

# Cambridge O Level

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**PHYSICS****5054/41**

Paper 4 Alternative to Practical

**May/June 2026**

MARK SCHEME

Maximum Mark: 40

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**Published**

This mark scheme contains the instructions and marking guidance that our examiners used to mark candidate responses for this component.

Before they start marking, examiners complete a standardisation process. They review a range of candidate responses and discuss the mark scheme in detail to agree which answers can and cannot be accepted. Examiners award marks where it is clear that candidate responses have met the requirements of the mark scheme. These requirements may vary between different components or different versions of the same component, depending on the exact requirements of the question and the candidate responses seen during the standardisation process.

Sometimes, our mark schemes may allow marks to be awarded to responses which contain elements that are factually incorrect or for content not covered by the syllabus. We do this in response to the demands of a specific question to support candidates and make sure that our assessments are fair. However, these allowances should not be used as a guide for teaching and learning.

We cannot discuss the mark scheme with schools, and we recommend that schools read the mark scheme together with the assessment material and the Principal Examiner Report for Teachers.

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This document consists of **11** printed pages.

**General marking principles**

All examiners must apply these marking principles when marking candidate responses.

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Examiners must award marks for each response in line with: <ul style="list-style-type: none"><li>the specific <b>content</b> defined in the mark scheme</li><li>the specific <b>skills</b> defined in the mark scheme or in the level descriptions</li><li>the <b>standard of response</b> required as exemplified by the standardisation scripts.</li></ul>                                                                                                                                                                                                                                                                                    |
| 2 | Examiners must award <b>whole marks</b> (not half marks, or other fractions).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 3 | Examiners must award marks <b>positively</b> . This means that: <ul style="list-style-type: none"><li>marks are not deducted for errors or omissions</li><li>marks are awarded for correct/valid answers as defined in the mark scheme and also for <b>other valid answers</b> which go beyond the scope of the syllabus and mark scheme referring to your team leader as appropriate</li><li>the quality of spelling, punctuation and grammar are judged <b>only</b> when the mark scheme indicates that these features are <b>specifically assessed</b> in the question. However, the meaning of all responses must be unambiguous.</li></ul> |
| 4 | Examiners must <b>consistently</b> apply the requirements of the mark scheme and any rules for what to do when candidates have not followed instructions correctly.                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 5 | Examiners must use the <b>full range of marks</b> defined in the mark scheme, unless limited by the quality of the candidate responses seen.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 6 | Examiners must award marks according to the mark scheme and <b>must not</b> award marks with grade thresholds or grade descriptions 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 | <p><u>'List rule' guidance</u></p> <p>For questions that require <b><i>n</i></b> responses (e.g. State <b>two</b> reasons ...):</p> <ul style="list-style-type: none"><li>• The response should be read as continuous prose, even when numbered answer spaces are provided.</li><li>• Any response marked <i>ignore</i> in the mark scheme should not count towards <b><i>n</i></b>.</li><li>• Incorrect responses should not be awarded credit but will still count towards <b><i>n</i></b>.</li><li>• Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should <b>not</b> 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.</li><li>• Non-contradictory responses after the first <b><i>n</i></b> responses may be ignored even if they include incorrect science.</li></ul> |

**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.

**Annotations guidance for centres**

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

**Annotations**

| <b>Annotation</b>                                                                   | <b>Meaning</b>                                                                 |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
|    | information missing or insufficient for credit                                 |
|    | benefit of the doubt given                                                     |
|    | contradiction in response, mark not awarded                                    |
|    | incorrect point or mark not awarded                                            |
|  | error carried forward applied                                                  |
|  | used to highlight parts of an extended response                                |
|  | highlight                                                                      |
|  | incorrect or insufficient point ignored while marking the rest of the response |
|  | two statements are linked                                                      |
|  | power of ten error                                                             |
|  | special case <b>no</b>                                                         |

| Annotation                                                                        | Meaning                                                               |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| <b>SEEN</b>                                                                       | point has been noted, but no credit has been given or blank page seen |
| <b>SF</b>                                                                         | error in number of significant figures                                |
| <b>T</b>                                                                          | answer outside the tolerance of the mark scheme                       |
|  | correct point or mark awarded                                         |
| <b>TV</b>                                                                         | response is too vague or there is insufficient detail in response     |
| <b>U</b>                                                                          | incorrect unit                                                        |
| <b>AE</b>                                                                         | evaluation attempted.                                                 |

**Mark Scheme Abbreviations:**

|                  |                                                                             |
|------------------|-----------------------------------------------------------------------------|
| ;                | separates marking points                                                    |
| /                | alternative responses for the same marking point                            |
| <b>R</b>         | reject the response                                                         |
| <b>A</b>         | accept the response                                                         |
| <b>I</b>         | ignore the response                                                         |
| ecf              | error carried forward                                                       |
| AVP              | any valid point                                                             |
| ora              | or reverse argument                                                         |
| AW               | alternative wording                                                         |
| <u>underline</u> | actual word given must be used by candidate (grammatical variants excepted) |
| ( )              | the word / phrase in brackets is not required but sets the context          |
| max              | indicates the maximum number of marks that can be given                     |
| mp               | marking point                                                               |
| cao              | Correct answer only                                                         |

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| Question  | Answer                                                                                                               | Marks | Guidance                                                                                             |
|-----------|----------------------------------------------------------------------------------------------------------------------|-------|------------------------------------------------------------------------------------------------------|
| 1(a)(i)   | $l = 7.5$ (cm)                                                                                                       | 1     | <b>A</b> value between 7.4 and 7.6 cm                                                                |
| 1(a)(ii)  | $l_t = 15(.0)$ (cm)                                                                                                  | 1     | ecf <b>1(a)(i)</b>                                                                                   |
| 1(a)(iii) | $d_1 = 2.0$ (cm)                                                                                                     | 1     |                                                                                                      |
| 1(a)(iv)  | $d_2 = 2.2$ (cm)                                                                                                     | 1     |                                                                                                      |
| 1(a)(v)   | 2.1 (cm)                                                                                                             | 1     | ecf <b>2(a)(iii)</b> and <b>2(a)(iv)</b>                                                             |
| 1(b)(i)   | 94 (g)                                                                                                               | 1     | correct answer only<br><b>not</b> 94.0                                                               |
| 1(c)      | 1.80(468...)                                                                                                         | 1     | correct calculation of density from their values of $m$ and $d$<br><b>any</b> significant figures >1 |
|           | 1.80 to 3 sf                                                                                                         | 1     | <b>A</b> any value stated to 3 significant figures                                                   |
|           | g / cm <sup>3</sup>                                                                                                  | 1     | <b>A</b> kg / m <sup>3</sup> if consistent with calculated value                                     |
| 1(d)      | the shape is not regular / difficult to make the diameter a constant value/cylinder bulges from one end to the other | 1     | owtte                                                                                                |

| Question  | Answer                                                       | Marks | Guidance                                                                                |
|-----------|--------------------------------------------------------------|-------|-----------------------------------------------------------------------------------------|
| 2(a)(i)   | series circuit with three 1.5 V cells, a switch and resistor | 1     | <b>A</b> closed switch<br><b>not</b> additional components unless attempt at thermistor |
|           | correct thermistor symbol in series                          | 1     |                                                                                         |
| 2(a)(ii)  | voltmeter in parallel across fixed resistor                  | 1     | <b>not</b> line through meter                                                           |
| 2(a)(iii) | $V_R = 2.3$ (V)                                              | 1     | correct answer only                                                                     |

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| Question  | Answer                                                                                                                            | Marks | Guidance                                                                                    |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------|-------|---------------------------------------------------------------------------------------------|
| 2(a)(iv)  | 450 / 449.6 ( $\Omega$ )                                                                                                          | 1     | ecf <b>2(a)(iii)</b><br>any significant figures >1                                          |
| 2(a)(v)   | $4.9 \times 10^{-3}$ (A)                                                                                                          | 1     | ecf <b>2(a)(iii)</b> and <b>2(a)(iv)</b><br>correctly rounded<br>any significant figures >1 |
| 2(b)(i)   | 770 / 774 ( $\Omega$ )                                                                                                            | 1     | any significant figures >1                                                                  |
| 2(b)(ii)  | as temperature decreases, resistance of the thermistor increases.                                                                 | 1     | I changes / proportional / inversely proportional                                           |
| 2(b)(iii) | (pd across the supply is constant and in iced water) the total resistance of the circuit is greater so the current will decrease. | 1     | I stated values of current                                                                  |
| 2(b)(iv)  | any value less than 450 ( $\Omega$ )                                                                                              | 1     | ecf <b>2(a)(iv)</b>                                                                         |

| Question  | Answer                                                               | Marks | Guidance                                                                                                         |
|-----------|----------------------------------------------------------------------|-------|------------------------------------------------------------------------------------------------------------------|
| 3(a)(i)   | 21.0 ( $^{\circ}\text{C}$ )                                          | 1     | correct answer only                                                                                              |
| 3(a)(ii)  | perpendicular viewing of the thermometer / take reading at eye level | 1     |                                                                                                                  |
| 3(b)(i)   | ensures the same temperature throughout the water                    | 1     | <b>A</b> to evenly distribute heat                                                                               |
| 3(b)(ii)  | $65(.0) \pm 1(.0)$ ( $^{\circ}\text{C}$ )                            | 1     |                                                                                                                  |
| 3(b)(iii) | axes labelled, quantity and unit                                     | 1     | reversed axes loses this mark only                                                                               |
|           | scales linear, not awkward                                           | 1     | x-axis scale <b>must</b> start from 0<br>scale must fill at least half the grid, no $\times 3$ , $\times 7$ etc. |
|           | points plotted accurately, to the nearest $\frac{1}{2}$ square       | 1     | <b>reject</b> large 'blobs' > $\frac{1}{2}$ square diameter                                                      |

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| Question  | Answer                                                                                                           | Marks | Guidance                                                                             |
|-----------|------------------------------------------------------------------------------------------------------------------|-------|--------------------------------------------------------------------------------------|
| 3(b)(iii) | thin best-fit curved line drawn labelled $\theta_1$                                                              | 1     | based on their plots<br>annotate the graph with ticks / crosses in mark scheme order |
| 3(b)(iv)  | a curve above the previously plotted line labelled $\theta_2$ starting from 70 °C                                | 1     | <b>A</b> a point-to-point line if repeated error                                     |
| 3(c)      | the rate of cooling is greater without the foil present                                                          | 1     | <b>I</b> cools faster<br><b>allow</b> temperature decrease per minute for rate       |
| 3(d)(i)   | measures average temperature of water / minimises the cooling effect near the edges of the beaker                | 1     | <b>A</b> to measure temperature of water rather than glass / beaker                  |
| 3(d)(ii)  | any <b>two</b> from:<br>volume of water<br>initial temperature of water<br>room temperature<br>time (of cooling) | 2     | <b>A</b> mass / amount<br><b>I</b> same beaker                                       |
| 3(d)(iii) | add a lid to the beaker                                                                                          | 1     | <b>A</b> use thicker foil<br><b>I</b> volume / initial temperature of water          |

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| Question | Answer                                                                                                                                                                                                                                                       | Marks | Guidance                                                                                                                                                   |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4        | <b>PUT 'SEEN' ON PAGE 14, BECAUSE CANDIDATES MAY WRITE PART OF THEIR ANSWER HERE</b>                                                                                                                                                                         |       |                                                                                                                                                            |
|          | MP1<br><b>additional apparatus</b><br>ammeter                                                                                                                                                                                                                | 1     | can be awarded from a diagram                                                                                                                              |
|          | MP2<br>connected in series                                                                                                                                                                                                                                   | 1     |                                                                                                                                                            |
|          | MP3<br><b>method</b><br>change the resistance / use the variable resistor <b>or</b> adjust the supply voltage (to change current and count the number of paper clips held for each value of current)                                                         | 1     |                                                                                                                                                            |
|          | MP4<br><b>control variable</b><br><b>one of:</b><br>mass / length of each paper clip<br>number of turns (on coil)                                                                                                                                            | 1     | all control variables must be stated explicitly and not implied from the method used<br><b>A</b> (length / diameter / material of) nail / same paper clips |
|          | MP5<br><b>table</b><br>table with columns and headings for current and number of paper clips <b>with correct units</b> .                                                                                                                                     | 1     | <b>A</b> plausible symbols e.g. $I$ , $n$<br><b>I</b> extra columns                                                                                        |
|          | MP6<br><b>processing and conclusion:</b><br><b>one of:</b><br>plot a graph / bar chart of number of paper clips held against current<br>OR<br>compare the readings in the table to see if / how / whether the current affects the number of paper clips held | 1     |                                                                                                                                                            |