

Name \_\_\_\_\_

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

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

I. Multiple Choice - 1 point each, 25 points total

II. Chirality Centers – 6 points

III. Nomenclature – 1.5 points each, 12 points total

IV. Mechanisms – 4 points each, 12 points total

V. Reaction Products – 3 points each, 24 points total

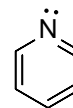
VI. Combined Spectroscopy Problem – 6 points

Chap 10/11 contribution = 15% of your score on Exam 4 - 15 points

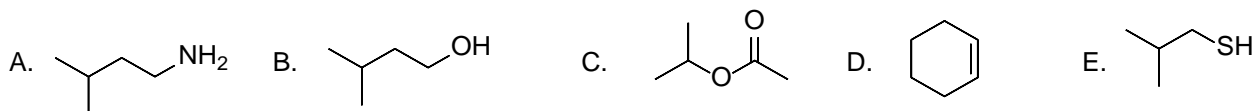
I. Multiple Choice

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

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



Use the following choices for questions 2-6

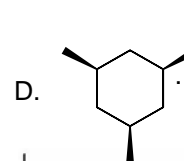
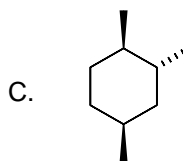
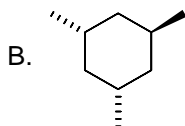
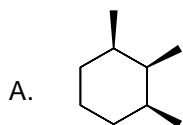


2. Which of the above is the **strongest** acid?  
 3. Which of the following is the **strongest** base?  
 4. Which has the **highest** bp?  
 5. Which is the **weakest** acid?  
 6. Which has the **lowest** bp?  
 7. How many resonances are theoretically present in the  $^{13}\text{C}$  NMR spectrum of 4-methylheptane?  
 A. eight      B. four      C. five      D. six      E. seven

For questions 15-20 indicate which type(s) of strain is(are) significant in the molecule given. Choose from the choices below.

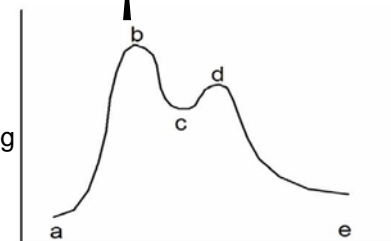
- A. both torsional and steric    B. both torsional and angle    C. torsional only    D. angle only    E. steric only

8. Gauche butane  
 9. Cyclobutane  
 10. Cyclohexane boat conformation  
 11. Which trimethylcyclohexane isomer of the choices below is the least strained?



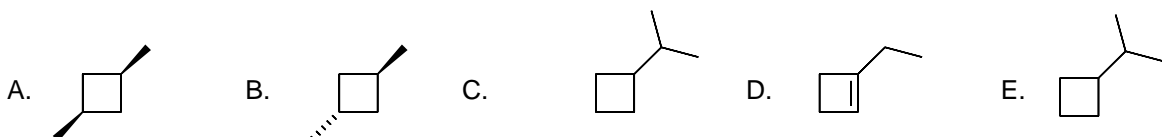
12. Which of the following reactions is the fastest? (See PE Diagram at right)  
 A.  $a \rightarrow c$       B.  $c \rightarrow a$       C.  $c \rightarrow e$       D.  $e \rightarrow c$

13. What points on the graph represent transition states? (See PE Diagram at right)  
 A. c only      B. b, c, and d      C. b and d      D. c and e

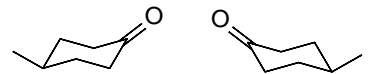


14. *Clitocybe dealbata*, also known as the ivory funnel, is a deadly poisonous mushroom that is easily mistaken for edible varieties. The active toxin in the mushroom is muscarine, which has been isolated and has  $[\alpha]_D = +8.0^\circ$ . A lab synthesis of this compound gave material with  $[\alpha]_D = +4.0^\circ$ . The synthetic material is which of the following?  
 A. It is a mixture of the natural muscarine structure and its enantiomer in a 3:1 ratio  
 B. It is a mixture of the natural muscarine structure and its enantiomer in a 2:1 ratio  
 C. It is a mixture of the natural muscarine structure and its enantiomer in a 1:1 ratio  
 D. It is a mixture of the natural muscarine structure and its enantiomer in a 4:1 ratio

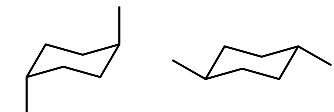
15. Which of the following cycloalkanes is chiral?



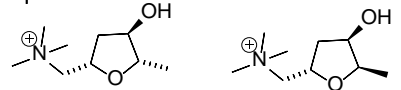
16. What is the relationship between the compounds shown at right?  
 A. constitutional isomers B. diastereomers C. enantiomers D. same compound



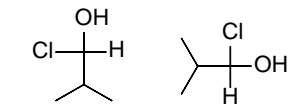
17. What is the relationship between the structures shown at right?  
 A. constitutional isomers B. diastereomers C. enantiomers D. same compound



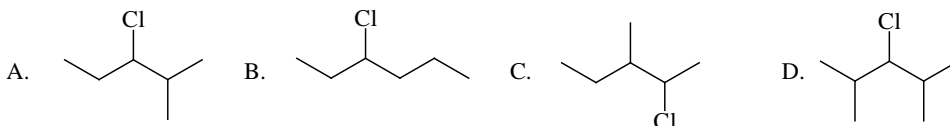
18. What is the relationship between the structures shown at right?  
 A. constitutional isomers B. diastereomers C. enantiomers D. same compound



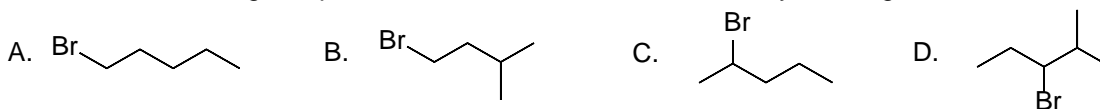
19. What is the relationship between the structures shown at right?  
 A. constitutional isomers B. diastereomers C. enantiomers D. same compound



20. Which of the following compounds would give the greatest percentage of substitution product as compared to elimination product when treated with sodium ethoxide?



21. Which of the following compounds is most reactive toward E2 dehydrohalogenation?



22. What is the expected % intensity of the  $M^{+}+1$  peak as compared to the  $M^{+}$  peak in the mass spectrum of 3,3-dimethyl-1-heptene?

A. 10% B. 30% C. 25% D. 100%

23. What diagnostic IR peak (wavenumbers) would be expected to be displayed in the spectrum of 3,3-dimethyl-1-heptene?

A. 2950 and 1700 B. 3050 and 1650 C. 3300 and 2250 D. 1950 and 1200

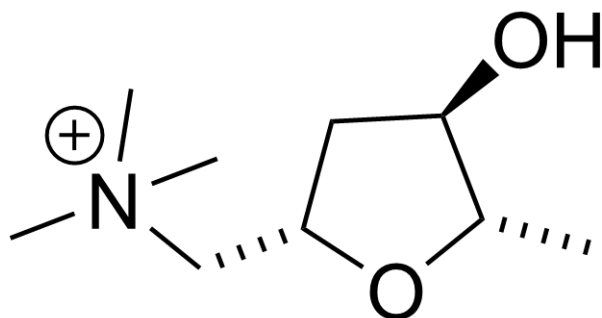
24. In mass spectrometry the x-axis is in units of  $m/z$ . What does the “z” represent?

A. charge B. time C. sleep D. frequency E. abundance

25. What are the units of the x-axis in an NMR spectrum?

A.  $\text{cm}^{-1}$  B. Hz C. seconds D.  $m/z$  E. ppm

II. (+)-Muscarine (structure shown below) the compound responsible for the toxicity of several varieties of mushrooms. A. What does the “(+)” indicate about the compound? B. Identify all chirality centers in the structure by marking them with an asterisk. C. Label the chirality as *R* or *S* as appropriate. Also show priorities of all groups around each of these chirality centers.



III.A. Give the structure of each of the following.

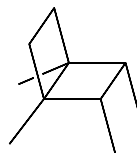
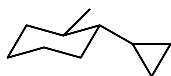
4R,2E-4-ethyl-2-octene

cycloocta-1,3,5-triene

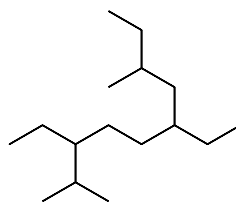
*trans*-1-*tert*-butyl-3-isopropylcyclohexane  
most stable conformer

2,2,5-trimethyloctane  
most stable conformer of C2-C3 bond

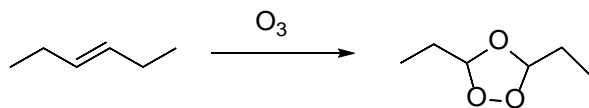
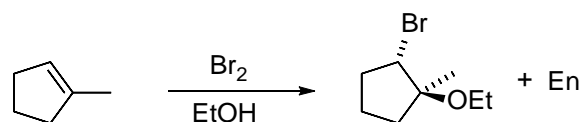
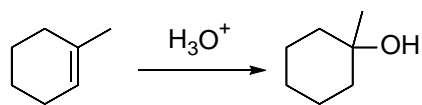
III.B. Name each of the following.



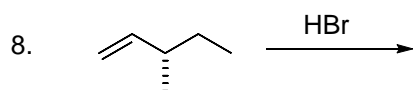
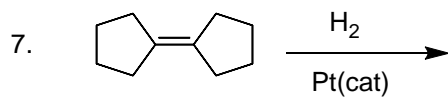
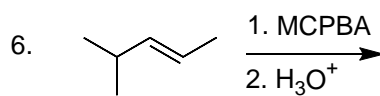
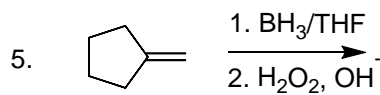
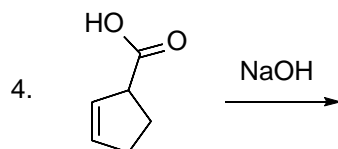
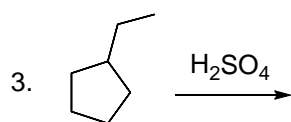
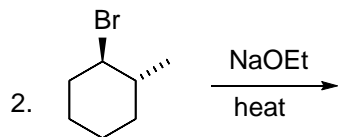
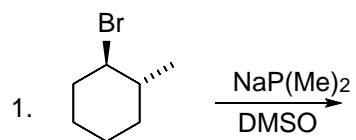
CH<sub>2</sub>Cl<sub>2</sub>



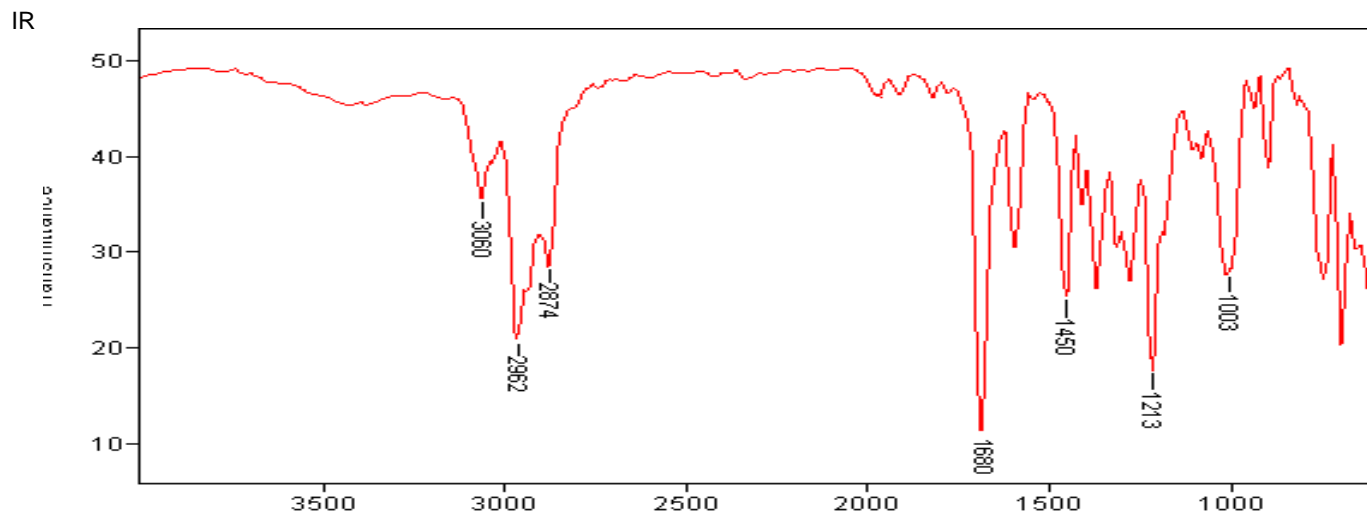
IV. Write out the mechanism for each reaction shown below using curved arrows to show electron flow. If the mechanism is concerted then also diagram the transition state showing all features necessary for prediction of the stereochemistry and regiochemistry of the product.



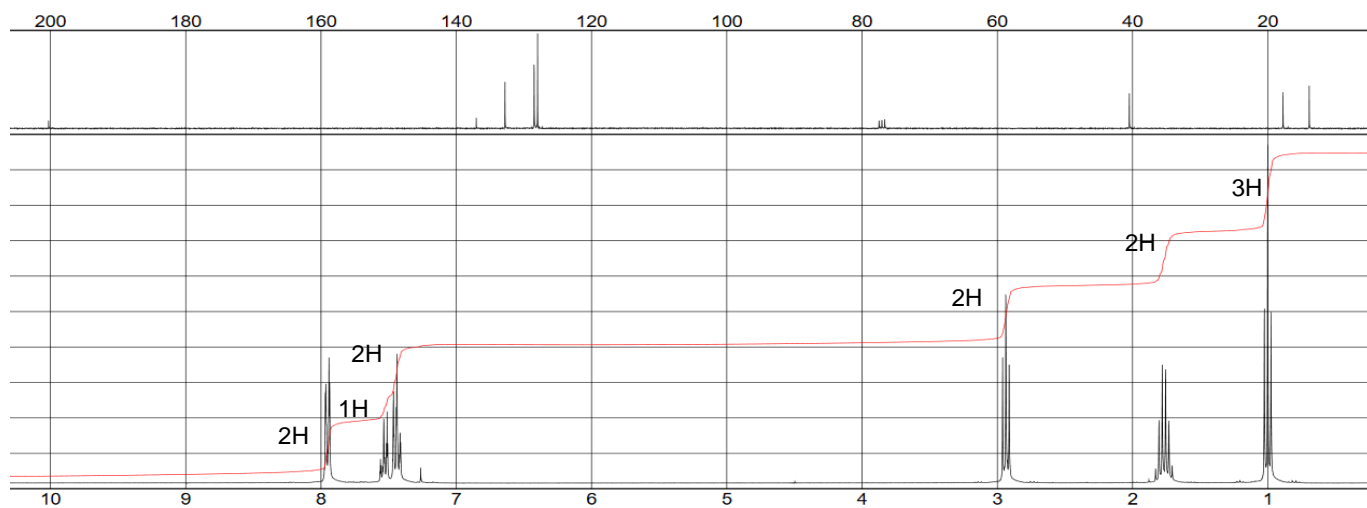
V. Predict the product of each of the following reactions. If the product can exist as stereoisomers then show the specific stereoisomer formed. If no reaction is expected to occur then write N.R. and explain your reasoning.



VI. Below are reproduced spectra of a compound with molecular formula  $C_{10}H_{12}O$ . Deduce the structure of this compound and label all key peaks in the spectra.



NMR –  $^{13}C$  NMR top,  $^1H$  NMR bottom



MS

