Name of the Student:_____
Max. Marks : 20 Marks **Time : 20 Minutes**

Mark Schemes

Q1.

Question Number	Acceptable Answer	Additional Guidance	Mark
	MAX 5 An explanation that makes reference to the following points: • The student has calculated the coun rate rather than the activity of the source (1) • The counts haven't been corrected for background (so there is systematic error in his data) (1) • The GM tube is too far away from the source (1) • α-radiation won't reach the GM-tube as it only has a short range in air (1) • Radiation spreads out from the source, so not all the emitted radiation reaches the GM-tube • GM tube won't detect all the gammas which enter it		5

Q2.

Question Number	Acceptable answers	Additional guidance	Mark
	• so the proportion of unstable nuclei does not change significantly over time **Or** activity does not change significantly over time (1)		1

Q3.

Question Number	Acceptable answers	Additional guidance	Mark
	• Calculation of mass difference in kg **(1)** • Use of $E = c^2 \Delta m$ **(1)** • $E = 2.77 \times 10^{-11}$ J **(1)**	Example of calculation: (235.0439 + 1.008665) u – (140.9144 + 91.9262+ (3×1.008665)) u = 0.186u (0.1860 u × 1.66 × 10^{-27} kg) × (3 × 10^8 m s^{-1})^2 = 2.77 × 10^{-11} J	**3**

Q4.

Question Number	Answer	Mark
(a)(i)	$^{7}_{3}\mathrm{Li} + {}^{1}_{1}\mathrm{X} \rightarrow 2 \times {}^{4}_{2}\mathrm{He}$ **(1)** X is a proton [Accept X is hydrogen/H] **(1)**	**2**
(a)(ii)	Attempt at calculation of mass difference **(1)** Use of 1 MeV = 1.60 × 10^{-13} J **(1)** $\Delta E = 2.77 \times 10^{-12}$ (J) **(1)** <u>Example of calculation:</u> $\Delta m = 6533.8\mathrm{MeV/c^2} + 938.3\mathrm{MeV/c^2} - \left(2 \times 3727.4\mathrm{MeV/c^2}\right) = 17.3\mathrm{MeV/c^2}$ $\Delta E = 17.3\mathrm{MeV}$ $\Delta E = 17.3\mathrm{MeV} \times 1.60 \times 10^{-13}\,\mathrm{J\,MeV^{-1}} = 2.768 \times 10^{-12}\,\mathrm{J}$	**3**
(b)	**Max 4** • Extremely high temperature and density needed **(1)** • High temperature because nuclei need high <u>energy</u> to overcome the (electrostatic) repulsive force **(1)** • Since nuclei must come very close for fusion to occur **Or** since nuclei must come close enough for (strong) nuclear force to act **(1)** • Very high density is needed to maintain a sufficient collision rate **(1)** • Reference to extreme conditions leading to containment problems **(1)**	**4**