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PHYSICS**9702/23**

Paper 2 AS Level Structured Questions

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MARK SCHEME

Maximum Mark: 60

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

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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
	$= 3.9 \text{ (3.86) kg m s}^{-1}$	A1
2(b)(ii)	$F = (3.9 / 4.0) = 0.97 \text{ (0.965) N}$	A1
2(c)(i)	change in momentum for A: $0.84 \times (4.7 - 8.8) = -3.4 \text{ (3.44)}$ change in momentum for B: $0.73 \times (4.7 - 0) = 3.4 \text{ (3.43)}$	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

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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)	$\text{KE} = \frac{1}{2}mv^2$ 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

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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	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)	$d \sin \theta = n\lambda$	C1
	$d = n / \text{gradient}$	
	= $2 / 8.0 \times 10^5 = 2.5 \times 10^{-6} \text{ m}$	A1
5(b)(iii)	straight line drawn with lower gradient (about $\frac{1}{2}$) and all points lower	B1

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Question	Answer	Marks
6(a)(i)	straight line <u>through the origin</u>	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 $I^2 R$	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> <i>both correct</i>		value	A	60	B	28	B1
	value							
A	60							
B	28							
7(b)(ii)	(electron) antineutrino	B1						