Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

PHYSICS **9702/21**

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.

Cambridge International is publishing the mark schemes for the October/November 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)(i)	distance in a specified direction (from a point)	**B1**
1(a)(ii)	change in velocity / time (taken)	**B1**
1(b)(i)	vertical component of velocity = $(5.5^2 - 4.6^2)^{1/2} = 3.0$ (m s^{-1}) **or** $5.5\cos\theta = 4.6$ (so θ = 33.2°) **and** $5.5\sin 33.2° = 3.0$ (m s^{-1})	**A1**
1(b)(ii)	$s = ut + ½at^2$ $0 = (3.0 \times t) - (½ \times 9.81 \times t^2)$ **or** $v = u + at$ $-3.0 = 3.0 - 9.81t$	**C1**
	$t = 0.61$ s	**A1**
1(b)(iii)	$d = 4.6 \times 0.61$ $= 2.8$ m	**A1**
1(b)(iv)	$E = ½mv^2$	**C1**
	ratio = $(½ \times m \times 4.6^2) / (½ \times m \times 5.5^2)$ **or** ratio = $(½ \times m \times 5.5^2 - m \times 9.81 \times 0.459) / (½ \times m \times 5.5^2)$	**C1**
	ratio = 0.70	**A1**
1(c)	straight line from positive value of v_y at $t = 0$ to negative value of v_y	**M1**
	straight line ends at $t = T$ and final magnitude of v_y greater than initial magnitude of v_y	**A1**

Question	Answer	Marks
2(a)	(p =) mv **or** 4.0×45 **or** 2.0×85 **or** $89v$	**C1**
	$(4.0 \times 45) - (2.0 \times 85) = 89\,v$ $v = 0.11\,\text{m s}^{-1}$	**A1**
2(b)(i)	**1.** speed of approach = $47\,\text{m s}^{-1}$ **and** **2.** speed of separation = 0	**A1**
2(b)(ii)	speed of separation less than/not equal to speed of approach **and** so inelastic collision	**A1**
2(c)	force is equal to rate of change of momentum	**B1**
	force on ball (by block) <u>equal and opposite</u> to force on block (by ball) so rates of change of momentum are <u>equal and opposite</u>	**B1**
	or	
	force on ball (by block) <u>equal and opposite</u> to force on block (by ball)	**(B1)**
	force is equal to rate of change of momentum so rates of change of momentum are <u>equal and opposite</u>	**(B1)**

Question	Answer	Marks
3(a)(i)	work (done) / time (taken)	**B1**
3(a)(ii)	energy of a mass due to its position in a gravitational field	**B1**
3(b)(i)	$P = Fv$	**C1**
	$= 2.0 \times 10^3 \times 45$ $= 9.0 \times 10^4$ W	**A1**
3(b)(ii)	**1.** $W = (2.0 \times 10^3) \times (45 \times 3.0 \times 60)$ **or** $W = 9.0 \times 10^4 \times 3.0 \times 60$	**C1**
	$W = 1.6 \times 10^7$ J	**A1**
	2. $(\Delta)E_P = mg(\Delta)h$	**C1**
	$= 1200 \times 9.81 \times 3.3 \times 3.0 \times 60$ $= 7.0 \times 10^6$ J	**A1**
	3. $W = 1.6 \times 10^7 - 7.0 \times 10^6$ $= 9.0 \times 10^6$ J	**A1**
3(b)(iii)	force $= (9.0 \times 10^6) / (45 \times 3.0 \times 60)$ $= 1.1 \times 10^3$ N	**A1**
3(b)(iv)	constant velocity so no resultant force	**B1**
	no resultant force so in equilibrium	**B1**

Question	Answer	Marks
4(a)	when (two or more) waves meet (at a point)	**B1**
	(resultant) displacement is the sum of the individual displacements	**B1**
4(b)(i)	constant phase difference (between the waves)	**B1**
4(b)(ii)	**1.** phase difference = 360° **or** 0	**B1**
	2. path difference $= 1.5\lambda$ $= 1.5 \times 610$ $= 920\,\text{nm}$	**A1**
4(b)(iii)	$\lambda = ax/D$	**C1**
	$x = 22/4$ (= 5.5 mm) **or** $22 \times 10^{-3}/4$ (= 5.5×10^{-3} m)	**C1**
	$a = (610 \times 10^{-9} \times 2.7)/(5.5 \times 10^{-3})$ $= 3.0 \times 10^{-4}\,\text{m}$	**A1**
4(b)(iv)	shorter wavelength **and** (so) separation decreases	**B1**
4(b)(v)	• no change to fringe separation/fringe width/number of fringes • bright fringes are brighter • dark fringes are unchanged *Any two of the above three points, 1 mark each.*	**B2**

Question	Answer	Marks
5(a)	region (of space) where a force acts on a (stationary) charge	**B1**
5(b)	$E = F / Q$	**B1**
	$F = ma$ **and** (so) $a = \dfrac{Eq}{m}$	**A1**
5(c)(i)	protons = 96	**A1**
	neutrons = 148	**A1**
5(c)(ii)	mass-energy is conserved/mass change is 'seen' as energy	**B1**
	energy released as gamma (radiation)/KE of α/KE of Pu	**B1**
5(c)(iii)	ratio $= \dfrac{2}{4} \times \dfrac{240}{94}$ **or** ratio $= \dfrac{2 \times 1.60 \times 10^{-19}}{4 \times 1.66 \times 10^{-27}} \times \dfrac{240 \times 1.66 \times 10^{-27}}{94 \times 1.60 \times 10^{-19}}$	**C1**
	ratio = 1.3	**A1**

Question	Answer	Marks
6(a)	<u>sum of</u> e.m.f.(s) equal to <u>sum of</u> p.d.(s)	**M1**
	around a loop/around a closed circuit	**A1**
6(b)(i)	current in variable resistor = (6.0 / 2.4) + (6.0 / 1.2) (= 7.5 A)	**C1**
	p.d. across variable resistor = 9.0 – 6.0 (= 3.0 V)	**C1**
	R = 3.0 / 7.5 = 0.40 Ω	**A1**
	or	
	$\frac{1}{R_T} = \frac{1}{2.4} + \frac{1}{1.2}$ $R_T = 0.80\ (\Omega)$	**(C1)**
	$\frac{3}{9} = \frac{R}{(R + 0.80)}$ **or** $\frac{3}{R} = \frac{6}{0.8}$	**(C1)**
	$R = 0.40\ \Omega$	**(A1)**
6(b)(ii)	$P = V^2 / R$ **or** $P = I^2R$ **or** $P = IV$	**C1**
	$P = 6.0^2 / 24$ **or** $2.5^2 \times 2.4$ **or** 6.0×2.5 = 15 W	**A1**

Question	Answer	Marks
6(b)(iii)	**1.** $R = \dfrac{\rho L}{A}$	C1
	ratio $= (2.4 / 1.2) \times (3 / 1)$ $= 6.0$	A1
	2. $(I = nAvq)$ $I_X / I_Y = 2.5 / 5.0$ **or** $1.2 / 2.4$ **or** 0.5	C1
	ratio $= (2.5 / 5.0) \times (1 / 3)$ **or** $(1.2 / 2.4) \times (1 / 3)$ $= 0.17$	A1