CHEMISTRY   **9701/52**

Paper 5 Planning, Analysis and Evaluation   **February/March 2023**

MARK SCHEME

Maximum Mark : 30

Cambridge International Examinations – 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.   <u>'List rule' guidance</u> (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   • 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
6.   <u>Calculation specific guidance</u>   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.

Examples of how to apply the list rule

State **three** reasons…. [3]

A

1. Correct	✔	
2. Correct	✔	2
3. Wrong	☐	

B
(4 responses)

1. Correct, Correct	✔, ✔	
2. Correct	✔	3
3. Wrong	ignore	

C
(4 responses)

1. Correct	✔	
2. Correct, Wrong	✔, ☐	2
3. Correct	ignore	

D
(4 responses)

1. Correct	✔	
2. Correct, CON (of 2.)	☐, (discount 2)	2
3. Correct	✔	

E
(4 responses)

1. Correct	✔	
2. Correct	✔	3
3. Correct, Wrong	✔	

F
(4 responses)

1. Correct	✔	
2. Correct	✔	
3. Correct	☐	2
CON (of 3.)	(discount 3)	

G
(5 responses)

1. Correct	✔	
2. Correct	✔	
3. Correct	✔	3
Correct	ignore	
CON (of 4.)	ignore	

H
(4 responses)

1. Correct	✔	
2. Correct	☐	
3. CON (of 2.)	(discount 2)	2
Correct	✔	

I
(4 responses)

1. Correct	✔	
2. Correct	☐	
3. Correct	✔	2
CON (of 2.)	(discount 2)	

Question	Answer	Marks	Guidance
1ai	All titres to nearest 0.05 cm^3 (10.50, 9.65, 9.90, 9.75)	1	
1aii	averaging of titres 1 and 3 (9.70)	1	A ECF from (a)(i) as long as titres are concordant
1b	A solution of known concentration	1	
1ci	To allow to reach equilibrium	1	R to reach completion Check latest MS (Nov 2020)
1cii	To allow solid to settle	1	A silver / ppt etc for solid
1d	Acid is in excess	1	
1e	$KMnO_4(aq)$	1	
1f	From colourless to pale pink	1	R Purple I pale purple Check latest MS (Mar 2021)
1g	Lower percentage error	1	
1h(i)	M1 Mol $MnO_4^-(aq)$ = 0.0200 x 21.10/1000 = 4.22 x 10^{-4} mol M2 Mol $Fe^{2+}(aq)$ = M1 x 5 = 2.11 x 10^{-3} mol Conc $Fe^{2+}(aq)$ = mol Fe^{2+} x 1000/25 = 0.0844 mol dm^{-3}	2	
(ii)	Same as $[Fe^{2+}(aq)]_{eqm}$	1	A react in 1:1 ratio
(iii)	0.100 − 0.0844 = 0.0156	1	A 0.100 − 0.0804 = 0.0196
(iv)	M1 K_c = 0.0156 / (0.0844 x 0.0844) = 2.19 M2 dm^3 mol^{-1}	2	A 0.0196 / (0.0804 x 0.0804) = 3.03
	Total	**15**	

Question	Answer	Marks	Guidance
2a	Order can only be determined experimentally	1	Allow stoichiometry of equation has nothing to do with order?
2b	M1 Dissolving solid in beaker M2 Transfer including washings M3 250 cm^3 volumetric flask topped up to the mark with distilled water	3	Check latest MS about distilled water at least once / Penalty for transferring using a pipette etc (Mar 2021/June 2021)
2ci	Repeat and average	1	
2cii	V	1	
2ciii	Step 4	1	
2di	<table><tr><td>Log V</td><td>Log(1/t)</td></tr><tr><td>0.699</td><td>-2.41</td></tr><tr><td>1.00</td><td>-2.08</td></tr><tr><td>1.10</td><td>-2.05</td></tr><tr><td>1.18</td><td>-1.88</td></tr><tr><td>X</td><td>X</td></tr><tr><td>1.30</td><td>-1.75</td></tr><tr><td>1.40</td><td>-1.64</td></tr></table> M1 Log V Correct values to 3 SF M2 log(1/t) Correct values to 3 SF	2	A ECF for SF on M2
2dii	M1 6 points plotted correctly M2 Line of best fit drawn	2	Check latest MS for standard wording Tolerance of +/- of ½ of one small square provided the point is in the correct square, unless the point should be on a grid line. Place plotting tick on grid above graph. Place line tick in rhs margin

Question	Answer	Marks	Guidance
			the co-ordinates chosen must cover at least 0.4 on x axis
2diii	Point at log V = 1.10 And (time is too high because) watch started too early or stopped too late	1	
2div	M1 Co-ordinates read and recorded correctly M2 Gradient calculated to 2 dp	2	Gradient approx. 1.1
2dv	(2dv – 1) / 1 = 10% AND Therefore other factors beyond apparatus error caused	1	A ECF if gradient < 5.25% away from 1
	Total	**15**	