CAMBRIDGE
International Education

Cambridge International AS & A Level

CHEMISTRY **9701/51**

Paper 5 Planning, Analysis and Evaluation **October/November 2024**

MARK SCHEME

Maximum Mark: 30

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the October/November 2024 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

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Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptions for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

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GENERIC MARKING PRINCIPLE 5: Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).
GENERIC MARKING PRINCIPLE 6: Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(a)</td><td>wear chemically resistant gloves.</td><td>1</td></tr>
<tr><td>1(b)</td><td>M1 Includes the following steps. Measure the mass of..
1 (Weighing) boat + solid
2 (Weighing) boat + residue / residual solid (after transfer)

M2 Table and units. Headings must be unambiguous, and correct units must be included for each heading.

<table><tr><td></td><td>/ g</td></tr><tr><td>Mass of boat + solid (before transfer)</td><td></td></tr><tr><td>Mass of boat (after transfer)</td><td></td></tr><tr><td>(Mass of) solid (transferred)</td><td></td></tr></table></td><td>2</td></tr>
<tr><td>1(c)</td><td>M1 Correctly placed vertical condenser including jacket.

M2 (Cold) water in at bottom and water out at the top of the condenser.</td><td>2</td></tr>
<tr><td>1(d)(i)</td><td>(alkaline aqueous) iodine is in excess.</td><td>1</td></tr>
<tr><td>1(d)(ii)</td><td>to ensure the reaction is complete.</td><td>1</td></tr>
</table>

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Question	Answer	Marks
1(d)(iii)	to remove **soluble** substances (from the residue / solid C). *Acceptable named soluble substances in order of diminishing likelihood to be mentioned* • *(aqueous alkaline) iodine* • *Sodium hydroxide* • *Solution B* • *Sodium hydrogencarbonate* • *Sodium iodide* • *$C_7H_5O_3^-$ Na^+* • *$C_2H_3O_2^-$ Na^+* • *Water washable impurities*	**1**
1(d)(iv)	The residue is less soluble in cold water.	**1**
1(e)(i)	amount of $(C_6H_2I_2O)_2$ = 0.764 / 687.6 = 1.111×10^{-3} mol	**1**
1(e)(ii)	amount of $C_9H_8O_4$ = 2 x 1(e)(i) (=2.222×10^{-3}) mass of aspirin = 2 × 1(e)(i) × 180 (= 0.400 g)	**1**
1(e)(iii)	percentage aspirin by mass = (1(e)(ii) / 0.409) × 100 (= 97.8%)	**1**
1(f)	amount / mass of solid C would be greater (than the true value) **AND** calculated percentage by mass would be greater than (e)(iii)	**1**

Question	Answer	Marks
2(a)	588 nm (589.7)	**1**
2(b)(i)	n ($C_{25}N_3H_{30}Cl$(s)) = 2.5×10^{-2} x 0.5 dm^3 = 1.25×10^{-2} mass of $C_{25}N_3H_{30}Cl$(s) = $1.25 \times 10^{-2} \times 407.5$ = **5.09 g**	**1**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(b)(ii)</td><td>M1 add a (small) volume of (distilled) water (to the small beaker)
AND
dissolve the $C_{25}N_3H_{30}Cl$(s)

M2 Transfer the solution to a 500 cm^3 volumetric flask with washings.

M3: make up to the (calibration) mark (with <u>distilled</u> water.)
AND
then mix the solution (by inverting the flask)</td><td>3</td></tr>
<tr><td>2(c)(i)</td><td><table><tr><th>Volume of 2.5×10^{-4} $moldm^{-3}$ crystal violet (solution E) / cm^3</th><th>Volume of distilled water / cm^3</th></tr><tr><td>0.00</td><td>20.00</td></tr><tr><td>4.00</td><td>16.00</td></tr><tr><td>8.00</td><td>12.00</td></tr><tr><td>12.00</td><td>8.00</td></tr><tr><td>16.00</td><td>4.00</td></tr><tr><td>20.00</td><td>0.00</td></tr></table></td><td>1</td></tr>
<tr><td>2(c)(ii)</td><td>absorbance (of aqueous $C_{25}N_3H_{30}Cl$)</td><td>1</td></tr>
<tr><td>2(d)(i)</td><td>M1 points plotted correctly.

M2 Straight line of best fit drawn.</td><td>2</td></tr>
</table>

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Question	Answer	Marks
2(d)(ii)	**M1** Most anomalous point circled. (Expected to be concentration 1.0×10^{-4} moldm^{-3} (solution 3) **M2** Volume of water added (to mixture) too large **OR** Volume of crystal violet solution / solution E added (to mixture) too small.	**2**
2(d)(iii)	(absorbance is) (directly) proportional (to concentration of crystal violet) (within experimental error).	**1**
2(d)(iv)	Repeat the procedure for the solution giving an anomalous result. (Solution 3)	**1**
2(e)(i)	Solutions being mixed (at t=0) so reading not possible.	**1**
2(e)(ii)	**M1** (**100**, 0.360) and (315, 0.180) **M2** half-life correctly calculated from points listed for **M1** (x1–x2) when $y_2 = 2y_1$	**2**
2(e)(iii)	first order **AND** half-lives are constant (within experimental error)	**1**

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