

Name of the Student: _____

Max. Marks : 17 Marks

Time : 17 Minutes

Mark Schemes

Q1.

Question Number	Answer	Mark
(a)(i)	Top line correct (1) Bottom line correct (1) ${}^2_1\text{H} + {}^3_1\text{H} \rightarrow {}^4_2\text{He} + {}^1_0\text{n}$	2
(a)(ii)	Attempt at mass deficit calculation (1) $\Delta E = 0.0175 \text{ GeV}$ (accept $2.8 \times 10^{-12} \text{ J}$) (1) <u>Example of calculation:</u> $\Delta m = (3.7274 + 0.939566 - 2.8089 - 1.8756) \text{ GeV}/c^2 = 0.0175 \text{ GeV}/c^2$ $\Delta E = 0.0175 \text{ GeV}$	2
(a)(iii)	Momentum is conserved (1) Mass of neutron is smaller, so speed is greater (1) $E_k = \frac{1}{2}mv^2$, so E_k is larger (1) Or Momentum is conserved (1) $E_k = p^2/2m$ (1) m of neutron is smaller, so E_k is larger (1)	3

(b)	Use of $\lambda = \frac{\ln 2}{t_{1/2}}$ (1) Use of $A = A_0 e^{-\lambda t}$ (1) t = 41 (years) (1) <u>Example of calculation:</u> $\lambda = \frac{\ln 2}{t_{1/2}} = \frac{0.693}{12.3 \text{ year}} = 0.0563 \text{ year}^{-1}$ $A = A_0 e^{-\lambda t} \quad \therefore t = \frac{\ln\left(\frac{A}{A_0}\right)}{-\lambda} = \frac{\ln(0.1)}{-0.0563 \text{ year}^{-1}} = 40.9 \text{ years}$	3
*(c)	QWC – Work must be clear and organised in a logical manner using technical wording where appropriate There is little possibility of a runaway fusion reaction (unlike fission) (1) There would not be any radioactive waste produced in the <u>fusion</u> process Or the flux of neutrons would produce radioactive isotopes when absorbed by materials in the reactor (1) A very/extremely high temperature (plasma) is required (1) Plasma must not touch reactor walls, so strong magnetic fields are required (1) If plasma touches the walls of the reactor its temperature falls (and fusion stops) (1)	5
	Total for question	15

Q2.

Question Number	Acceptable answers	Additional guidance	Mark
	- High energy electrons will have a short (de Broglie) wavelength (1) - The wavelength needs to be comparable/smaller than proton size (1)		2