Name of the Student:_____
Max. Marks : 23 Marks **Time : 23 Minutes**

Mark Schemes

Q1.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	• The ions experience a force perpendicular to their velocity (and the magnetic field) (1) • The (resultant) force on the ions causes an acceleration at right angles to their velocity (1) **Or** There is a magnetic force acting towards the centre of the path	For velocity accept direction of motion or direction of travel	2

Question Number	Acceptable Answer	Additional Guidance	Mark
(ii)	• Use of $r = \frac{mv}{BQ}$ (1) • $r = 0.23$ m (1)	Example of calculation: $r = \frac{mv}{BQ}$ $= \frac{(34.97 \times 1.66 \times 10^{-27})\,\text{kg} \times 2.2 \times 10^{5}\,\text{m s}^{-1}}{0.35\,\text{T} \times 1.6 \times 10^{-19}\,\text{C}} = 0.228\,\text{m}$	2

Question Number	Acceptable Answer	Additional Guidance	Mark
(iii) 1	• path drawn with less curvature (less overall deflection) (1)	MP1 awarded for path in the magnetic field	1

Question Number	Acceptable Answer	Additional Guidance	Mark
(iii) 2	• ions are more massive (1) • ions have the same charge so the radius of the path would be greater (1)		2

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Q2.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	• Use of $F = BQv$ and $F = EQ$ (1) • Algebra to show $v = \frac{E}{B}$ (1)		2
(ii)	• Use of $W = QV$ *and* $E_k = \frac{1}{2}mv^2$ (1) • Use of $v = \frac{E}{B}$ (1) • $\frac{e}{m} = 1.7 \times 10^{11}$ C kg^{-1} (1)	Example of calculation: $v = \frac{E}{B} = \frac{1.4 \times 10^4 \text{ V m}^{-1}}{1.5 \times 10^{-3} \text{ T}}$ $\frac{e}{m} = \frac{v^2}{2V}$ $\frac{e}{m} = \frac{\left(9.33 \times 10^6 \text{ m s}^{-1}{}^2\right)}{2 \times 250 \text{ V}} = 1.74 \times 10^{11}$ C kg^{-1}	3

Q3.

Question Number	Acceptable answers	Additional guidance	Mark
	• measures radius (allow between 4 cm and 6 cm) (1) • Use of $p = Bqr$ (1) • $B = 1.1$ T (range 0.95 T – 1.42 T) (1) • direction: out of page (1)	Allow use of their measured radius in MP2 Example of calculation: 9.1×10^{-20} N s $= B \times 1.6 \times 10^{-19}$ C $\times 0.52$ m $B = 1.09$ T	4

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Q4.

Question Number	Answer		Mark
(a)	The magnetic field (must be) at right angles to the current	**(1)**	**1**
(b)	All three units for force, length and current clearly identified (The unit of force is kg m s^{-2} , the unit of current is A, the unit of length is m) T = kg A^{-1} s^{-2}	**(1)** **(1)**	**2**
(c)	*Use* of $\rho = m/V$ Use of $mg = BIl$ $B = 0.53$ (T) (no u.e. as given in question for part (b)) Example of calculation $m = 2.7 \times 10^3$ kg $m^{-3} \times 10 \times 10^{-3}$ m $\times 10 \times 10^{-3}$ m $\times l$ $m = 0.27 \times l$ $B = (0.27 \times l \times 9.81$ m $s^{-2})/(5$ A $\times l)$ $B = 0.53$ T	**(1)** **(1)** **(1)**	**3**
(d)	(Magnetic field is) into paper/page	**(1)**	**1**
	Total for question		**7**

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