

CHEM 3311
Exam 1 ANSWER KEY
February 11, 2014

Time: 2 Hours

By printing and signing my name below (-2 if this information is not filled in), I pledge that
"On my honor, as a University of Colorado-Boulder student, I have neither given nor received unauthorized
assistance on this work."

PRINT YOUR NAME _____ Sign Here _____

Instructions

- 1) Please turn off your cell phone (contact me if you MUST have your cell phone on) and place it in your backpack.
- 2) This is a CLOSED BOOK exam; nothing is allowed except your student ID, a few pencils or pens, eraser, and **molecular models in a transparent/clear Ziploc bag** (quart size).
- 3) Use the blank areas of the exam for scratch work; scratch paper will be provided as needed.
- 4) If suspected of/caught cheating, you will receive at best an F for the exam. The instructor reserves the right to proceed further in compliance with university policies on academic violations.
- 5) You may NOT leave the room after the exam has started to minimize disruptions to other students (contact a proctor if there are extenuating circumstances). When you finish the exam, **please return the completed scantron sheet to the exam proctors** at the front desk, and leave as quietly as possible. You are allowed to take the exam and scratch paper with you.

On the computer graded answer sheet (also known as a scantron)

- enter **your name** and **student identification number** in the appropriate boxes.
- Enter your recitation section # in the four columns in the top left corner. (Write a zero before the recitation section # - for example, section 227 is written as 0227.)
- **Fill in the corresponding bubbles below your name, ID number, and recitation section.**

Enter all answers in the scantron by filling in the proper bubble with a No. 2 pencil. If you change an answer, erase the undesired mark thoroughly. Mark only the best answer to each question. Programmable calculators are not permitted during the exam.

Useful information is on the cover page. Use the back of the exam pages as scratch paper. There are **5 exam pages** (with 25 questions), a cover page, and two blank pages (scratch paper). When you are instructed to begin the exam, please check that you have all pages. Good luck!

1 H	
3 Li	4 Be
11 Na	12 Mg

					2 He
5 B	6 C	7 N	8 O	9 F	10 Ne
13 Al	14 Si	15 P	16 S	17 Cl	18 Ar

Table of Acidities

<u>Acid</u>	<u>pK_a Value</u>
HI	-10.1
HCl	-3.9
H ₃ O ⁺	-1.7
CH ₃ COOH	4.7
NH ₄ ⁺	9.3
Phenol	10
H ₂ O	15.7
Alcohols	16-18
HC≡CH	26
NH ₃	36
H ₂	37
H ₂ C=CH ₂	45
CH ₄	60

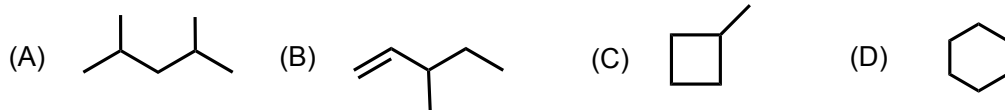
1. Draw a *stable* Lewis structure for nitromethane, $\text{H}_3\text{C}-\text{NO}_2$. What is the formal charge on N in this structure?

- (A) +1 (B) 0 (C) -1 (D) -2

2. Phosgene, COCl_2 , is a poisonous gas. What is the shape of this molecule? (Carbon is the central atom.)

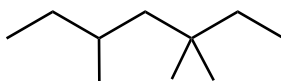
- (A) Bent (B) Linear (C) Tetrahedral (D) Trigonal Planar

3. Select the molecule that does *not* have any tertiary carbon atoms.



Correct Answer: D



4. What is the correct IUPAC name for the compound shown?

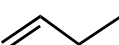



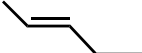
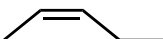
- (A) 3,5,5-Trimethylheptane (B) 3,3,5-Trimethylheptane
(C) 2-Ethyl-4,4-dimethylhexane (D) 2-Ethyl-2,4-dimethylhexane

For questions 5, 6, and 7, refer to the pairs of structures shown below:

(I) CH_3COCH_3 and $\text{CH}_3\text{CH}_2\text{CHO}$

(II)  and 

(III)  and 

(IV)  and 

5. Which pair represents resonance structures?

- (A) I (B) II
(C) III (D) IV

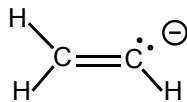
6. Which pairs of compounds are constitutional isomers?

- (A) I and II (B) I and III
(C) II and IV (D) III and IV

7. Which pair of compounds are stereoisomers?

- (A) I (B) II
(C) III (D) IV

8. What type of orbital contains the lone pair of electrons in the structure shown?



- (A) p orbital (B) sp hybrid orbital **(C) sp^2 hybrid orbital** (D) sp^3 hybrid orbital

9. What is the hybridization of **carbon 3** in 2,3-pentadiene?

- (A) sp** (B) sp^2 (C) sp^3 (D) sp^3d

10. The maximum number of constitutional isomers with the molecular formula C_4H_9Br is:

- (A) 2 (B) 3 **(C) 4** (D) 5

11. Which organic compound would have the highest boiling point? Assume that the molar masses are approximately similar.

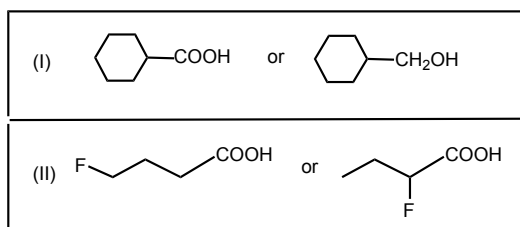
- (A) $(CH_3)_3N$ **(B) $CH_3CH_2NHCH_3$** (C) $CH_3CH_2OCH_3$ (D) $CH_3CH_2CH_2F$

12. Draw Newman projections of the THREE staggered conformations (not eclipsed conformations) of 2-methylbutane sighting down the C2-C3 bond (C2 in front). Select the statement/statements that **correctly** describes/describe these conformations.

- (I) Two of the three staggered conformations have the same energy.
 (II) There are two methyl-methyl gauche interactions in the least stable staggered conformation.

- (A) Only I (B) Only II
(C) Both I and II (D) Neither I nor II

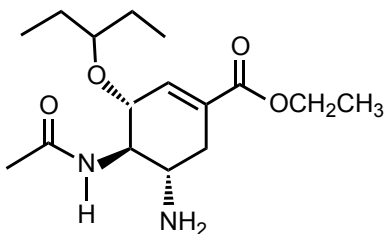
13. Select the **stronger** Brønsted acid in each pair.



- (A) and
- (B) and
- (C) and
- (D) and

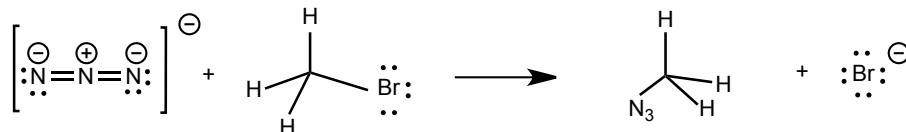
Correct Answer: B

19. Oseltamivir (commonly known as Tamiflu) is widely used for the treatment and prevention of influenza A and B viral infections, including avian flu. The structure of Oseltamivir is shown below:



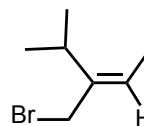
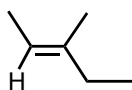
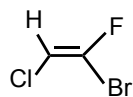
Which functional group is not present in this molecule?

- (A) amide (B) ester (C) ether **(D) ketone**
20. What is the bond order in He_2^+ using MO theory?
 (A) 0 **(B) 0.5** (C) 1 (D) 1.5
21. Using Frontier MO theory, select the **LUMO** (lowest unoccupied molecular orbital) in the reaction of CH_3COOH with NH_3 .
 (A) $\sigma_{\text{O-H}}$ in CH_3COOH **(B) $\sigma^*_{\text{O-H}}$ in CH_3COOH**
 (C) nonbonding MO in NH_3 (D) $\sigma^*_{\text{N-H}}$
22. Select the statement that **correctly** describes the reaction between the azide ion, N_3^- , and methyl bromide.
 Hint: Use the curved arrow notation!



- (A) The azide ion is the electrophile.
(B) The methyl bromide is the electrophile.
 (C) The azide ion acts as a Bronsted acid.
 (D) The azide ion acts as a Lewis acid.
23. What is the correct IUPAC name for the compound shown?
-
- (A) 1,2-Dimethylcyclohexene (B) 2,3-Dimethylcyclohexene
(C) 1,6-Dimethylcyclohexene (D) 1,3-Dimethylcyclohexene

24. Assign Z or E descriptors to the following molecules arranged *from left to right*.



(A) **Z, E, E**

(B) Z, E, Z

(C) E, Z, E

(D) E, E, Z

25. Which molecule has a net dipole moment?

(A) **1,1-dichloroethene**

(B) *trans*-1,2-dichloroethene

(C) ethene

(D) ethyne