Question Number	Answer	Mark
13(a)	Mass difference calculated (1) Conversion from u to kg (1) Use of $\Delta E = c^2 \Delta m$ (1) ΔE = 5.53 (MeV) (1) For full marks to be awarded some working should be shown – a bald answer scores zero. "Some working" must include at least two of the steps to the answer. <u>Example of calculation</u> Mass difference = (228.02873 - 224.02021 - 4.00260) u = 5.92×10^{-3} u Mass difference = 5.92×10^{-3} u × 1.66×10^{-27} kg u^{-1} = 9.83×10^{-30} kg $\Delta E = \left(3.00 \times 10^{8} \text{ m s}^{-1}\right)^2 \times 9.83 \times 10^{-30} \text{ kg} = 8.85 \times 10^{-13} \text{ J}$ $\Delta E = \frac{8.85 \times 10^{-13}\text{J}}{1.60 \times 10^{-13}\text{J MeV}^{-1}} = 5.53 \text{ MeV}$	**4**
13(b)	(Mathematical) statement of momentum conservation (1) Use of $E_\text{k} = \frac{p^2}{2m}$ **Or** use of $E_\text{k} = \frac{1}{2}mv^2$ and $p = mv$ (1) (Mathematical) statement of energy conservation (1) E_k=5.4 MeV and statement is correct (1) <u>Example of calculation</u> $p_\alpha = -p_\text{Ra}$ $2m_\alpha \ E_\alpha = \ 2m_{Ra} \ E_{Ra}$ $E_{Ra} = \frac{m_\alpha}{m_{Ra}} \times E_\alpha$ $E_\alpha + E_{Ra} = 5.5 \text{ MeV}$ $E_\alpha + \frac{m_\alpha}{m_{Ra}} \times E_\alpha = 5.5 \text{ MeV}$ $E_\alpha = \frac{m_{Ra}}{m_{Ra} + m_\alpha} \times 5.5 \text{ MeV}$ So $E_\text{k} = \frac{224}{228} \times 5.53 \text{ MeV} = 5.43 \text{ MeV}$	**4**
	Total for question 13	**8**