Centre No.						Paper Reference						Surname	Initial(s)
Candidate No.						6	2	4	3	/	0	2	Signature

Paper Reference(s)

6243/02

Edexcel GCE

Chemistry

Advanced Subsidiary/Advanced Level

Unit Test 3B

Friday 16 January 2004 – Morning

Time: 1 hour

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
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 question paper.
Show all the steps in any calculations and state the units.
You may use a calculator.

Information for Candidates

The total mark for this paper is 50. 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.

Leave blank

1. A series of tests was carried out on a white solid **X**.

In the tables below complete the inferences.

(a) A flame test was carried out on **X**.

Observation	Inference
The colour of the flame was green.	The metal ion is .....

(1)

(b) Dilute sulphuric acid was added to an aqueous solution of **X**.

Observation	Inference
White precipitate.	The precipitate is .....

(1)

(c) **X** was heated, very strongly.

Observation	Inference
A brown gas was evolved.	The gas is .....

(1)

(d) A sample of **X** was warmed with aqueous sodium hydroxide and aluminium powder.

Observation	Inferences
A gas was evolved which turned red litmus blue.	The gas is ..... The **anion** in **X** is .....

(2)

(e) The formula of **X** is .....

(1)

Q1

(Total 6 marks)

2. Two tests, carried out on an organic compound **Y**, gave the following observations.

Leave blank

Test		Observation
1	A few drops of **Y** are added to bromine solution.	The yellow solution becomes colourless.
2	**Y** is heated with aqueous sodium hydroxide. Dilute nitric acid and aqueous silver nitrate are added to the solution.	Yellow precipitate.

(a) Identify the functional group shown by **test 1**.

.....

(1)

(b) Identify the yellow precipitate in **test 2**.

.....

(1)

(c) **Y** contains three carbon atoms. Draw the full structure of **Y**.

(1)

(d) Give the structure of the **organic product** in **test 1**.

(1)

Q2

(Total 4 marks)

3. A laboratory technician is given the task of making up 5 dm^3 of aqueous sodium hydroxide of concentration 0.100 mol dm^{-3}. The technician finds the following data on sodium hydroxide.

Leave blank

- Formula NaOH
- Soluble in water
- Solid which absorbs moisture and acidic gases from the air
- Solid is corrosive
- Reacts with acids in aqueous solution
  e.g. $2NaOH(aq) + H_2SO_4(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$

The technician prepares the solution and checks its concentration, following the procedure outlined below.

I The technician calculates the mass of sodium hydroxide needed to make 5 dm^3 of 0.100 mol dm^{-3} solution.

II The technician adds 5 dm^3 of water to a plastic bucket.

III The technician weighs the calculated mass of sodium hydroxide, transfers it to the plastic bucket and stirs until the sodium hydroxide has dissolved.

IV The technician titrates 25.0 cm^3 samples of the sodium hydroxide solution with 0.0500 mol dm^{-3} sulphuric acid.

V The mean titre is 23.50 cm^3 of 0.0500 mol dm^{-3} sulphuric acid.

(a) Calculate the mass of sodium hydroxide that the technician needs to take, to make 5 dm^3 of solution of concentration 0.100 mol dm^{-3}.

(2)

(b) Calculate the concentration, in mol dm^{-3}, of the sodium hydroxide solution from the titration results in **IV** and **V**.

(3)

(c) The actual concentration of the sodium hydroxide solution is not exactly 0.100 mol dm^{-3} as the technician intended.

Leave blank

(i) Suggest ONE reason for this, which is a consequence of the way in which the technician makes up the solution.

.....

.....

(1)

(ii) Suggest ONE reason for this, which is a consequence of the chemical properties of the sodium hydroxide.

.....

.....

(1)

(d) (i) Explain the meaning of the term **corrosive** as applied to solid sodium hydroxide.

.....

.....

(1)

(ii) Suggest a safety precaution that the technician should take (apart from wearing a laboratory coat and eye protection) when weighing out the sodium hydroxide.

.....

.....

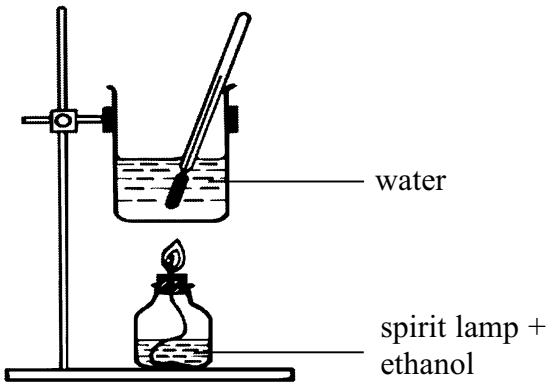
(1)

Q3

(Total 9 marks)

4. The apparatus shown in the diagram below may be used to find the enthalpy of combustion of alcohols.

Leave blank



Using the apparatus, a student recorded the results included in the table below.

Alcohol = ethanol, C_2H_5OH
Molar mass (C_2H_5OH) =46.0 g mol^{-1}
Volume of water in beaker = 200 cm^3
∴mass of water in beaker = 200 g
Weighings
Spirit lamp + ethanol before combustion = 198.76 g
Spirit lamp + ethanol after combustion = 197.68 g
Temperatures
Water before heating = 19.5 °C
Water after heating = 38.1 °C
Specific heat capacity of water = 4.18 J g^{-1} $°C^{-1}$

(a) What assumption is the student making about water to be able to state that its mass is numerically equal to its volume?

.....

(1)

(b) Calculate the heat gained by the water. Give your answer in kJ.

(2)

(c) Calculate the amount (number of moles) of ethanol used.

Leave blank

(2)

(d) Using your values from (b) and (c), calculate the enthalpy of combustion of ethanol. Give your answer to a number of significant figures consistent with the readings in the table. Include a sign and units in your answer.

(3)

QUESTION 4 CONTINUES OVERLEAF

(e) The student's evaluation of the experiment is given below.

Leave blank

> My calculated value of the enthalpy of combustion was numerically much less than the data book value. The reasons for my low value include:
>
> 1 heat losses to the surrounding air;
> 2 when I re-checked the mass of the spirit lamp and ethanol after combustion, I noticed that it had lost mass even when it was not being used;
> 3 a black solid which formed on the base of the beaker.

(i) Explain why the spirit lamp and ethanol **lost mass** even when not in use.

.....

.....

(1)

(ii) Suggest the identity of the black solid. Explain why its formation will lead to a low value for the enthalpy of combustion.

Identity .....

Explanation .....

.....

.....

(2)

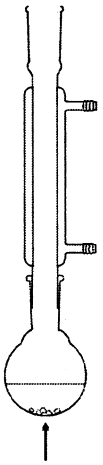
Q4

(Total 11 marks)

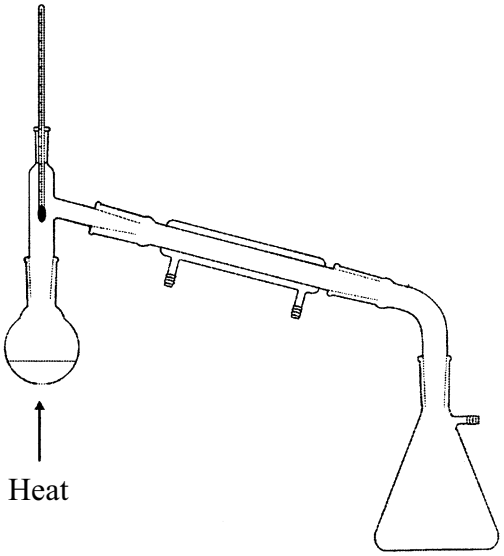
5. The alcohol 2-methylpropan-1-ol, $CH_3CH(CH_3)CH_2OH$, may be converted into a number of other organic compounds in reactions which are carried out using simple laboratory techniques. The apparatus shown below is used in two of these techniques.

Leave blank

Apparatus I



Apparatus II



The table below summarises two conversions of 2-methylpropan-1-ol.

Organic product of conversion	Reagents	Apparatus used in conversion
1-bromo-2-methylpropane $CH_3CH(CH_3)CH_2Br$	Sodium bromide + sulphuric acid	I and II
2-methylpropanal $CH_3CH(CH_3)CHO$	Sodium dichromate(VI) + sulphuric acid	II

(a) Give the name of the practical technique carried out in each apparatus shown above.

Apparatus I .....

Apparatus II .....

(2)

(b) The conversion of 2-methylpropan-1-ol into 1-bromo-2-methylpropane is summarised below.

Leave blank

$$CH_3CH(CH_3)CH_2OH \xrightarrow{NaBr + H_2SO_4} CH_3CH(CH_3)CH_2Br$$

(i) Calculate the maximum mass of 1-bromo-2-methylpropane that would be formed from 3.70 g of 2-methylpropan-1-ol.

[Molar mass of 1-bromo-2-methylpropane = 137 g mol^{-1}; Molar mass of 2-methylpropan-1-ol = 74 g mol^{-1}]

(2)

(ii) In a conversion, the actual yield of 1-bromo-2-methylpropane is 4.60 g. Calculate the percentage yield in this conversion.

(1)

(iii) When carrying out the conversion, the reagents are heated in Apparatus I for one hour. What does this suggest about the reaction?

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.....

(1)

(iv) After one hour, the contents of the flask in Apparatus I are allowed to cool, then transferred to Apparatus II and heated until the pure product collects. How could Apparatus II be used to check the purity of the product?

.....

.....

(2)

(c) When 2-methylpropan-1-ol is heated with sodium dichromate(VI) and sulphuric acid in Apparatus II, it is converted to 2-methylpropanal.

Leave blank

(i) Describe the colour change observed in the reaction flask.

.....

(1)

(ii) Explain why a different organic product forms if 2-methylpropan-1-ol is heated with sodium dichromate(VI) and sulphuric acid in Apparatus I.

.....

.....

(2)

(iii) Explain how the use of Apparatus II avoids the formation of this different product.

.....

.....

(1)

Q5

(Total 12 marks)

6. Group 2 carbonates are white solids which are decomposed by heat. In the equation below **Q** represents the symbol of any Group 2 element from magnesium to strontium.

Leave blank

$$QCO_3(s) \xrightarrow{\text{heat}} QO(s) + CO_2(g)$$

You are required to plan an experiment, which makes use of this decomposition, to find the relative atomic mass of **Q** and hence identify the Group 2 element in the carbonate. The only apparatus and materials available are:

- a test tube and a test tube holder, Bunsen burner, matches and a ceramic mat;
- a specimen tube containing a suitable quantity of the Group 2 carbonate;
- a balance.

You must include in your plan

- the procedure and the measurements you would take;
- an explanation of how the results would be used to identify the Group 2 element, **Q**;
- a discussion of the possible errors and the significance of these in identifying **Q**.

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Leave blank

Q6

(Total 8 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