

Name _____

General Instructions: Write your name the space above and on the provided Scan-tron form. **Do not put your name anywhere else in this exam book.**

Make sure that you read each question carefully and provide **complete** answers.

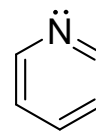
Time Limit = 55 min. Exams must be turned in immediately upon my call of time up.

Grading: Grading will be on the basis of a highest possible score of 100 points.

- I. Multiple Choice - 2 points each, 40 points total
 - II. Structures → Names - 3 points each, 12 points total
 - III. Names → Structures - 3 points each, 12 points total
 - IV. Drawing Isomers - 18 points
 - V. Explaining Theory behind Relative Acidities – 18 points
- Extra credit – 2 points

1. What is the formal charge on nitrogen in the structure at right?

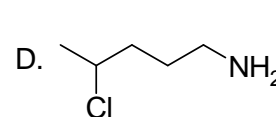
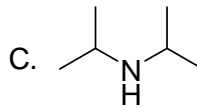
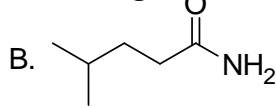
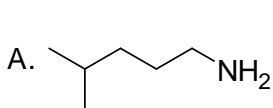
- A. +1 B. -1 C. 0 D. -2 E. +2



2. What is the hybridization of the carbon atoms in the structure at right?

- A. sp B. sp^3 C. sp^2 D. $sp^{1.5}$

3. Which of the following is the **strongest** acid?



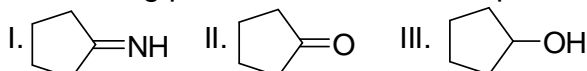
4. Which of the following is the **strongest** base?

- A. CH_3NH_2 B. CH_3OH C. CH_3SH D. CH_3CH_3

5. Which pair of reactants react with each other in an acid-base reaction whose equilibrium constant favors the products? (In other words, which of these is **not** "no reaction"?)

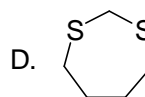
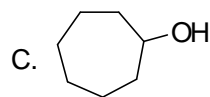
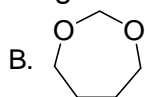
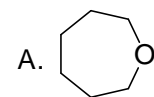


6. What is the order of the boiling points of the three compounds shown (from **highest** to **lowest**)?

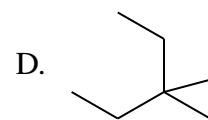
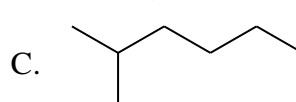
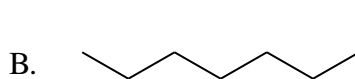
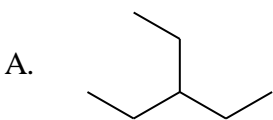


- A. III > II > I B. III > I > II C. II > I > III D. II > III > I

7. Which of the following is the **most** soluble in water?



8. Which of the following heptane isomers has the **lowest** boiling point?



9. Which of the choices to question #9 releases the most heat when combusted?

10. Which of the choices to question #9 exhibits the fewest peaks in its C-13 NMR spectrum?

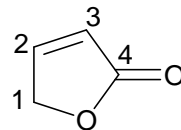
11. How many resonances are theoretically present in the ^{13}C NMR spectrum of 1-decene?

- A. eight B. five C. six D. ten E. twelve

12. Which of the following compounds has exactly three peaks in its ^{13}C NMR spectrum?
A. methylcyclohexane B. cyclopropane C. cyclohexene D. ethylcyclopentane

13. Which of these compounds gives a ^{13}C NMR signal at the lowest frequency?
A. cyclohexane B. CH_3CH_3 C. $(\text{CH}_3)_4\text{Si}$ D. benzene

14. Which of the indicated carbons gives the NMR signal with the **highest** frequency?
A. 1 B. 2 C. 3. D. 4.



15. What is the position of the ethyl and methyl groups in the most stable chair conformer of *cis*-1-ethyl-2-isopropylcyclohexane?
A. ethyl = equatorial, isopropyl = axial
B. ethyl = axial, isopropyl = equatorial
C. both groups are equatorial
D. both groups are axial

For questions 16-19 indicate which type(s) of strain is(are) significant in the molecule given. Choose from the choices below.

A. torsional only B. steric only C. angle only D. both torsional and steric E. both torsional and angle

16. the gauche conformer of butane

17. cyclopropane

18. cyclohexane boat conformation

19. cyclopentane

20. Which of these isomers of dimethylcyclohexane is the most stable?

A. *cis*-1,2 B. *trans*-1,2 C. *cis*-1,3 D. *trans*-1,3

II Show the structure of each of the following.

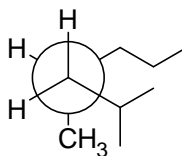
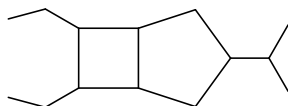
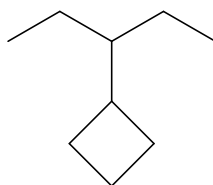
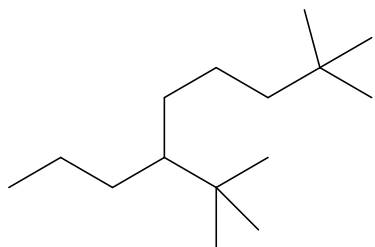
a. *cis*-2-octene

b. 4-isobutylnonane

c. 2,3-dimethylbutane
(most stable conformation around C2-C3 bond)

d. *cis*-1-butyl-3-ethylcyclohexane
(most stable conformation)

III. Name each of the following.



IV. Drawing Isomers

(a) There are six isomeric cycloalkanes with formula C_5H_{10} . Draw them. Be careful not to duplicate structures.

(b) There are three different bicyclohexanes. Draw them.

V. Explaining relative acidities.

For the six compounds in the table, explain in detail, using structural diagrams as appropriate, how the structures determine the relative acid strengths as indicated by the pK_a values. In other words, explain why the compounds have the order of acidity that they do.

	$\text{CH}_3\text{CH}_2\text{NH}_2$	$\text{CH}_3\text{C}\equiv\text{CH}$	$\text{CH}_3\text{CH}_2\text{OH}$	$\text{CH}_3\text{CH}_2\text{SH}$	$\text{CH}_3\text{CO}_2\text{H}$	$\text{CF}_3\text{CO}_2\text{H}$
pK_a	≈ 38	26	16.0	10.6	4.8	0.0