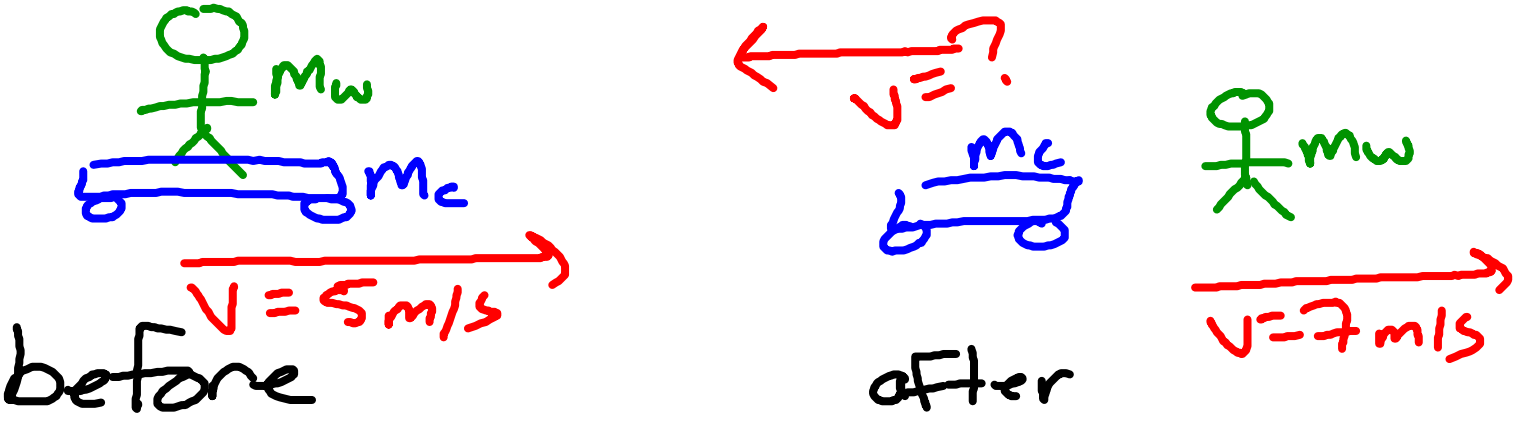
Example Conservation of Momentum Problem

A 50 kg woman is riding on a 10 kg cart moving east at 5.0 m/s. The woman jumps off the front of the cart and hits the ground at 7.0 m/s eastward, relative to the ground. Calculate the cart's velocity after the woman jumps off.



$$P_b = P_a \qquad p = mv$$

$$(m_w + m_c)v_b = m_w v_{wa} + m_c v_{ca}$$

$$\frac{(m_w + m_c)v_b - m_w v_{wa}}{m_c} = \frac{m_c v_{ca}}{m_c}$$

$$\frac{[(50\,kg + 10\,kg)5\,m/s - (50\,kg)(7\,m/s)]}{10\,kg} = v_{ca}$$

$$\boxed{-5\,m/s = v_{ca}}$$

Video of marble colliding with soda can.

What is the velocity of the marble before the collision?

960 Fr/s

$t_m = 4\,Fr \times \frac{1\,s}{960\,Fr} =$

$t_m = .00417\,s$

$t_c = 20\,Fr \times \frac{1\,s}{960\,Fr}$

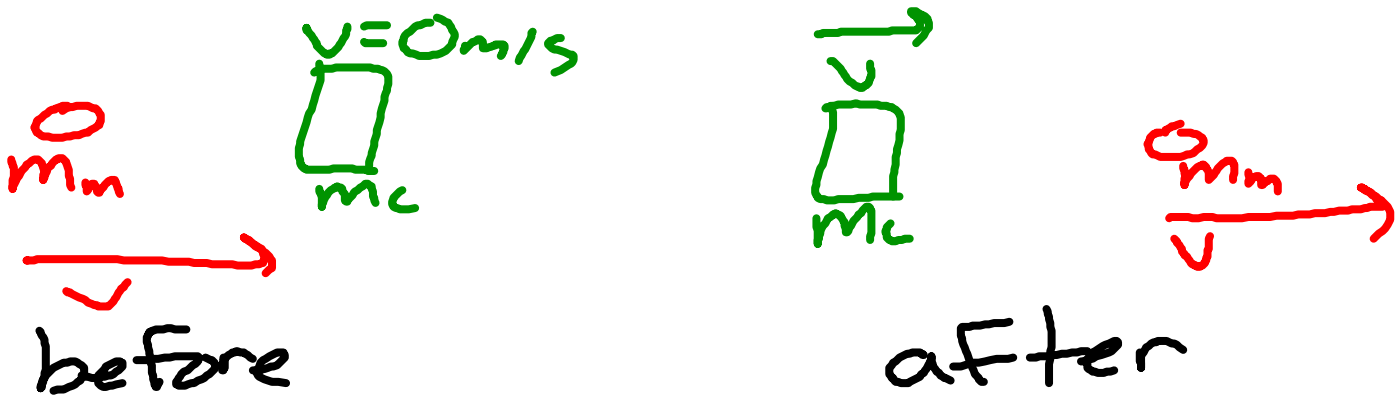
$t_c = .02083\,s$

M&M
→ 24cm = .24m
→ 4 Frames

Can
→ 18cm = .18m
→ 20 Frames

$V = \frac{d}{t}$

$V_m = \frac{.24m}{.00417s} = 57.6\,m/s$ $V_c = \frac{.18m}{.02083s} = 8.64\,m/s$



$P_b = P_a$

$\frac{m_m V_{mb} + m_c V_{cb}}{m_m} = \frac{m_m V_{ma} + m_c V_{ca}}{m_m}$

$$V_{mb} = \frac{[(.0023kg)(57.6 m/s) + (.013kg)(8.64 m/s)]}{(.0023kg)}$$

$$\boxed{V_{mb} = 106.4 m/s}$$