Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						6	2	4	5	/	0	1	Signature	

Paper Reference(s)

6245/01

Edexcel GCE

Chemistry

Advanced

Unit Test 5

(including synoptic assessment)

Thursday 23 June 2005 – Afternoon

Time: 1 hour 30 minutes

Examiner's use only

Team Leader's use only

Materials required for examination
Nil

Items included with question papers
Nil

Instructions to Candidates

In the boxes above, write your centre number and candidate number, your surname, initial(s) and signature.
Answer **ALL** the questions in the spaces provided in this question paper.
You may use a calculator. **Show all the steps in any calculations and state the units.**

Information for Candidates

The total mark for this paper is 75. The marks for individual questions and parts of questions are shown in round brackets: e.g. (**2**). There are 16 pages in this question paper. All blank pages are indicated.
A Periodic Table is printed on the back cover of this booklet.

Advice to Candidates

You are reminded of the importance of clear English and careful presentation in your answers.
You will be assessed on your Quality of Written Communication in this paper.

Question Number	Leave Blank
1	
2	
3	
4	
5	
Total	

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Answer ALL questions in the spaces provided.

1. (a) Pent-1-ene, $CH_3CH_2CH_2CH{=}CH_2$, polymerises in a similar manner to ethene.

(i) Draw enough of the chain of poly(pent-1-ene) to make the structure of the polymer clear.

(2)

(ii) Give the mechanism for the polymerisation of pent-1-ene, using a peroxide initiator RO–OR that produces RO· radicals. Show only the initiation and two propagation steps.

Include the use of an appropriate type of arrow to show the movement of an electron.

(4)

Leave blank

(b) Pent-1-ene reacts with hydrogen bromide to give 2-bromopentane as the major product.

(i) Give the mechanism for this reaction.

(3)

(ii) By considering the nature of the intermediates in this reaction, explain why the major product is 2-bromopentane rather than 1-bromopentane.

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(2)

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(c) Molecules of 2-bromopentane are chiral. If a single isomer of 2-bromopentane is reacted with hydroxide ions, the S_N1 reaction that results gives pentan-2-ol, but the product mixture shows no optical activity.

(i) How would you test for optical activity?

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(2)

(ii) Explain, in terms of the reaction mechanism, why the product mixture does **not** show optical activity.

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(3)

Q1

(Total 16 marks)

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2. (a) (i) Give the electronic configuration of:

Fe [Ar].....

Fe^{2+} [Ar].....

(2)

(ii) Draw the structure of the hexaaquairon(II) ion, $[Fe(H_2O)_6]^{2+}$, so as to clearly show its shape.

(1)

(iii) Give the equation for the complete reaction of sodium hydroxide solution with a solution of hexaaquairon(II) ions.

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(1)

(iv) State what you would **see** if the product mixture in (iii) is left to stand in air.

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(1)

(v) Give the equation for a reaction in which iron metal is used as a catalyst.

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(1)

Leave blank

(b) Consider the half reaction

$$Fe^{2+} + 2e^- \rightleftharpoons Fe \qquad E^{\ominus} = -0.44\ V$$

(i) Define the term **standard electrode potential** with reference to this electrode.

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(3)

(ii) Explain, with the aid of an equation, why the value of $E^{\ominus}$ suggests that iron will react with an aqueous solution of an acid to give Fe^{2+} ions and hydrogen gas.

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(3)

(iii) State why $E^{\ominus}$ values cannot predict that a reaction will occur, only that it is possible.

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(1)

Leave blank

(c) Use the following standard electrode potentials to explain why iron(III) iodide does **not** exist in aqueous solution.

$$Fe^{3+} + e^- \rightleftharpoons Fe^{2+} \qquad E^{\ominus} = +0.77\,V$$

$$I_2 + 2e^- \rightleftharpoons 2I^- \qquad E^{\ominus} = +0.54\,V$$

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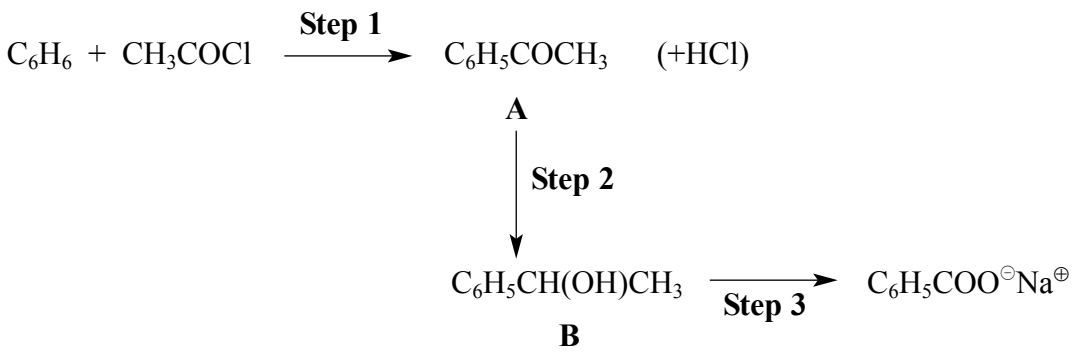
(2)

Q2

(Total 15 marks)

Leave blank

3. Consider the following reaction scheme:



(a) (i) State the catalyst that is needed for **Step 1**.

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(1)

(ii) Suggest a synthetic pathway that would enable you to make ethanoyl chloride from ethanol in two steps. You should give reagents, conditions and the structure of the intermediate compound. Experimental details and balanced equations are **not** required.

(4)

(b) Give the reagents and conditions needed for:

(i) **Step 2** .....

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(2)

(ii) **Step 3** .....

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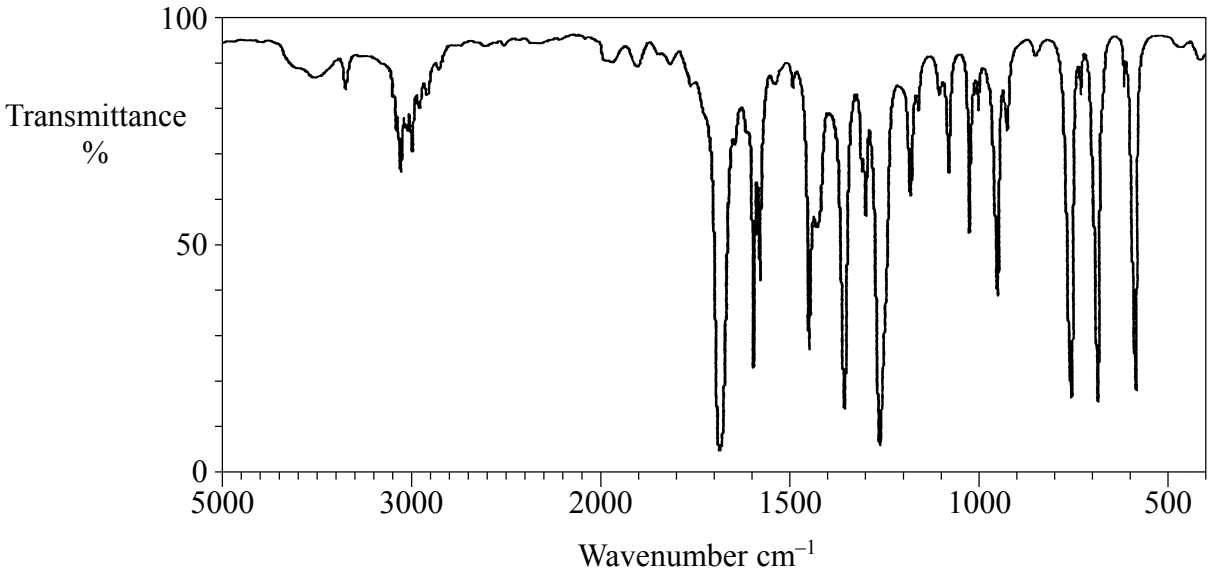
(3)

Leave blank

(c) The IR spectra for compounds **A** and **B** are shown.

Substance A



Substance B

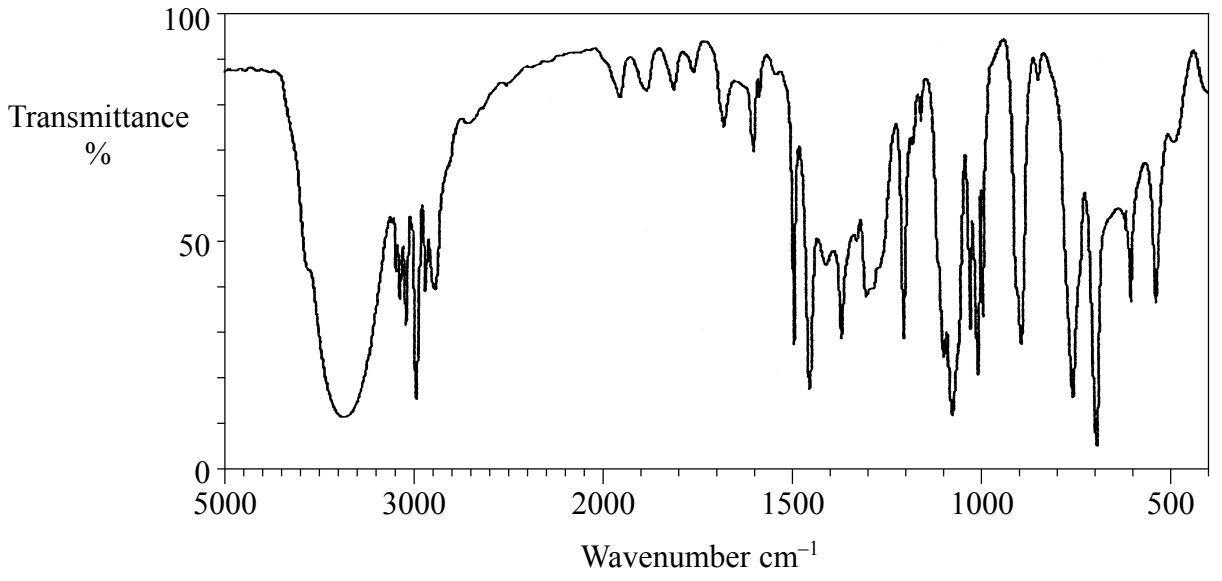


Table 1

Bond	Assignment	Wavenumber / cm^{-1}
C—H	Alkanes	2850–2950
	Alkenes, arenes	3000–3100
Benzene ring	Arenes	1450–1650
C═O	Aldehydes, ketones, esters, carboxylic acids	1680–1750
O—H	Free	3580–3670
	Hydrogen bonded in alcohols or phenols	3230–3550
	Hydrogen bonded in carboxylic acids	2500–3300

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(i) Using suitable data from Table 1, give evidence from the spectra which shows that compound **A** has been reduced. You will need to comment on both spectra.

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(3)

(ii) Compound **B** is chiral. The IR spectra of the two optical isomers of **B** are identical. Suggest why this is so.

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(2)

(d) Both compounds **A** and **B** will react with iodine in sodium hydroxide solution to give a yellow precipitate of triiodomethane (iodoform).

(i) **B** is oxidised to **A** during the reaction. Suggest the identity of the oxidising agent.

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(1)

(ii) Give the equation for the reaction of **A** with iodine in sodium hydroxide.

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(3)

(iii) Describe a chemical test to show that triiodomethane contains iodine.

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(4)

Q3

(Total 23 marks)

Leave blank

4. (a) Define the terms

(i) Overall order of reaction

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(1)

(ii) Rate constant

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(1)

(b) In a kinetic study of the reaction

$$CH_3I + OH^- \rightarrow CH_3OH + I^-$$

At a certain temperature the following data were obtained:

Experiment	$[CH_3I]$ / mol dm^{-3}	$[OH^-]$ / mol dm^{-3}	Initial rate / mol dm^{-3} s^{-1}
1	0.1	0.1	1×10^{-5}
2	0.2	0.1	2×10^{-5}
3	0.1	0.2	2×10^{-5}

(i) State the order of reaction with respect to CH_3I and with respect to OH^- ions. Give your reasons.

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(2)

(ii) Write the rate equation for the reaction.

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(1)

Leave blank

(iii) Calculate the value of the rate constant for this reaction, stating its units.

(2)

(c) The reaction

$$CH_3CH_2Br + OH^- \rightarrow CH_3CH_2OH + Br^-$$

has an S_N2 mechanism that proceeds through a transition state.

(i) Draw the mechanism, showing the structure of the transition state.

(3)

(ii) Draw a reaction profile for this exothermic reaction. Show the energy level of the transition state on the profile.

(2)

Q4

(Total 12 marks)

Leave blank

5. (a) Give the structural formula of the organic product when phenol is reacted with:

(i) sodium hydroxide solution

(1)

(ii) aqueous bromine

(1)

(iii) ethanoyl chloride.

(1)

Leave blank

(b) An azo dye can be made from benzenediazonium chloride.

(i) State the reagents and conditions needed to make benzenediazonium chloride from phenylamine.

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(3)

(ii) Write an equation, using structural formulae, to show the reaction between benzenediazonium ions and phenol to give the azo dye.

(2)

(iii) What condition is required for the reaction in (ii) above?

.....

(1) **Q5**

(Total 9 marks)

TOTAL FOR PAPER: 75 MARKS

END

THE PERIODIC TABLE

Period	1	2											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