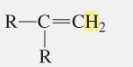
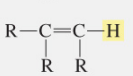


Table 14.4 Frequencies of Important IR Stretching Vibrations

Type of bond	Wavenumber (cm^{-1})	Intensity
C≡N	2260–2220	medium
C≡C	2260–2100	medium to weak
C=C	1680–1600	medium
C=N	1650–1550	medium
	~1600 and ~1500–1430	strong to weak
C=O	1780–1650	strong
C—O	1250–1050	strong
C—N	1230–1020	medium
O—H (alcohol)	3650–3200	strong, broad
O—H (carboxylic acid)	3300–2500	strong, very broad
N—H	3500–3300	medium, broad
C—H	3300–2700	medium

Table 15.1 Approximate Values of Chemical Shifts for ^1H NMR[a]

Type of proton	Approximate chemical shift (ppm)	Type of proton	Approximate chemical shift (ppm)
$-CH_3$	0.85		2.5–4
$-CH_2-$	1.20		2.5–4
	1.55		3–4
	1.7		4–4.5
	2.1	$R-NH_2$	Variable, 1.5–4
	2.3	R—OH	Variable, 2–5
$-C\equiv C-H$	2.4		Variable, 4–7
$R-O-CH_3$	3.3		6.5–8
	4.7		9.0–10
	5.3		Variable, 10–12
			Variable, 5–8

[a]The values are approximate because they are affected by neighboring substituents.

Table 15.3 Approximate Values of Chemical Shifts for ^{13}C NMR

Type of carbon	Approximate chemical shift (ppm)	Type of carbon	Approximate chemical shift (ppm)
$(CH_3)_4Si$	0	C—I	–20–10
$R-CH_3$	0–35	C—Br	10–40
		C—Cl	25–50
$R-CH_2-R$	15–55	C—N	40–60
		C—O	50–90
	25–55		165–175
	30–40		165–175
C≡C	70–90		175–185
C≡N	110–120		
C=C	80–145		190–200
C=N	150–170		
	110–170		205–220