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 Level

Unit Test 6B (Synoptic)

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 ALL the Questions in 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 (☒).
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 50. 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. Any blank pages are indicated.
A Periodic Table is printed on the back page 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.

Printer's Log. No.
NXXX25A
W850/R6246/57570 2/2/2/2

N X X X 2 5 A 0 1 1 6

Turn over

edexcel

Leave blank

SECTION A

Answer ALL parts of this question in the spaces provided.

1. Potassium is obtained from the mineral carnallite, KClMgCl2.xH2O, where x is the number of molecules of water of crystallisation.

(a) The value of x can be found by dissolving a known mass of carnallite in water, precipitating all the chloride ions as silver chloride, and weighing the precipitate.

A sample of pure carnallite of mass 5.55g was dissolved in water. An excess of aqueous silver nitrate in dilute nitric acid was added. The precipitate of silver chloride, AgCl, was filtered, washed and dried. It had a mass of 8.61g.

(i) Write the ionic equation, with state symbols, for the precipitation reaction forming silver chloride.

(1)

(ii) Explain why an excess of silver nitrate was used.

.....

.....

.....

(1)

(iii) Calculate the molar mass of carnallite and hence the number of molecules of water of crystallisation.

(6)

Leave blank

(b) Describe, with essential practical details, how you would distinguish between a sample of carnallite and a sample of rock salt (sodium chloride) using a flame test.

.....

.....

.....

.....

(2)

(Total 10 marks)

Q1

TOTAL FOR SECTION A: 10 MARKS

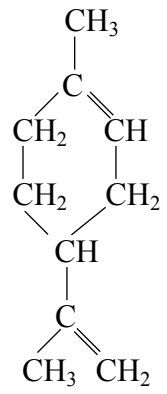
Leave blank

SECTION B

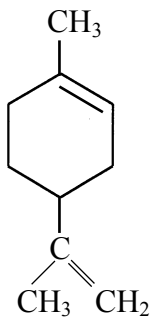
Answer TWO questions from this section in the spaces provided.

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

2. The structure of limonene [molar mass = 136 g mol^{-1}] is



which can be represented as



(a) (i) Limonene is a chiral molecule found in oil of orange and oil of lemon. Refer to its structure to explain why the molecule is chiral.

.....

.....

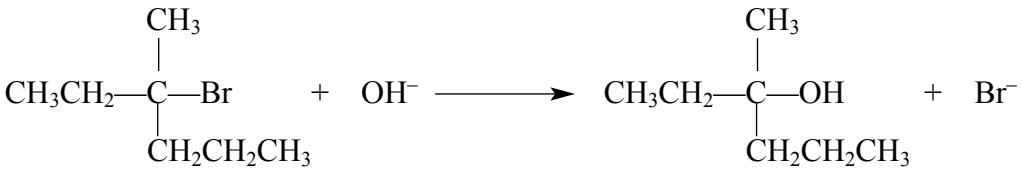
.....

.....

(2)

Leave blank

(ii) Some reactions and extraction processes can destroy the optical activity of the product.
Give the mechanism for the following reaction and hence explain why the reaction, if performed on a single optical isomer, would produce a mixture that was no longer optically active.



.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

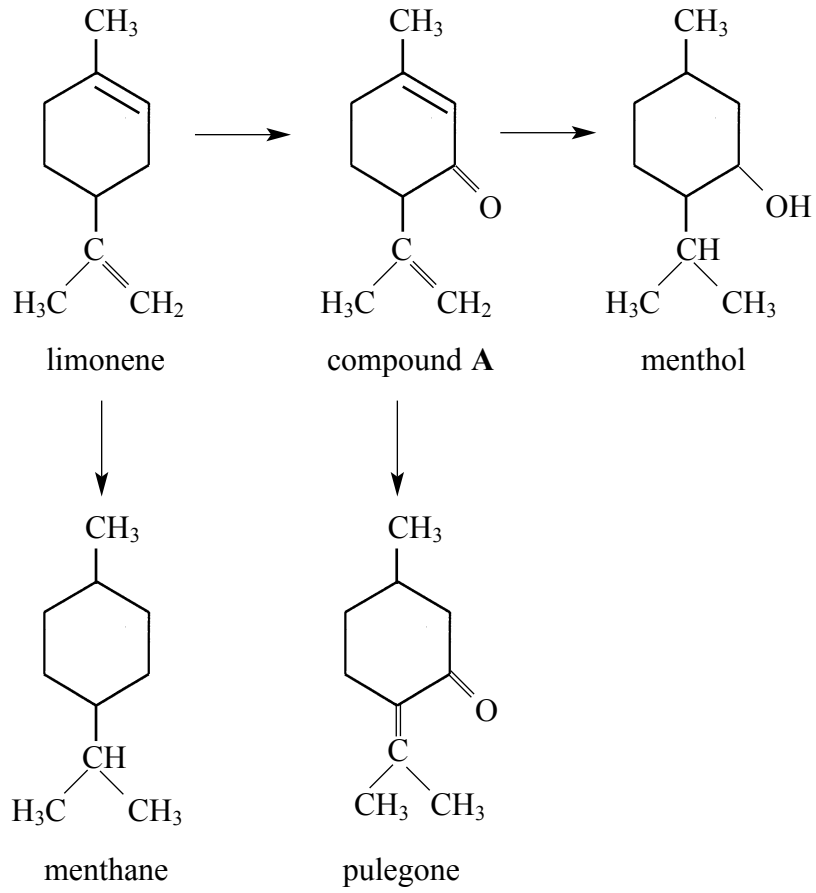
.....

.....

(7)

Leave blank

(b) Limonene can undergo the following conversions.



(i) Explain whether or not compound **A** and pulegone could be distinguished by simple chemical test tube reactions.

.....

.....

.....

.....

(2)

(ii) Explain whether or not compound **A** and pulegone could be distinguished using proton N.M.R. spectroscopy. You are not expected to say what the spectra might look like.

.....

.....

.....

.....

(2)

Leave blank

(iii) What particular features would enable the IR spectra of menthol and compound **A** to be distinguished?

.....

.....

.....

.....

(2)

(c) (i) In the reduction of limonene to menthane using hydrogen and a platinum catalyst, 0.68g limonene reacted with 240cm^3 of hydrogen. Show that this is consistent with the given structure of limonene.
[Molar volume of a gas at the temperature and pressure of the experiment is 24dm^3.]

(3)

(ii) If compound **A** were reacted with lithium aluminium hydride in dry ether, explain whether or not menthol would be the product.

.....

.....

.....

(2)

(Total 20 marks)

Q2

Leave blank

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

3. Ozone is important not only for its protective effects from ultraviolet radiation in the stratosphere, but also for water and sewage treatment. It is usually produced as a mixture with oxygen called ozonised oxygen.

(a) The amount of ozone in ozonised oxygen can be determined by using the ozone to oxidise iodide ions and titrating the liberated iodine in excess potassium iodide with standard sodium thiosulphate solution:

$$O_3 + 2I^- + H_2O \rightarrow O_2 + I_2 + 2OH^-$$
$$I_2 + 2S_2O_3^{2-} \rightarrow 2I^- + S_4O_6^{2-}$$

10 dm^3 of ozonised oxygen was shaken repeatedly with a solution of potassium iodide. The liberated iodine required 40.0 cm^3 of 1.00 mol dm^{-3} sodium thiosulphate solution for reduction.

What was the percentage by volume of ozone in the ozonised oxygen?
[The molar volume of ozone at the temperature and pressure of the experiment is 24 dm^3].

(5)

Leave blank

(b) Ozone can decompose to oxygen:

$$2O_3 \rightarrow 3O_2 \qquad \Delta H = -246 \text{ kJ}$$

(i) The reaction is slow in the absence of a catalyst. Use this fact and information from the equation to explain the difference between thermodynamic and kinetic stability.

.....

.....

.....

.....

.....

.....

.....

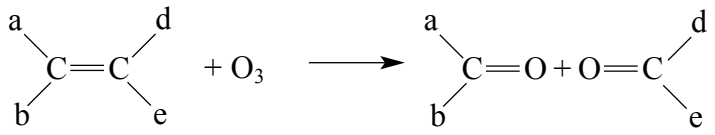
(4)

(ii) Sketch a Maxwell-Boltzmann distribution of molecular energies for a gas and use it to explain how a catalyst increases the rate of a gas-phase reaction at a given temperature.

(5)

Leave blank

(c) The alkene C_4H_8 has several isomers. Ozone can be used to distinguish these since it reacts with C=C bonds to give a mixture of carbonyl compounds, which are easily identifiable:



A particular sample of C_4H_8 gave the following results:

$$C_4H_8 \longrightarrow \underset{\mathbf{A}}{C_3H_6O} + CH_2O$$

A does not react with iodine and sodium hydroxide but does with ammoniacal silver nitrate solution. Use this information to deduce the structure of C_4H_8.

(6) **Q3**

(Total 20 marks)

Leave blank

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

4. (a) Aluminium extraction requires the production of pure aluminium oxide from bauxite, which is a mixture containing aluminium oxide, iron(III) oxide and silicon dioxide. Bauxite is crushed finely and treated with 10% aqueous sodium hydroxide solution; this gives a solution containing only sodium aluminate. An older process used much more concentrated sodium hydroxide solution, but this is now no longer used.

(i) State the acid-base characteristics of each of the oxides in bauxite.

.....

.....

.....

.....

.....

.....

(3)

(ii) Write an equation for the formation of sodium aluminate from aluminium oxide and sodium hydroxide.

(2)

(iii) The use of the more concentrated sodium hydroxide solution gave a final solution that was less pure than that found with the modern process. Suggest why this is so.

.....

.....

.....

.....

.....

(2)

Leave blank

(b) (i) Draw the structure of anhydrous aluminium chloride [molar mass = 267 g mol^{-1}] so as to show the shape of its molecules and the bonding present.

(3)

(ii) Explain why an aqueous solution of aluminium chloride is acidic.

.....

.....

.....

.....

.....

.....

(3)

Leave blank

(c) Thallium, Tl, is the element with the largest atomic number in Group 3. Thallium is known to form compounds in which it has oxidation states of +1 and +3.

Two structures have been proposed for the compound TlI_3:

- thallium in oxidation state +3 combined with three I^- ions
- thallium in oxidation state +1 combined with the I_3^- ion.

The I_3^- ion dissociates according to the equilibrium

$$I_3^- \rightleftharpoons I_2 + I^-$$

(i) Explain the term **oxidation state**.

.....

.....

(1)

(ii) In a determination of the structure of TlI_3, 0.585 g of the compound gave 0.235 g of silver iodide after suitable treatment with silver nitrate solution. Show that the oxidation state of thallium in TlI_3 is +1.

(4)

Leave blank

(iii) In the presence of a large excess of iodide ions TlI_3 reacts to form $[TlI_4]^-$, which is a complex of Tl +3:

$$TlI_3 + I^- \rightarrow [TlI_4]^-$$

What is the oxidising agent in this reaction? Give reasons for your choice.

.....

.....

.....

.....

.....

(2)

Q4

(Total 20 marks)

TOTAL FOR SECTION B: 40 MARKS

TOTAL FOR PAPER: 50 MARKS

END

BLANK PAGE

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