Inelastic Collisions

Question 1 Three particles, of masses $1\,\mathrm{kg}$, $3\,\mathrm{kg}$, and $2\,\mathrm{kg}$, simultaneously collide.

Before the collision, the middle particle was motionless, whereas the velocities of the other two were $1\,\mathrm{m\,s^{-1}}$ and $-3\,\mathrm{m\,s^{-1}}$ (see the diagram). Assuming that the particles collide non-elastically and coalesce, find their velocity after the collision. Which way will they be moving? *Paper 2006.*

Question 2 Three particles, of masses $4\,\mathrm{kg}$, $3\,\mathrm{kg}$, and $2\,\mathrm{kg}$, simultaneously collide.

Before the collision, the middle particle was motionless, whereas the velocities of the other two were $1\,\mathrm{m\,s^{-1}}$ and $-3\,\mathrm{m\,s^{-1}}$ (see the diagram). Assuming that the particles collide non-elastically and coalesce, find their velocity after the collision and the amount of mechanical energy lost in the collision *Paper 2007.*

Question 3 Consider a closed system of two particles of masses m_1 and m_2 located at $\mathbf{r}_1$ and $\mathbf{r}_2$ respectively. We suppose that the particles are moving (i.e. $\mathbf{r}_1$ and $\mathbf{r}_2$ depend on time t).

(a) Write the momentum $\mathbf{P}$ of the system in terms of m_1, m_2, $\dot{\mathbf{r}}_1$ and $\dot{\mathbf{r}}_2$.

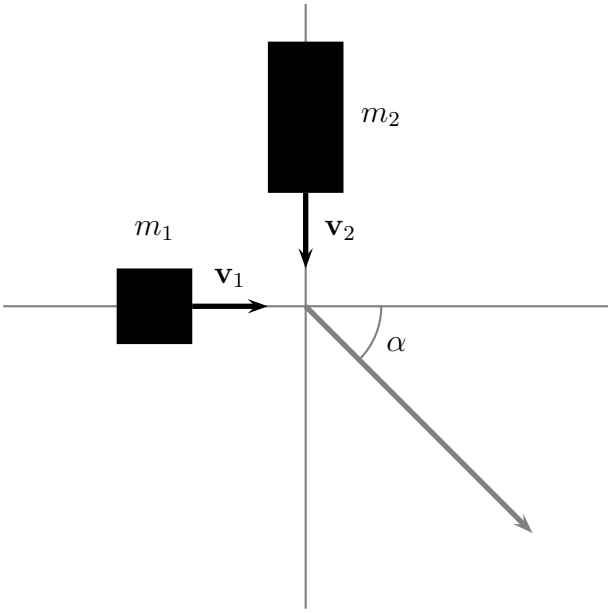
(b) Show that $\mathbf{P}$ does not depend on time.

Paper 2009.

Question 4 Two particles of masses m_1 and $m_2 = 2m_1$ collide. Their velocities before the collision are $\mathbf{v}_1$ and $\mathbf{v}_2$ are orthogonal as shown in the figure. Assuming that the system is closed and that the particles collide non-elastically and coalesce:

(a) Find their velocity $\mathbf{v}$ after the collision, in terms of $\mathbf{v}_1$ and $\mathbf{v}_2$.

(b) Find $\cos\alpha$ in terms of $\mathbf{v}_1$, and $\mathbf{v}_2$, where α is the angle between $\mathbf{v}_1$ and $\mathbf{v}$.



2009 paper.