Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						6	2	5	1	/	0	1	Signature	

Paper Reference(s)

6251/01

Edexcel GCE

Chemistry (Nuffield)

Advanced Subsidiary

Unit Test 1

Wednesday 7 June 2006 – Morning

Time: 1 hour 15 minutes

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

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initial(s) and your signature.
Answer **ALL** the questions. Write your answers in the spaces provided in this question paper.
Final answers to calculations should be given to an appropriate number of significant figures.

Information for Candidates

A Periodic Table is printed on the back cover of this paper.
The marks for individual questions and the parts of questions are shown in round brackets: e.g. (**2**).
The total mark for this paper is 60. There are 16 pages in this paper. Any blank pages are indicated.
Calculators may be used.

Advice to Candidates

You are advised to show all steps in any calculations.
You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, taking account of your use of grammar, punctuation and spelling.

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

SECTION A

1. (a) Write an equation for the reaction of calcium with oxygen to form calcium oxide, CaO.

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(1)

(b) Draw a 'dot and cross' diagram of calcium oxide, CaO, showing **all** the electrons. Indicate the charges clearly on your diagram.

(2)

(c) (i) Name the compound formed when calcium oxide reacts with water.

.....

(1)

(ii) Which pH or pH range would include the pH of a saturated solution of the product of this reaction?

pH	0–4	5–6	7	8–9	10–14

.....

(1) **Q1**

(Total 5 marks)

Leave blank

2. (a) The mass of one atom of the isotope $^{79}_{35}Br$ is 1.31×10^{-22} g. The molar mass of $^{79}_{35}Br$ is 79.0 g mol^{-1}.

Use this information to calculate a value for the Avogadro constant. Give your answer to **three** significant figures.

(2)

(b) According to the Periodic Table, the relative atomic mass of naturally occurring bromine is 80.

What information can you deduce from this about naturally occurring bromine? (No calculation is expected.)

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(1) **Q2**

(Total 3 marks)

Leave blank

3. (a) The electrical conductivities of the elements in the Periodic Table show periodicity.

What is meant by **periodicity**?

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(2)

(b) Describe the periodic pattern of electrical conductivity.

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(1)

(c) State ONE other **physical** property of an element which shows a periodic pattern.

.....

(1) **Q3**

(Total 4 marks)

TOTAL FOR SECTION A: 12 MARKS

Leave blank

SECTION B

4. This question is about the reactions of a compound **Z**, $CH_3CH(OH)CH_3$.

(a) Name compound **Z**.

.....

(1)

(b) Explain, in terms of its structure, why **Z** is classified as a **secondary** alcohol.

.....

.....

(1)

(c) Write an equation for the complete combustion of **Z** using the **molecular** formula for **Z**. State symbols are **not** required.

(2)

(d) A small piece of freshly cut sodium was added to **Z**. Give TWO observations which would be made.

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.....

.....

(2)

Leave blank

(e) A few drops of **Z** were put in a boiling tube with a mixture of sodium dichromate(VI) solution and dilute sulphuric acid and the mixture was warmed gently until a reaction occurred.

(i) What colour change would be observed?

From ..... to .....

(1)

(ii) Draw the **displayed** formula of the organic product of this reaction and name it.

Name .....

(2)

(iii) A pure sample of the organic product was mixed with Benedict's solution. State the colour of the mixture after it was warmed.

.....

(1)

Leave blank

(f) A sample of **Z** was dehydrated using a **solid** dehydrating agent.

(i) Name a suitable solid dehydrating agent.

.....

(1)

(ii) Draw a labelled diagram of the apparatus you would use to dehydrate **Z** and collect the gaseous product.

(3)

(Total 14 marks)

Q4

Leave blank

5. Sodium carbonate forms hydrated crystals. These contain water of crystallisation and their formula can be written as $Na_2CO_3.xH_2O$.

The value of x can be found by titrating a sodium carbonate solution, which is alkaline, with hydrochloric acid as follows:

- 7.15 g of hydrated sodium carbonate crystals were dissolved in water and made up to exactly 250 cm^3.
- 10.0 cm^3 of this solution was pipetted into a conical flask.
- The solution was titrated with hydrochloric acid of concentration 0.100 mol dm^{-3}.
- 20.0 cm^3 of the hydrochloric acid was needed.

The sodium carbonate in the crystals reacts as shown.

$$Na_2CO_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + CO_2(g) + H_2O(l)$$

(a) Name a container suitable for making up exactly 250 cm^3 of solution.

.....

(1)

(b) Suggest a suitable indicator for the titration and state the colour change you would see at the end-point.

Indicator .....

Colour change from ..... to .....

(2)

(c) Calculate the mass of hydrated crystals present in the 10.0 cm^3 sample.

(1)

(d) Calculate the number of moles of hydrochloric acid used in the titration.

(1)

Leave blank

(e) Use your answers from (c) and (d) to calculate the mass of the hydrated crystals which would react with **two** moles of hydrochloric acid.

(1)

(f) Deduce the molar mass of the hydrated sodium carbonate, using your answer to (e) and the equation for the reaction.

.....

(1)

(g) The molar mass of sodium carbonate, Na_2CO_3, is 106 g mol^{-1}. Use this value and your answer to (f) to work out the value of x in the formula for the hydrated crystals.

If you did not get an answer to (f) use the value 196 (this is not the answer you would get if you do the calculation correctly).

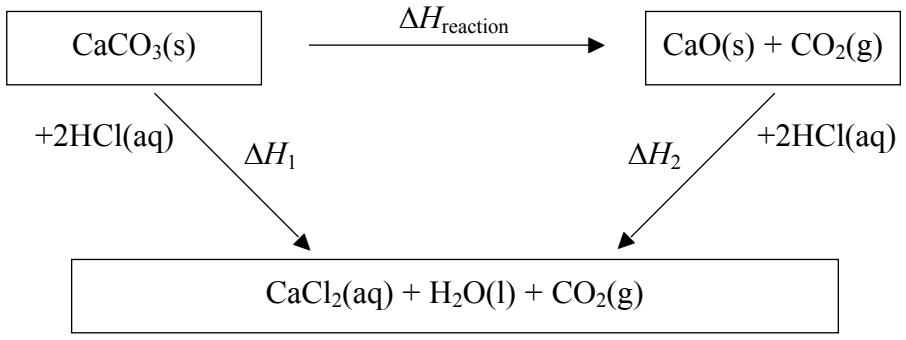
Use the Periodic Table as a source of data.

(2) **Q5**

(Total 9 marks)

Leave blank

6. The enthalpy change for the thermal decomposition of calcium carbonate cannot be measured directly, but can be found by carrying out two reactions as shown in the Hess cycle below.



(a) Suggest ONE reason why it is difficult to measure $\Delta H_{reaction}$ directly by experiment.

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(1)

(b) In an experiment to find ΔH_1, a student added 2.00 g of finely powdered calcium carbonate to 20.0 cm^3 of 2.50 mol dm^{-3} hydrochloric acid solution (an excess) in a polystyrene container. The temperature rose from 20.5 °C to 23.0 °C.

(i) Why is the calcium carbonate used in this experiment finely powdered, rather than in lumps? Explain why this is important for an accurate result.

.....

.....

.....

(2)

(ii) Calculate the energy change using the relationship below.

$$\underset{/J}{\text{Energy change}} = \underset{/J\,g^{-1}K^{-1}}{4.2} \times \underset{/g}{\text{mass of solution}} \times \underset{/K}{\text{temperature change}}$$

Assume that the mass of the solution is 20 g.

(1)

Leave blank

(iii) Calculate the enthalpy change, ΔH_1. Include a sign and units in your answer.
[The molar mass of $CaCO_3$ is 100 g mol^{-1}]

(3)

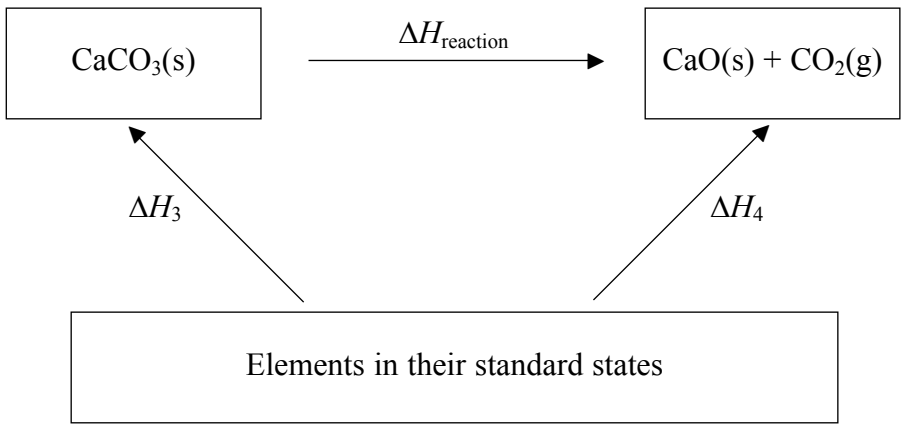
(iv) In another experiment, the value of ΔH_2 was found to be –181 kJ mol^{-1}.

Use this result and your answer to (iii) to calculate the value of $\Delta H_{reaction}$.

(2)

Leave blank

(c) The student checked the experimental results using information from the *Book of data* in another Hess cycle.



Name the enthalpy change represented by ΔH_3.

.....

(1)

Q6

(Total 10 marks)

Leave blank

7. This question is about the chemistry of sodium and magnesium.

(a) Sodium and chlorine react together as shown in the equation.

$$2Na(s) + Cl_2(g) \rightarrow 2NaCl(s)$$

Is sodium oxidised or reduced in this reaction? Explain your answer.

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.....

(1)

(b) (i) Sodium chloride and magnesium chloride can be distinguished by carrying out a flame test. State the observation you would make for each.

Sodium chloride .....

Magnesium chloride .....

(2)

(ii) Explain the changes which occur when electrons in sodium produce a flame colour.

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.....

(2)

(iii) Suggest ONE use for the coloured light produced by sodium.

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(1)

(c) Write the electron configuration of a magnesium **ion**, Mg^{2+}, using s, p notation.

.....

(1)

Leave blank

(d) The table below gives some ionisation energies for sodium and magnesium.

	First ionisation energy / kJ mol^{-1}	Second ionisation energy / kJ mol^{-1}
Sodium	496	4563
Magnesium	738	

(i) Write the chemical equation, with state symbols, which corresponds to the **first** ionisation energy of magnesium.

(2)

(ii) Explain why the first ionisation energy of magnesium is greater than the first ionisation energy of sodium.

.....

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(2)

Leave blank

(iii) Predict a value for the **second** ionisation energy of magnesium. Explain your choice.

Value ..... kJ mol^{-1}

Explanation .....

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(3)

(e) Which atom has the larger radius, sodium or magnesium? Explain your answer.

.....

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(1)

Q7

(Total 15 marks)

TOTAL FOR SECTION B: 48 MARKS
TOTAL FOR PAPER: 60 MARKS

END

THE PERIODIC TABLE

Period	Group 1	2											3	4	5	6	7	0
1	1 H Hydrogen 1																	2 He Helium 4
2	3 Li Lithium 7	4 Be Beryllium 9											5 B Boron 11	6 C Carbon 12	7 N Nitrogen 14	8 O Oxygen 16	9 F Fluorine 19	10 Ne Neon 20
3	11 Na Sodium 23	12 Mg Magnesium 24											13 Al Aluminium 27	14 Si Silicon 28	15 P Phosphorus 31	16 S Sulphur 32	17 Cl Chlorine 35.5	18 Ar Argon 40
4	19 K Potassium 39	20 Ca Calcium 40	21 Sc Scandium 45	22 Ti Titanium 48	23 V Vanadium 51	24 Cr Chromium 52	25 Mn Manganese 55	26 Fe Iron 56	27 Co Cobalt 59	28 Ni Nickel 59	29 Cu Copper 63.5	30 Zn Zinc 65.4	31 Ga Gallium 70	32 Ge Germanium 73	33 As Arsenic 75	34 Se Selenium 79	35 Br Bromine 80	36 Kr Krypton 84
5	37 Rb Rubidium 85	38 Sr Strontium 88	39 Y Yttrium 89	40 Zr Zirconium 91	41 Nb Niobium 93	42 Mo Molybdenum 96	43 Tc Technetium (99)	44 Ru Ruthenium 101	45 Rh Rhodium 103	46 Pd Palladium 106	47 Ag Silver 108	48 Cd Cadmium 112	49 In Indium 115	50 Sn Tin 119	51 Sb Antimony 122	52 Te Tellurium 128	53 I Iodine 127	54 Xe Xenon 131
6	55 Cs Caesium 133	56 Ba Barium 137	57 ► La Lanthanum 139	72 Hf Hafnium 178	73 Ta Tantalum 181	74 W Tungsten 184	75 Re Rhenium 186	76 Os Osmium 190	77 Ir Iridium 192	78 Pt Platinum 195	79 Au Gold 197	80 Hg Mercury 201	81 Tl Thallium 204	82 Pb Lead 207	83 Bi Bismuth 209	84 Po Polonium (210)	85 At Astatine (210)	86 Rn Radon (222)
7	87 Fr Francium (223)	88 Ra Radium (226)	89 ►► Ac Actinium (227)	104 Unq Unnil-quadium (261)	105 Unp Unnil-pentium (262)	106 Unh Unnil-hexium (263)												

Key

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

► Lanthanide elements	58 Ce Cerium 140	59 Pr Praseo-dymium 141	60 Nd Neodymium 144	61 Pm Promethium (147)	62 Sm Samarium 150	63 Eu Europium 152	64 Gd Gadolinium 157	65 Tb Terbium 159	66 Dy Dysprosium 163	67 Ho Holmium 165	68 Er Erbium 167	69 Tm Thulium 169	70 Yb Ytterbium 173	71 Lu Lutetium 175
►► Actinide elements	90 Th Thorium 232	91 Pa Protactinium (231)	92 U Uranium 238	93 Np Neptunium (237)	94 Pu Plutonium (242)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (245)	98 Cf Californium (251)	99 Es Einsteinium (254)	100 Fm Fermium (253)	101 Md Mendelevium (256)	102 No Nobelium (254)	103 Lr Lawrencium (257)