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

Unit Test 3B

Thursday 18 January 2007 – Morning

Time: 1 hour

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
7	
Total	

Materials required for examination
Nil

Items included with question papers
Nil

You may use a calculator.

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initial(s) 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.

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. 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.

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Turn over

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Answer ALL the questions. Write your answers in the spaces provided.

1. The tables below show a series of simple tests on different compounds. Fill in the spaces in the tables.

(a)

Test	Observation	Inference
The flame test was carried out on solid **A**.	.....	Potassium ions present in **A**.

(1)

(b)

Test	Observation	Inference
To an aqueous solution of **B**, add .... followed by	A yellow precipitate was produced that was insoluble in concentrated ammonia solution.	Iodide ions present in **B**.

(1)

(c)

Test	Observation	Inference
Add dilute hydrochloric acid to solid **C**. Heat the mixture and pass the gas through acidified potassium dichromate(VI) solution.	Orange solution goes green.	Gas evolved .... Anion in **C**.....

(2)

Leave blank

(d)

Test	Observation	Inference
Add dilute sulphuric acid to a solution of **D**.	.....	Calcium, strontium, or barium cation present.

(1)

(e)

Test	Observation	Inference
To an aqueous solution of **E**, add .... and .... Then warm the solution.	Gas evolved that turns red litmus blue.	Gas ammonia. Anion nitrate.

(2)

(f)

Test	Observation	Inference
Add dilute hydrochloric acid to a solution of **F**. Test the gas evolved with damp blue litmus paper.	.....	Gas chlorine.

(1)

Q1

(Total 8 marks)

Leave blank

2. Analysis shows that a compound has a molecular formula of $C_4H_8O_2$. It is suggested that the compound could be either **P**, which is an acid, or **Q**, which contains a C=C bond and alcohol groups.

$CH_3CH_2CH_2COOH$ **P** or $HOCH_2CH{=}CHCH_2OH$ **Q**

Describe ONE test which would give a positive result for **P** but **not** for **Q**.

Describe ONE test which would give a positive result for **Q** but **not** for **P**.

For each test you should name the reagent and the expected result.

	Test	Observation
P		

	Test	Observation
Q		

Q2

(Total 4 marks)

Leave blank

3. Compound **Z** is a salt of a Group 2 metal. Complete the table below and suggest the formula of **Z**.

Test	Observation	Inference
To a solution of **Z** in distilled water, add 5 cm^3 of dilute sulphuric acid.	No precipitate was produced.	
To a solution of **Z** in distilled water, add an **excess** of an aqueous solution of chlorine.	A black precipitate in a brown solution was produced.	

Formula of **Z** .....

Q3

(Total 3 marks)

Leave blank

4. 1-bromobutane can be prepared in a laboratory by heating under reflux butan-1-ol, sodium bromide and 50 % sulphuric acid.

The apparatus is then arranged for distillation and a mixture of water and 1-bromobutane is distilled off. This mixture is collected in a separating funnel where two layers form. The denser 1-bromobutane is separated from the water and dried by adding solid anhydrous calcium chloride.

The 1-bromobutane is finally purified by distillation, collecting the fraction boiling between 101–103 °C.

(a) (i) Explain how the apparatus for **heating under reflux** works and suggest why it is necessary.

.....

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.....

.....

.....

(3)

(ii) Draw a diagram of the apparatus used for the final **distillation**.

(3)

Leave blank

(b) Suggest ONE safety precaution that could be used when heating flammable liquids such as butan-1-ol.

.....

.....

(1) **Q4**

(Total 7 marks)

Leave blank

5. Tartaric acid is an organic acid. Volumetric analysis can be used to find out how many acid, –COOH, groups each molecule of the acid contains.

The formula of tartaric acid can be represented in this acid-base reaction as H_xTa.

Ta represents the rest of the tartaric acid molecule, and **x** is the number of hydrogen atoms in the molecule which are part of the acid, –COOH, groups.

The equation for its reaction with sodium hydroxide can be written as follows:

$$H_xTa + xNaOH \rightarrow Na_xTa + xH_2O$$

The value of **x** can be found by experiment. 25.0 cm^3 of 0.110 mol dm^{-3} tartaric acid solution was titrated with 0.235 mol dm^{-3} sodium hydroxide solution, using phenolphthalein as the indicator. The following results were obtained.

	1	2	3
Burette reading (final) / cm^3	36.25	23.50	47.35
Burette reading (initial) / cm^3	12.30	0.05	24.00
Volume of NaOH used / cm^3	23.95	23.45	23.35

(a) In this titration what is the colour change for the phenolphthalein indicator?

From .....

to .....

(1)

(b) State why the mean (or average) titre should be based only on titrations 2 and 3.

.....

(1)

Leave blank

(c) Calculate the mean titre.

(1)

(d) (i) Calculate the amount (moles) of tartaric acid in 25.0 cm^3 of 0.110 mol dm^{-3} solution.

(1)

(ii) Calculate the amount (moles) of sodium hydroxide in the mean titre.

(1)

(iii) Calculate the number of moles of sodium hydroxide that reacts with 1 mol of tartaric acid.

(1)

(iv) Hence state the value of **x**, which is also the number of –COOH groups in each tartaric acid molecule.

x = ...

(1)

Leave blank

(e) Tartaric acid has a molar mass of 150 g mol^{-1}. The percentage composition by mass is C 32%, H 4%, O 64%.

Use these data to show that the molecular formula of tartaric acid is $C_4H_6O_6$.

(4)

(f) Tartaric acid is a straight chain compound with molecular formula $C_4H_6O_6$. It contains two alcohol groups. Suggest a structural formula for the molecule.

(1)

(g) Most burettes are capable, if read correctly, of giving a reading which is ±0.05 cm^3 of the true value.

Suggest why the experiment is designed to give a titre of between 20 to 30 cm^3, rather than 5 to 10 cm^3. Justify your answer.

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(2)

Q5

(Total 14 marks)

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6. The enthalpy change for the reaction of anhydrous aluminium chloride, $AlCl_3$, with water can be found as follows:

- Add about 100 cm^3 of distilled water to a weighed polystyrene cup.
- Measure the steady temperature of the water.
- Add anhydrous aluminium chloride to the polystyrene cup, with stirring.
- Measure the highest temperature reached.
- Re-weigh the polystyrene cup and contents

Data		
Mass of anhydrous aluminium chloride	=	4.00 g
Mass of solution	=	104 g
Initial temperature	=	17.5 °C
Highest temperature reached	=	43.5 °C
Specific heat capacity of the solution	=	4.09 J g^{-1} $°C^{-1}$

(a) (i) Calculate the heat change in this experiment.

(2)

(ii) Assuming that 100 cm^3 of water is a large excess, calculate the enthalpy change, in kJ mol^{-1}, when one mole of aluminium chloride reacts. Include a sign and unit in your answer.

(3)

Leave blank

(b) In reactions of this type, the dissolving process may be slow and heat may be lost in cooling while the reaction is still going on. This can make it difficult to get an accurate measurement of the temperature change using the method above.

Suggest how, **using the same apparatus**, together with a clock, the **method** could be modified to find the maximum temperature change more accurately.

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(3) **Q6**

(Total 8 marks)

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7. Plan an investigation to find out the products from the action of heat on sodium hydrogencarbonate.

Three possible reactions are:

I $2NaHCO_3(s) \rightarrow Na_2CO_3(s) + H_2O(g) + CO_2(g)$

II $NaHCO_3(s) \rightarrow NaOH(s) + CO_2(g)$

III $2NaHCO_3(s) \rightarrow Na_2O(s) + H_2O(g) + 2CO_2(g)$

Describe an experiment, **based on the changes in mass on heating**, to establish which of these reactions take place. In your plan you should include:

- an outline of the procedure,
- what measurements you would make,
- how you would ensure that the results are as accurate as possible,
- an explanation, in detail, of how the results would be used to show which reaction has occurred.

Data
Molar masses/g mol^{-1}: $NaHCO_3 = 84$; $Na_2CO_3 = 106$; $NaOH = 40$; $Na_2O = 62$

(6)

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Q7

(Total 6 marks)

TOTAL FOR PAPER: 50 MARKS

END

THE PERIODIC TABLE

Key

Molar mass g mol^{-1}
Symbol
Name
Atomic number

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															

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