CHEM 2311
E1 practice-i (answers provided)

1. (32 points) Circle the letter **on the right** which corresponds to the answer to each question. There is only one correct answer for each question.

(i) Which statement is true about the carbon-carbon bonds of benzene?

   A. They are polar because of the overlap of the pi orbitals.  
   B. The single bonds are longer than the double bonds.  
   C. The sigma bonds are formed by the overlap of two sp² atomic orbitals.  
   D. Electrons move back and forth between adjacent C-C bonds.

   **(The correct answer is D.)**

(ii) Which will be the most polar bond?

   E. C–C   F. C–Br   G. C–Si   H. C–Cl

   **(The correct answer is E.)**

(iii) There are four alcohols (constitutional isomers) with the formula C₄H₁₀O. How many 1°, 2° and 3° alcohols are possible?

   I. One 1°, two 2° and one 3°   J. Two 1°, two 2° and no 3°   K. Two 1°, one 2° and one 3°   L. One 1°, one 2° and two 3°

   **(The correct answer is I.)**

(iv) Which of the following matches of functional groups and molecules are correct?

   a. Ketone  b. Aldehyde  i. CH₃COCH₃  ii. CH₃CN  
   c. Acid  d. Ester  iii. CH₃CH₂CO₂CH₃  iv. CH₃CO₂H  

   **(The correct answer is M.)**

(v) Which of the following statement is *not* true of resonance structures?

   Q. The arrangement of nuclei in all resonance structures must be the same.  
   R. The arrangement of electrons in all resonance structures must be different.  
   S. Each resonance structure must be a real molecule that can be isolated.  
   T. The actual molecule will be more stable than any single resonance structure.

   **(The correct answer is R.)**

(vi) What is the ground state electron configuration of sulfur?

   U. 1s²2s²2p⁶3s¹3p⁵  V. 1s²2s²2p⁶3s¹3p⁴  W. 1s²2s²2p⁶3s²3p⁴  X. 1s²2s²2p⁶3s²3p⁵

   **(The correct answer is V.)**

(vii) Which of the following compounds has a carbonyl bond?

   Y. Hydrocarbon  Z. Ketone  AA. Alcohol  BB. Halide

   **(The correct answer is Z.)**

(viii) Which atomic orbitals overlap for form the double bond of ethylene (CH₂=CH₂)?

   CC. sp² + sp² and p+p  
   DD. s + s and p+p  
   EE. sp² + sp² and s+s  
   FF. sp+ sp and p+p

   **(The correct answer is CC.)**
2. (36 points). Give a single answer for each part of the question in the spaces provided.

(a) Draw a resonance structure of the acetate anion, $A$, showing the location of all lone pairs of electrons and formal charges.

(b) Draw a constitutional isomer of the alkene $B$.

(c) Draw a stereoisomer of alkene $B$.

(d) What is the molecular formula of cocaine, $C$ (above)?

(e) Which atomic orbitals (indicate the appropriate hybridization) overlap to form the bonds labeled $a$, $b$ and $c$ in the structure of cocaine?

- $a. \text{C} + \text{O} = \sigma$
- $b. \text{C} + \text{C} = \sigma$
- $c. \text{C} + \text{O} = \sigma$ and $\text{C} + \text{O} = \pi$

(f) What is the approximate value of the O-C-O bond angle in the esters of cocaine? ________°
3 (32 points). Give answers for each part of the question in the spaces provided.

(a) Draw a line-bond structure of three aldehydes with the formula C₅H₁₀O.

(b) Draw a tertiary amine with formula C₄H₁₁N.

(c) Which compound in each of the following pairs has the higher boiling point? (Circle the correct answer). What is the strongest intermolecular force in the higher boiling compound in each pair?

(d) Hydrogen fluoride and ethyl fluoride (CH₃CH₂F) have similar molecular dipoles, yet HF has a higher boiling point. Explain.