

Chemistry 2541, Fall 2017

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).

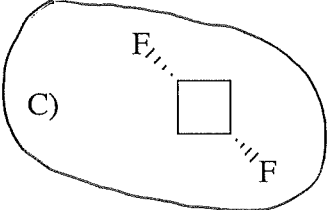
1. Which of the following is the ground-state electron configuration of **oxygen**?

- A) $1s^2 2s^2 2p_x^2 2p_y^2 2p_z^0$ B) $1s^2 2s^2 2p_x^1 2p_y^1 2p_z^1$
C) $1s^2 2s^2 2p_x^2 2p_y^2 2p_z^1$ D) $1s^2 2s^2 2p_x^2 2p_y^1 2p_z^1$

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

- A) $\begin{array}{cc} \delta- & \delta+ \\ \text{C} & \text{---} & \text{B} \end{array}$ B) $\begin{array}{cc} \delta- & \delta- \\ \text{C} & \text{---} & \text{B} \end{array}$ C) $\begin{array}{cc} \delta+ & \delta- \\ \text{C} & \text{---} & \text{B} \end{array}$ D) $\begin{array}{cc} \delta+ & \delta+ \\ \text{C} & \text{---} & \text{B} \end{array}$
- 2.5 ← 2.0

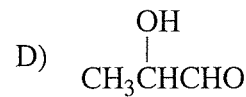
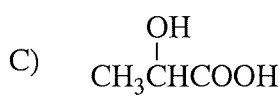
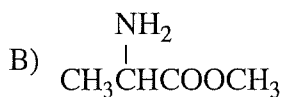
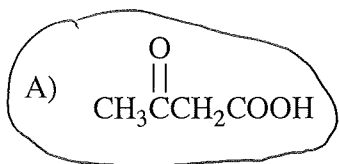
3. Which one of the following molecules is expected to have **dipole moment μ** different from **0 D**?

- A) $\text{F}-\text{C}\equiv\text{C}-\text{F}$ B) $\begin{array}{c} \text{H} \\ | \\ \text{F}-\text{C}=\text{C}-\text{F} \\ | \\ \text{H} \end{array}$ C)  D) $\begin{array}{c} \text{F} \\ | \\ \text{F}-\text{C}-\text{F} \\ | \\ \text{F} \end{array}$

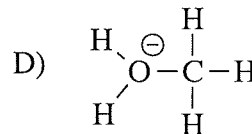
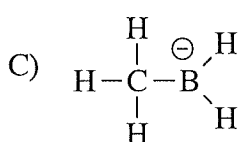
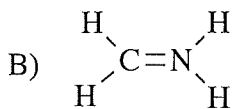
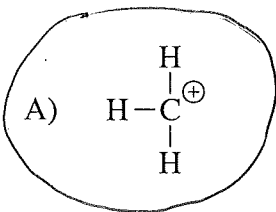
4. Which one of the following molecules contains an **alcohol** functional group?

- A) $\text{CH}_3\text{OCH}_2\text{CH}_2\text{OCH}_3$ B) $\text{HOCH}_2\text{CH}_2\text{NH}_2$ C) HOCCOOH D) CH_3COCH_3

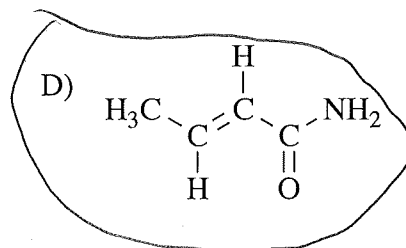
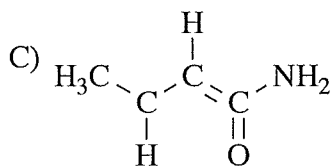
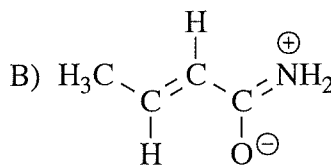
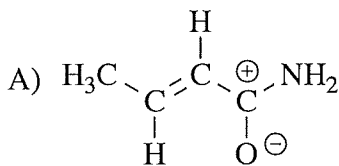
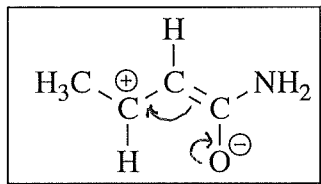
5. Which of the following molecules contains both a **ketone** functional group AND a **carboxylic acid** functional group?



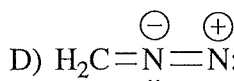
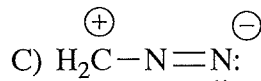
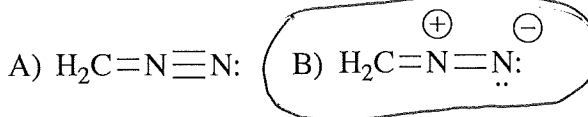
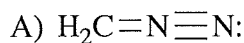
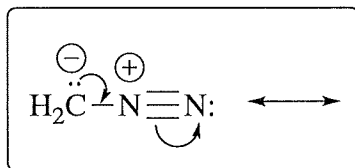
6. Which of the following molecules or polyatomic ions is a **correct Lewis structure** with correct formal charge?



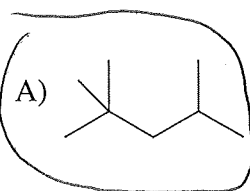
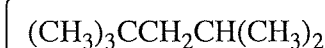
7. Which of the following structures represent the **major** resonance contributor of molecule in the box?



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



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

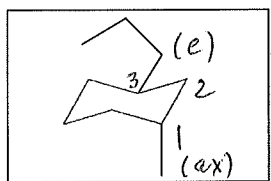


B)

C)

D)

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



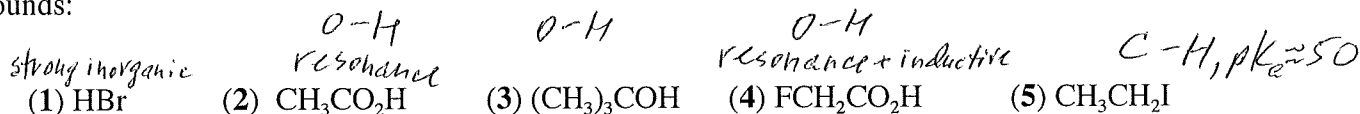
A) *cis*-1-methyl-3-propylcyclohexane

B) *trans*-1-methyl-3-propylcyclohexane

C) *cis*-1-butyl-3-methylcyclohexane

D) *trans*-1-butyl-3-methylcyclohexane

11. Which one of the following answers represents the order of increasing **acidity** for the following compounds:



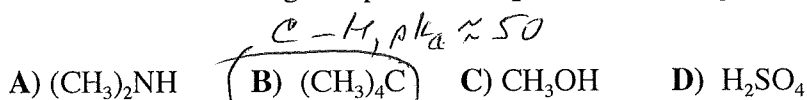
A) 5 (weakest) < 3 < 4 < 2 < 1 (strongest)

B) 3 (weakest) < 2 < 4 < 5 < 1 (strongest)

C) 5 (weakest) < 3 < 2 < 1 < 4 (strongest)

D) 5 (weakest) < 3 < 2 < 4 < 1 (strongest)

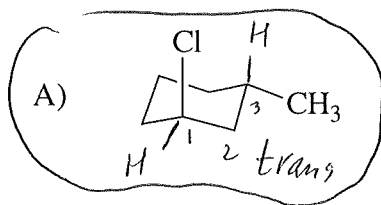
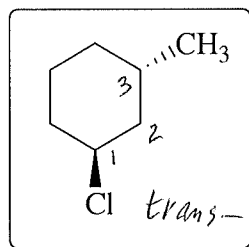
12. Which one of the following compounds has **pKa** with the **highest** numeric value?



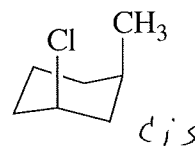
13. Which one of the following compounds is the **strongest base**?



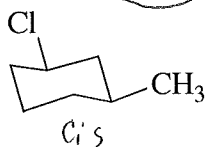
14. Which one of the following structures is the **chair** representation of the compound shown in the box?



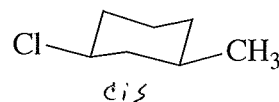
B)



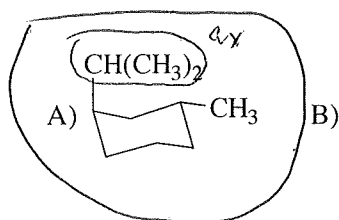
C)



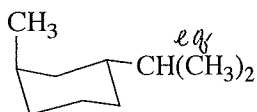
D)



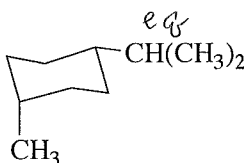
15. Which one of the following structures has the highest **diaxial interactions**?



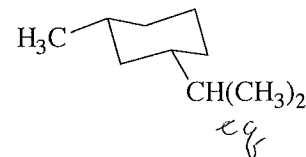
B)



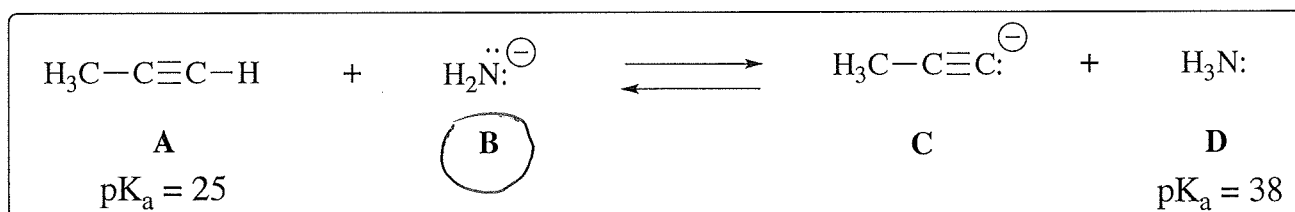
C)



D)

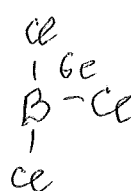


16. Which molecule in the following acid/base equilibrium is the **strongest base**?

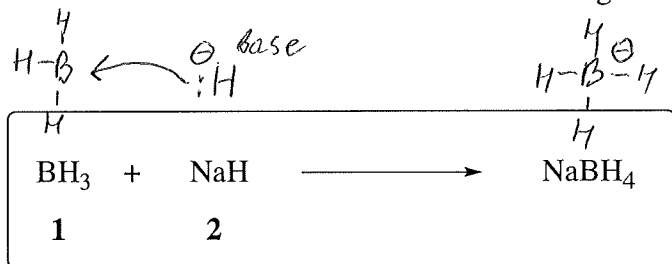


17. Which one of the following species is a **Lewis acid**?

- A) Cl^- B) :NH_3 C) BCl_3 D) AlF_4^-



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



- A) 1 is Lewis Acid and 2 is Lewis Base
 B) 1 is Lewis Base and 2 is Lewis Acid
 C) 1 is Bronsted Acid and 2 is Bronsted Base
 D) 1 is Bronsted Base and 2 is Bronsted Acid

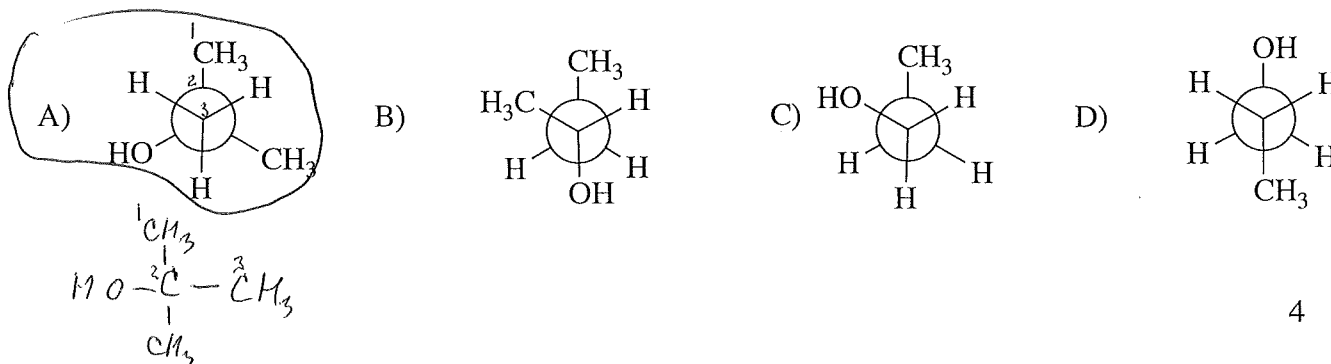
19. Which one of the following compounds has the strongest **intermolecular forces of attraction**?

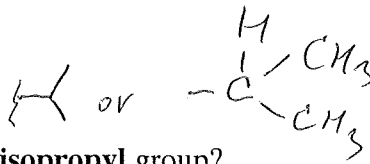
- A) $\text{CH}_3\text{CH}_2\text{CH}_3$ B) $\text{CH}_3\text{CH}_2\text{OH}$ C) $\text{HB}(\text{CH}_3)_2$ D) CH_3OCH_3

20. Which one of the following species is a **Lewis base**?

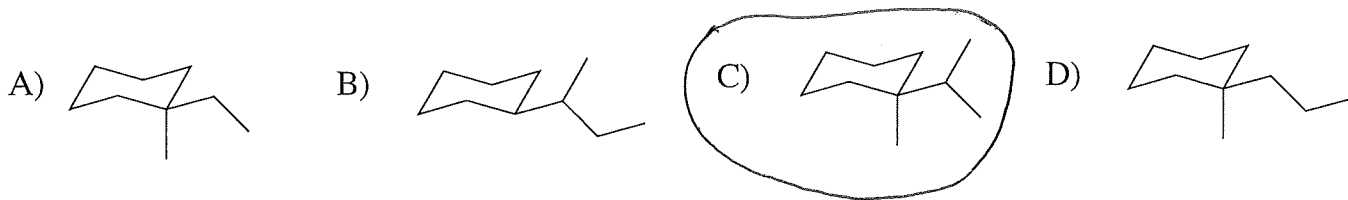
- A) $\begin{array}{c} \text{CH}_3 \\ | \\ \text{H}_3\text{C}-\text{C}^+ \\ | \\ \text{H} \end{array}$ B) $\text{CH}_3\ddot{\text{O}}\text{CH}_3$ C) $(\text{CH}_3)_4\text{N}^+$ D) $(\text{CH}_3\text{CH}_2)_3\text{B}$

21. Which one of the following Newman projections depicts a **tertiary alcohol**?





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

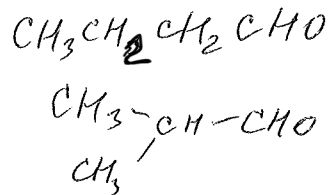


23. Which of the statements below is NOT true about **conformations**?

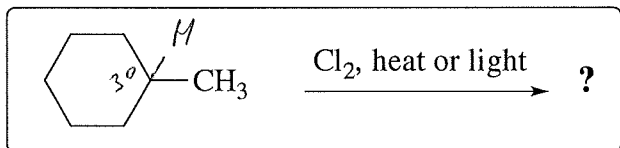
- A. They have the same molecular formula
 B. They have the same energy
 C. They have the same molecular weight
 D. They have the same connectivity of atoms

24. How many **aldehydes** have a molecular formula of $\text{C}_4\text{H}_8\text{O}$?

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

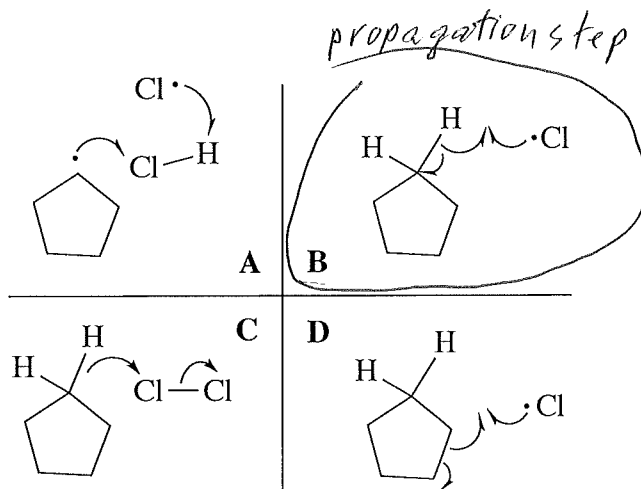
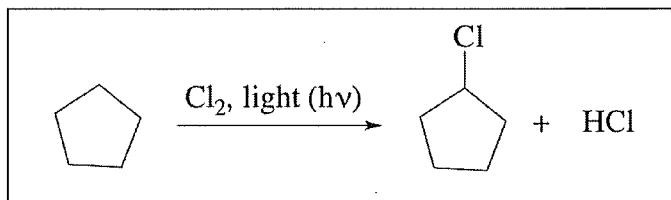


25. What is the IUPAC name of the major **product** for the reaction shown in the box?

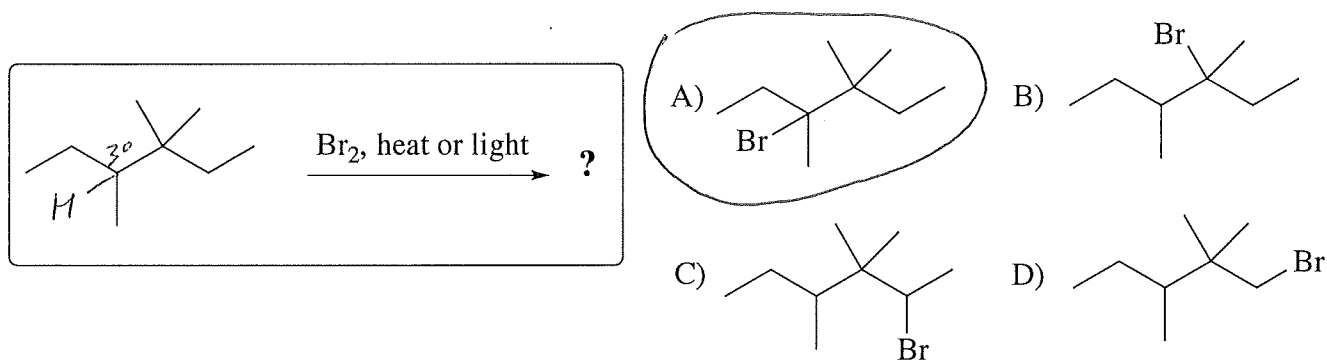


- A) *trans*-1-chloro-2-methylcyclohexane
 B) *cis*-1-chloro-2-methylcyclohexane
 C) 1-chloro-1-methylcyclohexane
 D) 1-chloro-4-methylcyclohexane

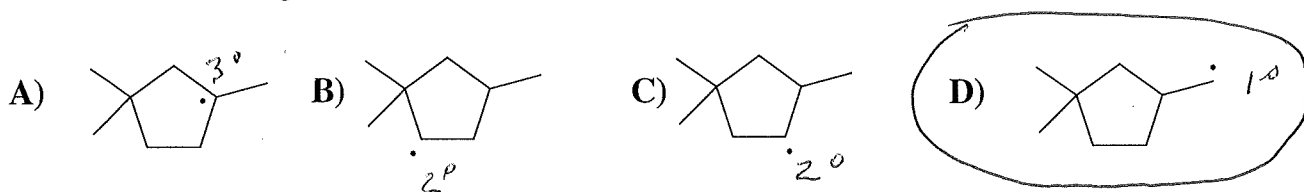
26. Which one of the following four schemes (A-D) represents a **step** in the **mechanism** of the reaction in the box?



27. What is the main product of the reaction shown in the box?

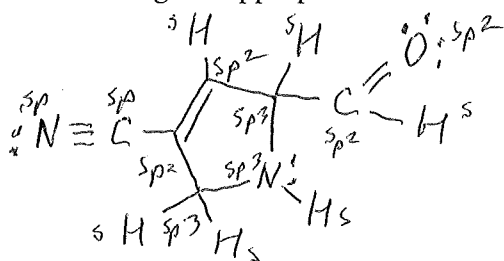


28. Which one of the following structures is the least stable radical?



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.



2pts each

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

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 4

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

Box 56: Total number of σ bonds 15

Box 57: Total number of π bonds 4

Box 58: Total number of non-bonding electrons in this molecule 8

