Cambridge Assessment International Education

Cambridge O Level

PHYSICS | **5054/22**

Paper 2 Theory | **October/November 2023**

MARK SCHEME

Maximum Mark: 75

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.

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	<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.

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.

Acronyms and shorthand in the mark scheme.

acronym/shorthand	explanation
A marks	Final answer marks which are awarded for correct final answers to numerical questions.
C marks	Compensatory marks which may be scored to give partial credit when final answer (A) marks have not been scored.
B marks	Independent marks which do not depend on other marks.
M marks	Method marks which must be scored before any subsequent final answer (A) marks 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 cannot be scored.
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.
owtte	Or words to that effect
ignore	If seen, this incorrect or irrelevant point may be disregarded, i.e. it is not to be treated as contradictory.
not/NOT	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. i.e. their error is carried forward to this question and they are not penalised a second time for one error.
cao	correct answer only

Question	Answer	Marks
1(a)	(a vector quantity) / it has a direction	**B1**
1(b)	**acceleration** and **momentum** underlined **and** no others	**B1**
1(c)	**speed:** (v =) $\sqrt{6.82 + 2.42}$ **or** $v^2 = 6.8^2 + 2.4^2$ **or** correct triangle / rectangle drawn / intersecting arcs (by eye)	**B1**
	speed: 7.1 – 7.3 (m / s)	**B1**
	angle: (θ =) $\tan^{-1}(6.8 / 2.4)$ **or** $\tan\theta = 6.8 / 2.4$ **or** 18 – 21(°) **or** **or** correct triangle / rectangle drawn / intersecting arcs **and** scale <u>used</u> $\geqslant$ 1 cm: 1 m / s	**B1**
	angle: 69 – 72(°)	**B1**

Question	Answer	Marks
2(a)	(p =) mv **or** 300×8000	**C1**
	2.4×10^6 (kg m / s)	**A1**
2(b)(i)	momentum conserved **or** $mv = m_1v_1 + m_2v_2$	**C1**
	(v_2 =) $(2.4 \times 10^6 – (150 \times 9000)) \div 150$ **or** (v_2 =) (1 050 000) / 150	**C1**
	7000 (m / s)	**A1**
2(b)(ii)	<u>from</u> energy stored as chemical (potential) energy	**B1**
2(b)(iii)	Δp **or** J **or** $I = 150 \times (9000 – 8000)$ **or** 150 000 **or** (a =) $(9000 – 8000) \div 0.20$ **or** (a =) 5000	**C1**
	(F =) $\Delta p / (\Delta)t$ **or** (F =) $I / (\Delta)t$ **or** (F =) ma **or** $150 \times (9000 – 8000) / 0.20$ **or** $150 \times 1000 / 0.20$	**C1**
	7.5×10^5 (N)	**A1**

Question	Answer	Marks
3(a)(i)	it / lamina is in the gravitational field (of Earth)	**B1**
3(a)(ii)	(F =) mg **or** 0.050 × 9.8 **or** 50 × 9.8 **or** 490	**C1**
	0.49 (N)	**A1**
3(b)(i)	(M =) $F \times x_{\perp r}$ **or** 0.49 × 8.0 **or** 0.49 × 0.080	**C1**
	0.039 (N m)	**A1**
3(b)(ii)	it / lamina moves clockwise (about the pivot)	**B1**
	it speeds up **and** then slows down **or** it oscillates (with decreasing amplitude) **or** overshoots	**B1**
	(stops with) G vertically below H	**B1**

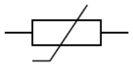
Question	Answer	Marks
4(a)(i)	$\Delta p = h\rho g$ **or** $1.0 \times 1.4 \times 10^4 \times 9.8$	**C1**
	1.4×10^5 **or** 1.372×10^5 **or** $1.0 \times 10^5 + (1.0 \times 1.4 \times 10^4 \times 9.8)$ **or** $1.0 \times 10^5 + 1.4 \times 10^5$	**C1**
	2.4×10^5 (Pa)	**A1**
4(a)(ii)	(F =) pA **or** $2.4 \times 10^5 \times 4.0 \times 10^{-4}$	**C1**
	95 (N) **or** 96 (N)	**A1**

Question	Answer	Marks
4(b)(i)	the liquid falls (in the tube)	**B1**
	then stops falling **or** reaches stability	**B1**
	(original) pressure of liquid at bottom of tube greater than pressure of liquid in basin immediately beneath it **or** pressure (of liquid in tube) becomes equal to atmospheric pressure / pressure in the container **or** leaving a vacuum (at the closed end of the tube)	**B1**
4(b)(ii)	height of liquid surface (in tube measured)	**B1**
	measured relative to level of liquid surface in container **or** $h\rho g$ (used) to calculate the pressure	**B1**

Question	Answer	Marks
5(a)(i)	faster-moving <u>particles</u> **and** (more likely to) escape (from the water)	**B1**
	remaining <u>particles</u> have less (average) kinetic energy / move more slowly (on average)	**B1**
5(a)(ii)	(work is done) moving particles apart (against the forces of attraction) **or** (energy needed) to supply the latent heat	**B1**
5(b)	any **two** from: no bubbles formed **or** occurs only at the surface occurs at any temperature is affected by exposed surface area / moving air over surface / temperature	**B2**

Question	Answer	Marks
6(a)	(frequency =) the <u>number</u> of wavelengths	**B1**
	(passing a point) per <u>unit</u> time	**B1**
6(b)	yes **and** within audible range (of human with healthy hearing)	**B1**

Question	Answer	Marks
6(c)	it / the loudspeaker / cone / coil is vibrating	**B1**
	when it / cone moves (forwards) it produces a compression / compresses (air) **or** when it moves (backwards) it produces a rarefaction / expands (air)	**B1**
	vibrations / compressions / rarefactions / energy / <u>change</u> in pressure / motion passed on (to neighbouring air)	**B1**
6(d)	space is a vacuum **or** no medium / air in space	**C1**
	sound cannot travel in a vacuum / space / without a medium	**A1**

Question	Answer	Marks
7(a)	 **and** drawn between T_1 and T_2	**B1**
7(b)(i)	(I =) V / R **or** 0.40 / 2.5	**C1**
	0.16 (A)	**A1**
7(b)(ii)	(P =) VI **or** 0.40×0.16 **or** (P =) I^2R **or** $0.16^2 \times 2.5$	**C1**
	0.064 (W)	**A1**
7(c)	resistance (of the thermistor / circuit) decreases	**B1**
	increase in current in circuit / R takes a larger proportion of the total resistance / voltage **and** voltmeter reading / it increases**.**	**B1**

Question	Answer	Marks
8(a)	steel	**B1**
8(b)(i)	magnetic field (lines of magnet) cut (by solenoid) **or** magnetic field (in solenoid) changes	**B1**
	electromotive force / e.m.f. induced / current induced	**B1**
	electromotive force / e.m.f. cause current (in closed circuit)	**B1**
8(b)(ii)	Lenz law mentioned **or** to oppose the change (causing the current)	**B1**
	(In order to) repel magnet (upwards) **or** upward force on magnet **or** repulsion (of magnet) mentioned **or** to oppose the magnet **or** resists motion of magnet	**B1**
8(c)	current / it changes direction	**B1**
	magnitude / size of current changes **or** current increases / decreases	**B1**

Question	Answer	Marks
9(a)	any **two** from: from gravitational potential energy **or** gravitational potential energy to .... **or** gravitational potential energy decreases kinetic energy mentioned to internal energy **or** internal energy increases	**B2**
9(b)(i)	different number of neutrons (in the nucleus)	**B1**
9(b)(ii)	(its nucleus only contains) only has one proton (alpha–particles contain two protons) **or** not enough protons	**B1**
9(b)(iii)	${}^{0}_{-1}(\beta)$	**B1**
	${}^{3}_{2}(\mathrm{He})$	**B1**

Question	Answer	Marks
9(b)(iv)	(nuclear reaction produces) a high temperature (in core)	B1
	outward force (due to high temperature / nuclear reaction) **or** force due to high temperature / nuclear reaction **or** radiation pressure	B1
	balances (gravitational) force (inwards)	B1
9(c)	(red supergiant explodes as) supernova (explosion)	B1

Question	Answer	Marks
10(a)(i)	horizontal path marked with γ **and** no other path indicated as γ	B1
10(a)(ii)	beta (β-radiation)	B1
	left-hand rule (mentioned)	B1
	first finger into page **and** thumb downwards	B1
	current opposite to motion **or** particles negative (and so are beta)	B1
10(a)(iii)	beta (β-radiation) completely absorbed	B1
	<u>some</u> gamma rays absorbed **or** (some) gamma passes through	B1
10(b)	(λ =) $v / f = 3.0 \times 10^{8} / 8.8 \times 10^{19}$	C1
	3.4×10^{-12} (m)	A1