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Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel
International Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Tuesday 5 May 2020

Afternoon (Time: 1 hour 20 minutes) | Paper Reference **WCH13/01**

Chemistry

International Advanced Subsidiary/Advanced Level
Unit 3: Practical Skills in Chemistry I

Candidates must have: Scientific calculator
Ruler

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.
- There is a Periodic Table 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 ▶

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Answer ALL the questions.

Write your answers in the spaces provided.

1 A white anhydrous crystalline solid **A** contains one cation and one anion.

Solid **A** was heated in a test tube and the following observations were made.

A brown gas was produced.

A glowing splint relit when placed in the mouth of the test tube.

A white solid remained in the test tube.

(a) Identify, by name or formula, the **two** gases formed.

(2)

.....

.....

(b) Identify, by name or formula, the anion present in **A**.

(1)

.....

(c) A flame test was carried out on **A** and a green colour was observed.

Identify, by name or formula, the cation present in **A**.

(1)

.....

(d) Give the **formula** of solid **A** and the **formula** of the white solid formed on heating.

(2)

Solid **A** .....

White solid .....

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(e) About 5 cm^3 of an aqueous solution of **A** was placed in each of two test tubes.

Five drops of aqueous sodium hydroxide were added to one of the test tubes and five drops of dilute sulfuric acid were added to the other.

In the table give the observations you would expect to make.

(2)

Addition of sodium hydroxide solution	Addition of dilute sulfuric acid solution

(Total for Question 1 = 8 marks)

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2 (a) A student was provided with aqueous solutions of four compounds:

hydrochloric acid
potassium carbonate
silver nitrate
sodium chloride

Four bottles, labelled **B**, **C**, **D** and **E**, each contained one of the solutions.
The student mixed pairs of the solutions to determine which was in each bottle.

The results are shown.

Solutions mixed	Observations
B and **C**	A white precipitate formed which did **not** dissolve on the addition of dilute nitric acid
B and **D**	A precipitate formed which dissolved with effervescence on the addition of dilute nitric acid
B and **E**	A white precipitate formed which did **not** dissolve on the addition of dilute nitric acid
C and **D**	Effervescence with bubbles of a colourless gas given off
C and **E**	No change
D and **E**	No change

Using the observations in the table, deduce the identity of the compound in each bottle.

(3)

B .....

C .....

D .....

E .....

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(b) To identify the cations in sodium chloride and potassium carbonate, a student carried out flame tests using the following method.

Step **1** A sample of solid sodium chloride was placed on a watch glass and a few drops of concentrated nitric acid were added. The solid and acid were mixed to form a paste.

Step **2** A length of copper wire was dipped into the paste.

Step **3** A Bunsen burner was set up with the air-hole closed. The copper wire containing the paste was placed into the Bunsen burner flame and the colour observed.

Step **4** The procedure was repeated using solid potassium carbonate.

For each of the Steps **1**, **2** and **3** give an improvement in the procedure explaining why the change is necessary.

(6)

Step	Improvement	Explanation
1		
2		
3		

(Total for Question 2 = 9 marks)

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3 This question is about three organic liquids, **F**, **G** and **H**.

(a) Tests were carried out on **F** and **G**.

Each liquid contained **one** functional group.

Test **1**

A spatula measure of phosphorus(V) chloride, PCl_5, was added to about 1 cm^3 of each liquid in separate test tubes.
Any gas evolved was tested with damp blue litmus paper.

F	G
Steamy fumes were given off. Damp blue litmus paper turned red	Steamy fumes were given off. Damp blue litmus paper turned red

(i) Identify, by name or formula, the steamy fumes produced in Test **1**.

(1)

.....

Test **2**

About 1 cm^3 of sodium hydrogencarbonate solution was added to 1 cm^3 of each liquid in separate test tubes.

F	G
No reaction	A colourless gas was given off that turned limewater cloudy

(ii) Identify, by name or formula, the gas produced in Test **2**.

(1)

.....

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(iii) Using the results from Tests **1** and **2** and the information at the start of the question, **name** the functional groups present in **F** and **G**.

(2)

Functional group in **F**	Functional group in **G**

(iv) **F** and **G** both have a molar mass of 46 g mol^{-1}.

Draw the **displayed** formula of **F** and **G**.

(2)

F	**G**

(v) State whether or not it is possible to distinguish between **F** and **G** using infrared spectra. Justify your answer.

Wavenumber values are not required.

(1)

.....

.....

.....

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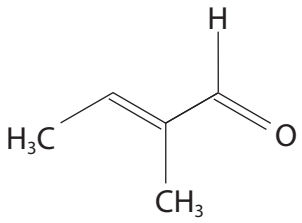
(b) The organic liquid **H** is a pheromone thought to be involved in communication between rabbits.



State the initial and final appearance of each mixture when the tests described were carried out on liquid **H**.

(4)

Tests	Observations
A few drops of **H** were shaken with bromine water.	
In a test tube, a few drops of **H** were added to 1 cm^3 of Benedict's or Fehling's solution. The mixture was warmed in a water bath.	

(Total for Question 3 = 11 marks)

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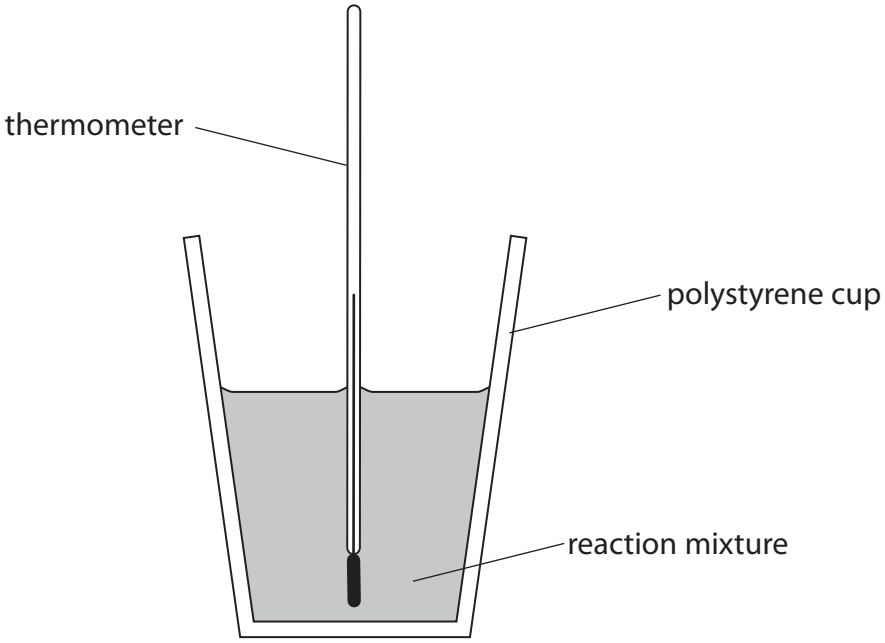
4 The enthalpy change of neutralisation of hydrochloric acid may be determined using the apparatus shown.



The equation for the reaction is

$$HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l)$$

Procedure

Step **1** Place 25.0 cm^3 of 1.00 mol dm^{-3} hydrochloric acid in a polystyrene cup. Record the temperature of the hydrochloric acid.

Step **2** Record the temperature of 30.0 cm^3 of 1.00 mol dm^{-3} sodium hydroxide.

Step **3** Add the sodium hydroxide to the hydrochloric acid in the polystyrene cup. Stir the mixture and record the maximum temperature reached.

(a) (i) Give a reason why an excess of sodium hydroxide was used.

(1)

.....

.....

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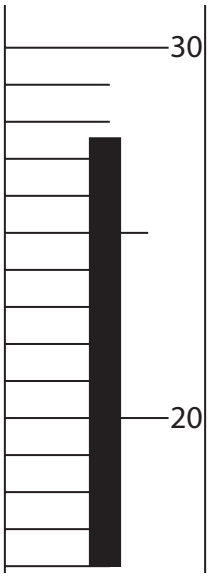
(ii) The diagram shows part of the thermometer when the temperature had reached its maximum.



Record the temperature in the table of results and then complete the table by giving the temperature change.

(1)

Results

Measurement	Temperature / °C
Temperature of 25 cm^3 hydrochloric acid	21.5
Temperature of 30 cm^3 sodium hydroxide	21.5
Mean starting temperature	21.5
Maximum temperature of the mixture	
Temperature change	

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(b) Calculate the enthalpy change of neutralisation of hydrochloric acid.

Include a sign and units in your answer.

[Assume: the density of both solutions and the mixture $= 1.0\ g\,cm^{-3}$
the specific heat capacity of the mixture $= 4.2\ J\,g^{-1}\,°C^{-1}$]

(4)

(c) The experiment was repeated using a glass beaker instead of a polystyrene cup.

Explain how the value obtained for the enthalpy change of neutralisation would be different.

(2)

(Total for Question 4 = 8 marks)

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5 A student carried out an experiment to identify the metal M in the hydrated carbonate $M_2CO_3.10H_2O$.

A solution was made by dissolving 3.56 g of the hydrated metal carbonate in distilled water and making the volume up to 250.0 cm^3 in a volumetric flask.

25.0 cm^3 of this solution was placed in a conical flask and titrated with 0.100 mol dm^{-3} of hydrochloric acid.

The equation for the reaction is

$$M_2CO_3(aq) + 2HCl(aq) \rightarrow 2MCl(aq) + H_2O(l) + CO_2(g)$$

(a) Name a suitable piece of apparatus to measure the 25.0 cm^3 of solution.

(1)

.....

(b) Methyl orange indicator was used in this titration.

Give the colour change in the conical flask at the end-point.

(2)

Colour change from ..... to .....

(c) The results of the titration are shown.

Number of titration	1	2	3
Burette reading (final) / cm^3	25.25	26.00	24.85
Burette reading (initial) / cm^3	0.00	1.00	0.05
Titre / cm^3			

(i) Complete the table.

(1)

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(ii) Using appropriate titrations, calculate the mean titre.

(1)

(iii) Using your answer to (c)(ii), calculate the number of moles of HCl in the mean titre.

(1)

(iv) Calculate the number of moles of M_2CO_3 in 25.0 cm^3 of the solution. Hence calculate the number of moles of M_2CO_3 in the 250.0 cm^3 volumetric flask.

(2)

(v) Using your answer in (c)(iv) and the mass of $M_2CO_3.10H_2O$ in the 250 cm^3 of solution, calculate the molar mass of $M_2CO_3.10H_2O$.

(1)

(vi) Use your answer to (c)(v) to identify metal M.

(2)

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(d) The titration was repeated without using an indicator.

Describe how you would obtain large, dry crystals of the metal chloride, MCl, from this titration solution.
Diagrams are not required.

(3)

(Total for Question 5 = 14 marks)

TOTAL FOR PAPER = 50 MARKS

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The Periodic Table of Elements

1	2											3	4	5	6	7	0 (8)
																	(18)
							1.0 H hydrogen 1										4.0 He helium 2
(1)	(2)		Key									(13)	(14)	(15)	(16)	(17)	
6.9 Li lithium 3	9.0 Be beryllium 4		relative atomic mass **atomic symbol** name atomic (proton) number									10.8 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
23.0 Na sodium 11	24.3 Mg magnesium 12	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	27.0 Al aluminium 13	28.1 Si silicon 14	31.0 P phosphorus 15	32.1 S sulfur 16	35.5 Cl chlorine 17	39.9 Ar argon 18
39.1 K potassium 19	40.1 Ca calcium 20	45.0 Sc scandium 21	47.9 Ti titanium 22	50.9 V vanadium 23	52.0 Cr chromium 24	54.9 Mn manganese 25	55.8 Fe iron 26	58.9 Co cobalt 27	58.7 Ni nickel 28	63.5 Cu copper 29	65.4 Zn zinc 30	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
85.5 Rb rubidium 37	87.6 Sr strontium 38	88.9 Y yttrium 39	91.2 Zr zirconium 40	92.9 Nb niobium 41	95.9 Mo molybdenum 42	[98] Tc technetium 43	101.1 Ru ruthenium 44	102.9 Rh rhodium 45	106.4 Pd palladium 46	107.9 Ag silver 47	112.4 Cd cadmium 48	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
132.9 Cs caesium 55	137.3 Ba barium 56	138.9 La* lanthanum 57	178.5 Hf hafnium 72	180.9 Ta tantalum 73	183.8 W tungsten 74	186.2 Re rhenium 75	190.2 Os osmium 76	192.2 Ir iridium 77	195.1 Pt platinum 78	197.0 Au gold 79	200.6 Hg mercury 80	204.4 Tl thallium 81	207.2 Pb lead 82	209.0 Bi bismuth 83	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106	[264] Bh bohrium 107	[277] Hs hassium 108	[268] Mt meitnerium 109	[271] Ds darmstadtium 110	[272] Rg roentgenium 111							

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

140 Ce cerium 58	141 Pr praseodymium 59	144 Nd neodymium 60	[147] Pm promethium 61	150 Sm samarium 62	152 Eu europium 63	157 Gd gadolinium 64	159 Tb terbium 65	163 Dy dysprosium 66	165 Ho holmium 67	167 Er erbium 68	169 Tm thulium 69	173 Yb ytterbium 70	175 Lu lutetium 71
232 Th thorium 90	[231] Pa protactinium 91	238 U uranium 92	[237] Np neptunium 93	[242] Pu plutonium 94	[243] Am americium 95	[247] Cm curium 96	[245] Bk berkelium 97	[251] Cf californium 98	[254] Es einsteinium 99	[253] Fm fermium 100	[256] Md mendelevium 101	[254] No nobelium 102	[257] Lr lawrencium 103

* Lanthanide series

* Actinide series

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