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Surname					Other names				
Centre Number					Candidate Number				
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Edexcel GCE

Chemistry
Advanced Subsidiary
Unit 3B: Chemistry Laboratory Skills I Alternative

Monday 7 January 2013 – Morning Time: 1 hour 15 minutes	Paper Reference 6CH07/01
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Candidates may use a calculator.	Total Marks
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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.

Turn over ►

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

- 1 (a) A student carried out a series of tests on solid potassium iodide, KI.
Complete the table below.

(5)

	Test	Observation	Inference
(i)	Carry out a flame test on potassium iodide.	Colour of flame is	Cation is K ⁺
(ii)	Dissolve potassium iodide in water. Add dilute nitric acid followed by aqueous silver nitrate.	Colour of precipitate formed is	Anion is I ⁻
(iii)	Test the precipitate formed in (ii) with concentrated ammonia solution.	Confirms iodide ions
(iv)	Dissolve potassium iodide in water. Add 10 drops of aqueous chlorine solution.	Colour of solution formed is	Formula of the coloured species is

- (v) A hydrocarbon solvent, which is less dense than water, was added to the solution formed in test (iv). What would you expect to see in the test tube after the solvent has been added, the contents of the test tube vigorously shaken and left to stand for a few minutes?

(2)

.....

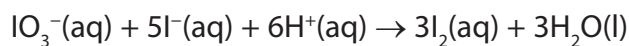
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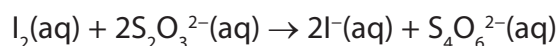
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- (b) In an experiment, iodide ions from potassium iodide react with iodate(V) ions and hydrogen ions from hydrochloric acid according to the ionic equation



The amount of iodine formed can be determined by titration with sodium thiosulfate solution of known concentration. The equation for this reaction is



30.0 cm³ of a solution of hydrochloric acid was added to an excess of potassium iodate(V) and potassium iodide solutions in a conical flask.

The iodine formed in the conical flask was titrated with sodium thiosulfate solution of concentration 0.100 mol dm⁻³. The mean titre was 45.00 cm³.

- (i) Name the indicator that is used in thiosulfate/iodine titrations.

(1)

- (ii) Give the colour change at the end-point of the titration.

(1)

From to

- (iii) Calculate the number of moles of sodium thiosulfate in the mean titre.

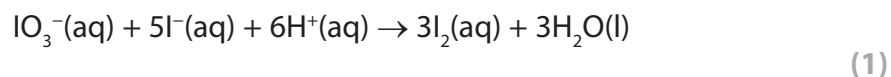
(1)

- (iv) Hence deduce the number of moles of iodine, I₂, which reacted with the number of moles of sodium thiosulfate calculated in (b)(iii).

(1)



- (v) How many moles of hydrogen ions, H^+ , are required to produce the number of moles of iodine stated in (b)(iv)?

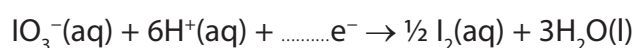


- (vi) Use your answer to (b)(v) to calculate the concentration of the hydrochloric acid in mol dm^{-3} .

(1)

- (c) Complete the half-equation showing the reduction of iodate(V) ions in acidic solution.

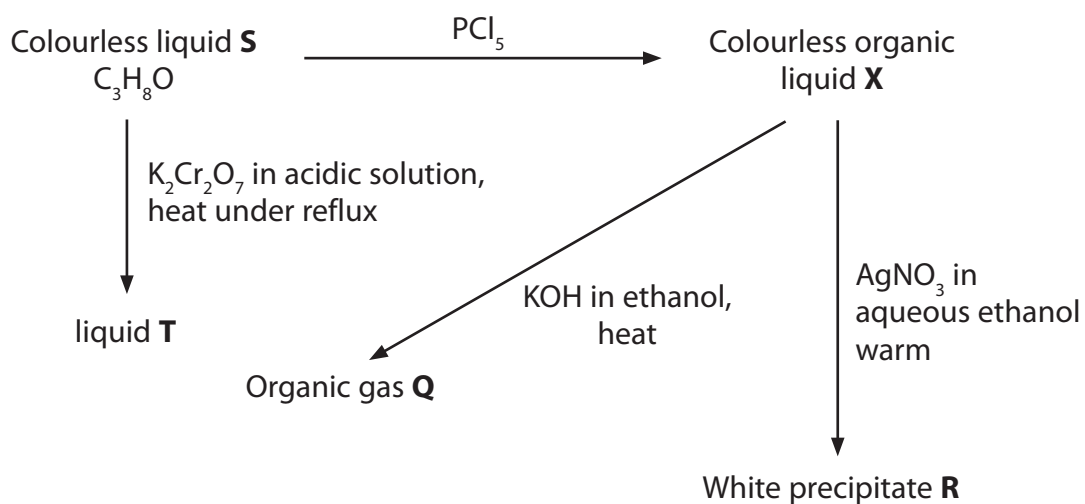
(1)



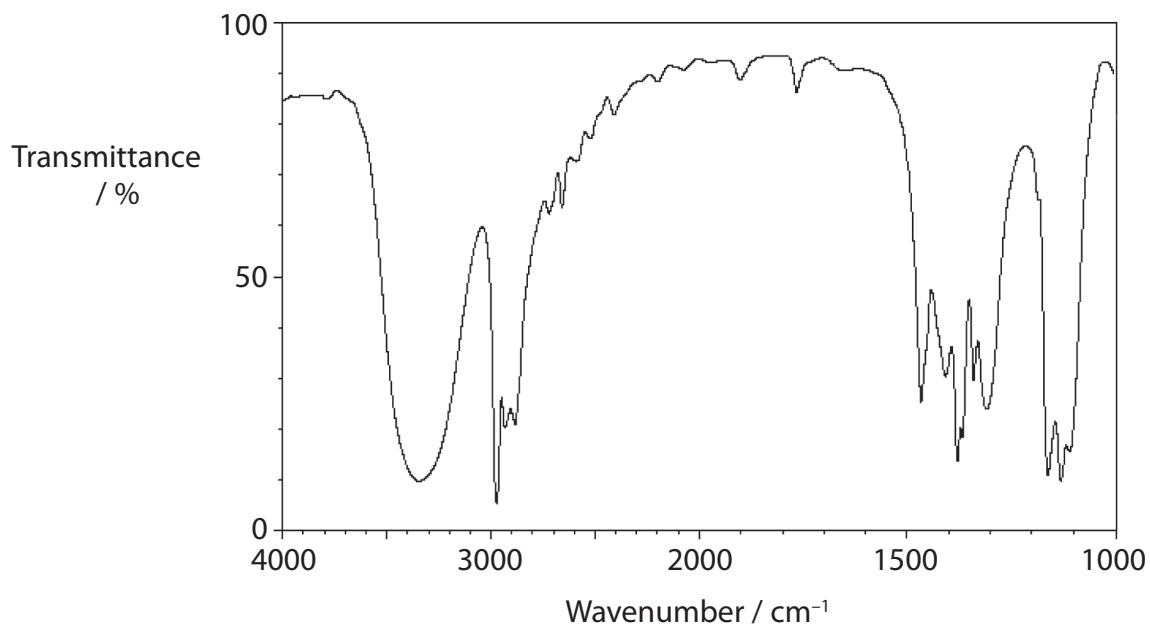
(Total for Question 1 = 14 marks)



2 Consider the following reaction scheme.



The infrared spectrum of compound **S** is shown below.



Bond	Group	Wavenumber range / cm^{-1}
C—H	alkane	2962 – 2853
	alkene	3095 – 3010
O—H	alcohol	3750 – 3200
C=C	alkene	1669 – 1645
C=O	aldehyde	1740 – 1720
	ketone	1720 – 1680

- (a) (i) Give the wavenumber range of the absorption in the infrared spectrum that shows that compound **S** is an alcohol.

(1)

- (ii) Identify the type of organic compound formed in the reaction of **S** with phosphorus(V) chloride, PCl_5 .

(1)

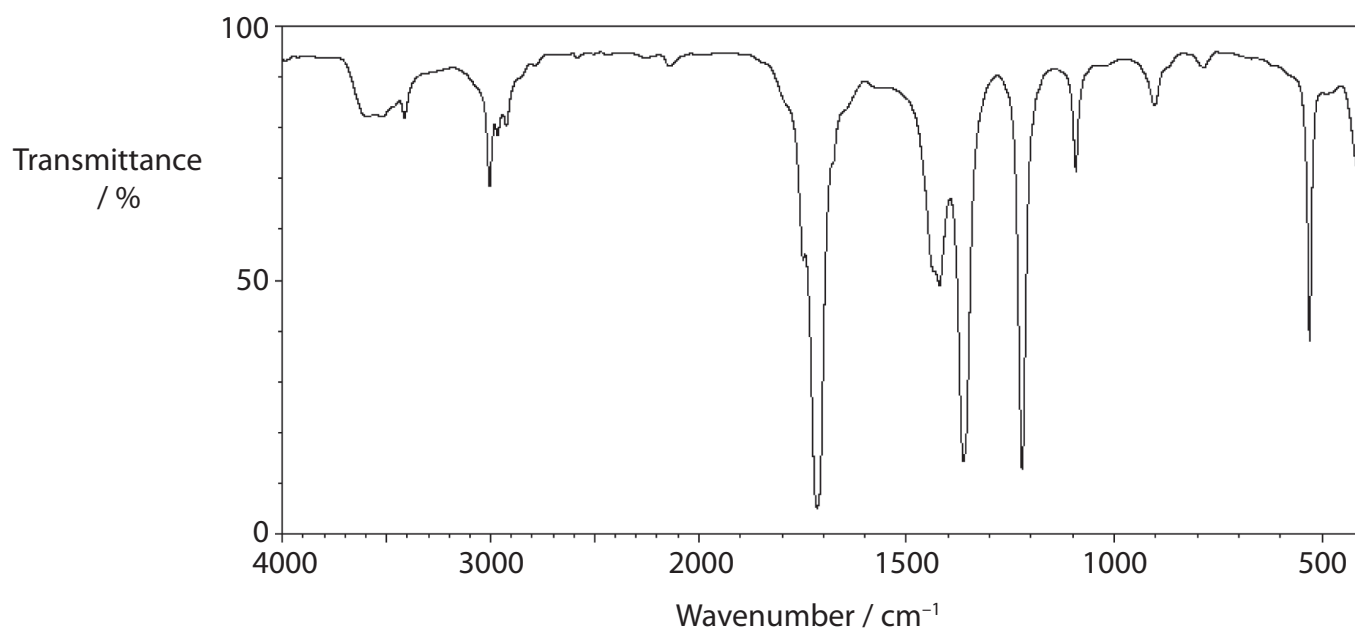


(b) Compound **T** does not produce carbon dioxide when added to a solution of sodium carbonate.

From this information **alone**, what can you deduce about compound **T**?

(1)

(c) The infrared spectrum of liquid **T** is shown below.



(i) Give the wavenumber range of the absorption in the infrared spectrum that shows that compound **T** is formed from a **secondary** alcohol.

(1)

(ii) Identify the type of organic compound **T**.

(1)



(iii) Draw the **skeletal** formula for **S**.

(1)

(d) Liquid **X** gives a white precipitate, **R**, on warming with an aqueous ethanolic solution of silver nitrate.

(i) Identify **R** by name or formula.

(1)

(ii) Describe what you would see if precipitate **R** was left in sunlight.

(1)

(iii) Suggest why an aqueous ethanolic solution of silver nitrate gives a better result in this test than would be obtained by aqueous silver nitrate.

(1)



(e) If **X** is heated with a concentrated ethanolic solution of potassium hydroxide, a gas **Q** is produced.

(i) Describe a test and its expected result to show that this gas is an alkene. (2)

Test

.....

Result

.....

(ii) Give the displayed formula of the alkene **Q**. (1)

(Total for Question 2 = 12 marks)



- 3** Weak acids such as ethanoic acid cannot be titrated with weak bases such as ammonia using an indicator since there is never any distinct colour change.

An alternative technique is to use thermometric titration as follows.

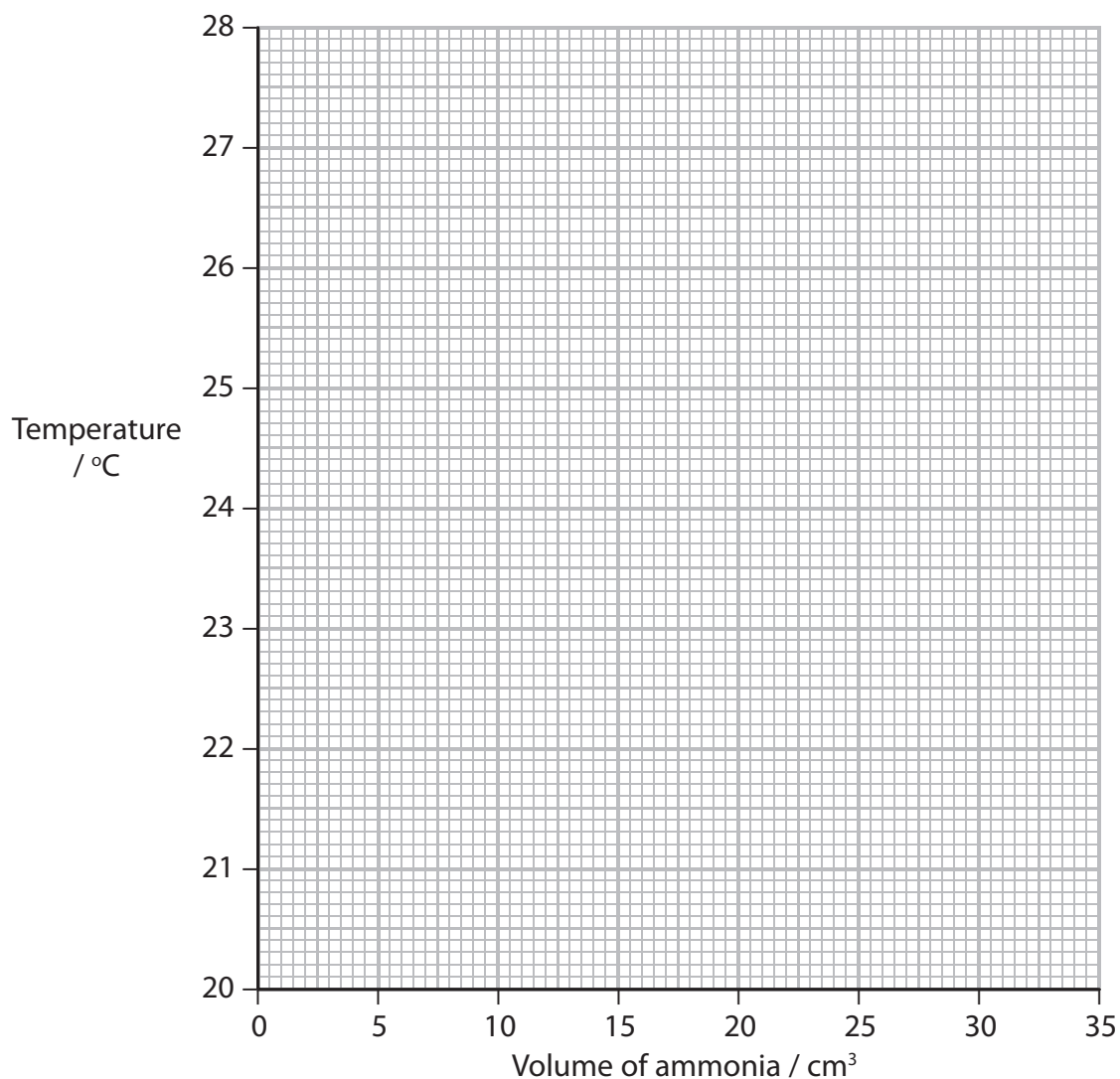
1. 30.0 cm³ of dilute ethanoic acid is placed in a polystyrene cup and its temperature measured.
2. 5.00 cm³ of ammonia solution of concentration 1.05 mol dm⁻³ is then added to the acid, the mixture stirred and the temperature measured again.
3. Further 5.00 cm³ portions of ammonia are added, followed by measurement of the temperature, until a total of 35.0 cm³ has been added.

The results of this experiment are tabulated below.

Volume of NH ₃ (aq) added /cm ³	0.00	5.00	10.0	15.0	20.0	25.0	30.0	35.0
Temperature /°C	20.7	22.4	24.0	25.7	26.4	25.3	24.0	22.7

- (a) (i) Plot these data on the axes below. Draw **two straight** lines through the points on your graph. Extrapolate the lines until they intersect, to enable you to determine the end-point volume.

(2)



(ii) State the volume of the ammonia solution at the end-point.

(2)

(iii) Explain why the temperature rises until the end-point is reached.

(1)

(iv) Explain why the temperature falls when more ammonia solution is added after the end-point.

(2)

(b) In a similar experiment, 25.0 cm^3 of ethanoic acid of concentration 2.00 mol dm^{-3} was reacted with 25.0 cm^3 of 2.00 mol dm^{-3} aqueous ammonia. The initial temperature was $20.6 \text{ }^\circ\text{C}$ and the temperature at the end-point was $29.8 \text{ }^\circ\text{C}$.

(i) Use the expression below to calculate the heat energy evolved in this reaction. (Assume that the density of the reaction mixture is 1.00 g cm^{-3} and that the specific heat capacity of the mixture is $4.18 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$.)

energy transferred = mass \times specific heat capacity \times temperature change
in joules

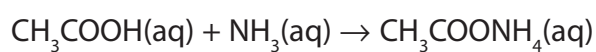
(2)



(ii) Calculate the number of moles of ethanoic acid used in this reaction.

(1)

(iii) The reaction that occurs is



Use your values from (b)(i) and (ii) to calculate the enthalpy change per mole for this reaction. Include a sign and units in your answer. Give your answer to **three** significant figures.

(3)

(Total for Question 3 = 13 marks)



4 The procedure below can be used to make 1-bromobutane.

1. Place a mixture of water, sodium bromide and butan-1-ol in a round-bottomed flask.
2. Slowly add a suitable volume of concentrated sulfuric acid to this mixture whilst it is also shaken and cooled.
3. When this addition is complete, heat the mixture under reflux for about 45 minutes.
4. Rearrange the apparatus for distillation and distil off the crude 1-bromobutane, collecting the distillate between 95 ° and 105 °C.
5. Shake the 1-bromobutane first with water, then with dilute sodium carbonate solution.
6. Separate the 1-bromobutane from the aqueous layer, add some anhydrous calcium chloride and leave the mixture to stand.
7. Decant the 1-bromobutane from the calcium chloride.

(a) (i) Explain why sodium bromide and sulfuric acid are required in **step 2**.

(1)

(ii) What would be the effect on this preparation if concentrated sulfuric acid was added in **step 2 without** water having been added in **step 1**? Justify your answer.

(2)

(b) Explain why the acid must be added slowly and with cooling in **step 2**.

(1)



(c) Draw a labelled diagram of the apparatus that could be used to carry out the distillation in **step 4**.

(4)

(d) Explain why the 1-bromobutane is shaken with sodium carbonate solution in **step 5**.

(1)

(e) What is the purpose of the calcium chloride in **step 6**?

(1)

(f) Suggest how you would obtain pure 1-bromobutane after **step 7**.

(1)

(Total for Question 4 = 11 marks)

TOTAL FOR PAPER = 50 MARKS



The Periodic Table of Elements

1	2	3	4	5	6	7	0 (8)								
							(18)								
<table border="1"> <tr> <td>1.0</td> <td>H</td> </tr> <tr> <td>hydrogen</td> <td>1</td> </tr> </table>		1.0	H	hydrogen	1										
1.0	H														
hydrogen	1														
<table border="1"> <tr> <td>relative atomic mass</td> <td></td> </tr> <tr> <td>atomic symbol</td> <td></td> </tr> <tr> <td>name</td> <td></td> </tr> <tr> <td>atomic (proton) number</td> <td></td> </tr> </table>		relative atomic mass		atomic symbol		name		atomic (proton) number							
relative atomic mass															
atomic symbol															
name															
atomic (proton) number															
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)								
6.9	9.0	45.0	47.9	50.9	52.0	54.9	55.8								
Li	Be	Sc	Ti	V	Cr	Mn	Fe								
lithium	beryllium	scandium	titanium	vanadium	chromium	manganese	iron								
3	4	21	22	23	24	25	26								
23.0	24.3	88.9	91.2	92.9	95.9	[98]	101.1								
Na	Mg	Y	Zr	Nb	Mo	Tc	Ru								
sodium	magnesium	yttrium	zirconium	niobium	molybdenum	technetium	ruthenium								
11	12	39	40	41	42	43	44								
39.1	40.1	87.6	87.6	137.3	183.8	186.2	190.2								
K	Ca	Sr	Rb	Ba	La*	Re	Os								
potassium	calcium	strontium	rubidium	barium	lanthanum	rhenium	osmium								
19	20	38	37	56	57	75	76								
132.9	137.3	178.5	178.5	180.9	183.8	186.2	190.2								
Cs	Ba	Hf	Ta	W	Re	Os	Ir								
caesium	barium	hafnium	tantalum	tungsten	rhenium	osmium	iridium								
55	56	72	73	74	75	76	77								
[223]	[226]	[227]	[261]	[262]	[266]	[264]	[277]								
Fr	Ra	Ac*	Rf	Db	Sg	Bh	Hs								
francium	radium	actinium	rutherfordium	dubnium	seaborgium	bohrium	hassium								
87	88	89	104	105	106	107	108								
140	141	144	147	150	152	157	159								
Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb								
cerium	praseodymium	neodymium	promethium	samarium	europium	gadolinium	terbium								
58	59	60	61	62	63	64	65								
232	[231]	238	[237]	[242]	[243]	[247]	[245]								
Th	Pa	U	Np	Pu	Am	Cm	Bk								
thorium	protactinium	uranium	neptunium	plutonium	americium	curium	berkelium								
90	91	92	93	94	95	96	97								
163	165	167	169	173	175	175	175								
Dy	Ho	Er	Tm	Yb	Lu	Lu	Lu								
dysprosium	holmium	erbium	thulium	ytterbium	lutetium	lutetium	lutetium								
66	67	68	69	70	71	71	71								
[251]	[254]	[253]	[256]	[254]	[257]	[257]	[257]								
Cf	Es	Fm	Md	No	Lr	Lr	Lr								
californium	einsteinium	fermium	mercurium	nobelium	lawrencium	lawrencium	lawrencium								
98	99	100	101	102	103	103	103								

Elements with atomic numbers 112-116 have been reported but not fully authenticated

* Lanthanide series
* Actinide series

