



# **Cambridge IGCSE™**

---

## **PHYSICAL SCIENCE**

**0652/41**

Paper 4 Extended Theory

**October/November 2023**

MARK SCHEME

Maximum Mark: 80

---

**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 2023 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

---

This document consists of **10** printed pages.

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**

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 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.

Question	Answer	Marks
1(a)	galvanising ;	1
1(b)	cracking ;	1
1(c)	precipitation ;	1
1(d)	reduction ;	1
1(e)	neutralisation ;	1
1(f)	fractional distillation ;	1

Question	Answer	Marks
2(a)	micrometer ;	1
2(b)(i)	X between extension 10–12 mm inclusive;	1
2(b)(ii)	gradient of straight line portion of graph shown on graph ; 0.65 ; N / mm ;	3

Question	Answer	Marks
3(a)	melts over a range / not one definite melting point ;	1
3(b)	key: + = sodium <b>AND</b> – = chloride ; diagram: alternating + and – ;	2
3(c)	sodium chloride stronger / more energy needed to break, (attractions) ; chlorine attractions <u>between molecules</u> ; sodium chloride attractions <u>between ions</u> ;	3

Question	Answer	Marks
4(a)	normal drawn and labelled <b>AND</b> labelled reflected ray above the mirror ; reflected ray drawn with correct angle ;	2
4(b)(i)	visible light <b>AND</b> infrared ;	1
4(b)(ii)	<i>any two from:</i> black ; matt / not shiny ; large surface area ;	2
4(b)(iii)	(in metal) particles <u>vibrate</u> ; idea of energy transferred by <b>electrons</b> ;	2
4(b)(iv)	hot water expands / particles move further apart ; hot water becomes less dense ;	2
4(b)(v)	water (vapour) / steam ;	1

Question	Answer	Marks
5(a)(i)	g ;	1
5(a)(ii)	addition ;	1
5(b)	<p><i>any one reactant:</i>  <i>reactant:</i> carbohydrates / sugar / named sugar e.g. glucose, maltose, sucrose ;</p> <p><i>any two from:</i>          yeast/enzymes ;          carbon dioxide produced ;          absence of oxygen ;          (warm to) 30 °C ;</p>	3
5(c)	<p><i>any two from:</i>  <i>(combustion of fossil fuels leads to):</i>          sulfur dioxide / SO<sub>2</sub> / NO<sub>x</sub> / oxides of nitrogen / acid rain ;          carbon dioxide / global warming / climate change ;          carbon monoxide ;          particulates ;          leads to respiratory problems</p>	2
5(d)	<p><i>any two from family of compounds:</i>          with same general formula ;          similar chemical properties ;          increase by CH<sub>2</sub> (between consecutive members of the group);</p>	2
5(e)	nonanol circled ;	1

Question	Answer	Marks
6(a)	16 (Nm) ;	1
6(b)(i)	(weight of rock =) 150 (N) ; (moment due to rock =) $150 \times 0.3$ or 45 (Nm) ; (total moment = 45 + 16) = 61 (Nm) ;	3
6(b)(ii)	76(25) ;	1
6(c)(i)	$0.006$ or $6 \times 10^{-3}$ ;	1
6(c)(ii)	$0.3 \times 0.3 \times h = 0.006$ / $0.006 \div 0.09$ ; 0.067 ;	2

Question	Answer	Marks
7(a)	(sodium) has one electron to lose from its outer shell (magnesium has two); (sodium) forms a (positive) ion more easily ;	2
7(b)	$Mg + 2HCl \rightarrow MgCl_2 + H_2$ M1 $H_2$ product; M2 correctly balanced equation ;	2
7(c)	calcium $\rightarrow$ iron $\rightarrow$ nickel $\rightarrow$ copper calcium and copper ; iron and nickel ;	2
7(d)(i)	<i>test:</i> limewater ; <i>observation:</i> turns cloudy/white precipitate formed ;	2
7(d)(ii)	sodium <u>chloride</u> ;	1
7(e)	donates a, proton / $H^+$ ;	1

Question	Answer	Marks
8(a)	theristor ;	1
8(b)(i)	(total $R = V \div I$ or $1.2 \div 0.004$ or 300 ; (resistance of $R = 300 - 200$ ) = 100 ;	2
8(b)(ii)	0.4 ;	1
8(c)	(total resistance =) $220 + 100$ or 320 ; (current =) $1.2 \div 320$ or 0.00375 or 0.0038 ; 0.375 / 0.38;	3
8(d)	<u>variable</u> resistor ;	1

Question	Answer	Marks
9(a)	<i>Mr Al<sub>2</sub>O<sub>3</sub> determination:</i> 102 ; ratio: 2:4 OR 1:2 mole ratio ; mass of Al: 108 (tonnes) ;	3
9(b)	nitrate / NO <sub>3</sub> <sup>-</sup> ;	1
9(c)	resistance to corrosion ;	1

Question	Answer	Marks
10(a)	$V_p \div V_s = N_p \div N_s$ or $12 \div 220 = 96 \div N_s$ or $220 \div 12 = N_s \div 96$ ; 1760 ;	2
10(b)	$I_p V_p = I_s V_s$ or $I_p \times 12 = 0.15 \times 220$ ; 2.75 or 2.8 ;	2
10(c)	magnetic field produced (in the core) ; (the magnetic field) needs to change (to induce an e.m.f.) ;	2

Question	Answer	Marks
10(d)(i)	<i>any two from:</i> (thicker wires) decrease the resistance ; less, heat / energy / power, lost (in wires); (idea of thicker wires) carry a larger current / allow more charge to flow ;	2
10(d)(ii)	some energy is 'lost' (from the system) ;	1

Question	Answer	Marks
11(a)	(atoms of the same element) with same proton number ; different nucleon number ;	2
11(b)	<chem>Cu(NO3)2</chem> ;	1