Chemistry 1315

Exam #1A-KEY

Name_____

1. **NO CELL PHONE—NO CALCULATOR.**
2. Make sure you showed your Buzz Card BEFORE the exam starts.
3. This is a closed book exam. Give or take no assistance from other students.

I promise to uphold Georgia Tech's Honor Code

Signature:_____

There are 5 sections on 9 pages. Read each questions carefully. **Write all answers and draw all structures clearly**. A blank page is included for scratch work (page 11). Grade is provided on page 10.

I- Questions. Please provide final answers on Scantron. Mark response on exam for your records.

2pts each

(1) Sodium, with a nuclear charge of +1, is less electronegative than nitrogen, with a nuclear charge of +7.

(a) True (b) False

(2) A covalent bond is a bond that results when atoms share electrons.

(a) True (b) False

(3) In the molecular orbital model of benzene, how many π-bonding molecular orbitals are there?

a) 6
b) 5
c) 4
d) 3

(4) The carbon-carbon bonds in benzene are of:

a) equal length and are shorter than the double bond of ethene
b) equal length and are intermediate between a double bond and a single bond.
c) unequal length and are alternately short and long around the ring.
d) equal length and intermediate between the carbon-carbon bond lengths in ethene and ethyne.

(5) Which of the following describes a triple bond?

a) Three pi bonds
b) Two sigma bonds and one pi bond
c) One sigma bond and two pi bonds
d) One sigma bond and one pi bond

(6) What is the conjugate base of ethanol (CH_3CH_2OH)?

a) $CH_3CH_2^-$
b) CH_3OCH_3
c) $CH_3CH_2O^-$
d) $CH_3CH_2OH_2^+$

(7) What compounds has the higher boiling point?

$CH_3CH_2CH_2OH$ CH_3CO_2H $CH_3CH_2CH_2CH_3$ CH_3CH_2CHO

I II III IV

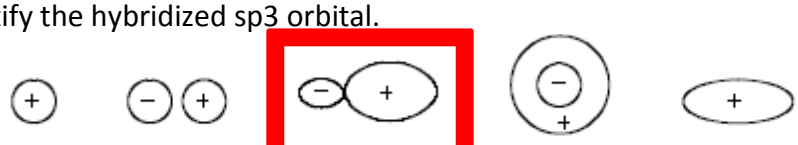
a) I

b) II

c) III

d) IV

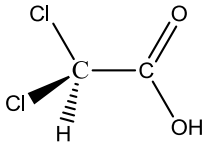
(8) Identify the hybridized sp3 orbital.



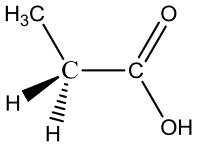
a) b) c) d) e)

(9) Which of the following molecules is the strongest acid?

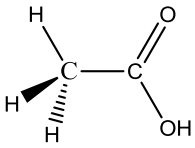
a)



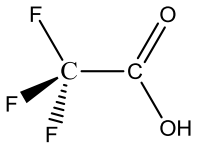
c)



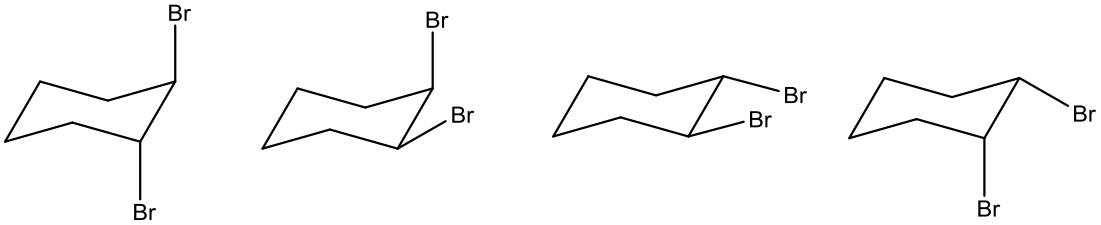
b)



d)



(10) Which of the following structures represent a cis isomer (hint: write the hydrogens at the substituted positions)?



I II III IV

a) III

b) I & II

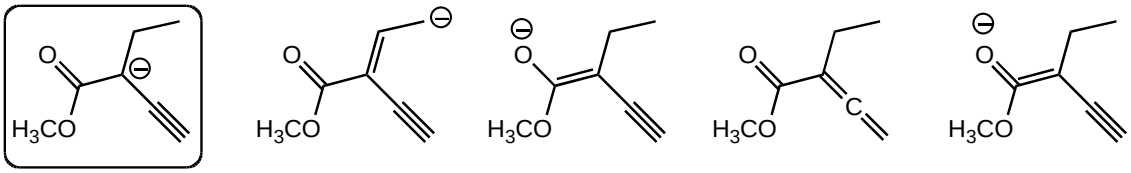
c) II & IV

d) All structures

(11) Which of the following is not true for enantiomers? They have the same:

a) Boiling point
b) Specific rotation
c) Melting point
d) Density

(12) Which of the following species is/are a resonance form(s) of the species in the box?



I II III IV

a) I and II
b) II and III
c) III
d) II

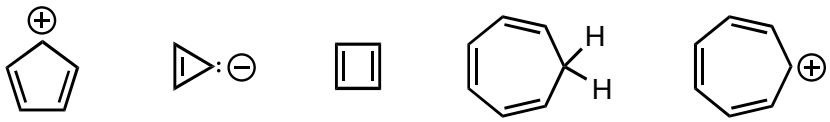
(13) According to molecular orbital theory, in the case of a carbon-carbon double bond, the carbon-carbon bonding electrons of higher energy occupy this molecular orbital:

a) σ bonding MO
b) π bonding MO
c) σ^* antibonding MO
d) π^* antibonding MO

(14) Cis-trans isomerism is possible only in the case of:

a) $CH_2=CBr_2$
b) $CH_2=CHBr$
c) BrCH=CHBr
d) $Br_2C=CHBr$

(15) Which of the following would you expect to be aromatic?



I II III IV V

a) I
b) II
c) III
d) IV
e) V

(16) A hydrogen bond is formed by hydrogen acting a bridge between two highly electronegative elements.

(a) True (b) False

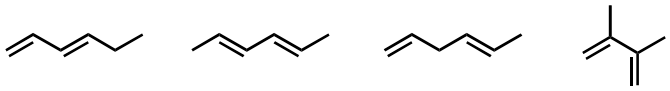
(17) The (S) enantiomer of a chiral compound always rotates the plane of polarized light to the left.

(a)True (b) False

(18) The rotational energy barrier associated with a carbon-carbon single bond is usually very large.

(a) True (b) False

(19) Which diene would be least stable?



I II III IV

a) I
b) II
c) III
d) IV

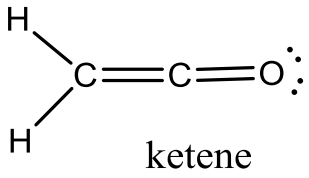
(20) The *meso* form of a molecule can be either dextrorotatory or levorotatory.

(a) True (b) False

II- Structures

a) For each of the following arrangement of atoms (i) draw a correct Lewis structure and (ii) indicate the formal charge associated with each of the atoms (except for hydrogens).

(a)

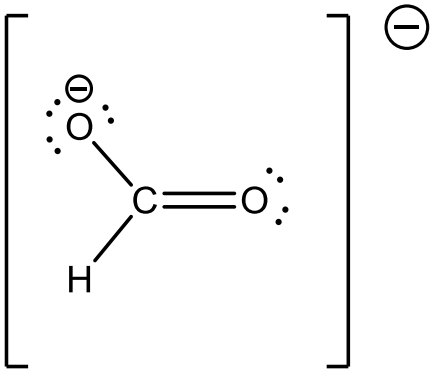


ketene

3 pts total: 1 = LPs, 1 = bonds, 1 = charges

Formal charge for all atoms = 0

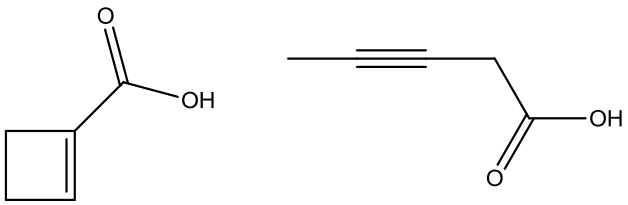
(b)



formate ion

3 pts total: 1 = LPs, 1 = bonds, 1 = charges

2) Draw **TWO** constitutional isomer for the molecule shown below.

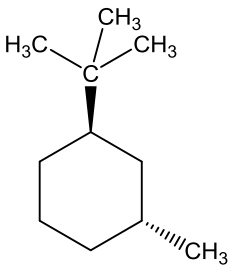


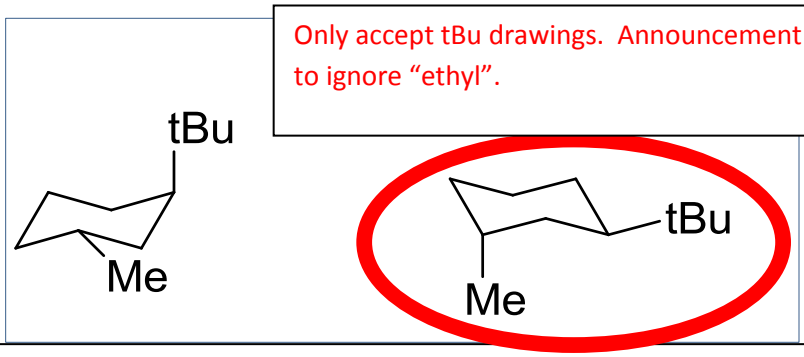
4 pts total (2pts each)

There's a bunch. I just put 2 down.

3) a. Draw the two chair conformers of structure of trans-1-ethyl-3-methylcyclohexane (shown below).

b. Circle the most stable conformer.



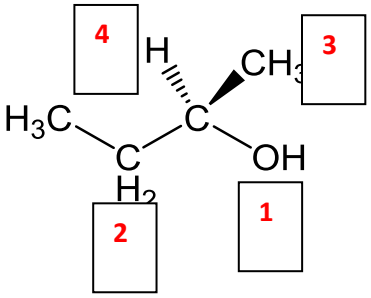


Only accept tBu drawings. Announcement made in class to ignore "ethyl".

8 pts: 1 per ring, 1 per R group, 2 for circling most stable.

They must be very explicit with axial/equatorial. They were warned that in-between would be wrong.

4) Assign (R) or (S) designations to the compound below.

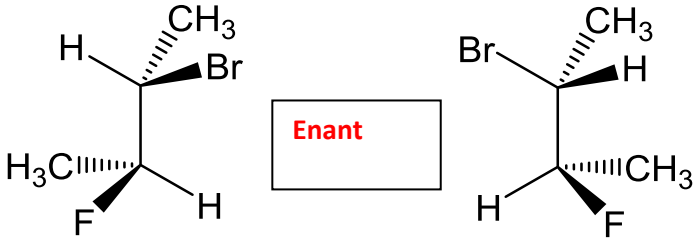


(R)

2pts

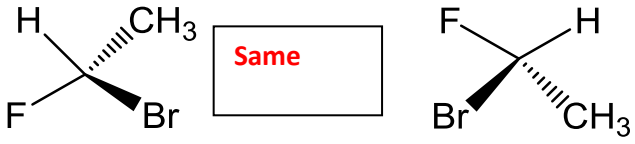
5) Indicate whether each of the following molecule pairs are identical, enantiomers, or diastereoisomers. **2 pts each**

a.



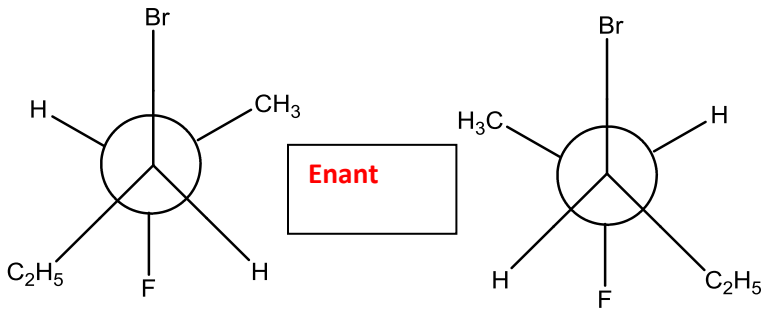
Enant

b.



Same

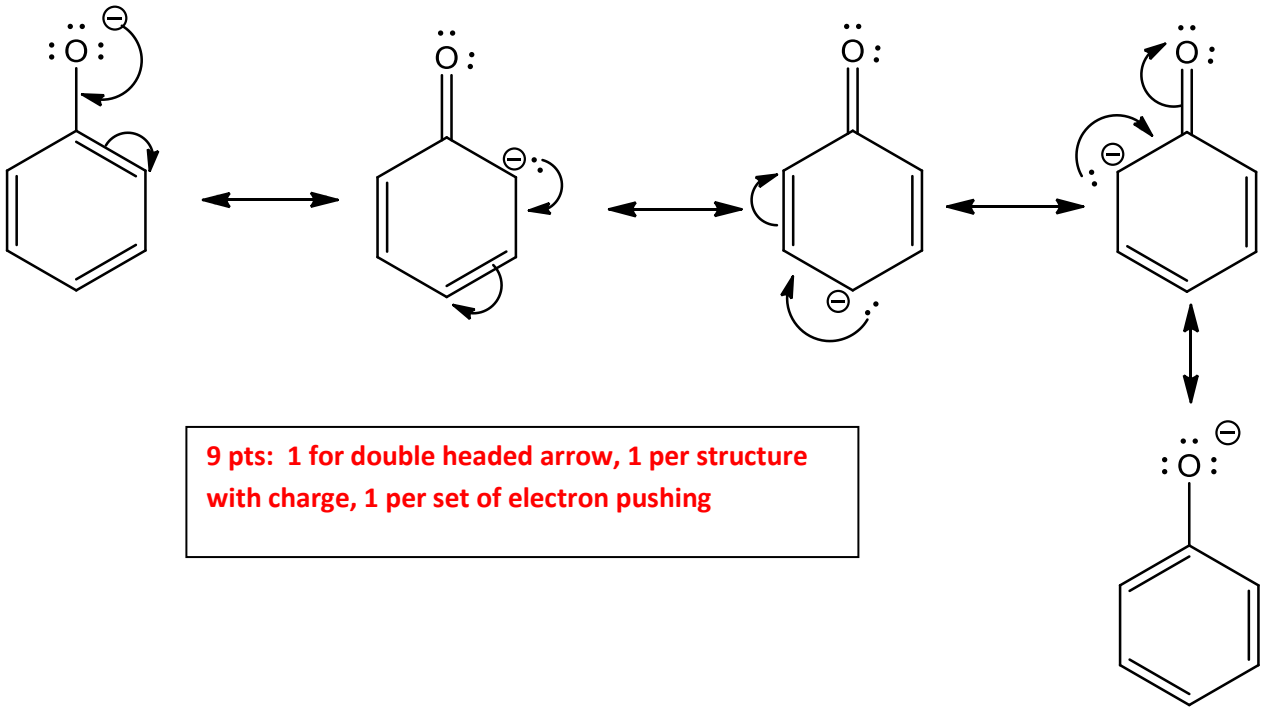
c.



III- Resonance Structures

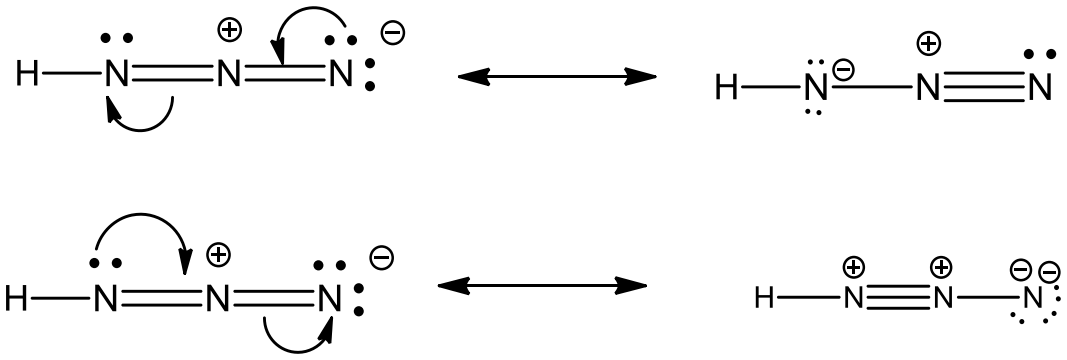
Draw the important contributing resonance structures for each of the following. ***Show all formal charges and the curved arrows that show the movement of electrons***.

1)



9 pts: 1 for double headed arrow, 1 per structure with charge, 1 per set of electron pushing

2)



3 pts: 1 for double headed arrow, 1 per structure with charge, 1 per set of electron pushing

Lower is a very minor contribution, but possible and should be marked correct.

IV- "Real-world" applications

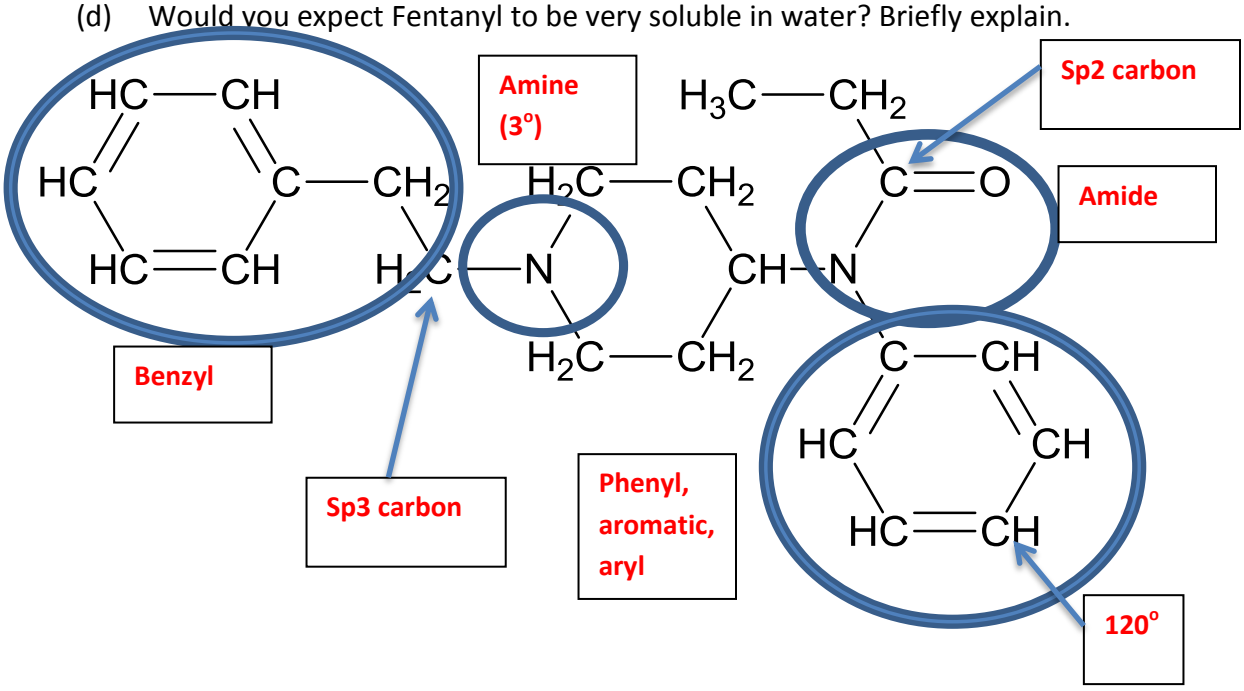
Fentanyl is 80 times as potent as morphine and is a synthesized opioid analgesic with a rapid onset and short duration of action. It is commonly used in pre-procedures. As recently as 2012, it was the most widely used synthetic opioid in clinical practice with several delivery methods.

(a) Complete this structure of Fentanyl by adding **ALL H atoms** and bonds that and unshared electron pairs. **10 pts: 0=bad, 5=mostly right, 10=perfect**

(b) Identify either the hybridization or bond angle for the carbon atoms indicated. **1 pt each**

(c) Circle and name the three functional groups in Fentanyl. **6 pts: 1 per correct circle, 1 per correct name**

(d) Would you expect Fentanyl to be very soluble in water? Briefly explain.



No, Fentanyl would not be soluble. Very nonpolar with little H bonding sites. 3pts

V- Bonus Question.

a- Who first develop a theory for covalent bonds, articulated around 6 postulates?

Lewis. 2pts

b- Why racemic form thalidomide, sold as a sedative, was removed from the market?

One form fine, the other form caused birth defects. 3pts.

Question	**Score**
I- Questions (Multiple choice & True/False)	_____/40
II- Chemical Structures	_____/26
III- Resonance Structures	_____/12
IV- "Real-world" applications	_____/22
V- Bonus Questions	_____/5

This page is for scratch work. Nothing on this page will be graded.