CAMBRIDGE
International Education

Cambridge IGCSE™

PHYSICS **0625/43**

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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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** and 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

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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.
- 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 N m / s
Pa	N / m^2
momentum	N s or kg m / s
impulse	N s or kg m / s
J	N m

- 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.

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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)	(scalar) does not have direction ***or*** vector has direction	**B1**
1(a)(ii)	(momentum =) mass × velocity	**B1**
1(b)(i)	43 m / s	**A3**
	$F\Delta t = \Delta(mv)$ ***OR*** $F = \Delta(mv) / \Delta t$ ***OR*** $F = ma$ ***OR*** $a = \Delta v / \Delta t$	C1
	$(u=)\ Ft / m$ ***OR*** $(u =)\ (27\,000 \times 1.5) / 950$	C1
1(b)(ii)	straight horizontal line from *y* axis extending to $t = 4.0$ s	**B1**
	straight line from $t = 4.0$ s with negative gradient meeting the x axis (less than half-way between 4.0 and the end of the time axis)	**B1**

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Question	Answer	Marks
2(a)	hang mass / weight on the bottom of the spring	**B1**
	use a ruler / metre rule ***AND*** measure / calculate <u>extension</u>	**B1**
	use of $k = F / x$ to calculate the spring constant ***OR*** k is the gradient of load-extension graph	**B1**
	any **one** of: • repeat measurements using different masses / weights and plot a load against extension graph • measure final length and initial length of spring and subtract to obtain (magnitude of) extension / change in length • use a pointer on the bottom of spring to obtain more accurate measurements on ruler	**B1**
2(b)(i)	maximum load that can be applied when the extension is proportional to load ***OR*** the maximum force up to which the extension is proportional to the load	**B1**
2(b)(ii)	(extension of spring Q =) 15 cm or 0.15 m ***AND*** (extension of spring R =) 110 cm or 1.1 m	**B1**
2(b)(iii)	Q ***AND*** extension produced by Q is the right length to allow baby to just reach the floor with feet ***OR*** Q ***AND*** extension produced by R is too big (for gentle bounces in the space provided) ***OR*** R would make the baby collapse on floor (so unsafe) ***OR*** bouncer would have to be hung higher if R was used	**A1**

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Question	Answer	Marks
3(a)(i)	good/better absorber (of radiation) ***OR*** bad / poor / worse reflector (of radiation)	**B1**
3(a)(ii)	doesn't work at night / in cloud cover / when there is no sun ***OR*** (sun has) variable output	**B1**
3(b)	any **two** from: • hydroelectric • tidal • wave • wind • geothermal • biofuels	**B2**
3(c)	9.2×10^6 J ***OR*** 9 200 000 J	**A4**
	(temperature rise =) 33 (°C) ***OR*** 43 – 10	C1
	$c = \Delta E / m\Delta\theta$ ***OR*** (E =) $m \times c \times \Delta\theta$ ***OR*** (E =) $40 \times 4200 \times (43 - 10)$ ***OR*** 5.5×10^6 (J)	C1
	$5.5 \times 10^6 \times (100 / 60)$ ***OR*** $5.5 \times 10^6 \times 1.667$ ***OR*** $5.5 \times 10^6 / 0.6$ ***OR*** efficiency $= \frac{\text{useful energy output}}{\text{total energy input}} \times 100\%$	C1

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Question	Answer	Marks
4(a)(i)	any **two** correct = 1 mark all **three** correct = 2 marks • speed decreases / gets less / slower • wavelength decreases / gets smaller / shorter • frequency unchanged / stays the same / no effect	**B2**
4(a)(ii)	(n =) sin 45 / sin 30	**B1**
4(a)(iii)	46° ***OR*** 45°	**A1**
	n = 1 / sin c ***OR*** (c =) $\sin^{-1}$ (1 / n) ***OR*** (c =) $\sin^{-1}$ (1 / 1.4) ***OR*** sin c = 1 / n	**M1**
4(b)(i)	total internal reflection ***AND*** i = r for initial reflection	**B1**
	ray reaches end of fibre after a total of 2 or 3 reflections only	**B1**
4(b)(ii)	any **two** from: • internet transmission / (highspeed) broadband • telephone networks • cable TV } ***OR*** telecommunications • endoscope • lasers in surgery • microscopy • military aircraft wiring • imaging (cameras) in industry • inspection of pipes or other hard to reach places	**B2**

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Question	Answer	Marks
5(a)(i)	four evenly spaced radial lines touching S ***AND*** no lines inside S	**B1**
	at least one arrow pointing towards S and none incorrect	**B1**
5 (a)(ii)	to the left ***OR*** away from the sphere / S	**B1**
5(a)(iii)	accelerates (due to a resultant force)	**B1**
	(moves) away from the (centre of the) sphere	**B1**
5(b)(i)	like charges repel	**B1**
5(b)(ii)	advantage: more even coat ***or*** less chance of paint particles clumping together ***or*** less chance of creating thicker patches	**B1**
	explain: positive / paint particles are attracted (by the same amount) to all parts of the negative sphere so they spread out ***or*** paint creates a fine mist so spreads out (over the surface)	**B1**
	OR advantage: more durable or better adhesion or cheaper ***or*** high transfer efficiency ***or*** less paint wasted or fewer drips or less paint sag ***or*** less overspray on floor / walls	**(B1)**
	explain: the positive/paint is attracted to the negative sphere / charges and forms a strong(er) bond	**(B1)**
	OR advantage: quicker to paint	**(B1)**
	explain: all surface is painted at the same time without having to turn the sphere / go around the other side owtte	**(B1)**

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Question	Answer	Marks
6(a)(i)	any **two** from: • if one resistor fails / breaks the others will still work • each resistor gets the full voltage / 12 V or lower (total) resistance or higher current • higher power	**B2**
6(a)(ii)	any **two** from: • evaporation / water evaporates • energy (from heater) transfers to particles ***OR*** particles gain energy (from the heater) • more energetic particles escape (from water / droplet) • particles leave from the surface (of the water / droplet)	**B2**
6(b)(i)	0.17 A	**A2**
	$R = V / I$ ***OR*** $(I =) V / R$ ***OR*** $(I =) 12 / 70$	C1
6(b)(ii)	610 J ***OR*** 620 J	**A3**
	$E = I \times V \times t$ ***OR*** $(E =) V \times I \times t$ ***OR*** $(E =) 12 \times 0.17 \times 300$	C1
	300 (s) ***OR*** 5×60	C1
6(b)(iii)	chemical	**A1**
6(b)(iv)	39 Ω	**A2**
	$1 / R_T = 1 / R_1 + 1 / R_2$ ***OR*** $1 / R_T = 1 / 90 + 1 / 70$ ***OR*** $(R_T =) 1 / (1 / R_1 + 1 / R_2)$ ***OR*** $(R_T =) 1 / (1 / 90 + 1 / 70)$	C1

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Question	Answer	Marks
7(a)(i)	100 (Nm)	**B1**
7(a)(ii)	0.44 m ***OR*** 0.45 m	**A3**
	total clockwise moment = total anticlockwise moment	C1
	(d =) 100 / 225 ***OR*** (d =) 100 / (23 × 9.8) ***OR*** 100 / (23 × g × d)	C1
7(b)(i)	(barrier arm) rotates anticlockwise ***OR*** (RHS of barrier arm) moves upwards	**B1**
	(when the switch is closed) coil produces a magnetic field ***OR*** coil / core becomes an (electro)magnet	**B1**
	(coil/core/electromagnet) attracts (iron) bar (downwards)	**B1**
7(b)(ii)	statement: (barrier arm) moves slower / goes up (more) slowly	**B1**
	explanation: decreases strength of (magnetic) field / smaller force / smaller moment	**B1**
7(b)(iii)	steel would become permanently magnetised	**B1**
	(so when switch is opened) barrier would stay up ***or*** bar A will stay attracted (to soft iron core)	**B1**

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Question	Answer	Marks
8(a)(i)	fission is splitting of <u>nuclei</u> ***OR*** fusion is the joining of <u>nuclei</u>	**B1**
8(a)(ii)	$^{10}_{5}B + {}^{1}_{0}n \rightarrow {}^{7}_{3}Li + {}^{4}_{2}\alpha$	
	B: proton number 5 and nucleon number 10	**B1**
	Li: proton number 3 and nucleon number 7	**B1**
	α: proton number 2 and nucleon number 4	**B1**
8(b)	alpha is less penetrating / has shorter range (than gamma)	**B1**
	alpha more easily absorbed / stopped by cancer / tumour cells ***or*** won't travel beyond cancer cells ***or*** so won't damage other / healthy cells	**B1**
	OR	
	alpha highly ionising (than gamma)	**(B1)**
	will destroy / damage cancer cells more easily	**(B1)**
8(c)	any **one** from: • reduce exposure time • increase distance between source and living tissue ***or*** stand in another room whilst radiation is emitted • use shielding ***or*** wear a <u>lead</u> apron ***or*** stand behind a glass partition / lead barrier	**B1**

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Question	Answer	Marks
9(a)	Q and V	**B1**
9(b)	red shift	**B1**
	(galaxy) moving away / receding (from Earth/us)	**B1**
9(c)	galaxies further away (are receding) with higher speed ***OR*** galaxies further away have greater redshift	**B1**
	Universe is expanding	**B1**

Question	Answer	Marks
10(a)	any **two** from: • (most of the) hydrogen has been converted to helium ***or*** hydrogen begins to run out • (star expands and) forms a red supergiant • (red supergiant) explodes as a supernova (forming a nebula)	**B2**
	core (of red supergiant collapses and) forms black hole ***OR*** a black hole forms at the centre (of the supernova/nebula)	**B1**
10(b)(i)	the distance travelled (in the vacuum of space) by light in one year	**B1**
10(b)(ii)	7.4×10^{16} km	**A2**
	9.5×10^{15} (m) or 9.5×10^{12} (km)	C1

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