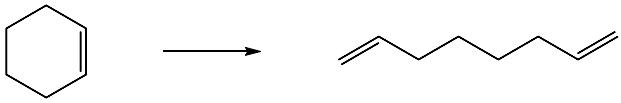
Organic Chemistry 2 Final Exam 15 Dec 2018 Student # Name

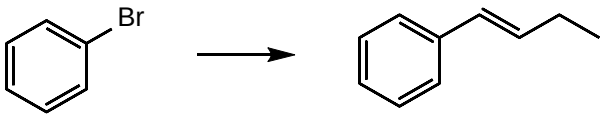
Total 140 points. Write your answers in the space provided. If you need more space, write on the back.

1. [4 x 3 points] Show the reactants and/or reagents needed to accomplish the following transformations. There may needs two steps; in that case mark the steps as 1 and 2.

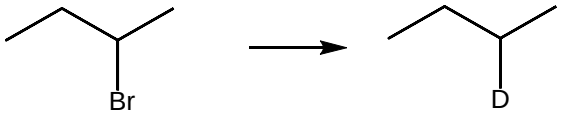
(a)



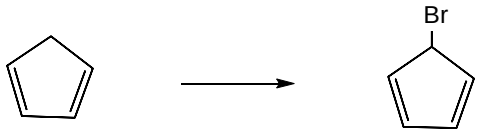
(b)



(c)

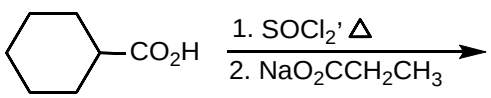


(d)

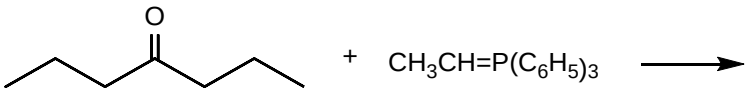


2. [5 x 3 points] Show the major product for each of the following reactions?

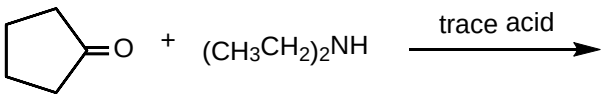
(a)



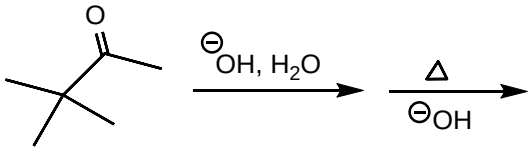
(b)



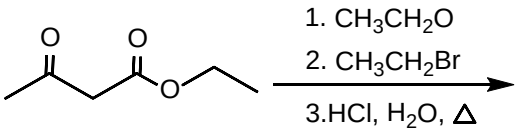
(c)



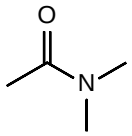
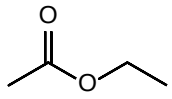
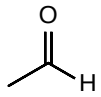
(d)



(e)



3. [12 points] For the compound A – D on the right, answer the following questions.

		pKa
A		30
B		25
C		20
D		17

(a) [6 pts] Give **<u>either</u>** the systematic or common name of **A**, **B**, and **D**.

A

B

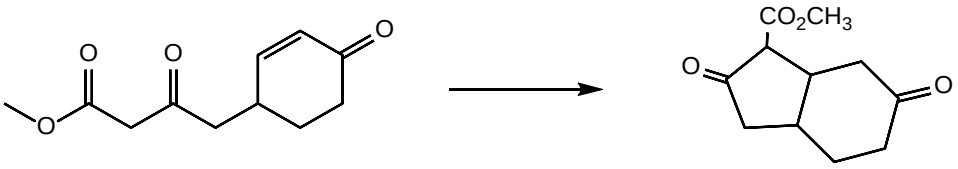
D

(b) [2 pts] How would you explain the reason why **D** is more acidic than **C**?

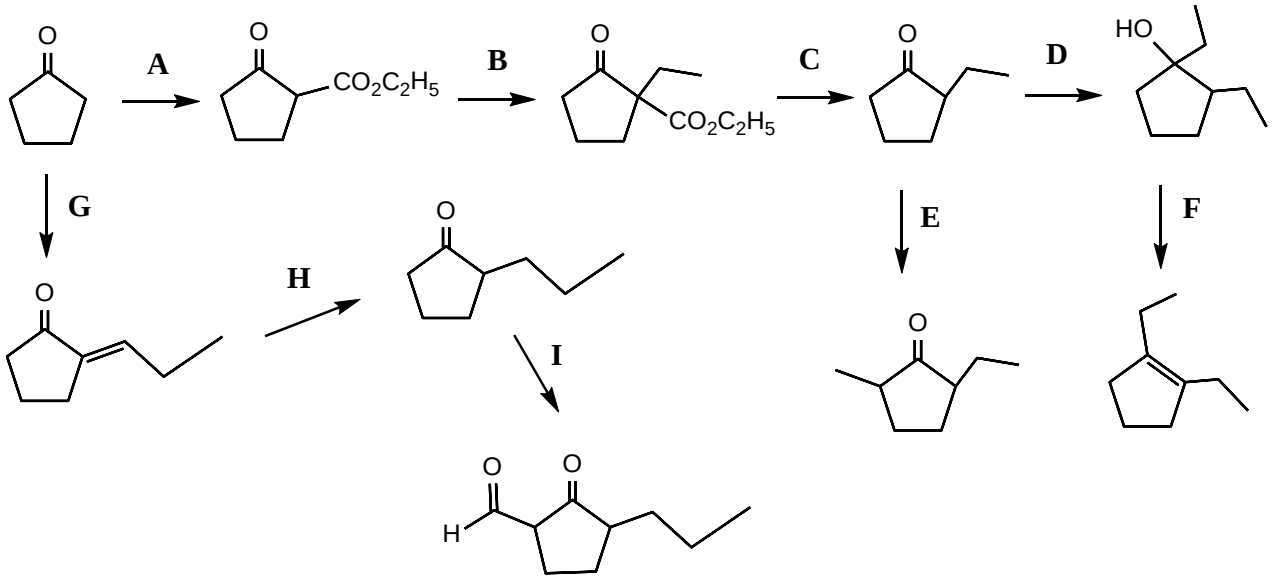
(c) [2 pts] How would you explain the reason why **B** is less acidic than **C**?

(d) [2 pts] How would you explain the reason why **A** is less acidic than **B**?

4. [7 pts] Show the stepwise mechanism including reagents for the following cyclization reaction.



5. [9 x 3 pts] Show the reactants and/or reagents needed for each reaction.



A

B

C

D

E

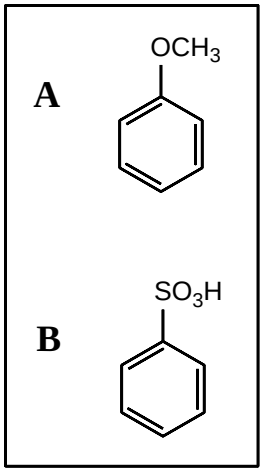
F

G

H

I

6. [18 points] For the compound A and B on the right, answer the following questions.



(a) [4 pts] Give the name of **A** and **B**.

A

B

(b) [2 + 4 pts] One of **A** and **B** is more reactive to electrophilic aromatic substitution reaction than benzene, and the other less reactive. Tell which is more reactive and explain why it is so by inductive **and** resonance effect. Do the same thing for the less reactive one.

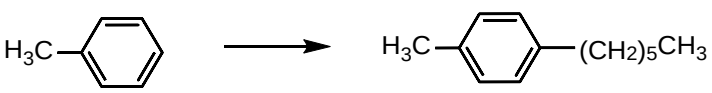
_____ is more reactive and _____ is less reactive than benzene

(c) [2 + 6 points] One of **A** and **B** is an ortho-para director, and the other is a meta director. Tell which is the ortho-para director, and explain why it is so by inductive **and** resonance effect.

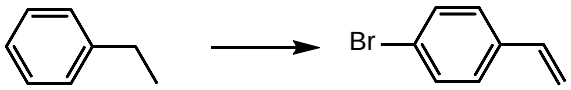
_____ is the ortho-para director

7. [4 x 5 pts] Show the synthetic steps for the following conversions. No need to explain.

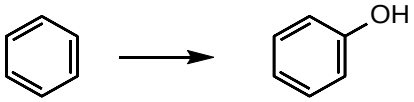
(a)



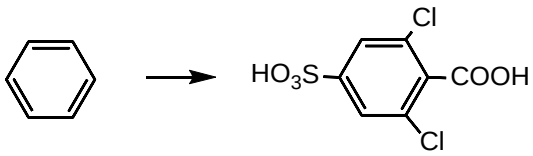
(b)



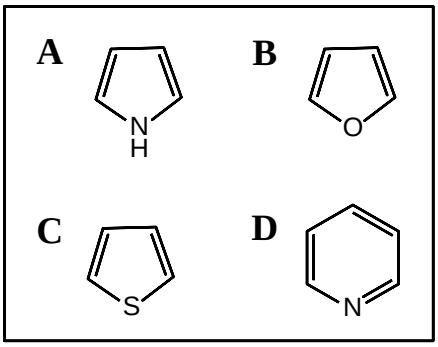
(c)



(d)



8. [9 pts] For the compounds A – D on the right, answer the following questions.



(a) [4 x 1 pt] Give the name of the compounds.

A

B

C

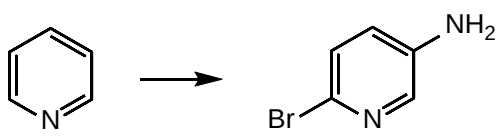
D

(b) [3 pts] **A**, **B**, and **C** are more reactive to electrophilic aromatic substitution reaction than benzene, and **D** less reactive. How would you explain?

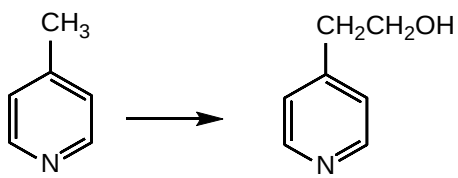
(c) [2 pts] **C** is less reactive to electrophilic aromatic substitution reaction than **B**. How would you explain?

9. [2 x 5 points] Show how the following compounds can be prepared from the given starting material.

(a)



(b)



10. [10 pts] Identify the compound, for which the spectra are given below. Try to assign as many peaks in the spectra as possible. You may show your assignments directly on the spectra. Draw the structure of the compound, and give your reasoning process on the bottom of this page and the top of the next page.

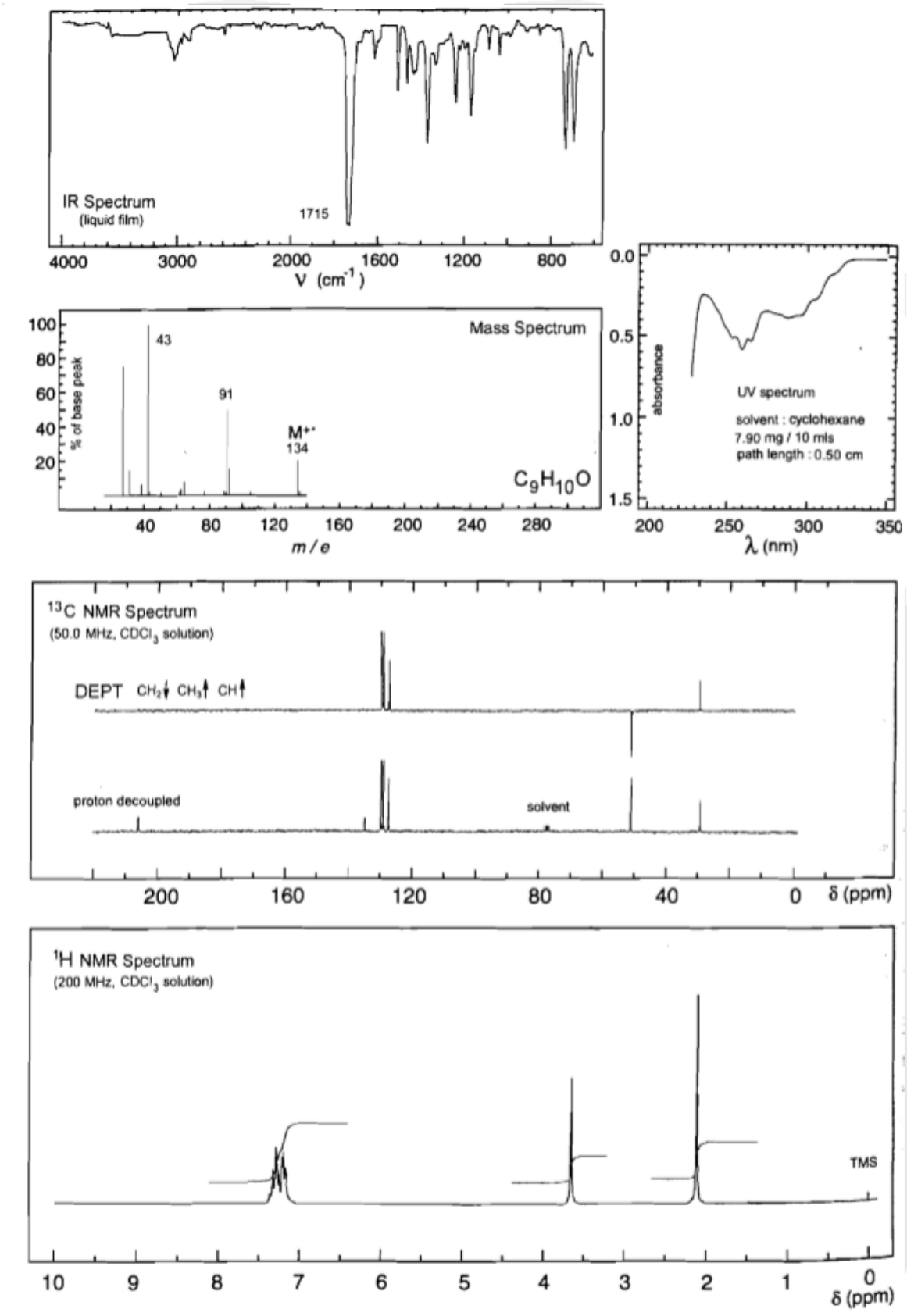
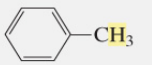
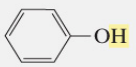
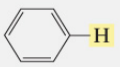


Table 14.4 Frequencies of Important IR Stretching Vibrations

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	I—C—H	2.5–4
$-CH_2-$	1.20	Br—C—H	2.5–4
—CH—	1.55	Cl—C—H	3–4
—C=C—CH_3	1.7	F—C—H	4–4.5
—C(=O)—CH_3	2.1	R—NH_2	Variable, 1.5–4
	2.3	R—OH	Variable, 2–5
—C≡C—H	2.4		Variable, 4–7
R—O—CH_3	3.3		6.5–8
R—C(R)=CH_2	4.7	—C(=O)—H	9.0–10
R—C(R)=C(R)—H	5.3	—C(=O)—OH	Variable, 10–12
		—C(=O)—NH_2	Variable, 5–8

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