Chemistry 2541, Summer 2018
Midterm Exam 1

(100 points)

Key

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. How many valence electrons does **oxygen** have?

A) 3 B) 4 C) 5 D) 6

2. Which of the following correctly describes **polarity** (partial charges) of a carbon-nitrogen bond?

A) $\overset{\delta-}{C}—\overset{\delta+}{N}$ B) $\overset{\delta-}{C}—\overset{\delta-}{N}$ C) $\overset{\delta+}{C}—\overset{\delta-}{N}$ D) $\overset{\delta+}{C}—\overset{\delta+}{N}$

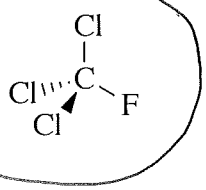
3. Which one of the following compounds has a **nonpolar** covalent bond?

A) F_2 B) NF_3 C) CO_2 D) CF_4

4. Which one of the following molecules is expected to have **dipole moment** μ different from **0 D**?

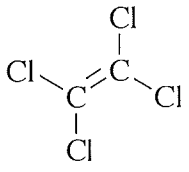
A) $Cl-C\equiv C-Cl$

B)



C) CCl_4

D)



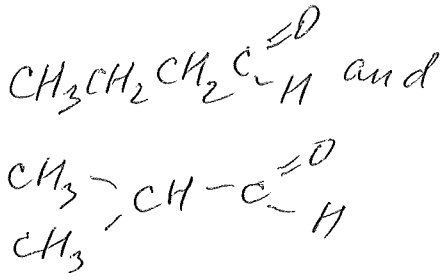
5. Which one of the following molecules contains a **ketone** functional group?

A) $HOCH_2COCH_3$ B) $HOCH_2CH_2NH_2$ C) HOOCCOOH D) CH_3CHO

6. Which functional groups are present in the molecule of **2-hydroxypropanal**, $CH_3CH(OH)CHO$?

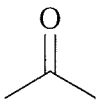
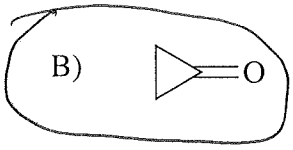
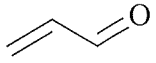
A) alcohol and carboxyl B) alcohol and aldehyde C) ketone and aldehyde D) carboxyl and hydroxyl

7. How many **aldehydes** will have a molecular formula of C_4H_8O?

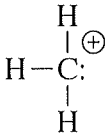
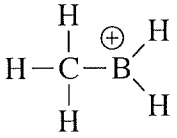
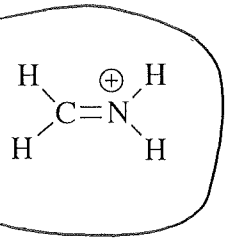
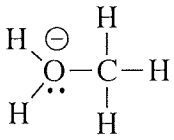


A) 1 B) 2 C) 3 D) 4

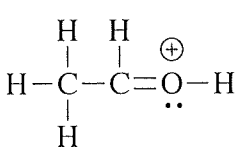
8. What is a line-angle structure of a **ketone** with molecular formula C_3H_4O?

A)  B)  C)  D) 

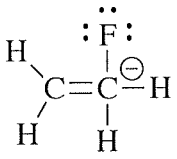
9. Which one of the following molecules or polyatomic ions is a **correct Lewis structure** with correct formal charge?

A)  B)  C)  D) 

10. Which of the following structures are *wrong* **Lewis structures** violating the octet rule and formal charges?



1



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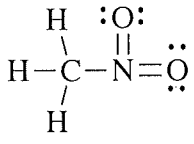
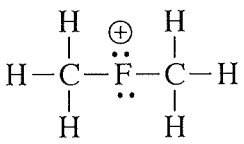


3



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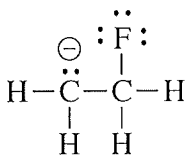
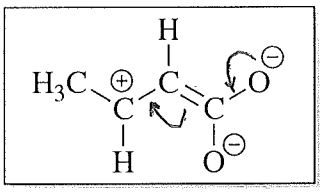
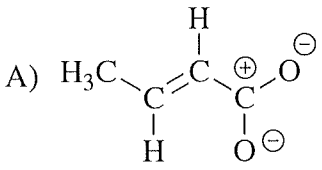


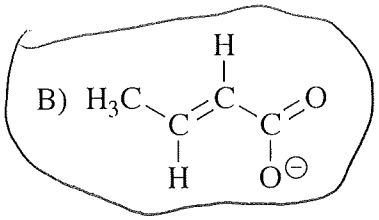
5

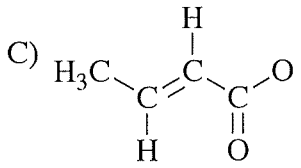
A) **1** and **3** B) **2** and **3** C) **2, 4,** and **5** D) **all are wrong**

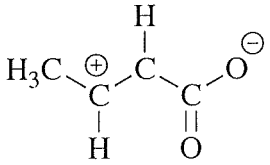
11. Which one of the following structures represents the **major** resonance contributor of molecule in the box?



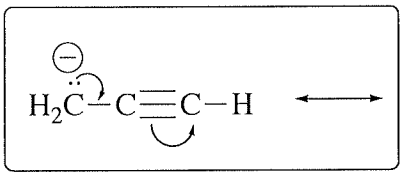
A) 

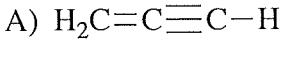
B) 

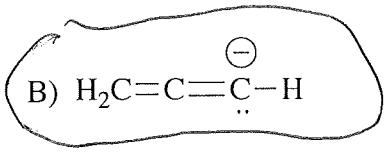
C) 

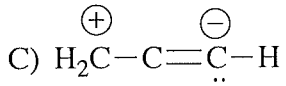
D) 

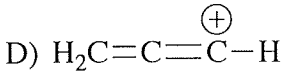
12. Which one of the following structures represents resonance contributor of molecule in the box in agreement with the shown **curved arrows**?



A) 

B) 

C) 

D) 

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

A) CH_3CH_2OH B) $CH_3CH_2CH_3$ C) $HB(CH_3)_2$ D) CH_3OCH_3

14. Which one of the following answers represents the order of decreasing **acidity** for the following compounds:

(**1**) CH_3CH_2I (**2**) FCH_2CO_2H (**3**) CH_3CH_2OH (**4**) CH_3NH_2 (**5**) HBr

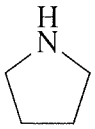
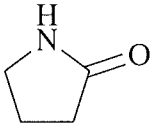
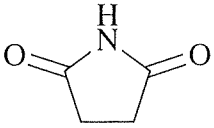
A) 1 (strongest) > 2 > 3 > 4 > 5 (weakest)
B) 2 (strongest) > 5 > 4 > 3 > 1 (weakest)
C) 5 (strongest) > 2 > 3 > 4 > 1 (weakest)
D) 1 (strongest) > 5 > 2 > 3 > 4 (weakest)

15. Which of the following represents the order of increasing **bacisity** for compounds the box?

(**1**) CH_3SNa (**2**) CH_3NHNa (**3**) CH_3ONa

A) **3** (weakest base) < **2** < **1** (strongest base)
B) **3** (weakest base) < **1** < **2** (strongest base)
C) **1** (weakest base) < **2** < **3** (strongest base)
D) **1** (weakest base) < **3** < **2** (strongest base)

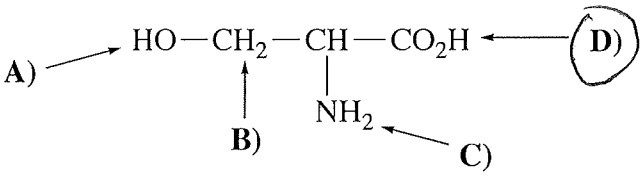
16. Which one of the following compounds is the **strongest acid**?

A)  B)  C)  D) 

17. Which one of the following compounds has **pKa** with the **highest** numeric value?

A) $(CH_3)_2NH$ **B)** $(CH_3)_3COH$ **C)** CH_3COOH **D)** H_2SO_4

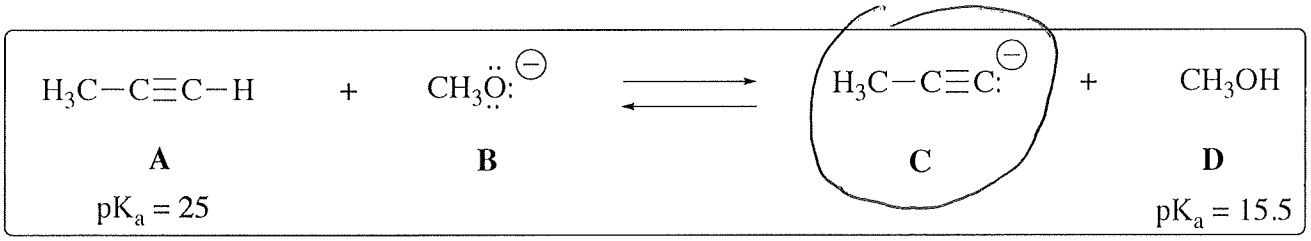
18. Indicate the most acidic proton or group of protons in the following compound:



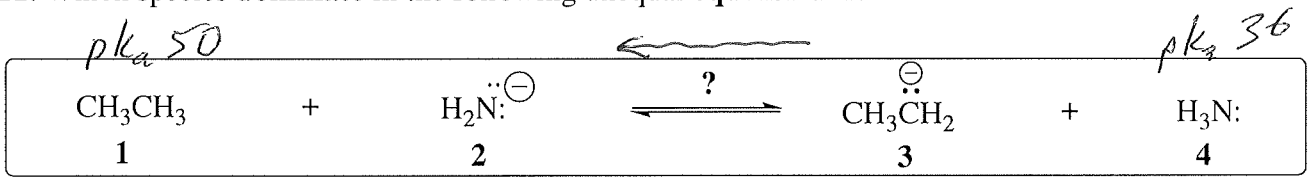
19. Which one of the following compounds is the **strongest base**?

A) $(CH_3)_3COLi$ **B)** $(CH_3)_2NLi$ **C)** $(CH_3)_3CLi$ **D)** $(CH_3)_3CF$

20. Which molecule or ion in the following acid/base equilibrium is the **strongest base**?

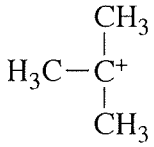


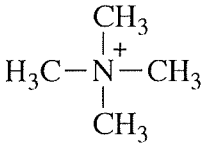
21. Which species **dominate** in the following unequal **equilibrium**?



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

22. Which of the following is a **Lewis base**?

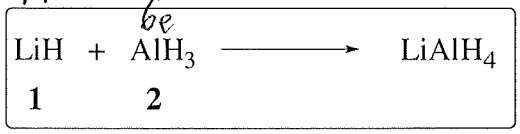
A) 

B) 

C) $(CH_3)_3N$:

D) $(CH_3)_3B$

23. Which statement is correct for the following reaction shown in the box?



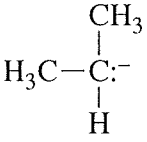
A) **1** is Bronsted Acid and **2** is Bronsted Base

B) **1** is Bronsted Base and **2** is Bronsted Acid

C) **1** is Lewis Acid and **2** is Lewis Base

D) **1** is Lewis Base and **2** is Lewis Acid

24. Which one of the following species is a **Lewis acid**?

A) 

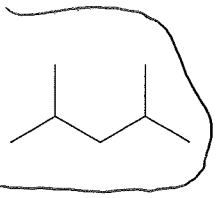
B) CH_3OCH_3

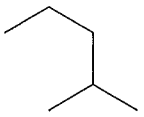
C) $(CH_3)_4N^+$

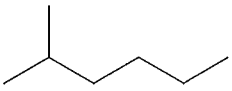
D) $(CH_3CH_2)_3B$

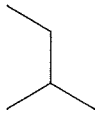
25. Which one of the following **line-angle formulas** corresponds to the condensed structural formula shown in the box?

$(CH_3)_2CHCH_2CH(CH_3)_2$

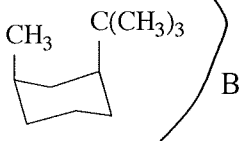
A) 

B) 

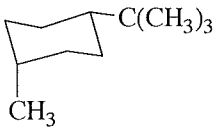
C) 

D) 

26. Which one of the following structures has the highest **diaxial interactions**?

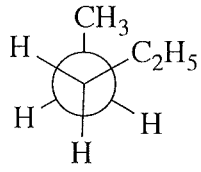
A) 

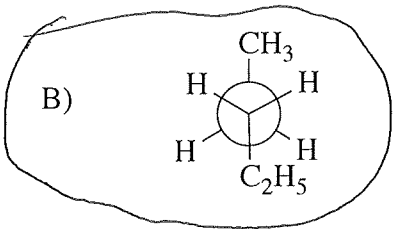
B) 

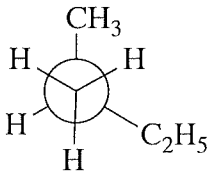
C) 

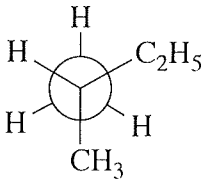
D) 

27. Which one of the following Newman projections represents the *anti* conformation of **pentane**?

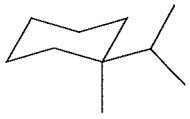
A) 

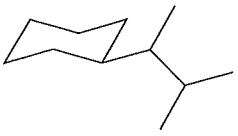
B) 

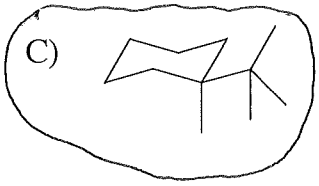
C) 

D) 

28. Which one of the molecules shown below contains a ***tert*-butyl** group?

A) 

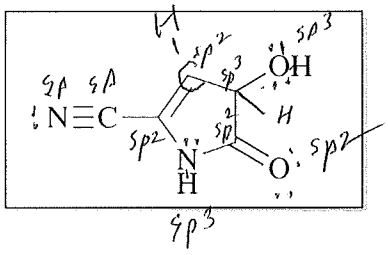
B) 

C) 

D) 

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 answer the following questions. Indicate your answers by marking the appropriate number in the boxes on the back of the Scantron form.



Box 51: Number of σ bonds formed by overlap of sp^2 and sp^3 orbitals 4

Box 52: Number of σ bonds formed by overlap of *sp* and *sp* orbitals 1

Box 53: Number of σ bonds formed by overlap of sp^2 and *sp* orbitals 1

Box 54: Number of σ bonds formed by overlap of *s* and sp^3 orbitals 3

Box 55: Number of σ bonds formed by overlap of sp^2 and sp^2 orbitals 2

Box 56: Total number of σ bonds 13

Box 57: Total number of π bonds 4

Box 58: Total number of non-bonding electrons in this molecule 12