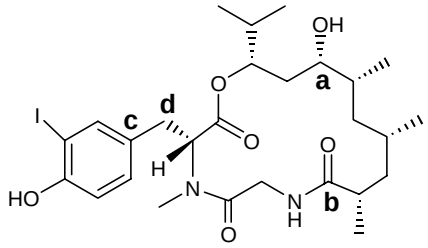
Chemistry 138 Practice Test 1

Part I: Multiple Choice Questions

A (8 marks)

The structure of (-)-doliculide (a potent anti-tumor agent) is shown below, answer the following questions based on the structure.



(-)-Doliculide

1. What are the hybridizations of carbon atom **a**, **b** and **c**?
A They are all sp^2
B **a** and **b** are sp^3, **c** is sp^2
C **a** and **c** are sp^3, **b** is sp^2
D **b** and **c** are sp^2, **a** is sp^3
E **b** and **c** are sp^3, **a** is sp^2

2. The shape at carbon atom **c** would be best described as:
A Tetrahedral
B Trigonal pyramidal
C Trigonal planar
D Linear
E None of the above

3. The σ-bond between carbon atoms **c** and **d** is formed by overlapping of what orbitals?
A sp^3(**c**)-sp^2(**d**)
B sp^2(**c**)-sp^3(**d**)
C sp^3(**c**)-sp^3(**d**)
D sp^2(**c**)-sp^2(**d**)
E None of the above

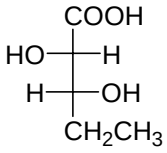
4. The configuration of carbon **a** is:
A *R*
B *S*
C Prochiral
D Not chiral
E None of the above

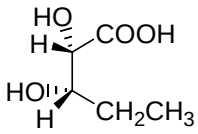
B (10 marks)

Which term best describes the relationship between the following pairs of compounds? Answer questions 5-9 using one of the following terms (A-F).

A Geomertical isomer
B Structural isomers
C Enantiomers
D Diastereomers
E Identical
F Not isomers

5.





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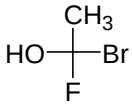

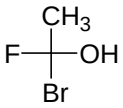

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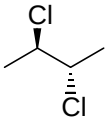

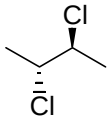

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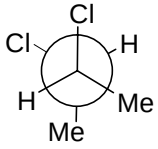

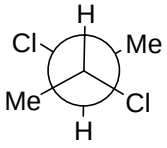

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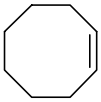
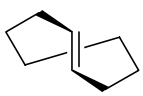
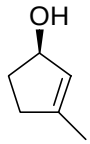




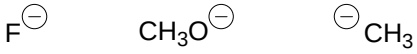
Part II: Short Answer Questions

1. (6 marks)
(a) Draw wedge-and-dash chemical structure of the following compound:
(*S*)-1-Bromopropyl 4-methoxybutanoate

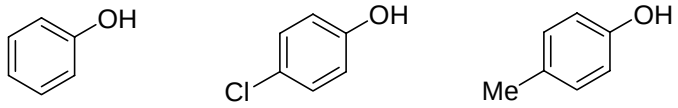
(b) Give the IUPAC name of the following compound:



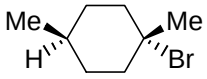
2. (4 marks)
(a) Which of the following compounds is most basic?



(b) Which of the following compounds is most acidic?



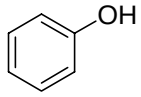
3. (8 marks)
(a) Draw both chair forms of the following molecule:

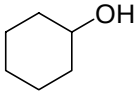


(b) Which one is more stable?
(Hint: Strain energy of one H-X 1,3-diaxial interaction: H-Me = 3.8 kJ/mol, H-Br = 1.0 kJ/mol)

(c) Estimate the energy difference between the two forms.

4. (14 marks)
(a) Draw the conjugate base for phenol and cyclohexanol (shown below), including all resonance structures.

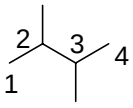




(b) Which conjugate base is more stable? Why?

(c) Can you predict which compound (phenol or cyclohexanol) is more acidic based on the answer from (b)? Explain.

5. (12 marks)
(a) Draw the most stable and the least stable forms of 2,3-dimethylbutane (shown below) using Newman projections, looking down the C-C bond from C2 to C3.



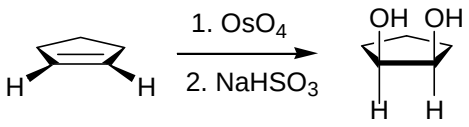
(2,3-dimethylbutane)

(b) Draw the most stable eclipsed conformation using Newman projection. What is the difference in the total strain energy between this conformation and the other less stable eclipsed conformation?
(H-H eclipsed = 4.0 kJ/mol, H-CH_3 eclipsed = 6.0 kJ/mol, CH_3-CH_3 eclipsed = 11.0 kJ/mol)

6. (20 marks)
Two dicarboxylic acids (A and B) have the general formula HOOC-CH=CH-COOH. Treatment of A with OsO_4 then $NaHSO_3$ yields (*2R,3S*)-dihydroxybutanedioic acid (C) as the only product. Treatment of B with OsO_4 then $NaHSO_3$ yields two products: (*2R,3R*)-dihydroxybutanedioic acid (D) and (*2S,3S*)-dihydroxybutanedioic acid (E).

Note: OsO_4 is a reagent for *syn* dihydroxylation of alkenes

e.g.



Answer the following questions:

(a) Draw Fischer projections of compounds C, D, E.

(b) What is the relationship between C and D? D and E?

(c) Is compound C chiral or achiral? Explain.

(d) Draw the structures of A and B. What is the relationship between them?