Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						1	5	3	0	/	4	H	Signature	

Paper Reference(s)

1530/4H

Edexcel GCSE

Chemistry A [1530]

Paper 4H

Higher Tier

Thursday 22 June 2006 – Afternoon

Time: 1 hour

Materials required for examination
Calculator

Items included with question papers
Nil

Examiner's use only

Team Leader's use only

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

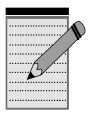
Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initial(s) and signature.
The paper reference is shown above.
Answer **ALL** questions in the spaces provided in this book.
Show all stages in any calculations and state the units. Calculators may be used.
Include diagrams in your answers where these are helpful.

Information for Candidates

The marks for the various parts of questions are shown in round brackets: e.g. (**2**).
This paper has seven questions. There are no blank pages.

Advice to Candidates



This symbol shows where the quality of your written answer will also be assessed.

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THE PERIODIC TABLE

Period	Group 1	2										3	4	5	6	7	0
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 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

Relative atomic mass
Symbol
Name
Atomic number

Leave blank

1. In the 1970s, the effects of pollution from power stations were being seen in the lakes of Britain and Scandinavia. The problem was due to sulphur dioxide being produced and forming acid rain, which contains sulphuric acid. The problem became so great that in many lakes all the fish died.

In North Wales, the water company treated the acidic lakes with thousands of tonnes of powdered limestone (mainly calcium carbonate). Sodium carbonate was not used.

Sodium carbonate solution has a pH of approximately 10.

(a) Sulphuric acid in the lakes reacts with calcium carbonate to form calcium sulphate. What is the state of the calcium sulphate formed?

.....

(1)

(b) If large lumps of limestone are used, the reaction starts but soon stops. Most of the limestone remains unreacted even though the lake is still acidic.

Explain why.

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.....

(2)

(c) (i) If sodium carbonate were used instead of calcium carbonate, what would happen to the excess sodium carbonate?

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(1)

(ii) Suggest what problem this might cause.

.....

.....

(1)

Q1

(Total 5 marks)

TURN OVER FOR QUESTION 2

Leave blank

2. Iron from the blast furnace is impure. It contains 7% impurities, including about 4% of carbon.
Impure iron has few uses and most of it is used to produce steels. In the production of steel, high pressure oxygen is blown through the molten impure iron.

(a) Why does impure iron from the blast furnace have few uses?

.....

(1)

(b) Why is oxygen used in steel production?

.....

(1)

(c) In steel production, other metals can be added to make alloy steels.

(i) Name an alloy steel.

.....

(1)

(ii) Give a use for this alloy steel.

.....

(1)

(d) Since the middle of the nineteenth century, iron and steel have been used to make ships. From late in the twentieth century, aluminium alloys have been used instead.

	density ($kg\ m^{-3}$)	**tensile strength (MPa)**
mild steel	7700	250
pure aluminium	2700	60–120
aluminium alloy	2800	240–400

(i) Explain why aluminium alloys are used instead of pure aluminium.

.....

(1)

Leave blank

(ii) Suggest why aluminium alloys are used instead of steel to make ships.

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(3) **Q2**

(Total 8 marks)

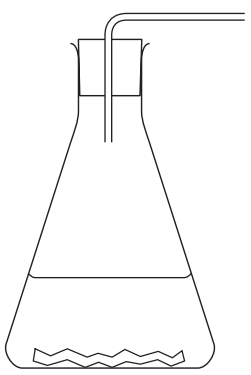
TURN OVER FOR QUESTION 3

Leave blank

3. Magnesium reacts with dilute sulphuric acid to form hydrogen gas.
The equation for the reaction is

magnesium	+	sulphuric acid	⟶	magnesium sulphate	+	hydrogen
Mg(s)	+	$H_2SO_4(aq)$	⟶	$MgSO_4(aq)$	+	$H_2(g)$

(a) Hydrogen is insoluble in water and is lighter than air.
Complete the diagram below to show how the volume of hydrogen produced could be measured.



(2)

(b) Describe the hazard associated with hydrogen.

.....

.....

(1)

(c) Describe the test to show that the gas collected was hydrogen.

.....

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(2)

Leave blank

(d) A student was asked to carry out the reaction between magnesium and dilute sulphuric acid to produce crystals of magnesium sulphate. The student was told to use an excess of magnesium.

(i) Why should an excess of magnesium be used?

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(1)

(ii) Magnesium sulphate is soluble.
Describe how the student could obtain pure, dry crystals of magnesium sulphate from the aqueous solution of magnesium sulphate.

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(3)

Q3

(Total 9 marks)

TURN OVER FOR QUESTION 4

Leave blank

4. In many areas of the country, hard water is a problem.

(a) Limestone is one rock that can react and dissolve to form hard water.

Name another rock that can make water hard when it comes into contact with rainwater.

.....

(1)

(b) A solid scale is formed on the inside of hot water pipes in hard water areas.

(i) Explain why the formation of scale on the inside of some old lead water pipes is an advantage.

.....

.....

(2)

(ii) Give a disadvantage of build-up of scale in water pipes.

.....

.....

(1)

(c) A student was asked to find out which salts, when dissolved in water, cause hardness.

(i) Describe how the student could carry out the experiment on crystals of a salt, using soap solution.

.....

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.....

(2)

Leave blank

(ii) The student obtained the following results:

substance tested	result
distilled water	permanent lather formed
calcium chloride	scum formed
magnesium chloride	scum formed
potassium chloride	scum formed
sodium chloride	permanent lather formed

One of the results is incorrect.

Identify which one is incorrect.

.....

(1)

Q4

(Total 7 marks)

TURN OVER FOR QUESTION 5

Leave blank

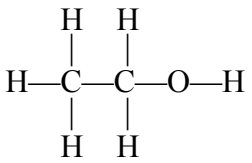
5. Ethanol (C_2H_5OH) is made, in industry, by the hydration of ethene.

(a) Complete the equation below for the hydration reaction

……. + ……. ⟶ C_2H_5OH

(1)

(b) Ethanol belongs to the **homologous series** of alcohols.
The structure of ethanol is shown.



(i) On this structure, circle the group of atoms which makes ethanol an alcohol.

(1)

(ii) Explain the meaning of the term **homologous series**.

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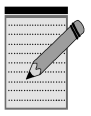
(2)

(c) Propanoic acid reacts with ethanol to form ethyl propanoate.

(i) Describe a different reaction to show that propanoic acid behaves as an acid.



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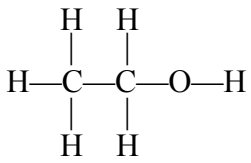
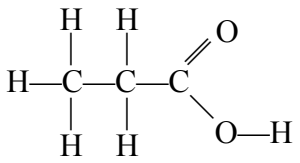
(3)

Leave blank

(ii) Draw the structure of ethyl propanoate.

ethanol	propanoic acid	ethyl propanoate
		

(2) Q5

(Total 9 marks)

TURN OVER FOR QUESTION 6

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6. Sulphuric acid is manufactured by the Contact process. In one stage of the process, a mixture of sulphur dioxide and air is heated to 400–450 °C and passed over a vanadium(V) oxide catalyst. An exothermic reaction takes place. About 95% of the sulphur dioxide is converted to sulphur trioxide.
The reaction is

$$2\ SO_2(g)\ +\ O_2(g)\ \rightleftharpoons\ 2\ SO_3(g)$$

(a) (i) What volume of oxygen would be required to react completely with 100 dm^3 of sulphur dioxide?
(Assume all gaseous volumes are measured at the same temperature and pressure.)

.....

.....

answer = ... dm^3

(1)

(ii) What volume of sulphur trioxide would be formed from the complete reaction of 100 dm^3 of sulphur dioxide?
(Assume all gaseous volumes are measured at the same temperature and pressure.)

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answer = ... dm^3

(1)

(b) State and explain the effects of carrying out the reaction at the higher temperature of 600 °C instead of 450 °C.

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(3)

Leave blank

(c) In the final stage of the process, the mixture is passed into an absorber. Here the sulphur trioxide reacts with the water present in concentrated sulphuric acid.
Write the equation for the reaction of sulphur trioxide with water.

.....

(2) **Q6**

(Total 7 marks)

TURN OVER FOR QUESTION 7

Leave blank

7. The concentration of a solution of sodium carbonate is found by titration with hydrochloric acid.

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

The solution of sodium carbonate is titrated with 0.100 mol dm^{-3} hydrochloric acid.

Here are the results of the titration.

volume of sodium carbonate solution used		= 10.0 cm^3
volume of 0.100 mol dm^{-3} hydrochloric acid needed	trial titration	= 20.8 cm^3
	1st titration	= 20.1 cm^3
	2nd titration	= 20.2 cm^3

(a) After the trial titration, why was it necessary to carry out two further titrations?

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(1)

(b) Describe, in detail, how the titration labelled '1st titration' should be carried out.
In your answer you should refer to the equipment needed and the experimental technique involved.

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(4)

Leave blank

(c) Calculate the concentration of the sodium carbonate solution in mol dm^{-3}.

You may do the calculation
Either by following steps (i), (ii) and (iii)
Or by using another method in (iii) only.

(i) Calculate the number of moles of hydrochloric acid (HCl) that reacted.

.....

.....

.....

answer = ... mol

(ii) Using the equation for the reaction, calculate the number of moles of sodium carbonate (Na_2CO_3) contained in 10.0 cm^3 of solution.

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answer = ... mol

(iii) Calculate the concentration of the sodium carbonate solution in mol dm^{-3}.

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.....

answer = ... mol dm^{-3}

(5)

QUESTION 7 CONTINUES OVERLEAF

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(d) Another solution of sodium carbonate has a concentration of 0.250 mol dm^{-3}.
Calculate the concentration of this solution in g dm^{-3}.
(Relative atomic masses: C = 12.0, O = 16.0, Na = 23.0)

.....

.....

.....

answer = ... g dm^{-3}

(2)

(e) Sodium chloride solution is produced in the titration.
If dilute nitric acid followed by silver nitrate solution is added to this solution, a white precipitate is formed.

Write the ionic equation, including state symbols, for this reaction.

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(3)

Q7

(Total 15 marks)

TOTAL FOR PAPER: 60 MARKS

END

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