**CHEM 100**                                    **Name**_____
**Exam 3**                                       **Summer 2011**

**Due by 3:00 PM Tuesday, June 26**
**NO LATE PAPERS ACCEPTED!**

Follow instructions on the attached exam. Clearly mark your answers. YOU MUST SHOW
YOUR WORK TO RECEIVE CREDIT.

**Instructions**

• *This exam MUST be completed INDIVIDUALLY and in your own words.* Group work or
  plagiarism will result in a zero for the exam. You may not receive assistance from anyone
  else.

• Before opening the exam, prepare for it like you would for a traditional, in-class exam.
  Review concepts and examples from the text, as well as those discussed in class. This
  preparation will help to maximize your effort on the exam and allow you to complete it more
  efficiently. You should be able to complete the exam in 50 minutes or less.

• Once you have completed the exam, you may refer to your textbook or lecture notes for a
  maximum of 20 minutes to verify and/or correct your answers. You MAY NOT use the
  internet!! **All answers must be in your own words, <u>verbatim copying from the text will
  result in a score of zero for the problem</u>.**

**"Open Book" Portion Time Restriction**

You may spend no more than twenty (20) minutes using your book or notes to aid you on this
exam. This <u>must</u> be in one continuous block of time. You are on your honor to adhere to this
restriction and record the time spent in the chart below.

| Date | Time Began | Time Finished | Total Time |
|------|-----------|---------------|------------|
|      |           |               |            |
| Total Time Spent with Open Book | | | |

**Pledge**

I pledge on my honor that I have completed the exam in accordance with the above instructions
and that I have not provided or received unethical assistance. I realize that failure to comply
with these instructions will result in a score of zero on the exam.


_____          _____
Signature                                                      Date

**Part I. Multiple choice**.  Circle the correct answer for each problem.  3 points each

1.  A compound containing only carbon and hydrogen and which has no double bonds between atoms is classified as an

    a. alkene.            b. alkyne.              c. aromatic.            d. alkane.

2.  In organic chemistry, compounds are generally classified by

    a. state.            b. color.              c. functional group.            d. odor.

3.  Monomers are

    a. ethylene.                              b. small polymers.
    c. small building blocks of polymers.            d. all of the above

4.  The segment of a polymer shown below represents a
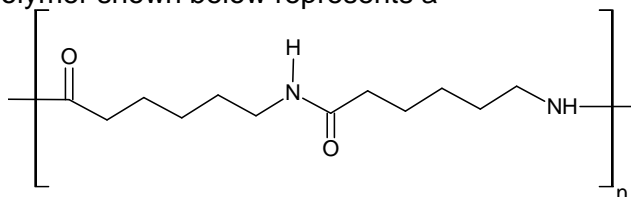


    a. polyester.              b. polyamide.            c. polyethylene.                d. polystyrene.

5.  $H_3O^+$ is called the

    a. hydroxide ion.                          b. hydrogen ion.
    c. hydrate ion.                            d. hydronium ion.

6.  The compound $CH_3NH_2$ reacts with water to form $CH_3NH_3^+$ and $OH^-$.  In this reaction, $CH_3NH_2$ is acting as a(n)

    a. salt.            b. base.              c. acid.            d. solvent.

7.  If the concentration of a dilute solution of nitric acid is 0.00010 M, what is the pH of that solution?

    a. 14.0              b. 7.0              c. 4.0              d. 5.0

8. The primary structure of a protein is determined by

   a. the intertwining of protein molecules to form a "functional" protein.
   b. the order of amino acids in the protein.
   c. the hydrogen bonding that gives the protein three dimensional shape.
   d. the amino acid composition.

9. The most important feature that distinguishes one DNA molecule from another is (are)

   a. the type of phosphate bonds.
   b. the order of the bases attached to the sugar phosphate backbone.
   c. the type of sugar in each molecule.
   d .all of the above features

10. Aspartame, shown below, is the artificial sweetener in Equal and Nutrasweet. What is the molecular formula of aspartame?
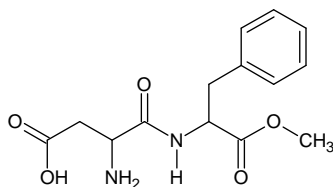


   a. $C_{13}H_{16}N_2O_5$        b. $C_{14}H_{18}N_2O_5$        c. $C_{14}H_{16}N_2O_5$        d. $C_{14}H_{16}N_2O_3$


**Part II.** Complete each of the following. Point values are noted by each question.

11. Identify the functional group shown in each structure: (8 points)
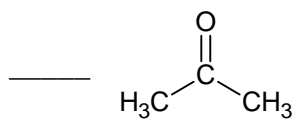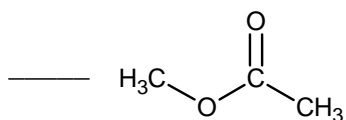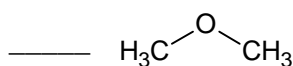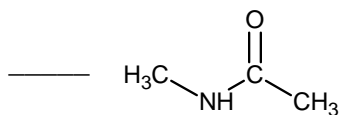


   A. ether
   B. ketone
   C. ester
   D. carboxylic acid
   E. amide
   F. amine

12. Briefly describe the similarities and differences between addition polymerization and condensation polymerization. (8 points)

13. Define the following terms in a sentence or two each: (8 points)
    a.  active site:

    b.  base pair:

    c.  peptide bond:

    d.  secondary protein structure:

14. Calculate the hydroxide ion concentration ([OH⁻], in moles OH⁻ per liter) and pH for a solution made by diluting 3.50 g of NaOH (molar mass = 40.00 g/mol) to 250 mL with water. (8 points)

**Part III.** Complete the following 4 problems. **YOU MUST DO ALL FOUR PROBLEMS!** Each problem is worth ten (10) points. You must show you work on calculations to receive partial credit. Report numerical results to the correct number of significant figures and with the appropriate units.

15. Hydrochloric acid (HCl) is classified as a strong acid, while acetic acid ($CH_3COOH$) is classified as a weak acid. Explain what these terms mean. If you could examine a 0.10 M solution of HCl and a separate solution 0.10 M of acetic acid on a molecular level, what would you expect to see in each? How would the pH of each solution compare?

16. Compounds that can serve as monomers for polymerization reactions must have one key property.  What property is this?  Show how this property manifests itself in both addition and condensation polymerization.

17. DNA and proteins are both polymers.  Outline the similarities and differences in the two materials.  How do inter- and intramolecular forces lead to interesting shapes of each polymer?

18. Alcohols and carboxylic acids react to form compounds by the process shown below.

$$R-\overset{\overset{\displaystyle O}{\|}}{C}-OH \ + \ H_2N-R' \longrightarrow R-\overset{\overset{\displaystyle O}{\|}}{C}-NH-R' \ + \ H_2O$$
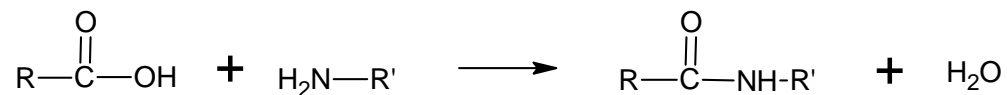
a. What type of functional group is formed when alcohols and carboxylic acids react?

b. The compound para-aminobenzoic acid (PABA) has seen significant use as a component of sunscreens. Complete the reaction of PABA with methyl amine.



$+ \ H_2N-CH_3 \longrightarrow$
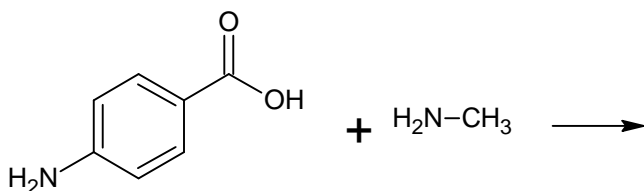
c. Complete the reaction of PABA with acetic acid.



$+ \ H_3C-\overset{\overset{\displaystyle O}{\|}}{C}-OH \longrightarrow$
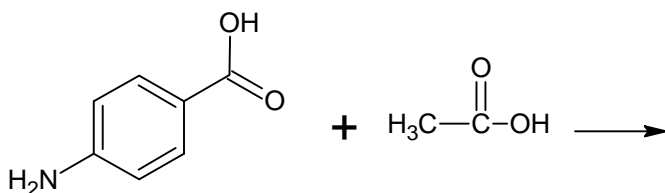
**Bonus (4 points)**

What is the molecular formula of PABA? (The structure of PABA is shown in above.)

## Possibly Useful Information

| $pH = -\log[H^+]$ | $[H^+] = 10^{-pH}$ |
|---|---|
| $[H^+][OH^-] = 1.0 \times 10^{-14}$ | $N_A = 6.02 \times 10^{23}\ mol^{-1}$ |

## PERIODIC CHART OF THE ELEMENTS

| IA | IIA | IIIB | IVB | VB | VIB | VIIB | VIII | | | IB | IIB | IIIA | IVA | VA | VIA | VIIA | INERT GASES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 H 1.00797 | | | | | | | | | | | | | | | | 1 H 1.00797 | 2 He 4.0026 |
| 3 Li 6.939 | 4 Be 9.0122 | | | | | | | | | | | 5 B 10.811 | 6 C 12.0112 | 7 N 14.0067 | 8 O 15.9994 | 9 F 18.9984 | 10 Ne 20.183 |
| 11 Na 22.9898 | 12 Mg 24.312 | | | | | | | | | | | 13 Al 26.9815 | 14 Si 28.086 | 15 P 30.9738 | 16 S 32.064 | 17 Cl 35.453 | 18 Ar 39.948 |
| 19 K 39.102 | 20 Ca 40.08 | 21 Sc 44.956 | 22 Ti 47.90 | 23 V 50.942 | 24 Cr 51.996 | 25 Mn 54.9380 | 26 Fe 55.847 | 27 Co 58.9332 | 28 Ni 58.71 | 29 Cu 63.54 | 30 Zn 65.37 | 31 Ga 69.72 | 32 Ge 72.59 | 33 As 74.9216 | 34 Se 78.96 | 35 Br 79.909 | 36 Kr 83.80 |
| 37 Rb 85.47 | 38 Sr 87.62 | 39 Y 88.905 | 40 Zr 91.22 | 41 Nb 92.906 | 42 Mo 95.94 | 43 Tc (99) | 44 Ru 101.07 | 45 Rh 102.905 | 46 Pd 106.4 | 47 Ag 107.870 | 48 Cd 112.40 | 49 In 114.82 | 50 Sn 118.69 | 51 Sb 121.75 | 52 Te 127.60 | 53 I 126.904 | 54 Xe 131.30 |
| 55 Cs 132.905 | 56 Ba 137.34 | *57 La 138.91 | 72 Hf 178.49 | 73 Ta 180.948 | 74 W 183.85 | 75 Re 186.2 | 76 Os 190.2 | 77 Ir 192.2 | 78 Pt 195.09 | 79 Au 196.967 | 80 Hg 200.59 | 81 Tl 204.37 | 82 Pb 207.19 | 83 Bi 208.980 | 84 Po (210) | 85 At (210) | 86 Rn (222) |
| 87 Fr (223) | 88 Ra (226) | ‡89 Ac (227) | 104 Rf (261) | 105 Db (262) | 106 Sg (266) | 107 Bh (262) | 108 Hs (265) | 109 Mt (266) | 110 ? (271) | 111 ? (272) | 112 ? (277) | | | | | | |

Numbers in parenthesis are mass numbers of most stable or most common isotope.

Atomic weights corrected to conform to the 1963 values of the Commission on Atomic Weights.

The group designations used here are the former Chemical Abstract Service numbers.

**\* Lanthanide Series**

| 58 Ce 140.12 | 59 Pr 140.907 | 60 Nd 144.24 | 61 Pm (147) | 62 Sm 150.35 | 63 Eu 151.96 | 64 Gd 157.25 | 65 Tb 158.924 | 66 Dy 162.50 | 67 Ho 164.930 | 68 Er 167.26 | 69 Tm 168.934 | 70 Yb 173.04 | 71 Lu 174.97 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

**‡ Actinide Series**

| 90 Th 232.038 | 91 Pa (231) | 92 U 238.03 | 93 Np (237) | 94 Pu (242) | 95 Am (243) | 96 Cm (247) | 97 Bk (247) | 98 Cf (249) | 99 Es (254) | 100 Fm (253) | 101 Md (256) | 102 No (256) | 103 Lr (257) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|