$$m_1v_1' + m_2v_2' = m_1v_1 + m_2v_2 \qquad ①$$

$$-v_1' + v_2' = e(v_1 - v_2) \qquad ②$$

① $-m_2 \times$ ②

$$(m_1 + m_2)v_1' = m_1v_1 + m_2v_2 - m_2e(v_1 - v_2) = m_1v_1 + m_2v_1 - m_2v_1 + m_2v_2 - m_2e(v_1 - v_2)$$
$$= (m_1 + m_2)v_1 - m_2(1+e)(v_1 - v_2)$$

$$\therefore v_1' = v_1 - \frac{m_2}{m_1 + m_2}(1+e)(v_1 - v_2)$$

① $+m_1 \times$ ②

$$(m_1 + m_2)v_2' = m_1v_1 + m_2v_2 + m_1e(v_1 - v_2) = m_1v_1 + m_1v_2 - m_1v_2 + m_2v_2 + m_2e(v_1 - v_2)$$
$$= (m_1 + m_2)v_2 + m_1(1+e)(v_1 - v_2)$$

$$\therefore v_2' = v_2 + \frac{m_1}{m_1 + m_2}(1+e)(v_1 - v_2)$$