
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.

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**Cambridge Assessment**
International Education

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 <i>All three correct scores 2 marks. Only two correct scores 1 mark.</i>	B2
1(b)(i)	time = $0.43 / 1.1$ = 0.39 s	A1
1(b)(ii)	$s = ut + \frac{1}{2}at^2$ = $\frac{1}{2} \times 9.81 \times 0.39^2$	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 and <u>so</u> no effect (on time taken).	A1

Question	Answer	Mark
2(a)(i)	force $\times$ 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 $E = \frac{1}{2}mv^2$	C1
	$(\Delta)E = \frac{1}{2} \times 580 \times (22^2 - 12^2) = 9.9 \times 10^4 \text{ J}$	A1
	2 $(\Delta)E = mg(\Delta)h$ $\Delta E = 580 \times 9.81 \times 13$	C1
	= $7.4 \times 10^4 \text{ J}$	A1

Question	Answer	Marks
2(b)(ii)	length = $(2\pi \times 13) / 4$ or $(\pi \times 26) / 4$ or $(\pi \times 13) / 2 = 20$ m	A1
2(b)(iii)	work done against resistive force = $9.9 \times 10^4 - 7.4 \times 10^4$	C1
	average resistive force = $(9.9 \times 10^4 - 7.4 \times 10^4) / 20$	
	= 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
	$\Delta p = [(580 \times 12)^2 + (580 \times 22)^2]^{0.5}$	C1
	= 1.5×10^4 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)	$E = \sigma / \epsilon$ or $E = FL / Ax$ or $E = \text{gradient} \times (L / A)$	C1
	$E = (4 \times 2.5) / (0.8 \times 10^{-3}) \times (9.4 \times 10^{-8})$	
	= 1.3×10^{11} Pa	A1

Question	Answer	Marks
3(b)(iii)	$E = \frac{1}{2}Fx$ or $E = \frac{1}{2}kx^2$ or $E = \text{area under graph}$ $E = \frac{1}{2} \times (2+4) \times 0.4 \times 10^{-3}$ or $E = (\frac{1}{2} \times 4 \times 0.8 \times 10^{-3}) - (\frac{1}{2} \times 2 \times 0.4 \times 10^{-3})$ or $E = [\frac{1}{2} \times 5000 \times (0.8 \times 10^{-3})^2] - [\frac{1}{2} \times 5000 \times (0.4 \times 10^{-3})^2]$	C1
	$E = 1.2 \times 10^{-3} \text{ J}$	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)	$v = f\lambda$ $f = 330 / 0.18$ $= 1800 \text{ Hz (1830 Hz)}$	C1
		A1
4(b)(ii)	$T = 1 / 1800 (= 5.5 \times 10^{-4})$ time-base setting $= (1.5 \times 5.5 \times 10^{-4}) / 8.0$ or $1 / (1800 \times 5.3)$ $= 1.0 \times 10^{-4} \text{ s cm}^{-1}$	C1
		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 $= \lambda / 2 = 0.18 / 2$ $= 0.090 \text{ m}$	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)	$m = \rho Ax$ $= 0.79 \times 13 \times 9.0 (=92.4)$ or $790 \times 13 \times 10^{-4} \times 0.090 (=0.0924)$ $t = 92.4 / 6.7$ or $0.0924 / 0.0067$	C1
	$= 14 \text{ s}$	A1

Question	Answer	Marks
5(a)	<u>sum of e.m.f.(s) = sum of p.d.(s)</u> around a loop / around a closed circuit	M1
		A1
5(b)(i)	1 $6.0 - 4.0I = 0$ $I = 1.5 \text{ A}$	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	
5(b)(iii)	<u>total</u> (circuit) resistance increases	B1
	current / I decreases or $P \propto I$ or $P \propto 1 / (\text{total resistance})$	
	power (transformed) decreases	
		A1

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