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PHYSICS **9702/23**

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

MARK SCHEME

Maximum Mark: 60

Published

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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**

Question	Answer	Marks
7(a)	electron **and** quark both underlined/clearly indicated and no others	**B1**
7(b)(i)	<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*	**B1**
7(b)(ii)	(electron) antineutrino	**B1**