You have 50 minutes to complete this exam. Exams are due promptly at 10:50. Partial credit will be given for partially correct answers in most cases, so be sure to show your work.

I. General Knowledge & Exam 3 review (44 pts)
1. (9 pts) Give the structures of the molecules indicated below and provide the names of any structures shown.

\[
\begin{align*}
\text{CH}_3\text{CH}_2\text{COOCH}_3 & \quad \text{methyl propionate} \\
\text{benzonitrile} & \quad \text{methyl diazonium cation} \\
\text{dimethyl carbonate} & \quad \text{D-Alanine} \\
\text{indole} & \quad \text{D-2-deoxyribose (Fischer projection)}
\end{align*}
\]

2. (6 pts) True or False. Read the questions carefully. (Circle T or F)
   i. More basic amines have lower electron density on the nitrogen atom.  \(T\) \(F\)
   ii. Naturally occurring sugars belong to the D family.  \(T\) \(F\)
   iii. Alkyl diazonium salts are unstable.  \(F\) \(T\)

3. (6 pts) Circle the more basic amine and briefly explain why (you may use resonance structures):
   a) \[
   \begin{align*}
   &\text{NH}_2 \\
   &\text{H}
   \end{align*}
   \]
   b) \[
   \begin{align*}
   &\text{CH}_3 \\
   \text{or} &\text{CF}_3 \quad \text{inductive effect of CH}_3 \text{ vs CF}_3
   \end{align*}
   \]
4. (12) In the shown below structure of a disaccharide
   a) Circle the anomeric carbons
   b) Box in the family carbons
   c) Point an arrow at carbon atom(s) which differ in stereochemistry from that in galactose
   d) Outline the glycoside link(s).
   e) Identify individual sugars and rings (below) 6
   f) Is it a reducing sugar? (Yes/No). Circle one.

   Provide full name for this structure:
   **2-O-α-D-glucopyranosyl-β-D-fructofuranoside**

   sugar 1 glucose 2 fructose
   ring 1 fructofuranose 2 fructose

5. (6 pts) Write the organic reactant(s) needed to prepare the products below in one step and provide the needed reagent(s) and/or conditions.

   ![Reaction A](image)
   a)  

   ![Reaction B](image)
   b)  

6. (5 pts) List two requirements for molecules participating in successful mixed aldol condensation reactions and show an example for each reaction.

   a) **only one enolizable**
      Example:  
      ![Example A](image)

   b) **very different pKa**
      Example:  
      ![Example B](image)
II. Reactions (32 pts, 3 pts each reaction, + 1 pt for each name) Draw structures (including stereochemistry) of the expected organic products formed under the following reaction conditions and provide the names of the reactions where requested.

1. \[
\text{PhCH} = \text{CHO} \quad \xrightarrow{\text{NaOH, MeOH}} \quad \text{PhCH} = \text{CHO}
\]
   rxn name: [Aldol reaction]

2. \[
\text{NMe}_3^+ \quad \text{CH}_3 \quad \xrightarrow{\text{heat}} \quad \text{CH}_3 \quad \xrightarrow{\text{}} \quad + \text{NMe}_3
\]
   rxn name: Hofmann elimination

3. \[
\text{CHO} + \text{NH}_2 \quad \xrightarrow{\text{NaB} (\text{CN}) \text{H}_3} \quad \text{N} - \text{CH}_2 \text{CH}_3
\]
   rxn name: Kiliani - Fischer

4. \[
\text{CHO} \quad \xrightarrow{\text{HCN}} \quad \text{OH} \quad \xrightarrow{1) \text{H}_2/\text{Pd}} \quad \text{CHO} \quad \xrightarrow{2) \text{H}_3\text{O}^+} \quad \text{HO} + \text{CHO}
\]
   compound name: D-glyceraldehyde

5. \[
\xrightarrow{(\text{CH}_3\text{CO})_2\text{O, excess}}
\]

6. \[
\text{COOEt} \quad \xrightarrow{1. \text{H}_2\text{O}^+} \quad \text{COOH}
\quad \xrightarrow{2. \text{Heat}}
\]

7. \[
\text{Br} \quad \xrightarrow{\text{NaNO}_2/\text{H}_2\text{SO}_4} \quad \text{CuCl} \quad \xrightarrow{\text{Sandmeyer rxn}}
\]
   rxn name: Sandmeyer rxn
III. Mechanism (20 pts) Provide detailed mechanisms for the transformations given below, showing every step in the process clearly. Use electron-pushing arrows to indicate the flow of electrons.

(a) (10 pts)

(b) (10 pts)
IV. Synthesis (10 pts) Provide a reaction sequence to accomplish one of the two following conversions (left to right) using any reagents needed to convert the carbons of the starting material into the product structure. Show reactants, products, and necessary reagents for each step in the sequence, but do not show mechanisms here. Mark clearly the problem that you want us to grade. Each synthesis requires a minimum of 4 steps:

(use inorganic reagents only)

(1)

(2)