Surname	Ot	ther names
Edexcel GCE	Centre Number	Candidate Number
Chemistr Advanced Subsidi Unit 3B: Chemistry	ary	ills I Alternative
1	•	ins i Aiternative
Friday 15 May 2009 – Mo Time: 1 hour 15 minute	rning	Paper Reference 6CH07/01

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
 - there may be more space than you need.

Information

- The total mark for this paper is 50.
- The marks for each question are shown in brackets
 use this as a guide as to how much time to spend on each question.
- You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, including your use of grammar, punctuation and spelling.
- A Periodic Table is printed on the back cover of this paper.

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.





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

1 (a) A student carries out a series of tests on X, a white powder known to be either calcium carbonate or magnesium carbonate. Complete the table below.

(6)

Test	Observation	Inference
Carry out a flame test on X .		Cation is magnesium.
Add dilute hydrochloric acid to X .		A gas is evolved.
	and a solution Y is formed.	
Pass the gas evolved in test (ii) through limewater.		Gas evolved in (ii) is
Add dilute sodium hydroxide to solution Y		The new substance observed is
until there is no further change.		

Test	Observation	Inference
Carry out a flame test on Z .	Red flame	Cation is either
		or
Acidify an aqueous solution of Z with dilute nitric acid. Then add a few drops of aqueous silver nitrate followed by concentrated aqueous ammonia until there is no further change.	Cream precipitate which	Anion is probably bromide.
Add concentrated sulfuric acid to solid Z .	Steamy fumes and	Probably hydrogen bromide and
	vapour seen.	Bromide confirmed.
Test the gases formed in (iii) with a piece of filter paper soaked in potassium dichromate(VI) solution.	Colour change from to	Sulfur dioxide present.
xplain, in terms of the redox)(iii).	x processes occurring, how sulf	fur dioxide is produced in (2)
	Carry out a flame test on Z . Acidify an aqueous solution of Z with dilute nitric acid. Then add a few drops of aqueous silver nitrate followed by concentrated aqueous ammonia until there is no further change. Add concentrated sulfuric acid to solid Z . Test the gases formed in (iii) with a piece of filter paper soaked in potassium dichromate(VI) solution.	Carry out a flame test on Z. Red flame Cream precipitate which Steamy fumes and Vapour seen. Colour change formed in (iii) with a piece of filter paper soaked in potassium dichromate(VI) solution. Cream precipitate which Colour change from to to to the processes occurring, how sulf

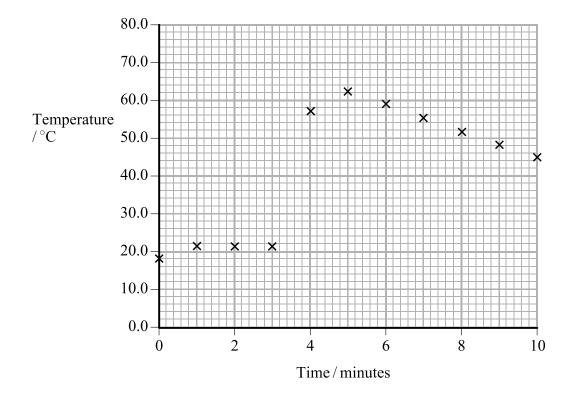
2 The enthalpy change for the reaction between zinc and copper(II) sulfate solution was determined using the procedure below. The ionic equation for the reaction is

$$Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$$

Procedure

- 1. Weigh about 5 g of zinc powder.
- 2. Measure 50.0 cm³ of 1.00 mol dm⁻³ copper(II) sulfate solution into a polystyrene cup.
- 3. Stir the solution continuously with a thermometer and measure the temperature of the solution each minute for 3 minutes.
- 4. At exactly 3.5 minutes add the zinc powder to the copper(II) sulfate solution.
- 5. Continue to stir the solution and read the temperature each minute from 4 to 10 minutes.

The results obtained are shown in the graph below.



(a) (i) Use the graph to estimate the maximum temperature change, ΔT , for the reaction. Show your working on the graph.

(2)

T =°C

(ii) Calculate the number of moles of copper(II) sulfate in 50.0 cm ³ of 1.00 mol dm ⁻³ solution.	(1)
(iii) The 5 g of zinc powder used is an excess. Calculate the mass of zinc that react exactly with 50.0 cm ³ of 1.00 mol dm ⁻³ copper(II) sulfate solution.	s (1)
(iv) Explain why the mass of zinc is not used in the calculation of the heat energy for the reaction.	(1)
(v) Use the value you have obtained for ΔT to calculate the heat energy produced in the reaction between zinc and copper(II) sulfate. Include units with your answer. Use the expression	
energy produced (J) = mass of solution \times specific heat capacity of solution \times temperature [Assume the specific heat capacity of the solution to be 4.18 J g ⁻¹ °C ⁻¹ and the density of the solution to be 1.00 g cm ⁻³ .]	re rise (2)

(vi)	Calculate the enthalpy change, ΔH , for this reaction. Your answer should be in units of kJ mol ⁻¹ , expressed to two significant figures and include a sign.	(2)
	ΔH =	kI mol ⁻¹
(b) (i)	Explain why the temperature of the solution is measured for 3 minutes before	KJ 11101
(b) (i)	adding the zinc.	
		(1)
(ii)	Explain why the temperature of the solution is measured over a period of time after adding the zinc.	(1)
(iii)	A polystyrene cup is used, rather than a glass beaker, to reduce heat loss. Explain why a polystyrene cup is a good choice.	(1)

	(1)
(v) Suggest a piece of apparatus suitable for measuring the 50.0 cm³ of copper(II) sulfate solution in this experiment.	(1)
(vi) Suggest ONE change in the apparatus used (other than using more accurate measuring equipment) that would improve the accuracy of the results.	(1)
In two further experiments, using more accurate equipment and an improved method the ΔH for the reaction between zinc and copper(II) sulfate was determined to be	d,
-216.8 kJ mol ⁻¹ while that for the reaction between zinc and lead(II) nitrate was found to be -154.0 kJ mol ⁻¹ . Place the three metals (copper, lead and zinc) in order of decreasing reactivity and	
$-216.8 \text{ kJ mol}^{-1}$ while that for the reaction between zinc and lead(II) nitrate was found to be $-154.0 \text{ kJ mol}^{-1}$.	(2)
-216.8 kJ mol ⁻¹ while that for the reaction between zinc and lead(II) nitrate was found to be -154.0 kJ mol ⁻¹ . Place the three metals (copper, lead and zinc) in order of decreasing reactivity and	(2)

3 An organic compound A has the structure shown below.

- (a) Give the observations that you would expect to make when each of the tests below is carried out. Give a brief chemical explanation of each reaction that occurs. Mechanisms are **not** required.
 - (i) A small amount of phosphorus(V) chloride is added to 2 cm³ of **A** in a test tube.

(2)

Observation
Explanation
(ii) A few drops of potassium manganate(VII) solution and 2 cm ³ of dilute sulfuric

(ii) A few drops of potassium manganate(VII) solution and 2 cm³ of dilute sulfuric acid are added to 2 cm³ of **A** in a test tube and the mixture is gently warmed.

(2)

Observation	 	 	
Evalanation			

(iii) A few drops of bromine water are added to 2 cm³ of **A** in a test tube and the mixture is shaken.

(2)

Observation	 	 	 	 	
Explanation	 	 	 	 	

(b) In the box b	elow, draw the displayed f	formula of the product	formed in (a)(iii).	(1)
		(Total	for Question 3 = '	7 marks)

4 2-chloro-2-methylbutane may be prepared by reacting 2-methylbutan-2-ol with concentrated hydrochloric acid:

$$(CH_3)_2C(OH)CH_2CH_3 + HCI \rightarrow (CH_3)_2C(CI)CH_2CH_3 + H_2O$$

The steps of the experimental procedure are as follows.

- 1. Place 5.00 cm³ of 2-methylbutan-2-ol and about 20 cm³ of concentrated hydrochloric acid into a separating funnel.
- 2. Continuously shake the mixture for 10 minutes.
- 3. Remove the aqueous layer and slowly add about 10 cm³ of dilute sodium hydrogencarbonate solution to the separating funnel.
- 4. Shake the mixture gently, inverting the separating funnel and opening the tap at regular intervals.
- 5. Remove the aqueous layer and transfer the organic layer to a conical flask.
- 6. Add a few pieces of anhydrous calcium chloride to the conical flask and shake the mixture.
- 7. Decant the liquid into a distillation flask and distil it to collect the pure 2-chloro-2-methylbutane.

Data

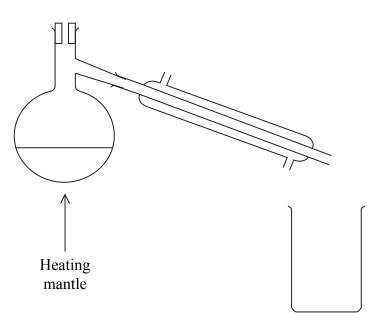
	2-methylbutan-2-ol	2-chloro-2-methylbutane
Density / g cm ⁻³	0.805	0.866
Molar mass / g mol ⁻¹	88	106.5
Boiling temperature / °C	102	85.5

(a) Draw a diagram of the separating funnel, clearly labelling the 2-methylbutan-2-ol and the concentrated hydrochloric acid layers (step 1). [The density of concentrated hydrochloric acid is 1.18 g cm⁻³.]

(2)

ry to continuously shake the 2-methylbutan-2-ol and the ochloric acid for the reaction to occur (step 2)?	(1)
se of the sodium hydrogencarbonate solution (step 3).	(1)
the separating funnel opened at regular intervals (step 4)?	(2)
se of the calcium chloride (step 6)?	(1)
decant the liquid (step 7)?	(1)

(c) An incomplete diagram of the distillation apparatus is shown below.



(i) Draw a thermometer in the diagram, showing clearly where the bulb of the thermometer is placed.

(ii) Draw clearly labelled arrows on the diagram to show the flow of water into and out of the condenser.

(1)

(1)



(d) The typical yield from this preparation is 70 %. Calculate the mass of 2-chloro-2-methylbutane that would be formed from 5.00 cm³ of 2-methylbutan-2-ol if a 70 % yield were obtained.

The equation for the reaction and the table of data are repeated below.

$$(\mathrm{CH_3})_2\mathrm{C}(\mathrm{OH})\mathrm{CH_2CH_3} + \mathrm{HCl} \rightarrow (\mathrm{CH_3})_2\mathrm{C}(\mathrm{Cl})\mathrm{CH_2CH_3} + \mathrm{H_2O}$$

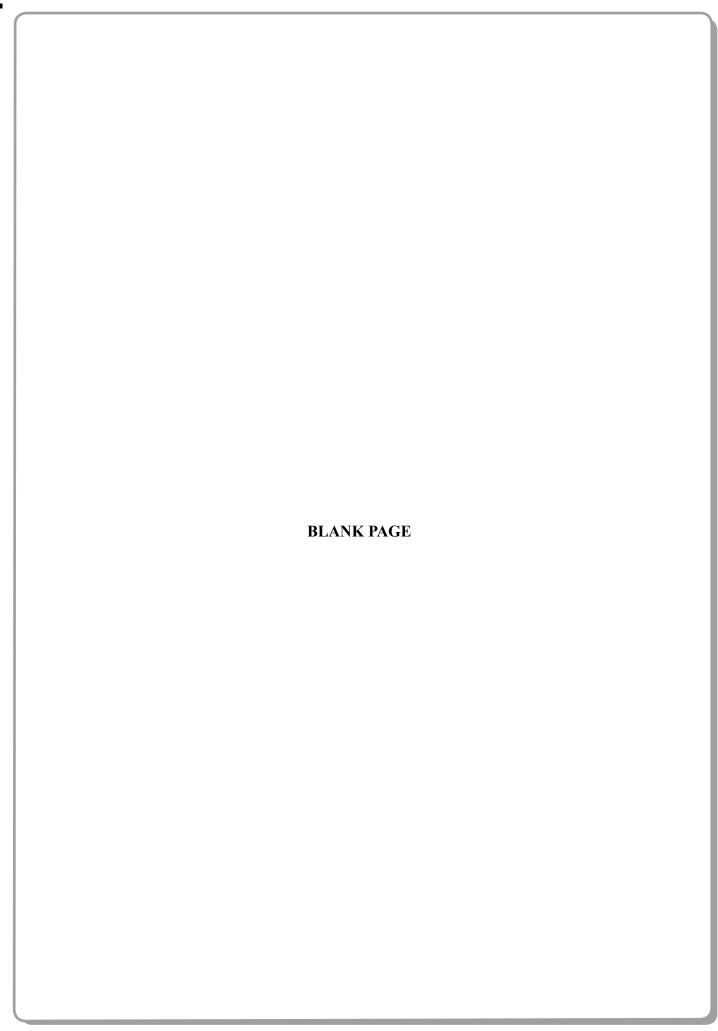
	2-methylbutan-2-ol	2-chloro-2-methylbutane							
Density / g cm ⁻³	0.805	0.866							
Molar mass / g mol ⁻¹	88	106.5							
Boiling temperature /°C	102	85.5							

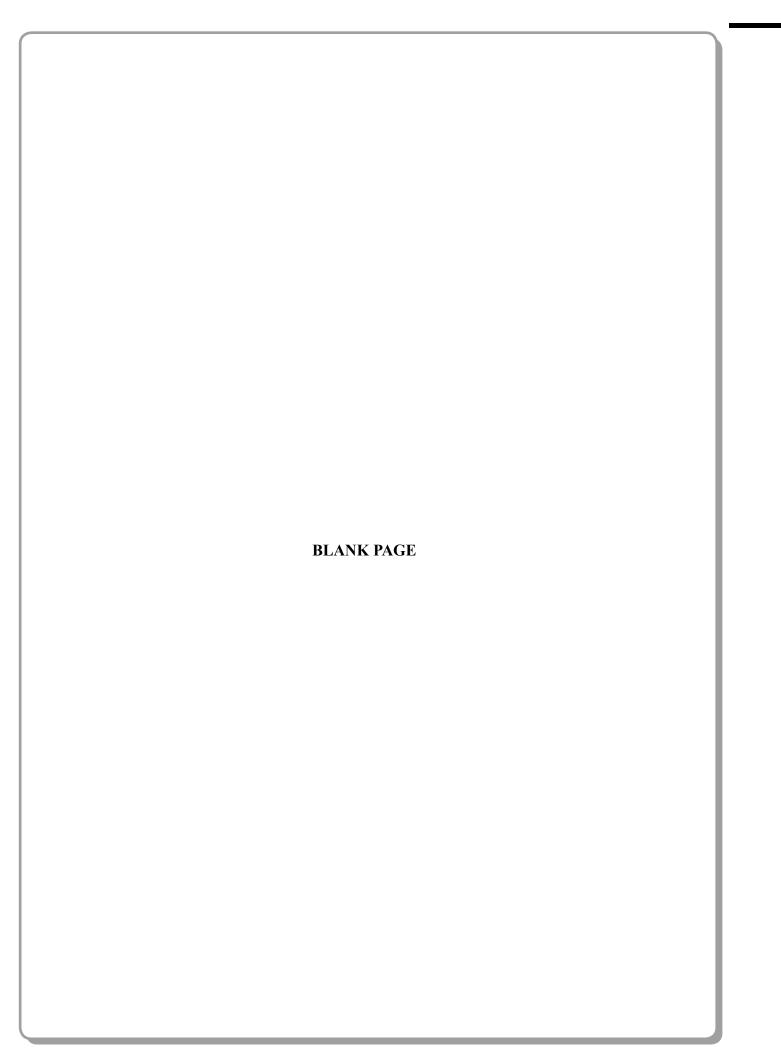
(2)

(Total for Question 4 = 12 marks)

TOTAL FOR PAPER = 50 MARKS







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	9	()	(0)	16.0	0	oxygen 8	32.1	S	sulfur 16	79.0	Se	selenium 34	127.6	<u>P</u>	tellurium 52	[506]	8	polonium 84	t :		nticated	173	Ϋ́	ytterbium	2	[254]	2	nobelium 1 102			
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