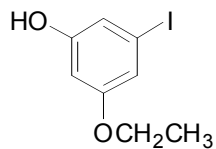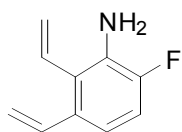**Sample Exam #2A**

A. Nomenclature (3 points each; 9 total points)

Please provide an acceptable name for each of the following compounds, noting stereochemistry where appropriate.
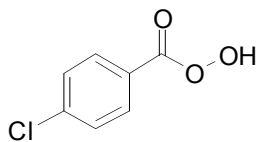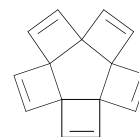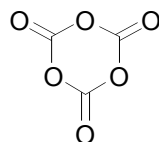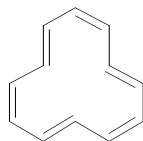
1.

HO—⟨ ⟩—I

OCH₂CH₃

_____

2.

NH₂

F

_____

3.

O

O—OH

Cl

_____

B. Facts (25 total points)

1. Label the following molecules as **aromatic**, **non-aromatic**, or **anti-aromatic**. (2 pts each)

_____   _____   _____   _____

_____   _____   _____   _____
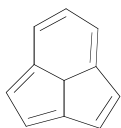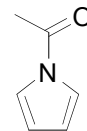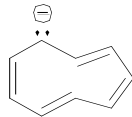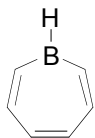
2. Provide a reasonable estimate of the **pK_a** for the following molecules. (1 pt each)

_____   _____   _____

_____   _____   _____

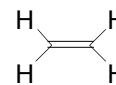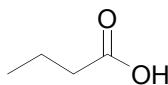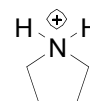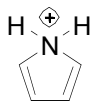3. Rank the following amines from least (**1**) to most (**3**) basic. (1 pt each)

_____   _____   _____
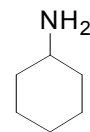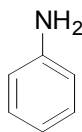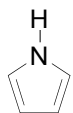
C. Reactions (7 points each; 28 total points)

Please provide the **major product**, **necessary reagents**, or **starting materials** in the **box** provided below. Be sure your drawing indicates stereochemistry if applicable.

1.

$O{=}$ OCH_3 [benzoate ester structure]

→

I— [benzene ring] —CH_2OH, O_2N— substituent

2.

[isovaleryl chloride structure with O, C, Cl]

→

[phenyl group]—CH(CN)—CH_2—CH($CH_3)_2$ with CN label
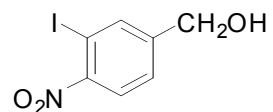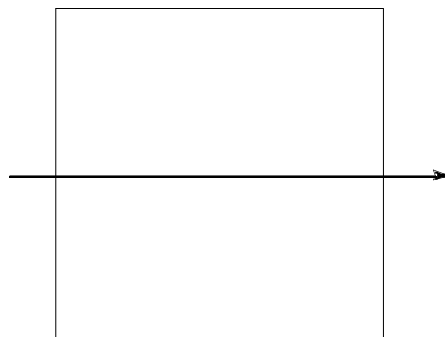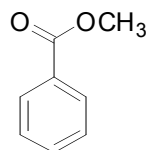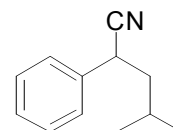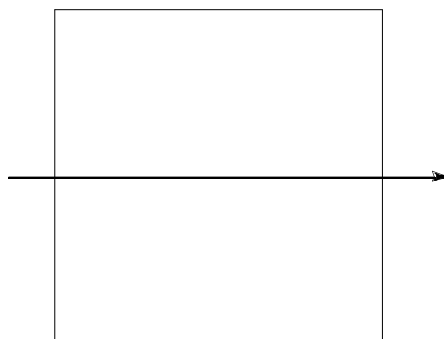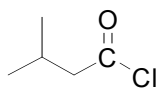
Reactions (continued)

3.

1. Na$_2$Cr$_2$O$_7$ / H$_2$SO$_4$

2. [thiophene structure] S
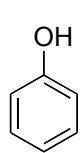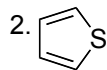
3. MCPBA
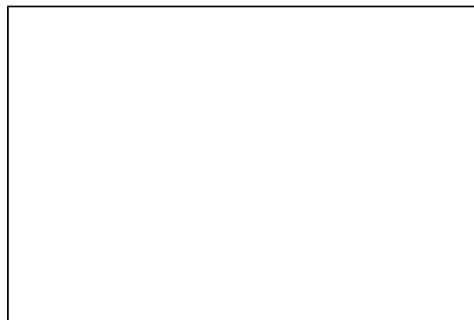
4.
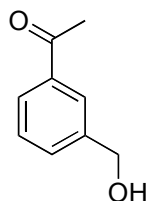
1. Cl$_2$, AlCl$_3$ (1 equiv.)

2. KMnO$_4$, H$_2$O, Δ

3. CH$_3$OH / H$^+$

4. NH$_3$, Δ, pressure

D. Mechanism (14 points)

Phenolphthalein, a common nonprescription laxative, is also an acid-base indicator that is colorless in acid and red in base. Phenolphthalein is synthesized by the acid-catalyzed reduction of phthalic anhydride with 2 equivalents of phenol. Draw a mechanism for the formation of phenolphthalein, using curved arrows to indicate "electron flow". **Show all intermediates and all formal charges.**

phthalic anhydride   phenol   phenolphthalein
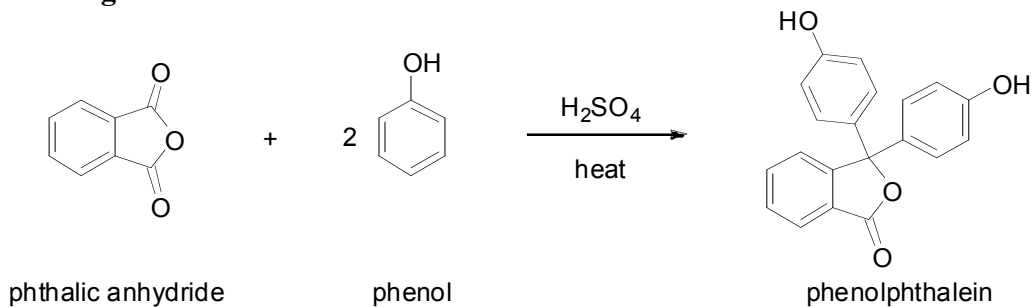
E. Synthesis (14 points)

Noting stereochemistry, synthesize the molecule below using any of the following reagents: alkanes, alkenes, or alkynes having **no more than <u>two</u> carbon atoms**, any inorganic reagents, any oxidizing or reducing agents, any peroxyacids, and benzene.
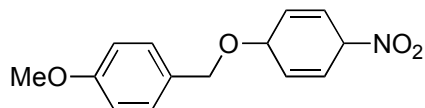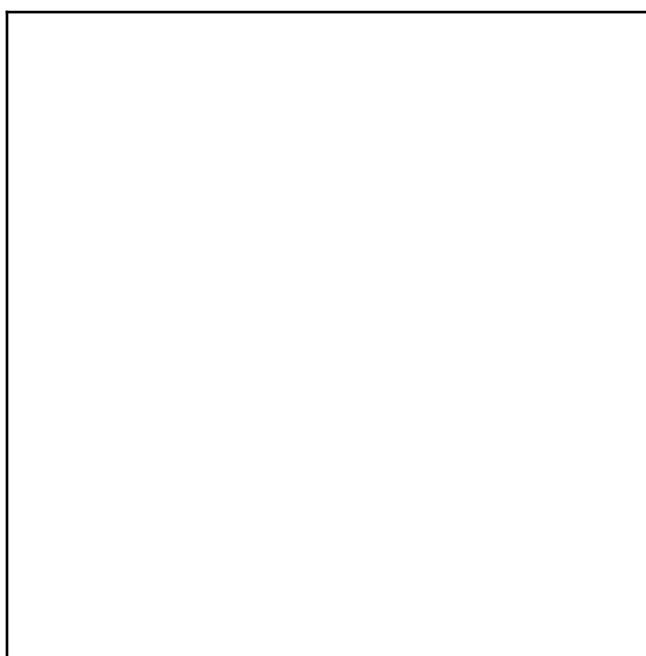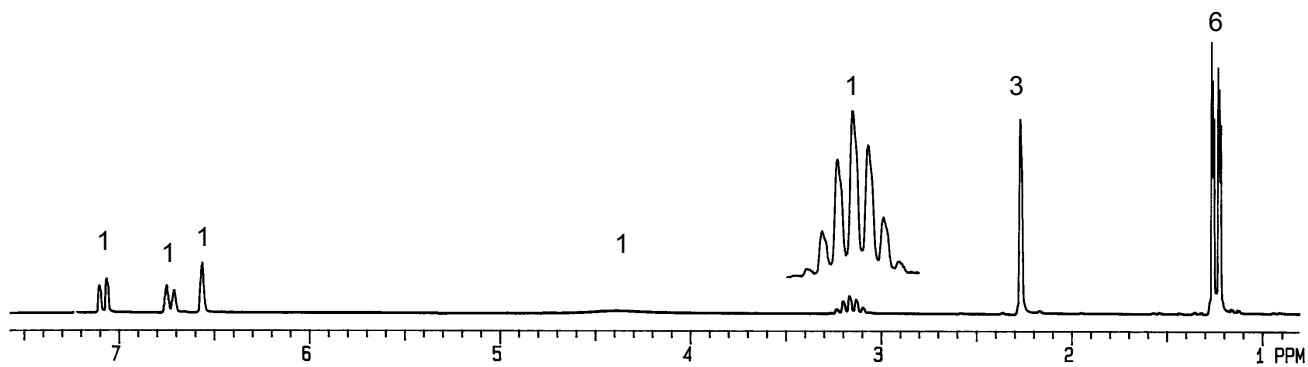
F. Spectroscopy (10 total points)

A compound with the formula $C_{10}H_{14}O$ exhibits the IR, ^1H NMR, and proton-decoupled ^{13}C NMR spectra shown on the following page. Please identify this compound and draw the structure **in the box** provided below.

C_10H_14O

% TRANSMITTANCE

3458
2963
2926
2872
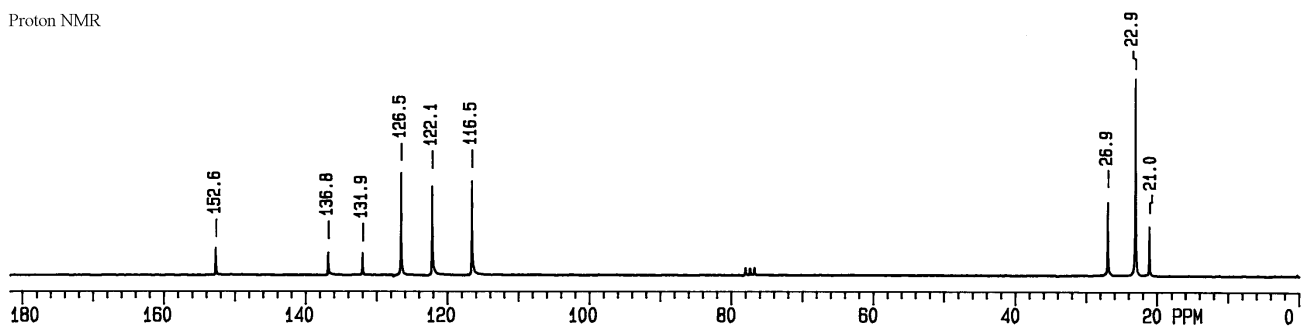1618
1583
1506
1458
1419
1290
1224
1153
1087
1113
1060
945
810

4000   3500   3000   2500   2000   1500   1000   600.0
WAVENUMBERS

Proton NMR

7   6   5   4   3   2   1 PPM

152.6   136.8   131.9   126.5   122.1   116.5   26.9   22.9   21.0

180   160   140   120   100   80   60   40   20 PPM   0

Carbon 13 NMR