Centre Number	Candidate Number

Candidate Name _____

CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Subsidiary Level

CHEMISTRY **8701/2**

PAPER 2

OCTOBER/NOVEMBER SESSION 2001 1 hour

Candidates answer on the question paper.
Additional materials:
    Data Booklet

TIME 1 hour

INSTRUCTIONS TO CANDIDATES

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

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES

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

You may lose marks if you do not show your working or if you do not use appropriate units.

A Data Booklet is provided.

FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
6	
TOTAL	

This question paper consists of 11 printed pages and 1 blank page.

[Turn over

1 **(a)** Give the full electron configuration of the following.

   (i) Mg ....

   (ii) Mg^{2+} ....

   (iii) O ....

   (iv) O^{2-} ....

[2]

(b) **(i)** Describe, with the aid of a diagram, the lattice structure of magnesium oxide.

   (ii) Use your diagram to interpret and explain **two** physical properties of magnesium oxide.

   ....

   ....

   ....

   ....

   (iii) State **two** large scale uses of magnesium oxide.

   ....

   ....

[5]

(c) Calcium oxide, unlike magnesium oxide, cannot be left open to the air since it reacts with two gases present in the air.

  (i) State which **two** gases react with calcium oxide.

....

 (ii) Write equations for the two reactions.

....

....

....

[3]

[Total : 10]

2 The reaction of ethanoic acid with ethanol to form ethyl ethanoate and water is an example of dynamic equilibrium. It is catalysed by the presence of H$^+$ ions.
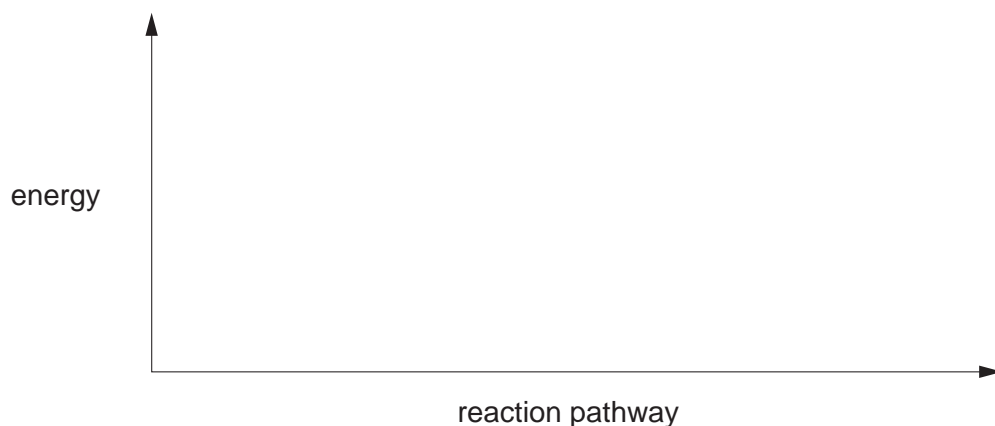
$$CH_3CO_2H(l) + C_2H_5OH(l) \rightleftharpoons CH_3CO_2C_2H_5(l) + H_2O(l)$$
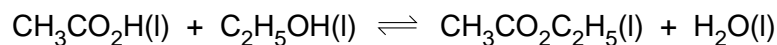
$$\Delta H = +14 \, kJ \, mol^{-1}$$

(a) **(i)** Explain what is meant by *dynamic equilibrium*.

....

....

(ii) On the axes below, draw and label a reaction pathway/energy diagram for both the catalysed and uncatalysed reaction.

Also label your diagram with the ΔH value given.

energy

reaction pathway

[5]

(b) **(i)** State the expression for the equilibrium constant, K_c, for this reaction.

(ii) State why, in determining the value of K_c for this reaction, it is only necessary to know the number of moles rather than the concentrations of each substance.

....

....

[2]

(c) In an experiment to determine K_c, 1.00 mol of ethanoic acid was allowed to reach equilibrium at 60 °C with 1.00 mol of ethanol in the presence of 0.100 mol of H$^+$ dissolved in 1.00 mol of water. It forms an homogeneous mixture.

  (i) At equilibrium, it was found that 0.43 mol of ethanoic acid was present.

   How many moles of each of the following are present at equilibrium?

   ethanol ....

   ethyl ethanoate ....

   water ....

  (ii) Use these values to calculate the equilibrium constant, K_c.

[4]

[Total : 11]

3 **(a)** Describe the appearance of bromine.

.... [1]

(b) Explain why bromine has a higher boiling point than chlorine.

....

....

.... [2]

(c) Write equations for the following reactions.

(i) phosphorus burning in an excess of chlorine

(ii) the product from **(i)** reacting with water

(iii) aqueous sodium chloride being added to aqueous silver nitrate

(iv) aqueous ammonia being added to the mixture from **(iii)**

[4]

(d) **(i)** Write the equation for the reaction of bromine with ethene.

....

(ii) State what type of organic reaction this is.

....

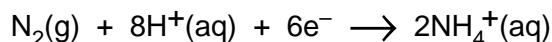**(iii)** Describe the mechanism of the reaction of bromine with ethene.

[5]

[Total : 12]

[Turn over

4 Biological fixation of nitrogen from the air can occur in three stages in soil, producing nitrate ions, NO_3^-. Protein is synthesised by the plant from nitrate ions.

Stage 1

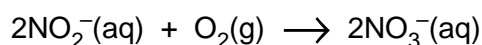At the root nodules of plants, nitrogen is converted into ammonium ions.

$$N_2(g) + 8H^+(aq) + 6e^- \longrightarrow 2NH_4^+(aq)$$

Stage 2

The action of aerobic bacteria oxidises ammonium ions to nitrite ions.

$$2NH_4^+(aq) + 3O_2(g) \longrightarrow 2NO_2^-(aq) + 4H^+(aq) + 2H_2O(l)$$

Stage 3

The action of other bacteria oxidises nitrite to nitrate ions.

$$2NO_2^-(aq) + O_2(g) \longrightarrow 2NO_3^-(aq)$$

(a) State the oxidation states of nitrogen in the four nitrogen containing species in this sequence.

N_2 .... NO_2^- ....

NH_4^+ .... NO_3^- ....   [2]

(b) (i) Comment on why Stage 1 should be energetically difficult.

....

....

(ii) Explain why the use of artificial fertilisers such as ammonium sulphate leads to the rapid growth of vegetables.

....

....

[2]

(c) The optimum pH for stage 2 to occur is 8.2.

(i) Calculate the hydrogen ion, H^+, concentration at this pH.

(ii) Suggest why a slightly alkaline soil favours Stage 2 going to completion.

....

....

....

(iii) Suggest what might be added to acidic soils to produce soils which have a pH of 8.2.

....

[3]

(d) Stages 2 and 3 do not occur in waterlogged soils. Suggest a reason why this is so.

....

.... [1]

(e) **(i)** Draw a dot and cross structure for the ammonium ion.

(ii) Predict its shape and bond angle.

....

[2]

[Total : 10]

5 Dodec-1-ene has the structure shown.

$$CH_3(CH_2)_9CH = CH_2$$
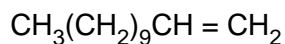
(a) Draw the structures of the organic molecules produced when dodec-1-ene reacts with each of the following.

(i) bromine	**(ii)** hydrogen bromide
(iii) hot, concentrated manganate(VII) ions	**(iv)** steam

[4]

(b) (i) What type of isomerism is shown by the organic products in **(i)**, **(ii)** and **(iv)**?

....

(ii) Draw structures to represent these isomers, choosing any **one** of these products.

[3]

(c) Dodec-2-ene shows another type of isomerism. Draw and label diagrams which show these two isomers.

[2]

[Total : 9]

6 The African weaver ant aggressively defends its territory by giving off alarm pheromones when threatened. Four organic compounds have been identified in the mandibular glands of these ants, and are related to this behaviour.

The structures of these molecules are as follows.

$$CH_3CH_2CH_2CH_2CH_2CH_2OH$$

A

$$CH_3(CH_2)_7\overset{\overset{\textstyle O}{\|}}{C}CH_2CH_3$$
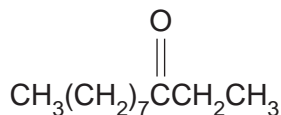
B
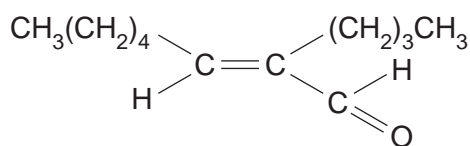
C
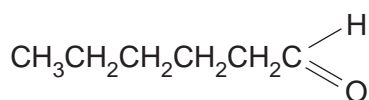
D

Outline a series of chemical tests, with the observations, to distinguish each compound from the others.

Positive identification is required for each compound, and this may require the use of more than one test.

A ....

....

....

B ....

....

....

C ....

....

....

D ....

....

....

[Total : 8]

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