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 Level

Unit Test 5

Friday 23 January 2004 – Afternoon

Time: 1 hour 30 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
Total	

Materials required for examination
Nil

Items included with question papers
Nil

Instructions to Candidates

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

Information for Candidates

The total mark for this paper is 75. 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 English and careful presentation in your answers.

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Answer ALL questions in the spaces provided.

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1. (a) Complete the electronic configurations for:

(i) a nickel atom;

$1s^2$ .....

(1)

(ii) a Ni^{2+} ion.

$1s^2$ .....

(1)

(b) Draw the ion hexaaqua nickel(II), $[Ni(H_2O)_6]^{2+}$, so as to clearly show its shape. Label on your diagram each **type** of bond present.

(3)

(c) If ammonia solution is added slowly to an aqueous solution containing nickel(II) ions, a pale green precipitate initially forms. This dissolves to give a blue solution in excess ammonia.

(i) Give the formula of the pale green precipitate.

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(1)

(ii) State the type of reaction occurring when ammonia solution is added as in (i) and explain the formation of the precipitate.

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(2)

(iii) Explain what occurs when excess ammonia is added.

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(2)

(Total 10 marks)

Q1

2. Consider the reaction scheme shown below, which starts with phenylethene.

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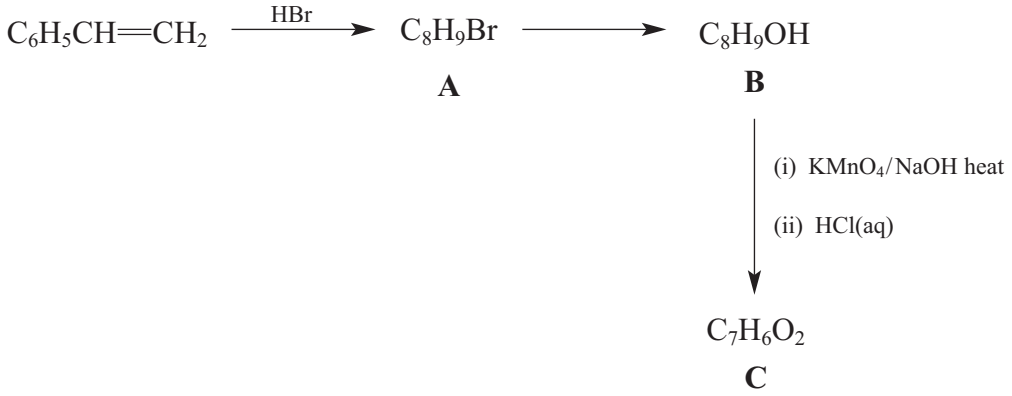

(a) (i) State the conditions under which hydrogen bromide could react with phenylethene. Give the structural formula of the major product.

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(3)

(ii) Give the mechanism for the reaction of hydrogen bromide with phenylethene. You may represent phenylethene as $RCH{=}CH_2$.

(3)

(iii) State why one isomer is the major product in the reaction in (i).

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(1)

(b) **B** is a secondary alcohol.

Leave blank

(i) What type of reaction is occurring in the conversion of **A** to **B**?

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(1)

(ii) Give the structural formula for **C**.

(1)

(iii) In the production of **C** from **B**, acidification of the reaction mixture is needed. Why is this?

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(1)

Q2

(Total 10 marks)

3. In an acidic solution, propanone reacts with iodine as follows:

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$$CH_3COCH_3 + I_2 \rightarrow CH_3COCH_2I + HI$$

The rate of this reaction can be followed by removing portions of the reaction mixture at known times, adding them to a solution of sodium hydrogen carbonate to stop the reaction and then titrating the mixture with standard sodium thiosulphate solution.

(a) (i) Write the ionic equation for the reaction of thiosulphate ions with iodine in aqueous solution.

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(2)

(ii) State which indicator is used in this titration, and describe what you would see at the end point.

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(2)

(b) Use the following data to deduce the rate equation for the reaction of propanone with iodine in acidic solution, given that the order with respect to $[H^+]$ is one.

$[CH_3COCH_3]$ /mol dm^{-3}	$[I_2]$ /mol dm^{-3}	Initial rate /mol dm^{-3} s^{-1}
1.0	0.10	3.2×10^{-3}
1.0	0.20	3.2×10^{-3}
2.0	0.10	6.4×10^{-3}

(3)

(c) What is meant by:

Leave blank

(i) order of reaction with respect to a particular reactant

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(1)

(ii) overall order of reaction.

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(1)

(d) What does the rate equation in (b) tell you about the involvement of iodine in the rate-determining step, and hence about the least number of steps in the reaction?

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(2)

(e) Sodium hydroxide cannot be used to stop the reaction, because very alkaline conditions cause another reaction to occur between propanone and iodine.

Write the equation for this reaction.

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(3)

Q3

(Total 14 marks)

Leave blank

4. The concentration of iron(II) ions in a solution can be found by titration with standard potassium manganate(VII) solution. In the reaction iron(II) ions are oxidised to iron(III) ions.

If a solution contains both iron(II) and iron(III) ions, the concentration of each ion can be found by:

- titrating samples of the original solution with standard potassium manganate(VII) solution
- reacting samples of the original solution with zinc and dilute sulphuric acid and then titrating with the same potassium manganate(VII) solution.

The following standard electrode potentials are required:

	$E^{\ominus}$/V
$Zn^{2+} + 2e^- \rightleftharpoons Zn$	– 0.76
$Fe^{2+} + 2e^- \rightleftharpoons Fe$	– 0.44
$Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$	+ 0.77
$MnO_4^- + 8H^+ + 5e^- \rightleftharpoons Mn^{2+} + 4H_2O$	+ 1.51

(a) (i) Use suitable $E^{\ominus}$ values to show that both iron(II) and iron(III) ions in solution should react with zinc to give iron metal.

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(3)

(ii) In practice the reaction produces only iron(II) ions and no iron metal.

$$2Fe^{3+} + Zn \rightarrow 2Fe^{2+} + Zn^{2+}$$

Suggest a reason for this.

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(1)

(b) (i) Derive the ionic equation for the reaction between iron(II) ions and manganate(VII), MnO_4^-, ions.

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(2)

(ii) State what you would see as iron(II) ions in solution are titrated with potassium manganate(VII). How would you detect the endpoint of the titration?

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(3)

(c) A solution containing both iron(II) and iron(III) ions was titrated with 0.0200 mol dm^{-3} potassium manganate(VII) solution, 18.20 cm^3 being required.

Another portion of the same volume of the same solution was reacted with zinc, and then titrated with the same potassium manganate(VII) solution; 25.30 cm^3 was required. What mass of zinc had reacted?

(5)

(d) (i) Explain, including an equation, why aqueous solutions of hexaaqua ions such as $[Fe(H_2O)_6]^{2+}$ are acidic.

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(3)

(ii) Suggest with reasons which of 0.1 mol dm^{-3} aqueous solutions of $[Fe(H_2O)_6]^{2+}$ and $[Fe(H_2O)_6]^{3+}$ would be the more acidic.

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(3)

Q4

(Total 20 marks)

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5. Carvone is an essential oil found as two enantiomers in nature; one enantiomer is found in caraway seed oil, the other in spearmint oil. The structural formula is:

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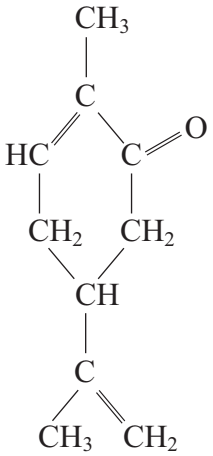

(a) (i) **On the formula above**, show with an asterisk (*) the chiral centre in carvone.

(1)

(ii) Each of the enantiometers of carvone is optically active. State how such activity is detected.

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(1)

(b) Give a test and the observed result to show that carvone is a carbonyl compound and a further test to show it is not an aldehyde.

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(4)

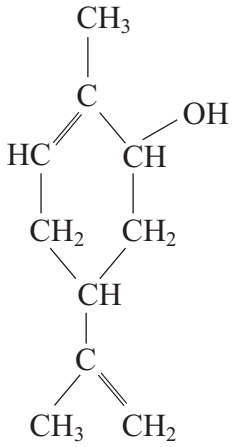
(c) In a particular preparation carvone was reduced with hydrogen and a platinum catalyst; 2.70 g of carvone reacted with 864 cm^3 of hydrogen. Calculate the reacting mole ratio of carvone to hydrogen and hence give, with reasons, the structural formula of the reduction product.

Leave blank

(The molar mass of carvone is 150 g mol^{-1}; 1 mol of gas occupies 24 dm^3 under the conditions of the experiment.)

(5)

(d) A different reducing agent, lithium tetrahydridoaluminate(III), $LiAlH_4$, gives compound **Z** from carvone. **Z** has the structure



(i) State the conditions used for reduction using $LiAlH_4$.

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(2)

(ii) Suggest why $LiAlH_4$ reduces the C═O bond but not the C═C bond.

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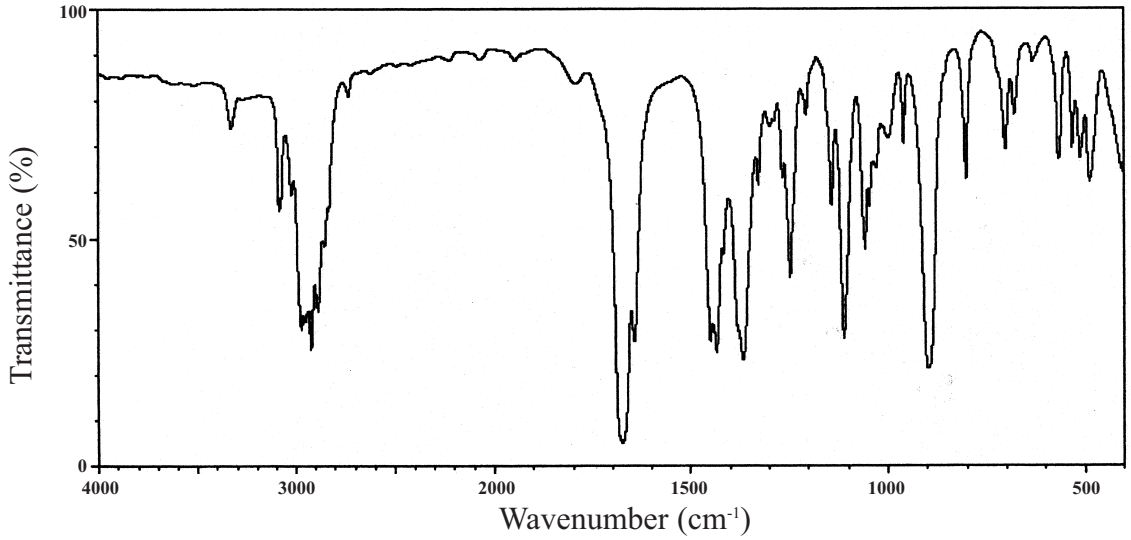
(2)

(iii) The infra-red spectra of carvone and of **Z**, together with a table of absorption frequencies for specified bonds are shown below.

Leave blank

Infra-red spectrum of carvone



Infra-red spectrum of Z

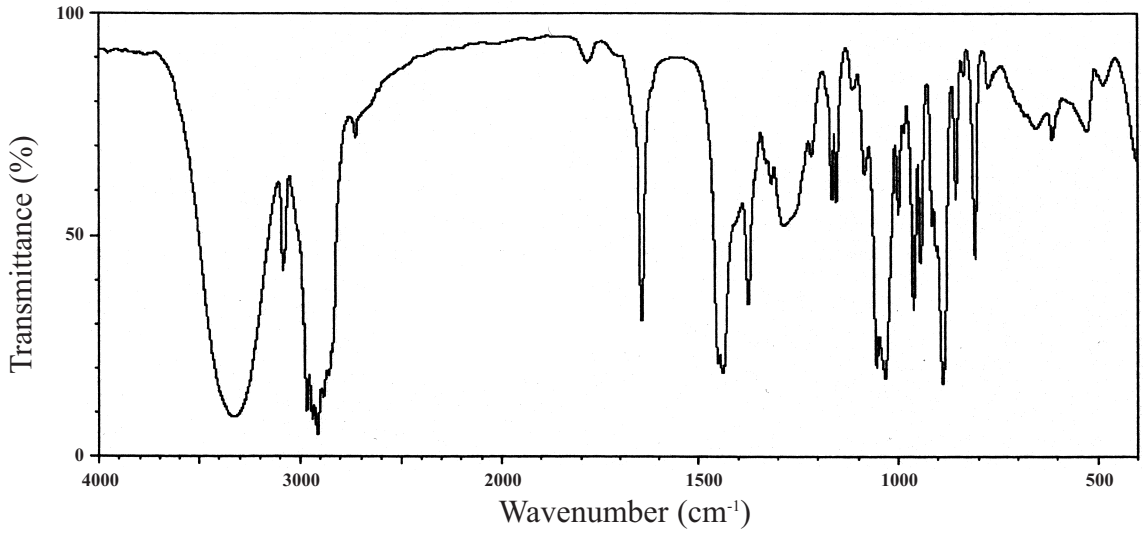


Table of infra-red absorption frequencies for specified bonds

Bond	Assignment	Wavenumbers/cm^{-1}
C—H	alkanes alkenes, arenes	2850–2950 3000–3100
C═O	aldehydes, ketones, esters, carboxylic acids	1680–1750
O—H	free hydrogen bonded in alcohols or phenols hydrogen bonded in carboxylic acids	3580–3670 3230–3550 2500–3300

Use evidence from the spectra to show that carvone has been reduced.

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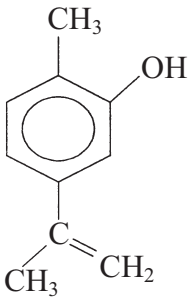
(3)

(e) **Z**, which is an alcohol, could be converted into the phenol



Phenols and alcohols have some reactions in common and some that are different.
Name a reagent that reacts with phenols and with alcohols in a different manner. Write equations for any reactions that occur between your chosen reagent and phenol and ethanol. If there is no reaction with one or other hydroxy compound you must say so.

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(3)

Q5

(Total 21 marks)

TOTAL FOR PAPER: 75 MARKS

END

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