CAMBRIDGE
International Education

# Cambridge O Level

**PHYSICS** **5054/22**

Paper 2 Theory **May/June 2024**

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 May/June 2024 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.



 **[Turn over**

**PUBLISHED**

## 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 descriptions 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:<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. |

**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)(i) | straight line (on speed-time graph) | **B1** |
| 1(a)(ii) | gradient of line steeper (for B)<br>**or** larger change in speed (in same time) | **B1** |
| 1(a)(iii) | (*a* = ) change in speed / time in any form | **C1** |
| | 2(.0) m / $s^2$ | **A1** |
| 1(b) | (p =) mv **or** (initial) momentum of A = 0.56 (kg m / s) | **B1** |
| | **and** final momentum of A and B = 1.4 × 0.4 = 0.56 | **B1** |
| 1(c) | Any two out of three:<br>• contact surfaces are more rigid / less pliable **aaw**<br>• decreases the time of contact **or** final velocity of B is larger (than 0.4 m / s) / final velocity of A is smaller<br>• increases acceleration **or** force = (mv - mu) / t **or** impulse / t | **B2** |

| Question | Answer | Marks |
|---|---|---|
| 2(a)(i) | (*V* =) length × breadth × height in any form | **C1** |
| | 6.7(2) × 1000 **clearly seen** or 6720 (kg) seen | **A1** |
| 2(a)(ii) | force per unit area | **B1** |
| 2(a)(iii) | Either<br>(*P* =) *dgh* in any form, e.g.1000 × 9.8 x 0.8<br>Or<br>(area of base) 2.1 × 4.0 **or** 8.4 ($m^2$) | **C1** |
| | 7800 (Pa) | **A1** |

| Question | Answer | Marks |
|---|---|---|
| 2(a)(iv) | ($\Delta T$ =) $E$ / $mc$ in any form | **C1** |
| | 18 (°C) | **C1** |
| | 28 (°C ) | **A1** |
| 2(b)(i) | fastest moving / more energetic particles escape | **B1** |
| | leaving slowest / less energetic particles | **B1** |
| 2(b)(ii) | ANY 2 from<br>higher temperature / wind / low humidity | **B1** |

| Question | Answer | Marks |
|---|---|---|
| 3(a)(i) | nuclear (energy in Sun) | **B1** |
| | chemical (energy in battery) | **B1** |
| 3(a)(ii) | less / no light / energy (reaching the charger)<br>**or** less / no electrical current (produced) | **B1** |
| 3(b) | conduction **and** energy passing from particle to particle in solid / from outside particles to air particles | **B1** |
| | convection **and** in air / hot air rises | **B1** |
| | radiation **and** emitted from surface | **B1** |
| 3(c) | ($Q$ = ) $It$ in any form | **C1** |
| | 4 900 | **A1** |
| | C **or** coulomb | **B1** |

| Question | Answer | Marks |
|---|---|---|
| 4(a)(i) | 0 | **B1** |
| 4(a)(ii) | normal correct by eye | **B1** |
| | angle of incidence correct and labelled | **B1** |
| 4(a)(ii) | angle of incidence greater than critical angle | **B1** |
| | from more dense to less dense (medium) / from high to low refractive index | **B1** |
| 4(b)(i) | infrared | **B1** |
| 4(b)(ii) | ANY 2 from<br>• more calls per second **or** greater bandwidth **or** faster speed<br>• less chance of hacking<br>• less interference<br>• less (information) noise<br>• longer transmission distances (before losing signal) / less attenuation<br>• thinner **or** lighter **or** less mass/weight | **B2** |

| Question | Answer | Marks |
|---|---|---|
| 5(a)(i) | electrons on both top lines | **B1** |
| | positive (charge on cloth) | **B1** |
| 5(a)(ii) | balloon / rubber / air is an insulator | **C1** |
| | electrons / charge unable to move through rubber / balloon / air<br>**or** little ionisation in air (caused by background radiation) | **A1** |

| Question | Answer | Marks |
|---|---|---|
| 5(b) | particles move faster | **B1** |
| | particles hit sides | **C1** |
| | particles hit sides more often / more frequently<br>**or** with greater force | **A1** |

| Question | Answer | Marks |
|---|---|---|
| 6(a) | current is (directly) proportional to potential difference (p.d.) | **B1** |
| | at constant temperature | **B1** |
| 6(b) | graph is a straight line **and** through the origin (for any one intensity of illumination). | **B1** |
| 6(c) | resistance decreases in bright(er) light | **B1** |
| | (use of Fig. 6.2 e.g.)<br>resistance values calculated as 80 and 130 (Ω)<br>**or** at same voltage with light has larger current<br>**or** at same current with light needs less voltage | **B1** |
| 6(d)(i) | 0.05(0 A) | **B1** |
| 6(d)(ii) | ($V$ = ) $IR$ in any form | **C1** |
| | (voltage across fixed resistor) 12 (V) **or** (total resistance =) 320 (Ω) | **C1** |
| | 16 (V) | **A1** |

| Question | Answer | Marks |
|---|---|---|
| 7(a)(i) | S pole on right and N pole on left of magnet | **B1** |
| 7(a)(ii) | place (one end of) compass (needle) on P and mark other end of needle (on paper) | **B1** |
| | move compass on so other end is next to / on marked point | **B1** |
| | continue (round field line and for other lines) **and** join marks | **B1** |
| 7(a)(iii) | place compass on P **and** direction is the direction pointed by the N pole / shaded end | **B1** |
| 7(b)(i) | magnetic field cuts coil **or** magnetic flux / field change in coil | **B1** |
| | **induces** an e.m.f. / by **induction** | **B1** |
| 7(b)(ii) | move magnet in and out once every 2 s / 0.5 times in one second | **B1** |
| 7(b)(iii) | reading positive and negative / both sides of zero | **B1** |
| 7(b)(iv) | larger rate of change of field / flux **or** larger rate of cutting of field lines | **B1** |

| Question | Answer | Marks |
|---|---|---|
| 8(a) | explosion | **C1** |
| | explosion of a red giant / massive star (at the end of its life cycle) | **A1** |
| 8(b) | clouds of dust / gas come together / collapse | **B1** |
| | due to gravitational attraction<br>**or**<br>resulting in an increase in temperature | **B1** |
| 8(c)(i) | milky way | **B1** |
| 8(c)(ii) | <u>distance</u> travelled by light in one year | **B1** |

| Question | Answer | Marks |
|---|---|---|
| 8(c)(iii) | (speed = ) distance / time **or** $2\pi R / T$ in any form | **C1** |
| | $2\pi \times 26\,000 \times 3 \times 10^8 \times 3.2 \times 10^7$ seen | **C1** |
| | 210 000 (m / s) | **A1** |

| Question | Answer | Marks |
|---|---|---|
| 9(a) | happens by itself / is not affected or caused by external conditions, e.g. temperature, pressure, another nuclear emission, etc. / not affected by the length of time the nucleus has already existed / happens for no reason | **B1** |
| 9(b) | two protons **or** two neutrons | **C1** |
| | two protons **and** two neutrons<br>**or** a helium <u>nucleus</u> | **A1** |
| 9(c)(i) | outline of cloud chamber with: either light **or** transparent window for viewing **or** outline of spark counter with fine wire and plate or grille close to wire | **B1** |
| | source of vapour, e.g. alcohol **or** voltage applied between wire and plate / grille | **B1** |
| | method of cooling clear, e.g. expand piston or dry ice **or** high voltage used ( > 200 V) | **B1** |
| 9(c)(ii) | time between tracks formed varies **or** number of tracks in a certain time varies **or** tracks go in any direction **or** time between sparks varies **or** number of sparks in a certain time varies | **B1** |

| Question | Answer | Marks |
|---|---|---|
| 9(c)(iii) | any halving seen, e.g. 120 → 60 or 3 half lives | **C1** |
| | 2(.0) Hours | **A1** |