

## 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  $sp^2$  atomic orbitals.  
 D. Electrons move back and forth between adjacent C-C bonds.

A  
B  
C  
D

(ii) Which will be the most polar bond?

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

E  
F  
G  
H

(iii) There are four alcohols (constitutional isomers) with the formula  $C_4H_{10}O$ . How many  $1^\circ$ ,  $2^\circ$  and  $3^\circ$  alcohols are possible?

- I. One  $1^\circ$ , two  $2^\circ$  and one  $3^\circ$                   J. Two  $1^\circ$ , two  $2^\circ$  and no  $3^\circ$   
 K. Two  $1^\circ$ , one  $2^\circ$  and one  $3^\circ$                   L. One  $1^\circ$ , one  $2^\circ$  and two  $3^\circ$

I  
J  
K  
L

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

- a. Ketone                  b. Aldehyde                  i.  $CH_3COCH_3$                   ii.  $CH_3CN$   
 c. Acid                  d. Ester                  iii.  $CH_3CH_2CO_2CH_3$                   iv.  $CH_3CO_2H$

- M. a-i and d-iii.                  N. c-iii and d-iv.                  O. b-ii and d-i.                  P. c-iv and d-ii.

M  
N  
O  
P

(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.

Q  
R  
S  
T

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

- U.  $1s^2 2s^2 2p^6 3s^1 3p^5$     V.  $1s^2 2s^2 2p^6 3s^1 3p^4$     W.  $1s^2 2s^2 2p^6 3s^2 3p^4$     X.  $1s^2 2s^2 2p^6 3s^2 3p^5$

U  
V  
W  
X

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

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

Y  
Z  
AA  
BB

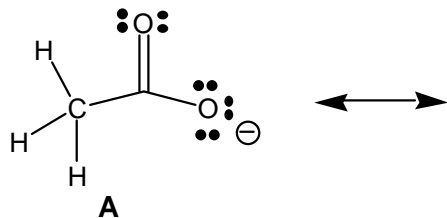
(viii) Which atomic orbitals overlap for form the double bond of ethylene ( $CH_2=CH_2$ )?

- CC.  $sp^2 + sp^2$  and  $p+p$   
 DD.  $s + s$  and  $p+p$   
 EE.  $sp^2 + sp^2$  and  $s+s$   
 FF.  $sp+p$  and  $p+p$

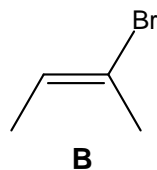
CC  
DD  
EE  
FF

2. (36 points). Give a single answer for each part of the question in the spaces provided.

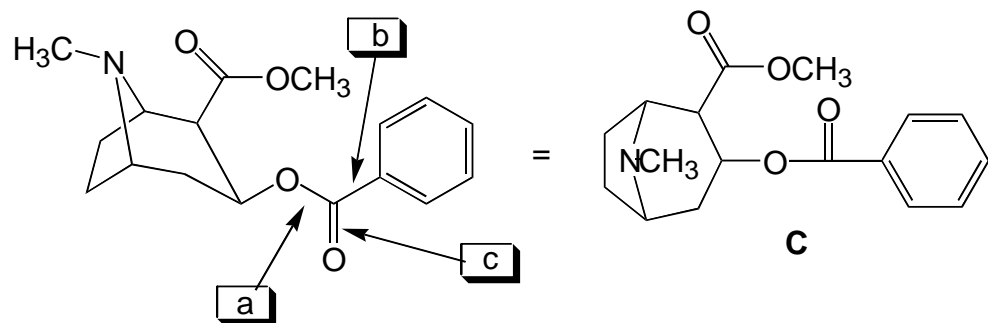
(a) Draw a resonance structure of the acetate anion, **A**, showing the location of all lone pairs of electrons and formal charges



(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.** C \_\_\_\_\_ + O \_\_\_\_\_ =  $\sigma$       **b.** C \_\_\_\_\_ + C \_\_\_\_\_ =  $\sigma$

**c.** C \_\_\_\_\_ + O \_\_\_\_\_ =  $\sigma$  and C \_\_\_\_\_ + 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.

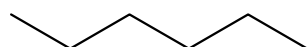
(a) Draw a line-bond structure of three aldehydes with the formula  $C_5H_{10}O$ .



(b) Draw a tertiary amine with formula  $C_4H_{11}N$ .



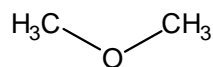
(c) Which compound in each of the following pairs has the higher boiling point? (Circle the correct answer). What is the strongest intermolecular force in the higher boiling compound in each pair?



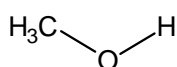
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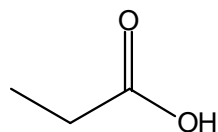
\_\_\_\_\_   
strongest intermolecular force



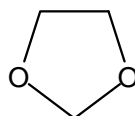
or



\_\_\_\_\_



or



\_\_\_\_\_

(d) Hydrogen fluoride and ethyl fluoride ( $CH_3CH_2F$ ) have similar molecular dipoles, yet HF has a higher boiling point. Explain.

