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CHEMISTRY **9701/33**

Paper 3 Advanced Practical Skills 1 **October/November 2024**

MARK SCHEME

Maximum Mark: 40

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.

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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.

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 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. • Any response marked *ignore* in the mark scheme should not count towards ***n***. • Incorrect responses should not be awarded credit but will still count towards ***n***. • Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response. • Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

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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.

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.

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Question	Answer	Marks
1(a)	**I 5 headings and units for data** • (Mass of conical) flask + **FA 2 /** g (referred to as x in **1(b)(i)**) • (Mass of) container + **FA 1** / g. • (Mass of empty) container (or with residual **FA 1**) / g • (Mass) **FA 1** (added) / g (referred to as y in **1(b)(i)**) • (Total mass of conical) flask and contents at end / after 15 mins / after reaction / final / g (referred to as z in **1(b)(i))**	**1**
	II Precision and calculation All four balance readings recording consistently either to 2 or to 3 d.p. **and** Subtraction for mass of **FA 1** correct	**1**
	III Accuracy (Q) mark Calculate supervisor to 2 d.p. = $\frac{\text{mass of FA 1}}{\text{mass loss}}$ Write this, in a ring, on each candidate's script. Calculate the ratio for each candidate to 2 d.p. Upper and lower limits for the accuracy mark are the supervisor value plus or minus 15% and then rounded to 2 d.p. Award mark **III** if rounded candidate value is between rounded upper and lower limits (inclusive).	**1**
1(b)(i)	**Correct calculation of mass loss (= mass of CO_2)** Mass loss = x + y – z (see **1(a)** answer **I**) **and** answer given to 2–4 sig figs.	**1**

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Question	Answer	Marks
1(b)(ii)	**Correct use** of **(b)(i)** to calculate M_r of **FA 1.** **M1** Correct expression to calculate no of moles of CO_2 produced $n(CO_2) = {}^{\textbf{(b)(i)}}/_{44}$ **M2** Correct use of data to calculate M_r $M_r = {}^{\text{mass of FA 1}}/_{\text{moles of } CO_2} = {}^{\text{mass of FA 1} \times 44}/_{\textbf{(b)(i)}}$ **and** answer given to 2–4 sig figs	**2**
1(c)(i)	**M1** **(**At lower temp) more CO_2 dissolves in the solution **and** less CO_2 escapes / mass loss reduced **OR** The reaction is slower (at a lower temperature) **and** less CO_2 produced / mass loss reduced **M2** Lower amount / moles of CO_2 (calculated) **or** lower amount / moles of (metal) carbonate (calculated) **and** higher M_r	**2**
1(c)(ii)	(Tilting) allows air to replace / displace carbon dioxide in the flask **or** (Tilting) tips out the (denser) carbon dioxide gas (from the flask) **or** (Tilting) allows the acid to react with solid <u>stuck to the walls (owtte)</u> of the conical flask.	**1**
1(d)	**Correct expression** Uncertainty **U** (for 2 d.p. balance) = 0.01 or 0.005 **and** % error in weighing **FA 1** = ${}^{2 \times \textbf{U}}/_{\text{mass of } \textbf{FA 1 (used)}} \times 100$	**1**

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Question	Answer	Marks
2(a)	**I** The following data are recorded • two burette readings **and** titre for the rough titration • initial and final burette readings for **two** (or more) accurate titrations **II** **Correct headings** and units in the **accurate** titration table and **titre values** recorded for accurate titrations • initial / start **and** (burette) reading / volume • final / end **and** (burette) reading / volume • titre **or** volume / **FB 2 and** used/added • unit: / cm^3 **or** (cm^3) **or** in cm^3 (for each heading) **or** cm^3 unit given for each volume recorded **III** All **accurate** burette readings are recorded to the nearest 0.05 cm^3 **IV** The **final** accurate titre recorded is within 0.10 cm^3 of any other accurate titre	**7**
	Award accuracy Q marks as follows: **V** Award if $\delta \leqslant 0.50\ cm^3$ **VI** Award if $\delta \leqslant .0.30\ cm^3$ **VII** Award if $\delta \leqslant 0.20\ cm^3$ If Supervisor's mean titre > 50.00 cm^3 then use the tolerances (0.30, 0.50, 0.80 cm^3) If Supervisor's mean titre < 10.00 cm^3 then halve the tolerances (0.25, 0.15, 0.10 cm^3) If Supervisor's mean titre < 5.00 cm^3 then use the tolerances (0.15, 0.10, 0.05 cm^3)	
2(b)	**Correctly calculates the mean titre to 2 decimal places.** • Candidate must take the average of two (or more) accurate titres that are within a total spread of not more than 0.20 cm^3. • 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 d.p.** and be rounded to nearest 0.01 cm^3. (e.g. 26.675 cm^3 must be rounded to 26.68 cm^3)	**1**

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Question	Answer	Marks
2(c)(i)	**All final numerical answers to parts 2(c)(ii), 2(c)(iii) and 2(c)(iv)** are quoted to 3 or 4 significant figures.	**1**
2(c)(ii)	**Correct use of (b)** Amount of HC*l* used = $^{4.02}/_{36.5} \times {}^{\textbf{(b)}}/_{1000}$ mol	**1**
2(c)(iii)	**Correct use of (c)(ii)** Concentration of Na_2CO_3 = $^{\textbf{(c)(ii)}}/_{2} \times {}^{1000}/_{25}$ mol dm^{-3}	**1**
2(c)(iv)	**Correct use of (c)(iii)** *M*r of Na_2CO_3 = $^{15.5(0)}/_{\textbf{(c)(iii)}}$	**1**
2(c)(v)	**Correct use of (c)(iv)** to calculate nearest whole number value of **x** **x** = $^{[\textbf{(c)(iv)} - 106]}/_{18}$	**1**
2(d)	**M1** Heat **FA 1** to drive off <u>water</u> (of crystallisation) **or** Heat **FA 1** to convert it to <u>anhydrous</u> (salt) **M2** (Heat to) constant mass (**or** description of procedure) **OR** Heat gently at first, with crucible lid on **and** to prevent solid frothing/spitting out of the crucible.	**2**

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Question	Answer	Marks
	FA 6 is $CuCO_3$; **FA7** is $CuSO_4$ mixed with H_2SO_4; **FA 8** is KI	
3(a)(i)	This part is 'blob-marked'. Each available marking point is shown by a bullet. • (**FA 6** is) a (light) green / blue-green **and** solid / powder • (When heated) condensation / steam / water vapour produced • Solid fluidises / jumps about in test tube (owtte) • Black residue / solid formed • Attempts to test (gas) with limewater • (Gas / carbon dioxide) and limewater gives a white precipitate • Gas is carbon dioxide	**3**
3(a)(ii)	(light) blue solution (formed)	**1**
3(a)(iii)	$CuO(s) + H_2SO_4(aq) \rightarrow CuSO_4(aq) + H_2O(l)$	**1**

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Question	Answer	Marks
3(b)(i)	**Observations** **Test 1:** blue ppt * insoluble in excess (NaOH) * **Test 2:** (pale) blue ppt * soluble / disappears in excess (NH_3) * Deep / dark blue colour forms (with excess) * (With acid) solution becomes paler blue **or** blue ppt forms * **Test 3:** fizzing / effervescence * blue ppt (forms) * **Test 4:** (off-)white precipitate / solid (forms) * (with starch) goes dark blue / blue-black / black* **Test 5:** Brown solid / ppt forms * Fizzing **or** <u>solution</u> goes paler (blue) **or** <u>solution</u> goes colourless * (gas) pops with a lighted splint * **Test 6:** White precipitate (forms) *	**6**
3(b)(ii)	**FA 8: extra test** • Add (aqueous) silver nitrate / $AgNO_3$ • (Pale) yellow precipitate formed • Precipitate is insoluble in (excess aqueous) ammonia • (**FA8**) contains I^- **OR** • Add (acidified aqueous) potassium manganate (VII) / $KMnO_4$ • Brown / yellow solution formed • Dark blue / blue-black / black colour with starch • (**FA8**) contains I^-	**2**

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Question	Answer	Marks
3(b)(iii)	4 **and** 5	**1**
3(b)(iv)	$Cu^{2+}(aq) + Fe(s) \rightarrow Fe^{2+}(aq) + Cu(s)$ **or** $Fe(s) + 2H^{+}(aq) \rightarrow Fe^{2+}(aq) + H_2(g)$	**1**

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