Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

PHYSICS **9702/23**

Paper 2 AS Level Structured Questions **May/June 2017**

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 will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the May/June 2017 series for most Cambridge IGCSE®, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

Question	Answer	Marks
1(a)(i)	R = 7(.0) N	**B1**
1(a)(ii)	R = 13 N	**B1**
1(b)(i)	forces resolved: 18 sin 65° (vertical) **and** 55 + 18 cos 65° (horizontal) **or** scale drawing: correct triangle drawn for forces	**B1**
	$F = [(18 \sin 65°)^2 + (55 + 18 \cos 65°)^2]^{1/2}$ = 65 (64.7) N **or** scale drawing: scale given, length of resultant given correctly, ± 1 N	**A1**
1(b)(ii)	angle = $\tan^{-1}$ [18 sin 65° / (55 + 18 cos 65°)] = $\tan^{-1}$ (16.3 / 62.6) **or** scale drawing: correct angle measured/direction correct on diagram below the 55 N force	**C1**
	angle = 15 (14.6)° (below the 55 N force) **or** scale drawing: angle = 15° ± 1°	**A1**
1(c)	(resultant) force = mass × acceleration	**C1**
	80 − 65 = 2.7a	**C1**
	a = 5.6 m s^{-2} [5.7 if 64.7 N used from **(i)**]	**A1**

Question	Answer	Marks
2(a)	(resultant) force is proportional/equal to the rate of change of momentum	**B1**
2(b)(i)	change in momentum $= m(v_2 - v_1)$ $= 0.84 \times (8.8 - 4.2)$	**C1**
	$= 3.9$ (3.86) kg m s^{-1}	**A1**
2(b)(ii)	$F = (3.9 / 4.0) = 0.97$ (0.965) N	**A1**
2(c)(i)	change in momentum for A: $0.84 \times (4.7 - 8.8) = -3.4$ (3.44) change in momentum for B: $0.73 \times (4.7 - 0) = 3.4$ (3.43)	**M1**
	change in momentum for B is equal and opposite to A	**A1**
2(c)(ii)	change in momentum equal (for A and B)	**M1**
	force is change in momentum / time and time (of collision) is the same hence force on A and B equal and opposite as for Newton's third law	**A1**
2(c)(iii)	inelastic as relative speed of approach not equal to relative speed of separation	**B1**

Question	Answer	Marks
3(a)	force per unit (positive) charge	**B1**
3(b)(i)	$a = (v^2 - u^2) / 2s$ $= [(18 \times 10^6)^2 - (2.5 \times 10^3)^2] / (2 \times 12 \times 10^{-3})$	**B1**
	$= 1.3\ (1.35) \times 10^{16}\ \text{m s}^{-2}$	**A1**
3(b)(ii)	KE = $\frac{1}{2} mv^2$ **or** $\frac{1}{2} m(v^2 - u^2)$	**C1**
	change in KE $= 0.5 \times 9.11 \times 10^{-31} \times [(18 \times 10^6)^2 - (2.5 \times 10^3)^2]$	**B1**
	$= 1.5\ (1.48) \times 10^{-16}\ \text{J}$	**A1**
3(b)(iii)	$E = F / e = ma / e$ **or** $eV = \Delta\text{KE}$ so $E = \Delta\text{KE} / (e \times d)$	**C1**
	$E = (9.11 \times 10^{-31} \times 1.35 \times 10^{16}) / 1.60 \times 10^{-19}$ **or** $E = (1.48 \times 10^{-16}) / (12 \times 10^{-3} \times 1.60 \times 10^{-19})$	**C1**
	$= 7.7\ (7.69) \times 10^4\ \text{V m}^{-1}$	**A1**
3(c)	charge on α opposite to electron/charge on α is positive	**B1**
	ΔKE is negative/KE reduced	**B1**
	charge of α greater/twice that of electron causes larger/twice ΔKE (in magnitude)	**B1**

Question	Answer	Marks
4(a)	the straight line does not go through the origin/the force is not proportional to extension (so does not obey Hooke's law)	**A1**
4(b)	elastic potential energy	**B1**
4(c)	remove the force/masses and the spring returns to its original length if elastic	**B1**
4(d)	work done is represented by/linked to area under the line ($\times g$)	**C1**
	work $= ½ (145 + 70) \times 10^{-3} \times 9.81 \times 120 \times 10^{-3}$	**C1**
	$= 0.13 (0.127)$ J	**A1**

Question	Answer	Marks
5(a)(i)	waves at the elements/slits	**B1**
	waves spread (into the geometric shadow)	**B1**
5(a)(ii)	**1.** waves (from each element/slit) overlap/meet/superpose	**B1**
	with a phase difference/path difference of zero	**B1**
	2. phase difference is 360°/path difference of λ	**B1**
5(b)(i)	e.g. gradient $= (0.40 - 0.32) / [(500 - 400) \times 10^{-9}]$	**C1**
	$= 8(.0) \times 10^{5}$	**A1**
5(b)(ii)	$d \sin\theta = n\lambda$ $d = n /$ gradient	**C1**
	$= 2 / 8.0 \times 10^{5} = 2.5 \times 10^{-6}$ m	**A1**
5(b)(iii)	straight line drawn with lower gradient (about ½) and all points lower	**B1**

Question	Answer	Marks
6(a)(i)	straight line through the origin	**B1**
6(a)(ii)	zero current for one direction (–ve *V*) up to zero or a few tenths of volt (+ve *V*)	**B1**
	straight line positive gradient/increasing gradient (+ve *V*)	**B1**
6(b)(i)	**1.** current = 2.8 A	**A1**
	2. 4(.0) A for each lamp	**C1**
	current in circuit = 8(.0) A	**A1**
6(b)(ii)	use of $R = V / I$ with correct values of *V* from graph for each arrangement	**C1**
	1. series resistance (= 2.1 + 2.1) = 4.2 or 4.3 Ω **or** (12 / 2.8) = 4.3 Ω	**A1**
	2. parallel resistance 1.5 Ω (each lamp 3.0 Ω) **or** (12 / 8.0) = 1.5 Ω	**A1**
6(b)(iii)	power = IV **or** V^2 / R **or** I^2R	**C1**
	ratio = $(2.8 \times 6.0) / (4.0 \times 12) = 0.35$	**A1**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>7(a)</td><td>electron and quark both underlined/clearly indicated and no others</td><td>B1</td></tr>
<tr><td>7(b)(i)</td><td><table><tr><td></td><td>value</td></tr><tr><td>A</td><td>60</td></tr><tr><td>B</td><td>28</td></tr></table>both correct</td><td>B1</td></tr>
<tr><td>7(b)(ii)</td><td>(electron) antineutrino</td><td>B1</td></tr>
</table>