UNIVERISTY OF TORONTO
FACULTY OF APPLIED SCIENCE AND ENGINEERING
CHE 391s Organic Chemistry and Biochemistry
Final Exam - Monday April 20th, 1998
EXAMINER: Prof. E.A. Edwards

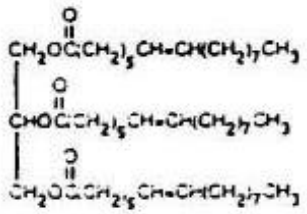
Answer all questions in the spaces provided. (9 pages; 24 questions)

Name _____ Student Number: _____

Marks or Minutes

Questions:

1. Predict the products of the reactions of glycerol tripalmitoleate (structure given below) with the following reagents:



3 a) glycerol tripalmitoleate $\xrightarrow[CCl_4]{Br_2}$

3 b) glycerol tripalmitoleate $\xrightarrow[Pd\ Catalyst]{H_2}$

3 c) glycerol tripalmitoleate $\xrightarrow[H_2O]{NaOH}$

Questions:

d) glycerol tripalmitoleate $\xrightarrow[H_3O^+]{KMnO_4}$

e) glycerol tripalmitoleate $\xrightarrow[NaOH]{KMnO_4}$

3 2. Rank the following compounds in order of increasing boiling points
a) 2-butanone
b) propanoic acid
c) pentane
d) 1-butanol

3 3. Rank the following compounds in order of increasing water solubility
a) butanal
b) butyric acid
c) pentane
d) 1-butanol

8 4. Which compound in each of the following pairs would you expect to have the higher boiling point? **Explain your answer**

Acetic acid and propanol

Propanoic acid and butanone

Acetic acid and butyric acid

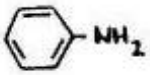
Trimethylamine and propylamine

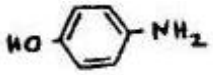
Questions:

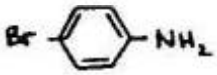
5. Rank the following compounds in order of increasing acidity

A) CH_3COOH B) CH_3CH_2COOH C) CF_3COOH
D) $CH_2ClCOOH$ E) C_6H_5OH F) CH_3CH_2OH

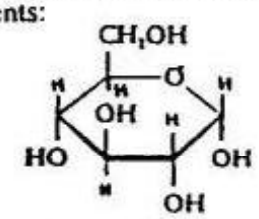
3 6. Rank the following compounds in order of increasing basicity

A) 

B) 

C) 

12 7. Predict the products of the reactions of glucose (structure given below) with the following reagents:

D-glucose 

a) glucose + $(CH_3CO)_2O$ (acetic anhydride) $\xrightarrow[pyridine,\ 0°C]{}$

b) glucose + CH_3CH_2I $\xrightarrow[base]{}$

c) glucose + CH_3CH_2OH $\xrightarrow[H^+\ catalyst]{}$

Marks or Minutes

Questions:

4 8. Reaction 7-b) is an example of an S_N2 reaction. Write the mechanism for a general S_N2 reaction between a nucleophile (Nu^-) and an alkyl halide (include transition state(s) and intermediates):

2 9. What feature of the alkyl halide enhance this S_N2 reaction?

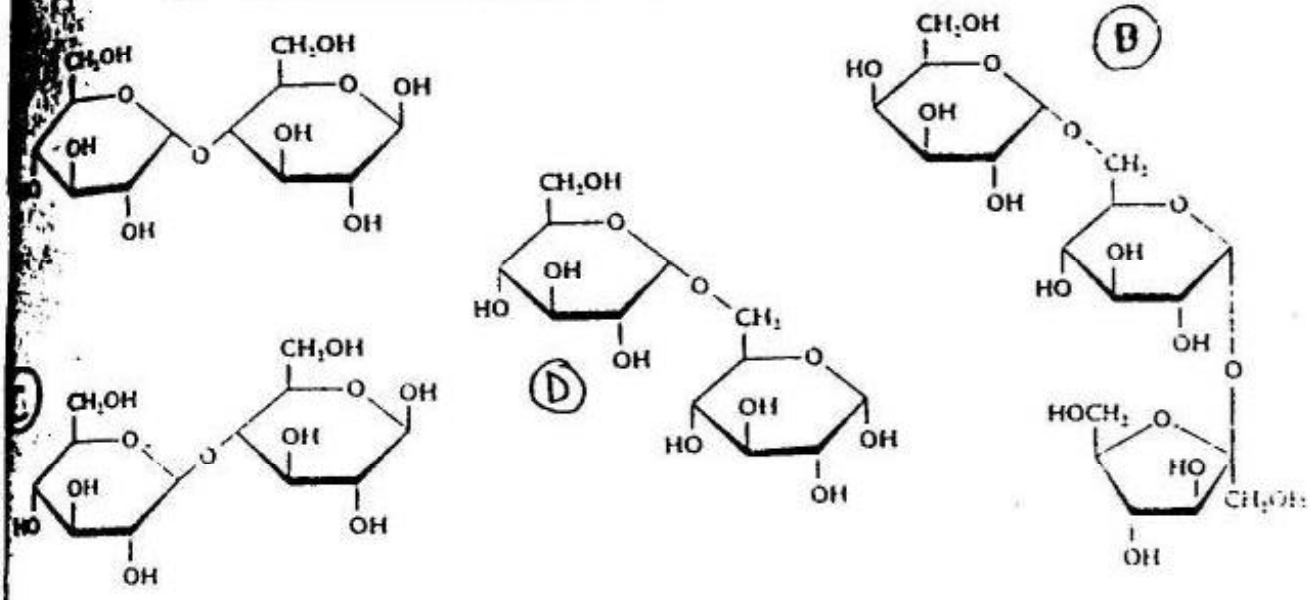
4 10. Reaction 7-a) is an example of a nucleophilic acyl substitution reaction. Write the general mechanism of this reaction between a nucleophile (Nu^-) and a carboxylic acid derivative (include transition states) and intermediates):

4 11. Rank carboxylic acid derivatives in order of increasing reactivity in nucleophilic acyl substitution reactions:

4 12. Although the overall result appears similar, what key differences can you identify between the S_N2 and nucleophilic acyl substitution reactions?

Questions:

13. The structures of four sugars (A-D) are shown below:



12 a) For each of the sugars (A-D) shown above, answer the following questions:

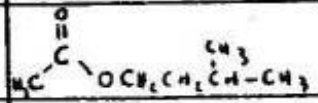
Structure	Type of linkage (s) (e.g. α-1,4')	Is it a "reducing-sugar"? Why?
A		
B		
C		
D		

4 b) Answer the following questions directly on the structure diagrams shown above:

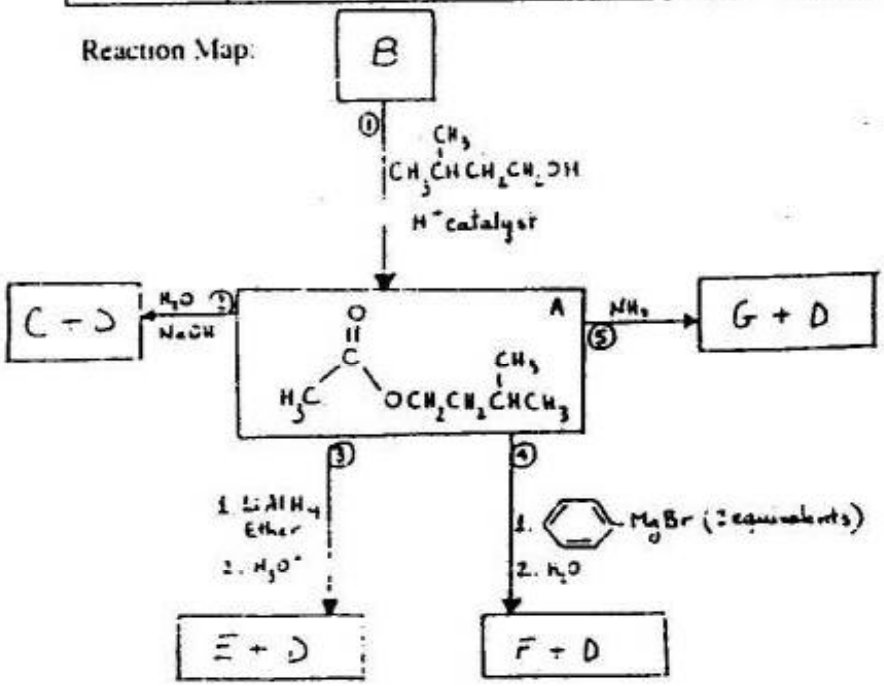
- Circle all of the stereocenters in structure A
- Use arrows to point to the glycosidic linkage(s) in structure B
- Use arrows to point to the hemiacetal carbon(s) in structure C
- Use arrows to point to the acetal carbon(s) in structure D

Questions:

14. a) Complete the following Table, using the incomplete reaction map below as a guide:

Reagent or Product	Structure	Name
A		
B		
C		
D		
E		
F		
G		

Reaction Map:



b) Fill in the blanks (refer to numbers on reaction arrows)

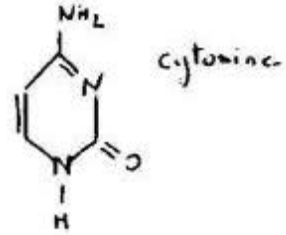
Reaction number _____ is a Fisher esterification

Reaction number _____ is a saponification reaction

Reaction number _____ is a reduction reaction

Questions:

15. Draw the structural formula for the nucleotide cytidine 5'-monophosphate. The base component is cytosine (shown below)



cytosine

2 16. How many total hydrogen bonds would exist between two complementary strands of a short piece of DNA given that one of the strands has the sequence CACGGT? (show your calculation)

3 17. Why are at least three bases needed to represent each word in the genetic code?

2 18. What are the two important regions of a tRNA molecule

Points or Minutes

Questions:

6 19. Which of the following statements about the genetic code are true and which are false? Correct false statements.

a) Each codon is composed of four bases

b) Some amino acids are represented by more than one codon

c) All codons represent an amino acid

d) Each living species is thought to have its own unique genetic code

e) The codon AUG at the beginning of a sequence is a signal for protein synthesis to begin at that codon

f) The code does not contain stop signals for protein sysnthesis

8 20. Explain why DNA fingerprinting is a powerful forensic tool; Describe the advantages of coupling PCR techniques with DNA fingerprinting

2 21. What is the primary structure of a protein: What type of bonding is responsible for primary structure?

3 22. What is the secondary structure of a protein: What type of bonding is responsible for secondary structure: give examples

Marks or Minutes

8

Questions:

23. Oxalic acid (HOOCCOOH) has two pKa values:
pK_{a1}=1.2 and pK_{a2} = 4.2
Draw the major form(s) of oxalic acid (i.e. protonated or deprotonated) in aqueous solution at the following values of pH:

a) at pH << 1.2

b) at pH=1.2

c) at pH=10

d) at 1.2<pH<4.2

10 24. Which of the following structures are aromatic? Why?

	Aromatic? (Yes/No)	Reason

a) 

b) 

c) 

d) 

e) 

THE END