2 An alpha particle moves towards a tritium nucleus as illustrated in Fig. 2.1.

alpha particle   tritium
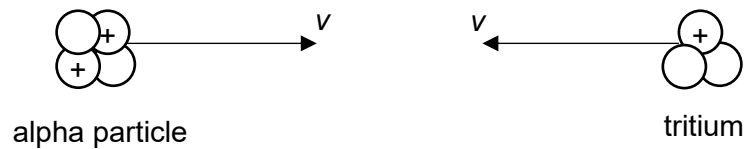
Fig. 2.1

The two particles initially have the same speed v and are far away from each other. The alpha particle comprises two neutrons and two protons, and can be regarded to have a mass of $4u$. The tritium nucleus comprises two neutrons and a proton, and can be regarded to have a mass of $3u$.

(a) (i) Explain if there is a moment at which both particles are instantaneously at rest.

....

....

....

....

.... [1]

(ii) At one instant during the interaction between the particles, both travel in the same direction with the same speed.

Show that this speed is $0.143v$.

[1]

(iii) In **(a)(ii)**, the total amount of kinetic energy has decreased when compared to the initial state of the system.

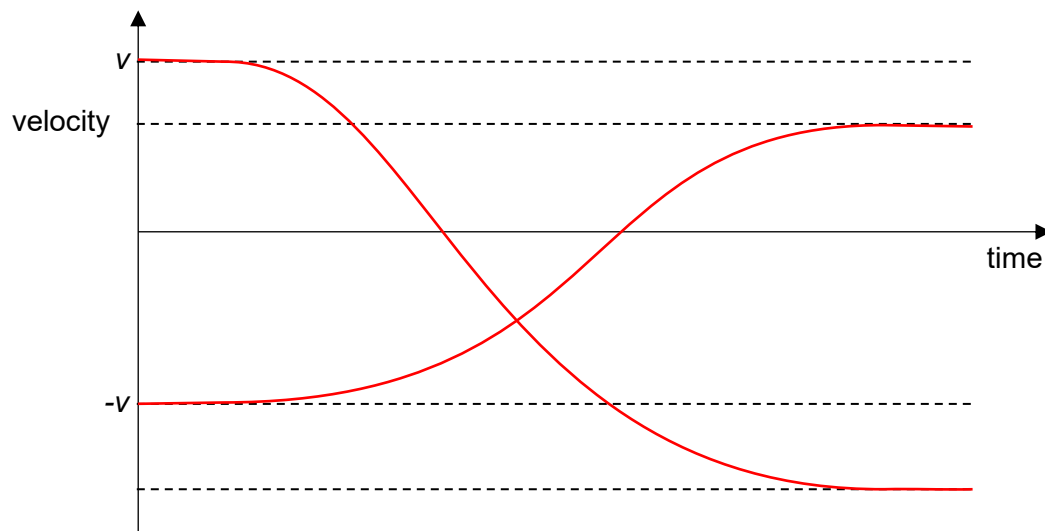Explain how the interaction can be regarded as an elastic interaction.

....

....

....

....

....

....

.... [2]

(b) Fig. 2.2 shows the variation of velocity with respect to time for both particles.

Fig. 2.2 (not to scale)

On Fig. 2.2,

(i) label the graph to show which curve is for the tritium nucleus, [1]

(ii) sketch a graph which shows the variation of velocity with time of the centre of mass of the alpha-tritium system. [1]

(c) Determine the final speed of each particle in terms of v.

final speed of alpha particle = …………………………………. v

final speed of tritium nucleus = …………………………………. v [3]

[Total: 9]