Centre No.						Paper Reference (complete below)							Surname	Initial(s)
Candidate No.										/			Signature	

Paper Reference(s)

6242/01

Edexcel GCE

Chemistry

Advanced Subsidiary

Unit Test C2

Wednesday 4 June 2003 – Morning

Time: 1 hour

Materials required for examination
Nil

Items included with question papers
Nil

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
Total	

Instructions to Candidates

In the boxes above, write your centre number, candidate number, surname and initials, the paper reference and your signature.
Answer ALL the questions in the spaces provided in this question paper.
Calculators may be used.
Show all the steps in any calculations and state the units.

Information for Candidates

The total mark for this paper is 60. The marks for the various parts of questions are shown in round brackets: e.g. (2).
A Periodic Table is printed on the back cover of this question paper.

Advice to Candidates

You are reminded of the importance of clear and orderly presentation in your answers.

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Success through qualifications

Answer all questions

Leave blank

1. Aluminium is obtained from the ore bauxite.

(a) The first stage is the purification of the ore.

(i) State the formula of the aluminium compound present in bauxite.

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(1)

(ii) Identify the **two** major impurities in bauxite.

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(2)

(iii) Explain, in terms of the properties of the substances in bauxite, why the addition of 10% sodium hydroxide solution is used to separate the aluminium compound from the impurities in the bauxite.

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(3)

(b) The final stage is electrolysis.

Leave blank

(i) State the name of the material used as the **cathode**.

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(1)

(ii) Write the ionic equation for the reaction that takes place at the **cathode**.

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(1)

(iii) Explain why the **anode** has to be replaced at regular intervals.

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(2)

Q1

(Total 10 marks)

78

2. (a) Bromine reacts with both ethane and ethene.

Leave blank

(i) Write the equations for the reactions below.

Ethane + bromine

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(1)

Ethene + bromine

.....

(1)

(ii) Classify the two reactions in terms of the type of reaction occurring.

Ethane + bromine

.....

(2)

Ethene + bromine

.....

(2)

(b) Chloroethene (vinyl chloride), $H_2C{=}CHCl$, can be polymerised in a similar type of reaction to the polymerisation of ethene.

(i) Draw the full structural formula of the polymer poly(chloroethene), sufficient to make the structure of the polymer clear.

(1)

(ii) State **one** use of poly(chloroethene).

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(1)

(iii) State and explain **one** environmental problem arising from the disposal of poly(chloroethene).

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(2)

(Total 10 marks)

Q2

3. Urea, which is used as a fertiliser in much of mainland Europe, Asia and Africa, is manufactured by the reaction of ammonia and carbon dioxide.

Leave blank

$$2NH_3(g) + CO_2(g) \rightarrow NH_2CONH_2(s) + H_2O(l)$$

(a) Define the term **standard enthalpy of formation**, $\Delta H_f^{\ominus}$, of urea.

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(3)

(b) Calculate the enthalpy change, $\Delta H^{\ominus}$, for the reaction above, given the following standard enthalpies of formation.

Substance	$\Delta H_f^{\ominus}$ / kJ mol^{-1}
$NH_3(g)$	−46.2
$CO_2(g)$	−393.5
$NH_2CONH_2(s)$	−632.2
$H_2O(l)$	−285.8

(3) **Q3**

(Total 6 marks)

80

4. (a) Halogenoalkanes react with many nucleophiles.

Leave blank

Define the term **nucleophile.**

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(2)

(b) (i) Identify the reagent and conditions necessary for the conversion of iodoethane to ethylamine, $C_2H_5NH_2$.

Reagent: .....

Conditions: .....

.....

(3)

(ii) State why the rate of reaction would be slower if bromobutane were used in place of iodoethane, with all other conditions remaining the same.

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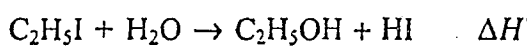
(1)

(c) Iodoethane reacts with water to form ethanol and hydrogen iodide.



$$C_2H_5I + H_2O \rightarrow C_2H_5OH + HI \qquad \Delta H^{\theta} = +36 \text{ kJ mol}^{-1}$$

Use some or all of the data below to calculate the C—I bond enthalpy.

Bond	Bond enthalpy /kJ mol^{-1}	Bond	Bond enthalpy /kJ mol^{-1}
C—H	413	H—I	298
C—C	347	C—O	358
H—O	464		

(3)

(d) Ethanol was heated under reflux with an excess of a mixture of potassium dichromate(VI) and dilute sulphuric acid. Draw the full structural formula of the organic product.

(1)

(Total 10 marks)

Q4

82

5. Crude oil is a mixture of compounds including members of the homologous series of alkanes. It is used to manufacture fuels, such as petrol, and petrochemicals, such as buta-1,3-diene.

Leave blank

(a) Define the term **homologous series.**

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(3)

(b) One of the reactions in the catalytic converter in the exhaust system of a car engine is

$$2NO(g) + 2CO(g) \rightleftharpoons N_2(g) + 2CO_2(g) \qquad \Delta H = -745 \text{ kJ mol}^{-1}$$

This reaction converts two poisonous gases into two harmless gases. The temperature in the catalytic converter is high.

(i) State, with a reason, which way the position of the equilibrium would shift if the temperature were lowered.

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(2)

(ii) The gases from the engine are **not** cooled before entering the converter. Explain why this is so.

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(2)

83

(c) Buta-1,3-diene is used in the manufacture of rubber.

Leave blank

(i) Write the full structural formula of buta-1,3-diene.

(1)

(ii) Explain whether or not buta-1,3-diene exists as geometric isomers.

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(1)

(iii) Predict the structural formula of the organic product of the reaction of buta-1,3-diene with an excess of an alkaline solution of potassium manganate(VII).

(2)

Q5

(Total 11 marks)

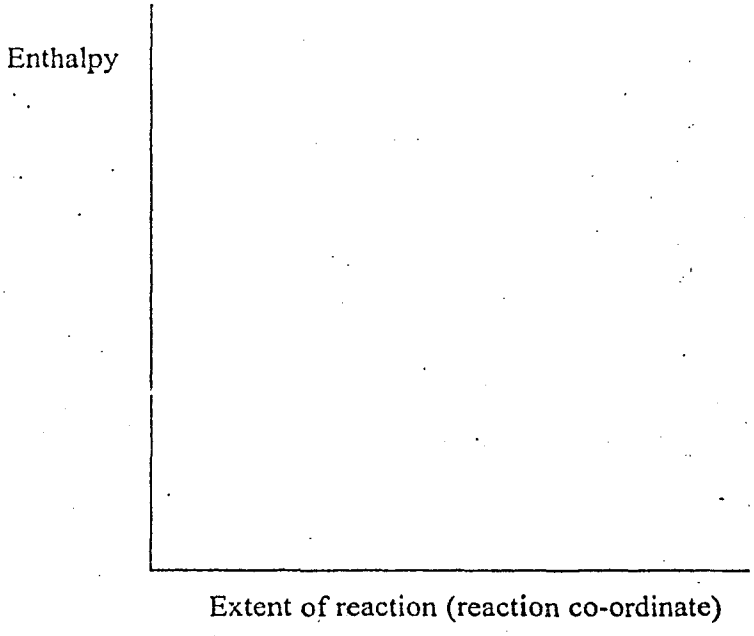
84

6. (a) Ammonia is manufactured by the Haber process

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \qquad \Delta H = -92.4 \text{ kJ mol}^{-1}$$

The usual conditions for this process are a catalyst of iron, a temperature of 400 °C and a pressure of 200 atmospheres.

Draw, on the axes below, an energy profile diagram for the **uncatalysed** reaction. Mark on your diagram the activation energy and the enthalpy change.



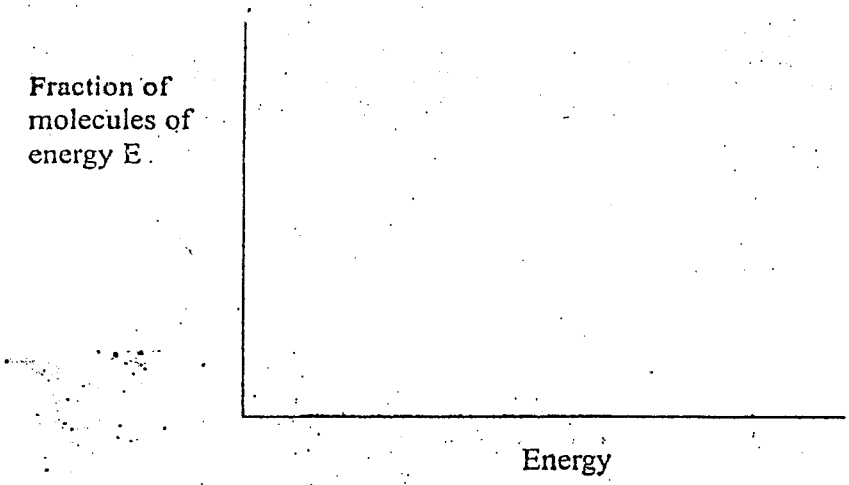
(4)

Leave blank

85

(b) (i) Draw, on the axis below, the Maxwell-Boltzmann distribution that could apply at 400°C and mark on your diagram the activation energies for the catalysed and the uncatalysed reaction.

Leave blank



(3)

(ii) **Use your diagram** to explain why the reaction is faster in the presence of the iron catalyst.

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(3)

(c) A mixture of nitrogen and hydrogen is kinetically stable at 25°C but kinetically unstable at 400°C. Explain why this is so.

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(3)

Q6

(Total 13 marks)

TOTAL FOR PAPER: 60 MARKS

END

86

THE PERIODIC TABLE

Period	1	2	Group										3	4	5	6	7	0
1	1 H Hydrogen 1																	4 He Helium 2
2	7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
3	23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulphur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
4	39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	63.5 Cu Copper 29	65.4 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
5	85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
6	133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
7	223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89															

Key

Molar mass g mol^{-1}

Symbol

Name

Atomic number

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	(147) Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	163 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	(231) Pa Protactinium 91	238 U Uranium 92	(237) Np Neptunium 93	(242) Pu Plutonium 94	(243) Am Americium 95	(247) Cm Curium 96	(245) Bk Berkelium 97	(251) Cf Californium 98	(254) Es Einsteinium 99	(253) Fm Fermium 100	(256) Md Mendelevium 101	(254) No Nobelium 102	(257) Lr Lawrencium 103