112 points

1. (6 pts) Name the following compounds: Use R or S where appropriate.

```
O
O
CH₃

O
NH₂

O
O
H
```

2. (6 pts) Draw the following:

- N,N-Dimethylformamide
- Benzoic anhydride
- Butanoyl chloride

3. (20 pts) Mechanism. Draw arrows to account for the step in the mechanism below. Provide lone pair electrons where needed.

```
O
O
CH₃
CH₃O
CH₃
CH₃OH
```

What is the name of this reaction? ____________________________

Why do we use MeO⁻/MeOH instead of OH⁻/H₂O?

Which proton Ha or Hb will be abstracted by the methoxide in Molecule A? Why?

What is the functional group of the structure that you have to draw?

The final product is reacted with NaOMe/MeOH and then reacted with benzyl bromide. The solution is heated with aqueous base for 3 hours and then acidified and heated, accompanied by evolution of a gas. What is the main organic product isolated?
4. (24 pts) Pick 3 out of the 9 reagents and put them in the correct order that would accomplish these reactions. **Pick 4 out of 5 (a-e) or graded in order.**

**a.**

\[
\begin{array}{c}
\text{1} \\
\text{2} \\
\text{3}
\end{array}
\]

Step 3 followed by acid workup

(Start with an alkylation.)

- a. NaOEt, HOEt
- b. CH₃MgBr (excess) ether
- c. CH₂O
- d. Ph₃P=CH₂
- e. LAH
- f. aqueous acid
- g. LDA
- h. CH₃Br
- i. 1. BH₃-THF 2. H₂O₂, OH⁻

**b.**

\[
\begin{array}{c}
\text{1} \\
\text{2} \\
\text{3}
\end{array}
\]

(Make a carboxylic acid first, then you must consider pKa of acid/base)

- a. NaOEt, HOEt
- b. CH₃MgBr (excess) ether
- c. NBS
- d. Ph₃P=CH₂
- e. KMnO₄
- f. aqueous acid
- g. NH₃
- h. CH₃Br
- i. SOCl₂

**c.**

\[
\begin{array}{c}
\text{1} \\
\text{2} \\
\text{3}
\end{array}
\]

Steps 1 and 2 followed by acid workup

(Consider alkylating first and then reducing the lactone.)

- a. NaOEt, HOEt
- b. CH₃MgBr (excess) ether
- c. (CH₃)₂CuLi
- d. PCC
- e. Jones
- f. aqueous acid
- g. CH₃Br
- h. LAH
- i. 1. BH₃-THF 2. H₂O₂, OH⁻

**d.**

\[
\begin{array}{c}
\text{1} \\
\text{2} \\
\text{3}
\end{array}
\]

(Go through an alcohol)

- a. NaOEt, HOEt
- b. CH₃MgBr (excess) ether
- c. (CH₃)₂CuLi
- d. Ph₃P=CH₂
- e. PCC
- f. aqueous acid
- g. CH₃Br
- h. LAH
- i. 1. BH₃-THF 2. H₂O₂, OH⁻
(make acid first, then convert acid next, …)

a. HOEt + H₂SO₄(conc)  b. CH₃MgBr (excess) ether  c. (CH₃)₂CuLi

d. Ag₂O (aq)  e. Jones  f. aqueous acid

g. CH₃Br  h. LAH  i. SOCl₂

5. (30 pts) Put reagents over the arrows. Each arrow gets one reagent (at least one step) except for the last arrow which gets two. Don’t forget the reagent over the bent arrow coming back — 3 answers on that line.
6. (12 pts) Which aldehydes or ketones are involved with the aldol products below? (They might be the same.) **Pick 2 out of 3. Cross out or graded in order.**

- ![Chemical structure](image1.png)
- ![Chemical structure](image2.png)
- ![Chemical structure](image3.png)

7. (12 pts) Provide reagents or organic products as indicated:

\[
\text{NC} \quad \text{C} \quad \text{CN} \quad \xrightarrow{\text{reagents}} \quad \text{HO} \quad \text{C} \quad \text{C} \quad \text{HO} \quad \xrightarrow{\text{dehydration by P}_2\text{O}_5} \quad \text{OO} \quad \text{HO} \quad \text{HO}
\]

- ![Chemical structure](image4.png)
- ![Chemical structure](image5.png)

**Draw product**

**Draw product**

**Name this one**

**Name this one**

**Bonus: (2 pts) Name the product from Name this one:**