Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

PHYSICS **9702/22**

Paper 2 AS Level Structured Questions **March 2018**

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 March 2018 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)	acceleration: vector speed: scalar power: scalar *All three correct scores 2 marks. Only two correct scores 1 mark.*	**B2**
1(b)(i)	time = 0.43 / 1.1 = 0.39 s	**A1**
1(b)(ii)	$s = ut + ½at^2$ $= ½ \times 9.81 \times 0.39^2$	**C1**
	= 0.75 m	**A1**
1(b)(iii)	1 horizontal line at a non-zero value of *a*.	**B1**
	2 curved line from origin with increasing gradient.	**B1**
1(c)	acceleration (of free fall) is unchanged / not dependent on mass <u>and</u> so no effect (on time taken).	**A1**

Question	Answer	Mark
2(a)(i)	force × distance <u>moved</u> in the direction of the force	**B1**
2(a)(ii)	energy (of a mass/body) due to motion / speed / velocity	**B1**
2(b)(i)	1 $E = ½mv^2$	**C1**
	$(\Delta)E = ½ \times 580 \times (22^2 – 12^2) = 9.9 \times 10^4$ J	**A1**
	2 $(\Delta)E = mg(\Delta)h$ $\Delta E = 580 \times 9.81 \times 13$	**C1**
	$= 7.4 \times 10^4$ J	**A1**

Question	Answer	Marks
2(b)(ii)	length = $(2\pi\times13) / 4$ or $(\pi\times26) / 4$ or $(\pi\times13) / 2 = 20$ m	A1
2(b)(iii)	work done against resistive force = $9.9 \times 10^4 - 7.4 \times 10^4$ average resistive force = $(9.9 \times 10^4 - 7.4 \times 10^4) / 20$	C1
	= 1300 N	A1
2(b)(iv)	from horizontal/right to vertical / up or 90°	A1
2(b)(v)	$p = mv$ or (580×22) or (580×12)	C1
	$\Delta p = [(580\times12)^2 + (580\times22)^2]^{0.5}$	C1
	$= 1.5 \times 10^4$ N s	A1

Question	Answer	Marks
3(a)(i)	force / (cross-sectional) area	B1
3(a)(ii)	extension / original length	B1
3(b)(i)	measure / determine / find diameter	B1
	using a micrometer / <u>digital</u> calipers	B1
	several measurements in different places / along the wire / around the circumference (and average them)	B1
3(b)(ii)	$E = \sigma / \varepsilon$ or $E = FL / Ax$ or $E =$ gradient $\times (L / A)$ $E = (4 \times 2.5) / (0.8 \times 10^{-3}) \times (9.4 \times 10^{-8})$	C1
	$= 1.3 \times 10^{11}$ Pa	A1

Question	Answer	Marks
3(b)(iii)	$E = ½Fx$ or $E = ½kx^2$ or E = area under graph $E = ½ \times (2+4) \times 0.4 \times 10^{-3}$ or $E = (½ \times 4 \times 0.8\times10^{-3}) - (½ \times 2 \times 0.4\times10^{-3})$ or $E = [\ ½ \times 5000 \times (0.8\times10^{-3})^2\ ] - [\ ½ \times 5000 \times (0.4\times10^{-3})^2\ ]$	**C1**
	$E = 1.2 \times 10^{-3}$ J	**A1**
3(c)	straight line from the origin and above the original line	**M1**
	straight line passes through (0.80, 8.0)	**A1**

Question	Answer	Marks
4(a)	(two) waves (travelling at same speed) in opposite directions overlap	**B1**
	(waves are same type and) have same frequency / wavelength	**B1**
4(b)(i)	$v = f\lambda$ $f = 330 / 0.18$	**C1**
	= 1800 Hz (1830 Hz)	**A1**
4(b)(ii)	$T = 1 / 1800$ (= 5.5×10^{-4}) time-base setting = $(1.5 \times 5.5 \times 10^{-4}) / 8.0$ or $1 / (1800 \times 5.3)$	**C1**
	= 1.0×10^{-4} s cm^{-1}	**A1**
4(b)(iii)	waveform drawn with same period as original waveform	**B1**
	waveform drawn with amplitude of 1.7 cm	**B1**
4(c)(i)	distance = $\lambda / 2 = 0.18 / 2$ = 0.090 m	**A1**

Question	Answer	Marks
4(c)(ii)	letter N shown at level B and at level A and not anywhere else.	**B1**
4(c)(iii)	$m = \rho A x$ $= 0.79 \times 13 \times 9.0$ (=92.4) or $790 \times 13 \times 10^{-4} \times 0.090$ (=0.0924) $t = 92.4 / 6.7$ or $0.0924 / 0.0067$	**C1**
	= 14 s	**A1**

Question	Answer	Marks
5(a)	<u>sum of</u> e.m.f.(s) = <u>sum of</u> p.d.(s)	**M1**
	around a loop / around a closed circuit	**A1**
5(b)(i)	1 $6.0 - 4.0I = 0$ $I = 1.5$ A	**A1**
	2 $6.0 + 6.0 = I\,(4.0 + R + 1.5)$ $12 = 1.5\,(4.0 + R + 1.5)$	**C1**
	$R = 2.5\,\Omega$	**A1**
	or $6.0 = I\,(R + 1.5)$ $6.0 = 1.5\,(R + 1.5)$	**(C1)**
	$R = 2.5\,\Omega$	**(A1)**
	or combines $6 = 4I$ and $6 = I(R + 1.5)$ to give $4 = R + 1.5$	**(C1)**
	$R = 2.5\,\Omega$	**(A1)**

Question	Answer	Marks
5(b)(ii)	$I = Anvq$ ratio = $1^2 / 2^2$	C1
	= 0.25	A1
5(b)(iii)	<u>total</u> (circuit) resistance increases	B1
	current / I decreases or $P \propto I$ or $P \propto 1 /$ (<u>total</u> resistance)	M1
	power (transformed) decreases	A1

Question	Answer	Marks
6(a)	–1 / decreases by 1	A1
6(b)	$I = Q / t$ or Ne / t	C1
	$= (9.8\times10^{10} \times 1.6\times10^{-19}) / (2.0 \times 60)$ $= 1.3 \times 10^{-10}$ (A)	C1
	= 130 pA	A1
6(c)	antineutrino(s) (emitted) / other particle(s) (emitted)	C1
	energy / momentum shared with antineutrino(s)	A1