Organic Chemistry
Amines
Practice Set

1. (22.1) Draw structures, give names, and classify as primary, secondary, or tertiary:
   a. the eight isomeric amines of formula $C_4H_{11}N$
   b. the five isomeric amine of formula C_7H_9N that contain a benzene ring

2. (22.2) Give the structural formulas of the following compounds:
   a. *sec*-butylamine
   b. *o*-toluidine
   c. anilinium chloride
   d. diethylamine
   e. *p*-aminobenzoic acid
   f. benzylamine
   g. isopropylammonium benzoate
   h. N,N-dimethylaniline
   i. 2-aminoethanol
   j. β-phenylethylamine
   k. N,N-dimethylaminocyclohexane
   l. diphenylamine
   m. 2,4-dimethylaniline
   n. tetra-*n*-butylammonium iodide

3. (22.3) Show how n-propylamine could be prepared from each of the following:
   a. *n*-propyl bromide
   b. *n*-propyl alcohol
   c. propionaldehyde
   d. 1-nitropropane
   e. propionitrile
   f. *n*-butyramide
   g. *n*-butyl alcohol
   h. ethyl alcohol

4. (22.4) Outline all steps in a possible laboratory synthesis of the following compounds from benzene, toluene, and alcohols of four carbons or fewer, using any needed inorganic reagents:
   a. isopropylamine
   b. *n*-pentylamine
   c. *p*-toluidine
   d. ethylisopropylamine
   e. α-phenylethylamine
   f. β-phenylethylamine
   g. *m*-chloroaniline
   h. *p*-aminobenzoic acid
   i. 3-aminoheptane
   j. N-ethylaniline
   k. 2,4-dinitroaniline
   l. 2-amino-1-phenylpropane (*benzedrine*)
   m. *p*-nitrobenzylamine
   n. 2-amino-1-phenylethanol

5. (23.1) Write complete equations, naming all organic products, for the reaction (if any) of *n*-butylamine with:
   a. dilute HCl
   b. dilute H_2SO_4
   c. acetic acid
   d. dilute NaOH
   j. benzyl bromide
   k. bromobenzene
   l. excess methyl iodide, then Ag_2O
   m. product (l) + strong heat

e. acetic anhydride
f. isobutyryl chloride
g. *p*-nitrobenzoyl chloride + pyridine
h. benzenesulfonyl chloride + KOH(aq)
i. ethyl bromide
n. $CH_3COCH_3 + H_2 + Ni$
o. HONO ($NaNO_2$ + HCl)
p. phthalic anhydride
q. sodium chloroacetate
r. 2,4,6-trinitrochlorobenzene

6. (23.8) Give the reagents and any special conditions necessary to convert p-toluene-diazonium chloride into:
   a. toluene
   b. *p*-cresol, p-$CH_3C_6H_4OH$
   c. *p*-chlorotoluene
   d. *p*-bromotoluene
   e. *p*-iodotoluene
   f. *p*-fluorotoluene
   g. *p*-tolunitrile, p- $CH_3C_6H_4CN$
   h. 4-methyl-4'-(N,N-dimethylamino)azobenzene
   i. 2,4-dihydroxy-4'-methylazobenzene