Name of the Student:_____
Max. Marks : 19 Marks **Time : 19 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

Q2.

Question Number	Acceptable Answers
*	This question assesses a student's ability to show a coherent and logically structured answer with linkages and fully-sustained reasoning. Marks are awarded for indicative content and for how the answer is structured and shows lines of reasoning. The following table shows how the marks should be awarded for indicative content. Indicative content: • the lambda particle is neutral • because it does not leave a track **Or** two tracks are opposite charged • momentum of proton/ pion can be determined by measuring radius of curve • using $p = Bqr$ • law of conservation of momentum can then be applied • so momentum/energy of the lambda particle can be determined

Additional Guidance	Mark
<table><tr><th>IC points</th><th>IC mark</th><th>Max linkage mark available</th><th>Max final mark</th></tr><tr><td>6</td><td>4</td><td>2</td><td>6</td></tr><tr><td>5</td><td>3</td><td>2</td><td>5</td></tr><tr><td>4</td><td>3</td><td>1</td><td>4</td></tr><tr><td>3</td><td>2</td><td>1</td><td>3</td></tr><tr><td>2</td><td>2</td><td>0</td><td>2</td></tr><tr><td>1</td><td>1</td><td>0</td><td>1</td></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td></tr></table> IC4 – p and r recognisable from the context of the answer IC5 and 6 can be awarded for a labelled momentum vector triangle	**6**

Q3.

Question Number	Acceptable answers	Additional guidance	Mark
(i)	• Converts eV to J **(1)** • use of $\Delta m = \Delta E / c^2$ **(1)** • mass = 1.98×10^{-27} (kg) **(1)**	Example of calculation $m = \frac{1115\ \text{V} \times 1.6 \times 10^{-19}\text{C} \times 10^6}{(3 \times 10^8)^2 (\text{ms}^{-1})^2}$ $m = 1.98 \times 10^{-27}\ \text{kg}$	**3**
(ii)	• Converts prefix G to M **(1)** **Or** M to G • Determines total energy / mass of lambda before decay **(1)** • kinetic energy = 4985 MeV **(1)**	Example of calculation 4.95 GeV = 4950 MeV Total Energy and mass before decay = 4950 + 1115 = 6065 MeV Total after = 140 + 940 + E_k E_k = 6065 – 1080 = 4985 MeV	**3**