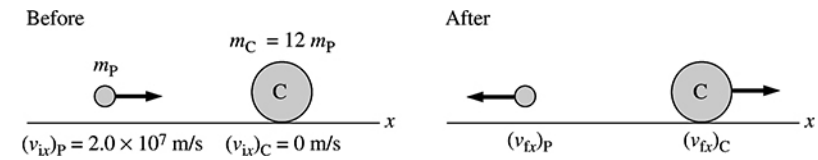
10.26. Model: This is a case of a perfectly elastic collision between a proton and a carbon atom. The collision obeys the momentum as well as the energy conservation law.

Visualize:



Solve: Momentum conservation: $m_P(v_{ix})_P + m_C(v_{ix})_C = m_P(v_{fx})_P + m_C(v_{fx})_C$

Energy conservation: $\frac{1}{2}m_P(v_{ix})_P^2 + \frac{1}{2}m_C(v_{ix})_C^2 = \frac{1}{2}m_P(v_{fx})_P^2 + \frac{1}{2}m_C(v_{fx})_C^2$

These two equations can be solved, as described in the text through Equations 10.39 to 10.43:

$$(v_{fx})_P = \frac{m_P - m_C}{m_P + m_C} m_P + m_C (v_{ix})_P = \left(\frac{m_P - 12m_P}{m_P + 12m_P}\right)(2.0\times10^7 \text{ m/s}) = -1.69\times10^7 \text{ m/s}$$

$$(v_{fx})_C = \frac{2m_P}{m_P + m_C}(v_{ix})_P = \left(\frac{2m_P}{m_P + 12m_P}\right)(2.0\times10^7 \text{ m/s}) = 3.1\times10^6 \text{ m/s}$$

After the elastic collision the proton rebounds at 1.69×10^7 m/s and the carbon atom moves forward at 3.08×10^6 m/s.