CAMBRIDGE
International Education

Cambridge IGCSE™

PHYSICS **0625/41**

Paper 4 Extended Theory **October/November 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 October/November 2024 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

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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 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.

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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.

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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.

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Specific Instructions for Marking 0625/Paper 4

Preparation for Marking

Instructions and handbooks, for markers using RM Assessor 3 can be found at RM support portal.

Marking

M1. Blank pages, additional objects and marking outside the question zone.

Blank pages attached to the first part of **Q1** should be annotated with SEEN on all scripts. Link any work on these pages as appropriate.
Annotate any blank Additional Objects with SEEN.
Link any other additional objects to the question or questions applicable.
Examiners must ensure that they view the whole exam paper for each candidate. This will sometimes mean scrolling through a large zone to ensure that no working relevant to either the current or any other question is missed.
Where a candidate's answer extends beyond the marking zone, examiners must view the whole page (or link to other pages) to annotate and mark the whole answer. To view the whole page, deselect any annotation tool from the mouse, then click in the bottom right-hand corner of the marking zone where 'view whole page' appears. For instructions to link to other pages see above.

M2. Use of Annotation tools.

Examiners annotate scripts to explain their reasons for awarding or not awarding marks, noting:

- for **all** questions with **two** or **more** marks, it is **mandatory** to annotate with ticks placed to indicate where each mark is awarded. In a calculation where the final answer (A) mark is awarded all the ticks should be placed near to the final answer.
- annotations and comments must never suggest or imply that a mark has been deducted e.g. –1
- for questions with only one mark maximum, examiners' ticks to show the mark is awarded are not mandatory
- SF, SC and ECF annotations must be used as appropriate (see table of annotation tools)
- Examiners are expected to use annotations where they have considered an answer and made a marginal judgement.

annotation tool	use of annotation tool on scripts
tick	mark awarded (a tally is shown next to the annotation tool so you can check the mark you enter agrees with number of ticks placed)
cross	incorrect / not creditworthy
SEEN	this page/item has been considered by the examiner (see M1)
BOD	benefit of doubt given

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annotation tool	use of annotation tool on scripts
NBOD	no benefit of doubt given
text box	allows a comment written by the examiner to be included on the script
ECF	error carried forward (ecf) has been applied
^	omission mark
Highlighter and zig-zag lines	used to highlight a particular point
CON	contradiction (to a correct point in the answer)
NAQ	The answer provided is not an answer to the question asked. (Note: Do not use this annotation where no response has been made and the mark NR awarded.)
SF	error in the number of significant figures of a final answer
TV	too vague
I	ignore
SC	special case

M3. Acronyms and shorthand in the mark scheme.

acronym/shorthand	explanation
A mark	Final answer mark which is awarded for fully correct final answers including the unit.
C mark	Compensatory mark which may be scored when the final answer (A) mark for a question has not been awarded.
B mark	Independent mark which does not depend on any other mark.
M mark	Method mark which must be scored before any subsequent final answer (A) mark can be scored.

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acronym/shorthand	**explanation**
Brackets ( )	Words not explicitly needed in an answer, however if a contradictory word / phrase / unit to that in the brackets is seen the mark is not awarded.
Underlining	The underlined word (or a synonym) must be present for the mark to be scored. If the word is a technical scientific term, the word must be there.
/ or **OR**	Alternative answers any one of which gains the credit for that mark.
owtte	Or words to that effect.
ORA	Or reverse argument
ignore	Indicates either an incorrect or irrelevant point which may be disregarded, i.e., not treated as contradictory.
insufficient	an answer not worthy of credit on its own.
CON	An incorrect point which contradicts any correct point and means the mark cannot be scored.
ecf [question part]	Indicates that a candidate using an erroneous value from the stated question part must be given credit here if the erroneous value is used correctly here.
cao	correct answer only

M4. Miscellaneous

Equations and formulae. Where a C, B or M mark is available for quoting a formula or equation this can be done in any form and in words, symbols or numbers unless the mark scheme specifies otherwise.

Use of ecf. The mark scheme notes where ecf is applicable, in the guidance section of the final answer mark. However, it should be applied for all relevant C marks as well. **Always annotate ecf if applied.** See Science specific Marking point 4 above.
Units.

- A numerically correct final answer without a unit is awarded the final answer (A) mark if the unit is shown correctly in the candidate's working.
- A numerically correct answer with a missing or incorrect unit is not awarded the final answer (A) mark. C (B or M) marks are awarded from the candidate's working.

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- Accept units with incorrect use of upper-case and lower-case symbols, e.g. pA for Pa.
- Unless the mark scheme for a specific question part states otherwise, the only permitted derived units are:

unit	permitted derived units
W	J / s or Nm / s
Pa	N / m^2
momentum	Ns or kg m / s
impulse	Ns or kg m / s
J	Nm

- Note: J is **not** permitted as the unit for moments.

Significant Figures.

- Unless otherwise indicated in the mark scheme, final answers expressed to two or more significant figures receive the final answer (**A)** mark if the candidate's answer rounds to the mark scheme answer.
- A final answer expressed to one significant figure is only awarded the final answer (**A)** mark where the final answer is exact to one sig. fig. (This applies to all answers, including answers using ecf.)
- A correct numerical answer, quoted with fewer significant figures than required by the mark scheme (even if in the working it has the required number of significant figures), is not awarded the final answer (**A**) marks. **C** (B or M) marks are awarded as appropriate.

Fractions. An answer expressed as a fraction is not a numerically correct final answer unless the fraction is explicitly stated in the mark scheme.
Crossed out work. When only part of an answer is crossed out the crossed-out work must be ignored. However, work which has been **wholly** crossed out and **not replaced** and can easily be read, should be marked as if it had not been crossed out**.** Look to see if it has been replaced on a blank page or another part of the same page before attempting to mark the crossed-out work.

Marking diagrams on-screen. Differences in magnification and/or individual computer screen settings can alter the appearance of diagrams. If it is necessary to check line lengths or angles use the ruler and protractor tools provided within RM Assessor 3 to ensure consistency across all examiners.
NR. (# or / key on the keyboard). Use this (instead of giving 0 marks) if the answer space for a question is completely blank or contains no readable words, figures or symbols.

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Question	Answer	Marks
1(a)(i)	43 cm **AND** 63 cm	**B1**
1(a)(ii)	20 cm	**B1**
1(b)	0.28 N / cm	**A2**
	$k = F / x$ **OR** (k =) F / x **OR** 5.6 / 20	C1
1(c)(i)	4.9 N	**B1**
1(c)(ii)	3.2(0) m / s^2	**A3**
	$F = ma$ **OR** (a =) F / m **OR** (6.5 – 4.9) / 0.50	C1
	(resultant force =) 6.5 – 4.9 **OR** 1.6	C1

Question	Answer	Marks
2(a)(i)	1.8 × 10^5 kg m / s **OR** 1.8 × 10^5 N s	**A2**
	$p = mv$ **OR** (p =) mv **OR** 1400 × 130	C1
2(a)(ii)	(scaled) area under the (graph) line	**B1**
2(a)(iii)	420 m	**A2**
	½$v_{max}t$ **OR** ½ × 130 × 6.5 **OR** ½bh	C1
2(b)(i)	gradient is negative **OR** speed decreases	**B1**
2(b)(ii)	gradient is changing **OR** line / graph / it is a curve / curved	**B1**
2(c)	(from) kinetic (energy store)	**B1**
	to internal / thermal (energy store as final store)	**B1**

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Question	Answer	Marks
3(a)	force × perpendicular distance (from pivot)	**A2**
	Any one from: • force × distance from pivot • reference to <u>perpendicular</u> distance (from pivot) • reference to <u>perpendicular</u> force	C1
	(it measures the) turning effect (of a force)	**B1**
3(b)(i)	point where (all) the weight (of an object) seems to act	**B1**
3(b)(ii)	2.2×10^7 N m	**A2**
	1.7 (m) **OR** 3.4 / 2 **seen**	C1
3(c)	resultant force = 0 **OR** (all) forces cancel out owtte	**B1**
	resultant moment = 0 **OR** moments balance owtte	**B1**

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Question	Answer	Marks
4(a)	1 Any one method to transfer measurable amount of thermal energy for $\Delta\theta$: (a) to aluminium block (with electrical heater) (b) from aluminium block to known liquid (c) from known liquid to insulated aluminium (calorimeter) (d) to known liquid and aluminium (calorimeter)	**B1**
	2 Determination of energy transferred for $\Delta\theta$, to match workable method in 1: (a) Use of $E = Pt$ **OR** $E = IVt$ (b) Use of $E = mc\Delta\theta$ with s.h.c. of known liquid (c) Use of $E = mc\Delta\theta$ with s.h.c. of known liquid (d) Use of $E = Pt$ **OR** $E = IVt$ **AND** $E = mc\Delta\theta$ (with known s.h.c. of liquid)	**B1**
	3 Any one measurement from: • initial and final temperature / temperature change • time (of heating) • mass of aluminium	**B1**
	4 $c = E / m\Delta\theta$ **OR** $(c =) E / m\Delta\theta$	**B1**
4(b)(i)	Any three from: 1 (net) transfer of energy from higher temperature to lower temperature **OR** (net) transfer of energy from water / to dish 2 (energy transfer) by conduction **OR** aluminium is a good conductor (of thermal energy) 3 temperature of water decreases **AND** temperature of dish increases 4 no (net) transfer of energy when temperature of dish = temperature of water	**B3**
4(b)(ii)	(particles) gain energy in <u>kinetic</u> store (as temperature of aluminium increases)	**B1**
	(average) separation of (aluminium) particles increases **OR** (aluminium) particles move further apart owtte	**B1**
4(b)(iii)	(water) molecules with more/enough energy escape from the surface	**A2**
	escape of more energetic molecules (from water) **OR** (molecules) leave from the surface	C1

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Question	Answer	Marks
5(a)	0.20 m	**B1**
5(b)	any value in range from 330 m / s ⩽ value ⩽ 350 m / s	**B1**
5(c)(i)	**(b)** ÷ **(a)** evaluated **AND** Hz	**A2**
	$f = v / \lambda$ **OR** ($f =$) v / λ **OR (b)** ÷ **(a)**	C1
5(c)(ii)	audible/yes/it is **OR** inaudible / no / it isn't <u>consistent with value in **5(c)(i)**</u> **AND** consistent explanation with reference to 20 (Hz) ⩽ normal range of human hearing ⩽ 20 000 (Hz)	**B1**
5(d)	1 (explanation mentions) diffraction	**M1**
	2 Only a little diffraction owtte	**A1**
	3 (because) gap width large (compared to wavelength) owtte	**A1**
	4 Little / no sound heard at J **AND** (some) sound heard at K	**A1**

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Question	Answer	Marks
6(a)	work done by a unit charge passing through a component	**A2**
	(electrical) work done **AND** moving charge	C1
6(b)	(p.d. =) E – reading on voltmeter **OR** subtract reading on voltmeter from E	**B1**
6(c)(i)	(intensity of light on LDR) increased **AND** (temperature of thermistor) decreased	**B1**
6(c)(ii)	reading on voltmeter / it decreases	**B1**
	*Any **two** from:* 1 e.m.f. is constant 2 R_{LDR} / $R_{thermistor}$ decreases **OR** R_{LDR} is a smaller proportion of the total resistance 3 V_{LDR} / $V_{thermistor}$ decreases **OR** V_{LDR} is a smaller proportion of e.m.f. 4 $\frac{R1}{R2} = \frac{V1}{V2}$	**B2**

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Question	Answer	Marks
7(a)	(soft) iron	**B1**
7(b)(i)	(at least) one complete field line between the poles of the bar (either above or below the bar)	**B1**
	no crossing **AND** attempt at correct shape **AND** at least six lines from / to poles	**B1**
	at least **one** arrowhead towards S pole	**B1**
7(b)(ii)	current (in the coil) decreases	**B1**
	(current decreases so magnetic field) strength decreases	**B1**
	(field strength decreases so) fewer field lines (in same area) **OR** (field strength decreases so) field lines further apart	**B1**
7(c)	*Any two from:* 1 (changing resistance causes) changing current (through solenoid) 2 (changing current causes) changing magnetic field (around solenoid) 3 (square) coil cuts (changing) magnetic field **OR** coil in changing magnetic field	**B2**
	e.m.f. <u>induced</u> (between terminals)	**B1**

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Question	Answer	Marks
8(a)	6 electrons **AND** 6 protons (i.e. 6 × **AND** 6 ●)	**B1**
	8 neutrons (i.e. 8 ○)	**B1**
	protons and neutrons in nucleus **AND** electrons orbiting nucleus	**B1**
8(b)	(carbon) has one more neutron **OR** nitrogen has one fewer neutron	**B1**
	(carbon) has one fewer proton / electron **OR** nitrogen has one more proton / electron	**B1**
8(c)(i)	electron	**B1**
8(c)(ii)	a neutron changes into a proton (and electron)	**B1**
8(d)	17 000 years	**A3**
	1.2×10^{11} / 9.6×10^{11} **OR** 1 / 8 **OR** one halving seen e.g. $9.6 \times 10^{11} \div 2$	C1
	3 (half-lives) **OR** $1 / 8 \times 9.6 \times 10^{11} = 1.2 \times 10^{11}$	C1

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Question	Answer	Marks
9(a)	group / collection of (billions of) stars	**B1**
9(b)	9.5×10^{17} (km)	**A2**
	(1 light-year =) 9.5×10^{15} (m) **OR** (1 light-year =) $3 \times 10^{8} \times 365 \times 24 \times 3600$	C1
9(c)(i)	increase in wavelength (of light from far galaxy) **OR** (amount of) redshift	**B1**
9(c)(ii)	brightness of a supernova	**B1**
9(c)(iii)	(their) speeds are (directly) proportional to distances (from Earth) **OR** $H_0 = v / d$	**B1**
9(c)(iv)	4.5×10^{17} (s)	**A2**
	(age of Universe =) $1 / H_0$ **OR** $1 / (2.2 \times 10^{-18})$	C1

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