CAMBRIDGE
International Education

Cambridge IGCSE™ (9–1)

PHYSICS **0972/42**

Paper 4 Theory (Extended) **May/June 2026**

MARK SCHEME

Maximum Mark: 80

Published

This mark scheme contains the instructions and marking guidance that our examiners used to mark candidate responses for this component.

Before they start marking, examiners complete a standardisation process. They review a range of candidate responses and discuss the mark scheme in detail to agree which answers can and cannot be accepted. Examiners award marks where it is clear that candidate responses have met the requirements of the mark scheme. These requirements may vary between different components or different versions of the same component, depending on the exact requirements of the question and the candidate responses seen during the standardisation process.

Sometimes, our mark schemes may allow marks to be awarded to responses which contain elements that are factually incorrect or for content not covered by the syllabus. We do this in response to the demands of a specific question to support candidates and make sure that our assessments are fair. However, these allowances should not be used as a guide for teaching and learning.

We cannot discuss the mark scheme with schools, and we recommend that schools read the mark scheme together with the assessment material and the Principal Examiner Report for Teachers.

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General marking principles

All examiners must apply these marking principles when marking candidate responses.

1	Examiners must award marks for each response in line with: • the specific **content** defined in the mark scheme • the specific **skills** defined in the mark scheme or in the level descriptions • the **standard of response** required as exemplified by the standardisation scripts.
2	Examiners must award **whole marks** (not half marks, or other fractions).
3	Examiners must award marks **positively**. This means that: • marks are not deducted for errors or omissions • marks are awarded for correct/valid answers as defined in the mark scheme and also for **other valid answers** which go beyond the scope of the syllabus and mark scheme referring to your team leader as appropriate • the quality of spelling, punctuation and grammar are judged **only** when the mark scheme indicates that these features are **specifically assessed** in the question. However, the meaning of all responses must be unambiguous.
4	Examiners must **consistently** apply the requirements of the mark scheme and any rules for what to do when candidates have not followed instructions correctly.
5	Examiners must use the **full range of marks** defined in the mark scheme, unless limited by the quality of the candidate responses seen.
6	Examiners must award marks according to the mark scheme and **must not** award marks with grade thresholds or grade descriptions 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	<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.

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6	<u>Calculation specific guidance</u> 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	<u>Guidance for chemical equations</u> 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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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 standardisation 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
✓	correct point or mark awarded
✗	incorrect point or mark not awarded
^	information missing or insufficient for credit
A	allow or accept
AE	evaluation attempted
I	incorrect or insufficient point ignored while marking the rest of the response
CON	contradiction in response, mark not awarded
BOD	benefit of the doubt given
ECF	error carried forward applied
NAQ	response has not answered question

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Annotation	Meaning
RE	rounding error
SEEN	point has been noted, but no credit has been given or blank page seen
SF	error in number of significant figures
TE	transcription error
TV	response is too vague or there is insufficient detail in response
T	answer outside the tolerance of the mark scheme
	used to highlight parts of an extended response
	used to highlight parts of an extended response
MO	mandatory mark not awarded
SC	special case

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Acronyms and shorthand in the mark scheme

acronym/shorthand	**explanation**
A mark	Final answer mark which is awarded for fully correct final answers.
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.
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.
ORA	Or reverse argument.
owtte	Or words to that effect.
ignore or **I**	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.
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.
- Where a C mark is available for quoting an equation and another C mark is available for rearranging and/or substituting numbers into an equation, a candidate who only writes down the equation in the rearranged (and / or numerical) form in one step gains both C marks.

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.

- Where the unit for a numerical answer is not included on the question paper and if the mark scheme doesn't specify otherwise, the only permitted derived units are:

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

- NB J is **not** permitted as the unit for moments.
- Accept units with incorrect use of upper case and lower case symbols e.g. pA for Pa

Significant Figures.

- Numerical answers are expected to be given to the number of significant figures given in the final answer in the mark scheme.
- Answers given to **more** SFs than expected are awarded the A mark if, when rounded to the correct number of SF, the answer matches the mark scheme answer (allowing for ecf).
- Where a final answer is given to **too few** SF, and the mark scheme answer **has been seen** in the working to at least the expected number of SF, annotate the first occurrence with the SF annotation and the A mark is not awarded. Annotate subsequent occurrences with the ignore annotation and award the A marks.
- Where a final answer is given to **too few** SF, and the mark scheme answer **has not been seen** in the working to at least the expected number of SF, annotate with AE annotation and the A mark is not awarded.

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Arithmetic errors and Transcription errors. Where a (probable) transcription error or arithmetic error is identified in working, ignore the error when awarding C marks.

Fractions. A final answer expressed as a fraction is only accepted if 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	Guidance
1(a)(i)	(constant) acceleration	**B1**	
	constant speed **OR** constant velocity	**B1**	**TV** zero acceleration **A** steady speed **OR** stable speed
	increasing deceleration	**B1**	**A** increasing negative acceleration **A** non-uniform or changing deceleration **CON** decreasing acceleration
1(a)(ii)	130 (m)	**A2**	
	area under graph **OR** ½ × 18 ×14 **OR** ½*bh*	**C1**	
1(b)(i)	direction	**B1**	**I** unit
1(b)(ii)	acceleration, electric field strength **AND** weight 3 correct – 2 marks 2 correct – 1 mark	**B2**	**CON** additional incorrect quantities i.e. apply 'list rule'

Question	Answer	Marks	Guidance
2(a)(i)	perpendicular to motion owtte **OR** towards the <u>centre</u> (of the orbit)	**B1**	**I** middle for centre **TV** towards the Earth
2(a)(ii)	2.9 (m / s^2)	**A3**	**SC** 2 marks for 13 (m / s^2) **A** 2.7 (m / s^2) if use of *g* as 10 clearly shown in working
	(resultant) force = force due to rocket – *mg* **OR** {1.9 × 10^5 – 1.5 × 10^4 × 9.8} **OR** 43 000 SEEN	**C1**	**A** use of *g* as 10 if equation given in symbols first (this gives 40 000)
	(*a* =) *F*/*m* **OR** {1.9 × 10^5 – 1.5 × 10^4 × 9.8} / 1.5 × 10^4	**C1**	**A** {1.9 × 10^5} / 1.5 × 10^4

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Question	Answer	Marks	Guidance
2(b)(i)	any **two** from: • particles move (fast) **OR** particles have (high) kinetic energy **OR** particles have (large) momentum • particles collide with the walls of the balloon • pressure is (total) force (due to collisions) per unit area	**B2**	**A** atoms or molecules for particles **I** particles move faster / gain kinetic energy / gain momentum **A** particles collide with balloon **A** $p = F / A$
	collisions with walls cause force (on walls of the balloon) **OR** particles have change of momentum on collision with walls owtte	**B1**	**A** collision with walls produces an impulse **I** force = rate of change of momentum
2(b)(ii)	(228 – 273 =) –45 (°C)	**B1**	**A** use of –273. 1 or –273.15 for absolute zero

Question	Answer	Marks	Guidance
3(a)(i)	(m =) ρV **OR** (m =) $\rho \times$ rate of flow $\times$ time	**M1**	must be in words or symbols
	$1000 \times 0.0045 \times 4(.0)$ (=18)	**A1**	**A** $1000 = m / \{0.0045 \times 4(.0)\}$
3(a)(ii)	1.7×10^6 (J) **OR** 1.7 M(J)	**A2**	
	(E =) $mc\Delta\theta$ **OR** (E =) $18 \times 4200 \times \{38 - 15\}$ **OR** (E =) $18 \times 4200 \times 23$	**C1**	**A** T for θ **I** t for θ **I** Q for E
3(a)(iii)	7100 (W) **OR** 7.1 k(W) **OR** 7200 (W) **OR** 7.2 k(W)	**A2**	**A** 7300 (W) **OR** 7.3 k(W) ecf from **3(a)(ii)**
	(P =) (Δ)E / t **OR** (P =) $\{1.7 \times 10^6\} / 240$	**C1**	**A** any recognisable values for energy and time to award this mark **A** (P =) W / t **I** (W =) (Δ)E / t **OR** (P =) Q / t

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Question	Answer	Marks	Guidance
3(b)	any **one** from: • temperature of the water entering the shower is higher **OR** initial temperature of water is higher • smaller mass / volume (flowing through the shower) per min • rate of flow of water decreases	**B1**	**A** pressure of water decreases **TV** water is slower **TV** heated for a longer time **TV** temperature of surroundings is higher **I** water leak

Question	Answer	Marks	Guidance
4(a)	(impulse =) force × time	**B1**	must be in words **A** (impulse =) change of momentum **TV** (impulse =) mass × change in velocity
4(b)(i)	270 (N)	**A2**	
	$F = \Delta p / t$ **OR** $F(\Delta)t = \Delta\{mv\}$ **OR** (F =) {55 × 4.6} / 0.95	**C1**	**A** $F = ma$ **AND** $a = \Delta v / t$
4(b)(ii)	time for impact is long(er) owtte	**B1**	**A** by bending knees, it takes a long(er) time
	same impulse or same change of momentum	**M1**	
	force is small(er)	**A1**	
4(b)(iii)	1.4 N / cm^2	**A2**	**A** 1.4×10^4 Pa **OR** 1.4×10^4 N / m^2
	(p =) F / A **OR** (p =) 530 / 380	**C1**	(p =) 530 / {380 × 10^N}

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Question	Answer	Marks	Guidance
5(a)	(thermal) energy is transferred from the skin to the water	**B1**	**A** heat for thermal energy
	more energetic particles escape from surface of water owtte	**B1**	**A** fast(er) moving particles escape from surface of water **A** atoms or molecules for particles **I** particles vibrate
	remaining particles (in water) have low(er) (average kinetic) energy (and hence lower temperature)	**B1**	**A** slow(er) moving particles (in water) remain **A** atoms or molecules for particles
5(b)	any **two** from: (air) temperature (amount of) wind owtte surface area (of clothes)	**B2**	 **A** Sun shines **OR** cloud cover owtte **A** humidity **A** colour of clothes

Question	Answer	Marks	Guidance
6(a)	… rays parallel to the principal axis converge after passing through the lens owtte	**A2**	**A** meet for converge **A** intersect for converge **A** due to refraction *for* after passing through the lens **A** …rays parallel to the principal axis which, after passing through the lens, appear to diverge from

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Question	Answer	Marks	Guidance
6(a)	… (parallel) rays converge after passing through the lens owtte	**C1**	**A** meet for converge **A** intersect for converge **A** due to refraction *for* after passing through the lens **A** …rays appear to diverge from after passing through the lens
6(b)	any **two** from: • ray from top of object, parallel to principal axis and to the centre of lens refracted through F on the right of the lens • ray from top of object through the centre of the lens undeviated • ray from top of object through F to the left of the lens and to the centre of the lens refracted parallel to the principal axis to the right of the lens	**M2**	mark intent for 1st and 3rd bullet points accept correct refraction at <u>both</u> surfaces of the lens **CON** additional incorrect rays
	image drawn from intersection of rays to the principal axis, arrow shown in correct position and direction (and labelled I)	**A1**	**SC** 2 marks if the **only** error is refraction at one surface of the lens instead of centre of the lens
6(c)	radio (waves)	**B1**	

Question	Answer	Marks	Guidance
7(a)(i)	(alternating) current / a.c.	**B1**	**A** flow of charge or moving electrons **CON** induced current
	(permanent) magnet	**B1**	
	air (particles)	**B1**	

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Question	Answer	Marks	Guidance
7(a)(ii)	0.77 m	**A2**	
	(λ =) v / f **OR** (λ =) 340 / 440	**C1**	
7(b)	(sound with frequency) above 20 kHz	**B1**	**A** sound with frequencies above the (normal) range of audible hearing for humans

Question	Answer	Marks	Guidance
8(a)(i)	(an electric) charge **OR** charged particle	**B1**	**A** negative **AND** positive (particles) **TV** electron, proton or ion **CON** reference to magnetism
	(an electrostatic) force **OR** <u>attraction or repulsion</u>	**B1**	**TV** push or pull **CON** reference to magnetism
8(a)(ii)	four field lines evenly spaced, perpendicular to the plates and which all touch both plates	**B1**	**A** more than 4 lines **A** curved lines at each of edges and 2 straight lines if spacing correct, by eye **A** evenly spaced lines not across all the width of the plates **I** anything beyond the edges of the plates
	at least one arrow upwards towards negative plate and no incorrect arrows	**B1**	
8(b)(i)	fuse	**B1**	
8(b)(ii)	resistance decreases	**B1**	
	relay (coil) gets stronger	**B1**	**A** increases
	the switch	**B1**	**I** armature

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Question	Answer	Marks	Guidance
8(b)(iii)	380 (C)	**A2**	
	(Q =) It **OR** (Q =) 3.2 × 120	**C1**	

Question	Answer	Marks	Guidance
9(a)(i)	similarity: (same) number of protons **AND** difference: (different) number of neutrons / nucleons	**B1**	**I** same atomic number **I** different mass number **CON** number of electrons
9(a)(ii)	smooth curve, with negative gradient of decreasing magnitude, starting from 16 μg on mass axis	**B1**	**A** small gap at starting point
	curve, with negative gradient of decreasing magnitude, which does not reach time axis	**B1**	
	value of 8 μg corresponding to 5700 years on the graph **OR** value of 4 μg corresponding to 11 400 years on the graph	**B1**	**A** any correct corresponding point e.g. 2.58 μg at 15 000 years **CON** 2.6 μg at 15 000 years if obtained from 15 000 / 5700
9(b)	background	**B1**	
9(c)	any **one** from: radon (gas) rocks / buildings food / drink cosmic rays	**B1**	 **A** soil / ground **A** fruit **I** nuclear weapons testing **I** medical procedures **I** emissions from uranium **CON** CMBR

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Question	Answer	Marks	Guidance
10(a)(i)	neutron bombards / is absorbed by a (heavy) nucleus	**B1**	
	(heavy) nucleus splits (into smaller daughter nuclei) owtte	**B1**	
	large amounts of energy (and radioactive products) are released owtte	**B1**	**CON** energy is created
10(a)(ii)	water steam	**B1**	**TV** water vapour for steam
	turbine	**B1**	
10(a)(iii)	advantage - any **one** from: • is available 24 hours per day • is not dependent on the Sun shining	**B1**	**A** more reliable **A** higher energy yield **A** not affected by the weather **TV** greater efficiency
	disadvantage – any **one** from: • danger if any leak of radiation • produces hazardous / dangerous waste • difficulty of storage of used radioactive material • nuclear waste must be stored for a long time • not renewable	**B1**	**I** releases dangerous radiation **TV** produces radioactive waste **A** expensive to build / decommission nuclear power plant **TV** cost unqualified **I** severe consequences if accident or meltdown occurs
10(b)	tidal **OR** geothermal	**B1**	**CON** tidal waves

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Question	Answer	Marks	Guidance
11(a)	**statement** / **approximate time taken** The Earth orbits the Sun once. — 365 days The Earth rotates once on its axis. — 24 hours Light travels from the Sun to the Earth — 8.3 min The Moon orbits the Earth once. — 1 month all correct – 2 marks 1 or 2 correct – 1 mark	**B2**	
11(b)	(T =) $2\pi r / v$	**B1**	must be in words or symbols **A** s for v **A** t for T **A** (T =) $\pi d / v$
	(T =) $\{2\pi \times 7.78 \times 10^8\} / \{4.7(0) \times 10^4 \times 24 \times 365\}$ **OR** (T =) 104 000 (hours)	**B1**	**A** (T =) $\{2\pi \times 7.78 \times 10^8\} / \{4.7(0) \times 10^4\}$ **A** (T =) $\{2\pi \times 7.78 \times 10^8\} \div \{4.7(0) \times 10^4 \times$ incorrect time conversion$\}$
	correct conversion from hours to years **OR** 11.87 SEEN **OR** 11.88 SEEN	**B1**	e.g. $4.7(0) \times 10^4 \times 24 \times 365$ **OR** 411 720 000 SEEN **OR** candidate's time in hours / $\{24 \times 365\}$ **OR** 1 year = 24×365 (hours) **OR** 1 year = 8760 (hours)
11(c)(i)	distance travelled (in a vacuum) by light in one year	**B1**	**A** distance travelled (in space) by light in one year
11(c)(ii)	3.3×10^6 (m / s)	**A2**	

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Question	Answer	Marks	Guidance
11(c)(ii)	(v =) H_0d **OR** (v =) $2.2 \times 10^{-18} \times 1.6 \times 10^{8} \times 9.5 \times 10^{15}$ **OR** (v =) $2.2 \times 10^{-18} \times 1.6 \times 10^{8} \times 3.0 \times 10^{8} \times 3600 \times 24 \times 365$	**C1**	must be in words or symbols in any form **A** $2.2 \times 10^{-18} \times 1.6 \times 10^{8} \times$ candidate's incorrect value for conversion from light years to metres

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