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**PHYSICS**

**9702/23**

Paper 2 AS Level Structured Questions

**May/June 2017**

MARK SCHEME

Maximum Mark: 60

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**Published**

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This document consists of **7** printed pages.

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

Question	Answer	Marks
2(a)	(resultant) force is proportional/equal to the rate of change of momentum	<b>B1</b>
2(b)(i)	change in momentum = $m(v_2 - v_1)$ $= 0.84 \times (8.8 - 4.2)$	<b>C1</b>
	$= 3.9$ (3.86) kg m s <sup>-1</sup>	<b>A1</b>
2(b)(ii)	$F = (3.9 / 4.0) = 0.97$ (0.965) N	<b>A1</b>
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)	<b>M1</b>
	change in momentum for B is equal and opposite to A	<b>A1</b>
2(c)(ii)	change in momentum equal (for A and B)	<b>M1</b>
	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	<b>A1</b>
2(c)(iii)	inelastic as relative speed of approach not equal to relative speed of separation	<b>B1</b>

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

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 = $\frac{1}{2} (145 + 70) \times 10^{-3} \times 9.81 \times 120 \times 10^{-3}$	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 with a phase difference/path difference of zero	B1
	2. phase difference is $360^\circ$ /path difference of $\lambda$	B1
		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)	$d \sin \theta = n\lambda$ $d = n / \text{gradient}$	C1
	= $2 / 8.0 \times 10^5 = 2.5 \times 10^{-6} \text{ m}$	A1
5(b)(iii)	straight line drawn with lower gradient (about $\frac{1}{2}$ ) and all points lower	B1

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

Question	Answer	Marks						
7(a)	electron <b>and</b> quark both underlined/clearly indicated and no others	<b>B1</b>						
7(b)(i)	<div style="display: flex; align-items: center; justify-content: center;"> <div style="margin-right: 20px;"><i>both correct</i></div> <table border="1" style="border-collapse: collapse;"> <tr> <td style="width: 40px;"></td> <td style="width: 40px;">value</td> </tr> <tr> <td style="text-align: center;">A</td> <td style="text-align: center;">60</td> </tr> <tr> <td style="text-align: center;">B</td> <td style="text-align: center;">28</td> </tr> </table> </div>		value	A	60	B	28	<b>B1</b>
	value							
A	60							
B	28							
7(b)(ii)	(electron) antineutrino	<b>B1</b>						