Organic chemistry i final exam assignment

004: 121 Organic I Fall 2010 Final Exam Please read each question carefully before answering. Answer the questions in ink in the spaces provided inside. If you make changes as you go, please make sure your final answer is clearly indicated. Scratch papers are available at the end. Total points = 150. You have 120 min. Good Luck!

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Grading: Q. # 1. 2. 3. 4. 5. 6. 7. Score (Max) _____ (60 pts) _____ (18 pts) _____ (17 pts) _____ (13 pts) _____ (18 pts) _____ (12 pts) _____ (12 pts)

Total _____ (150) Chem. 121 Final Exam Fall 2010

Name_____ 1. (3 pts each) Please circle one answer for each question. A. The following compound is named: A. 2, 2-dimethyl-4-butanol B. 2-methyl pentanol C. hexanol D. 3, 3-dimethyl-butanol E. 4, 4-dimethyl-pentanol B. Indicate the hybridization of all of the second row elements in the following compound. A. 1-sp2; 2-sp2; 3-sp3; 4-sp2 B. 1-sp3; 2-sp2; 3-sp3; 4-sp3 C. 1-sp; 2-sp2; 3-sp3; 4-sp3 D. 1-sp; 2-sp ; 3-sp ; 4-sp 3 2 3 OH 3 1 2 4 OH E. 1-sp; 2-sp2; 3-sp2; 4-sp3 C.

Rank the following hydrogens (1, 2, and 3) in order of increasing acidity. A. 1, 2, 3 B. 2, 3, 1 C. 3, 2, 1 D. 3, 1, 2 E. 2, 1, 3 D. Which one of the following compounds has the highest boiling point? A. (CH3CH2)3N B. CH3CHCl(CH2)4CH3 C. CH3(CH2)5CH3 D. CH3(CH2)5NH2 E. CH3(CH2)5Cl H OH 1 3 2 H Page 2 % Chem. 121 Final Exam Fall 2010

Name_____ E. Consider the molecule below, the nitrogen atom can best act as a A. electrophile B. nucleophile C. base D.

acid E. none of the above N F. Name the following compound. A. R, S-1, 3-dichloro-cyclopentane B.

S, S-1, 3-dichloro-cyclopentane C. trans-1, 3-dichloro-cyclopentane D. A and C E. B and C Cl Cl G. How many stereogenic centers are in the following molecule? A. 1 B. 2 C. 3 D. 4 E. 5 H. The following compounds are: A. enantiomers B. diastereoisomers. C. identical. D. meso compounds. E. None of the above. I. Which of the following has at least one stereogenic center? None A B C Page 3 D E % J. What is the correct stereochemical assignment for each of the following alkenes? A. B. C D. E. A = E; B = Z; C = E A = Z; B = E; C = E A = Z; B = Z; C = Z A = E; B = E; C = Z A = E; B = E; C = E A B C K.

The order of stability of the following conformers is (from stable at left to unstable on right): A. B. C D. E. 4, 2, 1, 3 1, 4, 2, 3 1, 3, 4, 2 4, 1, 2, 3 2, 1, 4, 3 OH OH HO OH 1 2 3 4 L. What is the IUPAC name of the following alcohol? A. S-2-ethyl-5, 5-dimethyl-R-cyclohexanol B. R-2-ethyl-5, 5-dimethyl-R-cyclohexanol C. S-2-ethyl-5, 5-dimethyl-S-cyclohexanol D. S-6-ethyl-3, 3-dimethyl-cyclohexane E. S-3-ethyl-R-6-S-6-dimethyl-cyclohexanol HO M. Predict the most likely mechanism(s) for the reaction of cis-3-methyl-chloro-cyclohexane with sodium methoxide (in methanol as the solvent) – circle one option. A.

SN2 B. C. D. E. E1 SN1 E2 E2 and SN2 N. With which reagent is cis-2-methyl-cyclopentanol most likely to undergo rearrangement? A. NaOH in protic solvent B. C. D. E. water Concentrated H2SO4 KOC(CH3)3 in aprotic solvent NaNH2 in aprotic solvent Chem. 121 Final Exam Fall 2009 Name_____ O. The rate equation that

describes the reaction shown below is: A. k[A] B. C. D. E. k[C][D] k[B] k[A][B] k([C][D][E]/[A][B]) Br + NaOC(CH3)3 + NaBr + HOC(CH3)3 A B C D E P. The main product of the oxidation of the following compound with KMnO4 is: OH OH OH OH OH OH OH OH OH OH A

Q. B C D E The main product of the ozonolysis of the same compound (question 1. P. above) is: O O O A O O B O O C O O D R. E O How many products (including stereoisomers) would you expect to obtain upon mono-chlorination of S-2-bromo-pentane with Cl2 and light? A. 2 B. 3 C. 4 D. 6 E. 7 S. How many products (including stereoisomers) may result from light activated reaction of propene with NBS (note that the concentration of the by product Br2 is maintained low throughout the reaction)? A. 1 B. C. D. E. 2 3 4 5 Page 5 % Chem. 121 Final Exam Fall 2009

Name_____ T.

How many propagation steps are required in the radical polymerization of vinyl chloride to form the following short PVC (poly-vinylchloride)? A. 1 B. C. D. E. 2 3 4 5 RO Cl Cl Cl OR Page 6 % Chem. 121 Final Exam Fall 2009

Name_____ 2. A. (3 pts) cyclohexene and 3-hexyne are (circle one): constitutional-isomers stereo-isomers conformers unrelated compounds B. (3 pts) The boiling point of cyclohexene is higher than that of 3-hexyne (circle one): True False C. (3 pts) The hydrogenation product of cyclohexene is heavier than that of 3-hexyne circle one): True False

D. (3 pts). The intermolecular force(s) that holds the cyclohexene molecules together in solid or liquid is (are): ____van der Waals and

polar_____ E. (3 pts). The intermolecular force(s) that holds the 3-hexyne molecules together in solid or liquid is (are): ____ only van der Waals _____ F. (3 pts) The 4-pentene-1-ol and hexane have the same molecular weight. Circle the one that is more soluble in water. Page 7 % Chem. 121 Final Exam Fall 2009 Name_____ 3. A. 12 pts) Draw the mechanism for this reaction. Br KOC(CH3)3 BrH O- + + H No anti-periplanar hydrogens prohibit E2! identical Br confortmers Br Br B. (5 pts) Draw the transition state for the step in which the C-Br bond is cleaved. a ? Br ?+ Page 8 % Chem. 121 Final Exam Fall 2009 Name_____ 4. A. (3 pts) Circle all the stereogenic centers in the following compound. HO B. (10 pts) The specific rotation of l-sutinin is [?] = -10 ? *ml*g-1*dm-1. Using a 1 dm cell, the measured light rotation of 1 g*ml-1 sample of synthesized and purified sutinin is ? -1?. What is the composition of the sample in this sample – what is the portion of l-sutinin vs. d-sutinin? (explain your answer in no more than 5 lines, or show your calculations) Explanation: (-) rotation indicates excess of l; 1 out of 10 is 10 % that are excess of l over d (i. e. , ee); 90 % optical activity is canceled, i. e. , 45 % d cancel 45 % l so the total l is 55 %. Calculations: ? pure = [?] l C = -10·1·1 = -10? ee = (? mixture/ ? pure)·100 = (-1/-10)·100 = 10 % ee = |(% one enantiomer – % the other enantiomer)| = 10 % Since ? is negative l-sutinin is in excess. e = |(%[l-sutinin] – %[d-sutinin])| = 10 % 100 % = %[l-sutinin] + %[d-sutinin] so %[d-sutinin] = 100 % -%[l-sutinin] ee = |(%[l-sutinin] – (100 % -%[l-sutinin]) | = 10 % %[l-sutinin] = 110 % /2 = 55 % %[d-sutinin] = 100 – 55 = 45 % Page 9 % Chem. 121 Final Exam Fall 2009 Name_____ 5. The tert-butoxy catalyzed

elimination of HBr from the following alkyl bromide is described in the energy diagram below. Use the reaction coordinate diagram below to answer the following questions. 2 Br 3 E n e r g y Ea ? H ? 1 Reaction coordinate) (3 pts) How many intermediates are there in the reaction? none b) (3 pts) Is the overall reaction exothermic or endothermic (circle one)? c) (3 pts) Does the transition state more closely resemble reactants or products (circle one)? d) (4 pts) Label the two vertical arrows as Ea and ? H?. e) (5 pts) Draw the transition state (state 2 in the scheme): Br ?- a H ? + OH Page 10 % Chem. 121 Final Exam Fall 2009 Name_____ 6. (12 pts) Devise the synthesis of propionic acid from acetylene (ethyne) as the ONLY carbon source.

Present the synthetic path from reactants to product and the needed inorganic reagents by the arrows. ? 2 eq. Na/NH3 NaH O3 HBr Br HO O CO2 Page 11 % Chem. 121 Final Exam Fall 2009 Name_____ 7. (12 pts) Devise the conversion of the following reactant to the following product – see scheme below. You should get only the correct enantiomer (no recemic mixture or mixed diastereomers). Present the synthetic path from reactants to product and the needed inorganic reagents by the arrows. OH Br ? O HO NaOH Sharpless epoxidation – DET OH CH3OH / H2SO4 O OH Page 12 %