Organic Chemistry
Carboxylic Acids
Practice Set

1. (19.1) Give the common names and IUPAC names for the straight-chain saturated carboxylic acids containing the following numbers of carbon atoms: 1, 2, 3, 4, 5, 6, 8, 10, 12, 16, 18

2. (19.2) Give the structural formula and, where possible, a second name (by a different system) for each of the following:
   a. Isovaleric acid
   b. trimethylacetic acid
   c. α,β-dimethylcaproic acid
   d. 2-methyl-4-ethyloctanoic acid
   e. phenylacetic acid
   f. γ-phenylbutyric acid
   g. Adipic acid
   h. P-toluic acid
   i. Phthalic acid
   j. isophthalic acid
   k. terephthalic acid
   l. *p*-hydroxybenzoic acid
   m. potassium α-methylbutyrate
   n. magnesium-2-chloropropanoate
   o. maleic acid
   p. α,α'-dibromosuccinic acid
   q. isobutyronitrile
   r. 2,4-dinitrobenzonitrile

3. (19.3) Write equations to show how each of the following compounds could be converted into benzoic acid:
   a. toluene
   b. bromobenzene
   c. benzonitrile
   d. benzyl alcohol
   e. benzotrichloride
   f. acetophenone (Hint: See Sec. 18.21)

4. (19.4) Write equations to show how each of the following compounds could be converted into *n*-butyric acid:
   a. *n*-butyl alcohol
   b. *n*-propyl alcohol
   c. *n*-propyl alcohol (a second way)
   d. methyl *n*-propyl ketone

5. (19.6) Write equations to show the reaction (if any) of benzoic acid with:
   a. KOH
   b. Al
   c. CaO
   d. Na_2CO_3
   e. NH_3(aq)
   f. H_2, Ni, 20°C, 1 atm
   g. $LiAlH_4$
   h. hot $KMnO_4$
   i. PCl_5
   j. PCl_3
   k. $SOCl_2$
   l. Br_2/Fe
   i. Br_2 + P
   j. HNO_3/H_2SO_4
   k. fuming sulfuric acid
   l. CH_3Cl, $AlCl_3$
   q. *n*-propyl alcohol, H^+

6. (19.11) Complete the following, giving the structures and names of the principal organic products.
    a. $C_6H_5CH{=}CHCOOH + KmMnO_4 + OH^- + heat$
    b. *p*-$CH_3C_6H_4COOH + HNO_3 + H_2SO_4$
    c. Succinic acid + $LiAlH_4$, followed by H^+
    d. $C_6H_5COOH + C_6H_5CH_2OH + H^+$
    e. product (d) + $HNO_3 + H_2SO_4$
    f. *n*-butyric acid + Br_2, P
    g. *cyclo*-$C_6H_{11}MgBr + CO_2$, followed by H_2SO_4
    h. product (g) + $C_2H_5OH + H^+$
    i. product (g) + $SOCl_2$ + heat
    j. *m*-$CH_3C_6H_4COCH_3 + KMnO_4 + OH^-$

7. (19.14) Outline a possible laboratory synthesis of the following compounds from benzene, toluene, and alcohols of four carbons or fewer, using any needed inorganic reagents:
    a. ethyl α-methyl butyrate
    b. 3,5-dinitrobenzoyl chloride
    c. α-amino-*p*-bromophenylacetic acid
    d. α-hydroxypropionic acid
    e. *p*-$HO_3SC_6H_4COOH$
    f. 2-pentenoic acid
    g. *p*-toluamide
    h. *n*-hexyl benzoate
    i. 3-bromo-4-methylbenzoic acid
    j. α-methylphenylacetic acid
    k. 2-bromo-4-nitrobenzoic acid
    l. 1,2,4-benzenetricarboxylic acid