Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

PHYSICS **9702/22**

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

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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.

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Question	Answer	Marks
1(a)	$v_X = (6.0^2 - 4.8^2)^{1/2} = 3.6\,(\text{m s}^{-1})$ **or** $6.0\sin\theta = 4.8$ (so $\theta = 53.1°$) **and** $v_x = 6.0\cos 53.1° = 3.6\,(\text{m s}^{-1})$	**A1**
1(b)(i)	straight line from (0, 4.8) to (0.49, 0)	**M1**
	straight line continues with same slope to (0.98, –4.8) (labelled Y)	**A1**
1(b)(ii)	a horizontal line	**M1**
	from (0, 3.6) to (0.98, 3.6) (labelled X)	**A1**
1(c)	$s = ut + \frac{1}{2}at^2$ $= (4.8 \times 0.49) + (\frac{1}{2} \times -9.81 \times 0.49^2)$ **or** $s = \frac{1}{2}(u + v)t$ **or** area under graph $= \frac{1}{2} \times (4.8 + 0) \times 0.49$ **or** $s = vt - \frac{1}{2}at^2$ $= \frac{1}{2} \times 9.81 \times 0.49^2$ **or** $v^2 = u^2 + 2as$ $s = 4.8^2 / (2 \times 9.81)$	**C1**
	$s = 1.2\,\text{m}$	**A1**

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Question	Answer	Marks
1(d)	$(\Delta)E = mg(\Delta)h$	**C1**
	$E = ½mv^2$	**C1**
	ratio = $(½ \times m \times 3.6^2) / (m \times 9.81 \times 1.2)$ **or** ratio = $[(½ \times m \times 6.0^2) – (m \times 9.81 \times 1.2)] / (m \times 9.81 \times 1.2)$ **or** ratio = $(½ \times m \times 3.6^2) / (½ \times m \times 4.8^2)$	**C1**
	ratio = 0.56	**A1**
1(e)	(force due to) air resistance acts in opposite direction to the velocity **or** (with air resistance, average) resultant force is larger (than weight)	**B1**

Question	Answer	Marks
2(a)	ampere kelvin (**allow** mole, candela) *any two correct answers, 1 mark each*	**B2**
2(b)(i)	frictional (force)/friction	**B1**
2(b)(ii)	$W\cos 31° \times 3.0$ **or** 90×6.0	**C1**
	$W\cos 31° \times 3.0 = 90 \times 6.0$ $W = 210\,\text{N}$	**A1**
2(b)(iii)	$X = 90\sin 31°$ $= 46\,\text{N}$	**A1**

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Question	Answer	Marks
3(a)	sum/total momentum (of a system of bodies) is constant **or** sum/total momentum before = sum/total momentum after	**M1**
	for an isolated system **or** no (resultant) external force	**A1**
3(b)(i)	$m = \rho V$	**C1**
	$= 1.3 \times \pi \times 0.045^2 \times 1.8 \times 2.0 = 0.030$ (kg)	**A1**
3(b)(ii)	**1.** $(\Delta)p = (\Delta)mv$	**C1**
	$= 0.030 \times 1.8$ $= 0.054$ N s	**A1**
	2. $F = 0.054/2.0$ **or** $0.030 \times 1.8/2.0$ $= 0.027$ N	**A1**
3(b)(iii)	force on air (by propeller) equal to force on propeller (by air)	**M1**
	and opposite (in direction)	**A1**
3(b)(iv)	resultant force $= 0.20 \times 0.075$ (= 0.015 N) frictional force $= 0.027 - 0.015$	**C1**
	$= 0.012$ N	**A1**

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Question	Answer	Marks
4(a)	vibration(s)/oscillation(s) (of particles) parallel to direction of propagation of energy	**B1**
4(b)(i)	phase difference = 180°	**A1**
4(b)(ii)	$v = f\lambda$	**C1**
	$\lambda/2$ = 25 (cm) or 0.25 (m)	**C1**
	f = 330 / 0.50 = 660 Hz	**A1**
4(b)(iii)	(readings from graph =) 2.6 and 4.0	**C1**
	ratio = $(2.6/4.0)^{1/2}$ = 0.81	**A1**

Question	Answer	Marks
5(a)	$n\lambda = d\sin\theta$	**C1**
	$\lambda = 640 \times 10^{-9}$ (m)	**C1**
	$2 \times 640 \times 10^{-9} = 1.7 \times 10^{-6} \times \sin\theta$ so θ = 49(°)	**A1**
5(b)	$2 \times 640 \times 10^{-9} = 3 \times \lambda$ **or** $1.7 \times 10^{-6} \times \sin 49° = 3 \times \lambda$	**C1**
	$\lambda = 4.3 \times 10^{-7}$ m	**A1**

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Question	Answer	Marks
6(a)	joule / coulomb	**B1**
6(b)(i)	$7.0 = (I \times 5.2) + (I \times 6.0) + 1.4$	**C1**
	$I = 0.50\,\text{A}$	**A1**
6(b)(ii)	$R = 1.4/0.50$ $= 2.8\,\Omega$	**A1**
6(b)(iii)	$P = EI$ **or** $P = VI$ **or** $P = I^2R$ **or** $P = V^2/R$	**C1**
	efficiency = $[(0.50^2 \times 6.0)/(7.0 \times 0.50)]$ $(\times 100)$ **or** efficiency = $[(0.50 \times 3.0)/(7.0 \times 0.50)]$ $(\times 100)$ **or** efficiency = $[(3.0^2/6.0)/(7.0 \times 0.50)]$ $(\times 100)$	**C1**
	efficiency = 43%	**A1**
6(b)(iv)	$R = \rho l/A$	**C1**
	$\alpha = \rho/R$ $= 3.7 \times 10^{-7}/6.0$ $= 6.2 \times 10^{-8}\,\text{m}$	**A1**

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Question	Answer	Marks
7(a)	*A*: (cross-sectional) area (of wire)	**B1**
	n: number of free electrons per unit volume **or** number density of free electrons	**B1**
7(b)	line drawn between (X, v_x) and (Y, $4v_x$)	**M1**
	line has increasing gradient	**A1**

Question	Answer	Marks
8(a)	antineutrino **and** positron both underlined (and no other particles)	**B1**
8(b)(i)	nucleon number = 27	**A1**
	proton number = 13	**A1**
8(b)(ii)	weak (nuclear force/interaction)	**B1**
8(b)(iii)	an (electron) antineutrino / $\bar{\nu}_{(e)}$ is produced (and this has energy)	**B1**
	X has kinetic energy	**B1**

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