4 An α-particle moves in a straight line through a vacuum with a constant speed of $4.1 \times 10^6\,\mathrm{m\,s^{-1}}$. The α-particle enters a uniform electric field at point A, as shown in Fig. 4.1.

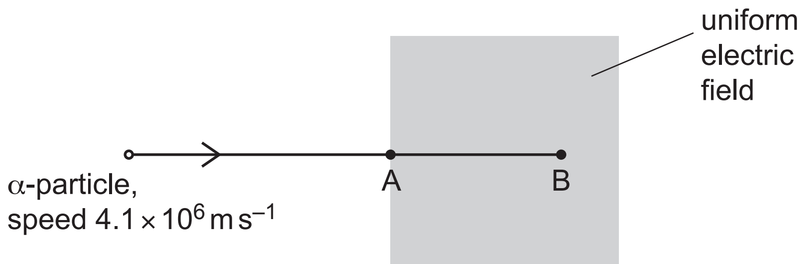

Fig. 4.1

The α-particle continues to move in the same straight line until it is brought to rest at point B by the electric field. The deceleration of the α-particle by the electric field is $2.7 \times 10^{14}\,\mathrm{m\,s^{-2}}$.

(a) State the direction of the electric field.

.... [1]

(b) Calculate the distance AB.

distance = ... m [2]

(c) Calculate the electric field strength.

electric field strength = ... $\mathrm{V\,m^{-1}}$ [3]

(d) The α-particle is at point A at time t = 0.

On Fig. 4.2, sketch the variation with time t of the momentum of the α-particle as it travels from point A to point B. Numerical values are not required.

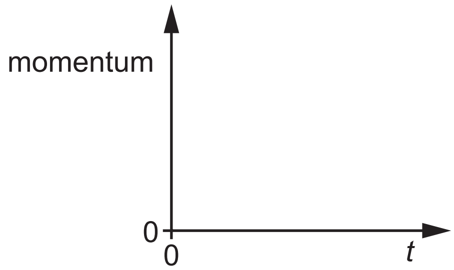

Fig. 4.2

[1]

(e) State the name of the quantity that is represented by the gradient of the graph in **(d)**.

.... [1]

(f) A β^- particle now enters the electric field along the same initial path as the α-particle and with the same initial speed of $4.1 \times 10^6\,\mathrm{m\,s^{-1}}$.

(i) Calculate the kinetic energy, in J, of the β^- particle at point A.

kinetic energy = ... J [3]

(ii) State and explain the differences between the electric force on the β^- particle in the electric field and the electric force on the α-particle in the electric field.

....

....

....

....

.... [3]

(iii) The β^- particle is produced by the decay of a nucleus. State the name of another lepton that is produced at the same time as the β^- particle.

.... [1]

[Total: 15]