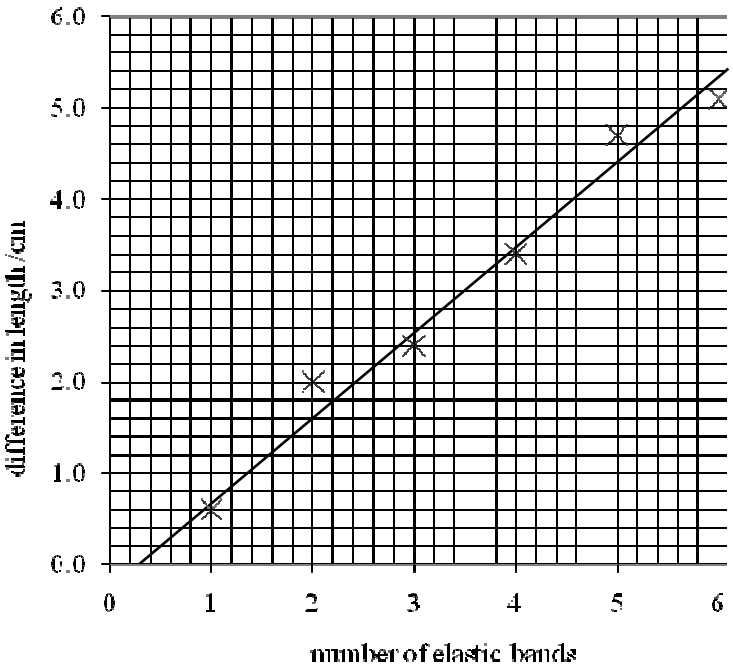
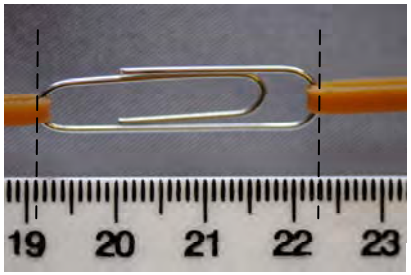
<table>
<tr><th colspan="3">Question number</th><th>Answer</th><th>Accept</th><th>Reject</th><th>Marks</th></tr>
<tr><td>1</td><td>(a)</td><td></td><td>
<table>
<tr><td>Type of radiation</td><td>Charge</td><td>Source</td></tr>
<tr><td>Alpha particle</td><td>(+)2</td><td>Unstable nucleus</td></tr>
<tr><td>Beta particle</td><td>- 1</td><td>Unstable nucleus</td></tr>
<tr><td>Gamma ray</td><td>0</td><td>Unstable nucleus</td></tr>
</table>
(As shown)
2 ;
Unstable nucleus;</td><td>++

Unstable nuclei</td><td>-2</td><td>2</td></tr>
</table>

Question number			Answer	Accept	Reject	Marks
1	(b)		Any three of: MP1 - Idea that alpha particles would not penetrate (enough); e.g. alpha particles absorbed / stopped by {aluminium / foil / a few cm air / paper / card} MP2 - Idea that gamma rays would be too penetrative; e.g. gamma rays {are not absorbed / are unaffected} MP3 - Idea that some beta particles will pass through the foil; e.g. not all of the beta particles are absorbed MP4 - Idea of a correlation between thickness and absorption; e.g. thinner aluminium absorbs fewer beta particles	Ignore references to danger or harm All ideas may be expressed in terms of penetration or absorption. No need to see the word “aluminium,” provided the meaning is clear. Accept paper or card will stop alpha for MP1 Accept comparisons of aluminium thickness for MP4		3
	(c)	(i)	$^{90}_{39}Y$ both 90 and 39 for mark			1
		(ii)	B (the number of protons increases);			1
					Total	**7**

Question number			Answer	Accept	Reject	Marks
3	(a)	(i)	5.1			1
		(ii)	Suitable scale chosen (>50% of grid used); Axes labelled with quantities and units; Plotting to nearest half square (minus one for each plotting / error);; Line of best fit acceptable; Sample graph:  	Ignore 6 bands point Line below points 2,5 and above points 1,3,4 Ecf from (a)(i) e.g. an appropriate curve Orientation of axes unimportant 1 0.6 2 2.0 3 2.4 4 3.4 5 4.7 6 (5.1)		5

Question number			Answer	Accept	Reject	Marks
3	(a)	(iii)	Any two of It is a straight line; Gradient / slope / correlation is <u>positive</u>; Line does / doesn't pass through origin; Idea of correlated variables, e.g. direct / indirect proportionality [depending on projection to the origin], length increases with number of bands;	Ecf from (a)(i)/(ii) Related statement e.g. curve, line forced through origin or mention of "anomaly"		2
	(b)		3.2 ± 0.1 (cm) ; ; Sample working:  	Allow evidence of two readings from scale for one mark, e.g. subtraction (22.3 - 9.1) or appropriate drawing on the photograph	Direct measurement of photograph with a ruler	2

Question number			Answer	Accept	Reject	Marks
6	(c)		183 (m);			1
	(d)		Any three of: MP1 Electrons move OR there is a current Or negative charge moves; MP2 (Discharge) to earth OR across cloud OR to named object – tree, house, lightning conductor; MP3 Air conducts; MP4 Phenomenon e.g. thunder clap / lightning;	Sparks generate radio waves; Lightning causes (radio) interference; Correct reference to electrostatic attraction / repulsion ;		3
					Total	**11**

Question number			Answer	Accept	Reject	Marks
7	(a)		B			1
	(b)	(i)	Word equation or $V_p I_p = V_s I_s$;	$V_p/V_s = I_s/I_p$ or $V_s/V_p = I_p/I_s$ or $I_1V_1 = I_2V_2$		1
		(ii)	Correct equation substituted OR rearranged; Answer; Vp/Vs = Is/Ip or Vs/Vp = Ip/Is e.g. 230 x 0.25 = 12 x I_s , so I_s = (230 x 0.25) ÷ 12 = 4.8 (A)	Bald answer;; 4.79 (A) , 4.792 (A)		2
	(c)		Two of MP1 Idea of energy / power lost; MP2 Idea of efficiency ≠ 100%; MP3 Idea of less available energy/power/voltage/current; MP4 Idea of resistance increasing (with temperature);			2
					Total	**6**

Question number			Answer	Accept	Reject	Marks
8	(c)	(i)	4.8 (m/s) ;			1
		(ii)	Idea that momentum is conserved; Substitution; Calculation; e.g. $p_1 = p_2$ / $m_1 \times v_1 = (m_1 + m_2) \times v_2$ $6.4 \times 6 = (6.4 + m_2) \times 4.8$ $m_2 = (38.4 \div 4.8) - 6.4 = 8 - 6.4$ $= 1.6$ (kg)	Allow e.c.f. from incorrect momentum calculation in (b)(ii) and /or incorrect velocity reading e.g.: Idea of conservation of momentum; $m_2 = [(b)(ii) \div (c)(i)] - 6.4$; correct evaluation of this; e.g. 5 m/s → 1.28 kg Allow for one mark - A calculation that only leads to total mass e.g. = 8 kg;		3
					Total	**9**