

1. Particles 1 and 2 collide in space where no external forces are present. Particle 1, with mass  $m_1 = 5$  kg, moves directly up the  $x$  axis and collides with particle 2 (which has mass  $m_2 = 10$  kg). The below lists a pre-collision (unprimed) and a post-collision (primed) position (in m) and velocity (in m/s).

particle mass	pre-collision	post-collision
$m_1 = 5$ kg	$\vec{r}_1 = -16\hat{i}$ $\vec{v}_1 = 15\hat{i}$	$\vec{r}'_1 = 10\hat{i} + 8\hat{j}$ $\vec{v}'_1 = 11\hat{i} + 8\hat{j}$
$m_2 = 10$ kg	$\vec{r}_2 = -1\hat{i}$ $\vec{v}_2 = \vec{0}$	$\vec{r}'_2 = 1\hat{i} - 4\hat{j}$ $\vec{v}'_2 = 2\hat{i} - 4\hat{j}$

- A. Show that the initial momentum in the  $x$  direction equals the final momentum in the  $x$  direction.
- B. Show that the initial momentum in the  $y$  direction equals the final momentum in the  $y$  direction.
- C. Calculate the total kinetic energy in the pre-collision state and in the post-collision state. Is this an elastic collision?
- D. Calculate the relative velocity vector:  $\vec{v} = \vec{v}_1 - \vec{v}_2$  in the pre-collision and post-collision states. Are the relative *speeds* be equal?