

16 1. Give structures for each of the following compounds:

Triethyl ammonium chloride

Acetic formic anhydride

Methyl benzoate ester

N,N-dibutylethanamide

Propanenitrile

ethanamine

2-Methyl-2-hexanamine

Dimethylmalonate ester

8 2. (i) Show the product(s) for reaction between propylamine and propanoyl bromide (6 pts). (ii) What is the name of this compound (2 pts)?

- 10 3. You can hydrolyze ethyl butanoate using either acid or base conditions. (i) Show the complete reaction mechanism, including a tetrahedral intermediate, for the base catalyzed (in presence of  $\text{OH}^-$  ion and water) hydrolysis (6 pts). (ii) Show the correct structures for the hydrolysis products of this ester in acid and in base (4 pts; 1 point for each correct structure).
- 10 4. Starting with benzene, show how you could produce N,N-dimethyl aniline. Use any reagents needed, but you must start with benzene, and go from there.
- 10 5. (i) Show how you would produce the tetraoctylammonium ion starting with ammonia and 1-bromooctane (5 pts). (ii) Explain how the tetraoctylammonium ion functions as a phase-transfer catalyst and how this catalyst could be used to catalyze the formation of pentanenitrile from appropriate starting materials (be sure to start with the correct alkyl halide).

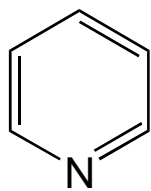
- 10 6. Starting with ethyl acetate and methyl benzoate, show the reaction mechanism, and the major mixed Claisen condensation product for this reaction, which uses an ester enolate ion. Show how to produce the ion, and show the mechanism for each part of the reaction.

- 12 7. Rank the following compounds in order of *increasing* basicity (weakest to strongest). The weakest base has as its conjugate acid the lowest  $pK_a$  (4 pts).

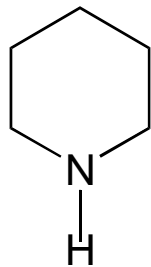
\_\_\_\_\_ > \_\_\_\_\_ > \_\_\_\_\_ > \_\_\_\_\_  
*Weakest Base* *Strongest Base*

Ammonia, Aniline, Ethylamine, and amide ion ( $\text{NH}_2^-$ )

Which of the following compounds is the most basic, and why (4 pts)?



Pyridine



piperidine

Show the structure of aniline as you normal draw it. Then, show three additional resonance structures for aniline, which helps to explain some of its base properties (4 pts).

- 12 8. Show reactions required to prepare an amine from the starting materials listed below, using any other reagent necessary to produce an amine. The amine should have the number of carbons shown in each of the starting reactants.

Propyl bromide

Nitrobenzene

Phthalimide (phthalic acid is benzene dicarboxylic acid)

- 12 9. Show the product for reaction between nitrous acid and *p*-nitroaniline (4 pts).

Show the reaction product, and its name, when each of the following chemicals reacts with the diazonium ion you just produced in the first part of problem #9 (2 pts).

HOH

CuCl

CuCN

H<sub>3</sub>PO<sub>2</sub>