

**NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY**

**DEPARTMENT OF APPLIED CHEMISTRY**

**BACHELOR OF SCIENCE HONOURS DEGREE**

**END OF SEMESTER EXAMINATIONS – AUGUST 2009**

**ORGANIC CHEMISTRY II – SCH 1202**

**TIME – THREE HOURS.**

**INSTRUCTIONS TO CANDIDATES:**

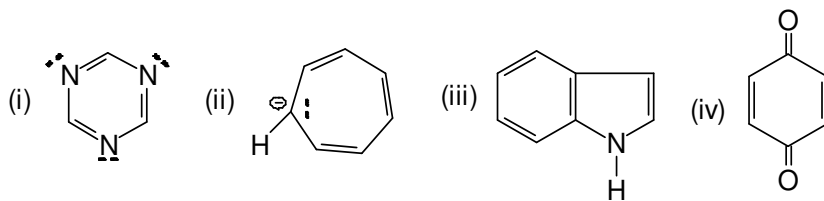
1. ANSWER ALL QUESTIONS FROM SECTION A AND ANY THREE FROM SECTION B. SECTION A CARRIES 40 MARKS AND EACH QUESTION IN SECTION B CARRIES 20 MARKS. MARKS ARE ALLOCATED AS INDICATED IN BRACKET.
2. START EACH QUESTION ON A NEW PAGE. (NOT EACH PART OF A QUESTION).
3. SHOW MECHANISM, CHEMICAL STEPS OR SYNTHESIS BY MEANS OF CURVED ARROWS.

**TOTAL MARKS = 100**

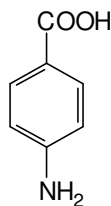
**THIS QUESTION PAPER CONSISTS OF *FIVE PRINTED PAGES* (ON ONE SIDE ONLY) INCLUDING THE TOP PAGE WITH THE INSTRUCTIONS.**

## SECTION A:

1. (a) Suggest four criteria which indicate that benzene is very stable compound. (4 Marks)
- (b) Draw isomeric structures for the molecular formula  $C_7H_7Br$  (4 Marks)
- (c) Explain Huckel's rule in your own words. (4 Marks)
- (d) State whether the following compounds are aromatic or non-aromatic and also indicate the number of pi electrons present in the compounds.



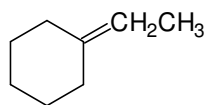
- (4 Marks)
- (e) *trans*-(*e,e*)-1,4-dimethyl cyclohexane is more stable than its *cis*-(*a,a*)-isomer. Explain this observation with an appropriate chair confirmations. (4 Marks)
- (f) Explain with the aid of chemical equations, why phenyl amine is less basic than ethylamine. (4 Marks)
- (g) Show how carbonyl compounds can exist in the enol-form and as the enolate ion which leads to alpha ( $\alpha$ ) substitution reaction. (4 Marks)
- (h) *p*-amino benzoic acid (PABA) is widely used as a sunscreen agent. Propose a synthesis of PABA starting from benzene. Use reagents of your choice.



- (4 Marks)
- (i) What are the functions of the following spectrometers?
- (i) Mass spectrometer
  - (ii) Infra-red spectrometer
  - (iii) NMR spectroscopy
  - (iv) UV-visible spectroscopy
- (4 Marks)
- (j) With an appropriate example, explain what is an  $\alpha$ -amino acid? (4 Marks)

**SECTION B:**

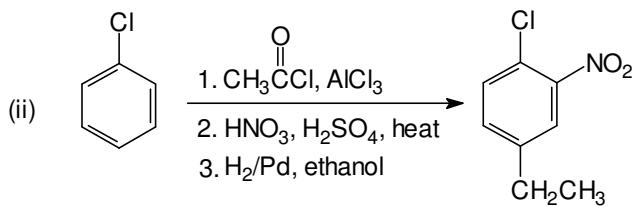
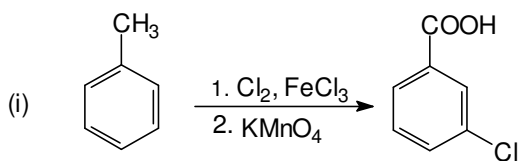
2. (a) What carbonyl compound and what phosphorus ylide might you use to prepare the following compound?



Outline the possible synthesis of ylide starting from triphenyl phosphine and halide of your choice. Write the mechanism of this Wittig reaction.

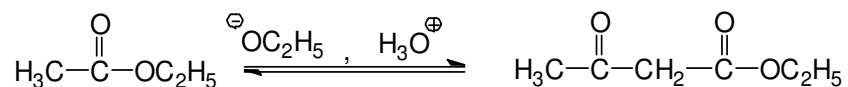
(10 Marks)

- (b) As written, the following syntheses have certain flaws. What is wrong with each one? Suggest the correct steps to produce the products. (No mechanism required).



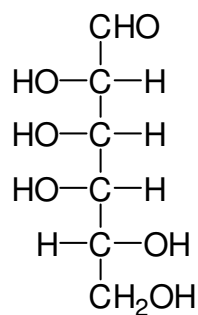
(10 Marks)

3. (a) Suggest the mechanism for the following Claisen condensation reaction.



(5 Marks)

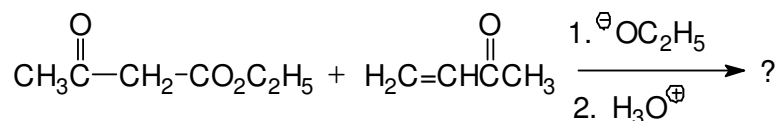
(b) You are given the following monosachharide:



D-talose

- (i) Draw Fischer projection. (1 Mark)
- (ii) Draw Haworth projection and indicate the type of reaction involved. (2 Marks)
- (iii) Give the type of the isomers Haworth projection produces. (1 Mark)
- (iv) Write Kiliani-Fischer synthesis (chain lengthning) for D-talose. For this reaction you may need HCN, acidic solution and reducing agent. (No mechanism required). (3 Marks)
- (v) What will be the products when D-talose reacts with (I) reducing agent such as sodium borohydride and (II) oxidizing agent such as nitric acid. (2 Marks)

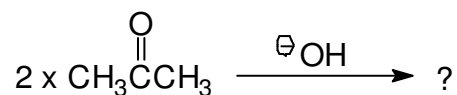
(c) Write reaction mechanism for the following Michael reaction.



(6 Marks)

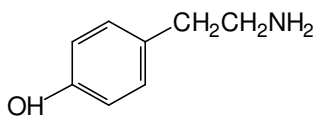
4. (a) Pyrrol and pyridine are both aromatic compounds. Explain why pyrrol undergo electrophilic substitution at position two while pyridine undergo electrophilic substitution at carbon three. (10 Marks)
- (b) Why is  $-\text{NHCOCH}_3$  group substituted to benzene ring found to be moderately *o*- and *p*- directing while  $-\text{NH}_2$  group substituted to benzene ring is highly reactive and forms 2,4,6- substituted product. (5 Marks)
- (c) Write reaction mechanism for the following reaction and indicate the

type of reaction that has taken place.



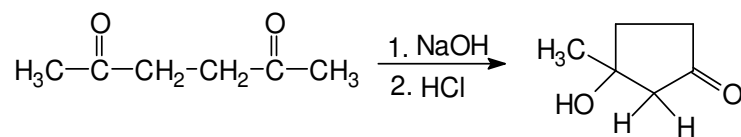
(5 Marks)

5. (a) Tyramine is an alkaloid found, among other places, in mistletoe and ripe cheese. How would you synthesise tyramine from benzene. You are provided with the following reagents;  $\text{AlCl}_3$ ,  $\text{CH}_3\text{Cl}$ ,  $\text{SO}_3/\text{H}_2\text{SO}_4$ ,  $\text{NaOH}$  solution, acidic solution, Bromine,  $\text{NaCN}$ , reducing agent such as  $\text{LiAlH}_4$ ,  $\text{H}_2\text{O}$ , peroxide or UV radiation lamp and any other reagents you may need. (No mechanism required).



(7 marks)

- (b) Write reaction mechanism for the following reaction.



(5 Marks)

- (c) Friedel-Crafts alkylation has limitations. State them and give one example of each.

(8 Marks)

\*\*\*\*\*END OF PAPER\*\*\*\*\*