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

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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 = $(140 / 300) \times 100$ = 47%	A1
4(d)(iii)	curved line from the origin	M1
	gradient of line increases	A1

Question	Answer	Marks
4(a)	$E = \frac{1}{2}mv^2$	C1
	$= \frac{1}{2} \times 0.25 \times 2.3^2$ $= 0.66$ J	A1
4(b)	$E = \frac{1}{2}kx^2$ **or** $E = \frac{1}{2}Fx$ **and** $F = kx$	C1
	$x = [(2 \times 0.66) / 420]^{0.5}$ $= 0.056$ m	A1
	or	
	$E = \frac{1}{2}kx^2$	(C1)
	$\frac{1}{2}mv^2 = \frac{1}{2}kx^2$ $x = (0.25 \times 2.3^2 / 420)^{0.5}$ $= 0.056$ 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 $0.25 \times (2.3 + 1.5) / 0.086$ $= 11$ N	A1
4(d)	curved line from the origin with an increasing gradient	B1