



### A: (20 points) Elastic Collision

Two elastic balls collide in one dimension. Their masses are  $m_1 = 3\text{kg}$  and  $m_2 = 4\text{kg}$ . Before the collision, their velocities are  $v_1 = +12\text{m/s}$  and  $v_2 = -2\text{m/s}$ . What is  $V_{CM}$ , the velocity of their center of mass? What is the impulse  $\Delta p_2$  received by  $m_2$  during the collision? What is  $\Delta K$ , the change in the system total kinetic energy?

• (5pts)  $V_{CM} = \underline{+4\text{ m/s}}$

Elastic collision  $\Rightarrow \underline{\underline{\Delta K = 0}}$

• (10pts)  $\Delta p_2 = \underline{+48\text{ kg}\cdot\text{m/s}}$

• (5pts)  $\Delta K = \underline{0}$

$$M = m_1 + m_2 = \underline{7\text{ kg}}$$

$$P = m_1 v_1 + m_2 v_2 = \underline{+28\text{ kg}\cdot\text{m/s}}$$

•  $P = M V_{CM} \Rightarrow V_{CM} = P/M = \boxed{+4\text{ m/s}}$

• Final  $v_2'$ : (see text.)

$$v_2' = \frac{2m_1}{m_1 + m_2} v_1 + \frac{m_2 - m_1}{m_1 + m_2} v_2 = \frac{+10\text{ m/s}}$$

$$p_2' = m_2 v_2' = +40\text{ kg}\cdot\text{m/s}$$

$$p_2 = m_2 v_2 = -8\text{ kg}\cdot\text{m/s}$$

•  $\Delta p_2 = p_2' - p_2 = \boxed{+48\text{ kg}\cdot\text{m/s}}$