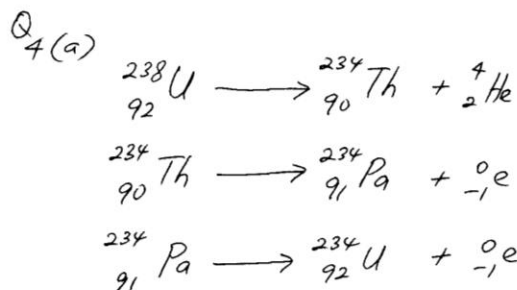


Sem 1 (2005/2006): Nuclear Reactions



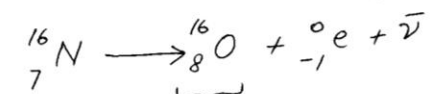
Q4(b)(i)

Atom	n	P
C	6	6
N	9	7
Ne	9	10
S	16	16

(ii) S-32 is a stable nuclei because the n:p = 1:1

(iii) For N-16: n:p = 9:7 = 1.286:1
 It is above the belt of stability

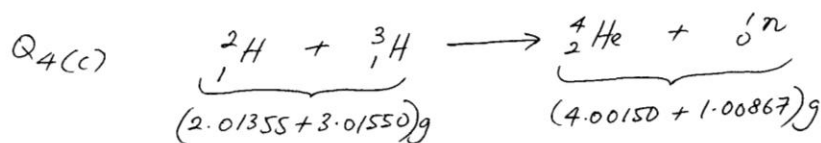
(iv) Since the n:p = 1.286, therefore the N nuclei will undergo β emission. This will decrease N (no. of neutrons) and increase Z (no. of protons)



$$\frac{n}{p} = 1.286 \quad \frac{n}{p} = 1.0$$

P (stable)

The β -emission converts the N-16 into a O-16 nuclei in which the n/p = 1.0 (stable nuclei)

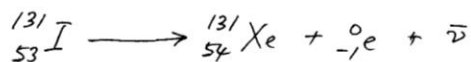


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$$\begin{aligned} Q_4(c) \quad \Delta m &= m_{\text{reactants}} - m_{\text{products}} \\ &= (2.01355 + 3.01550)g - (4.00150 + 1.00867)g \\ &= 5.02905 - 5.01017 = 0.01888 g \\ &= (0.01888 \times 10^{-3}) \text{ kg} \\ \Delta E &= (\Delta m)c^2 \\ &= (1.888 \times 10^{-5} \text{ kg})(3 \times 10^8 \text{ m s}^{-1})^2 \\ \Delta E &= 1.699 \times 10^{12} \text{ J} \\ &= 1.699 \times 10^9 \text{ kJ} \leftarrow \text{for } 5.02905 \text{ g of reactants (H-2, H-3)} \end{aligned}$$

$$\begin{aligned} \therefore \text{The energy released per gram of reactants} \\ &= \left(\frac{1.699 \times 10^9}{5.02905} \right) \text{ kJ g}^{-1} \text{ reactants} \\ &= 3.3740 \times 10^8 \text{ kJ g}^{-1} \text{ reactants (Ans)} \end{aligned}$$

Q4(d)(i) The balanced equation for the decay process is:



(ii) Given: $t_{1/2} = 8.05 \text{ days}$; $N_0 = 25.0 \text{ mg}$; $t = 30 \text{ days}$, $N_t = ?$

$$\ln \frac{N_0}{N_t} = kt; \quad k = \frac{\ln 2}{t_{1/2}}$$

$$\ln N_t = -kt + \ln N_0$$

$$= -\left(\frac{\ln 2}{t_{1/2}}\right)t + \ln N_0$$

$$\ln N_t = -\left(\frac{0.6931}{8.05 \text{ d}}\right)(30 \text{ d}) + \ln(25.0)$$

$$\ln N_t = -2.58298 + 3.2189 = 0.63592$$

$$\therefore N_t = 1.89 \text{ mg (Ans)}$$

After 30 days, 1.89 mg of the salt will remain in the body.