OCR
Oxford Cambridge and RSA

Foundation

GCSE

Chemistry A Gateway Science

J248/03: Paper 3 (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2023

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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MARKING INSTRUCTIONS

PREPARATION FOR MARKING

RM ASSESSOR

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Online Training*; *OCR Essential Guide to Marking*.
2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are available in RM Assessor.
3. Log-in to RM Assessor and mark the **required number** of practice responses ("scripts") and the **required number** of standardisation responses.

MARKING

1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the RM Assessor 50% and 100% (traditional 50% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone, email or via the RM Assessor messaging system.

5. Work crossed out:

   a. where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks

   b. if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there, then add the annotation SEEN to confirm that the work has been read.

7. There is a NR (No Response) option. Award NR (No Response)

   - if there is nothing written at all in the answer space
   - OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')
   - OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the question.

   Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).

8. The RM Assessor **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**

   If you have any questions or comments for your Team Leader, use the phone, the RM Assessor messaging system, or email.

9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response:

Read through the whole answer from start to finish, using the Level descriptors to help you decide whether it is a strong or weak answer. The indicative scientific content in the Guidance column indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the skills and science content evidenced within the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.

Once the level is located, award the higher or lower mark:

The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.

The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.

In summary:

The skills and science content determines the level.

The communication statement determines the mark within a level.

Level of response question on this paper is **19(a)**.

11. Annotations available in RM Assessor

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
	Benefit of doubt given
	Contradiction
	Rounding error
	Error in number of significant figures
	Error carried forward
	Level 1
	Level 2
	Level 3
	Benefit of doubt not given
	Noted but no credit given
	Ignore

Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

Annotation	Meaning
/	alternative and acceptable answers for the same marking point
✓	Separates marking points
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
__	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

12. **Subject-specific Marking Instructions**

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

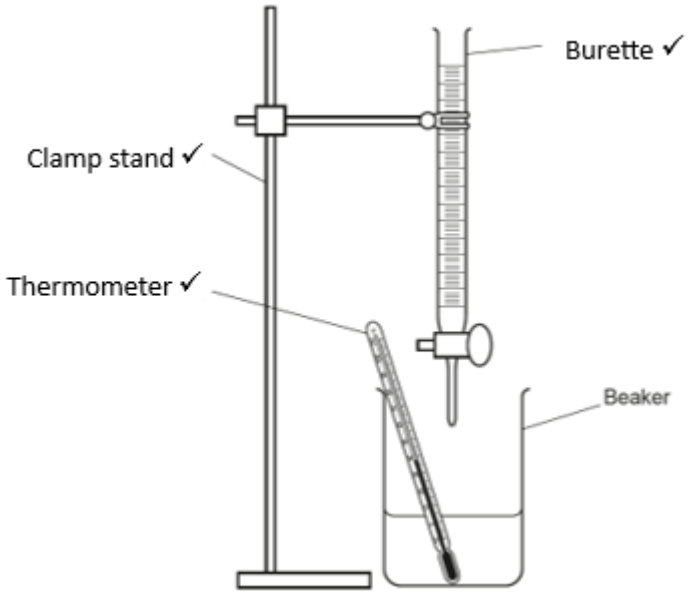
The breakdown of Assessment Objectives for GCSE (9-1) in Chemistry A:

	Assessment Objective
AO1	**Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.**
AO1.1	Demonstrate knowledge and understanding of scientific ideas.
AO1.2	Demonstrate knowledge and understanding of scientific techniques and procedures.
AO2	**Apply knowledge and understanding of scientific ideas and scientific enquiry, techniques and procedures.**
AO2.1	Apply knowledge and understanding of scientific ideas.
AO2.2	Apply knowledge and understanding of scientific enquiry, techniques and procedures.
AO3	**Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions and develop and improve experimental procedures.**
AO3.1	Analyse information and ideas to interpret and evaluate.
AO3.1a	Analyse information and ideas to interpret.
AO3.1b	Analyse information and ideas to evaluate.
AO3.2	Analyse information and ideas to make judgements and draw conclusions.
AO3.2a	Analyse information and ideas to make judgements.
AO3.2b	Analyse information and ideas to draw conclusions.
AO3.3	Analyse information and ideas to develop and improve experimental procedures.
AO3.3a	Analyse information and ideas to develop experimental procedures.
AO3.3b	Analyse information and ideas to improve experimental procedures.

For answers to Section A if an answer box is blank ALLOW correct indication of answer e.g. circled or underlined.

Question	Answer	Marks	AO element	Guidance
1	D	1	1.1	
2	B	1	1.2	
3	D	1	2.1	
4	C	1	1.1	
5	B	1	1.2	
6	A	1	2.2	
7	C	1	2.2	
8	D	1	2.1	
9	C	1	1.2	
10	B	1	1.2	
11	D	1	1.1	
12	C	1	2.1	
13	A	1	1.1	
14	C	1	2.2	
15	D	1	2.2	

Question			Answer	Marks	AO element	Guidance
16	(a)		A reaction between an acid and an alkali is neutralisation. ✓ Acids form OH^- ions in solution. Alkalis have a pH of less than 7. Sodium hydroxide, NaOH, is an example of an acid. ✓	1	1.1	
	(b)	(i)	**First check the answer on answer line** **If answer = 4.35 award 3 marks** 4.37 + 4.31 + 4.38 or 13.06 ✓ 13.06 ÷ 3 = 4.3533 ✓ **3 significant figures:** = 4.35 ✓	3	 1.2 1.2 2.1	 **DO NOT ALLOW** 4.37 + 4.38 only **ALLOW ECF** from incorrect total mass **ALLOW ECF** for significant figure mark
		(ii)	H_2O (l) CO_2 (g) Correct formulae ✓ State symbols ✓	2	 2.1 1.1	**ALLOW** H_2O (l) or CO_2 (g) for 1 mark if both species and state symbols not correct Mark for state symbol dependent on correct species
		(iii)	Filtration ✓	1	1.2	**ALLOW** filter **DO NOT ALLOW** sieving
		(iv)	Crystallisation ✓	1	1.2	**ALLOW** evaporation **ALLOW** heat it (so the solvent evaporates) **IGNORE** (simple) distillation

Question			Answer	Marks	AO element	Guidance
17	(a)	(i)		3	3 x 1.2	**ALLOW** retort stand / stand **IGNORE** just clamp
		(ii)	**Any one from:** Use a polystyrene cup (instead of a beaker) / put a lid / covering on the beaker (to keep heat in) / insulate the (outside of the) beaker / Use a digital thermometer / data logger (to measure the temperature) ✓	1	3.3b	**IGNORE** seal the beaker **ALLOW** idea of clamping or holding the thermometer in the middle of the solution / don't let thermometer touch the beaker **ALLOW** stir the solution

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>Linear scale on both axes ✓

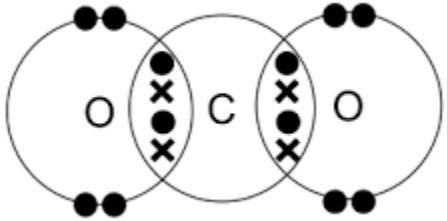
Points plotted correctly ✓

<table><tr><th>Volume of acid (cm^3)</th><th>Temperature (°C)</th></tr><tr><td>0</td><td>18</td></tr><tr><td>5</td><td>20</td></tr><tr><td>10</td><td>23</td></tr><tr><td>15</td><td>26</td></tr><tr><td>20</td><td>27</td></tr><tr><td>25</td><td>26</td></tr><tr><td>30</td><td>24</td></tr></table></td><td>2</td><td>2 x 2.2</td><td>x-axis must begin from 0

ALLOW ±½ small square
ALLOW bar chart or histogram
MP2 is dependent on MP1

IGNORE any line of best fit</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>(As the acid is added) the temperature increases ✓

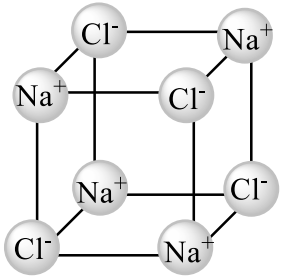
Idea that after 20 cm^3 (of acid is added) / after the reaction is complete, the temperature decreases ✓</td><td>2</td><td>2 x 3.1a</td><td></td></tr>
<tr><td></td><td></td><td>(iii)</td><td>The temperature increases ✓</td><td>1</td><td>2.1</td><td>ALLOW the reaction gets hotter
IGNORE idea that energy / heat is released</td></tr>
<tr><td></td><td>(c)</td><td></td><td>Idea of the (minimum) amount of energy needed for a reaction to start or occur ✓</td><td>1</td><td>1.1</td><td>ALLOW idea of the (minimum) amount of energy for a successful collision (to occur)</td></tr>
</table>

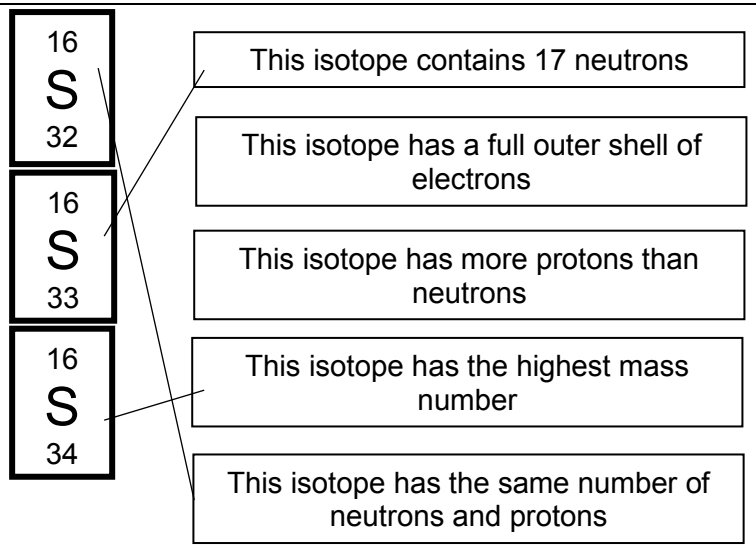
Question			Answer	Marks	AO element	Guidance
18	(a)		Alpha / positively charged particles were fired at gold leaf ✓ Idea that most particles went (straight) through ✓ Idea that some particles were repelled by the (positive charge of the) nucleus ✓	3	3 x 1.1	**IGNORE** electrons for MP1 **ALLOW** some particles went (straight) through **ALLOW** idea that particles were deflected or reflected **DO NOT ALLOW** idea that <u>most</u> particles were repelled
	(b)		A proton has a positive charge and a relative mass of 1. ✓ An atomic radius is approximately 1×10^{-12} m. An electron has a negative charge and a relative mass of 1. Most of the mass of the atom is in the nucleus. ✓ The radius of an atom is much smaller than the radius of a nucleus. ✓✓	2	2 x 1.1	
	(c)		 Two shared pairs of electrons between C and each O ✓ Rest of structure correct ✓	2	2 x 2.2	**ALLOW** electrons as all dots, all crosses, or a mix of dots and crosses **ALLOW** diagrams with inner electron shells, but inner shells must be correct if shown Second marking point is dependent on two shared pairs of electrons between C and each O

Question			Answer	Marks	AO element	Guidance
	(d)	(i)	**Any three from:** Particles move faster in gas / move slower in solid ✓ Particles have more energy in gas / less energy in solid ✓ Particles are further apart in gas / closer together in solid ✓ Particles are arranged more randomly in gas / arranged regularly in solid ✓ Forces between particles are weaker in gas / stronger in solid ✓	3	3 x 1.1	**Answers must be comparative** **ALLOW** atoms / molecules for particles **ALLOW** idea of particles (vibrating) in a fixed position for regular arrangement in a solid
		(ii)	**Temperature and pressure:** 1.0 MPa and a temperature value between -55 and -41 °C✓ **Reason:** Idea that the temperature selected is between the melting and boiling point (so will be a liquid) / Idea that lower than -56°C CO_2 is a solid and above -40°C CO_2 is a gas ✓ 1.0 MPa has a melting and boiling point (whereas 0.1 MPa does not) / 1.0 MPa does not have a sublimation point ✓	3	3 x 3.2b	MP dependent on correct temperature **ALLOW ORA** for 0.1MPa **ALLOW** idea that 1.0 MPa is the pressure when CO_2 can be a liquid (between -55 and -41 °C)

Question			Answer	Marks	AO element	Guidance
19	(a)*		Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Accurately applies knowledge and a detailed understanding to explain the product made at the electrode in each experiment **AND** Determines that the scientist should use experiment 2 *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Clearly, but with some limitations, applies knowledge and understanding to explain the product made at the electrode in each experiment **AND** Determines that the scientist should use experiment 2 *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Attempts to apply knowledge and understanding to explain the product made at the electrode in one of the experiments	**6**	**4 x 2.2 2 x 3.2b**	**AO3.2b Applies knowledge and understanding of electrolysis** • In experiment 1, molten copper chloride contains only Cu^{2+} ions and Cl^- ions • In experiment 2, copper sulfate solution contains Cu^{2+}, SO_4^{2-}, H^+ and OH^- ions • Positive metal / hydrogen ions are attracted to the negative cathode • Negative non-metal ions and are attracted to the positive anode • Cu^{2+} ions are less reactive than H^+ ions • Cu^{2+} ions are discharged in preference to H^+ ions **AO3.2b Analyses information and ideas to draw conclusions** • Experiment 1 forms chlorine at the anode • Experiment 1 forms copper at the cathode • Experiment 2 forms copper at the cathode • Experiment 2 forms oxygen at the anode • Experiment 2 should be used

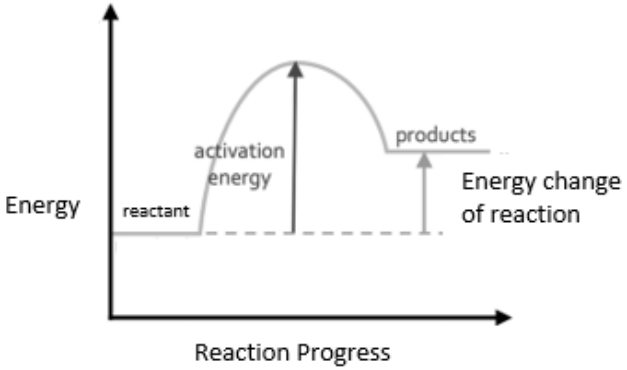
Question			Answer	Marks	AO element	Guidance
			There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant. **0 marks** *No response or no response worthy of credit.*			
	(b)		Electrodes should be in the lead bromide / electrolyte ✓ Lead bromide should be molten / the lead bromide should be heated (until it is molten) ✓	**2**	**2 x 3.3b**	**IGNORE** use inert electrodes **IGNORE** connect the wire together **IGNORE** lead bromide should be in aqueous solution
	(c)		$2Br^- - \mathbf{2e^-} \rightarrow \mathbf{Br_2}$ Correct species ✓ Balancing ✓	**2**	**2 x 1.2**	Second MP is dependent on the first

Question			Answer	Marks	AO element	Guidance
20	(a)		Idea of using filtration to separate the sand from the water and dissolved salt ✓ Idea of using distillation to collect the water from the salt solution ✓ Idea that the salt is left in the flask (after removal of the water by distillation) ✓ Correct choice of apparatus for at least one of the 3 stages of the method ✓	4	4 x 3.3a	Marks can be awarded from labelled diagrams **DO NOT ALLOW** stages in incorrect order **ALLOW** idea of salt remaining after water is evaporated
	(b)		 Sodium ion labelled as Na^+ **and** chloride ion labelled as Cl^- ✓ Alternately labelled ions ✓	2	2 x 1.2	**DO NOT ALLOW** atoms rather than ions; scores 0 marks **ALLOW** information provided in the form of a key **IGNORE** labelling as 'sodium ion' / 'chloride ion'; must be symbols

Question			Answer	Marks	AO element	Guidance
	(c)	(i)		2	2 x 2.1	All three correct = 2 marks Two correct = 1 mark
		(ii)	**First check the answer on answer line** **If answer = 121.3 award 2 marks** 33 + (4 x 16) + 24.3 ✓ = 121.3 ✓	2	2 x 2.2	
		(iii)	Solvent / mobile phase ✓	1	3.3b	**IGNORE** use a different liquid **IGNORE** change the concentration of the solvent **DO NOT ALLOW** (change) the stationary phase
		(iv)	Strong electrostatic attraction (between oppositely charged ions) / strong forces between oppositely charged ions / strong ionic bonds ✓ Lots of energy is required to overcome the forces / bonds ✓	2	2 x 2.1	**DO NOT ALLOW** references to intermolecular forces, covalent bonds or metallic bonds – scores 0 for question

Question			Answer	Marks	AO element	Guidance
21	(a)		(Substance) 3 ✓ **And any two from:** Polymers have low melting points / substance 3 has a low melting point✓ Polymers do not conduct electricity / substance 3 does not conduct electricity ✓ Polymers can be flexible / substance 3 is flexible ✓	**3**	**3 x 2.1**	(Substance) 1 or 2 scores 0 for the question **IGNORE** references to boiling point **ALLOW** maximum 1 mark for a correct explanation if Substance 4 is chosen
	(b)		Idea that polymer <u>chains</u> without cross-links can slide or move over each other / **ORA** ✓ The intermolecular forces holding polymer <u>chains</u> together are weaker than cross-links / **ORA** ✓	**2**	**2 x 1.1**	**Assume unqualified answer refers to polymers without cross-links** **IGNORE** references to the polymer chains stretching **ALLOW** idea that cross-links are covalent bonds
	(c)		(Part A) - substance 3 **AND** (Part B) – substance 1 ✓ **Explanations** Part A needs to be an insulator / Part A needs to protect from electrical shock / Part A needs to be flexible (so wire can bend) ✓ Part B needs to conduct electricity ✓	**3**	**3 x 3.2a**	**DO NOT ALLOW** named substances (e.g., plastic / metal) for MP1 **ALLOW** Part A does not conduct electricity MP2 and MP3 are independent of MP1

Question			Answer	Marks	AO element	Guidance
22	(a)	(i)	**First check the answer on answer line** **If answer = 7.2 (g) award 3 marks** Moles of oxygen = 0.45 ÷ 2 = 0.225 ✓ M_r of oxygen = 16 x 2 = 32 ✓ Mass of oxygen = 0.225 x 32 = 7.2 (g) ✓	3	3 x 2.1	**ALLOW ECF** from incorrect moles of oxygen and/or M_r of oxygen
		(ii)	**First check the answer on answer line** **If answer = 5.42 x 10^{23} award 3 marks** Moles of NO_2 = 0.45 x 2 = 0.9 ✓ Molecules of NO_2 = 0.9 x (6.02 x 10^{23}) = 5.418 x 10^{23} ✓ **3 significant figures:** = 5.42 x 10^{23} ✓	3	3 x 2.1	**ALLOW ECF** from incorrect moles of NO_2 **ALLOW ECF** if significant figures correct from incorrect calculation of molecules of NO_2

Question	Answer	Marks	AO element	Guidance
(b)	 Products line labelled above reactant line ✓ Curve up, then down from reactant to products (on endothermic reaction profile) ✓ Activation energy labelled ✓ Energy change labelled ✓	4	4 x 1.1	**ALLOW** 1 mark MAX for correctly labelled activation energy on an exothermic reaction profile **DO NOT ALLOW** double headed arrow or line without arrow **DO NOT ALLOW** double headed arrow or line without arrow

Question			Answer	Marks	AO element	Guidance
	(c)	(i)	Idea that 2 electrons are lost to form a full outer shell ✓	1	2.1	**ALLOW** idea that magnesium has (only) 2 outer shell electrons which are lost / idea that magnesium loses 2 electrons to become stable **IGNORE** just the idea that magnesium loses 2 electrons
		(ii)	$Mg^{2+} + 2OH^- \rightarrow Mg(OH)_2$ Correct formulae ✓ Balancing ✓	2	2 x 2.1	**ALLOW** any correct multiple, including fractions **ALLOW** = instead of → **DO NOT ALLOW** and / & instead of '+' **IGNORE** state symbols **DO NOT ALLOW** $Mg^{2+}(OH)^-_2$ **ALLOW** 1 mark for a balanced equation with a minor error in subscripts / formulae e.g., $Mg^{2+} + 2Oh^- \rightarrow Mg(OH)_2$

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