

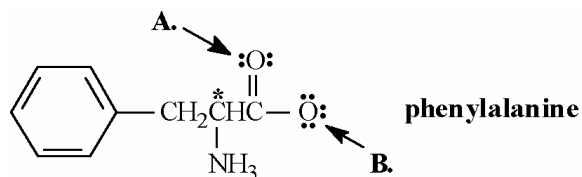
Name: _____

Student ID# _____

CH 231 Test I Chapters 1, 2, 3 (Sept. 19, 2006)

- You have 105 minutes to complete the exam.

1. (14 pts) Phenylalanine is an amino acid that is essential to human nutrition. The representation below shows the structure of phenylalanine at physiological pH.

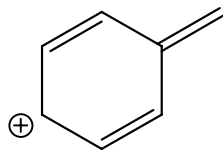


- A. Assign any formal charges to atoms in this representation of phenylalanine.
- B. Draw a *skeletal structural* representation of phenylalanine. Depict the geometry at the carbon atom with the asterisk (*) using the standard *wedge-dash convention*.
- C. What is the hybridization at the nitrogen atom?
- D. What is the hybridization at oxygen atom **B.**?
- E. What is the hybridization of the carbon atoms in the arene?

Score: _____/100

Combined Avg. through Test I: _____%

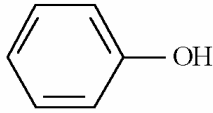
2. (15 pts) Draw *four additional* resonance structures of the species below, then draw the *resonance hybrid*.



3. (6 pts) Phosgene (a common industrial chemical and a chemical warfare agent used during World War I), $\text{Cl}_2\text{C}=\text{O}$, has a smaller dipole moment than formaldehyde (a common industrial chemical and tissue preservative), $\text{H}_2\text{C}=\text{O}$, even though phosgene contains electronegative chlorine atoms rather than hydrogens. Explain.

4. (8 pts) Acidity Constants

Consider the acidity constants below to answer the following questions.

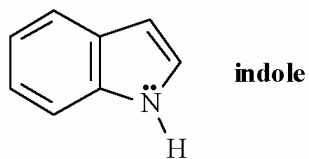
<u>ACID</u>	<u>STRUCTURE</u>	<u>$\text{p}K_a$</u>
phenol		10.00
ethanol	$\text{CH}_3\text{CH}_2\text{OH}$	16.00
water	HOH	15.74

A. Which acid above will be almost completely deprotonated by NaOH ?

B. Which acid has the *strongest* conjugate base? Draw the structure of the conjugate base.

C. Explain why phenol has a much lower $\text{p}K_a$ than ethanol.

5. (8 pts) Indole is pleasant smelling in highly dilute solutions and had been used in perfumery. Use the structure of indole, below, to answer the following questions.



A. Indole can function as a Brønsted-Lowry acid in the presence of strong bases. Formulate a reaction, showing electron flow with arrows that demonstrates this reactivity of indole.

B. Indole can function as a Lewis base in the presence of strong acid. Formulate a reaction, showing electron flow with arrows that demonstrates this reactivity of indole.

6. (12 pts) Draw molecules that contain the following:

a. primary alcohol

b. secondary bromoalkane

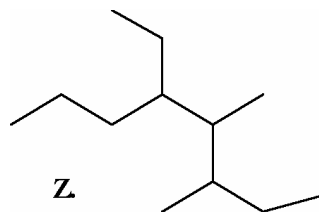
c. isopropyl group

d. tertiary nitrile

e. both 1° and 2° alcohols

f. quaternary carbon

7. (8 pts) Consider the representation below to answer the following questions.



A. Provide the IUPAC name for compound **Z**.

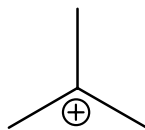
B. Draw a constitutional isomer of compound **Z** that contains a *tert*-butyl group. Correctly name your isomer.

8. (6 pts) Draw structures corresponding to each of the following names.

cis-1-*sec*-butyl-2-ethylcycloheptane

3-cyclobutylpentane

9. (9 pts) Although almost all stable organic species have tetravalent carbon atoms, species with trivalent carbon atoms also exist. Carbocations, such as that represented below, are one such class.



- How many valence electrons does the positively charged carbon atom have?
- What is the hybridization at the charged carbon atom?
- What is the geometry of the carbocation?

10. (14 pts) Circle and clearly label the functional groups present in the molecule below. Put a small box around any methylene groups in the structure.

