Cambridge Assessment International Education

Cambridge International AS & A Level

PHYSICS **9702/23**

Paper 2 AS Level Structured Questions **May/June 2021**

MARK SCHEME

Maximum Mark: 60

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.

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[Turn over

Abbreviations

/	Alternative and acceptable answers for the same marking point.
( )	Bracketed content indicates words which do not need to be explicitly seen to gain credit but which indicate the **context** for an answer. The context does not need to be seen but if a context is given that is incorrect then the mark should not be awarded.
___	Underlined content must be present in answer to award the mark. This means either the exact word or another word that has the same technical meaning.

Mark categories

B marks	These are independent marks, which do not depend on other marks. For a **B** mark to be awarded, the point to which it refers must be seen specifically in the candidate's answer.
M marks	These are method marks upon which **A** marks later depend. For an **M** mark to be awarded, the point to which it refers must be seen specifically in the candidate's answer. If a candidate is not awarded an **M** mark, then the later **A** mark cannot be awarded either.
C marks	These are compensatory marks which can be awarded even if the points to which they refer are not written down by the candidate, providing subsequent working gives evidence that they must have known them. For example, if an equation carries a **C** mark and the candidate does not write down the actual equation but does correct working which shows the candidate knew the equation, then the **C** mark is awarded. If a correct answer is given to a numerical question, all of the preceding **C** marks are awarded automatically. It is only necessary to consider each of the **C** marks in turn when the numerical answer is not correct.
A marks	These are answer marks. They may depend on an **M** mark or allow a **C** mark to be awarded by implication.

Annotations

✓	Indicates the point at which a mark has been awarded.
X	Indicates an incorrect answer or a point at which a decision is made not to award a mark.
XP	Indicates a physically incorrect equation ('incorrect physics'). No credit is given for substitution, or subsequent arithmetic, in a physically incorrect equation.

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ECF	Indicates 'error carried forward'. Answers to later numerical questions can always be awarded up to full credit provided they are consistent with earlier incorrect answers. Within a section of a numerical question, ECF can be given after AE, TE and POT errors, but **not** after XP.
AE	Indicates an arithmetic error. Do not allow the mark where the error occurs. Then follow through the working/calculation giving full subsequent ECF if there are no further errors.
POT	Indicates a power of ten error. Do not allow the mark where the error occurs. Then follow through the working/calculation giving full subsequent ECF if there are no further errors.
TE	Indicates incorrect transcription of the correct data from the question, a graph, data sheet or a previous answer. For example, the value of 1.6×10^{-19} has been written down as 6.1×10^{-19} or 1.6×10^{19}. Do not allow the mark where the error occurs. Then follow through the working/calculation giving full subsequent ECF if there are no further errors.
SF	Indicates that the correct answer is seen in the working but the final answer is incorrect as it is expressed to too few significant figures.
BOD	Indicates that a mark is awarded where the candidate provides an answer that is not totally satisfactory, but the examiner feels that sufficient work has been done ('benefit of doubt').
CON	Indicates that a response is contradictory.
I	Indicates parts of a response that have been seen but disregarded as irrelevant.
M0	Indicates where an A category mark has not been awarded due to the M category mark upon which it depends not having previously been awarded.
^	Indicates where more is needed for a mark to be awarded (what is written is not wrong, but not enough). May also be used to annotate a response space that has been left completely blank.
SEEN	Indicates that a page has been seen.

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Question	Answer	Marks
1(a)(i)	two correct scalar quantities e.g. time, mass, distance, temperature	**B1**
	two correct vector quantities e.g. force, acceleration, velocity, displacement	**B1**
1(a)(ii)	magnitude	**B1**
	unit	**B1**
1(b)(i)	north component of velocity = 11 m s^{-1}	**A1**
	east component of velocity = 7.5 m s^{-1}	**A1**
1(b)(ii)	velocity = 7.5 – 2.7 = 4.8 m s^{-1}	**A1**
1(b)(iii)	velocity = $\sqrt{(11^2 + 4.8^2)}$	**C1**
	= 12 m s^{-1}	**A1**
1(b)(iv)	angle = $\tan^{-1}$ (4.8 / 11)	**C1**
	= 24°	**A1**

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Question	Answer	Marks
2(a)	change in velocity / time (taken)	**B1**
2(b)(i)	air resistance increases (with speed/with time)	**B1**
	resultant force decreases (as speed increases/with time) so acceleration decreases (as speed increases/with time)	**B1**
	when air resistance equals the weight the speed/velocity/v becomes constant	**B1**
2(b)(ii)	speed = 36 m s^{-1}	**A1**
2(b)(iii)	height given by area under the curve	**C1**
	height = 950 m *Round to two significant figures and award 2 marks for a value in the range 920–980 m and 1 mark for a value in the range 900–910 m or 990–1000 m.*	**A2**
2(b)(iv)	line starting at (0, 9.8)	**B1**
	curve with negative gradient between t = 0 and t = 20 s	**B1**
	line showing zero acceleration between t = 20 s and t = 30 s	**B1**

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Question	Answer	Marks
3(a)	force × distance	**M1**
	perpendicular distance of (line of action of) force from the point	**A1**
3(b)(i)	distance moved by pointer = 123 – 86 (= 37 mm)	**C1**
	(extension =) 37 × (1.8 / 52.6) = 1.3 (mm) **or** sin or tan θ = 37 / 526 (so θ = 4.0° so extension =) sin or tan θ × 18 = 1.3 (mm)	**A1**
3(b)(ii)	moment = $0.472 \times 9.81 \times 6.2 \times 10^{-2}$	**C1**
	= 0.29 N m	**A1**
3(b)(iii)	$(\Delta)F \times 1.8 \times 10^{-2} = 0.29$	**C1**
	ΔF = 16 N	**A1**
3(b)(iv)	$k = F / x$	**C1**
	= $16 / (1.3 \times 10^{-3})$ = 1.2×10^{4} N m^{-1}	**A1**

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Question	Answer	Marks
4(a)	(when two or more) waves meet/overlap (at a point)	**B1**
	(resultant) displacement is sum of the individual displacements	**B1**
4(b)	intensity $\propto$ amplitude^2	**C1**
	maximum intensity = $9I$	**A1**
4(c)(i)	$x = \lambda D / a$	**C1**
	$= (550 \times 10^{-9} \times 1.2) / (0.35 \times 10^{-3})$	**C1**
	$= 1.9 \times 10^{-3}$ m	**A1**
4(c)(ii)	red light has longer wavelength (than 550 nm) so distance (between fringes) increases	**B1**

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Question	Answer	Marks
5(a)	energy per unit charge	**B1**
	energy transferred by source driving charge around the complete circuit **or** energy transferred from other forms to electrical energy	**B1**
5(b)	there is a p.d. across the internal resistance/r	**B1**
	change in current/I results in a change in p.d. across the internal resistance	**B1**
	$V = E$ – p.d. across internal resistance **or** change in p.d. across r causes a change in V (as e.m.f. is constant)	**B1**
5(c)(i)	$E = 7.4$ V	**A1**
5(c)(ii)	maximum current = 0.92 A	**A1**
5(c)(iii)	$r = E / I_{MAX}$ **or** (–)gradient	**C1**
	e.g. $r = 7.4 / 0.92$ $= 8.0\ \Omega$	**A1**
5(d)	straight line with negative gradient that is smaller in magnitude than the original line	**B1**
	line which would have intercept on V-axis below the original line	**B1**

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Question	Answer	Marks
6(a)(i)	up up down	**B1**
6(a)(ii)	up down down	**B1**
6(a)(iii)	(alpha-particle is) 2 protons and 2 neutrons	**C1**
	6 up, 6 down	**A1**
6(b)(i)	most of an atom is empty space **or** the nucleus (volume) is (very) small compared with the atom	**B1**
6(b)(ii)	the nucleus is charged	**B1**
	the majority of the mass of atom is in the nucleus	**B1**
6(c)	$F = Eq$ **and** $a = F / m$	**C1**
	$a = Eq / m$ ratio = $(e / m) / (2e / 4m)$ $= 2$	**A1**

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