7 A stationary nucleus P of mass 243 u decays by emitting an α-particle of mass 4 u to form a different nucleus Q, as illustrated in Fig. 7.1.

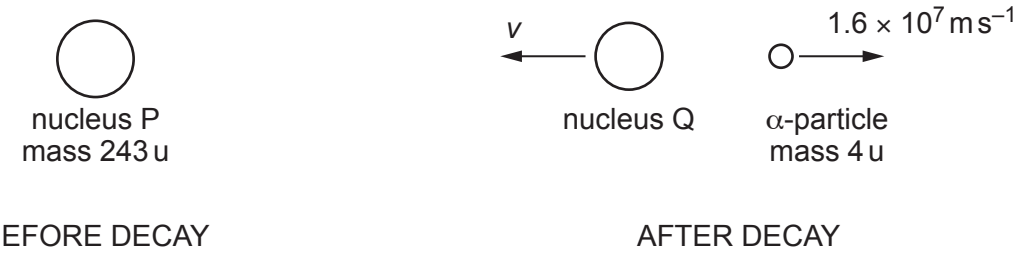

Fig. 7.1

The initial speed of the α-particle is $1.6 \times 10^7\,\text{m s}^{-1}$.

(a) the principle of conservation of momentum to explain why the initial velocities of nucleus Q and the α-particle must be in opposite directions.

.....

.....

.....

..... [2]

(b) Determine the initial speed v of nucleus Q.

v = ... m s^{-1} [2]

(c) Calculate the initial kinetic energy, in MeV, of the α-particle.

kinetic energy = ... MeV [3]

(d) A graph of number of neutrons N against proton number Z is shown in Fig. 7.2.

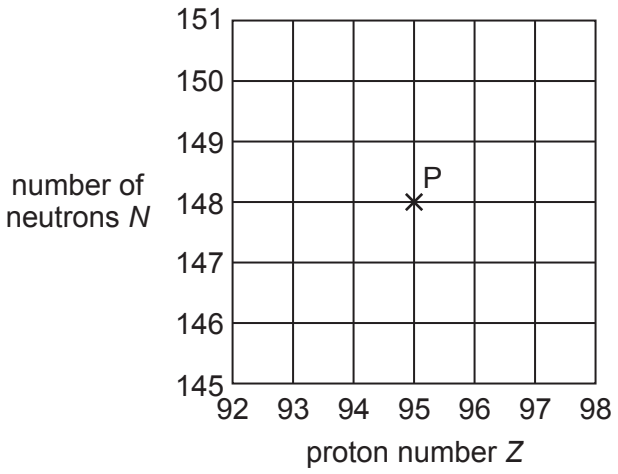

Fig. 7.2

The graph shows a cross that represents nucleus P.

A nucleus R has a nucleon number of 242 and is an isotope of nucleus P.

Nucleus R decays by emitting a β^- particle to form a different nucleus S.

(i) On Fig. 7.2, draw a cross to represent:

1. nucleus R (label this cross R)

2. nucleus S (label this cross S).

[2]

(ii) State the name of the other lepton, in addition to the β^- particle, that is emitted during the decay of nucleus R.

..... [1]

[Total: 10]