3 Francium-208 is radioactive and emits α-particles with a kinetic energy of 1.07×10^{-12} J to form nuclei of astatine, as illustrated in Fig. 3.1.

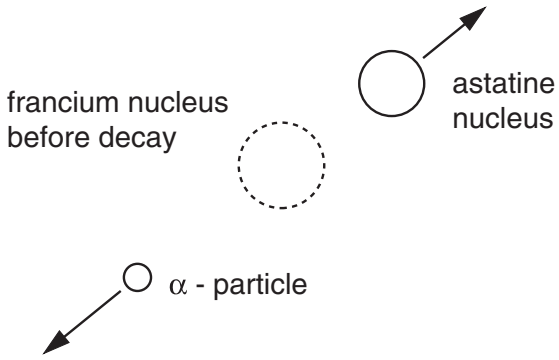

Fig. 3.1

(a) State the nature of an α-particle.

.....

..... [1]

(b) Show that the initial speed of an α-particle after the decay of a francium nucleus is approximately 1.8×10^7 m s^{-1}.

[2]

(c) **(i)** State the principle of conservation of linear momentum.

.....

.....

..... [2]

(ii) The Francium-208 nucleus is stationary before the decay. Estimate the speed of the astatine nucleus immediately after the decay.

For Examiner's Use

speed = ... $m\,s^{-1}$ [3]

(d) Close examination of the decay of the francium nucleus indicates that the astatine nucleus and the α-particle are not ejected exactly in opposite directions.

Suggest an explanation for this observation.

.....

.....

..... [2]

[Turn over