3 A stationary nucleus of mass 220u undergoes radioactive decay to produce a nucleus D of mass 216u and an α-particle of mass 4u, as illustrated in Fig. 3.1.

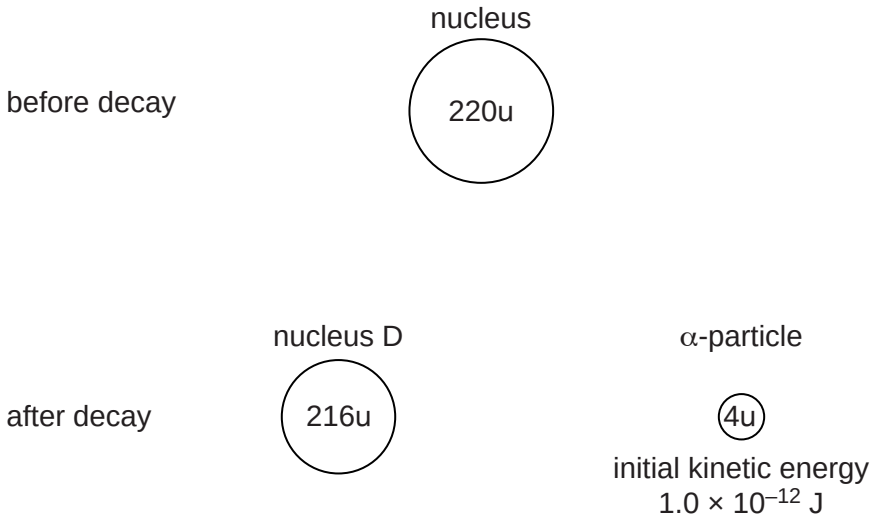

Fig. 3.1

The initial kinetic energy of the α-particle is 1.0×10^{-12} J.

(a) (i) State the law of conservation of linear momentum.

.....

.....

..... [2]

(ii) Explain why the initial velocities of the nucleus D and the α-particle must be in opposite directions.

.....

.....

..... [2]

(b) (i) Show that the initial speed of the α-particle is $1.7 \times 10^{7}\,\text{m s}^{-1}$.

[2]

(ii) Calculate the initial speed of nucleus D.

For Examiner's Use

speed = ... $m\,s^{-1}$ [2]

(c) The range in air of the emitted α-particle is 4.5 cm.
Calculate the average deceleration of the α-particle as it is stopped by the air.

deceleration = ... $m\,s^{-2}$ [2]