Name of the Student:_____
Max. Marks : 17 Marks **Time : 17 Minutes**

Mark Schemes

Q1.

Question Number	Acceptable answers	Additional guidance	Mark
	• converts eV using 1.6×10^{-19} (1) • divides by c^2 i.e. $(3 \times 10^8)^2$ (1) • mass = 2.0×10^{-27} kg (1)	Example of calculation $m = \frac{1116\text{V} \times 10^6 \times 1.6 \times 10^{-19}\text{C}}{(3 \times 10^8\,\text{m s}^{-1})^2}$ $m = 2.0 \times 10^{-27}$ kg	3

Q2.

Question Number	Answer	Mark
	Conversion to Joules by $\times 1.6 \times 10^{-19}$ (C) (1) Divide by $(3 \times 10^8)^2$ (1) Mass = 2.49×10^{-28} kg (1) Example of calculation Mass = 140×10^6 eV $\times 1.6 \times 10^{-19}$ J eV^{-1} / $(3 \times 10^8$ m s$^{-1})^2$ Mass = 2.49×10^{-28} kg	3

Q3.

Question Number	Acceptable answers	Additional guidance	Mark
	• it does not leave a track so it is not charged (1) • the charge before the decay is -1 (the pion) and after is -1 (the muon) + 0 (the antineutrino) so it is not charged (1)	Not charged should appear in MP1 or MP2 to get 2 marks	2

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Q4.

Question Number	Acceptable answers	Additional guidance	Mark
	Any **two** from: • Each lepton has an antiparticle **(1)** • Baryon number = 0 **(1)** • Leptons are fundamental particles **(1)** • Leptons interact via the weak force **(1)** • Leptons have a lepton number which isn't zero **(1)**		**2**

Q5.

Question Number	Acceptable Answer	Additional Guidance	Mark
	• The hydrogen ion must be (about 2000 times) more massive than the electron • **Or** the electron must be (about 2000 times) less massive than the hydrogen ion **(1)**	Accept "proton" for "hydrogen ion"	**1**

Q6.

Question Number	Answer	Mark
*	(QWC – Work must be clear and organised in a logical manner using technical wording where appropriate) **Max 6** **Fixed target** There is momentum before the collision so there must be momentum after the collision. **(1)** So particle(s) created must have some kinetic energy **(1)** So not all KE converted to mass **(1)** **Colliding beams** (If particles have the same mass and speed), total initial momentum is zero **(1)** Momentum after collision will be zero **(1)** If one stationary particle is created **(1)** All of the kinetic energy of the particle is converted to mass **(1)**	**6**
	Total for question	**6**

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