Chemistry 2541, Spring 2017
Midterm Exam 1
(100 points)

Important notes:
- Please use the provided Scantron form for your answers; you can keep the sheet with the questions and can use it as scratch paper
- Do not forget to write your name on the Scantron form
- You will not receive credit for unmarked answers or for more than one mark on answer line
- Your scores will be posted on eGradebook; graded Scantron forms will not be returned to students.

Questions 1-28 (84 pts): Please mark the appropriate box on the front of the Scantron form (3 pts each).

1. Which of the following is the ground-state electron configuration of oxygen?

   A) 1s² 2s² 2pₓ² 2pᵧ¹ 2pᵢ¹  B) 1s² 2s² 2pₓ¹ 2pᵧ¹ 2pᵢ¹
   C) 1s² 2s² 2pₓ² 2pᵧ² 2pᵢ⁰  D) 1s² 2s¹ 2pₓ² 2pᵧ² 2pᵢ¹

2. Which of the following correctly describes polarity of a nitrogen-oxygen bond in the following molecule?

   A) \( \text{H}^+ \text{N}^\delta- \text{O}^\delta+ \text{H} \)
   B) \( \text{H}^\delta+ \text{N}^\delta- \text{O}^\delta- \text{H} \)
   C) \( \text{H}^\delta+ \text{N}^\delta- \text{O}^\delta- \text{H} \)
   D) \( \text{H}^\delta- \text{N}^\delta- \text{O}^\delta- \text{H} \)

3. Which of the following molecules is expected to have dipole moment \( \mu \) different from 0 D?

   A) F₂C≡CF₂  B) F₃C─C≡C─CF₃  C) BF₃  D) NF₃

4. Which of the following molecules contains an alcohol functional group?

   A) CH₃OCH₂CH₂CHO  B) CH₃OCH₂OCH₂OH  C) HOOCCH₂COOH  D) CH₃OCH₂OOCOOH

5. Which of the following molecules contains both an aldehyde functional group AND a carboxylic acid functional group?

   A) HOCH₂CH₂CHO  B) OHCCH₂OCH₂OCH₂NH₂  C) HOOCCH₂COOH  D) OHCCH₂CO₂H
6. Which one of the following polyatomic ions is a correct Lewis structure with correct formal charge?

A) \( \text{H}^- \text{O}^- \text{C}^- \text{H}^- \)  
B) \( \text{H}^+ \text{C} \equiv \text{C}^- \)  
C) \( \text{H}^- \text{C} \equiv \text{B}^- \text{H}^- \)  
D) \( \text{H}^+ \text{C} \equiv \text{N}^+ \text{H}^- \)

7. Which of the following structures represents the major resonance contributor of molecule in the box?

![Resonance Structures](image)

A) \( \text{H}_3\text{C} \equiv \text{C} \equiv \text{C} \equiv \text{NH}_2 \)  
B) \( \text{H}_3\text{C} \equiv \text{C} \equiv \text{C} \equiv \text{NH}_2 \)  
C) \( \text{H}_3\text{C} \equiv \text{C} \equiv \text{C} \equiv \text{NH}_2 \)  
D) \( \text{H}_3\text{C} \equiv \text{C} \equiv \text{C} \equiv \text{NH}_2 \)

8. Which of the following structures represents resonance contributor of molecule in the box in agreement with the shown curved arrows?

![Curved Arrows](image)

A) \( \text{H}_2\text{C} \equiv \text{N} \equiv \text{N} \)  
B) \( \text{H}_2\text{C} \equiv \text{N} \equiv \text{N} \)  
C) \( \text{H}_2\text{C} \equiv \text{N} \equiv \text{N} \)  
D) \( \text{H}_2\text{C} \equiv \text{N} \equiv \text{N} \)

9. Which of the line-angle formulas corresponds to the condensed structural formula shown in the box?

![Condensed Structural Formula](image)

A) \( (\text{CH}_3)_3\text{CCH(\text{CH}_3)CH(\text{CH}_3)_2} \)  
B) \( (\text{CH}_3)_3\text{CCH(\text{CH}_3)CH(\text{CH}_3)_2} \)  
C) \( (\text{CH}_3)_3\text{CCH(\text{CH}_3)CH(\text{CH}_3)_2} \)  
D) \( (\text{CH}_3)_3\text{CCH(\text{CH}_3)CH(\text{CH}_3)_2} \)

10. What is the IUPAC name for the compound shown in the box?

A) \( \text{cis}-1\text{-ethyl-2-methylcyclohexane} \)  
B) \( \text{trans}-1\text{-ethyl-2-methylcyclohexane} \)  
C) \( \text{cis}-1\text{-methyl-2-propylcyclohexane} \)  
D) \( \text{trans}-1\text{-methyl-2-propylcyclohexane} \)
11. What is the IUPAC name for the compound shown in the box?

A) (2S,3S)-2-bromo-3-chlorobutane  B) (2S,3R)-2-bromo-3-chlorobutane  
C) (2R,3S)-2-bromo-3-chlorobutane  D) (2R,3R)-2-bromo-3-chlorobutane

12. Which is the structure of (R)-1,1,2-trimethylcyclopentane?

A)  
B)  
C)  
D)  

13. Which of the following is the chair representation of the compound shown in the box?

A)  
B)  
C)  
D)  

14. Which of following Newman projections represents a meso compound?

A)  
B)  
C)  
D)  

15. What is the configuration (R or S) at the carbon atoms 2 and 3 of the molecule shown in the box?

A) 2S,3S  B) 2S,3R  
C) 2R,3S  D) 2R,3R
16. Which of the following molecules is expected to be the most stable?

A) \( \text{CH}_3 \text{C}(\text{CH}_3)_3 \)
B) \( \text{CH}_3 \text{C}(\text{CH}_3)_3 \)
C) \( \text{CH}_3 \text{C}(\text{CH}_3)_3 \)
D) \( \text{H}_3 \text{C} \text{C}(\text{CH}_3)_3 \)

17. Consider the following orders of priority (highest to lowest). Which order is incorrect?

A) \( \text{CH}_2\text{OH} > \text{CH}_2\text{CH}_3 > \text{CH}_3 > \text{H} \)
B) \( \text{OH} > \text{CH} = \text{CH}_2 > \text{CH}_3 > \text{H} \)
C) \( \text{OH} > \text{CH}_2\text{CH}_2\text{Cl} > \text{CHO} > \text{CH}_3 \)
D) \( \text{NH}_2 > \text{CH}_2\text{SH} > \text{CH}_2\text{OH} > \text{CH}_2\text{CH}_3 \)

18. Consider the structures shown in the box. Which of the following pairs of these structures are diastereomers?

A) I and II  B) I and III  
C) I and IV  D) I and V

19. Which of the following molecules contains two chiral centers?

A) \( \text{CH}_3 \text{H} \text{C} \text{H} = \text{CH}_2 \)
B) \( \text{H}_3 \text{C} \text{COOH} \)
C) \( \text{HOOC} \text{H} \text{H} \text{HOOC} \)
D) \( \text{H}_3 \text{C} \text{COOH} \)

20. Which one of the following molecules is a meso compound?

A) \( \text{CH}_3 \)
B) \( \text{CH}_3 \) (CH3)
C) \( \text{CH}_3 \text{CH} \text{CH}_3 \)
D) \( \text{CH}_3 \text{CH}_3 \text{CH} \text{CH}_3 \)

21. Which one of the following compounds has the strongest intermolecular forces of attraction?

A) \( \text{CH}_3\text{CH}_2\text{CO}_2\text{H} \)
B) \( \text{CH}_3\text{CHO} \)
C) \( \text{HB(CH}_3)_2 \)
D) \( \text{HO} \)
22. Which one of the following molecules is chiral?

A)  

B)  

C)  

D)  

23. Which of the following depicts a secondary (2°) alcohol?

A)  

B)  

C)  

D)  

24. Which of the molecules shown below contains an isopropyl group?

A)  

B)  

C)  

D)  

25. Which of the statements below is NOT true about conformations?

A. They have the same molecular formula  
   B. They have the same molecular weight  
   C. They have the same connectivity of atoms  
   D. They have the same energy  

26. How many ketones have a molecular formula of C₃H₆O?

A) 1  
B) 2  
C) 3  
D) 4  

27. Which sets of curved arrows correctly describes the flow of electrons in the resonance contributors?

A)  

B)  

C)  

D)  
28. Which of the following compounds has the **shortest carbon-carbon** bond?

A) \( \text{ } \)

B) \( \text{ } \)

C) \( \text{ } \)

D) \( \text{ } \)

**Question 29 (16 pts):** Please mark your answers in the appropriate box on the back of the Scantron form (2 pts each)

29. Consider the molecule shown below and answers the following questions. Indicate your answers by marking the appropriate number in the boxes on the back of the Scantron form.

[Diagram of the molecule]

**Box 51:** Number of \( \sigma \) bonds formed by overlap of \( sp^2 \) and \( sp^3 \) orbitals

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**Box 53:** Number of \( \sigma \) bonds formed by overlap of \( sp^2 \) and \( sp \) orbitals

**Box 54:** Number of \( \sigma \) bonds formed by overlap of \( s \) and \( sp^3 \) orbitals

**Box 55:** Number of \( \sigma \) bonds formed by overlap of \( sp^2 \) and \( sp^2 \) orbitals

**Box 56:** Total number of \( \sigma \) **bonds**

**Box 57:** Total number of \( \pi \) **bonds**

**Box 58:** Total number of **non-bonding electrons** in this molecule