Please check the examination details below before en	tering your candidate information
Candidate surname	Other names
Centre Number Candidate Number	
Pearson Edexcel Internation	nal Advanced Level
Time 1 hour 20 minutes Paper reference	WCH16/01
Chemistry	
International Advanced Level	
UNIT 6: Practical Skills in Chemis	try II
You must have:	Total Marks
Scientific calculator	

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.
- Show all your working in calculations and include units where appropriate.
- Check your answers if you have time at the end.

Turn over ▶





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

- 1 This question is about copper and some of its compounds.
 - (a) Two tests were carried out on separate samples of an aqueous solution of copper(II) sulfate.
 - (i) Test 1

A few drops of aqueous sodium hydroxide were added to a sample of the copper(II) sulfate solution.

State what you would see.

(1)

(ii) Test 2

A few drops of concentrated hydrochloric acid were added to another sample of the copper(II) sulfate solution.

More of the concentrated hydrochloric acid was added until it was present in excess.

Describe the changes that would be observed during this test.

(2)

(b) Describe a test, and its positive result, to confirm the presence of the sulfate ion in another sample of the copper(II) sulfate solution.

(2)





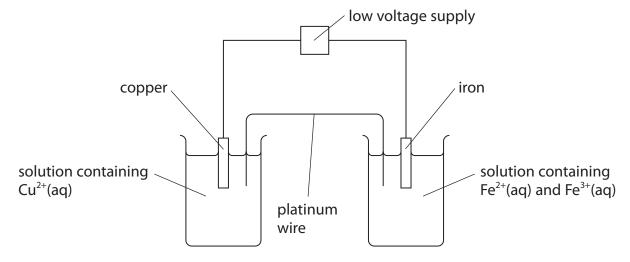
(c) An electrochemical cell was made from the electrode systems represented by these half-equations:

$$Cu^{2+}(aq) + 2e^{-} \rightleftharpoons Cu(s)$$
 $E^{\ominus} = +0.34V$
 $Fe^{3+}(aq) + e^{-} \rightleftharpoons Fe^{2+}(aq)$ $E^{\ominus} = +0.77V$

(i) Calculate $E_{\text{cell}}^{\ominus}$ for the electrochemical cell.

(1)

(ii) A student drew a diagram of an experiment to measure the standard emf of the cell.



Identify three mistakes in this diagram and the changes needed to correct them.

Assume that standard conditions were used.

(3)

Mistake	Change needed to correct mistake



(d) Brass is an alloy of copper and zinc.
A student determined the percentage of copper in a sample of brass.

Procedure

- weigh the sample of brass
- place the brass in a beaker and add concentrated nitric acid until all the brass dissolves
- transfer the solution and washings to a 250.0 cm³ volumetric flask
- make the solution up to the mark with distilled water and mix well
- pipette 25.0 cm³ of the solution into a conical flask
- neutralise the excess nitric acid in the solution
- add 10 cm³ of potassium iodide solution (an excess) to the conical flask
- titrate the iodine produced with 0.100 mol dm⁻³ sodium thiosulfate solution using starch indicator
- repeat the titration until concordant titres are obtained.
- (i) Copper and zinc both react with concentrated nitric acid to form the metal nitrates, nitrogen dioxide and water.

Write the balanced equation for the reaction of zinc with concentrated nitric acid.

State symbols are not required.

(1)

(ii) Name the most suitable piece of apparatus to measure the 10 cm³ of potassium iodide solution.

(1)

(iii) State at what point in the titration the starch solution should be added.

(1)



(iv) Only Cu²⁺ ions in the solution react with the aqueous potassium iodide.

$$2Cu^{^{2+}} \ + \ 4I^{^{-}} \ \rightarrow \ 2CuI \ + \ I_2$$

The iodine reacts with sodium thiosulfate solution.

$$2S_2O_3^{2-} \ + \ I_2 \ \to \ S_4O_6^{2-} \ + \ 2I^-$$

Results

Mass of brass sample = 3.90 g

Mean titre of $0.100 \, \text{mol dm}^{-3}$ sodium thiosulfate solution = $28.60 \, \text{cm}^3$

Calculate the percentage, by mass, of copper in this sample of brass. Give your answer to an appropriate number of significant figures.

(5)

(Total for Question 1 = 17 marks)



2 Two organic compounds, **A** and **B**, are colourless liquids.

Each compound contains only **one** functional group.

- (a) Two tests were carried out on **A**. The observation for each test was recorded in the table.
 - (i) Complete the statements in the inference column by writing the names or formulae of the functional groups.

(2)

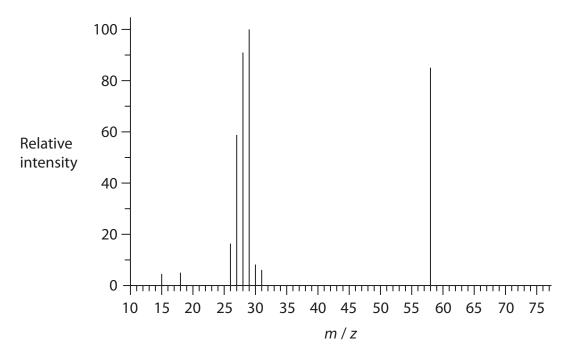
Test	Observation	Inference
Test 1		A could contain
A few drops of A were added to 2 cm ³ of a solution of 2,4-dinitrophenylhydrazine (Brady's reagent)	An orange precipitate formed	or
Test 2		
A few drops of A were added to 2 cm ³ of Fehling's solution		The functional group present in A is
The mixture was warmed in a water bath	A red precipitate formed	

(ii) Give the name or formula of the red precipitate formed in **Test 2**.

(1)



(b) A simplified mass spectrum of **A** is shown.



(i) Give the formula of **one** of the ions responsible for the peak at m / z = 29.

(1)

(ii) A contains one functional group.

Give the m/z value of the molecular ion and the structure of **A**.

(1)

m / z value of the molecular ion

structure of **A**



- (c) Two tests were carried out on **B**.
 - (i) Complete the statements in the observation and inference columns.

(2)

Test	Observation	Inference
Test 3		
2 drops of B were dissolved in 2 cm ³ of water		
A few drops of Universal Indicator were added to the solution	The colour of the mixture was	The solution is alkaline
Test 4		
B was added drop by drop to aqueous copper(II) sulfate until B was present in excess	A pale blue precipitate formed with the first few drops of B This dissolved to form a deep	The name of the functional group in B is
	blue solution when excess B was added	

(ii) **B** has a molar mass of 59 g mol⁻¹.

Suggest a structure for **B**.

(1)

(Total for Question 2 = 8 marks)



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3 A student carried out an experiment to determine the enthalpy change when solid lithium chloride, LiCl, dissolved in water to form a solution.

Procedure

- Step 1 Use a pipette to place 25.0 cm³ of distilled water into a polystyrene cup.
- Step 2 Measure and record the initial temperature of the water.
- Step **3** Add 2.12 g of lithium chloride to the water.
- Step 4 Stir the mixture and record the highest temperature reached.
- (a) Give a reason why a polystyrene cup was used instead of a glass beaker in Step 1.

(1)

(b) The temperature rise was 12.5 °C.

Calculate the enthalpy change for the formation of this solution of lithium chloride.

Include a sign and units in your answer.

[Assume: specific heat capacity of the solution = $4.18 \,\mathrm{Jg^{-1} \, {}^{\circ}C^{-1}}$ density of the solution = $1.00 \,\mathrm{g\,cm^{-3}}$]

(3)

	(Total for Question 3 = 10 ma	rks)
	Include the use of a stopwatch and details of a graph you would plot.	(5)
	Describe changes to the procedure that would give a more accurate temperature rise.	
(d)	The temperature rise in this experiment was lower than expected, due to heat loss to the surroundings.	
(1)		
		(1)
	Calculate the percentage uncertainty in the temperature change in this experiment.	
(c)	The thermometer used to measure the temperature change had an uncertainty of $\pm 0.25^{\circ}\text{C}$ for each measurement.	



4 This question is about the alkaline hydrolysis of an ester, X.

X is an alkyl benzoate and can be represented by the formula C_6H_5COOR , where R is the alkyl group.

The equation for the hydrolysis is

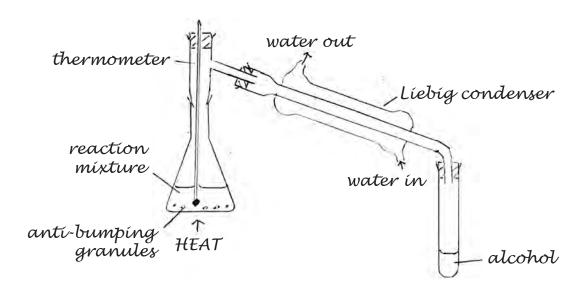
$$C_6H_5COOR + NaOH \rightarrow C_6H_5COONa + ROH$$

Procedure

- Step **1** Measure 5.0 cm³ of **X** and pour it into a pear-shaped flask. Add 25 cm³ (an excess) of aqueous sodium hydroxide solution and a few anti-bumping granules.
- Step 2 Heat the flask and contents under reflux for 20 minutes.
- Step **3** Allow the apparatus to cool and then rearrange it for distillation. Distil the mixture and collect about 2 cm³ of the alcohol ROH.
- Step 4 Allow the pear-shaped flask to cool, pour the contents into a beaker and add excess dilute hydrochloric acid.

 Impure benzoic acid forms as crystals in the mixture.
- Step **5** Recrystallise the benzoic acid using water as the solvent.
- Step **6** Weigh the dry crystals and determine their melting temperature.

(a) A student drew a diagram of the apparatus set up for distillation in Step 3.
 There are three errors in the diagram.
 Assume the apparatus is clamped correctly and an appropriate heat source is used.



Identify the three errors and how they should be corrected.							
	(3)						



	Describe a chemical test, and its positive result, to show the presence of an –OH group in any alcohol.	
	on group in airy diconon	(2)
c)	(i) Write an equation for the reaction taking place in Step 4 . Use structural formulae for the organic substances. State symbols are	
	not required.	(1)
		(1)
	(ii) State what should be done to separate the benzoic acid from the mixture	
	produced in Step 4 , before carrying out Step 5 .	(1)
d)	Describe the first stage in the recrystallisation process in Step 5 .	
		(1)
	The melting temperature of pure benzoic acid is 122 °C.	
	State two ways in which the melting temperature changes if the benzoic acid is not pure.	(2)
		(2)



- (f) The molar mass of \mathbf{X} , C_6H_5COOR , is $178\,\mathrm{g\,mol}^{-1}$.
 - (i) Deduce the formula of the alkyl group, R.

(1)

(ii) Use your answer to (f)(i) to draw the structures of the four possible alcohols, ROH.

(2)



(iii) The part of the ¹³C NMR spectrum of **X** corresponding to the R group contains only two peaks.

Deduce the structure of X.

(2)

(Total for Question 4 = 15 marks)

TOTAL FOR PAPER = 50 MARKS



Md No Lr mendetevium nobelium tawrencium

[253] Fm femium 100

£ # %

Np Pu Am Pu Am Pu αmericium 93 94

uranium

protactinium

thorium

[231] Pa

232

92

6

8

[247] 64

103

102

101

[257]

[254]

[256] 69

lutetium

3

Yb ytterbium 70

Tm

167 Er erbium

165 Ho Holmium

Dy dysprosium

159

157 G

152 Eu

150

[147]

144

14 T

Cerium

· Lanthanide series Actinide series

Pr Nd Pm Sm Eu Gd Tb

68

19

99

65

63

62

61

9 238

29

rted	Ru radon 86	[222]	Xenon xenon 54	krypton 36	83.8 Kr	39.9 Ar argon 18	Ne neon	4.0 He helium	0 (8)		
эееп герог	At astatine 85	[210]	lodine 53	bromine 35	79.9 Br	35.5 Cl chlorine 17	F fluorine 9	(17)	7		
116 have t	Po polanium 84	[209]	Te tellurium 52	selenium 34	79.0 Se	32.1 S sulfur 16	Oxygen 8	(16)	9		
Elements with atomic numbers 112-116 have been reported but not fully authenticated	Bi bismuth 83	209.0	Sb antimony 51	arsenic 33	74.9 As	31.0 P phosphorus 15	N nitrogen 7	(15)	'n		
atomic nur but not f	Pb lead 82	207.2	S # 8	germanium 32	72.6	Si Siticon 14	C Carbon 6	(14)	4		
ents with	TI thaillium 81	204.4	indium 49	gallium 31	69.7 Ga	27.0 Al atuminium 13	10.8 boron 5	(13)	m		
Elem	Hg mercury 80	200.6	Cd cadmium 48	zinc 30	65.4 Zn	(12)					
[272] Rg roentgenium	Au gold 79	197.0	Ag silver 47	copper 29	63.5	(11)					
Ds damstactium	Pt platinum 78	195.1	Pd palladium 46	nickel 28	58.7	(01)					
(277) [268] Hs Mt hassium meitnerium d	lridium 77	192.2	Rh rhodfum 45	cobalt 27	58.9	(6)					
	Os osmium 76	190.2	Ru ruthenium 44	iron 26	55.8 Fe	(8)		1.0 Hydrogen			
[264] Bh bohrium		0									
[266] Sg seaborgium 106	W tungsten 74	183.8	Mo Tc motybdenum technetium 42 43	chromium manganese 24 25	52.0 Cr	(9)	nass iol				
Db dubnium s	Ta tantalum 73	180.9	Niobium 41	vanadium 23	50.9	(5)	relative atomic mass atomic symbol name atomic (proton) number	Key			
[261] Rf nutherfordum	Hf hafnium 72	178.5	Zr zirconium 40	titanium 22	47.9 Ti	(4)	atomic				
AC*	La* lanthanum 57	138.9	yttrium 39	scandium 21	45.0	(3)					
Ra radium	Ba barium la 56	137.3	Sr strontium 38	calcium s	40.1 C	Mg magnesium 12	Be beryllium 4	(2)	7		
[223] Fr francium	Cs caesium 55	132.9	Rb rubidium 37	potassium 19	39.1 K	Na Sodium	Li Lithlum 3	(1)	-		