Cambridge Assessment International Education

Cambridge IGCSE™

PHYSICS **0625/41**

Paper 4 Extended Theory **October/November 2023**

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 2023 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 descriptors 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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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.
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.
I or **OR**	Alternative answers any one of which gains the credit for that mark.
owtte	Or words to that effect.
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

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.

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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 Nm / s
Pa	N / m^2
momentum	Ns or kgm / s
impulse	Ns or kgm / 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.

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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)	20 J	**A2**
	($\Delta.E_p =$**)** $mg(\Delta)h$ **OR** $0.2(0)\times 9.8\times 10$	C1
1(b)(i)	14 J	**A2**
	$(E_k =)$ $\frac{1}{2}mv^2$ **OR** $\frac{1}{2} \times 0.2(0) \times 12^2$	C1
1(b)(ii)	$p = mv$ **OR (**$\Delta p =$**)** $mv - mu$	**B1**
	$(\Delta p =)$ $0.2(0)\times\{14+12\}$ **OR** $0.2(0)\times\{14--12\}$ **OR** $p_{\text{ before}} = 0.2(0) \times 14$ **AND** $p_{\text{ after}} = 0.2(0) \times (-)12$	**B1**
	$(\Delta p =)$ $2.8-\{-2.4\}$ $(= 5.2\ \text{kg m/s})$ **OR** $(\Delta p =)$ $0.2(0)\times\{14--12\}$	**B1**
1(b)(iii)	21 N	**A2**
	$(F =)$ $\Delta p / (\Delta)t$ **OR** $F = (\Delta)mv / (\Delta)t$ **OR** $5.2 / 0.25$	C1

Question	Answer	Marks
2(a)	*any three from:* • free / delocalised / mobile electrons • (electrons) gain (thermal) energy from hotplate / particles • (electrons) move through(out) copper / metal **OR** (electrons) move to distant particles • electrons transfer energy from higher temperature (region) to lower temperature (region) **OR** (electrons) collide with (distant) particles / transfer energy to (distant) particles	**B3**
2(b)	(shiny surfaces are) poor emitters of radiation	**B1**
	reduces energy loss (from the pan / copper) **OR** less energy transferred to surroundings	**B1**
2(c)	convection	**B1**

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Question	Answer	Marks
3(a)	particles (of liquid) are touching / close to each other	**B1**
	forces (of repulsion) between particles (of liquid) are large	**B1**
3(b)(i)	$(\Delta p =)\ \rho g(\Delta)h$	**B1**
	$1000 \times 9.8 \times 0.087$ **OR** $(\Delta p =)$ 852.6 (Pa)	**B1**
3(b)(ii)	12 N	**A2**
	$p = F / A$ **OR** $(F =)\ pA$ **OR** 850×0.014	C1
3(b)(iii)	1.2 kg	**A2**
	$g = W / m$ **OR** $(m =)\ F / g$ **OR** $12 / 9.8$	C1

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Question	Answer	Marks
4(a)(i)	(point / place / position) where (all) the weight (seems to) acts	**B1**
4(a)(ii)	a small tilt / rotation makes G no longer vertically above the base **OR** small tilt / rotation produces moment (that topples transmitter)	**B1**
4(b)(i)	arrow(head) marked along wire W towards ground	**B1**
4(b)(ii)	moment = $F \times d$ **AND** correct indication of F and d on Fig. 4.1.	**A3**
	(moment is) force × (perpendicular) distance (from base / pivot)	C1
	(moment is) force × perpendicular distance (from base / pivot)	C1
4(c)	a use of radio waves, e.g. RFID / astronomy / Bluetooth / RADAR / wifi	**B1**

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Question	Answer	Marks
5(a)	*Any three from:* • description of how the (energy from) water is released • mention of transfers between energy stores • (moving) water turns turbine • turbine turns / drives generator • name of method to match description	**B3**
5(b)	advantage of generating electricity from energy stored in water	**B1**
	disadvantage of generating electricity from energy stored in water	**B1**
5(c)	any **two** from: • geothermal (energy / power) • tidal (energy / power) • nuclear (energy / power)	**B2**

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Question	Answer	Marks
6(a)(i)	any **two** from: • ray from top / bottom of object, parallel to principal axis, refracted through right-hand principal focus • straight ray from same point on object through optical centre • ray that (seems to) come from left-hand principal focus through same point of object and refracted parallel to principal axis	**M2**
	rays traced back to intersection **AND** intersection / image labelled I	**A1**
6(a)(ii)	(distance =) 35.5 cm to 38.5 cm	**A2**
	7.1 to 7.7 (cm) **OR** (distance =) 35.0 (cm) to 40.0 (cm)	C1
6(b)	virtual **AND** *any one from:* • cannot be projected on a screen • (real) light (ray) does not pass through image • light only seems to come from image	**B1**
6(c)	*any one from:* • long-sightedness focuses image behind retina / back of eye **OR** longsightedness produces blurry / fuzzy images (of close objects) • converging lens reduces focal length (of eye) • (converging lens) puts image further away (from the eye)	**B1**
	(converging lens gives) sharp/focussed image on retina / back of eye **OR** (with lens) rays converge on retina / back of eye	**B1**

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Question	Answer	Marks
7(a)	electrons move from cloth to rod	**A2**
	(plastic) rod gains electrons	C1
7(b)(i)	(region) where an (electric) charge experiences a force	**B1**
7(b)(ii)	At least three radial field lines distributed evenly around outside of S **AND** touching S **AND** not inside S	**B1**
	arrow on (at least one) field line pointing towards S	**B1**
7(c)	arrow through Z **and** away from (centre of) sphere	**B1**

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Question	Answer	Marks
8(a)(i)	900 C	**A2**
	$I = Q / t$ **OR** ($Q =$) It **OR** 1.5 × 600	C1
8(a)(ii)	2.0 Ω	**A3**
	$R = V / I$ **OR** ($R_{tot} =$) V / I **OR** 9.(0) / 1.5 **or** 6.(0)	C1
	($R_{cyl} =$) total resistance – P **OR** ($R_{cyl} =$) 6.0 – 4.0	C1
8(b)	1200 s	**A4**
	R is directly proportional to l **OR** (new cylinder) twice as long means twice R	C1
	R is inversely proportional to A **OR** (new cylinder) half cross-sectional area means twice R	C1
	(resistance of cylinder =) 4 × **(a)(ii)** (Ω)	C1

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Question	Answer	Marks
9(a)(i)	(americium-241 has) one neutron fewer (in the nucleus)	**B1**
9(a)(ii)	(different) number of protons (in nucleus)	**B1**
	(different) number of neutrons (in nucleus)	**B1**
9(b)(i)	$^{241}_{95}Am \rightarrow {}^{237}_{93}Np + {}^{4}_{2}a$	**A3**
	any two from: $_{95}Am$ ^{237}Np $^{4}_{2}a$	C2
9(b)(ii)	(α-particles have) more kinetic energy (than β-particles)	**B1**
	(α-particles have) more charge (than β-particles)	**B1**
9(b)(iii)	Low(er) (initial) activity OR Few emissions per unit time	**M1**
	so smoke detectors are not hazardous to humans **OR** so disposal of old detectors is cheap / easy	**A1**

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Question	Answer	Marks
10(a)	hydrogen nuclei fuse to become helium nuclei	**A3**
	nuclear reactions **OR** (nuclear) fusion	C1
	hydrogen fuses into helium	C1
10(b)(i)	(observed) wavelength is longer / wavelength is shifted towards the red end of the spectrum	**A2**
	(light from galaxy) redshifted / shifted towards red (end of spectrum)	C1
10(b)(ii)	change in wavelength (or starlight due to redshift)	**B1**
10(c)(i)	5.9×10^{24} m	**A2**
	$H_0 = v/d$ **OR** ($d =$) v / H_0 **OR** $1.3 \times 10^{7} / 2.2 \times 10^{-18}$ **OR** 5.9×10^{N} (m)	C1
10(c)(ii)	1.4×10^{10} (years)	**A2**
	(age =) $1 / H_0$ **or** $1 / 2.2 \times 10^{-18}$ **or** 4.5×10^{17}	C1

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