Exam 2 Summer 2017

Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Seat Number\_\_\_\_\_\_\_\_

Student ID\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The exam consists of 8 questions worth 104 points on a total of 9 pages. It will be scored out of 100 points. The maximum score you may receive is 100 points.

1. \_\_\_\_\_/14
2. \_\_\_\_\_/12
3. \_\_\_\_\_/12
4. \_\_\_\_\_/12
5. \_\_\_\_\_/12
6. \_\_\_\_\_/12
7. \_\_\_\_\_/16

8. \_\_\_\_\_\_/14

Total:

Regrading: All requests for regrades must be submitted in writing within 48 hours of the return of the exam. You must explicitly state what has been misgraded and why it is an error. The entire exam will be regraded, which could result in points being added or deducted overall.

1. (14pts) Draw an arrow mechanism for the following bimolecular substitution reaction.



In the space below, draw a structure of the transition state for the rate determining step of the reaction:

Would you expect the following changes to the reaction to make the rate of the reaction faster, slower, or stay the same?

Change the nucleophile to H2S: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Change the solvent to CH3CH2OH: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Change the substrate to (R)-2-bromopentane: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Heat the reaction: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Change the leaving group to HO-: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Change the substrate to 2-bromo-2-methylpentane: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. (12pts) Draw an arrow mechanism for the following E1 elimination reaction, including all intermediates.



Draw an energy diagram based on the mechanism you proposed, assuming that the reaction is exothermic overall. On the energy diagram, label the intermediate and the rate determining transition state. Label the axes of the graph.



3. (12pts) Choose TWO of the following THREE substitution reactions. Propose a major product for the reaction and label the mechanism of formation of the product as Sn1 or Sn2. Clearly mark the one you do not want graded or else the first two will be graded.



4. (12pts) Choose 3 of the following 4 ELIMINATION reactions, and indicate whether the reaction mechanism will be E1 or E2. Predict the major product(s) of the three reactions you chose. Be sure to include proper stereochemistry. Put an “X” in the box you do not want graded, or else the first three will be graded.



5. (12pts) Indicate which of the reagents or starting materials is necessary for 3 of the following 4 transformations, then EXPLAIN your choice. CLEARLY MARK the one you do not want graded with an “X” or else the first three will be graded.



6. (12pts) Draw two chair conformations for cis-1-ethyl-3-methylcyclohexane.

Use data from the table below to determine the difference in stability between the two conformations in kcal/mol.

|  |  |
| --- | --- |
| Substituent in axial position | Go (kcal/mol) |
| -H | 0 |
| -CH3 | 1.7 |
| -CH2CH3 | 1.75 |
| -CH(CH3)2 | 2.2 |
| -C(CH3)3 | 5.0 |

Use the thermodynamic rule of thumb to approximate the percentage of each conformation at equilibrium: 90%/10%, 99%/1%, 99.9%/0.1%, or in between those values.

7. (16pts) On the compounds below, mark each chiral center R or S, as appropriate. In the boxes next to them, draw their enantiomer and draw one diastereomer. If the compound does not have an enantiomer or diastereomer, write “None” in the appropriate box. Blank boxes will be marked incorrect.



Circle any of the compound above that are meso compounds.

8. (14pts) Draw two chair conformations for the compound below. Which of the two is the more stable structure? Which of the two is the reactive conformation for an E2 reaction?



Draw a mechanism for the elimination of this molecule under E2 conditions. Be sure to draw the starting material in its reactive conformation. What product(s) are produced?



Is the product of this reaction optically active or optically inactive? Explain.