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Surname

Other names

Pearson Edexcel
International
Advanced Level

Centre Number

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Candidate Number

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Chemistry

Advanced

Unit 6: Chemistry Laboratory Skills II

Thursday 25 January 2018 – Afternoon

Time: 1 hour 15 minutes

Paper Reference

WCH06/01

Candidates must have: Scientific calculator

Total Marks

Instructions

- Use **black** ink or **black** 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.
- Try to answer every question.
- Check your answers if you have time at the end.
- Show all your working in calculations and include units where appropriate.

Turn over ►

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

- 1 A series of tests is carried out on a solid compound, **X**.
X contains one cation and one anion.
 Complete the Inference column in the table.

	Test	Observation	Inference	
(a)	Record the appearance of X	Yellow crystalline solid	..... ..... .....	(1)
(b)	Carry out a flame test on X	Yellow flame	.....	(1)
(c)	Add a few cm ³ of dilute sulfuric acid to a small amount of solid X in a test tube. Shake the test tube gently	Solid X dissolves and an orange solution is formed	The orange solution contains the anion with the formula	(1)
(d)	To the solution formed in (c), add a few drops of ethanol and warm the mixture carefully	Orange solution turns green	..... ..... ..... .....	(2)
(e)	To half of the green solution formed in (d), add aqueous sodium hydroxide, drop by drop, until in excess	A green precipitate initially forms which dissolves in excess sodium hydroxide to form a green solution	The formula of the green precipitate is The formula of the ion responsible for the colour of the green solution formed is	(2)

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	Test	Observation	Inference
(f)	To the remaining half of the green solution formed in (d), add a spatula measure of zinc powder	Green solution turns blue	<p>The formula of the ion responsible for the colour of the blue solution formed is</p> <p>.....</p> <p>The role of zinc in this reaction is</p> <p>.....</p> <p>.....</p>
			(2)
(g)	<p>Filter off the excess zinc from the mixture remaining after (f), collecting the filtrate in a test tube.</p> <p>Shake the test tube vigorously for a few minutes</p>	Blue solution turns green	<p>The formula of the ion responsible for the colour of the green solution is</p> <p>.....</p> <p>Type of reaction that has occurred is</p> <p>.....</p> <p>.....</p>
			(2)

(Total for Question 1 = 11 marks)

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2 A series of tests is carried out on two organic compounds, **Y** and **Z**.

Each molecule of **Y** and **Z** contains

- **three** carbon atoms
- **one** functional group.

(a) Complete the Inference column, taking the information above into account. You should state what **further** information the tests and observations give you about the original compound **Y**.

	Test	Observation	Inference about compound Y	
(i)	Add a small spatula measure of phosphorus(V) chloride to 1 cm ³ of Y in a test tube. Test any fumes given off with damp blue litmus paper	Steamy fumes are given off which turn damp blue litmus paper red	..... .....	(1)
(ii)	Add 2 cm ³ of sodium carbonate solution to 1 cm ³ of Y in a test tube	No change	..... .....	(1)
(iii)	Add 2 cm ³ of sodium hydroxide solution to 1 cm ³ of Y in a test tube. Add iodine solution, drop by drop, until the iodine is just in excess	A pale yellow solid with an antiseptic smell forms	..... ..... .....	(1)

(iv) Use your inferences in (a)(i) to (iii), and the information from the beginning of the question, to identify compound **Y**, by writing its name or formula.

(1)

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- (v) The mass spectrum of compound **Y** has a peak at $m/e = 45$.
Give the formula of the species responsible for this peak and explain how this species is formed from a molecule of compound **Y**.

(2)

Species responsible:

How this species is formed from a molecule of compound **Y**:

- (b) Two tests are carried out on compound **Z**. Complete the table by filling in the Inference column.

	Test	Observation	Inference
(i)	Add a small spatula measure of phosphorus(V) chloride to 1 cm ³ of Z in a test tube. Test any fumes given off with damp blue litmus paper	Steamy fumes are given off which turn damp blue litmus paper red	The steamy fumes are
			(1)
(ii)	Add 2 cm ³ of sodium carbonate solution to 1 cm ³ of Z in a test tube Bubble any gas formed through limewater	Vigorous fizzing occurs The limewater turns milky	The functional group present in compound Z is
			(1)

- (iii) Use your inferences in (b)(i) and (b)(ii), and the information from the beginning of the question, to identify compound **Z**, by writing its name or formula.

(1)

(Total for Question 2 = 9 marks)



- 3 An experiment is carried out to investigate the kinetics of the reaction between iodine and propanone in the presence of hydrogen ions.

The chemical equation for the reaction is



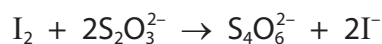
The rate equation for the reaction is

$$\text{rate} = k [\text{CH}_3\text{COCH}_3]^a [\text{H}^+]^b [\text{I}_2]^c$$

where a , b and c are the orders with respect to the species shown in the rate equation. It is known that a , the order with respect to propanone, is 1.

Procedure:

- Propanone, water and dilute hydrochloric acid are placed in a conical flask in a water bath
- Once the temperature of the mixture has equilibrated, a solution of iodine in potassium iodide is added and a clock is started
- At suitable time intervals, a known volume of the reaction mixture is transferred into a series of flasks numbered 1 to 6. Each flask contains excess aqueous sodium hydrogencarbonate solution which quenches the reaction
- The contents of each flask are titrated with a solution of sodium thiosulfate of known concentration.



- (a) The following data were obtained in an experiment carried out at 25 °C.

Flask number	1	2	3	4	5	6
Time / min	2	6	10	12	14	18
Volume of sodium thiosulfate / cm ³	18.80	14.40	10.40	8.20	6.00	2.00

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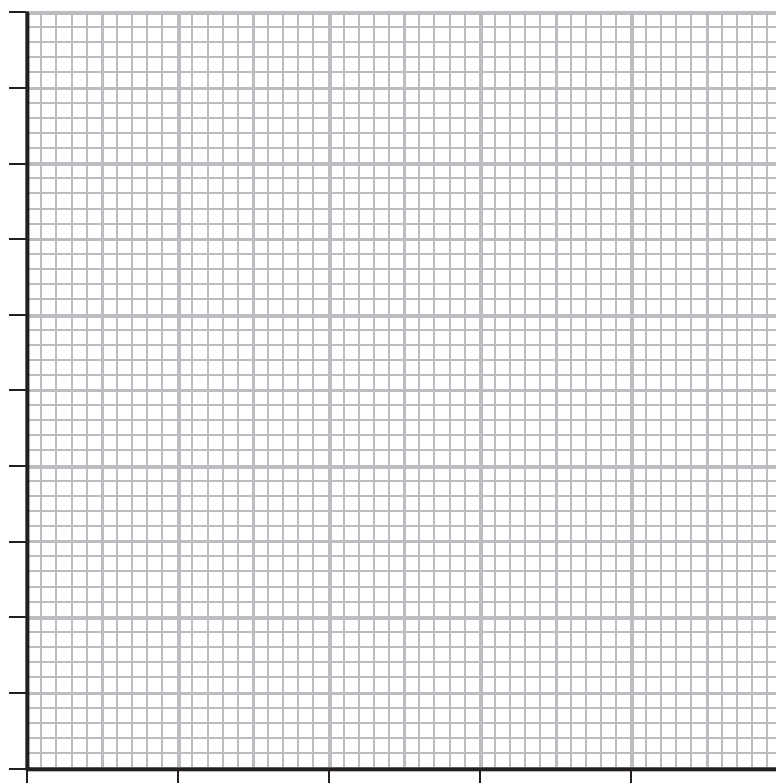
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- (i) Plot a graph of volume of sodium thiosulfate (y-axis) against time (x-axis).

Label the axes.

(4)



- (ii) The order with respect to iodine can be determined from the graph plotted in (a)(i). Explain why the actual concentration of iodine does **not** need to be calculated in this experiment.

(1)

- (iii) In this experiment, the concentrations of both the propanone and the hydrochloric acid are chosen so as to be in large **excess**. Explain why this is necessary when determining c , the order with respect to iodine.

(2)



(iv) Give the value of c , the order with respect to iodine.
Justify your answer.

(2)

.....

.....

.....

.....

(b) (i) State the indicator used in the iodine-thiosulfate titration.
Describe the colour change that is observed at the end-point.

(2)

Indicator.....

Colour change at end-point to

(ii) The indicator named in (b)(i) should not be added at the start of the titration.
State when the indicator is added to the mixture in the conical flask and
explain why it should **not** be added at the start.

(2)

.....

.....

.....

.....

(c) The titre obtained from the sample at 18 minutes has the greatest uncertainty.
Explain why this is so.

(1)

.....

.....

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- (d) In a similar experiment, the concentration of the hydrochloric acid was doubled whilst keeping all other variables the same.
The gradient of the graph plotted with these data was double the gradient of the graph plotted in (a)(i).

Deduce the value of b , the order with respect to hydrogen ions, and justify your answer. (2)

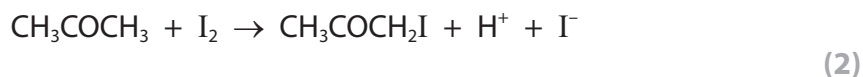
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- (e) Suggest an alternative practical technique which can be used to monitor the progress of the reaction. Justify your choice.



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(Total for Question 3 = 18 marks)

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- 4 The compound 2-ethanoylaminobenzoic acid, $C_9H_9NO_3$, is extremely reactive and is only prepared under strictly controlled conditions.

The steps of the procedure to prepare this compound and determine its melting temperature are as follows:

- Step 1 Transfer 3.70 g of 2-aminobenzoic acid, $C_7H_7NO_2$, to a dry 50 cm³ pear-shaped flask fitted with a reflux condenser
- Step 2 Add 7.0 cm³ of ethanoyl chloride (an excess) by pouring it carefully down the reflux condenser
- Step 3 Heat the contents of the pear-shaped flask slowly to boiling, and heat under reflux for 15 minutes
- Step 4 Allow the mixture to cool and then add 5.0 cm³ of water
- Step 5 Heat the solution slowly to boil it for a few minutes
- Step 6 Allow the solution to cool slowly to room temperature
- Step 7 Collect the crystals of 2-ethanoylaminobenzoic acid using suction filtration
- Step 8 Recrystallise the 2-ethanoylaminobenzoic acid
- Step 9 Determine the melting temperature of the pure dry crystals of 2-ethanoylaminobenzoic acid.

- (a) Explain, in terms of changes of state, how the process of heating under reflux works and give **two** reasons why it is often necessary to heat chemicals under reflux as in Step 3.

(3)

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(b) (i) Give the reason why water is added in Step 4.

(1)

.....
.....

(ii) Suggest why the reaction mixture was cooled before the water was added in Step 4.

(1)

.....
.....

(c) Suggest **two** advantages of using suction filtration in Step 7 compared to normal filtration.

(2)

.....
.....
.....
.....

(d) Give **two** features of the results of the melting temperature determination in Step 9 that would confirm the crystals of 2-ethanoylaminobenzoic acid were pure.

(2)

.....
.....
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- (e) In the balanced equation for this reaction, the mole ratio of 2-aminobenzoic acid, $C_7H_7NO_2$:2-ethanoylaminobenzoic acid, $C_9H_9NO_3$, is 1 : 1.

In an experiment, 3.70 g of 2-aminobenzoic acid, $C_7H_7NO_2$, produced 2.42 g of 2-ethanoylaminobenzoic acid, $C_9H_9NO_3$.

Calculate the percentage yield of the product in this reaction.

(3)

(Total for Question 4 = 12 marks)

TOTAL FOR PAPER = 50 MARKS



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The Periodic Table of Elements

1	2	3	4	5	6	7	0 (8)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
6.9 Li lithium 3	9.0 Be beryllium 4	23.0 Na sodium 11	24.3 Mg magnesium 12	39.1 K potassium 19	40.1 Ca calcium 20	87.6 Sr strontium 38	137.3 Ba barium 56	4.0 He helium 2
27.0 Al aluminium 13	28.1 Si silicon 14	27.0 B boron 5	12.0 C carbon 6	14.0 N nitrogen 7	16.0 O oxygen 8	19.0 F fluorine 9	20.2 Ne neon 10	31.0 P phosphorus 15
27.0 Al aluminium 13	28.1 Si silicon 14	27.0 B boron 5	12.0 C carbon 6	14.0 N nitrogen 7	16.0 O oxygen 8	19.0 F fluorine 9	20.2 Ne neon 10	31.0 P phosphorus 15
69.7 Ga gallium 31	72.6 Ge germanium 32	69.7 Ga gallium 31	72.6 Ge germanium 32	74.9 As arsenic 33	79.0 Se selenium 34	79.9 Br bromine 35	83.8 Kr krypton 36	74.9 As arsenic 33
114.8 In indium 49	118.7 Sn tin 50	114.8 In indium 49	118.7 Sn tin 50	121.8 Sb antimony 51	127.6 Te tellurium 52	126.9 I iodine 53	131.3 Xe xenon 54	121.8 Sb antimony 51
204.4 Tl thallium 81	207.2 Pb lead 82	204.4 Tl thallium 81	207.2 Pb lead 82	209.0 Bi bismuth 83	209.0 Po polonium 84	[210] At astatine 85	[222] Rn radon 86	209.0 Po polonium 84
65.4 Zn zinc 30	63.5 Cu copper 29	65.4 Zn zinc 30	63.5 Cu copper 29	107.9 Ag silver 47	107.9 Ag silver 47	107.9 Ag silver 47	107.9 Ag silver 47	107.9 Ag silver 47
112.4 Cd cadmium 48	106.4 Pd palladium 46	112.4 Cd cadmium 48	106.4 Pd palladium 46	107.9 Ag silver 47	106.4 Pd palladium 46	106.4 Pd palladium 46	106.4 Pd palladium 46	106.4 Pd palladium 46
200.6 Hg mercury 80	195.1 Pt platinum 78	200.6 Hg mercury 80	195.1 Pt platinum 78	197.0 Au gold 79	197.0 Au gold 79	197.0 Au gold 79	197.0 Au gold 79	197.0 Au gold 79
[272] Rg roentgenium 111	[271] Ds darmstadtium 110	[272] Rg roentgenium 111	[271] Ds darmstadtium 110	[268] Mt meitnerium 109	[268] Mt meitnerium 109	[268] Mt meitnerium 109	[268] Mt meitnerium 109	[268] Mt meitnerium 109
[277] Hs hassium 108	[264] Bh bohrium 107	[277] Hs hassium 108	[264] Bh bohrium 107	[266] Sg seaborgium 106	[266] Sg seaborgium 106	[266] Sg seaborgium 106	[266] Sg seaborgium 106	[266] Sg seaborgium 106
[262] Db dubnium 105	[262] Rf rutherfordium 104	[262] Db dubnium 105	[262] Rf rutherfordium 104	[262] Db dubnium 105	[262] Db dubnium 105	[262] Db dubnium 105	[262] Db dubnium 105	[262] Db dubnium 105
140 Ce cerium 58	141 Pr praseodymium 59	140 Ce cerium 58	141 Pr praseodymium 59	144 Nd neodymium 60	144 Nd neodymium 60	144 Nd neodymium 60	144 Nd neodymium 60	144 Nd neodymium 60
232 Th thorium 90	231 Pa protactinium 91	232 Th thorium 90	231 Pa protactinium 91	238 U uranium 92	238 U uranium 92	238 U uranium 92	238 U uranium 92	238 U uranium 92
150 Sm samarium 62	152 Eu europium 63	150 Sm samarium 62	152 Eu europium 63	157 Gd gadolinium 64	157 Gd gadolinium 64	157 Gd gadolinium 64	157 Gd gadolinium 64	157 Gd gadolinium 64
163 Dy dysprosium 66	165 Ho holmium 67	163 Dy dysprosium 66	165 Ho holmium 67	169 Tm thulium 69	169 Tm thulium 69	169 Tm thulium 69	169 Tm thulium 69	169 Tm thulium 69
175 Lu lutetium 71	173 Yb ytterbium 70	175 Lu lutetium 71	173 Yb ytterbium 70	175 Lu lutetium 71	175 Lu lutetium 71	175 Lu lutetium 71	175 Lu lutetium 71	175 Lu lutetium 71
[255] Lr lawrencium 103	[254] No nobelium 102	[255] Lr lawrencium 103	[254] No nobelium 102	[256] Md mendelevium 101	[256] Md mendelevium 101	[256] Md mendelevium 101	[256] Md mendelevium 101	[256] Md mendelevium 101
[257] Lr lawrencium 103	[254] No nobelium 102	[257] Lr lawrencium 103	[254] No nobelium 102	[254] Es einsteinium 99	[254] Es einsteinium 99	[254] Es einsteinium 99	[254] Es einsteinium 99	[254] Es einsteinium 99
[257] Lr lawrencium 103	[254] No nobelium 102	[257] Lr lawrencium 103	[254] No nobelium 102	[254] Es einsteinium 99	[254] Es einsteinium 99	[254] Es einsteinium 99	[254] Es einsteinium 99	[254] Es einsteinium 99

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

* Lanthanide series

* Actinide series

1.0 H hydrogen 1

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

