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

Paper Reference(s)

6246/02

Edexcel GCE

Chemistry

Advanced

Unit Test 6B (Synoptic)

Tuesday 24 January 2006 – Afternoon

Time: 1 hour 30 minutes

Examiner's use only		

Team Leader's use only		

Question Number	Leave Blank
1	
2	
3	
4	
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, initial(s) and signature.
Answer Section A in the spaces provided in this question paper.
Answer **TWO** questions in Section B in the spaces provided in this question paper. Indicate which question you are answering by marking the box (☒). If you change your mind about an answer, put a line through the box (~~☒~~) and then mark your new question with a cross (☒).
Show all the steps in any calculations and state the units.

Information for Candidates

The total mark for this paper is 50. The marks for individual questions and parts of questions are shown in round brackets: e.g. (**2**). There are 20 pages in this question paper. All blank pages are indicated.
A Periodic Table is printed on the back cover of this question paper.
You may use a calculator.

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.

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SECTION A

Answer ALL parts of this question in the spaces provided.

1. Domestic bleaches contain sodium chlorate(I), NaOCl.

(a) Write the **ionic** equation to show the disproportionation of the chlorate(I) ion. Use oxidation numbers to explain the meaning of the term disproportionation in this reaction.

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(3)

(b) Domestic bleaches are dilute solutions of sodium chlorate(I). The amount of ClO^- ions in a sample can be found by reacting it with excess acidified potassium iodide solution.

$$ClO^- + 2I^- + 2H^+ \rightarrow I_2 + Cl^- + H_2O$$

The iodine produced is then titrated with standard sodium thiosulphate solution.

- 10.0 cm^3 of a domestic bleach was pipetted into a 250 cm^3 volumetric flask and made up to the mark with distilled water.
- A 25.0 cm^3 portion of the solution was added to excess acidified potassium iodide solution in a conical flask.
- This mixture was titrated with 0.100 mol dm^{-3} sodium thiosulphate solution, using starch indicator added near the end point.
- The mean titre was 12.50 cm^3.

(i) Give the colour change you would see at the end point.

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(1)

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(ii) The equation for the reaction between iodine and thiosulphate ions is

$$2S_2O_3^{2-} + I_2 \rightarrow S_4O_6^{2-} + 2I^-$$

Calculate the amount (moles) of chlorate(I) ions in 1.00 dm^3 of the **original** bleach.

(5)

(iii) Use the equation below to calculate the mass of chlorine available from 1.00 dm^3 of the **original** bleach. Give your answer to 3 significant figures.

$$ClO^- + Cl^- + 2H^+ \rightarrow Cl_2 + H_2O$$

(1)

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(c) Sodium thiosulphate can be used to remove the excess chlorine from bleached fabrics.

$$S_2O_3^{2-} + 4Cl_2 + 5H_2O \rightarrow 2SO_4^{2-} + 10H^+ + 8Cl^-$$

By considering the change in oxidation number of sulphur, explain whether chlorine or iodine is the stronger oxidising agent when reacted with thiosulphate ions.

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(d) Starch-iodide paper can be used to test for chlorine. It contains starch and potassium iodide.

Explain the reactions taking place when a piece of damp starch-iodide paper is put in a gas jar of chlorine. State what you would see.

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(2) Q1

(Total 14 marks)

TOTAL FOR SECTION A: 14 MARKS

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SECTION B
Answer any TWO questions from this section in the spaces provided.

If you answer Question 2 put a cross in this box ☒.

2. (a) Describe the bonding in magnesium and explain why it is a good conductor of electricity.

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(b) Explain why magnesium carbonate decomposes at a lower temperature than barium carbonate.

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(c) Propanoic acid, CH_3CH_2COOH, can be synthesised from bromoethane.

Give the reagents and conditions for each step in the synthesis.

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(d) Propanoic acid is a weak acid with acid dissociation constant, $K_a = 1.35 \times 10^{-5}$ mol dm^{-3}.

(i) A solution of propanoic acid has pH 3.10.
Calculate the concentration of propanoic acid in the solution.

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(ii) Write an equation to show the dissociation of propanoic acid in water and use it to explain why propanoic acid alone is not a buffer solution.

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(iii) Calculate the pH of the buffer solution obtained when 10.0 cm^3 of 0.100 mol dm^{-3} sodium hydroxide solution is added to 25.0 cm^3 of 0.100 mol dm^{-3} propanoic acid.

(4) **Q2**

(Total 18 marks)

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If you answer Question 3 put a cross in this box ☒.

3. Iodine and propanone react together in the presence of dilute hydrochloric acid according to the equation:

$$CH_3COCH_3 + I_2 \xrightarrow{H^+(aq)} CH_3COCH_2I + HI$$

The rate of reaction can be measured by recording the decrease in the concentration of the iodine.

The results of four experiments are given below:

Experiment	initial $[CH_3COCH_3]$ /mol dm^{-3}	initial $[I_2]$ /mol dm^{-3}	initial $[H^+]$ /mol dm^{-3}	Rate /mol dm^{-3} s^{-1}
1	0.40	0.0040	0.40	1.5×10^{-5}
2	0.80	0.0040	0.40	3.0×10^{-5}
3	0.40	0.0020	0.40	1.5×10^{-5}
4	0.80	0.0020	0.80	6.0×10^{-5}

(a) (i) State the order of the reaction with respect to CH_3COCH_3, I_2 and H^+. Justify your answer.

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(ii) Give the value of the overall order of the reaction.

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(b) Write the rate equation for the reaction.
Calculate the value of the rate constant and give its units.

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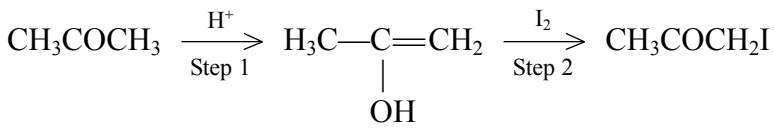
(c) A suggested mechanism for the reaction is shown below:



Use your answers to (a)(i) to compare the relative rates of the two steps. Explain your reasoning.

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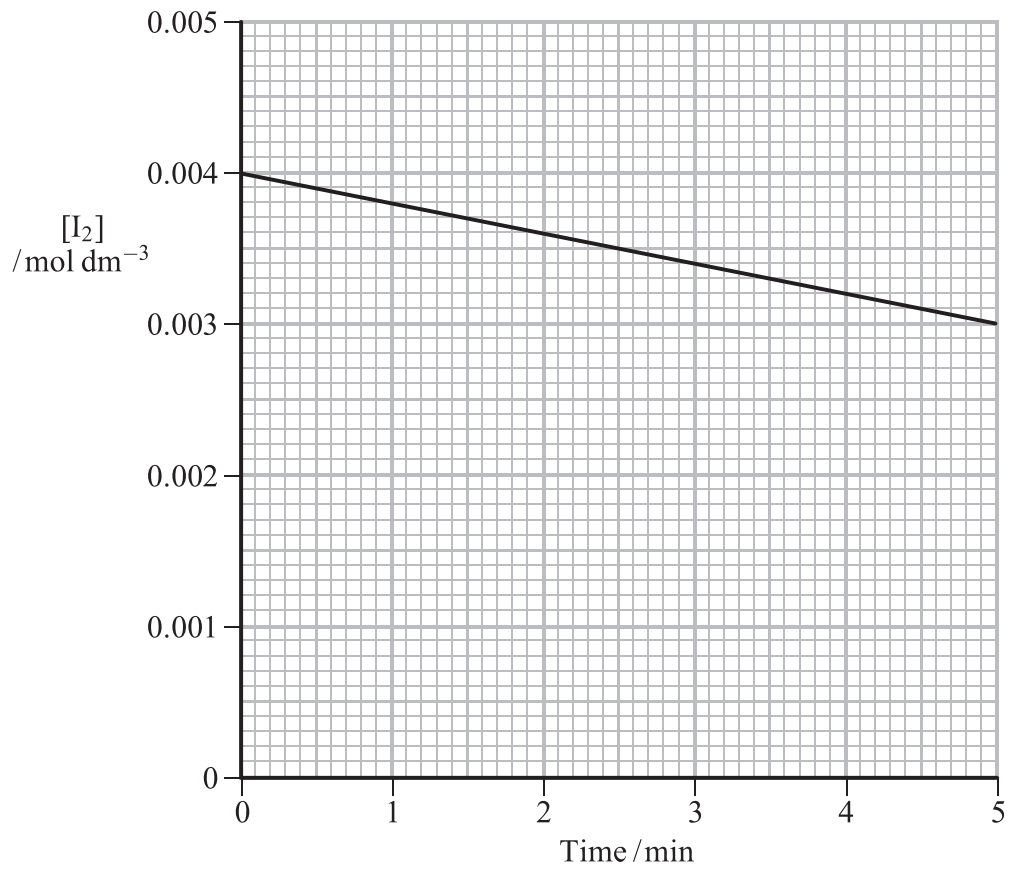
(d) The graph below represents the change in concentration of iodine in Experiment 1 over a 5 minute period.



Add labelled lines to represent Experiment 2 and Experiment 3.

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(e) (i) Propanone can also react with iodine to form a pale yellow precipitate of tri-iodomethane. What other reagent is needed for this reaction?

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(1)

(ii) Propanone reacts with lithium tetrahydridoaluminate, $LiAlH_4$, in dry ether. Suggest which reagent needs to be added to liberate the final organic product. Draw the **full** structural formula of this product.

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(f) State and explain how the n.m.r. spectra of propanone and propanal would differ.

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Q3

(Total 18 marks)

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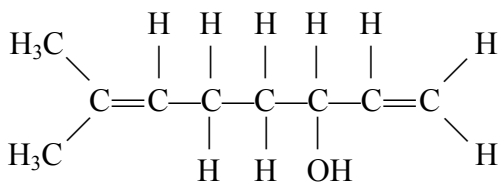
If you answer Question 4 put a cross in this box ☒.

4. Lavender oil contains the compound linalool



(a) Describe simple test tube reactions to identify each of the functional groups present in linalool.

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(b) (i) Draw the structural formula of the product of the reaction between linalool and excess hydrogen using a suitable catalyst.

(1)

(ii) A sample of lavender oil contained 65.0% linalool. Calculate the volume of hydrogen needed to react with 2.00 g of lavender oil.

[The molar volume of hydrogen is 24.0 $dm^3 mol^{-1}$ under the conditions of the experiment. The molar mass of linalool is 140 $g\ mol^{-1}$.]

(3)

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(c) (i) Draw the structural formula of the organic product formed when linalool reacts with an **excess** of alkaline solution of potassium manganate(VII), $KMnO_4$.

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(ii) Suggest why the organic product in (c)(i) is soluble in water, whereas linalool is almost totally insoluble.

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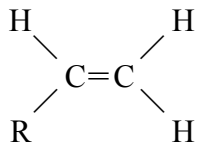
(d) Hydrogen bromide reacts with C=C bonds such as those in linalool.

Show the mechanism for the reaction of hydrogen bromide with a compound



where R represents an alkyl group.

(4)

(e) Linalool can exhibit stereoisomerism. Name the type of stereoisomerism and draw clear diagrams to show the shape of the two isomers and the relationship between them.

(2) **Q4**

(Total 18 marks)

TOTAL FOR SECTION B: 36 MARKS

TOTAL FOR PAPER: 50 MARKS

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THE PERIODIC TABLE

Period	1	2											3	4	5	6	7	0
	Group																	
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