Name of the Student:_____
Max. Marks : 26 Marks **Time : 26 Minutes**

Mark Schemes

Q1.

Question Number	Acceptable answers		Additional guidance	Mark
	• converts eV to J	(1)	Example of calculation: $m = \frac{106\,\text{V} \times 1.6 \times 10^{-19}\,\text{C} \times 10^{6}}{(3 \times 10^{8})^{2}\,(\text{ms}^{-1})^{2}}$	
	• use of $\Delta m = \Delta E / c^2$	(1)		
	• mass = 1.9×10^{-28} (kg)	(1)	$m = 1.88 \times 10^{-28}$ kg	(3)

Q2.

Question Number	Acceptable answers		Additional guidance	Mark
	• Neutral particles do not leave a track/ionise	(1)		
	• Reference to conservation laws to deduce the properties of particles	(1)		3
	• Tracks of decay particles can determine momentum of lambda particle	(1)		

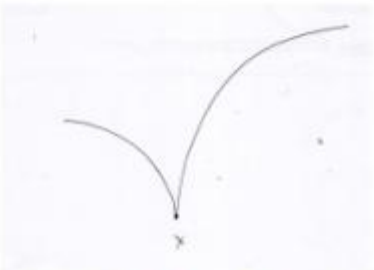
Q3.

Question Number	Acceptable answers		Additional guidance	Mark
	• $\pi^- \rightarrow \mu(^-) + \overline{\nu_{(\mu)}}$	(1)	Any symbol allowed for the muon	1

Q4.

Question Number	Acceptable answers	Additional guidance	Mark
	• Muon is a lepton (1) • Muons / leptons are fundamental particles (1) • Pion is a meson (1) • Pions / mesons consist of a quark and antiquark (1)		4

Q5.

Question Number	Answer	Mark
	Diagram: Path curves in opposite sense (1) With a greater radius of curvature (1) [For Mp2 drawn line must start at X , upwards at less than 45° to vertical and go above printed line. Look at curvature close to X, do not penalise if later it curves more/less.]  **Explanation: (these marks are independent of the diagram)** (Antihelium) has opposite charge (to proton) **Or** reference to proton +ve **and** antihelium -ve (1) See $r = p/BQ$ (1) r is doubled **Or** p/Q is doubled (1) [equation may appear near diagram.]	5
	Total for question	5

Q6.

Question Number	Answer		Mark
(a)(i)	Three quarks **Or** three antiquarks (accept the letter q to represent quarks)	**(1)**	**1**
(a)(ii)	Quark and an antiquark (accept the letter q to represent quarks)	**(1)**	**1**
(b)	Similarity: they have the same mass **Or** same magnitude of charge Difference: opposite charge	**(1)** **(1)**	**2**
(c)(i)	Up and antistrange (in words or symbols, and can be in either order)	**(1)**	**1**
(c)(ii)	μ^- $+\square_\mu$ $K^- \rightarrow \mu^- + \square_\mu$	**(1)** **(1)**	**2**
(c)(iii)	Energy = 2×494 MeV eV to J conversion Energy = 1.58×10^{-10} (J) (division by c^2 and subsequent multiplication by c^2 is not penalised) Example of calculation	**(1)** **(1)** **(1)**	**3**
	Energy = $2 \times 494 \times 10^6$ eV $\times$ 1.6×10^{-19} J eV^{-1} Energy = 1.58×10^{-10} J		
	Total for question		**10**