Question Number	Answer		Mark
22(a)	There is a (resultant) force on the electrons in the vertical direction	**(1)**	
	So the electrons are accelerated vertically	**(1)**	
	But in the horizontal direction the electrons have a constant speed	**(1)**	**3**
22(b)(i)	Use of $W = QV$	**(1)**	
	Use of $E_K = \frac{1}{2}mv^2$	**(1)**	
	$v = 1.73 \times 10^7$ (m s^{-1})(minimum 3 sf required)	**(1)**	**3**
	Example of calculation $E_K = 1.6 \times 10^{-19}\ C \times 850\ V = 1.36 \times 10^{-16}\ J$ $v = \sqrt{\frac{2 \times 1.6 \times 10^{-19}\ C \times 850\ V}{9.11 \times 10^{-31}\ kg}} = 1.73 \times 10^7\ m\ s^{-1}$		
22(b)(ii)	Use of $s = ut$	**(1)**	
	Use of $F = EQ$	**(1)**	
	Use of $F = ma$	**(1)**	
	Use of $s = ut + \frac{1}{2}at^2$	**(1)**	
	$s = 0.028$ m (Allow ecf from (b)(i))	**(1)**	**5**
	Example of calculation $t = \frac{7.5 \times 10^{-2}\ m}{1.73 \times 10^7\ m\ s^{-1}} = 4.34 \times 10^{-9}\ s$ $F = 1.7 \times 10^4\ V\ m^{-1} \times 1.6 \times 10^{-19}\ C = 2.72 \times 10^{-15}\ N$ $a = \frac{2.72 \times 10^{-15}\ N}{9.11 \times 10^{-31}\ kg} = 2.99 \times 10^{15}\ m\ s^{-2}$ $s = \frac{1}{2} \times 2.99 \times 10^{15}\ m\ s^{-2}\ (4.34 \times 10^{-9}\ s)^2 = 0.028\ m$		

22(b)(iii)	Use of $F = BQv \sin\theta$ with $F = \frac{mv^2}{r}$ to obtain $\frac{e}{m} = \frac{v}{Br}$ **Or** Use of $p = mv$ with $r = \frac{p}{BQ}$ to obtain $\frac{e}{m} = \frac{v}{Br}$	**(1)**	**4**
	$\frac{e}{m} = 1.65 \times 10^{11}$ C kg^{-1} (ecf from (b)(i))	**(1)**	
	Substitutes standard values into $\frac{e}{m}$	**(1)**	
	Standard value of $\frac{e}{m} = 1.76 \times 10^{11}$ C kg^{-1} calculated **and** comparison with experimental value **and** clear conclusion	**(1)**	
	Example of calculation $\frac{e}{m} = \frac{1.73 \times 10^{7} \text{ m s}^{-1}}{3.0 \times 10^{-3} \text{ T} \times 3.5 \times 10^{-2} \text{ m}} = 1.65 \times 10^{11} \text{ C kg}^{-1}$ $\frac{e}{m} = \frac{1.6 \times 10^{-19} \text{ C}}{9.11 \times 10^{-31} \text{ kg}} = 1.76 \times 10^{11} \text{ C kg}^{-1}$		
	Total for question 22		**15**