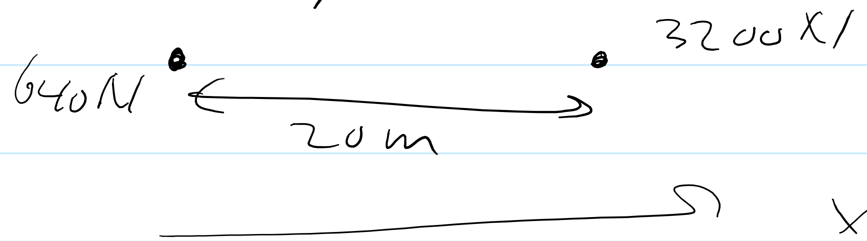
Quiz 7

Friday, November 6, 2015 10:26 AM

(1) Conservation of momentum

$\Rightarrow$ center of mass remains stationary

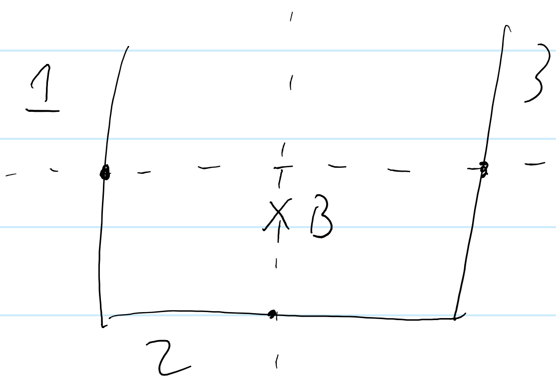


$$x_{cm} = \frac{m_h x_h + m_b x_b}{m_h + m_b} = \frac{w_h x_h + w_b x_b}{w_h + w_b}$$

$$= \frac{20 \cdot 3200}{3200 + 640} = 16.7\ m$$

$\Rightarrow$ Bear will move $20 - 16.7 = 3.3\ m$

(2)



From symmetry, it has to be B

(3) Conservation of momentum in x-direction

$\Rightarrow m_b v_{bx} + m_w v_{wx} = \text{constant} = 0$

$\Rightarrow v_{wx} = -\frac{m_b}{m_w} v_{bx} = -\frac{5}{10} 6 = -3 \text{ m/s}$

(4) $v = v_0 + gt = gt$.

$\Rightarrow p = mv = mgt = 98 \frac{kg\,m}{s}$

(5) For collision, $\vec{p}$ = conserved

m = mass of bullet

M = mass of block

v = velocity of bullet

$\tilde{v}$ = velocity of block + bullet

$\Rightarrow mv = (m+M)\tilde{v}$

Conservation of energy

$\frac{1}{2}(m+M)\tilde{v}^2 = (m+M)gh$

$\Rightarrow \tilde{v} = \sqrt{2gh}$

$\Rightarrow v = \frac{m+M}{m}\tilde{v} = \frac{m+M}{m}\sqrt{2gh}$

$= 808 \text{ m/s}$

6 Conservation of momentum

$$m_r v_r = (m_r + m_c) v$$

$$\Rightarrow v = \frac{m_r}{m_r + m_c} v_r = \frac{2000}{500+2000} \cdot 3$$

7 $p_i = p_f$

$$\Rightarrow m_A v_A + m_B v_B = (m_A + m_B) v$$

$$\Rightarrow v = \frac{m_A v_A + m_B v_B}{m_A + m_B} = 0 \ \frac{m}{s}$$

Energy lost:

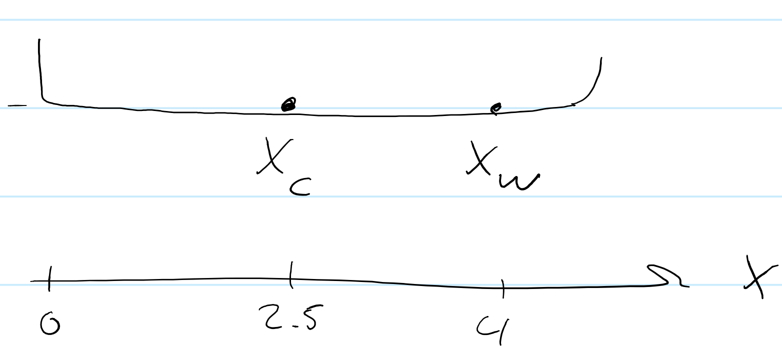
$$K_i - K_f = \frac{1}{2} m_A v_A^2 + \frac{1}{2} m_A v_A^2$$

$$- \frac{1}{2} (m_A + m_B) v^2$$

$$= K_i = 3750 \text{ J}$$

8 Center of mass of canoe cannot move since $\vec{F}_{net} = 0$

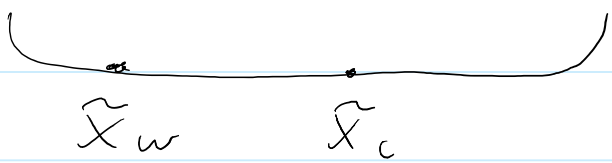
Before



$$x_{cm} = \frac{m_c x_c + m_w x_w}{m_c + m_w} = \frac{60(2.5) + 45(4)}{105}$$

$$= 3.14\,m$$

After



$$\tilde{x}_{cm} = \frac{m_c \tilde{x}_c + m_w \tilde{x}_w}{m_c + m_w} = 3.14\,m$$

Also $\tilde{x}_c - \tilde{x}_w = 1.5\,m \Rightarrow \tilde{x}_w = \tilde{x}_c - 1.5$

$$\Rightarrow m_c \tilde{x}_c + m_w(\tilde{x}_c - 1.5) = (m_c + m_w)3.14$$

$$\Rightarrow \tilde{x}_c = \frac{(m_c + m_w)3.14 + 1.5\,m_w}{m_c + m_w}$$

$$= 3.14 + 0.64 = 3.78\,m$$

$\Rightarrow$ canoe has moved $3.78 - 2.5$

$$= 1.28\,m$$