Cambridge Assessment International Education

Cambridge IGCSE™ (9–1)

PHYSICS (9–1) **0972/41**

Paper 4 Extended Theory **May/June 2021**

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 2021 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.

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.

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.

Question	Answer	Marks
1(a)(i)	any value from 35 to 43 m / s^2	**A2**
	(a =) (v – u) / t in any form **or** gradient (of line) **or** (58 – 50) / 0.20 **or** equivalent values from the graph	**C1**
1(a)(ii)	3800 N	**A3**
	(F =) ma in any form **or** Δp / Δt in any form **or** 76 × candidate's **1(a)(i)** **or** 760 seen	**C1**
	76 × candidate's **1(a)(i)** evaluated **or** 76 × (candidate's **1(a)(i)** + 10) **or** 76 × (candidate's **1(a)(i)**)+ 760	**C1**
1(b)	(deceleration because) upward force greater than weight **or** upward resultant force	**B1**
	air resistance decreases (with decreasing speed / with time) **or** deceleration decreases **or** resultant (upward) force decreases	**B1**
	(until / finally) weight equals air resistance **or** forces balance **or** at terminal / constant velocity / speed	**B1**
1(c)	at zero speed there is no air resistance	**B1**
	weight / downwards force is (still) acting **or** there is (now) a resultant force (downwards at zero speed)	**B1**
	OR forces balance at a speed greater than zero	**(B1)**
	speed cannot decrease / no deceleration once forces balance	**(B1)**

Question	Answer	Marks
2(a)(i)	0.078 N s **or** 0.078 kg m / s	**A2**
	(I =) $m_t(\Delta)v_t$ in any form **or** 1.2×0.065	**C1**
2(a)(ii)	150 m / s	**A2**
	$v_b = (m_t + v_t) / m_b$ in any form **or** initial momentum = final momentum **or** $1.2(0052) \times 0.065 / 0.00052$ **or** $0.078(0338) / 0.00052$	**C1**
2(b)	work done against / due to / because of friction **or** kinetic energy (of trolley) used to do work	**B1**
	kinetic energy decreases (to zero)	**B1**
	thermal energy produced	**B1**

Question	Answer	Marks
3(a)	molecules (already very) close / touching	**B1**
	(repulsive) forces (very) large	**B1**
3(b)(i)	6.5×10^5 Pa	**A3**
	(p =) F / A in any form **or** 8800 / 0.016 **or** (F_{air} =)$1.0 \times 10^5 \times 0.016$	**C1**
	5.5×10^5 **or** 5.5×10^5 (+ 1.0×10^5) **or** (1600 + 8800) / 0.016	**C1**
3(b)(ii)	pressure due to (increased height of) oil in cylinder mentioned **or** pressure (in liquid) increases as depth increases	**B1**
	to keep the upwards force constant **or** to lift the (extra) oil **or** to counteract / oppose the increased pressure / force / weight of the oil	**B1**
3(b)(iii)	(initial) force has to be greater than 8800 N to start the motion **or** the upwards force (just) balances the weight (so no movement) **or** piston / oil has weight **or** friction (between moving parts)	**B1**

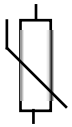
Question	Answer	Marks
4(a)	aluminium is a (good) conductor (of heat) **and** plastic is a poor conductor / does not conduct (heat)	**B1**
4(b)(i)	increase in kinetic energy of molecules **or** increase in potential energy of molecules	**B1**
4(b)(ii)	any **three** from: • atoms (touching the hotplate) / lattice vibrate (faster) • atoms pass on energy / vibration to neighbouring atoms / to other atoms by collision • atoms pass on energy to electrons • electrons hit <u>distant</u> atoms **or** electrons move (through lattice)	**B3**
4(b)(iii)	<u>molecules</u> escape from the liquid (as a vapour)	**B1**
	bonds broken / (attractive) forces overcome	**B1**
	<u>molecules</u> gain potential energy **or** work done (to separate molecules / break bonds / overcome forces)	**B1**
4(b)(iv)	840 W	**A3**
	(E =) ml_v in any form **or** $0.11 \times 2.3 \times 10^6$ **or** 2.53×10^5	**C1**
	(rate =) ml_v / t in any form **or** $0.11 \times 2.3 \times 10^6 / 300$ **or** $2.53 \times 10^5 / 300$	**C1**

Question	Answer	Marks
5(a)	molecules / they speed up **or** gain kinetic energy	**B1**
	molecules move further apart **or** push others away	**B1**
5(b)	forces between liquid molecules weak(er than in solids)	**B1**
	less energy / work done to separate molecules **or** greater separation for same work done / same increase in energy	**B1**
5(c)(i)	greater sensitivity	**B1**
	volume increase (of liquid in second thermometer) is greater **or** liquid moves a greater distance (for the same temperature increase)	**B1**
5(c)(ii)	smaller range **and** either of: • smaller temperature increase for liquid / meniscus to reach end of tube • expands more / greater sensitivity **and** tube of same length	**B1**
5(d)(i)	statement of <u>problem</u> (e.g. bridges buckle (in hot weather))	**B1**
5(d)(ii)	suggested solution to problem stated in **5(d)(i)** (e.g. allow gaps at the ends of the bridge)	**B1**
	more detail (e.g. as the bridge expands the gaps close)	**B1**

Question	Answer	Marks
6(a)	two points labelled C at the centre of the two compressions	**B1**
6(b)	6200−6500 Hz	**A3**
	(λ =) value from 0.051 to 0.053 (m) seen anywhere	**C1**
	(f =) v / λ in any form **or** 330 / 0.052 **or** 330 / 5.2 **or** 63	**C1**
6(c)	compressions / rarefactions closer **or** more compressions / rarefactions (in same distance)	**B1**
	less diffraction / spreading out	**B1**
	(because of) smaller wavelength **or** ratio wavelength / gap width smaller	**B1**

Question	Answer	Marks
7(a)(i)	any **three** from: • *y*-axis labelled *e.m.f.* **and** *x*-axis labelled *time* • at least one cycle of a sinusoidal wave • only **two** complete cycles of a sinusoidal wave • constant amplitude **and** constant period for first two periods of a sinusoidal wave	**B3**
7(a)(ii)	peak **or** trough **or** corresponding time labelled P	**B1**
7(a)(iii)	(amplitude / maximum e.m.f.) increases	**B1**
	(e.m.f.) changes direction more often **or** greater frequency	**B1**
7(b)	alternating current in primary coil	**B1**
	alternating / changing magnetic field **or** magnetic field cuts secondary coil (continuously)	**B1**
	(alternating) e.m.f. induced in the secondary coil	**B1**

Question	Answer	Marks
7(c)	smaller current (and same resistance when the power is transmitted and an equal rate)	**B1**
	less thermal energy loss / produced (in cables)	**B1**

Question	Answer	Marks
8(a)	 **and** between P and Q	**B1**
8(b)	1.5 V **c.a.o.**	**B1**
8(c)(i)	1600 Ω	**A3**
	($V_{800\,\Omega}$ =) 4.0 (V)	**C1**
	(I =) V / R in any form or 4.0 / 800 or 0.0050 (A) **or** (R =) V / I or 8.0 / 0.0050	**C1**
	OR 1600 Ω	**(A3)**
	($V_{800\,\Omega}$ =) 4.0 (V)	**(C1)**
	(R_{Th} =) $R_{800\,\Omega} \times V_{Th} / V_{800\,\Omega}$ in any form **or** (R_{Th} =) 800 × 8.0 / 4.0 in any form	**(C1)**
	OR 1600 Ω	**(A3)**
	$\frac{12}{800+R_{Th}}$ **or** $\frac{8.0}{R_{Th}}$ **or** $\frac{R_{Th}}{800+R_{Th}}$	**(C1)**
	$\frac{12}{800+R_{Th}} = \frac{8.0}{R_{Th}}$ in any form	**(C1)**

Question	Answer	Marks
8(c)(ii)	larger proportion of the e.m.f. (across thermistor) **or** smaller voltage across 800 Ω	**B1**
	temperature (of thermistor) is smaller / has decreased	**B1**
	resistance of thermistor / circuit is large(r)	**B1**

Question	Answer	Marks
9(a)	$^{2}_{1}H$ **and** $^{3}_{1}H$ **and** in this order	**B1**
9(b)(i)	joining together of (small / H) nuclei	**B1**
	to produce a bigger nucleus / He nucleus **or** with the release of energy	**B1**
9(b)(ii)	($^{2}_{1}H + ^{3}_{1}H \rightarrow$) $^{1}_{0}n$	**B1**
	(+) $^{4}_{2}(....)$	**B1**
	He **or** α seen	**B1**
9(c)	any **two** from: • geothermal (energy) • tidal (energy) • nuclear (energy)	**B2**