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

Mark Schemes

Q1.

Question Number	Acceptable answers	Additional guidance	Mark
	An explanation that makes reference to: • Identifies (very) high temperature **and** (very) high density (1) • (Very) high temperature to provide enough energy to overcome the (electrostatic) repulsive force between nuclei (1) • (Very) high density to give big enough collision rate to maintain reaction (1)	Accept pressure for density in MP1 Accept correct reference to strong force	3

Q2.

Question Number	Acceptable answers	Additional guidance	Mark
	• Fusion involves an increase in binding energy (per nucleon) as the number of nucleons increases (1) • Fission involves an increase in binding energy (per nucleon) as the number of nucleons decreases (1) • If binding energy per nucleon increases energy is released in the process (1)	Accept reference to larger/smaller nuclei for number of nucleons increases/decreases	3

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Q3.

Question number	Acceptable answers	Additional guidance	Mark
	An explanation that makes reference to the following points: • Resonance is occurring… **(1)** • …when the driving frequency/forced vibration (at walking frequency) matches the natural frequency … **(1)** • …energy transfer is maximum **(1)** • Supporting the observation that the amplitude rapidly increases **(1)**		**4**

Q4.

Question Number	Acceptable answers		Additional guidance	Mark
(i)	• Use of ratio of atoms and atoms per g • Number of nuclei = 2.9×10^{17}	**(1)** **(1)**	$N = 0.3\ g \times 8.1 \times 10^{21}\ g^{-1} \times 0.012/100$ $= 2.9 \times 10^{17}$	**2**

Question Number	Acceptable answers		Additional guidance	Mark
(ii)	• use of $\ln 2 = \lambda t_{1/2}$ • use of activity = λN (ecf from (b)(i)) • activity = 5.1 (Bq) (use of show that value gives 5.3 Bq)	**(1)** **(1)** **(1)**	$\ln 2 = \lambda \times 1.25 \times 10^9$ years $= \lambda \times (1.25 \times 10^9 \times 365 \times 24 \times 60 \times 60)$ s $\lambda = 1.76 \times 10^{-17}\ s^{-1}$ $A = 1.76 \times 10^{-17}\ s^{-1} \times 2.9 \times 10^{17}$ $= 5.1$ Bq	**3**

Question Number	Acceptable answers		Additional guidance	Mark
(iii)	• use of count rate = (counts – background counts) / time • calculates percentage of activity from (b)(ii) **Or** applies 7.5% to activity from (b)(ii) • Comparative statement consistent with their values	**(1)** **(1)** **(1)**	**MP3** can only be awarded if Activity from (ii) is used. A clear comparison with the corresponding value must be made e.g. percentage = 0.8 % which is < 7.5 % so not efficient **Or** detects 176 but should detect 379 counts in 10 min, so not efficient **Or** should detect a rate of at least 0.63 Bq, so not efficient <u>Example of calculation</u> Recorded count rate = (176 - 150) ÷ 600 s = 0.04 Bq 0.04 Bq × 100 ÷ 5.1 Bq = 0.78 % (ecf from (b)(ii) for MP3)	**3**

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Question Number	Acceptable answers	Additional guidance	Mark
(iv)	**Max two from** • emissions are in all directions (1) • some emitted particles may be absorbed by the material in the sample (1) • some emitted particles may be absorbed by the window (1) • some emitted particles pass (right) through detector (1)		**2**

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