Organic Chemistry Laboratory I Final Exam May 19, 2016

Your Name key

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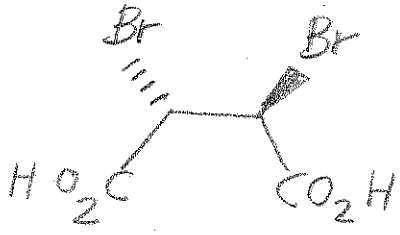
1. A student ran the bromination reaction using maleic acid instead of fumaric acid. 10 pts

maleic acid

4 a. Draw the expected product.



3 b. The student was instructed to react 5 moles of maleic acid with an excess of Br_2. What should he or she do to ensure that an excess of Br_2 is present in the reaction flask?

add extra Br_2 dropwise
making sure his/her solution remains yellow
throughout the reaction

3 c. Based on the instructions from part b above, what is the theoretical yield of product (in moles)?

5

2. Pure eugenol boils at 254°C, yet steam distils at approximately 98°C. What is the main reason why you purified eugenol via steam distillation rather than via an ordinary distillation? 8 pts

to avoid decomposition

3. At the end of the nucleophilic substitution experiment, a student isolated iodooctane along with a number of impurities, including hexadecyltributylphosphonium ion, K^+, Br^- and bromooctane. The student transferred the impure iodooctane to a separatory funnel and washed the product layer with water. 10 pts

$CH_3(CH_2)_{15}P^+(Bu)_3$

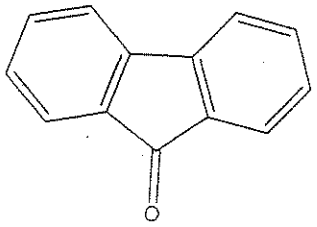
hexadecyltributylphosphonium ion

6 a. Which impurities will be removed by the water wash? $K^{\oplus}$, $Br^{\ominus}$, $CH_3(CH_2)_{15}\overset{\oplus}{P}(Bu)_3$

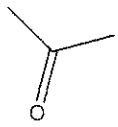
4 b. Which impurities will NOT be removed by the water wash?

bromooctane

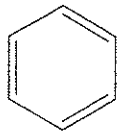
4. What is the strongest intermolecular force present in each situation given below? 20 pts (4 pts x 5)



fluorenne



acetone



benzene

a. fluorenone with acetone dipole dipole

b. fluorenone with hexane van der waals (london dispersion)

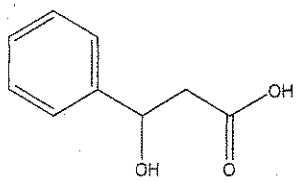
c. fluorenone with silica gel H bonding

d. fluorenone with benzene van der waals

e. In which of the four situations above is the intermolecular force between fluorenone and the other compound the greatest?

C

5. A student needed to recrystallize an impure sample of 3-phenyl-3-hydroxypropanoic acid. She had a choice of using water or acetone for her recrystallization. Knowing that at room temperature the solubility of 3-phenyl-3-hydroxypropanoic acid in water is 5 grams per mL and in acetone is 100 grams per mL, which solvent should she choose? Justify your answer. 10 pts



3-phenyl-3-hydroxypropanoic acid

H_2O should be used since the solute is slightly soluble in water.

The solute is way too soluble in acetone. If acetone is used, no solute will be recovered upon cooling in ice.

6. Two students distilled the same mixture containing two unknown liquids. Student A observed his temperature to more or less remain constant throughout the distillation while student B observed a constant temperature ONLY at the very beginning and very end of his distillation. Which distillation (A or B) did a better job of separating the two compounds? Explain. 10 pts

3 B did a better job

7 When the temp levels off near the beginning or end of a distillation it is a sign that the lower or higher boiling material is distilling off separately. A constant temperature throughout means that the distillation never properly resolved or separated the two compounds.

7. The instructions for the Nucleophilic Substitution experiment stated the following: 16 pts (4×4)

Place 10 mmol of bromooctane and 0.5 mmol hexadecyltributylphosphonium bromide in a 25 mL round bottomed flask equipped with a 1/2" stir bar. Add 6.5 mL (50 mmol) of saturated KCl solution. Attach a water cooled condenser to your flask. Stir the reaction mixture **vigorously** and heat it for 1 hour in a 60°C water bath.

How would you expect a student's percent octyl chloride to change (increase, decrease, no change) if he or she

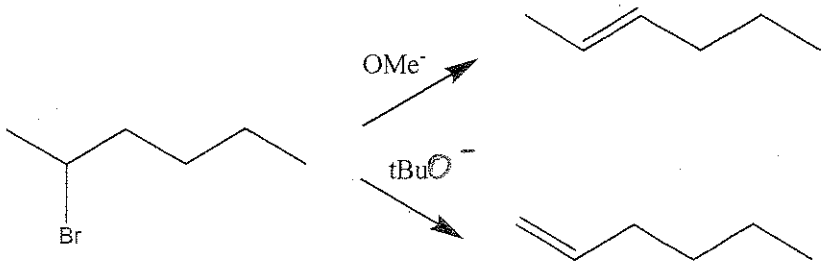
a. heated for only 30 minutes — dec

b. heated in boiling water — inc

c. added 50 mmols KCl, but used a dilute, rather than saturated KCl solution — dec

d. forgot to stir the reaction while heating — dec

8 8a. Explain why the products of the following two reactions differ: 10 pts



OMe⁻ follows zayzeff's rule

tBuO⁻ is hindered & gives the less substituted product

2 8b. How you could use Gas Chromatography to determine how the products of the two reactions differ?

the two alkenes exit the GC instrument at different times and give peaks at different times

based on known retention times, it can be determined what products form

9. In the following diagram, group X is gauche to two ring carbons. Circle the two carbons. 6 pts