UNIVERSITY OF TORONTO

FACULTY OF APPLIED SCIENCE AND ENGINEERING

FINAL EXAMINATION, DECEMBER 19, 2001

CHE203F - APPLIED CHEMISTRY II

Examiner – B. McKague

Time 2.5 hours

Student Name: _____

Student Number: _____

Answer all of the questions in the space provided on the question sheets. Marks are shown in parentheses to the left of each question. There are a total of 100 marks.

Marks

1. Draw chemical structures for the following compounds.

(8) (a) 3-Hydroxy-2-methylbutanal

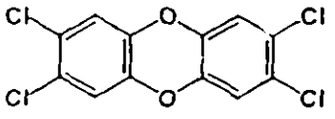
(b) Cycloheptyl phenyl ether

(c) (E)-4-Methyl-2-hexene

(d) Trichloronitromethane

2. The chemical structure of the environmental contaminant known as "dioxin" is shown below.

(8)



(a) What functional groups are present in dioxin?

(b) Does dioxin have a dipole moment?

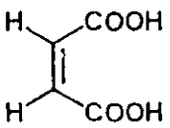
(c) What is a major reaction product of the reaction of dioxin with 2 moles of HNO_3/H_2SO_4?

(d) Would you expect dioxin to react with 2 moles of NaOH at room temperature? If yes, what is a major reaction product. If no, why not?

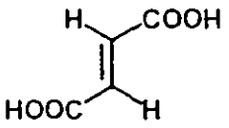
3.

(a) What kind of isomers are **1** and **2**?

(10)

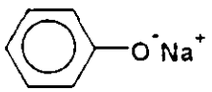


1

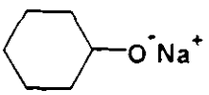


2

(b) Which of **1** and **2** is the stronger base and very briefly, why?



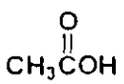
1



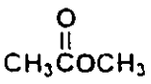
2

(c) Does an S_N1 reaction proceed faster in water or ethanol?

(d) Which of **1** and **2** is higher boiling and very briefly, why?

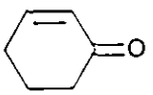


1

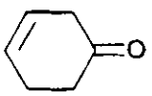


2

(e) Which of **1** and **2** is more stable and very briefly, why?

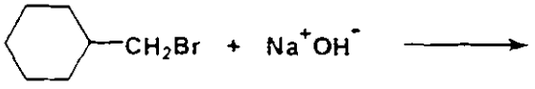


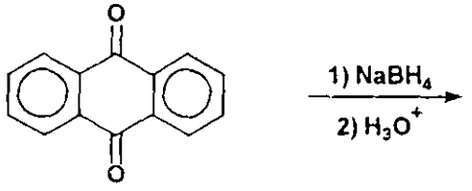
1

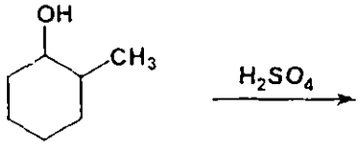


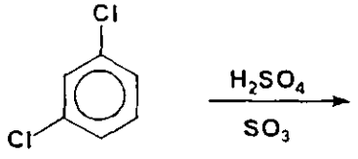
2

4. Draw chemical structures for the products from the following reactions. In cases where more than one product is obtained, indicate which product is major and which product is minor.

(a) 

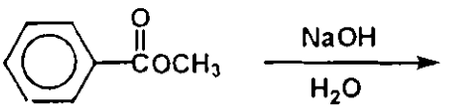
(21) (b) 

(c) 

(d) 

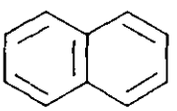
(e) RCH_2OH $\xrightarrow[2)\ H_3O^+]{1)\ KMnO_4/OH^-}$

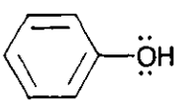
(f) CH_3CH_2Br $\xrightarrow[2)\ CH_3CHO\ \ 3)\ H_3O^+]{1)\ Mg}$

(g) 

5. Organic structures which have delocalized electrons, i.e. resonance, have increased stability. Draw resonance structures for the following compounds.

(9) (a) CH_3NO_2

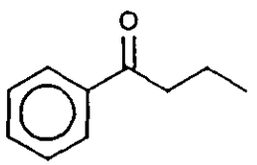
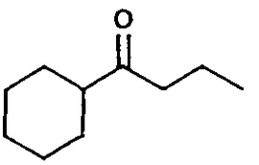
(b) 

(c) 

6. Write a mechanism for the reaction of phenol with bromine which explains the formation of the *para* isomer of the product.

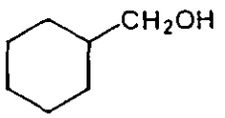
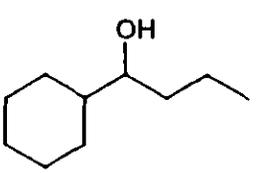
(8)

7. Show the chemical reactions and reagents you would use to prepare the compound on the right from the compound on the left.

(a)  

(15)

(b) $CH_3CHBr(CH_3)$ $CH_3CHCHO(CH_3)$

(c)  

8.

(a) What are three requirements for a compound to be aromatic?

(6)

(b) When naming aromatic compounds with substituents when can the terms *ortho-*, *meta-* and *para-* be used?

9. When acid is added to a mixture of an aldehyde and an alcohol, an equilibrium is established involving the aldehyde, a hemiacetal and an acetal.

(a) Show equations for these reactions (no mechanisms) using ethanal and ethanol as the aldehyde and alcohol respectively. How would you shift the equilibrium to the right?

(15)

(b) Show how 5-hydroxypentanal would react if it was treated with acid.

(c) Show what reaction would occur if the product from (b) was heated with sulfuric acid.