THE OPEN UNIVERSITY OF SRI LANKA

B. Sc DEGREE PROGRAMME / STAND ALONE COURSE 2007 / 2008

LEVEL 5 - FINAL EXAMINATION

CHU 3131 / CHE 5131

THE CHEMISTRY OF AMINO ACIDS, SUGARS AND RELATED COMPOUNDS

DURATION: 2 1/2 HOURS

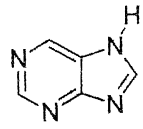
Thursday 3rd July 2008 — 1.30 - 4.00 p.m.

Answer any FOUR (04) questions only.
If you have answered more than four questions, only the first four answers will be marked.

1. (a) Explain briefly the functions of (i) Messenger RNA
(ii)Transfer RNA

(20 Marks)

(b) Indicate the compounds from which N-1, C-6 and N-3 of the purine ring is formed during biosynthesis.

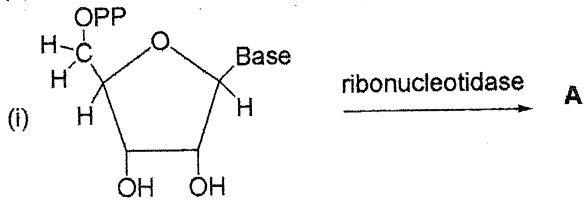


Purine

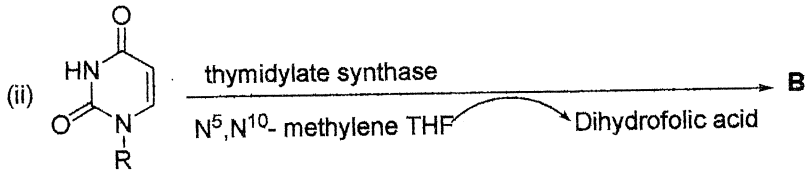
(15 Marks)

(c) Complete the missing compounds **A** and **B** in the following biosynthetic pathways.

(i)

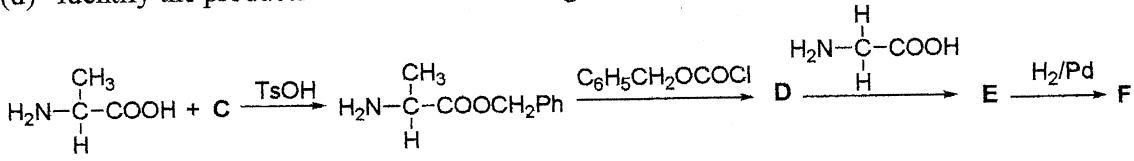


(ii)



(20 Marks)

(d) Identify the products **C** –**F** in the following reaction scheme.

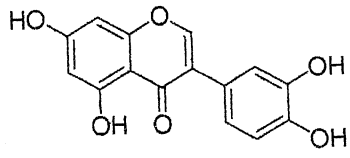


(25 Marks)

(e) Explain **two** methods that can be used to resolve an amino acid mixture that contains D/L alanine.

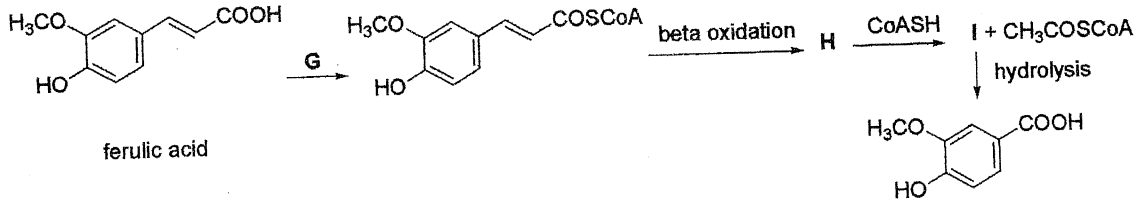
(20 Marks)

2. (a) Name the **two** pathways by which the isoflavanoid shown below is biosynthesized. Label the rings as A, B and C and clearly indicate the rings formed by each pathway.



(20 Marks)

(b) (i) Ferulic acid labeled at C-2 with ^{14}C was fed into a plant. Complete the biosynthetic pathway leading to vanillic acid by identifying the missing compounds and co-enzymes (**G** – **I**).



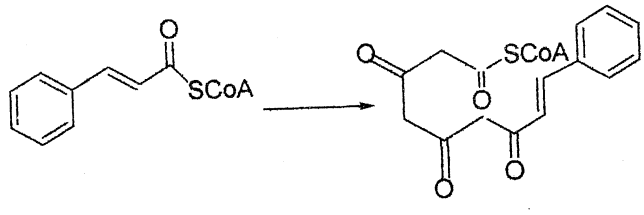
ferulic acid

(ii) Indicate the position of labeling in $CH_3COSCoA$ formed from **H**.

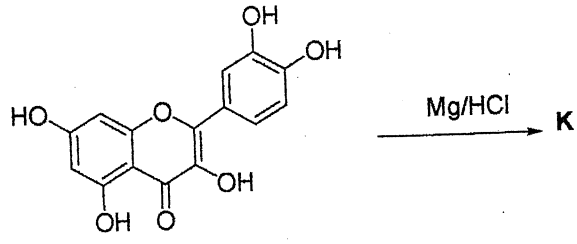
(20 Marks)

(c) Identify the missing compounds **J** and **K** in the following reaction schemes.

(i) **J** +



(ii)

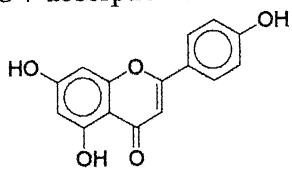


(20 Marks)

(d) Explain briefly the effect of dietary tannins on protein digestion.

(10 Marks)

(e) Compound **L** shows a UV absorption band in the region 250 – 270 nm.



L

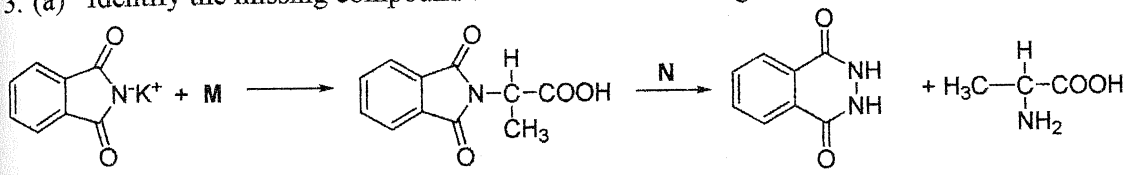
(i) Will the compound **L** show bathochromic shift on adding $AlCl_3$? Explain your answer.

(ii) Giving reasons identify which OH group is ionized with sodium acetate.

(iii) Does the compound **L** react with vanillin in sulphuric acid? Explain briefly.

(30 Marks)

3. (a) Identify the missing compound **M – N** in the following reaction scheme.



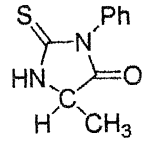
(20 Marks)

(b) (i) Deduce the structure of the pentapeptide **P** from the following data.

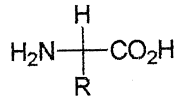
(I) The product obtained by treating **P** with phenyl isothiocyanate (PhN=C=S) followed by hydrolysis with CF_3COOH gave phenyl thiohydantoin **Q**.

(II) Initially a high concentration of methionine, followed by phenyl alanine was obtained when **P** was reacted with carboxypeptidase

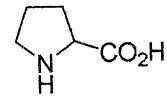
(III) Partial acid hydrolysis of **P** yielded peptides Pro.Phe, Ala.Gly and Gly.Pro.Phe



(**Q**)



R = H Glycine (gly)
= CH_3 Alanine (ala)
= $C_6H_5CH_2$ Phenyl alanine (Phe)
= $CH_3SCH_2CH_2$ Methionine (Met)

Pro = 

(35 Marks)

(ii) Giving reasons identify whether the peptide **P** will be cleaved by trypsin.

(10 Marks)

(c) Identify the missing compounds **R** and **S** in the following synthetic scheme.

(15 Marks)

(d) Explain the following terms.

(i) homodetic peptide

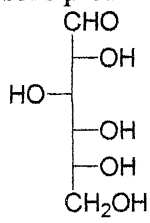
(ii)heterodetic peptide

(20 Marks)

4. (a) i. Draw the structure of hexose (**A**) which is the C-3 epimer of D-glucose.

ii. Give the structure of the product when **A** reacts with excess of phenylhydrazine.

iii. Another aldohexose (**B**) gives the same product as **A** when reacted with phenylhydrazine. Giving reasons predict the structure of **B**?



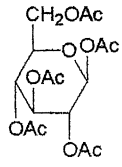
D-glucose

(25 Marks)

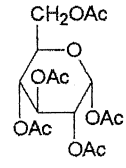
(b) Give the structure of β- D-glucose. Explain using appropriate structures, how when crystalline β-D-glucose ($[\alpha]_D = +19°$) is dissolved in water the specific rotation ($[\alpha]_D$) slowly changes to + 52.5° with time.

(20 Marks)

(c) Giving reasons explain how you would distinguish the following two aldopyranose derivatives **P** and **Q** using ^{1}H NMR spectral data.



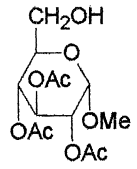
P



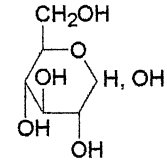
Q

(25 Marks)

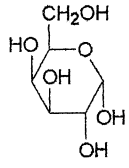
(d) Give the structures of **R** – **W** of the following reaction sequences.

i. 

$\xrightarrow{PBr_3}$ **R** $\xrightarrow{H_2 / Ni / NaOH}$ **S**

ii. 

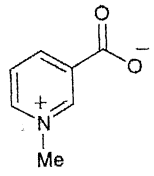
$\xrightarrow[80\ °C]{CH_3COCl / dry\ MeOH}$ **T** $\xrightarrow{CH_3SOCH_2^-\ Na^+ / DMSO}$ **U** $\xrightarrow{8\%\ HCl}$ **V**

iv. 

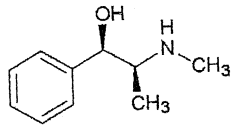
$\xrightarrow[0\ °C]{p\text{-TsCl / Pyridine}}$ **W**

(30 Marks)

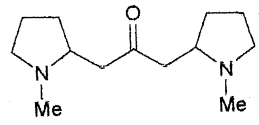
5. (a) Classify the following alkaloids into their groups according to the nucleus present.



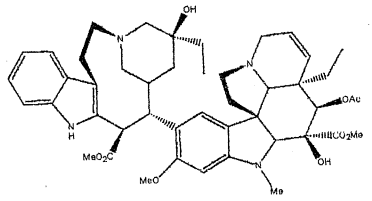
Trigonelline



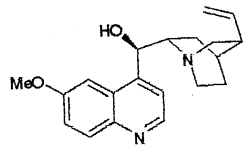
Ephedrine



Cuscohygrine



vinblastine



quinine

(20 Marks)

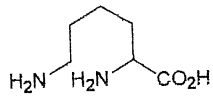
(b) An alkaloid **A** ($C_9H_{13}NO_3$) was found to be optically active. It is soluble in aqueous NaOH and re-precipitated by CO_2. It gives green colour with neutral $FeCl_3$. When boiled with aqueous KOH it evolves $MeNH_2$. When oxidized with CrO_3 **A** gave a ketone. When **A** is fused with KOH, it yields 3,4-dihydroxybenzoic acid.

Deduce the structure of the alkaloid **A**.

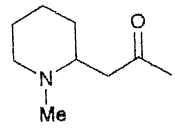
Give the structure of the product when **A** is subjected to Hoffman exhaustive methylation.

(30 Marks)

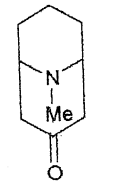
(c) Postulate the biosynthetic pathway leading to N-methylisopelletierine and pseudopelletierine from lysine.



lysine



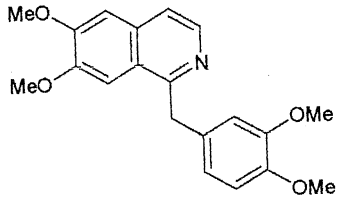
N-methylisopelletierine



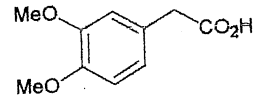
pseudopelletierine

(20 Marks)

(d) Propose a synthesis of papaverine staring from (3,4-dimethoxyphenyl)acetic acid.



papaverine



(3,4-Dimethoxyphenyl)acetic acid

(30 Marks)

6. (a) Using an appropriate example, explain the steps involved in the identification of constituent monosaccharide units in a disaccharide.

(20 Marks)

(b) Briefly explain giving an appropriate example, what is meant by methylation analysis in the process of structure elucidation of carbohydrates.

(20 Marks)

(c) What information can you obtain from the following experiments with respect to structure elucidation of oligosaccharides?.

i. Enzymic hydrolysis
ii. Reaction with Tollens reagent.

(10 Marks)

(d) Giving five examples (with their structures) write a short account of biological active alkaloids.

(50 Marks)