43. (a) Let m_1 be the mass of one sphere, v_{1i} be its velocity before the collision, and v_{1f} be its velocity after the collision. Let m_2 be the mass of the other sphere, v_{2i} be its velocity before the collision, and v_{2f} be its velocity after the collision. Then, according to Eq. 10–38,

$$v_{1f} = \frac{m_1 - m_2}{m_1 + m_2} v_{1i} + \frac{2m_2}{m_1 + m_2} v_{2i} \, .$$

Suppose sphere 1 is originally traveling in the positive direction and is at rest after the collision. Sphere 2 is originally traveling in the negative direction. Replace v_{1i} with v, v_{2i} with $-v$, and v_{1f} with zero to obtain $0 = m_1 - 3m_2$. Thus $m_2 = m_1/3 = (300\,\mathrm{g})/3 = 100\,\mathrm{g}$.

(b) We use the velocities before the collision to compute the velocity of the center of mass:

$$v_{\mathrm{com}} = \frac{m_1 v_{1i} + m_2 v_{2i}}{m_1 + m_2} = \frac{(300\,\mathrm{g})(2.0\,\mathrm{m/s}) + (100\,\mathrm{g})(-2.0\,\mathrm{m/s})}{300\,\mathrm{g} + 100\,\mathrm{g}}$$

which yields $v_{\mathrm{com}} = 1.0$ m/s.