CHM 2210: ORGANIC CHEMISTRY II — Third Exam, Form 3
Section 02, Professor A. Herriott — November 29, 2007

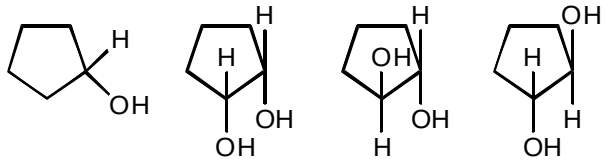
No electronic devices (calculators, cell phones, laptops, etc) may be used or consulted during the exam. All scrap work should be done on the extra page provided; no additional paper may be used. **Your name and Panther ID should be placed in three places**; at the end of this paragraph to indicate acceptance of all policies, on page 7 of the exam (Part B) and on your answer sheet. Use a number 2 pencil on answer sheet and be sure to include **the form of your exam on the answer sheet.**

Name _____ Panther ID _____

1. Which reaction of an alkene proceeds with *anti* addition?
   A) Hydroboration/oxidation
   B) Bromination
   C) Oxidation with cold $KMnO_4$
   D) Hydrogenation
   E) Oxymercuration-demercuration

2. Which of the following could not be used to synthesize 2-bromopentane efficiently?
   A) 1-Pentene + HBr $\rightarrow$
   B) 2-Pentene + HBr $\rightarrow$
   C) 2-Pentanol + HBr $\rightarrow$
   D) 2-Pentanol + PBr_3 $\rightarrow$
   E) All of the above would afford good yields of 2-bromopentane

3. Epoxidation followed by reaction with aqueous base converts cyclopentene into which of these?

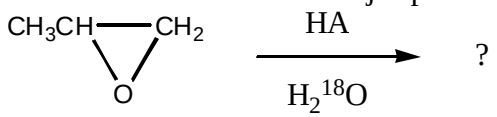


I II III IV

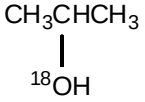
A) I B) II C) III D) IV E) Equal amounts of III and IV

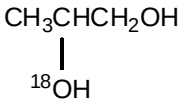
4. Which of the compounds listed below would you expect to have the highest boiling point? (They all have approximately the same molecular weight.)
   A) $CH_3CH_2CH_2CH_2CH_3$
   B) $CH_3CH_2CH_2CH_2OH$
   C) $CH_3CH_2CH_2OCH_3$
   D) $CH_3CH_2CH_2Cl$
   E) $CH_3CH_2OCH_2CH_3$

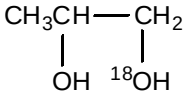
5. Select the structure of the major product formed in the following reaction.

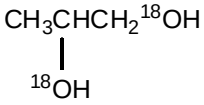


A) $CH_3CH_2CH_2{}^{18}OH$

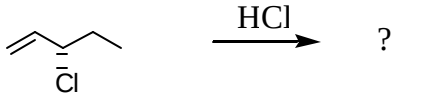
B) 

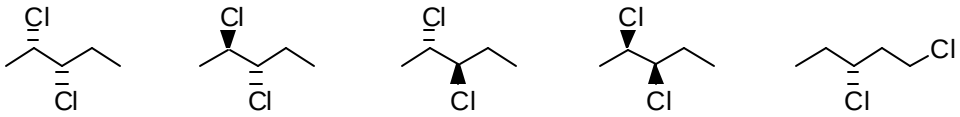
C) 

D) 

E) 

6. Addition of hydrogen chloride to the following molecule would produce:

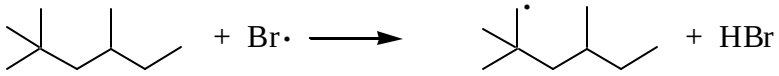


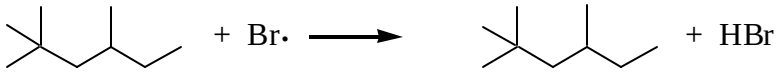


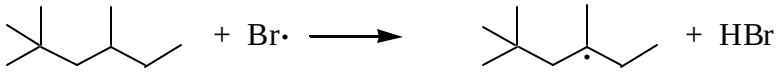
I II III IV V

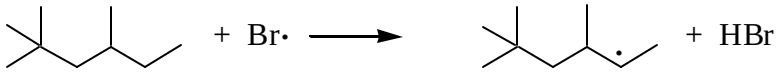
A) I and II B) II and III C) I and IV D) V E) I, II, III, and IV

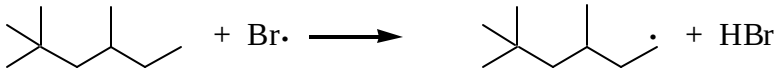
7. Which of the following reactions would have the smallest energy of activation?

A) 

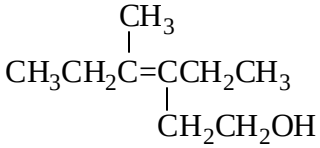
B) 

C) 

D) 

E) 

8. What is the correct IUPAC name for the following compound?

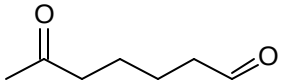


A) 3-methyl-4-ethyl-3-hexen-6-ol
B) 4-ethyl-3-methyl-3,6-hexenol
C) 3-ethyl-4-methyl-3-hexen-1-ol
D) 3-methyl-4-(2-hydroxyethyl)-3-hexene
E) 3-(2-hydroxyethyl)- 3-methyl-3-hexene

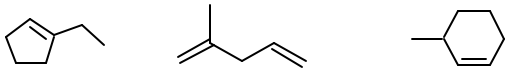
9. Using small amounts of quaternary ammonium cations compounds such as tetrabutylammonium (Q^+) or crown ethers such as 18-crown-6 to shuttle inorganic reactants into organic solvents is called
A) polymerization
B) biomimetic solvolysis
C) symbiotic quaternization
D) spontaneous hyperoxidation
E) phase transfer catalysis

10. What is the chief product of the acid-catalyzed hydration of 2,5-dimethyl-2-hexene?
A) 2,5-dimethyl-1-hexanol
B) 2,5-dimethyl-2-hexanol
C) 2,5-dimethyl-3-hexanol
D) 2,5-dimethyl-2,3-hexanediol
E) 2,5-dimethyl-3,4-hexanediol

11. Compound **C** has the molecular formula C_7H_{12}. On catalytic hydrogenation, 1 mol of **C** absorbs 1 mol of hydrogen and yields a compound with the molecular formula C_7H_{14}. On ozonolysis and subsequent treatment with zinc and acetic acid, **C** yields only:



The structure of **C** is:

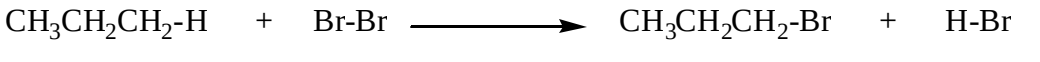


I II III

IV V

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

12. The bond dissociation energies for the relevant bonds are given below each of the species involved in the following reaction. Calculate the overall ΔH° for the reaction.



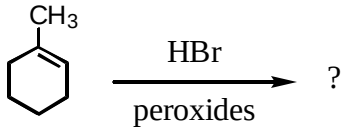
ΔH^o=423 kJ/mol ΔH^o=193 kJ/mol ΔH^o=294 kJ/mol ΔH^o=366 kJ/mol

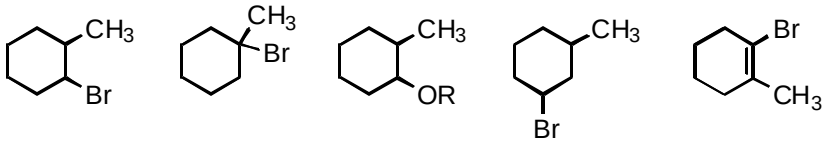
A) +616 kJ / mol
B) -101 kJ / mol
C) -173 kJ / mol
D) +57 kJ kJ / mol
E) -44 kJ / mol

13. When 3-methyl-2-pentene is treated with mercuric acetate, $Hg(O_2CCH_3)_2$, in a THF-ethanol mixture and the resulting product reacted with $NaBH_4$ in basic solution, the principal product formed is which of these?

A) 3-methyl-3-pentanol
B) 3-ethoxy-3-methylpentane
C) 3-methyl-2-pentanol
D) 2-ethoxy-3-methylpentane
E) 1-ethoxy-3-methylpentane

14. What would be the major product of the following reaction?





I II III IV V

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

15. <u>cis</u>-3-Methylcyclopentanol is treated with CH_3SO_2Cl in the presence of a base. The product of the reaction then is allowed to react with KI in methanol. What is the final product?

A) <u>trans</u>-1-Iodo-3-methylcyclopentane
B) <u>cis</u>-1-Iodo-3-methylcyclopentane
C) 1-Methylcyclopentene
D) 2-Methylcyclopentene
E) 3-Methylcyclopentene

16. Which alkene would yield <u>only</u> CH_3CH_2COOH on oxidation with hot alkaline potassium permanganate (followed by acid work-up)?

A) *(E)*-2-hexene
B) *(Z)*-2-hexene
C) 2-methyl-2-pentene
D) *(E)*-3-hexene
E) *(E)*-4-methyl-2-pentene

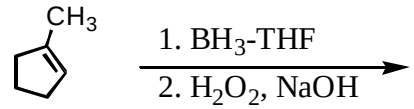
17. Which of the following can be described as "chiral, primary alcohol"?

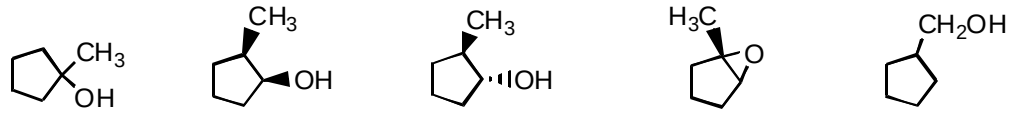
A) $CH_3CH_2CH_2CH_2CH_2OH$
B) $(CH_3)_2CHCH_2CH_2OH$
C) $CH_3CH_2CH(CH_3)CH_2OH$
D) $(CH_3)_2CHCHOHCH_3$
E) Two of the above

18. Which of the reactions listed below would be exothermic?

A) $H–H \longrightarrow 2H\cdot$
B) $H\cdot + CH_3–H \longrightarrow CH_3–H + H\cdot$
C) $CH_3\cdot + CH_3\cdot \longrightarrow CH_3–CH_3$
D) $CH_3\cdot + CH_3–H \longrightarrow CH_3–H + CH_3\cdot$
E) All of the above

19. Which product(s) would you expect to obtain from the following sequence of reactions?



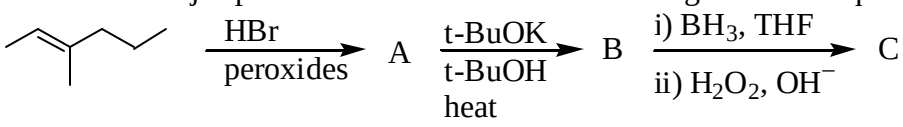


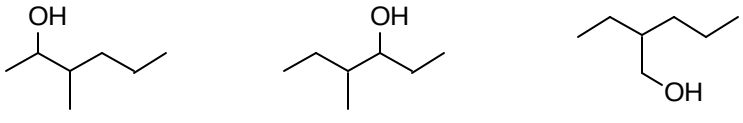
\+ enantiomer + enantiomer + enantiomer

I II III IV V

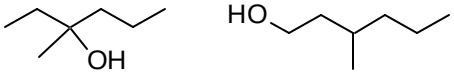
A) I B) II C) III D) IV E) V

20. What is the major product obtained from the following reaction sequence?





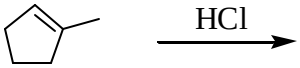
I II III

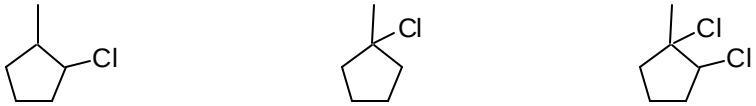


IV V

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

21. What would be the major product of the following reaction?





I II III

IV V

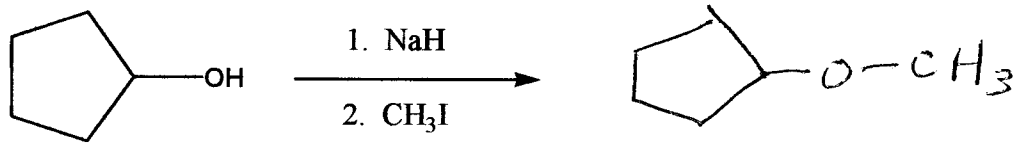
A) I B) II C) III D) IV E) V

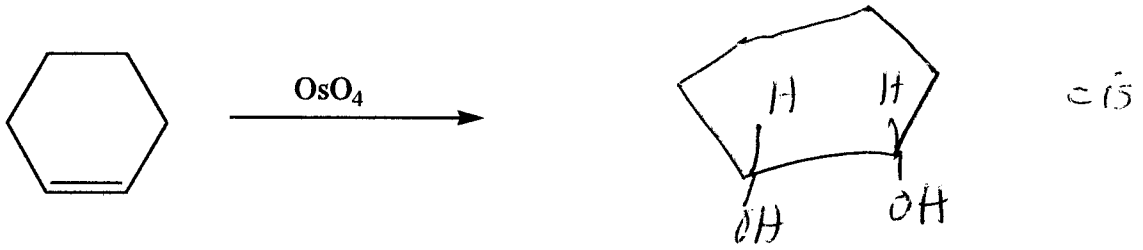
22. The most resistant compound to the action of hot alkaline $KMnO_4$ is:
A) Pentane B) 1-Pentene C) 2-Pentene D) 2-Pentyne E) Cyclopentene

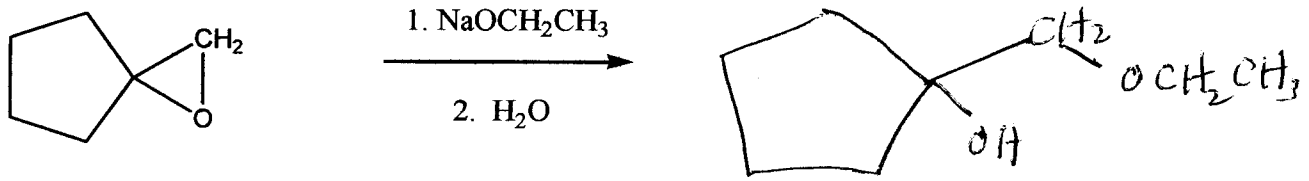
Answer Key

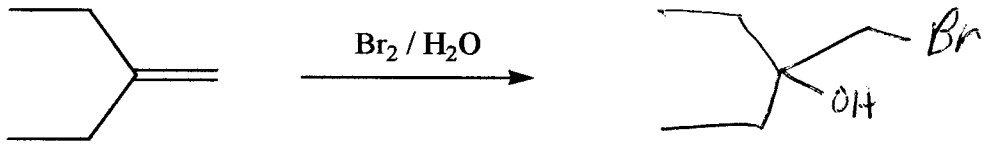
1. B
2. B
3. E
4. B
5. C
6. A
7. C
8. C
9. E
10. B
11. E
12. E
13. B
14. A
15. A
16. D
17. C
18. C
19. C
20. E
21. B
22. A

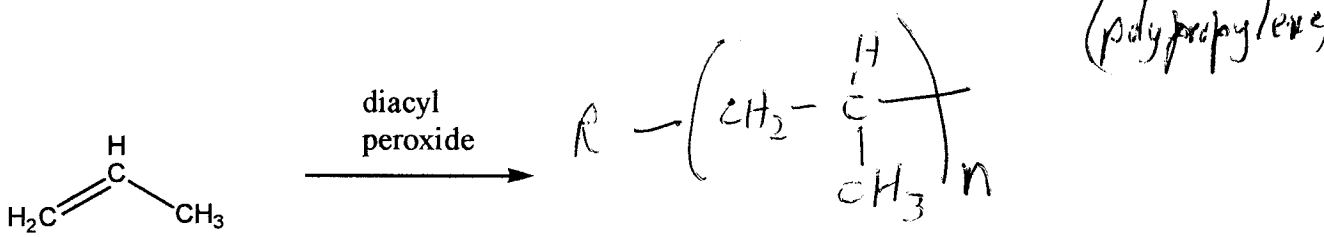
Part B (20 points, 4 each) Give the major organic product, including stereochemistry if applicable

1. 

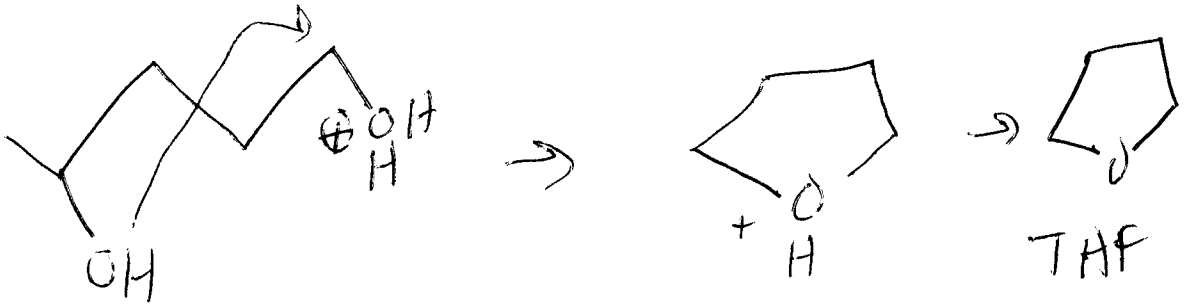
2. 

3. 

4. 

5. 

Bonus (2 points) (do this last!) When 1,4-butanediol is treated with sulfuric acid, a lower boiling liquid X is produced. If shaken at room temperature with bromine or potassium permanganate, X does not decolorize either one. Give the structure of X and a mechanism for its formation.



Part C (5 points) Write the reaction mechanism for the monochlorination of ethane with molecular chlorine to produce ethyl chloride. Show all steps and intermediate products.

chain initiation $Br_2 \rightarrow Br\cdot + Br\cdot$

propagation $Br\cdot + CH_3-CH_3 \rightarrow HBr + CH_3-CH_2\cdot$

$CH_3-CH_2\cdot + Br_2 \rightarrow CH_3-CH_2-Br + Br\cdot$

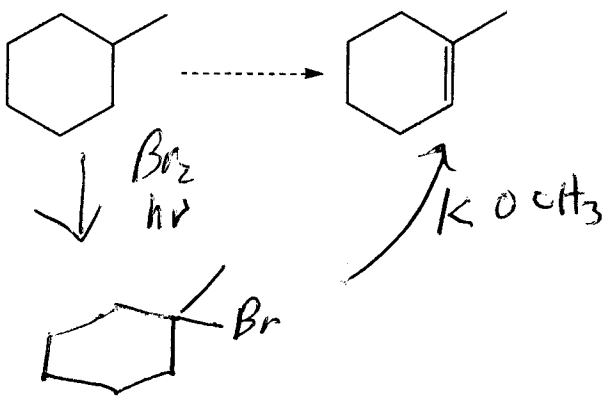
repeat second & third steps many times

termination $2\ CH_3-CH_2\cdot \rightarrow CH_3-CH_2-CH_2-CH_3$

$CH_3CH_2\cdot + Br \rightarrow CH_3-CH_2Br$

Part D: (10 points) Provide a reasonable multi-step synthetic pathway for the following conversions, showing any needed reagents and intermediate products.

1.



2.