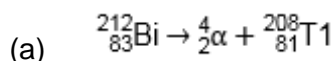


Name of the Student: _____

Max. Marks : 18 Marks

Time : 18 Minutes

Mark Schemes

Q1.

either **(1)** (for both atomic mass numbers, 4 and 208)
 and **(1)** (for both atomic numbers, 2 and 81)

[or **(1)** for ${}_{81}^{208}\text{Tl}$ and incorrect α]

2

- (b) (i) $E_k = (\frac{1}{2}mv^2) = 6.1 \times 10^6 \times 1.6 \times 10^{-19}(\text{J})$ **(1)**
 substitution for $m = 4.0 \times 1.66 \times 10^{-27}(\text{kg})$ **(1)**

$$v = \left(\frac{2 \times 6.1 \times 10^6 \times 1.6 \times 10^{-19}}{4.0 \times 1.66 \times 10^{-27}} \right)^{1/2} \quad \mathbf{(1)} \quad (= 1.7 \times 10^7 \text{m s}^{-1})$$

- (ii) correct use of conservation of momentum $m_{\text{Tl}} v_{\text{recoil}} = m_{\alpha} v$ **(1)**
 substitution of $m_{\text{Tl}} = 208u$ **(1)**
 (allow C.E. for mass = 208)

$$v_{\text{recoil}} = \frac{4 \times 1.7 \times 10^7}{208} = 3.3 \times 10^5 \text{m s}^{-1} \quad \mathbf{(1)}$$

(allow C.E. for value of v)

6

[8]**Q2.**

- (a) (i) (inner) orbiting electron [or electron surrounding the nucleus] **(1)**
 captured by a proton (in the nucleus) **(1)**
 converted into a neutron **(1)**

The Quality of Written Communication marks are awarded for the quality of answers to this question.

- (ii) daughter nuclide / nucleus / atom might be excited and
 energy given up as electromagnetic radiation
 [or orbiting electrons drop down to fill space (left by captured electron)] **(1)**

The Quality of Written Communication marks are awarded for the quality of answers to this question.

(iii) $^{205}\text{Pb} \rightarrow ^{203}\text{Pb} + \alpha + \gamma$ (1) + ... (1) (1) (1) (1) Follow 0.2t for 0.2t+1

max 5

(b) (i) (use of $N = N_0 e^{-\lambda t}$ and $N \propto \text{activity}$ gives)

$$290 = 1200 \exp(-\lambda \times 24 \times 60 \times 60) \quad (1)$$

$$\frac{\ln(1200/290)}{24 \times 60 \times 60} \quad (1)$$

$$\lambda = \frac{\ln(1200/290)}{24 \times 60 \times 60} \quad (1) (= 1.64 \times 10^{-5} \text{ s}^{-1})$$

(ii) (use of $T_{1/2} = \ln 2 / \lambda$ gives) $T_{1/2} = \frac{\ln 2}{1.64 \times 10^{-5}} \quad (1)$

$$= 4.2(3) \times 10^4 \text{ s} \quad (1) (= 11.(7) \text{ hr})$$

(use of $\lambda = 1.6 \times 10^{-5} \text{ s}^{-1}$ gives $T_{1/2} = 4.3 \times 10^4 \text{ s}$ or 12 hr)

(iii) (use of $\frac{\Delta N}{\Delta t} = \lambda N$ gives) $(-)\dot{1}200 = (-)1.64 \times 10^{-5} N \quad (1)$

$$N = 7.3(2) \times 10^7 \text{ (nuclei)} \quad (1)$$

(use of $\lambda = 1.6 \times 10^{-5} \text{ s}^{-1}$ gives $N = 7.5 \times 10^7$ (nuclei))

max 5

[10]