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 × 0.76) correct magnitude of any one moment about A	C1
	correct magnitudes of any two moments about A	C1
	(23 × 0.48) + (W × 0.76) = 27 × 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
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
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
1(a)	force × displacement in the direction of the force	B1
1(b)	$P = Fs / t$ $= (\text{kg m s}^{-2} \times \text{m}) / \text{s}$	C1
	$= \text{kg m}^2\,\text{s}^{-3}$	A1
1(c)(i)	$84 \times 10^3 = v^3 \times 0.56$	C1
	$v = 53\ \text{m s}^{-1}$	A1
1(c)(ii)	percentage uncertainty = (5% + 7%) / 3 (= 4%) **or** fractional uncertainty = (0.05 + 0.07) / 3 (= 0.04)	C1
	absolute uncertainty $= 0.04 \times 53$ $= (\pm)\ 2\ \text{m s}^{-1}$	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