Question	Answer	Marks
7(a)	92 protons and 146 neutrons (in nucleus)	B1
	92 (orbital) electrons	B1
7(b)	charge = $2e$ $(= 2 \times 1.60 \times 10^{-19}$ C)	C1
	mass = 4u $(= 4 \times 1.66 \times 10^{-27}$ kg)	C1
	ratio $= (2 \times 1.60 \times 10^{-19}) / (4 \times 1.66 \times 10^{-27})$ $= 4.8 \times 10^{7}$ C kg^{-1}	A1
7(c)(i)	up down down / udd	B1
7(c)(ii)	up up up / uuu	B1

Question	Answer	Marks
4(a)	sum/total momentum before = sum/total momentum after **or** sum/total momentum (of a system of objects) is constant	M1
	if no (resultant) external force/for a closed system	A1
4(b)(i)	$(3.0 \times 4.0 \times \cos\theta)$ **or** $(2.5 \times 4.8 \times \cos\theta)$ **or** (5.5×3.7)	C1
	$(3.0 \times 4.0 \times \cos\theta) + (2.5 \times 4.8 \times \cos\theta) = (5.5 \times 3.7)$	C1
	$\theta = 32°$	A1
4(b)(ii)	(initial $E_K = \frac{1}{2} \times 3.0 \times 4.0^2 + \frac{1}{2} \times 2.5 \times 4.8^2 =) 53$ (J) **or** (final $E_K = \frac{1}{2} \times 5.5 \times 3.7^2 =) 38$ (J)	C1
	values of initial E_K and final E_K both correct **and** inelastic stated	A1

Question	Answer	Marks
2(a)	force (on droplet of water) in horizontal direction is zero.	B1
2(b)	(time taken =) 3.5 / 6.6 = 0.53 (s)	A1
2(c)	$s = ut + \frac{1}{2}at^2$ $s = \frac{1}{2} \times 9.81 \times 0.53^2$	C1
	$h = 1.4$ m	A1

Question	Answer	Marks
2(d)	displacement is straight-line distance (from P to Q) so less (than distance along path) or displacement is the shortest distance (from P to Q).	B1
2(e)	$(\text{displacement})^2 = 3.5^2 + 1.4^2$	C1
	displacement = 3.8 m	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
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

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)	$(p =)\ 0.25 \times 2.3$ **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