9.43. **Model:** Let the system be bullet + target. No external horizontal forces act on this system, so the horizontal momentum is conserved. Model the bullet and the target as particles. Since the target is much more massive than the bullet, it is reasonable to assume that the target undergoes no significant motion during the brief interval in which the bullet passes through.

**Visualize:**

![Pictorial representation of bullet and target](image)

**Solve:** (a) By assuming that the target has negligible motion during the interval in which the bullet passes through, the time is that needed to slow from 1200 m/s to 900 m/s in a distance of 30 cm. We’ll use kinematics to first find the acceleration, then the time.

\[ a = \frac{(v_f)^2 - (v_i)^2}{2\Delta x} = \frac{(900 \text{ m/s})^2 - (1200 \text{ m/s})^2}{2(0.30 \text{ m})} = -1.05 \times 10^6 \text{ m/s}^2 \]

\[ \Rightarrow \Delta t = \frac{(v_f) - (v_i)}{a} = \frac{900 \text{ m/s} - 1200 \text{ m/s}}{-1.05 \times 10^6 \text{ m/s}^2} = 2.86 \times 10^{-4} \text{ s} = 286 \mu\text{s} \]

The average force on the bullet is \( F_{av} = m\Delta v = 26,200 \text{ N} \).

(b) Now we can use the conservation of momentum equation \( p_i = p_f \) to find

\[ m_T (v_{i_T}) + m_B (v_{i_B}) = m_T (v_{f_T}) + m_B (v_{f_B}) = 0 + m_B (v_{f_B}) \]

\[ \Rightarrow (v_{i_T}) = \frac{m_B (v_{i_B}) - m_B (v_{i_B})}{m_T} = 0.025 \text{ kg} \times \frac{(1200 \text{ m/s}) - (900 \text{ m/s})}{350 \text{ kg}} = 0.0214 \text{ m/s} \]