CAMBRIDGE
International Education

Cambridge O Level

PHYSICS **5054/21**

Paper 2 Theory **May/June 2025**

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 2025 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

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: 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	<u>'List rule' guidance</u> 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.

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 standard isation 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

Annotation	Meaning
	information missing or insufficient for credit
	used to highlight parts of an extended response
AE	evaluation attempted
BOD	benefit of the doubt given
CON	contradiction in response, mark not awarded
	incorrect point or mark not awarded
ECF	error carried forward applied
I	incorrect or insufficient point ignored while marking the rest of the response
LNK	two statements are linked
MO	mandatory mark not awarded
NBOD	benefit of doubt was considered, but the response was decided to not be sufficiently close for benefit of doubt to be applied.

Annotation	Meaning
POT	power of ten error
SEEN	point has been noted, but no credit has been given or blank page seen
SF	error in number of significant figures
TV	response is too vague or there is insufficient detail in response
	correct point or mark awarded
U	Incorrect unit

Question	Answer	Marks
1(a)	curve upwards (at start) with decreasing gradient labelled A	**B1**
	horizontal line labelled B	**B1**
1(b)	gradient / slope decreases **or** increase in speed for same time less at later times	**B1**
1(c)(i)	air resistance / drag	**B1**
1(c)(ii)	air resistance / upwards force increases (with increased speed)	**B1**
	air resistance / upwards force equals / balances weight	**B1**
1(d)	vector diagram showing 400 N and 100 N force at right angles with correct resultant and all directions shown	**B1**
	410 (N)	**B1**
	12–16°	**B1**

Question	Answer	Marks
2(a)	(total) clockwise moments = anticlockwise moments	**M1**
	in equilibrium	**A1**
2(b)(i)	19.6 or 20 N	**B1**
2(b)(ii)	80 × 3 × **(b)(i)** = 90 × weight	**B1**
	52 (N) **and** weight of suitcase does not exceed maximum	**B1**
2(c)(i)	(place) where weight of object (can be taken to) acts	**B1**
2(c)(ii)	centre of gravity falls outside base / to the left of P	**B1**
	weight causes anticlockwise moment / turning effect	**B1**

Question	Answer	Marks
3(a)	*Any three from*: • reduction in chemical energy store in battery • electrical work done by motor • mechanical work done on weight • increase in gravitational energy store of weight • increase in thermal energy (in motor or air) • electrical heating (by current)	**B3**
3(b)(i)	useful or output energy < input energy	**B1**
3(b)(ii)	total energy is constant	**B1**
	energy from power supply = energy gained by weight + thermal energy (to air / due to friction)	**B1**
3(c)	(*E* =) power × time in any form	**C1**
	180 J	**A1**

Question	Answer	Marks
4a(i)	faster particles escape (from water on skin)	**B1**
	leaving behind slower particles	**B1**
4(a)(ii)	*Any one of*: • evaporation occurs on the surface • boiling is at one temperature • boiling involves the formation of bubbles (in the liquid) • boiling occurs inside the liquid	**B1**
4(b)(i)	cold air sinks	**B1**
	cold air is dense(r than hot air)	**B1**
4(b)(ii)	($T_f = T_i$ -) E / mc in any form **or** 14.8 **or** 15 seen	**C1**
	5.2 (°C)	**A1**

Question	Answer	Marks
5(a)(i)	C and R marked correctly	**B1**
5(a)(ii)	compressions are where pressure is high / particles close together / density is high	**B1**
5(b)(i)	0.75 (Hz)	**B1**
5(b)(ii)	*speed:* no change	**B1**
	wavelength: decreases	**B1**
5(b)(iii)	at least 3 wavefronts in the shallow region parallel to each other **and** on correct side of normal	**M1**
	refracted towards the surface on correct side of surface **and** join wavefronts shown	**A1**
5(c)	spreading out / bending at an edge / obstacle **or** spreading out after passing through a (small) gap / hole	**B1**

Question	Answer	Marks
6(a)(i)	voltmeter across X and ammeter in series anywhere in circuit	**B1**
6(a)(ii)	*Any two from*: • X and R share voltage / p.d. of battery **or** e.m.f. of battery = p.d. across X + p.d. across R • as R varies, p.d. across X **and** R vary • if R increases then p.d. across R increases • If R increases then p.d, across X decreases	**B2**
6(b)(i)	directly proportional	**B1**
6(b)(ii)	resistance = 90 × 3.6 / 60 **or** 5.4 Ω seen	**B1**
	(I =) V / R in any form or with any resistance	**C1**
	1.7 A	**A1**
6(b)(iii)	as length increases current decreases	**C1**
	(current) inversely proportional (to length)	**A1**
6(c)	inversely proportional	**B1**

Question	Answer	Marks
7(a)	magnetic field produced by current (in primary)	**B1**
	(iron) core transmits magnetic field to secondary coil **or** magnetic field is changing / reversing / alternating	**B1**
	induction of output voltage (in secondary coil)	**B1**
7(b)(i)	off the scale (of the voltmeter) / too large (for voltmeter)	**B1**
7(b)(ii)	$V_S / V_P = N_P / N_S$ in any form	**C1**
	96	**A1**
7(c)(i)	sensible alternating trace either side of mid-line	**B1**
7(c)(ii)	measure or mention of height of trace	**B1**
	multiply height by Y–gain value	**B1**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td rowspan="2">8(a)</td><td>protons and neutrons</td><td>C1</td></tr>
<tr><td>145 neutrons 94 protons</td><td>A1</td></tr>
<tr><td rowspan="2">8(b)(i)</td><td>a neutron hits / absorbed by a (plutonium) nucleus</td><td>B1</td></tr>
<tr><td>(at least) one released neutron causes another (Pu) nucleus to split / fission</td><td>B1</td></tr>
<tr><td rowspan="2">8(b)(ii)</td><td>control rods absorb neutrons</td><td>B1</td></tr>
<tr><td>insert / lower rods (between fuel rods) to decrease reaction</td><td>B1</td></tr>
<tr><td>8(c)</td><td>Any two from:

• charge is different
• mass is different
• alpha particles made of 2 protons and / or 2 neutrons / beta particle is an electron
• ionising effect
• penetrating power</td><td>B2</td></tr>
<tr><td rowspan="2">8(d)(i)</td><td rowspan="2"><table><tr><td>cloud chamber:
closed container with source S inside or outside and some means of cooling

presence of vapour / volatile liquid</td><td>spark counter:
fine wire and plate with source nearby

(high) voltage between wire and plate or
plates charged positive and negative</td></tr></table></td><td>B1</td></tr>
<tr><td>B1</td></tr>
<tr><td>8(d)(ii)</td><td>ionisation (of air)</td><td>B1</td></tr>
</table>

Question	Answer	Marks
9(a)	protostar, stable star in that order for first two boxes **or** red super giant, supernova, black hole in that order for last three boxes	**C1**
	protostar, stable star, red super giant, supernova, black hole in that order	**A1**
9(b)(i)	gravity / gravitational attraction mentioned	**B1**
9(b)(ii)	high temperature **or** pressure of light / radiation	**B1**
9(c)(i)	<u>distance</u> light travels in one year	**B1**
9(c)(ii)	8200 years	**B1**
9(c)(iii)	SN185 is not moving / little speed (away from Earth so no redshift)	**B1**
	SN2014J (is much further from Earth) so) is moving away faster (so has substantial redshift) **or** larger redshift due to expansion of universe (with time)	**B1**
9(d)	by fusion	**B1**
	supernova / explosion of star **or** <u>fusion</u> mentioned in a star	**B1**