Cambridge Assessment International Education

# Cambridge O Level

**PHYSICS** **5054/21**

Paper 2 Theory **October/November 2022**

MARK SCHEME

Maximum Mark: 75

**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 2022 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

This document consists of **15** printed pages.

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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 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.

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|---|
| GENERIC MARKING PRINCIPLE 5:<br><br>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:<br><br>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. |

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**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<br><br>For questions that require ***n*** responses (e.g. State **two** reasons …):<br><br>• The response should be read as continuous prose, even when numbered answer spaces are provided.<br>• Any response marked *ignore* in the mark scheme should not count towards ***n***.<br>• Incorrect responses should not be awarded credit but will still count towards ***n***.<br>• 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.<br>• 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) | measure length / attach marker | **B1** |
| | attach load **and** measure new length **and** calculate extension<br>**or** attach load **and** read extension (using marker) against zeroed rule | **B1** |
| | obtain a new result for different load **or** use of rule(r) **or** calculation of extension explained | **B1** |
| 1(b)(i) | straight line of positive gradient from origin **and** for at least half of the drawn line | **B1** |
| | curve of increasing gradient starting at end of straight line<br>**and** never becomes vertical | **B1** |
| 1(b)(ii) | P marked where the gradient starts to change | **B1** |
| 1(c) | ($x$ =) 0.014 × 5.5 / 3.5 **or** extension is directly proportional to load | **C1** |
| | 0.022 m | **A1** |

| Question | Answer | Marks |
|---|---|---|
| 2(a) | (change in g.p.e.=) $mgh$ **or** $0.12 \times 10 \times 0.45$ | **C1** |
| | 0.54 J | **A1** |
| 2(b) | k.e. = $\frac{1}{2}mv^2$ **or** $0.54 = \frac{1}{2} \times 0.12 \times v^2$ | **C1** |
| | ($v$ =) $\sqrt{2gh}$ **or** $\sqrt{2\ 10\ \ 0.45}$ **or** $v^2 = 2 \times 0.54 / 0.12$ **or** $v^2 = 9$ | **C1** |
| | 3.0 m / s | **A1** |
| 2(c)(i) | not enough (kinetic) energy (at C) to travel beyond D / to top of circle **or** more g.p.e. needed originally to travel beyond D / to top of circle **or** g.p.e. gained cannot be greater than original g.p.e. (transferred to k.e) | **B1** |
| 2(c)(ii) | it travels back down to C **and** returns to A | **B1** |

| Question | Answer | Marks |
|---|---|---|
| 3(a) | (D$p$ =) $hrg$ **or** $0.57 \times 1.4 \times 10^4 \times 10$ | **C1** |
| | $8.0 \times 10^4$ **or** $7.98 \times 10^4$ **or** $1.0 \times 10^5 + (0.57 \times 1.4 \times 10^5 \times 10)$ | **C1** |
| | $1.8 \times 10^5$ Pa | **A1** |
| 3(b)(i) | (air molecules) speed up | **B1** |
| | (they) hit the liquid surface harder **or** hit the liquid surface more often | **B1** |
| | (increased / extra) force on (surface of liquid) **or** air pressure increases | **B1** |
| 3(b)(ii) | (as the liquid moves / as air volume increases) difference between liquid levels / $h$ increases | **B1** |
| | (eventually) pressures balance / become equal / stay balanced | **B1** |

| Question | Answer | Marks |
|---|---|---|
| 4(a) | electromagnetic (waves) **or** components of electromagnetic spectrum | **B1** |
| 4(b)(i) | number of oscillations / cycles / wavelengths | **B1** |
| | per unit time | **B1** |
| 4(b)(ii) | gamma rays | **B1** |
| 4(c)(i) | X-rays directed towards body part with (suspected) broken bone | **B1** |
| | X-rays pass through flesh but not (to same extent) through bones | **B1** |
| | image produced by digital / electronic / CCD / CMOS detector | **B1** |
| 4(c)(ii) | X-rays (may) cause cancer / cell mutation / birth defect / miscarriage **or**<br>X-rays show the bone structure rather than foetal development **or** image would not be clear | **B1** |

| Question | Answer | Marks |
|---|---|---|
| 5(a)(i) | $3.2 \times 10^{-19}$ / (–)$1.6 \times 10^{-19}$ **or** 2 more protons than electrons shown by charges | **B1** |
| | (2 + 2 =) 4 | **B1** |
| 5(a)(ii) | $^{9}_{4}Be$ | **B1** |
| 5(b) | a form of an element | **B1** |
| | with a particular number of neutrons / nucleons | **B1** |
| 5(c) | electrons and nucleus opposite charged **or** electrons negative and nucleus positive | **B1** |
| | (electrostatic / electric) force of attraction **or** unlike charges attract | **B1** |

| Question | Answer | Marks |
|---|---|---|
| 6(a) | soft iron | **B1** |
| 6(b)(i) | ($P$ =) $VI$ **or** 220 × 39 | **C1** |
| | $8.6 \times 10^3$ W | **A1** |
| 6(b)(ii) | ($Q$ =) $It$ **or** 39 × 4.5 **or** 39 × 4.5 × 60 **or** 39 × 4.5 × 60 × 60 **or** 39 × 4.5 × 3600 | **C1** |
| | 180 **or** 11 000 **or** 39 × 4.5 × 60 × 60 **or** 39 × 4.5 × 3600 | **C1** |
| | $6.3 \times 10^5$ C | **A1** |
| 6(c) | resistance increases with temperature **or** resistance lower (because of (low / ambient) temperature) | **B1** |

| Question | Answer | Marks |
|---|---|---|
| 7(a) | acceleration / increase in speed **and** gravity / weight mentioned | **B1** |
| | air resistance / friction increases (with speed) | **B1** |
| | terminal / constant velocity reached **or** air resistance (becomes) equal to accelerating force | **B1** |
| 7(b) | (distance travelled =) area under the graph **or** ($x$ =) ½($u$ + $v$)$t$<br>**or** ½ × 15.2 × 4.0 | **C1** |
| | 35 – (½ × 15.2 × 4.0) **or** 30.4 **or** 30 | **C1** |
| | 4.6 m | **A1** |
| 7(c)(i) | (magnitude of deceleration =) gradient **or** D$v$ / D$t$ **or** 15.2 / 4.0<br>**or** equivalent numbers (from graph) in same ratio | **C1** |
| | 15.2 / 4.0 **or** equivalent numbers in same ratio | **C1** |
| | 3.8 m / $s^2$ | **A1** |
| 7(c)(ii) | ($F$ =) $ma$ **or** (46 + 9.0) × 3.8 **or** 55 × 3.8 | **C1** |
| | 210 N | **A1** |
| 7(c)(iii) | <u>from</u> kinetic energy (and from gravitational potential energy) | **B1** |
| | <u>to</u> thermal energy **and** no intermediate energy | **B1** |
| 7(d) | due to his mass **or** mass mentioned | **B1** |
| | (his) mass resists a change to its state of motion | **B1** |

| Question | Answer | Marks |
|---|---|---|
| 8(a)(i) | vertical biconcave lens shape along P | **B1** |
| 8(a)(ii) | on right of P, middle ray continues in straight line | **B1** |
| | other two rays diverge from middle ray | **B1** |
| 8(b)(i) | continuations of the three rays meet at a point **and** on continuation of middle ray | **B1** |
| | meeting point within eye **and** rays strike back of eye at different places | **B1** |
| 8(b)(ii) | image is sharp / focused / not blurred | **B1** |
| 8(b)(iii) | light diverges before entering eye **or** meeting point now on the back of the eye | **B1** |
| 8(c)(i) | **one** point on principal axis 4.0 cm from the centre of the lens indicated | **B1** |
| | any **two** rays from:<br>paraxial ray from tip of object to lens **and** seems to come from left-hand principal focus after refraction<br>ray from tip of object towards right-hand principal focus (until lens) **and** paraxial after refraction<br>ray from tip of object reaching the centre of the lens | **B2** |
| | image marked at correct intersection | **B1** |
| 8(c)(ii) | virtual **and** light only seems to come from the image **or** light does not pass through image | **B1** |
| 8(c)(iii) | E marked on the right of the dashed line | **B1** |
| 8(c)(iv) | height of candidate's I / 3.5 | **C1** |
| | 0.30 ≤ magnification ≤ 0.50 | **A1** |

| Question | Answer | Marks |
|---|---|---|
| 9(a) | always positive **or** never negative **or** direction does not change | **B1** |
| | constant value **or** size does not change | **B1** |
| 9(b)(i) | ($I$ =) $V$ / $R$ **or** 12 / (20 + 28) **or** 12 / 48 | **C1** |
| | 0.25 A | **A1** |
| 9(b)(ii) | YZ in magnetic field **or** magnetic field between poles (of magnet) | **M1** |
| | (electric) current in YZ **or** interacts with field of current / YZ | **A1** |
| 9(b)(iii) | downwards; middle, right-hand box ticked **i.e.**<br>towards N ☐ towards Z ☐<br>towards S ☐ downwards ☑<br>towards Y ☐ upwards ☐ | **B1** |
| 9(b)(iv) | current from Z to Y page / into page **and** magnetic field left to right | **B1** |
| | (Fleming's) left-hand rule / other appropriate rule mentioned / described | **B1** |

| Question | Answer | Marks |
|---|---|---|
| 9(c)(i) | $1 / R_T = 1 / R_1 + 1 / R_2$ **or** $(R_T =)\ R_1\ R_2 / (R_1 + R_2)$ **or** $1 / R_T = 1 / 20 + 1 / 30$ **or** $1 / R_T = 5 / 60$ **or** $1 / R_T = 1 / 12$ **or** $(R_T =)\ 20 \times 30 / (20 + 30)$ | **C1** |
| | 12 | **C1** |
| | 40 W | **A1** |
| 9(c)(ii) | resistance decreases **or** resistance is less (with $S_2$ closed) | **B1** |
| | current increases **and** force increases | **B1** |
| 9(c)(iii) | 1.5 | **B1** |