



Cambridge International AS & A Level

CHEMISTRY

9701/31

Paper 3 Paper 31 (Advanced Practical Skills 1)

May/June 2020

MARK SCHEME

Maximum Mark: 40

Published

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This mark scheme is published to support teachers and students and should be read together with the question paper. It shows the requirements of the exam. The answer column of the mark scheme shows the proposed basis on which Examiners would award marks for this exam. Where appropriate, this column also provides the most likely acceptable alternative responses expected from students. Examiners usually review the mark scheme after they have seen student responses and update the mark scheme if appropriate. In the June series, Examiners were unable to consider the acceptability of alternative responses, as there were no student responses to consider.

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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 descriptors 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).

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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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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).

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Science-Specific Marking Principles

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| 1 | Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly. |
| 2 | The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored. |
| 3 | Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection). |
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5 'List rule' guidance (see examples below)

For questions that require *n* responses (e.g. State **two** reasons ...):

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- Any response marked *ignore* in the mark scheme should not count towards *n*
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Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

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Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

Question	Answer	Marks
1(a)	I The following headings and data are recorded in the space provided - mass of container with FA 1 - mass of (empty) container - mass of FA 1 used, correctly subtracted - consistent decimal places for weighings (at least one d.p.)	1
	II All the following data is recorded - two burette readings and titre for the rough titration - initial and final burette readings for two (or more) accurate titrations	1
	III Titre values recorded for accurate titrations, and Appropriate headings and units in the accurate titration table - initial / start (burette) reading / volume - final / end (burette) reading / volume - titre or volume used / added / or FA 1 added (<i>not 'difference' or 'total' or 'amount'</i>) - unit: / cm³ or (cm³) or in cm³ (for each heading) or cm³ unit given for each volume recorded	1
	IV All accurate burette readings are recorded to the nearest 0.05 cm ³ .	1
	V The final accurate titre recorded is within 0.10 cm ³ of any other accurate titre	1
	Award VI , VII and VIII if $\delta \leq 0.020$ (cm ³ g ⁻¹) Award VI and VII if $0.020 < \delta \leq 0.040$ Award VI , only if $0.040 < \delta \leq 0.060$	3
1(b)	Candidate calculates the mean correctly. - Candidate must take the average of two (or more) titres that are within a total spread of not more than 0.20 cm³. - Working/explanation must be shown or ticks must be put next to the two (or more) accurate readings selected. - The mean should be quoted to 2 dp and be rounded to nearest 0.01 cm³.	1
1(c)(i)	Correct calculation (expressed to 3 or 4 sf) No of moles of KMnO ₄ used = $0.0200 \times \text{mean titre} / 1000$ <i>The candidate's mean titre must be used in the calculation</i>	1

Question	Answer	Marks
1(c)(ii)	Correct use of (i) to calculate concentration of FA 4 Concentration of FA 4 = ans (i) $\times 5 \times 1000 / 25$	1
1(c)(iii)	Correct expression for M_r $M_r = \text{mass of FA 1 used} \times 4 / \text{answer (ii)}$ alternatively: $M_r = \text{ans (i)} / 4$	1

Question	Answer	Marks
2(a)	I Unambiguous table of data - Mass of cup - Mass of cup + FA 5 - Mass of FA 5 used - Initial temperature or temperature of water / °C - Final / maximum temperature / °C - Temperature rise / °C - Both experiments must be attempted	1
	II Readings recorded appropriately - All four thermometer readings recorded to .0 or .5. - All four subtractions correct (two masses and two temp rises). - No thermometer reading is less than 10 °C - Mass of FA 5 used for first experiment is 4.0–4.2 g - Mass of FA 5 used for second experiment is 5.0–5.2 g	1
	III + IV Accuracy marks Check and correct temp subtractions for candidate and supervisor. Round each measured temperature to 0.5 °C if necessary Compare the temperature rises for the two experiments.	
	Award III if candidate's rise is within 1.0 °C of supervisor in Expt 1 .	1
	Award IV if candidate's rise within 1.0 °C of supervisor in Expt 2 .	1
2(b)(i)	Correct calculation of energy change (2, 3 or 4 sf) Energy change = $30 \times 4.2 \times \text{temp rise (J)}$	1
2(b)(ii)	Correct calculation of no of moles of Na₂CO₃ used (2–4 sf) $n = \frac{\text{mass claimed}}{106}$	1
2(b)(iii)	Correct use of (i) and (ii) to calculate enthalpy change (2–4 sf) Enthalpy change = $-\frac{\text{energy}}{1000 \times \text{moles}}$	1

Question	Answer	Marks
2(c)(i)	Accuracy improvement Plot graph to obtain better (estimate of) temp rise or plot a cooling curve	1
2(c)(ii)	Error = 0.5	1
	Correct calculation of % error to 2 or more sig fig $\% \text{ error} = \frac{2 \times 0.5}{\text{temp rise (expt 2)}} \times 100$	1

Question	Answer	Marks
FA 1/FA 6 is $(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$; FA 7 is H_2O_2 ; FA 8 is ethanol		
3(a)(i)	Reagents used are NaOH and NH_3	1
	FA 6 dissolved in (distilled) water (before carrying out tests)	1
	Observations with both cold alkalis - With NaOH: green ppt, insoluble in excess - With NH_3: green ppt, insoluble in excess OR - If only one of NaOH or NH_3 was selected, award this mark if the observation is correct, but it must include 'ppt turns brown'.	1
	Observation when heated with NaOH Fizzing/bubbling and <u>gas</u> / NH_3 turns (moist red) litmus to blue	1
	Both ions correctly identified Iron(II) and ammonium (Fe^{2+} and NH_4^+)	1

Question	Answer	Marks
3(a)(ii)	Anion test and first observation - Add barium nitrate/chloride - White precipitate	1
	Observation with acid and conclusion: - white ppt is insoluble in specified mineral acid (not H₂SO₄) - sulfate / SO₄²⁻ present	1
3(a)(iii)	Ionic equation <i>Any one of the following equations, provided that the appropriate test was carried out.</i> - Fe²⁺(aq) + 2OH⁻(aq) → Fe(OH)₂(s) - NH₄⁺(aq) + OH⁻(aq) → NH₃(g) + H₂O(l or g) - Ba²⁺(aq) + SO₄²⁻(aq) → BaSO₄(s)	1
3(a)(iv)	Correct use of <i>M_r</i> to calculate no of moles water. Mass of water = (392) - 55.8 - 192.2 – 36	1
	n(H₂O) = $\frac{392 - 284}{18}$ (expressed as integer)	1

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3(b)(i)	Award one mark for every two correct observations (*) as shown in table below	5																	
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3(b)(ii)	FA 8 is ethanol or propan-2-ol or butan-2-ol (<i>or any secondary 2-ol</i>) Correct reference to the <u>CHI₃</u> test or to CH ₃ CH(OH)- or CH ₃ CO group	1																	
	Correct reference to the redox reaction with KMnO ₄ (provided that FA 8 was identified as an alcohol/aldehyde).	1																	
3(b)(iii)	FA 7 is an <u>oxidising agent</u> because <u>iodine</u> is formed.	1																	



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Question	Answer	Marks
1(a)	I The following data must be shown - burette readings and titre for rough titration 2 × 2 'box' showing both accurate burette readings	1
	II Headings and units correct for accurate titration table and headings match readings. - initial / start (burette) reading / volume + unit (allow vol but not V) - final / end (burette) reading / volume + unit (allow value for reading) - titre or volume / FA 4 used / added (not 'difference' or 'total') + unit Units: (cm³) or / cm³ or in cm³ or cm³ by every entry	1
	III All accurate burette readings to 0.05 cm ³	1
	IV The final accurate titre recorded is within 0.10 cm ³ of any other accurate titre.	1
1(b)	Candidate must average two (or more) titres that are all within 0.20 cm ³ . Working must be shown or ticks must be put next to the two (or more) accurate titres selected.	1
1(c)(i)	Answers for (ii) , (iii) to 3–4 sf and answer to (iv) is an integer.	1
1(c)(ii)	$\frac{1}{2} ((b) \times 0.1 / 1000)$	1
1(c)(iii)	$(25 \times 0.015) / 1000 = 3.75 \times 10^{-4}$	1
1(c)(iv)	Display of $\frac{(ii)}{(iii)} = \frac{1+y}{2}$	1
	Correctly calculates y to the nearest odd integer	1

Question	Answer	Marks
1(c)(v)	Identifies ion as IO_3^- Allow ecf from (iv) as below. $\text{IO}_4^- + 7\text{I}^- + 8\text{H}^+ \rightarrow 4\text{I}_2 + 4\text{H}_2\text{O}$ $\text{IO}_3^- + 5\text{I}^- + 6\text{H}^+ \rightarrow \text{I}_2 + 3\text{H}_2\text{O}$ $\text{IO}_2^- + 3\text{I}^- + 4\text{H}^+ \rightarrow \text{I}_2 + 2\text{H}_2\text{O}$ $\text{IO}^- + \text{I}^- + 2\text{H}^+ \rightarrow \text{I}_2 + \text{H}_2\text{O}$	1
1(d)(i)	$(0.06/25) \times 100 = 0.24\%$	1
1(d)(ii)	Not correct as KI is in excess (so volume does not matter)	1

Question	Answer	Marks
2(a)	I Table to include initial and final mass of stoppered container with FB 5, initial and final temperature, mass added and temperature change. All with correct units.	1
	II All masses recorded to the same precision and all temperatures recorded to .0 or .5 °C.	1
	Examiner calculates ΔT / mass for candidate and for supervisor	
	III Award if the difference in the ratio between candidate and Supervisor is within $0.20\text{ }^\circ\text{C g}^{-1}$	1
	IV Award if the difference in the ratio between candidate and Supervisor is within $0.40\text{ }^\circ\text{C g}^{-1}$	1
2(b)(i)	correctly calculates $4.2 \times \text{temp change} \times 20$	1
2(b)(ii)	correct expression showing 248.2 moles of thiosulfate = candidate mass / 248.2 answer to 2–4 sf	1
	$\Delta H = + \text{ans (i)} / \text{moles of thiosulfate}$ answer to min 2 sf penalise	1

Question	Answer	Marks
2(b)(iii)	2 arrows linking to $\text{Na}_2\text{S}_2\text{O}_3$ (aq) with correct values indicated for each step	1
	$\Delta H = -7.7 - (\text{ans (b)(ii)})$ default value +39.9	1
2(c)	anhydrous is exothermic, therefore the temperature drop would be less / final temp would be higher / temperature change would be less	1

Question	Answer	Marks
FB 3 = KI(aq); FB 4 = Na ₂ S ₂ O ₃ (aq); FB 6 = NH ₄ Br(aq); FB 7 = FeCl ₃ / H ⁺ (aq); FB 8 = FeSO ₄ / H ⁺ (aq)		
3(a)(i)	Selects NaOH and warms. For co-ord: If get ppt with cold reagent is this a CON?	1
	Fizzing / bubbling and gas given off / NH ₃ turns (damp) red litmus blue	1
3(a)(ii)	Add AgNO ₃ gives a cream ppt	1
	Add NH ₃ (aq) ppt is insol / partially soluble AND Add FB 4 ppt is sol	1
3(a)(iii)	NH ₄ Br	1
3(b)(i)	Add FB 3 gives a red-brown / orange-brown / yellow-brown / yellow solution AND Add starch the solution goes blue / black.	1
3(b)(ii)	Add FB 4 turns the solution purple AND On standing becomes yellow / colourless / allow faint ppt.	1
	Add NaOH gives a (dirty/dark) green ppt	1
3(b)(iii)	Fe ²⁺ is present	1
	Fe ³⁺ has been reduced (by S ₂ O ₃ ²⁻) mark on obs in (ii)	1

Question	Answer	Marks							
3(c)(i)	Add H ₂ O ₂ solution turns yellow	1							
	Add NaOH gives red / brown ppt AND effervescence	1							
	Gas given off relights a glowing splint and gas is oxygen	1							
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3(c)(ii)	Fe ³⁺ (aq) + 3OH ⁻ (aq) → Fe(OH) ₃ (s)	1							



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6 Calculation specific guidance

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form, (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient (*a*) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

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7 Guidance for chemical equations

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

Question	Answer	Marks
1(a)	I Initial and final burette readings and volume added recorded for rough titre and accurate titre details tabulated.	1
	II Initial and final burette readings recorded and vol of FA 2 added recorded for each accurate titration. Headings and units correct for accurate titrations. Headings: initial/final (burette) reading / volume or reading / volume at start/ finish and volume/ FA 2 added/used or titre and units (cm ³) or / cm ³ or in cm ³ or cm ³ by every entry	1
	III All accurate burette readings are recorded to the nearest 0.05 cm ³ .	1
	IV The final accurate titre recorded is within 0.1 cm ³ of any other accurate titre.	1
	V, VI and VII Award V, VI and VII for $\delta \leq 0.20 \text{ cm}^3$ Award V and VI for $0.20 \text{ cm}^3 < \delta \leq 0.30 \text{ cm}^3$ Award V for $0.30 \text{ cm}^3 < \delta \leq 0.50 \text{ cm}^3$	3
1(b)	Calculation of mean Candidate must average two (or more) accurate titres where the total spread is $\leq 0.20 \text{ cm}^3$. Working must be shown or ticks must be put next to the two (or more) accurate readings selected.	1
1(c)(i)	Correctly calculates moles of FA 2 = $\frac{0.105 \times \text{vol in (b)}}{1000}$ correct to 3–4 sf but do not penalise more than once in this question.	1
1(c)(ii)	Moles in 25.0 cm ³ = same as (i) and shows moles in 1 dm ³ answer $\times 40$ (3–4 sf)	1
1(c)(iii)	Uses $M_r = \frac{6.20}{\text{moles from (ii)}}$	1

Question	Answer	Marks
1(c)(iv)	Chooses acid with M_r nearest to that found and explains choice $\text{HCOOH} = 46$; $\text{CH}_2=\text{CHCOOH} = 72$ $\text{C}_2\text{H}_4\text{ClCOOH} = 111.5$	1
1(d)	Add bromine / acidified (or alkaline) potassium manganate(VII) and CH_2CHCOOH decolourises (turns green) but $\text{C}_2\text{H}_5\text{COOH}$ does not	1
1(e)	(Volume of alkali doubled) $\rightarrow$ moles of acid doubled	1
	$\rightarrow M_r$ halved Allow 1 for volume of alkali more $\rightarrow$ more moles acid $\rightarrow M_r$ less	1

Question	Answer	Marks
2(a)	Table with headings and units. Headings for initial T FA 3 , initial T FA 4 , average initial T, highest T, T rise. Experiments 1 and 2 clearly shown.	1
	All thermometer readings to .5 °C	1
	Correct calculation of average initial Ts and T rises	1
	Both T rises for Experiments 1 and 2 within 1 °C of each other	1
2(b)(i)	Correctly calculates $50 \times 4.2 \times \text{T rise from Expt 1}$ and answer to 2–4 sf	1
2(b)(ii)	Correctly uses moles FA 3 = $\frac{120.1}{122}$ (= 0.9844)	1
	Correctly calculates $\frac{\text{answer}}{40} = 0.0246$ (= 0.025) mol	1
2(b)(iii)	Correctly uses $\frac{\text{(i)}}{1000 \times \text{(ii)}}$ (to 2–4 sf) and negative sign	1
2(c)	Correctly calculates Expt 1 $\frac{0.5}{25} + \frac{0.5}{25} \times 100 = 4\%$	1
	Expt 2 $\frac{0.5}{50} + \frac{0.5}{25} + \frac{0.5}{25} = 5\%$	1
2(d)	With HCl T rise more (<i>comparison needed</i>)	1
	In organic acid some energy needed to break O–H bond / to release H ⁺ (from the molecule)	1

Question	Answer			Marks																
FA 5 is HCOOH FA 6 is CH ₃ CHO or C ₂ H ₅ CHO FA 7 is CH ₃ C=OCH ₃ FA 8 is MgSO ₄ .7H ₂ O																				
3(a)(i)	Award one mark for every two correct observations (*) as shown in table below			5																
<table><tr><td>test</td><td>FA 5</td><td>FA 6</td><td>FA 7</td></tr><tr><td>+ Mg</td><td>Fizz / bubbling / effervescence * Gas / hydrogen pops with lighted splint *</td><td>No visible reaction / no change *</td><td>No visible reaction / no change *</td></tr><tr><td>+ Tollens'</td><td>Silver mirror / black / dark grey solid *</td><td>Silver mirror / black / dark grey solid *</td><td>No visible reaction / no change *</td></tr><tr><td>+ MnO₄⁻/H⁺</td><td>(Purple) decolourised *</td><td>(Purple) decolourised *</td><td>No visible reaction / no change / remains purple *</td></tr></table>					test	FA 5	FA 6	FA 7	+ Mg	Fizz / bubbling / effervescence * Gas / hydrogen pops with lighted splint *	No visible reaction / no change *	No visible reaction / no change *	+ Tollens'	Silver mirror / black / dark grey solid *	Silver mirror / black / dark grey solid *	No visible reaction / no change *	+ MnO ₄ ⁻ /H ⁺	(Purple) decolourised *	(Purple) decolourised *	No visible reaction / no change / remains purple *
test	FA 5	FA 6	FA 7																	
+ Mg	Fizz / bubbling / effervescence * Gas / hydrogen pops with lighted splint *	No visible reaction / no change *	No visible reaction / no change *																	
+ Tollens'	Silver mirror / black / dark grey solid *	Silver mirror / black / dark grey solid *	No visible reaction / no change *																	
+ MnO ₄ ⁻ /H ⁺	(Purple) decolourised *	(Purple) decolourised *	No visible reaction / no change / remains purple *																	
3(a)(ii)	FA 5 = (carboxylic) acid / COOH / RCOOH			1																
	FA 6 = aldehyde / CHO / RCHO			1																
	FA 7 = ketone / RC=OR / RCOR / RCOR'			1																
3(b)(i)	Steam / condensation / water vapour and white residue / leaves white solid / solid remains white			1																
3(b)(ii)	Chooses (aqueous) NaOH and (aqueous) NH ₃ and indicates use of a solution of FA 8 / FA 8(aq) NaOH white ppt * insol in excess* NH ₃ white ppt* insol in excess*			1																

Question	Answer	Marks
3(b)(iii)	Mg^{2+} <i>Do not allow magnesium / Mg</i>	1



Cambridge International AS & A Level

CHEMISTRY

9701/34

Paper 3 Paper 34 (Advanced Practical Skills 2)

May/June 2020

MARK SCHEME

Maximum Mark: 40

Published

Students did not sit exam papers in the June 2020 series due to the Covid-19 global pandemic.

This mark scheme is published to support teachers and students and should be read together with the question paper. It shows the requirements of the exam. The answer column of the mark scheme shows the proposed basis on which Examiners would award marks for this exam. Where appropriate, this column also provides the most likely acceptable alternative responses expected from students. Examiners usually review the mark scheme after they have seen student responses and update the mark scheme if appropriate. In the June series, Examiners were unable to consider the acceptability of alternative responses, as there were no student responses to consider.

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

Cambridge International is publishing the mark schemes for the June 2020 series for most Cambridge IGCSE™ and Cambridge International A & AS Level components, and some Cambridge O Level components.

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 descriptors 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.

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.

Science-Specific Marking Principles

- | | |
|---|--|
| 1 | Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly. |
| 2 | The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored. |
| 3 | Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection). |
| 4 | The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted. |

5 'List rule' guidance (see examples below)

For questions that require ***n*** responses (e.g. State **two** reasons ...):

- The response should be read as continuous prose, even when numbered answer spaces are provided
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Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form, (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient (***a***) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

7 Guidance for chemical equations

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

Question	Answer	Marks
1(a)	I Initial and final burette readings and volume added recorded for rough titre and accurate titre details tabulated.	1
	II Initial and final burette readings recorded and vol of FB 3 added recorded for each accurate titration. Headings and units correct for accurate titrations. Headings: initial / final (burette) reading / volume or reading / volume at start / finish and volume / FB 3 added/used or titre and units (cm ³) or / cm ³ or in cm ³ or cm ³ by every entry	1
	III All accurate burette readings are recorded to the nearest 0.05 cm ³ . Do not award this mark if: 50(.00) is used as an initial burette reading; More than one final burette reading is 50(.00) Any burette reading is > 50(.00)	1
	IV The final accurate titre recorded is within 0.10 cm ³ of any other accurate titre.	1
1(a)	V, VI and VII Award V, VI and VII for $\delta \leq 0.30 \text{ cm}^3$ Award V and VI for $0.30 \text{ cm}^3 < \delta \leq 0.50 \text{ cm}^3$ Award V for $0.30 \text{ cm}^3 < \delta \leq 0.80 \text{ cm}^3$	3
1(b)	Calculation of mean Candidate must average two (or more) accurate titres where the total spread is $\leq 0.20 \text{ cm}^3$. Working must be shown or ticks must be put next to the two (or more) accurate readings selected.	1
1(c)(i)	all answers to (ii) , (iii) , (iv) and (v) to 3–4 sf (minimum 4 answers)	1
1(c)(ii)	Correctly calculates moles NaOH = $\frac{(\mathbf{b}) \times 0.100}{1000}$ to 3–4 sf and same answer for moles of HCl	1

Question	Answer	Marks
1(c)(iii)	Correctly calculates moles $\text{HCl} = \frac{25.0 \times 0.200}{1000} = 5.00 \times 10^{-3}$ and moles neutralised = moles HCl above – moles HCl in (i)	1
1(c)(iv)	$\text{Na}_2\text{CO}_3(\text{aq}) + 2\text{HCl}(\text{aq}) \rightarrow 2\text{NaCl}(\text{aq}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$ and correctly uses moles $\text{Na}_2\text{CO}_3 = \frac{\text{moles in HCl in (ii)}}{2}$	1
1(c)(v)	ans (iii) $\times 100$ $37.5 / ((\text{iii}) \times 100)$ can be done in either order $\text{moles} = \frac{37.5}{100 \times (\text{iii})} = 2 \text{ marks}$ any error loses 1 mark	1
1(c)(vi)	Correctly calculates $x ((\text{Mr} - 106) / 18)$ and gives to nearest integer allow ecf even if negative integer.	1
1(d)	Disadvantage: if make mistake all the solution is wrong Advantage: quicker/ larger volume has less % error	1

Question	Answer	Marks
2(a)	I Table with headings and units for 3 weighings and 3 calculated masses	1
	II Mass FB 4 used between 1.80 and 2.20 g masses of FB 4 , residue and water lost correctly calculated.	1
	III Ratio within 1.95–2.15 of supervisor ratio	1
	III and IV Ratio within 2.00–2.10 of supervisor ratio	1
2(b)(i)	Correctly calculates moles water = $\frac{\text{mass water}}{18}$ to 2–4sf Penalise sf only once in this question.	1
2(b)(ii)	$\text{MSO}_4 \cdot 7\text{H}_2\text{O}(\text{s}) \rightarrow \text{MSO}_4(\text{s}) + 7\text{H}_2\text{O}(\text{g})$ and correctly uses moles anhydrous = (ii) / 7	1
2(b)(iii)	Correctly uses mass $\frac{\text{FB 4}}{\text{moles anhydrous}} = M_r$	1
2(b)(iv)	Shows $A_r \text{ M} + 222.1 = M_r \text{ FB 4}$ and calculates A_r of M	1
	identifies M as Group 2 metal with nearest A_r	1
2(c)(i)	To avoid water being picked up (from air)	1
2(c)(ii)	A_r higher with explanation Mass water lost less $\rightarrow$ moles water lost less $\rightarrow$ moles anhydrous more $\rightarrow M_r$ higher $\rightarrow A_r$ higher very little effect because very little water vapour absorbed if lid prevented loss in (i) then allow A_r lower as ecf	1

Question	Answer	Marks						
FB 5 is Zn FB 6 is ZnSO ₄ .7H ₂ O FB 7 is propanone								
3(a)(i)	(Yellow solution goes) to blue / green	1						
	then to lilac / violet / mauve	1						
3(a)(ii)	any two from; - blue (ignore green if before blue) - green / yellow - KMnO₄ loses purple colour	1						
3(a)(iii)	Redox	1						
3(a)(iv)	Fizz / bubbles / effervescence	1						
	Gas / H ₂ (gas) burns with a pop / pops with a lighted splint	1						
3(b)(i)	<table><tr><td>test</td><td>observation</td></tr><tr><td>FB 6 + NaOH</td><td>white ppt* soluble in excess*</td></tr><tr><td>FB 6 + NH₃</td><td>white ppt* soluble in excess *</td></tr></table>	test	observation	FB 6 + NaOH	white ppt* soluble in excess*	FB 6 + NH ₃	white ppt* soluble in excess *	2
	test	observation						
	FB 6 + NaOH	white ppt* soluble in excess*						
	FB 6 + NH ₃	white ppt* soluble in excess *						
Award one mark for every two correct observations (*)								
3(b)(ii)	FB 5 is Zn / zinc (metal)	1						
3(b)(iii)	Zn(s) + H ₂ SO ₄ (aq) → ZnSO ₄ (aq) + H ₂ (g) ecf for incorrect FB 5 provided gas is produced.	1						

Question	Answer	Marks
3(c)(i)	Choice of reagent: Tollens' and warming / Fehling's and warming / Benedict's and warming / Sandell's and warming / acidified potassium manganate(VII)	1
	Positive test for ethanal – silver mirror / black (or dark grey) solid for Tollens' Red / brown (solid / ppt) for Fehling's / Benedict's / Sandell's Purple to colourless for acidified manganate(VII) negative result for propanone – no reaction	1
3(c)(ii)	Negative test result and FB 7 is propanone	1



Cambridge International AS & A Level

CHEMISTRY

9701/35

Paper 3 Paper 35 (Advanced Practical Skills 1)

May/June 2020

MARK SCHEME

Maximum Mark: 40

Published

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7 Guidance for chemical equations

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State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

Question	Answer	Marks
1(a)	I The following data is shown - two burette readings for the rough titration - titre for rough titration - initial and final burette readings for two (or more) accurate titrations	1
	II Appropriate headings and units for accurate titration. and volume FA 1 added recorded for each accurate titre. <i>Headings should match readings.</i> - initial / start and (burette) reading / volume - final / end and (burette) reading / volume - titre or volume / FA 1 and used / added - unit: / cm³ or (cm³) or in cm³ or cm³ for each entry	1
	III All accurate burette readings are to the nearest 0.05 cm ³ .	1
	IV The final accurate titre recorded is within 0.10 cm ³ of any other accurate titre.	1
	Award V , VI and VII if $\delta \leq 0.20$ (cm ³) Award V and VI if $0.20 < \delta \leq 0.50$ Award V , only, if $0.50 < \delta \leq 0.80$	3
1(b)	Calculation of mean - Candidate must average two (or more) accurate titres where the total spread is ≤ 0.20 cm³. - Working must be shown or ticks must be put next to the two (or more) accurate readings selected. - The mean should normally be quoted to 2 dp rounded to the nearest 0.01 cm³. (e.g.: 26.666 must be rounded to 26.67 cm³).	1
1(c)(i)	All numerical answers in 1(c) are given to 3 or 4 sf	1
1(c)(ii)	Correctly calculates $0.02 \times (\mathbf{b}) / 1000$	1
1(c)(iii)	Correctly uses answer (ii) $\times 5 / 2$ (or equivalent)	1

Question	Answer	Marks
1(c)(iv)	Correctly uses $8.06 / (40 \times \text{answer (iii)})$	1
1(c)(v)	Correct expression $(\text{answer (iv)} - 88) \div 2$	1
1(c)(vi)	Correct answer K / potassium <i>Allow ecf of group 1 metal ion:</i> $(Li < 15.0; 15.0 \leq Na < 31.1; 31.1 \leq K \leq 62.3; 62.3 \leq Rb \leq 109.2; 109.2 \leq Cs)$	1

Question	Answer	Marks
2(a)	I Both colours and states correct: (from) (pale) pink crystals / solid to off-white / beige / buff / (pale) brown powder / solid	1
	II Table of data Must show all of the following: • mass of crucible (+ lid) • mass of crucible (+ lid) + FA 4 • mass of crucible (+ lid) + residue • mass of FA 4 • mass of residue • mass of water lost	1
	III Recording of data • Unit / g, (g) or in grams • all three balance readings recorded to same number of dp	1
	IV Calculations Calculates correctly the mass of FA 4 , mass of residue and mass of water lost.	1
2(b)(i)	Correctly calculates $\text{mol MnSO}_4 = \text{mass residue} \div 151(.0)$ and answer to 2–4 sf	1
2(b)(ii)	Correctly calculates $\text{mol H}_2\text{O} = \text{mass water lost} \div 18$ and answer to 2–4 sf	1
2(b)(iii)	Correctly uses $\text{ans (ii)} \div \text{ans (i)}$ and x is an integer	1
2(c)(i)	Heat to constant mass	1
2(c)(ii)	The changes in masses (of residue and water) will be too small to change the integer value.	1

Question	Answer	Marks						
FA 5 is MnCl ₂ (aq); FA 6 is water in place of methylpropan-2-ol; FA 7 is butan-1-ol; FA 8 is butan-2-ol								
3(a)(i)	Off-white / pale brown / buff / beige ppt and insoluble in excess / ppt darkens / ppt turns brown / darker brown	1						
3(a)(ii)	Selects (aqueous) silver nitrate and (aqueous) sodium hydroxide with aluminium and either mention of heating or testing gas with red litmus Selection of any other reagent, Ba ²⁺ , negates this mark.	1						
	Clear test / observation sections suitable for two tests	1						
	White ppt with Ag ⁺ and no ammonia with Devarda's test	1						
3(a)(iii)	FA 5 = Mn ²⁺ and Cl ⁻	1						
3(a)(iv)	Mn ²⁺ (aq) + 2OH ⁻ (aq) → Mn(OH) ₂ (s)	1						
3(a)(v)	3 observations = 1 mark	1						
	<table><tr><td>test</td><td>residue</td></tr><tr><td>+ H₂O₂</td><td>no visible reaction</td></tr><tr><td>+ NaOH</td><td>dark brown ppt / solid AND effervescence / bubbling / fizzing</td></tr></table>		test	residue	+ H ₂ O ₂	no visible reaction	+ NaOH	dark brown ppt / solid AND effervescence / bubbling / fizzing
	test		residue					
	+ H ₂ O ₂		no visible reaction					
	+ NaOH	dark brown ppt / solid AND effervescence / bubbling / fizzing						
(gas / O ₂ / fizz) relights glowing splint / makes splint glow brighter								
3(a)(vi)	redox / disproportionation / catalysis	1						

Question	Answer				Marks								
3(b)(i)	Award one mark for every two correct observations				3								
	test	FA 6	FA 7	FA 8									
	+ H ⁺ / MnO ₄ ⁻	no reaction / no change / remains purple	purple decolourised <i>allow turns (pale) yellow-brown / brown</i>	purple decolourised									
	+ I ₂ / NaOH	no reaction / no change / no ppt	no reaction / no change / no ppt	pale yellow ppt									
3(b)(ii)	<table><tr><td>alcohol</td><td>FA...</td></tr><tr><td>butan-1-ol</td><td>FA 7</td></tr><tr><td>butan-2-ol</td><td>FA 8</td></tr><tr><td>methylpropan-2-ol</td><td>FA 6</td></tr></table>				alcohol	FA...	butan-1-ol	FA 7	butan-2-ol	FA 8	methylpropan-2-ol	FA 6	2
					alcohol	FA...							
					butan-1-ol	FA 7							
					butan-2-ol	FA 8							
	methylpropan-2-ol	FA 6											
3 correct award 2 marks, 1 correct award 1 mark													
3(b)(iii)	$\text{CH}_3(\text{CH}_2)_2\text{CH}_2\text{OH} + [\text{O}] \rightarrow \text{CH}_3(\text{CH}_2)_2\text{CHO} + \text{H}_2\text{O}$ or $\text{CH}_3(\text{CH}_2)_2\text{CH}_2\text{OH} + 2[\text{O}] \rightarrow \text{CH}_3(\text{CH}_2)_2\text{COOH} + \text{H}_2\text{O}$ or $\text{CH}_3\text{CH}_2\text{CHOHCH}_3 + [\text{O}] \rightarrow \text{CH}_3\text{CH}_2\text{COCH}_3 + \text{H}_2\text{O}$				1								