Candidate Name	Centre Number	Candidate Number
		2

GCE AS/A level

334/01

CHEMISTRY CH4

P.M. THURSDAY, 12 June 2008

1 hour 40 minutes

FOR EXAMINER'S USE ONLY		
Section	Question	Mark
A	1	
	2	
	3	
B	4	
	5	
TOTAL MARK		

ADDITIONAL MATERIALS

In addition to this examination paper, you will need:
- a calculator;
- an 8 page answer book;
- a **Data Sheet** which contains a **Periodic Table** supplied by WJEC. Refer to it for any **relative atomic masses** you require.

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces at the top of this page.

Section A Answer **all** questions in the spaces provided.
Section B Answer **both** questions in Section B in a separate answer book which should then be placed inside this question-and-answer book.

Candidates are advised to allocate their time appropriately between **Section A (35 marks)** and **Section B (40 marks)**.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

The maximum mark for this paper is 75.

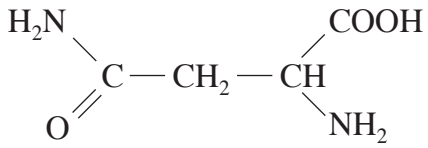
Your answers must be relevant and must make full use of the information given to be awarded full marks for a question.

You are reminded that marking will take into account the Quality of Written Communication in all written answers.

SECTION A

Answer **all** *the questions in the spaces provided.*

1. Asparagine is a vital component of many plants, where it is used to transport and store nitrogen. It has the structure shown below.



Asparagine

(a) State the **three** functional groups present in asparagine. [2]

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(b) Asparagine occurs as two stereoisomers. Name the type of stereoisomerism and explain why it occurs in this particular molecule. [2]

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.....

.....

(c) Asparagine is a white solid with a high melting temperature (182 °C). Explain the bonding in asparagine solid which leads to the high melting temperature. [2]

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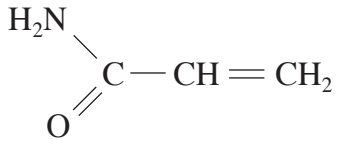
.....

.....

(d) 1 mole of asparagine reacts with 2 moles of sodium hydroxide on gentle warming. Draw the structure of the organic product formed when asparagine reacts with NaOH. [2]

(e) When cooking food at high temperature, asparagine can react to produce 2-propenamide (acrylamide), also a white solid and a possible carcinogen.



2-propenamide

(i) Give one test, including reagents and expected observations, which would distinguish between the two white solids asparagine and 2-propenamide. [2]

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(ii) One method which has been suggested to remove 2-propenamide from food is to induce alkene polymerisation.

I. Classify the type of reaction involved in alkene polymerisation. [1]

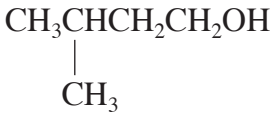
.....

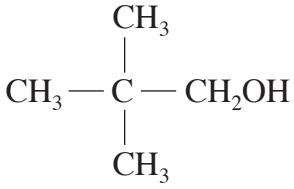
II. Draw the repeating unit for the polymer formed by the alkene polymerisation of 2-propenamide. [1]

Total [12]

2. Compound **A**, a pheromone used by honey bees, has the molecular formula $C_7H_{14}O_2$. On refluxing with sodium hydroxide solution and subsequent acidification, compound **A** reacts to give ethanoic acid and an alcohol, **B**, $C_5H_{12}O$.

(a) On oxidation with acidified potassium dichromate solution, **B** gives a carboxylic acid. Two of the **four** possible structures for **B** are shown below.





Draw the remaining **two** possible structures for **B**. [2]

(b) When **B** is treated with a dehydrating agent, a **branched** alkene, compound **C**, is the product.

(i) Name a suitable dehydrating agent for this reaction. [1]

.....

(ii) Draw the structures of the **two** branched alkenes which could be compound **C**. [2]

(c) When hydrogen bromide, HBr, is added across the double bond in alkene **C**, the main product contains a chiral centre. Use this information together with parts (a) and (b) to identify compounds **A**, **B**, and **C**. [4]

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(d) (i) Name the functional group in the pheromone **A**. [1]

.....

(ii) State the reagents and conditions necessary to convert **B** back into the pheromone **A**. [2]

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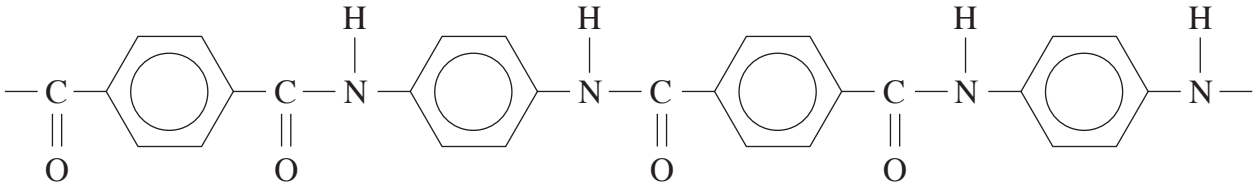
Total [12]

3. *(a)* Kevlar is an organic polymer with five times the strength of steel. It is used in bullet-proof vests. A section of the Kevlar chain is shown below.



(i) Name the class of polymers to which Kevlar belongs. [1]

.....

(ii) Two different molecules combine to form the polymer and water only. Classify the type of polymerisation reaction which is occurring. [1]

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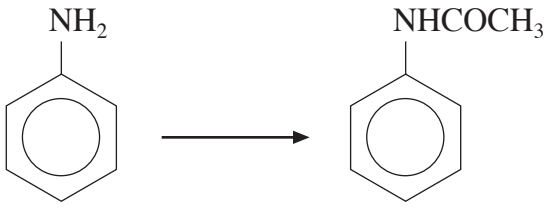
(iii) Draw the structures of the two molecules which react to form the polymer. [2]

(b) Another method of producing the same linkage is by ethanoylation, such as the conversion shown below.



State the reagent which could produce this conversion at room temperature and write an equation for the reaction. [2]

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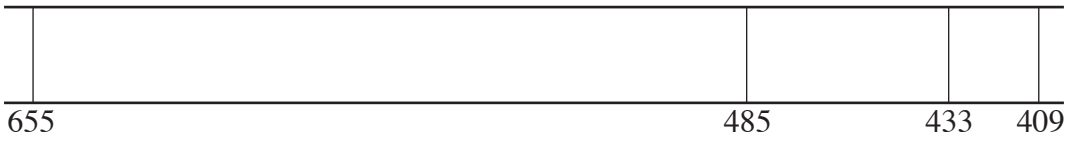
(c) The diagram shows the **visible** section of the atomic hydrogen emission spectrum.



Wavelength (nm)

(i) Explain why the spectrum consists of a series of discrete lines. [2]

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.....

.....

(ii) On the diagram, mark the red end and the violet end of the spectrum. [1]

(iii) For each of the following two lines, state both the electron energy levels (shells) involved in the transition to produce the line. [2]

655 nm line .....

433 nm line .....

Total [11]

Section A Total [35]

SECTION B

Answer **both** *questions in the separate answer book provided.*

4. *(a)* Two organic compounds **P** and **Q** are to be identified.

(i) **P** produced effervescence when added to saturated sodium hydrogencarbonate solution.
Q gave an orange precipitate with 2, 4 - dinitrophenylhydrazine and a pale yellow precipitate with iodine in alkaline solution.
Identify the groups in **P** and **Q** whose presence is confirmed by these tests. [2]

(ii) The two compounds produced the following *m*/*z* peaks in a mass spectrometer:

1st spectrum 60, 45, 15 2nd spectrum 58, 43, 28, 15.

State the relative molecular masses of the two compounds. [1]

(iii) Using all the information in (i) and (ii), identify the two compounds **P** and **Q**, giving full reasons for your choice. Your answer should state which mass spectrum corresponds to **P** and which to **Q** and include the identity of the ion responsible for each peak in the two mass spectra. [6]

(b) Propanoic acid has the formula CH_3CH_2COOH.

(i) List the peaks which would be found in the NMR spectrum of propanoic acid. For each peak give the approximate chemical shift (ppm) and the splitting of the peak. [3]

(ii) Explain why propanoic acid is completely soluble in water but butanoic acid, $CH_3CH_2CH_2COOH$, is less soluble. [2]

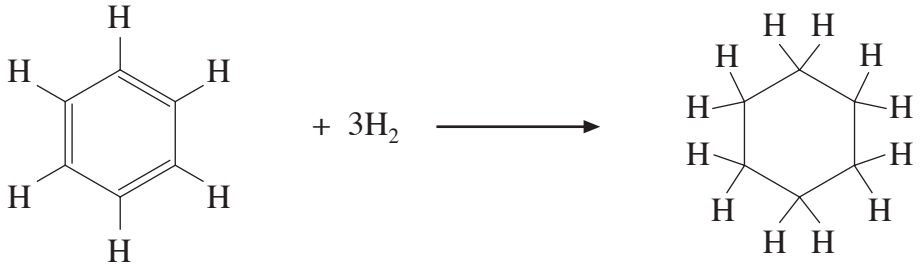
(iii) State the reagent(s) and conditions necessary to convert propanoic acid into

I. ethane, [2]
II. propan-1-ol, [2]
III. propanoyl chloride. [2]

Total [20]

5. *(a)* Describe the structure of, and bonding in, benzene. You may include appropriate diagrams in your answer. [5]

(b) The following reaction represents the hydrogenation of cyclohexa-1, 3, 5-triene



(i) Calculate $\Delta H^{\ominus}$ for the hydrogenation reaction given the following bond enthalpies (kJ mol^{-1}).

C – H 412 H – H 436 C – C 346 C = C 612 [3]

(ii) Given the experimental value

benzene + $3H_2$ → C_6H_{12} $\Delta H^{\ominus} = -210$ kJ mol^{-1}

explain the term ***delocalisation energy of benzene*** and calculate it. [2]

(c) Give the mechanism for the nitration of benzene to form nitrobenzene. [3]

(d) (i) A reaction sequence is shown below.

$C_6H_5NO_2$ → $C_6H_5NH_2$ → $C_6H_5N_2Cl$ → C_6H_5OH

For each of the three stages, give the reagents and conditions necessary to bring about the conversion. [5]

(ii) Give one test to show that the final product is a phenol. [2]

Total [20]

Section B Total [40]