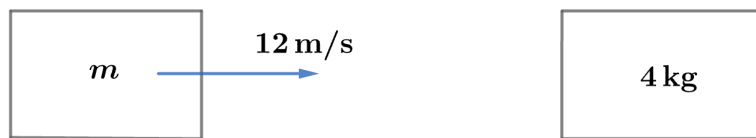


2013 F=ma Exam: Problem 14

Kevin S. Huang

Initially, mass m is moving at 12 m/s towards the 4 kg mass at rest.

Ground frame:



We go to the CM frame (moving at v_{CM}):

CM frame:



Recall the total linear momentum $p_{\text{tot}} = M_{\text{tot}}v_{\text{CM}}$ so $p_{\text{tot}} = 0$ in the CM frame (since the CM is at rest by definition). Then after an elastic collision, the velocities just flip directions: The speeds of both objects stay the same which conserves energy. Flipping velocities changes the sign of the momentum. But $-p_{\text{tot}} = p_{\text{tot}}$ since $p_{\text{tot}} = 0$ so momentum is also conserved.

CM frame (after collision):



Lastly, we go back to the ground frame (adding velocity v_{CM} to the right on both objects):

Ground frame (after collision):



We are given that mass m moves to the left with velocity 6 m/s . Thus,

$$12 \text{ m/s} - 2v_{\text{CM}} = 6 \text{ m/s}$$

$$v_{\text{CM}} = 3 \text{ m/s}$$

so the answer is B.