CHEM 3331, Professor Zhang, Fall 2019
Second hour exam, Oct 22, 2019

Printed Name:____________________  Student ID:________________

Recitation TA Name:_______________  Recitation day and time:_______

Scores:
1)  
2)  
3)  
4)  
5)  

CU Honor Code Pledge: On my honor, as a University of Colorado at Boulder Student, I have neither given nor received unauthorized assistance.

This is a closed-book exam. The use of notes, models, calculators, scratch paper will not be allowed during the exam. Please put all your answers on the test. Use the backs of the pages for scratch.

Partial Periodic Table
1) (27pts) 
   a) The following compound reacts with sodium methoxide (1.0 equivalent) to give one major product (>90% yield). Draw the structure of this major product. (6pts)
   
   ![Structure](image)

   b) If both F atoms are replaced with Cl atoms, will the reaction go faster or slower? No need to explain why. (3pts)

   c) The reaction above involves formation of reactive intermediate anions. Draw all the important resonance contributors to the structure of the anion intermediate. (10pts)

   
   d) Please identify which one(s) of the following reactions can occur. For the working reaction(s), give the structure(s) of the product(s), AND circle the **fastest** reaction. If no reaction can occur, just write “N.R.” on the right side of the reaction arrow. (8pts)

   
   ![Reactions](image)
2) (15 pts) Give the single major product of each of the following reactions, carefully showing stereochemistry if appropriate. If a racemate is formed, show only one enantiomer, and label it “rac”. All reactions have an appropriate aqueous work up.

a) \[
\text{HO-CH=CH-OH} \xrightarrow{\text{MnO}_2} \]

b) \[
\text{Cyclohexane} \xrightarrow{\text{NBS}} \]

c) \[
\text{Ph-CH-OH} \xrightarrow{\text{Jones reagent}} \text{Ph-HCH-OH} \]

3) (18 pts) Propose reagents for accomplishing the following transformations. NOTE: more than one step may be required! Try to make your synthesis efficient (i.e. the desired product should be the major product, and generally a shorter synthesis is better than a longer one). You must use the starting material given; you may use any other reagents you need.

a) \[
\text{CH_3CO} \xrightarrow{\text{Jones reagent}} \text{HO-CN} \]

b) \[
\text{Cyclohexane} \xrightarrow{\text{NBS}} \text{Ph-CH_3} \]

c) \[
\text{H-CO-Br} \xrightarrow{\text{H_2O}} \text{H-Ph-COCH_3} \]
4) (16 pts) Provide the product and mechanism for the following reaction. Show every intermediate with the proper charges and all the arrows required for each step of the reaction. (4 pts for product, 12 pts for mechanism).

\[
\begin{align*}
\text{Product:} & \quad \text{Mechanism:} \\
\text{HO-} & \xrightarrow{\text{H}_2\text{SO}_4 \text{ (1\%)} \quad \text{molecular sieve}} \quad \text{HO-}
\end{align*}
\]

5) (24 pts) Propose a synthesis of each of the following two (2) targets from the given starting material. Other allowed starting materials include triphenylphosphine and/or any other organic molecules containing five (5) carbons or less. You may use any necessary inorganic reagents. Try to make your synthesis efficient (i.e. the desired product should be the major product, and generally a shorter synthesis is better than a longer one). More than one step may be required.

\[
\begin{align*}
\text{a) } & \quad \text{b) }
\end{align*}
\]
b) \[ \text{benzene} \rightarrow \text{bromobenzene} \]