

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Pearson Edexcel
International
Advanced Level

Centre Number

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Candidate Number

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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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Pearson

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 cm³ 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)



Turn over

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



(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)



Turn over

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)



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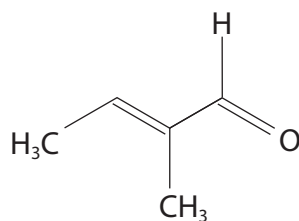
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- (b) The organic liquid **H** is a pheromone thought to be involved in communication between rabbits.



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)

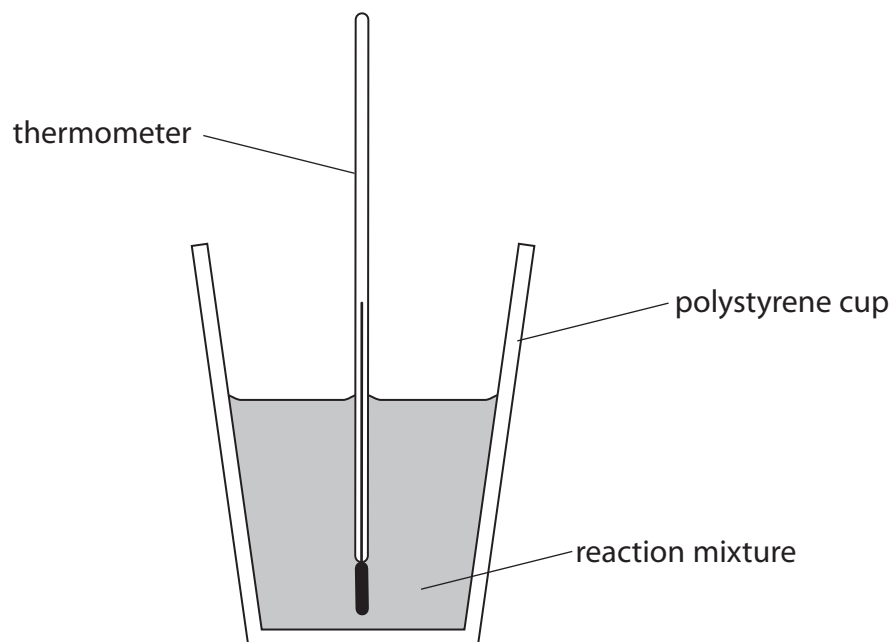


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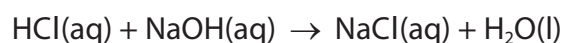
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4 The enthalpy change of neutralisation of hydrochloric acid may be determined using the apparatus shown.



The equation for the reaction is



Procedure

Step 1 Place 25.0 cm³ 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 cm³ 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)

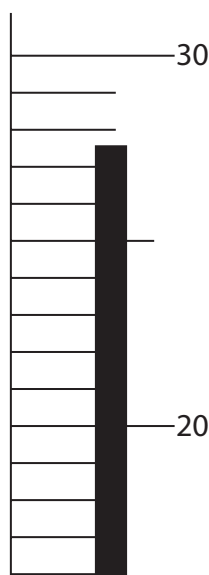
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- (ii) The diagram shows part of the thermometer when the temperature had reached its maximum.



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 = $4.2 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$]

(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)

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(Total for Question 4 = 8 marks)



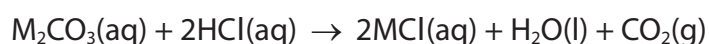
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- 5 A student carried out an experiment to identify the metal M in the hydrated carbonate $M_2CO_3 \cdot 10H_2O$.

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 $0.100 \text{ mol dm}^{-3}$ of hydrochloric acid.

The equation for the reaction is



- (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)



(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 $M_2CO_3 \cdot 10H_2O$ in the 250 cm^3 of solution, calculate the molar mass of $M_2CO_3 \cdot 10H_2O$. (1)

(vi) Use your answer to (c)(v) to identify metal M. (2)

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P 6 2 5 8 6 A 0 1 5 1 6



The Periodic Table of Elements

	1	2	Key										18					
			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
			relative atomic mass															
			atomic symbol															
			name															
			atomic (proton) number															
6.9	Li	3	45.0	47.9	50.9	52.0	54.9	55.8	58.9	58.7	63.5	65.4	10.8	12.0	14.0	16.0	19.0	4.0
	Be	4	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	B	C	N	O	F	He
	beryllium		scandium	titanium	vanadium	chromium	manganese	iron	cobalt	nickel	copper	zinc	boron	carbon	nitrogen	oxygen	fluorine	helium
23.0	Na	11	88.9	91.2	92.9	95.9	[98]	101.1	102.9	106.4	107.9	112.4	27.0	28.1	31.0	32.1	35.5	39.9
	Mg	12	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	Al	Si	P	S	Cl	Ar
	magnesium		yttrium	zirconium	niobium	molybdenum	technetium	ruthenium	rhodium	palladium	silver	cadmium	aluminium	silicon	phosphorus	sulfur	chlorine	argon
39.1	K	19	87.6	91.2	92.9	95.9	[98]	101.1	102.9	106.4	107.9	112.4	69.7	72.6	74.9	79.0	79.9	83.8
	Ca	20	Sr	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	Ga	Ge	As	Se	Br	Kr
	calcium		strontium	zirconium	niobium	molybdenum	technetium	ruthenium	rhodium	palladium	silver	cadmium	gallium	germanium	arsenic	selenium	bromine	krypton
85.5	Rb	37	88.9	91.2	92.9	95.9	[98]	101.1	102.9	106.4	107.9	112.4	114.8	118.7	121.8	127.6	126.9	131.3
	Sr	38	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
	rubidium		yttrium	zirconium	niobium	molybdenum	technetium	ruthenium	rhodium	palladium	silver	cadmium	indium	tin	antimony	tellurium	iodine	xenon
132.9	Cs	55	138.9	178.5	180.9	183.8	186.2	190.2	192.2	195.1	197.0	200.6	204.4	207.2	209.0	209.0	210	[222]
	Ba	56	La*	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
	barium		lanthanum	hafnium	tantalum	tungsten	rhenium	osmium	iridium	platinum	gold	mercury	thallium	lead	bismuth	polonium	astatine	radon
[223]	Fr	87	[226]	[261]	[262]	[266]	[264]	[277]	[268]	[271]	[272]							
	Ra	88	Ac*	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg							
	radium		actinium	rutherfordium	dubnium	seaborgium	bohrium	hassium	meitnerium	darmstadtium	roentgenium							

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

* Lanthanide series

* Actinide series

140	Ce	58	141	Pr	59	144	Nd	60	150	Sm	62	152	Eu	63	157	Gd	64	163	Dy	66	165	Ho	67	167	Er	68	169	Tm	69	173	Yb	70	175	Lu	71
	cerium		praseodymium	neodymium	promethium	samarium	europium	gadolinium	terbium	erbium	holmium	ytterbium	lutetium	thulium	thulium	thulium	thulium	thulium	thulium	thulium	thulium	thulium	thulium	thulium	thulium	thulium	thulium	thulium	thulium	thulium	thulium	thulium	thulium	thulium	thulium
232	Th	90	[231]	Pa	91	238	U	92	[242]	Pu	94	[243]	Am	95	[247]	Cm	96	[251]	Cf	98	[254]	Fm	100	[255]	Es	99	[256]	Md	101	[254]	No	102	[257]	Lr	103
	thorium		protactinium	uranium	plutonium	americium	curium	berkelium	californium	einsteinium	fermium	nobelium	lawrencium	lawrencium	lawrencium	lawrencium	lawrencium	lawrencium	lawrencium	lawrencium	lawrencium	lawrencium	lawrencium	lawrencium	lawrencium	lawrencium	lawrencium	lawrencium	lawrencium	lawrencium	lawrencium	lawrencium	lawrencium	lawrencium	lawrencium

