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Candidate surname	Other names

Pearson Edexcel
International Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Tuesday 7 May 2019

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 page 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 The use of ammonium carbonate in smelling salts is due to the formation of ammonia which counters the effects that cause fainting.

When ammonium carbonate is heated gently, it decomposes to form ammonia, water and carbon dioxide.

(a) Write the equation for the decomposition of ammonium carbonate.
State symbols are not required.

(1)

(b) Complete the table, giving a **chemical** test, not involving indicators, and its result for each of the products of the decomposition of ammonium carbonate.

(6)

Product	Chemical test	Result of test
ammonia		
water		
carbon dioxide		

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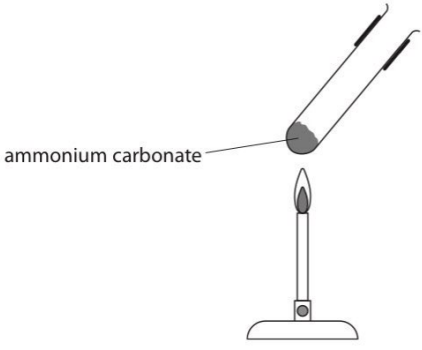
(c) Complete the diagram to show how you would collect the carbon dioxide obtained by heating ammonium carbonate, using another test tube as the **only** additional apparatus.

(1)



(d) A sample of ammonium carbonate was dissolved in distilled water and the solution tested.

Complete the table to give the expected observations and the identity of the observed products.

	Test	Observation	Observed product
(i)	About 1 cm^3 of barium chloride solution was added to 5 cm^3 of the ammonium carbonate solution	....	....
(ii)	About 5 cm^3 of hydrochloric acid was added to the mixture from (i)	....	....

(2)

(2)

(Total for Question 1 = 12 marks)

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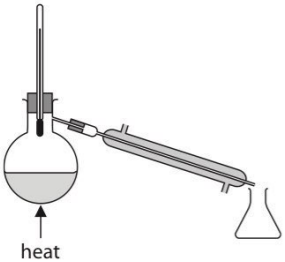
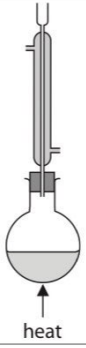
2 A group of students was asked to investigate a liquid organic compound **A**.
They were told that it was an alcohol with molecular formula $C_4H_{10}O$.

(a) A chemical test may be used to confirm the presence of the hydroxyl group in **A**.

Identify a suitable reagent for this test, giving the positive result.

(2)

(b) The students suggested that oxidation of **A** would help to identify it.
The sets of apparatus shown below were provided for the students' use.

		
Apparatus 1	Apparatus 2	Apparatus 3

(i) Identify the reagent mixture that can be used to oxidise **A**.

(1)

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(ii) One student said that if **A** was a primary alcohol this could be shown by oxidising it to the corresponding aldehyde and testing the product.

Identify which apparatus (1, 2 or 3) should be used for this oxidation.
Justify your answer.

(2)

(iii) A chemical test may be used to confirm the presence of an aldehyde.
Identify the reagent used, giving the positive result of the test.

(2)

(iv) State whether or not a positive result for the test in (b)(iii), together with the molecular formula, would allow the alcohol **A** to be identified.
Justify your answer.

(1)

(v) Another student said that if **A** was a secondary alcohol this could be shown by oxidising it to the corresponding ketone.

Identify which apparatus (1, 2 or 3) should be used for this oxidation.
Justify your answer.

(2)

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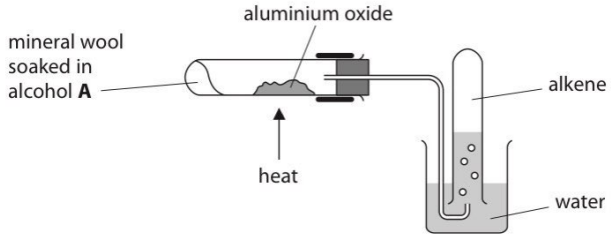
(c) In a further experiment, the students passed the vapour of **A** over heated aluminium oxide to form an alkene.

The apparatus used is shown.



(i) Give **two** reasons for the use of the mineral wool.

(2)

(ii) Explain why it is necessary to remove the delivery tube from the heated tube immediately when heating stops.

(2)

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(d) The alkene formed in (c) was reacted with a small amount of bromine giving a compound with molecular formula $C_4H_8Br_2$.

(i) State the colour **change** when the alkene reacts with bromine.

(1)

(ii) The mass spectrum of $C_4H_8Br_2$ had a pair of peaks at $m/z = 107$ and $m/z = 109$ and also peaks at $m/z = 79$ and $m/z = 81$ due to the isotopes of bromine.

One student suggested that these peaks showed that alcohol **A** must be butan-2-ol.

Explain how these peaks support the student's suggestion.

(3)

(Total for Question 2 = 18 marks)

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3 A group of students carried out a thermochemistry experiment to determine the relative atomic mass of a metal, **M**.

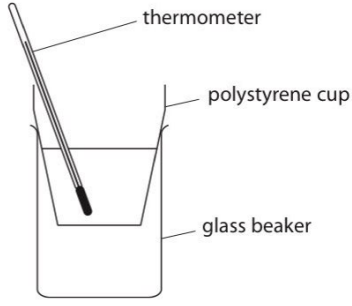
Procedure

Step **1** Transfer 50.0 cm^3 of a 1.35 mol dm^{-3} solution of copper(II) sulfate to an expanded polystyrene cup placed in a glass beaker.

Step **2** Weigh out, as accurately as possible, a known mass of the finely powdered metal **M**.

Step **3** Measure the temperature of the copper(II) sulfate solution.

Step **4** Quickly add all of the powdered metal, stir the mixture continuously and note the highest temperature reached.



(a) Each student carried out the experiment using a different mass of the metal.

(i) Give a reason, other than preventing heat loss, for placing the polystyrene cup in a glass beaker.

(1)

.....

.....

.....

(ii) Name the piece of apparatus suitable for measuring 50.0 cm^3 of copper(II) sulfate solution.

(1)

.....

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(iii) Powdered metal reacts much faster than filings or granules.

Suggest why this is important in this experiment.

(1)

.....

.....

(b) The students' results were collected in a table.

Mass of metal / g	Initial temperature / °C	Final temperature / °C	Temperature change / °C
0.50	20.0	27.0	7.0
1.10	20.0	34.0	14.0
2.00	21.0	58.0	37.0
3.10	20.0	58.5	38.5
3.80	20.5	70.5	50.0
5.10	19.0	74.5	55.5
6.00	20.0	74.0	54.0
7.00	21.0	76.0	55.0
8.30	20.0	75.0	55.0

(i) Plot a labelled graph of mass of metal on the horizontal axis against temperature change on the vertical axis.

(3)

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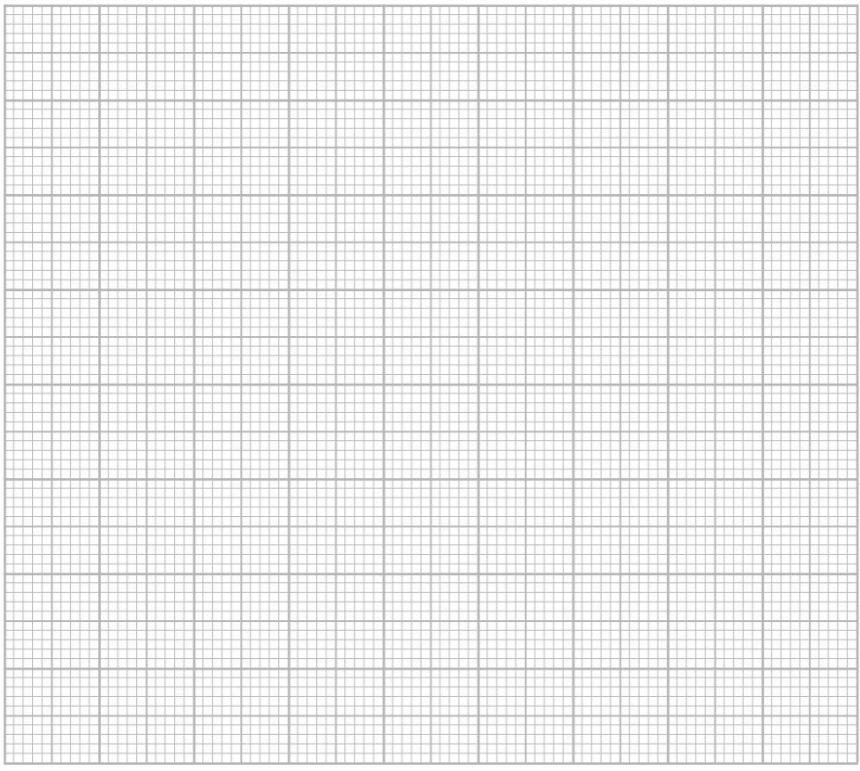

(ii) Determine the mass of metal **M** that reacts exactly with 50.0 cm^3 of 1.35 mol dm^{-3} copper(II) sulfate by drawing appropriate best-fit straight lines. You **must** show your working on the graph.

(2)

Mass of metal **M** ..... g

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(iii) The equation for the reaction of **M** with copper(II) sulfate is

$$M(s) + CuSO_4(aq) \rightarrow MSO_4(aq) + Cu(s)$$

Use the equation and your answer to (b)(ii) to calculate the relative atomic mass of **M**.

Give your answer to an appropriate number of significant figures.

(3)

(iv) One mass of **M** in the experiment gave an anomalous data point. Suggest a reason, other than measurement error, for this anomaly.

(1)

.....

.....

.....

.....

.....

(Total for Question 3 = 12 marks)

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4 Solid sodium hydroxide absorbs water from the air.
The purity of a sample of sodium hydroxide may be determined by titration.

Procedure

Step **1** Weigh a sample of sodium hydroxide in a beaker.

Step **2** Dissolve the sodium hydroxide in distilled water and transfer the solution and washings to a 250.0 cm^3 volumetric flask. Make the solution up to the mark with distilled water and mix thoroughly.

Step **3** Pipette 25.0 cm^3 of the sodium hydroxide solution into a conical flask and add a few drops of methyl orange indicator.

Step **4** Titrate the sodium hydroxide solution with hydrochloric acid of known concentration. Repeat the titration until concordant results are obtained.

Results

Mass of solid sodium hydroxide = 0.95 g

Concentration of hydrochloric acid = 0.0950 mol dm^{-3}

Titration Results

Burette readings	Rough	1	2	3
Final reading / cm^3	25.05	26.10	24.70	29.30
Initial reading / cm^3	0.00	2.00	1.00	5.00
Titre / cm^3	25.05	24.10	23.70	24.30

(a) State what is meant by the term 'concordant results'.

(1)

.....

.....

(b) Using appropriate titres, calculate the mean titre.

(1)

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(c) State the colour **change** at the endpoint of the titration.

(2)

From ..... to .....

(d) The equation for the reaction is

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

Calculate the purity of the sodium hydroxide, NaOH, as a percentage by mass.

(4)

(Total for Question 4 = 8 marks)

TOTAL FOR PAPER = 50 MARKS

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The Periodic Table of Elements

1	2											3	4	5	6	7	0 (8)
							1.0 H hydrogen 1										(18) 4.0 He helium 2
(1)	(2)											(13)	(14)	(15)	(16)	(17)	
6.9 Li lithium 3	9.0 Be beryllium 4											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							

Key: relative atomic mass / **atomic symbol** / name / atomic (proton) number

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

* Lanthanide series	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
* Actinide series	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

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