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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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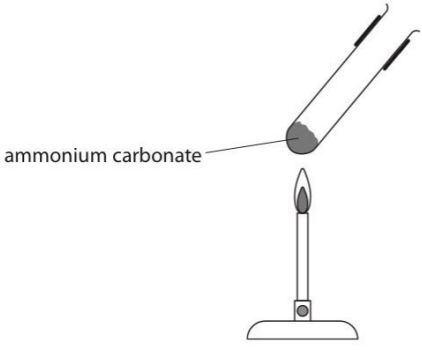


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(c) Complete the diagram to show how you would collect the carbon dioxide obtained by heating ammonium carbonate, using another test tube as the **only** additional apparatus.

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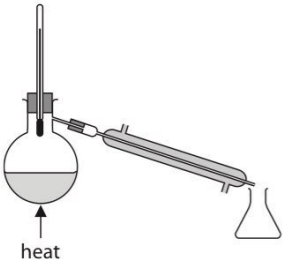
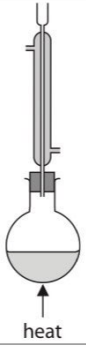
**2** A group of students was asked to investigate a liquid organic compound **A**.
They were told that it was an alcohol with molecular formula $C_4H_{10}O$.

(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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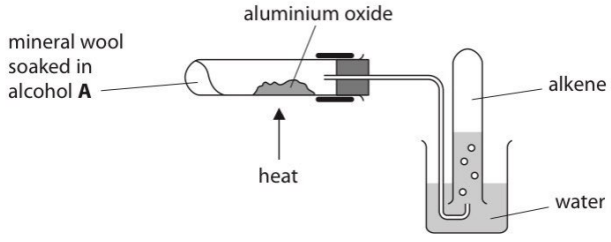


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(c) In a further experiment, the students passed the vapour of **A** over heated aluminium oxide to form an alkene.

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**.

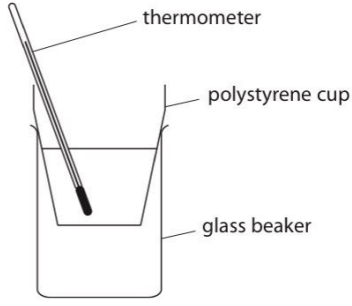
**Procedure**

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)**

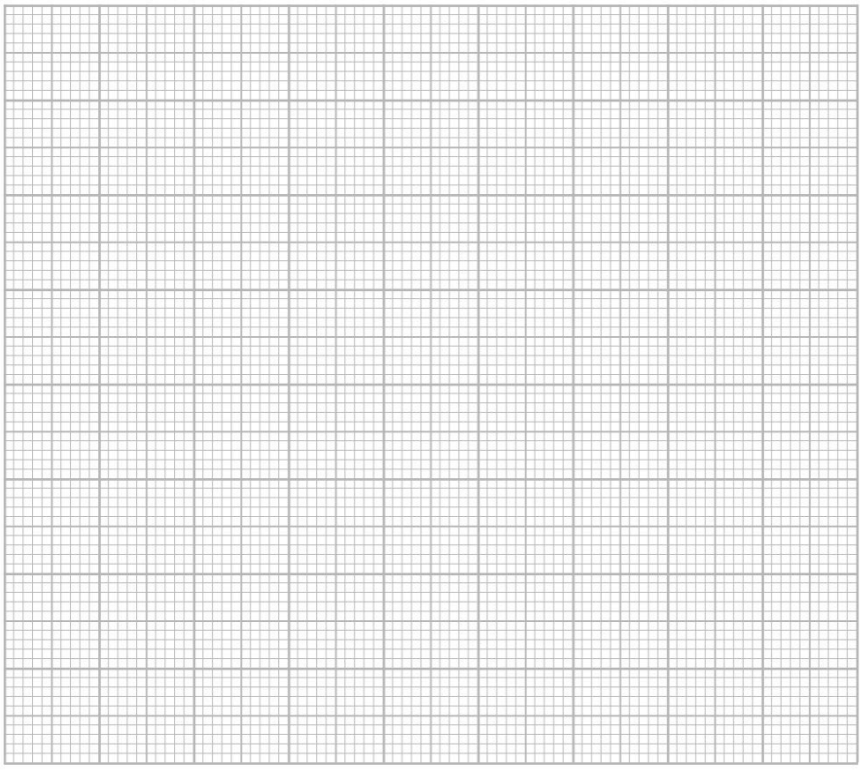
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(ii) Determine the mass of metal **M** that reacts exactly with 50.0 $cm^3$ of 1.35 mol $dm^{-3}$ copper(II) sulfate by drawing appropriate best-fit straight lines. You **must** show your working on the graph.

**(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)**

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**(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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