

# Organic Chemistry 1 – CHM 2210

## Exam 1 (September 19, 2001)

Name (print): \_\_\_\_\_

Signature: \_\_\_\_\_

Student ID Number: \_\_\_\_\_

There are 14 multiple choice problems (4 points each) on this exam - one of them is a bonus question. Record the answers to the multiple choice questions on THIS PAGE. There are also 5 short answer questions. Please take care in drawing the chemical structures for these short answers. You will be graded out of 100 points.

1 \_\_\_\_\_

8 \_\_\_\_\_

2 \_\_\_\_\_

9 \_\_\_\_\_

3 \_\_\_\_\_

10 \_\_\_\_\_

4 \_\_\_\_\_

11 \_\_\_\_\_

5 \_\_\_\_\_

12 \_\_\_\_\_

6 \_\_\_\_\_

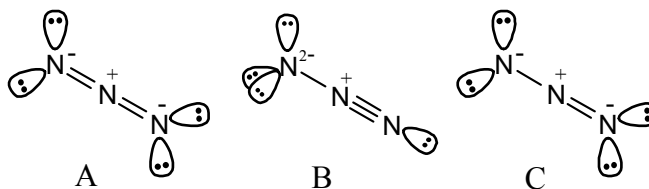
13 \_\_\_\_\_

7 \_\_\_\_\_

14 \_\_\_\_\_

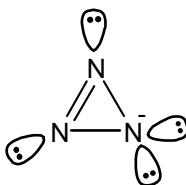
1. Which of the following are correct Lewis structures, including formal charges, for the azide ion,  $\text{N}_3^-$ ?

- a) A only  
b) B only  
c) C only  
d) both A and B  
e) all of the above



2. Is the structure shown below a legitimate Lewis structure for the azide ion ( $\text{N}_3^-$ )?

- a) Yes  
b) No



3. The formal charge on sulfur in the compound below is \_\_\_\_.

- a) +2  
b) +1  
c) 0  
d) -1

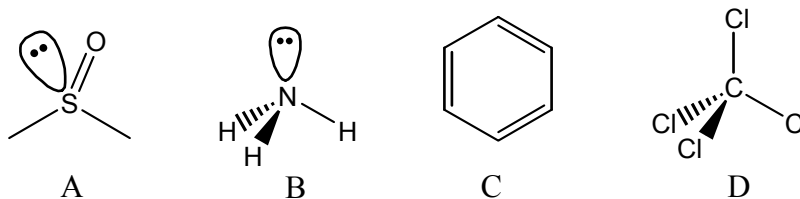


4. The following classes of compounds contain a carbonyl group:

- a) Ethers, aldehydes, and ketones  
b) Aldehydes, esters, and amides  
c) Ketones, ethers, aldehydes, and amides  
d) Nitrile, amides, aldehydes, and ketones

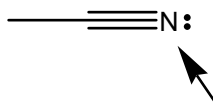
5. Which of the following solvents should be capable of dissolving ionic compounds?

- a) A  
b) B  
c) C  
d) D  
e) A and B



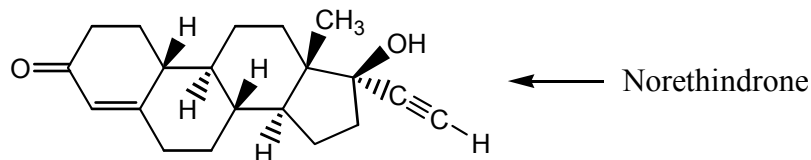
6. Choose the correct hybridization for the atom indicated in the molecule below.

- a)  $sp$   
b)  $sp^2$   
c)  $sp^3$   
d) none of the above



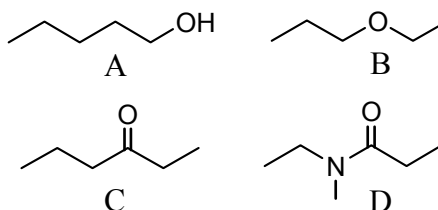
7. Which of the following sentences correctly describes norethindrone (below)?

- a) An alkyne that contains an hydroxyl group, a carbon-carbon double bond, and an aldehyde
- b) A tertiary alcohol that contains a carbon-carbon double and triple bond, and a ketone
- c) An alkene that contains a carbon-carbon triple bond, an ether, and an hydroxyl group
- e) None of the above



8. Rank the following compounds from higher boiling point to lower.

- a)  $A > B > C > D$
- b)  $B > C > A > D$
- c)  $A > D > C > B$
- d) none of the above

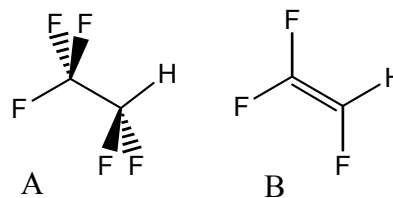


9. Which would you expect to be the stronger acid?

- a)  $\text{CH}_2\text{FCO}_2\text{H}$
- b)  $\text{CH}_2\text{BrCO}_2\text{H}$
- c) Not possible to distinguish from the information given

10. Which would you expect to be the stronger acid?

- a) A
- b) B
- c) Not possible to distinguish from the information given

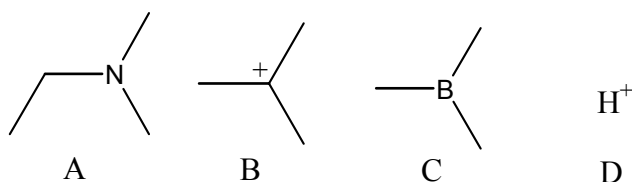


11. Which of the molecules below can hydrogen bond to another of the same compound?

- a)  $\text{CH}_3\text{CH}_2\text{COOCH}_3$
- b)  $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$
- c)  $\text{CH}_3\text{CH}_2\text{COCH}_2\text{CH}_3$
- d)  $(\text{CH}_3\text{CH}_2)_2\text{CHOH}$
- e) all of the above

12. Which of the following are potential Lewis acids?

- a) A, B & D
- b) B, C & D
- c) C only
- d) D only
- e) Not possible to distinguish from the information given

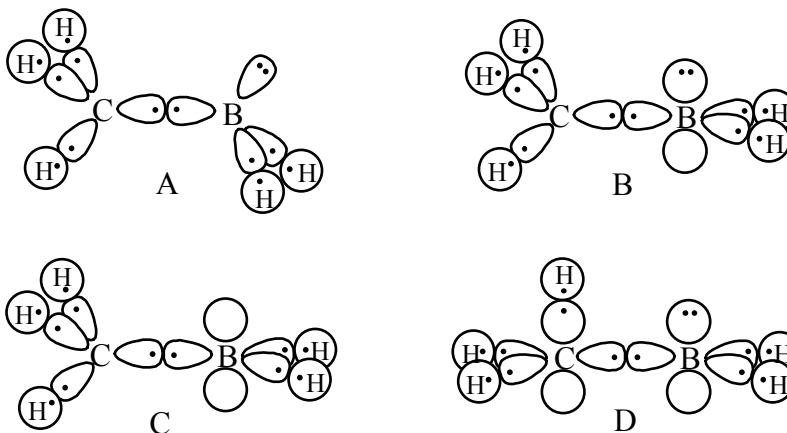


13. Complete the following sentence. A negative value of  $\Delta G^\circ$  is associated with reactions that...

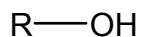
- a) favor the formation of products
- b) have an equilibrium constant greater than 1 ( $K_{eq} > 1$ )
- c) disfavor product formation
- d) both a and b
- e) none of the above

14. Which of the following is the correct molecular orbital picture of  $\text{CH}_3\text{BH}_2$ ?

- a) A
- b) B
- c) C
- d) D



15. Provide a generalized molecular formula (using R groups – see example) for the following functional groups (8 points):



example: alcohol

nitrile

ketone

aldehyde

ether

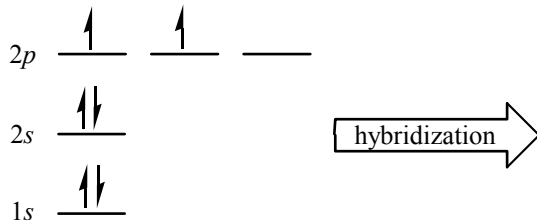
carboxylic acid

ester

amide

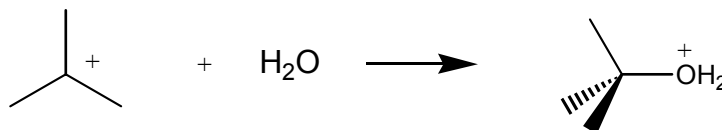
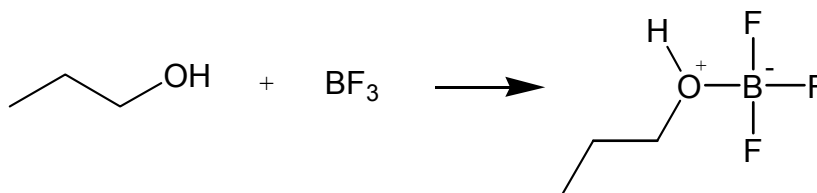
primary amine

16. The electron configuration of carbon is given below. Show how this configuration is hybridized to arrive at the electron configuration of carbon found in methane (8 pts).

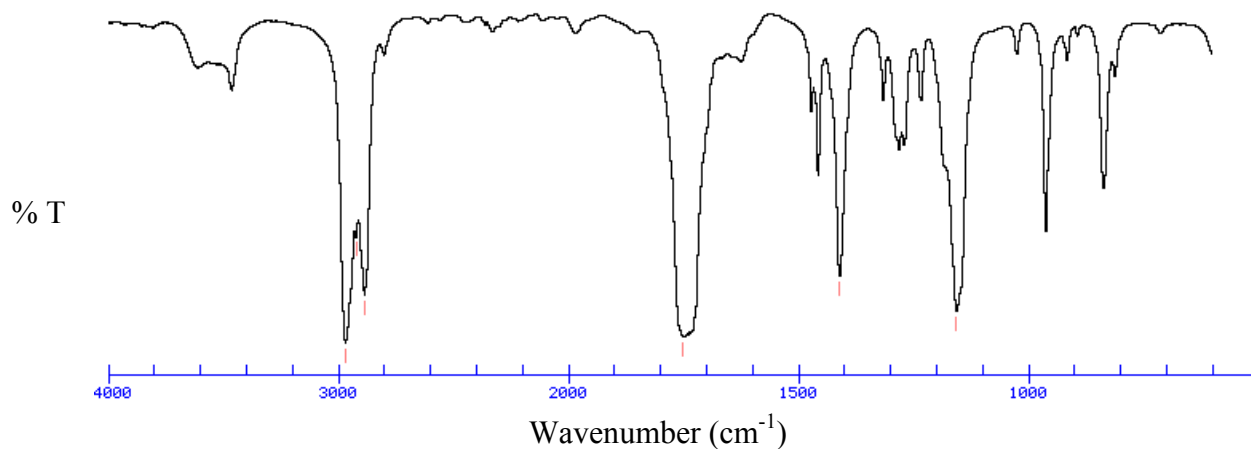


17. *Carefully* draw the hybridized molecular orbitals of an  $sp^3$  carbon atom (10 pts).

18. Show a curved arrow mechanism for the following reactions showing all lone pairs and indicating which reagents act as the Lewis acid and which act as the Lewis base (8 pts).



19. Propose a molecular structure that is consistent with the IR spectrum given below and the molecular formula  $C_5H_8O$  (14 pts).



<i>Functional Group</i>	<i>Characteristic Absorption (cm<sup>-1</sup>)</i>
Alkyl C-H	2950 - 2850 (m or s)
Alkenyl C-H	3100 - 3010 (m)
Alkenyl C=C	1680 - 1620 (v)
Alkynyl C-H	~3300 (s)
Alkynyl C≡C	2260 - 2100 (v)
Aromatic C-H	~3030 (v)
Alcohol/Phenol O-H	3550 - 3200 (broad, s)
Carboxylic Acid O-H	3000 - 2500 (broad, v)
Amine N-H	3500 - 3300 (m)
Nitrile C≡N	2260 - 2220 (m)
Aldehyde C=O	1740 - 1690 (s)
Ketone C=O	1750 - 1680 (s)
Ester C=O	1750 - 1735 (s)
Carboxylic Acid C=O	1780 - 1710 (s)
Amide C=O	1690 - 1630 (s)
Amide N-H	3700 - 3500 (m)

s = strong, m = medium, w = weak, v = variable