7 **(a)** The ^{226}Ra nucleus undergoes alpha decay according to

$$^{226}_{88}\text{Ra} \rightarrow {}^{222}_{86}\text{Rn} + {}^{4}_{2}\text{He}$$

Data for the nuclei in the reaction are given in Fig. 7.1.

nucleus	mass / *u*
$^{226}_{88}$Ra	226.0254
$^{222}_{86}$Rn	222.0176
$^{4}_{2}$He	4.0026

Fig. 7.1

(i) Show that the energy released in this decay, Q, is 4.86 MeV.

[2]

(ii) This energy, *Q*, must be shared by the alpha particle and the daughter nucleus.

Use conservation of energy and momentum to show that

$$Q = K_\alpha\left(1+\frac{M_\alpha}{M}\right)$$

where K_α is the kinetic energy of the alpha particle, M_α is the mass of the alpha particle, and M is the mass of the daughter nucleus.

[3]

(iii) **1.** Hence calculate the kinetic energy of the alpha particle emitted in this decay process.

kinetic energy = ... MeV [2]

2. Comment on your answer in **(a)(iii)1.** with reference to **(a)(i)**.

…….. [1]

(b) The alpha particle produced in this decay travelled 25 mm in a cloud chamber. Given that, on average, an alpha particle creates 5.0×10^3 ion pairs per mm of track in the cloud chamber, determine the energy required to produce an ion pair.

Energy required to produce an ion pair = ... J [3]

[Total: 11]