Question	Answer	Marks
3(a)	$v^2 = u^2 + 2as$ $s = 5.6^2 / (2 \times 9.81)$	C1
	(max height =) $3.1 + 5.6^2 / (2 \times 9.81) = 4.7$ (m)	A1
3(b)	$s = ut + \frac{1}{2}at^2$ $4.7 = \frac{1}{2} \times 9.81 \times t^2$	C1
	$t = 0.98$ s	A1
3(c)	line drawn from a non-zero speed at $t = 0$ to a greater speed at $t = T$	B1
	a single sloping straight line drawn from $t = 0$ to $t = T$	B1
	line starts with a positive non-zero value of v and ends with a negative non-zero value of v	B1
3(d)	acceleration (of the ball)	B1
3(e)(i)	(magnitudes of accelerations are) equal / same	B1
3(e)(ii)	(speeds are) equal / same	B1

Question	Answer	Marks
3(a)	point where (all) the weight (of an object) is taken to act	B1
3(b)(i)	vertical component = 45 sin 37° = 27 N	A1
3(b)(ii)	the magnitudes of the three moments about A are (23×0.48), (27×0.56) and $(W \times 0.76)$ correct magnitude of any one moment about A	C1
	correct magnitudes of any two moments about A	C1
	$(23 \times 0.48) + (W \times 0.76) = 27 \times 0.56$ $W = 5.4$ N	A1
3(b)(iii)	horizontal component = 45 cos 37° = 36 N	A1
3(b)(iv)	decrease	B1
3(b)(v)	$\sigma = F / A$	C1
	$\sigma = F / \pi r^2$ or $4F / \pi d^2$ so $\sigma = 5.3 \times 10^7 \times \pi r^2 / \pi (3r)^2$ $= 5.3 \times 10^7 / 9$ $= 5.9 \times 10^6$ Pa	A1

Question	Answer	Marks
6(a)	energy transferred per (unit) charge (from electrical to other forms)	B1
6(b)	same/equal current (in X and Y)	B1
	$P = I^2R$ (and $R_X > R_Y$) **or** $P = VI$ **and** $V_X > V_Y$	M1
	(so) X (dissipates more power)	A1
6(c)(i)	$I = Q / t$	C1
	$= 650 / 540$ $= 1.2$ A	A1
6(c)(ii)	$V = W / Q$ **or** W / It	C1
	$= 4800 / 650$ **or** $4800 / (1.2 \times 540)$ $= 7.4$ V	A1
	or	
	$V = P / I$ **and** $P = W / t$	(C1)
	$= 8.9 / 1.2$ $= 7.4$ V	(A1)
6(c)(iii)	$I = 4.5 + 1.2$ (= 5.7 A)	C1
	$9.0 = 7.4 + 5.7r$ **or** $9.0 = 5.7\ (1.3 + r)$ $r = 0.28\ \Omega$	A1

Question	Answer	Marks
6(a)(i)	$P = VI$	C1
	$I = 36 / 8.0$ $= 4.5$ A	A1
6(a)(ii)	charge $= 4.5 \times 50$ $= 225$	C1
	number $= 225 / 1.6 \times 10^{-19}$ $= 1.4 \times 10^{21}$	A1
6(a)(iii)	$R = V^2 / P$ or $R = V / I$ or $R = P / I^2$ $= 8.0^2 / 36$ or $= 8.0 / 4.5$ or $= 36 / 4.5^2$	C1
	$= 1.8\ \Omega$	A1

Question	Answer	Marks
6(b)	$R = \rho L / A$	C1
	$L = (1.8 \times 0.25 \times 10^{-6}) / 1.4 \times 10^{-6}$ $= 0.32$ m	A1
6(c)	(larger cross-sectional area, same length, same resistivity and so) less resistance	M1
	(same p.d. and more current so) more power (dissipated)	A1
6(d)	current (in wire) is the same	M1
	(same p.d. across wire so) power stays the same	A1

Question	Answer	Marks
4(a)	ratio = 300 / 3200 = 0.094	A1
4(b)	$E = ½mv^2$ or $E \propto v^2$	C1
	ratio = $(0.094)^{0.5}$ = 0.31	A1
4(c)	work (done against frictional force) = 3200 – 300 (=2900)	C1
	length = 2900 / 76 = 38 m	A1
4(d)(i)	$E = ½kx^2$ or $E = ½Fx$ and $F = kx$ $140 = ½ \times 63 \times x^2$ or $140 = ½Fx$ and $F = 63x$	C1
	$x = 2.1$ m	A1
4(d)(ii)	percentage efficiency = (140 / 300) × 100 = 47%	A1
4(d)(iii)	curved line from the origin	M1
	gradient of line increases	A1

Question	Answer	Marks
4(a)	$E = ½mv^2$	C1
	$= ½ \times 0.25 \times 2.3^2$ $= 0.66$ J	A1
4(b)	$E = ½kx^2$ **or** $E = ½Fx$ **and** $F = kx$	C1
	$x = [(2 \times 0.66) / 420]^{0.5}$ $= 0.056$ m	A1
	or	
	$E = ½kx^2$	(C1)
	$½mv^2 = ½kx^2$ $x = (0.25 \times 2.3^2 / 420)^{0.5}$ $= 0.056$ m	(A1)
4(c)(i)	(p =) 0.25 × 2.3 **or** 0.25 × 1.5	C1
	change in momentum = 0.25 (2.3 + 1.5) = 0.95 N s	A1
4(c)(ii)	resultant force = 0.95 / 0.086 or 0.25 × (2.3 + 1.5) / 0.086 = 11 N	A1
4(d)	curved line from the origin with an increasing gradient	B1

Question	Answer	Marks
2(a)	$F = \rho gV$ $0.071 = 1.2 \times 9.81 \times V$	C1
	$(V = 6.03 \times 10^{-3}\ m^3)$ $4/3 \times \pi \times r^3 = 6.03 \times 10^{-3}$ $r = 0.11$ m	A1
2(b)	$m = 0.053 / 9.81$ $(= 5.4 \times 10^{-3}$ kg)	C1
	$F = 0.071 - 0.053$ $(= 0.018$ N)	C1
	$a = (0.071 - 0.053) / (0.053 / 9.81)$ $= 3.3\ m\ s^{-2}$	A1
2(c)(i)	$v^2 = u^2 + 2as$ $3.6^2 = (-1.4)^2 + 2 \times 9.81 \times s$ **or** $3.6^2 = 1.4^2 + 2 \times 9.81 \times s$	C1
	$s = 0.56$ m	A1
2(c)(ii)	single straight line from any positive non-zero value of v at $t = 0$ to any negative non-zero value of v at $t = T$	B1
	line starting at (0, 1.4) and ending at (T, –3.6)	B1