A particle of mass m is moving with speed u in the direction $\frac{1}{\sqrt{2}}(\mathbf{i}+\mathbf{j})$ with respect to a Cartesian coordinate system. A second particle, of mass $2m$, moves with speed v in the direction $\frac{1}{\sqrt{2}}(\mathbf{i}-\mathbf{j})$, and the two particles collide at the origin O. Following the collision, the two particles coalesce and move together in the $\mathbf{j}$-direction.

(i) Show that $u = 2v$.

(ii) Show that the speed of the combined particle after the collision is $\sqrt{2}u/3$.

(iii) Determine whether or not the collision is elastic.