Cambridge Assessment International Education

Cambridge IGCSE™

PHYSICS **0625/31**

Paper 3 Core Theory **October/November 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 October/November 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.

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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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Examples of how to apply the list rule
State **three** reasons…. [3]

A

1	Correct	✓	**2**
2	Correct	✓	
3	Wrong	×	

B (4 responses)

1	Correct, Correct	✓, ✓	**3**
2	Correct	✓	
3	Wrong	ignore	

C (4 responses)

1	Correct	✓	**2**
2	Correct, Wrong	✓, ×	
3	Correct	ignore	

D (4 responses)

1	Correct	✓	**2**
2	Correct, CON (of 2.)	×, (discount 2)	
3	Correct	✓	

E (4 responses)

1	Correct	✓	**3**
2	Correct	✓	
3	Correct, Wrong	✓	

F (4 responses)

1	Correct	✓	**2**
2	Correct	✓	
3	Correct CON (of 3.)	× (discount 3)	

G (5 responses)

1	Correct	✓	**3**
2	Correct	✓	
3	Correct Correct CON (of 4.)	✓ ignore ignore	

H (4 responses)

1	Correct	✓	**2**
2	Correct	×	
3	CON (of 2.) Correct	(discount 2) ✓	

I (4 responses)

1	Correct	✓	**2**
2	Correct	×	
3	Correct CON (of 2.)	✓ (discount 2)	

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RM Assessor3 annotations:

annotation	suggested use
tick	mark awarded (note the ticks are added up next to the tick annotation, check the total you enter agrees)
cross	no mark awarded
SEEN	indicates page seen
BOD	benefit of doubt given
NBOD	no benefit of doubt given
on page comment	gives a text box to write comment –much easier to use than in the previous version of RM assessor
ECF	error carried forward
^	omission mark
?	unclear
U UU	unit penalty applied unit penalty not applied because already applied earlier in same question

annotation	suggested use
wavy line (horizontal or vertical)	used to highlight a particular point
CON	contradiction
NAQ	not answered question
PD	poor diagram
SF SFSF	error in number of significant figures significant figure error not penalized.
POT	power-of-ten error
TV	too vague
I	ignore
SC	special case

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NOTES ABOUT MARK SCHEME SYMBOLS & OTHER MATTERS

M marks	are method marks upon which further marks depend. For an M mark to be scored, the point to which it refers **must** be seen in a candidate's answer. If a candidate fails to score a particular M mark, then none of the dependent marks can be scored.
B marks	are independent marks, which do not depend on other marks. For a B mark to scored, the point to which it refers must be seen specifically in the candidate's answers.
A marks	In general, A marks are awarded for final answers to numerical questions. If a final numerical answer, eligible for A marks, is correct, with the correct unit and an acceptable number of significant figures, all the marks for that question are normally awarded.
C marks	are compensatory marks in general applicable to numerical questions. These can be scored even if the point to which they refer are not written down by the candidate, **provided subsequent working gives evidence that they must have known it.** For example, if an equation carries a C mark and the candidate does not write down the actual equation but does correct substitution or working which shows that they knew the equation, then the C mark is scored. A C mark is not awarded if a candidate makes two points which contradict each other. Points which are wrong but irrelevant are ignored.
Brackets ( )	around words or units in the mark scheme are intended to indicate wording used to clarify the mark scheme, but the marks do not depend on seeing the words or units in brackets e.g. 10 (J) means that the mark is scored for 10, regardless of the unit given.
Underlining	indicates that this must be seen in the answer offered, or something very similar.
OR / or	indicates alternative answers, any one of which is satisfactory for scoring the marks.
e.e.o.o.	means 'each error or omission'.
o.w.t.t.e.	means 'or words to that effect'.
Ignore	indicates that something which is not correct or irrelevant is to be disregarded and does not cause a right plus wrong penalty.
Spelling	Be generous about spelling and use of English. If an answer can be understood to mean what we want, give credit. However, beware of and do not allow ambiguities: e.g. spelling which suggests confusion between reflection / refraction / diffraction or thermistor / transistor / transformer.
Not/NOT	indicates that an incorrect answer is not to be disregarded, but cancels another otherwise correct alternative offered by the candidate i.e. right plus wrong penalty applies.

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e.c.f.	means 'error carried forward'. This is mainly applicable to numerical questions, but may occasionally be applied in non-numerical questions if specified in the mark scheme. This indicates that if a candidate has made an earlier mistake and has carried an incorrect value forward to subsequent stages of working, marks indicated by e.c.f. may be awarded, provided the subsequent working is correct.
Significant Figures	Answers are normally acceptable to any number of significant figures $\geqslant 2$. Any exceptions to this general rule will be specified in the mark scheme.
Units	Deduct one mark for each incorrect or missing unit from **an answer that would otherwise gain all the marks available for that answer: maximum 1 per question.** No deduction is incurred if the unit is missing from the final answer but is shown correctly in the working. Condone wrong use of upper and lower case symbols, e.g. pA for Pa. **Use the annotation U to signify where a unit penalty has been applied.**
Arithmetic errors	Deduct only one mark if the **only** error in arriving at a final answer is clearly an arithmetic one. Regard a power-of-ten error as an arithmetic one.
Transcription errors	Deduct only one mark if the only error in arriving at a final answer is because given or previously calculated data has clearly been misread but used correctly.
Fractions	Only accept these where specified in the mark scheme.
Crossed out work	Work which has been crossed out **and not replaced but can easily be read**, should be marked as if it had not been crossed out.
Use of **NR**	(# key on the keyboard) Use this if the answer space for a question is completely blank or contains no readable words, figures or symbols.

Annotation

To increase marking transparency, reduce the number of enquiries about results and assist team leaders, the following is mandatory:

- For **all** questions with two or more marks, examiners should tick to indicate where each credit is awarded.
- For questions with one mark, examiners do not need to annotate the script to indicate that credit is awarded.
- Any text annotation or annotation in a comment box should never contain -1 or allow a possible misinterpretation that negative marking was applied.

Normally place the ticks close to where the mark is scored.

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Question	Answer	Marks
1(a)	1.6 (cm) OR 14.8 (cm) seen OR used	**C1**
	13.2 (cm)	**A1**
1(b)(i)	(top pan / chemical / beam) balance	**B1**
1(b)(ii)	22 (cm^3) OR 18 (cm^3) seen OR used	**C1**
	4(.0) (cm^3)	**A1**
1(c)	(density =) mass ÷ volume OR (d =) m ÷ v in any form	**C1**
	93.6 ÷ 12	**C1**
	7.8 (g / cm^3)	**A1**

Question	Answer	Marks
2(a)(i)	6.14 (s) AND 6.28 (s)	**B1**
2(a)(ii)	(6.14 + 6.28) ÷ 2 OR 12.42 ÷ 2	**C1**
	6.21 (s)	**A1**
2(a)(iii)	idea of decreasing (angle of) slope OR less steep OR smaller gradient	**B1**
2(b)	(average speed =)(total) distance ÷ (total) time in any form	**C1**
	1.2 ÷ 7.8	**C1**
	0.15 (m / s)	**A1**

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Question	Answer	Marks
2(c)	distance = area under graph OR ½ × base × height	**C1**
	4.0 × 1.6 × 0.5	**C1**
	3.2 (m)	**A1**

Question	Answer	Marks
3(a)	any **three** from: line drawn alongside cotton thread / string hang triangle from a different corner (B or C) repeat marking of string (position on the card) centre of mass is where lines intersect	**B3**
3(b)	(moment of weight =) weight × distance (of direction of force from pivot)	**C1**
	(moment =) 1.4 × 20	**C1**
	28 (N cm)	**A1**

Question	Answer	Marks
4(a)	horizontal section at 20 °C	**B1**
	line starting at (0, 50) line decreasing (steadily) (from (0, 50)) to 20 °C in 30 minutes (by eye) line decreasing from 20 °C **AND** line reaches 5 °C at time of 80 mins	**B3**
4(b)	any **two** from: (in solid state molecules / they are) close(r)(than in liquids / gases) (in solid state molecules / they are) in regular arrangement (in solid state molecules / they are) in fixed positions (in solid state molecules / they can only) vibrate	**B2**

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Question	Answer	Marks
5(a)	(P =) F ÷ A OR (pressure =) force ÷ area in any form	**C1**
	12 ÷ 25	**C1**
	0.48 (N / cm^2)	**A1**
5(b)	Any **four** from: molecules in air moving at high speed / kinetic energy molecules collide with (plastic) bottle OR wall (of bottle) force of collisions (per unit area) cause pressure fewer air molecules or collisions on inside(compared to outside) (and so) greater force OR pressure on outside (than inside)	**B4**

Question	Answer	Marks
6(a)(i)	R	**B1**
6(a)(ii)	P	**B1**
6(a)(iii)	idea of: number of (complete) waves {sent out or produced or passing a point} {in one second or unit time}	**B1**
6(b)	any **four** from: (student A) bangs two blocks of wood together (student B) starts stopwatch when (sees) blocks or wood collide (student B) stops stopwatch when she hears echo repeat (experiment) AND calculate average (time) uses 240 m as distance travelled by sound owtte use s= d ÷ t	**B4**

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Question	Answer	Marks
7(a)(i)	ray drawn refracted away from normal	**B1**
7(a)(ii)	angle of incidence correctly identified	**B1**
7(a)(iii)	angle of refraction correctly identified	**B1**
7(b)	total internal reflection (at flat surface)	**B1**
	angle (of incidence) is greater than the critical angle	**B1**
7(c)(i)	(The speed of visible light is) same (as) (the speed of X-rays.)	**B1**
	(The frequency of visible light is) lower OR smaller (than the frequency of X-rays)	**B1**
7(c)(ii)	example of medical / security imaging or treatment of cancer	**B1**

Question	Answer	Marks
8(a)(i)	N marked on left AND S on the right of magnet	**B1**
8(a)(ii)	(soft-iron / bar / it) is attracted to the (N pole of the) magnet	**B1**
	(soft-iron / bar / it) becomes induced magnet	**B1**
	with opposite pole nearest to magnet	**B1**
8(b)(i)	electrons move	**M1**
	from the rod OR to the cloth	**A1**
8(b)(ii)	**TWO** electrical conductors named	**B1**

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Question	Answer	Marks
9(a)(i)	voltmeter	**B1**
9(a)(ii)	volts	**B1**
9(b)(i)	(*R*=) $V \div I$ or $V = I \times R$ or in any form	**C1**
	6.4 ÷ 0.2	**C1**
	32 (Ω)	**A1**
9(b)(ii)	increase the length (of the wire using the same thickness)	**B1**
	smaller diameter (of wire using the same length)	**B1**

Question	Answer	Marks
10(a)(i)	connect (both ends of) wire to galvanometer	**B1**
	move wire relative to magnet owtte	**B1**
10(a)(ii)	any **two** from: increase strength of magnet(ic field) OR strong(er) magnet turn wire into a coil owtte increase the speed (of relative motion)	**B2**
10(b)(i)	arrow drawn from N to S on Fig. 10.1	**B1**
10(b)(ii)	any **two** from: increase (battery) voltage OR larger current in coil increase strength of magnet(ic) field OR strong(er) magnet increase number of turns in coil	**B2**
10(b)(iii)	reverse polarity of battery owtte OR reverse magnet(ic field) owtte	**B1**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>11(a)</td><td>
<table>
<tr><td rowspan="2">property</td><td colspan="3">type of radiation</td></tr>
<tr><td>α-particles</td><td>β-particles</td><td>γ-rays</td></tr>
<tr><td>largest mass</td><td>✓</td><td></td><td></td></tr>
<tr><td>most ionising</td><td>✓</td><td></td><td></td></tr>
<tr><td>most penetrating</td><td></td><td></td><td>✓</td></tr>
<tr><td>negatively charged</td><td></td><td>✓</td><td></td></tr>
<tr><td>greatest speed</td><td></td><td></td><td>✓</td></tr>
</table>
</td><td>B3</td></tr>
<tr><td rowspan="3">11(b)</td><td>idea of 3 half-lives OR 45 ÷ 15</td><td>C1</td></tr>
<tr><td>80 ÷ 8 OR 80 × ½ × ½ × ½</td><td>C1</td></tr>
<tr><td>10 (mg)</td><td>A1</td></tr>
</table>

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