THE OPEN UNIVERSITY OF SRI LANKA

B.Sc. DEGREE PROGRAMME / STAND ALONE COURSE 2008/2009

LEVEL 5-FINAL EXAMINATION

CHU 3131/CHE 5131
THE CHEMISTRY OF AMINO ACIDS, SUGARS AND RELATED COMPOUNDS

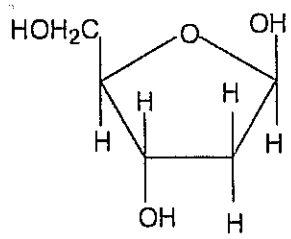
DURATION: 2½ HOURS

Wednesday15th July 2009 1.30 p.m.- 4.00 p.m.

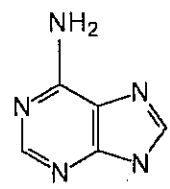
Answer any FOUR questions only.

If you have answered more than four questions, only the first four answers will be marked.

1. (a) Draw the structure of nucleotide, deoxyadenosine 5'-mono phosphate formed from 2'-deoxyribose, adenine and phosphate.



2'-Deoxyribose



adenine

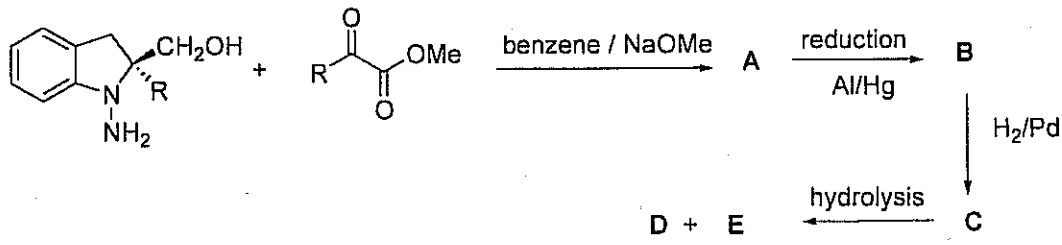
(20 marks)

(b). Explain briefly the functions of DNA and RNA (m-RNA, t-RNA, r-RNA).

(30 marks)

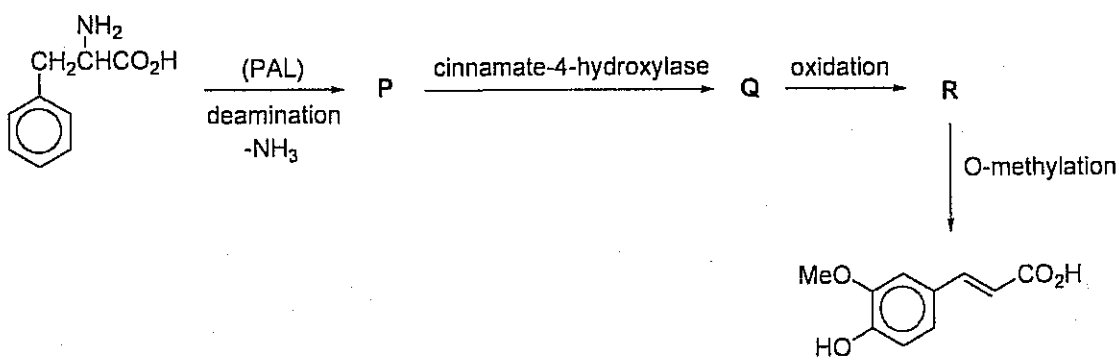
PQ1745

(c). Identify the products (**A** - **E**) of the following reaction scheme. Write the mechanism of the reaction.



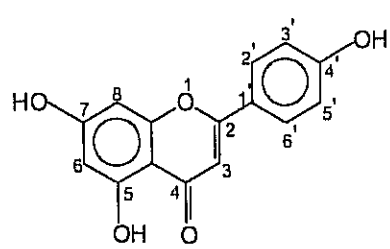
(50 marks)

2. (a) Write the intermediates (**P** - **R**) in the biosynthesis of ferulic acid from phenylalanine, $PhCH_2CH(NH_2)COOH$.



(30 marks)

(b). Apigenin (**A**) is a flavonoid. Ethanolic solution of (**A**) shows a UV absorption band in the region 250-270nm.



Apigenin (A)

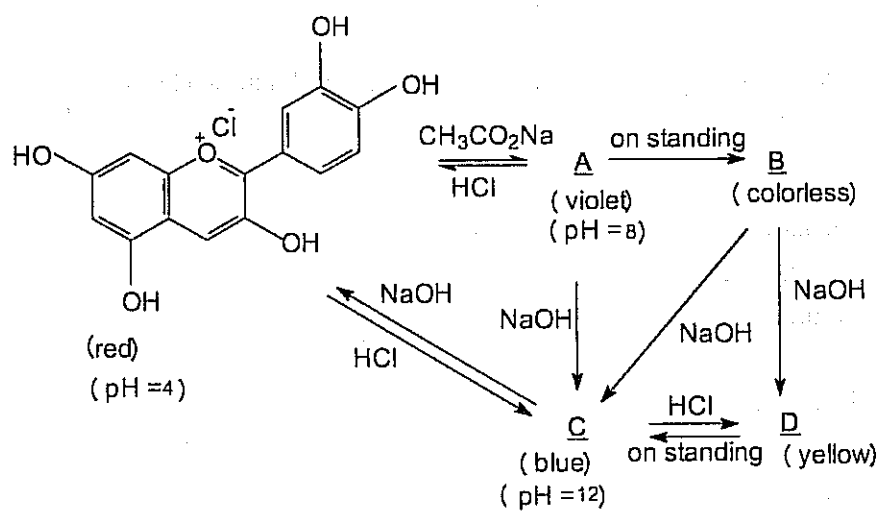
(i) Explain the shift observed in the UV spectrum of Apigenin (**A**), when $AlCl_3$ is added.

(ii) What change would you expect in the UV spectrum of (**A**) when alcoholic NaOAc is added? Explain.

(iii) Explain why the OH group at C-5 of (A) is less acidic than that at C-7.
(iv) Indicate clearly the carbon atoms that contain hydrogen atoms which could show *ortho* and *meta* coupling in the ^{1}H-NMR spectrum of Apigenin (A).

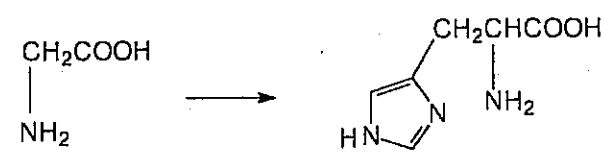
(40 marks)

(c). Flowers often change colours when immersed in water at various pH values indicated below. Identify the ions responsible for each of the colours and indicate the mechanism of the reaction involved.



(30 marks)

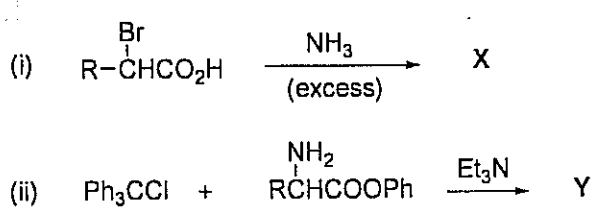
3. (a) How would you effect the following transformation? Give the necessary reagents and write the mechanism for the reaction.



glycine histidine

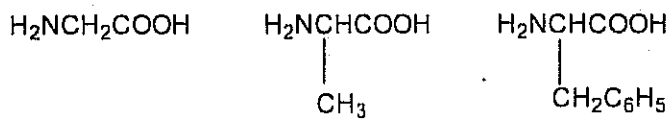
(30 marks)

(b). Predict the products of the following reactions.



(30 marks)

(c). Write down the structure of the pentapeptide Ala.Gly.Ala.Phe.Gly. Give the structure only of the DNP derivative obtained when the pentapeptide Ala.Gly.Ala.Phe.Gly is treated with 2,4-dinitroflurobenzene and then hydrolysed with 6N HCl. What is the structure of the reaction product obtained when the pentapeptide is treated with phenylisothiocyanate followed by mild acid hydrolysis? Give the mechanism of the reaction.



Glycine (Gly) Alanine (Ala) Phenylalanine (Phe)

(40 marks)

4. (a) i. What is meant by "mutarotation"?

ii. Taking D-glucose as an example, explain what happens during mutarotation.

(25 Marks)

(b) D-galactose is the C-4 epimer of D-glucose.

i. Draw the Fischer projection formula of D-galactose.

ii. Draw the chair conformation of methyl-α- D-galactopyranoside.

iii. Draw the Haworth projection formula of methyl-β- D-galactofuranoside.

iv. Give the structure of the product when D-galactose reacts with excess phenylhydrazine.

v. Another aldohexose **A**, gives the same product as D-galactose when treated with excess phenyl hydrazine. Giving reasons, predict the structure of aldohexose **A**.

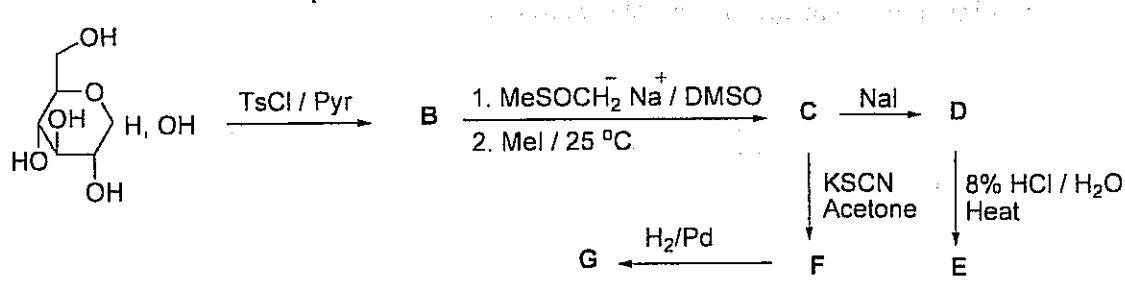
(30 Marks)

(c) i. Give the structure of the product when D-glucose is reacted with bromine water at 25 °C.

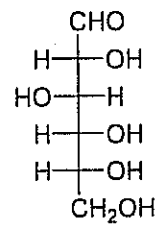
ii. Give the structures of the products when the above solution is evaporated at 35 °C and at high temperature.

(15 Marks)

(d) Give the structures of compounds **B** – **G** in the following reaction scheme.



(30 Marks)

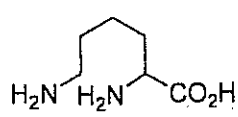


D-glucose

5. (a) Giving necessary chemical equations, describe how you would isolate the alkaloid fraction from a methanol extract of a plant.

(20 Marks)

(b) Postulate the biosynthetic pathway leading to pseudopelletierine from lysine.

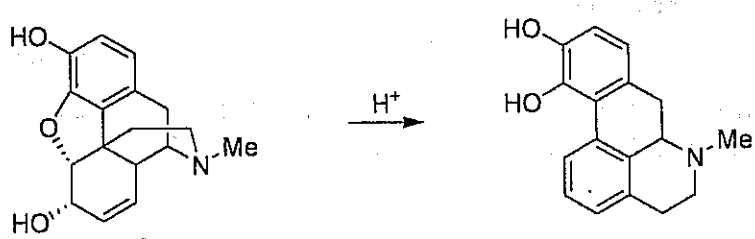


lysine

pseudopelletierine

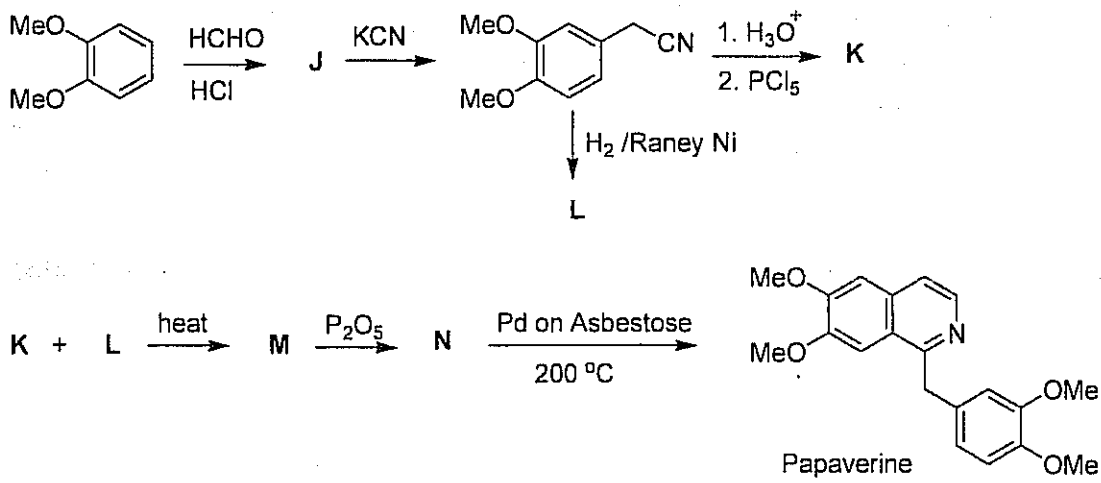
(30 Marks)

(c) Give the mechanism for the following conversion.



(25 Marks)

(d) The following reaction scheme depicts the synthesis of papaverine from 1,2-dimethoxy benzene. What are the structures of compounds **J** – **N**?

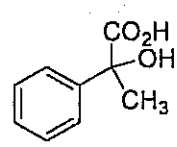


(25 Marks)

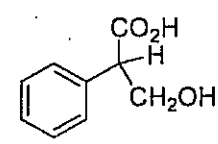
6. (a) (+)-Gentibiose, **J** ($C_{12}H_{22}O_{11}$) gave a silver mirror when treated with Tollens reagent. Complete hydrolysis followed by GLC analysis of alditol acetates showed that **J** contains only glucose. Treatment of (+) gentibiose with MeI in the presence of dimsyl anion gave the product **K**, which upon acid hydrolysis gave 2,3,4,6-tetra-*O*-methyl-D-glucopyranose and 2,3,4-tri-*O*-methyl-D-glucopyranose. ^{1}H NMR spectrum of **K** showed a doublet at δ 4.8 (J = 7.0 Hz) among the other signals, which was assigned to the anomeric proton at the glycoside linkage. Deduce the structure of (+)-gentibiose.

(50 Marks)

(b) Propose a synthetic route to prepare tropic acid *via* atropic acid starting from acetophenone.



Atropic acid



Tropic acid

(30 marks)

(c) Giving relevant structures of compounds, write a short account on biologically active alkaloids. (*It is sufficient to consider four examples from different structural types*).

(20 marks)