Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

PHYSICS **9702/22**

Paper 2 AS Level Structured Questions **October/November 2019**

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.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the October/November 2019 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.

Question	Answer	Marks
1(a)	scalar quantity has (only) magnitude	**B1**
	vector quantity has magnitude and direction	**B1**
1(b)(i)	$E = F / Q$	**C1**
	$= \text{kg m s}^{-2} / \text{A s} = \text{kg m A}^{-1}\text{ s}^{-3}$	**A1**
1(b)(ii)	$b = Q / x^2 E$ $= \text{A s} / \text{m}^2 \text{ kg m A}^{-1}\text{ s}^{-3}$	**C1**
	$= \text{A}^2\text{ s}^4\text{ kg}^{-1}\text{ m}^{-3}$	**A1**

Question	Answer	Marks
2(a)	change in velocity / time (taken)	**A1**
2(b)(i)	weight ≫ (force due to) air resistance **or** (force due to) air resistance is negligible <u>compared to weight</u>	**B1**
2(b)(ii)	$s = ut + ½at^2$ $0.280 = ½ \times 9.81 \times t^2$	**C1**
	$t = 0.24$ s	**A1**

Question	Answer	Marks
2(b)(iii)	total distance fallen = 0.280 + 0.080 = 0.360 $0.360 = ½ \times 9.81 \times t^2$ t = 0.27 s	**C1**
	time taken = 0.27 – 0.24 = 0.03 s	**A1**
	or	
	$v = 9.81 \times 0.239$ **or** $(2 \times 9.81 \times 0.280)^{0.5}$ **or** $(2 \times 0.280) / 0.239$ = 2.34 ($m s^{-1}$)	**(C1)**
	$0.080 = 2.34t + ½ \times 9.81 \times t^2$ solving quadratic equation gives t = 0.03 s *allow any correct method using equations of uniform accelerated motion*	**(A1)**
2(c)	(average) resultant force/acceleration/speed/velocity (of low-density ball) is less	**B1**
	(so) time interval is longer	**B1**

Question	Answer	Marks
3(a)	force on body A (by body B) is equal (in magnitude) to force on body B (by body A)	**B1**
	force on body A (by body B) is opposite (in direction) to force on body B (by body A)	**B1**
3(b)(i)	$m_X \times 5v$ **or** $(m_X + m_Y) \times v$	**C1**
	$m_X \times 5v = (m_X + m_Y) \times v$ (so) $m_Y / m_X = 4$	**A1**
3(b)(ii)	$(E =) \frac{1}{2}mv^2$	**C1**
	ratio $= [\frac{1}{2} \times (m_X + m_Y) \times v^2] / [\frac{1}{2} \times m_X \times (5v)^2]$	**C1**
	$= 0.2$	**A1**
3(b)(iii)	ratio = 1	**A1**
3(c)(i)	**1.** (magnitude of resultant force is) zero	**B1**
	2. (magnitude of resultant force is) constant	**B1**
	(direction of resultant force is) opposite to the momentum	**B1**
3(c)(ii)	horizontal line from (0 ms, 0 squares) ending at (20 ms, 0 squares)	**B1**
	straight line from (20 ms, 0 squares) ending at (40 ms, 4.0 squares [= 4.0 cm vertically])	**B1**
	horizontal line from (40 ms, 4.0 squares) ending at (60 ms, 4.0 squares)	**B1**

Question	Answer	Marks
4(a)(i)	(vertically) upwards/up	**B1**
4(a)(ii)	increases (with time/velocity/depth)	**B1**
4(b)(i)	for a body in (rotational) equilibrium	**B1**
	<u>sum/total</u> of clockwise moments about a point = <u>sum/total</u> of anticlockwise moments about the (same) point	**B1**
4(b)(ii)	$(F_B \times 5.0)$ **or** (380×2.5) **or** (750×1.6)	**C1**
	$(F_B \times 5.0) = (380 \times 2.5) + (750 \times 1.6)$ $F_B = 430$ N	**A1**
4(b)(iii)	taking moments about C: $(380 \times 2.5) = 750 \times (2.0 - x)$	**C1**
	$(2.0 - x) = 1.3$ $x = 0.7$ m	**A1**
	or	
	moments may be taken about other points, e.g. about D: $(380 \times 4.5) + (750 \times x) = 1130 \times 2.0$	**(C1)**
	$x = 0.7$ m	**(A1)**

Question	Answer	Marks
5(a)	distance moved by wavefront/energy during one cycle/oscillation/period (of source) **or** <u>minimum</u> distance between two wavefronts **or** distance between two <u>adjacent</u> wavefronts	**B1**
5(b)	$(T =)\ 2.0 \times 2.5$ (= 5.0 ms) **or** $2.0 \times 2.5 \times 10^{-3}$ (= 5.0×10^{-3} s)	**C1**
	$f = 1 / (5.0 \times 10^{-3})$ = 200 Hz	**A1**
5(c)(i)	(path difference =) $8.0 + (20.8^2 - 8.0^2)^{0.5} - 20.8 = 6.4$ (m)	**A1**
5(c)(ii)	• <u>path difference</u> = 4λ • waves (meet at C) in phase • constructive interference (of waves) *any two points, one mark each*	**B2**
5(c)(iii)	$v = 200 \times 1.6$ = 320 (m s^{-1})	**C1**
	$\Delta t = 6.4 / 320$ **or** $27.2 / 320 - 20.8 / 320$ = 0.020 s	**A1**
5(c)(iv)	$3\lambda = 6.4$ $\lambda = 2.1$ m	**A1**

Question	Answer	Marks
6(a)	<u>sum of</u> current(s) into junction = <u>sum of</u> current(s) out of junction **or** (algebraic) sum of current(s) at a junction is zero	**B1**
6(b)(i)	$R = V / I$	**C1**
	$= 0.60 / 7.5 \times 10^{-3}$	**C1**
	$= 80\ \Omega$	**A1**
6(b)(ii)	resistance decreases	**B1**
6(c)(i)	$E = 0.60 + 0.30$ $= 0.90\ \text{V}$	**A1**
6(c)(ii)	(I =) 9.3 – 7.5	**C1**
	$I = 1.8$ (mA) **or** 1.8×10^{-3} (A) $R = 0.90 / 1.8 \times 10^{-3}$ $= 500\ \Omega$	**A1**
	or	
	total resistance = $0.90 / 9.3 \times 10^{-3} = 96.8$ (Ω) total resistance of diode and X = $0.90 / 7.5 \times 10^{-3} = 120$ (Ω) $1 / 96.8 = 1 / R + 1 / 120$	**(C1)**
	$R = 500\ \Omega$	**(A1)**

Question	Answer	Marks
6(c)(iii)	$P = VI$ **or** I^2R **or** V^2 / R	**C1**
	$= 0.60 \times 7.5 \times 10^{-3}$ **or** $(7.5 \times 10^{-3})^2 \times 80$ **or** $0.60^2 / 80$ $= 4.5 \times 10^{-3}$ W	**A1**
6(c)(iv)	current = 2.5 mA	**A1**

Question	Answer	Marks
7(a)	number of protons = 92	**A1**
	number of neutrons = 142	**A1**
7(b)	5.6 MeV $= 5.6 \times 1.60 \times 10^{-19} \times 10^6$ $(= 8.96 \times 10^{-13}$ J)	**C1**
	number $= 0.15 / (5.6 \times 1.60 \times 10^{-13})$ $= 1.7 \times 10^{11}$	**A1**
	or	
	0.15 W $= 0.15 / (1.60 \times 10^{-19} \times 10^6)$ $(= 9.38 \times 10^{11}$ MeV s^{-1})	**(C1)**
	number $= 9.38 \times 10^{11} / 5.6$ $= 1.7 \times 10^{11}$	**(A1)**