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Question	Answer	Marks
3(a)	$E_{(P)} = \frac{1}{2}kx^2$ or $E_{(P)} = \frac{1}{2}Fx$ and $F = kx$	C1
	$0.048 = \frac{1}{2} \times k \times (2.1 \times 10^{-2})^2$ $k = 220 \text{ N m}^{-1}$	A1
3(b)	$E_{(K)} = \frac{1}{2}mv^2$	C1
	$0.048 = \frac{1}{2} \times 7.5 \times 10^{-3} \times v^2$ $v = 3.6 \text{ m s}^{-1}$	A1
3(c)(i)	$(\Delta)E = mg(\Delta)h$	C1
	$0.039 = 7.5 \times 10^{-3} \times 9.81 \times (\Delta)h$ $\Delta h = 0.53 \text{ m}$	A1
3(c)(ii)	$F \times 0.53 = 0.048 - 0.039$	C1
	$F = 0.02 \text{ N}$	A1
3(d)	sketch: curved line from the origin	M1
	curved line has increasing gradient	A1

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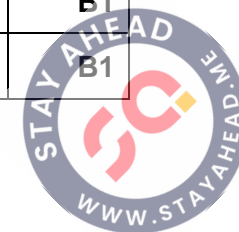
Question	Answer	Marks
4(a)(i)	component of momentum = $0.25 \times 3.7 \times \sin 27^\circ$	C1
	= 0.42 N s	A1
4(a)(ii)	$m_z \times 5.5 \times \sin 44^\circ = 0.42$ or $m_z \times 5.5 \times \sin 44^\circ = 0.25 \times 3.7 \times \sin 27^\circ$ $m_z = 0.11 \text{ kg}$	A1
4(a)(iii)	magnitudes: equal	B1
	directions: opposite	B1
4(b)	$4 + 6 = 2 + v$ $v = 8 \text{ m s}^{-1}$	A1



Question	Answer	Marks
5(a)(i)	light intensity has maximum value at 0° , 180° , 360° and zero intensity at 90° , 270°	M1
	'sinusoidally-shaped' curve	A1
5(a)(ii)	$4.2 = 7.6 \cos^2 \theta$	C1
	$\theta = 42^\circ$	A1
5(b)	wave passes (through) an aperture or wave passes (by / through / around) an edge	B1
	wave spreads (into geometrical shadow)	B1
5(c)(i)	$n\lambda = d \sin \theta$	C1
	$d = (3 \times 4.3 \times 10^{-7}) / \sin 68^\circ$ $= 1.4 \times 10^{-6} \text{ m}$	A1
5(c)(ii)	$1.4 \times 10^{-6} \times \sin 68^\circ = 2 \times \lambda$ or $3 \times 4.3 \times 10^{-7} = 2 \times \lambda$	C1
	$\lambda = 6.5 \times 10^{-7} \text{ m}$	A1



Question	Answer	Marks
6(a)	$R = \rho L / A$	C1
	$\rho = 0.92 \times 5.3 \times 10^{-7}$ $= 4.9 \times 10^{-7} \Omega \text{ m}$	A1
6(b)(i)	(current =) $6.4 / 1600 = 4.0 \times 10^{-3} \text{ (A)}$	A1
6(b)(ii)	charge = $4.0 \times 10^{-3} \times 3.2 \times 60$ (= 0.768 C)	C1
	number = $0.768 / 1.6 \times 10^{-19}$ $= 4.8 \times 10^{18}$	A1
6(b)(iii)	$6.4 / E = 1600 / (1400 + 1600)$ or $E = 6.4 + (4.0 \times 10^{-3} \times 1400)$ or $E = 4.0 \times 10^{-3} (1600 + 1400)$	C1
	$E = 12 \text{ V}$	A1
6(b)(iv)	$P = I^2 R$ or $P = VI$ or $P = V^2 / R$	C1
	ratio = $(6.4^2 / 1600) / [(4.0 \times 10^{-3})^2 \times 1400]$ $= 1.1$	A1
6(c)(i)	increase	B1
6(c)(ii)	increase	B1
6(c)(iii)	decrease	B1



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Question	Answer	Marks
7(a)	only baryon and nucleon underlined	B1
7(b)	number of α -particles = 6	B1
	number of β^- particles = 4	B1
7(c)	charm antiquark (charge) = $-\frac{2}{3}(e)$ or $-\frac{2}{3}(e) + q = -1(e)$	B1
	(other quark $q = -\frac{1}{3}(e)$ so) down / strange / bottom	B1

