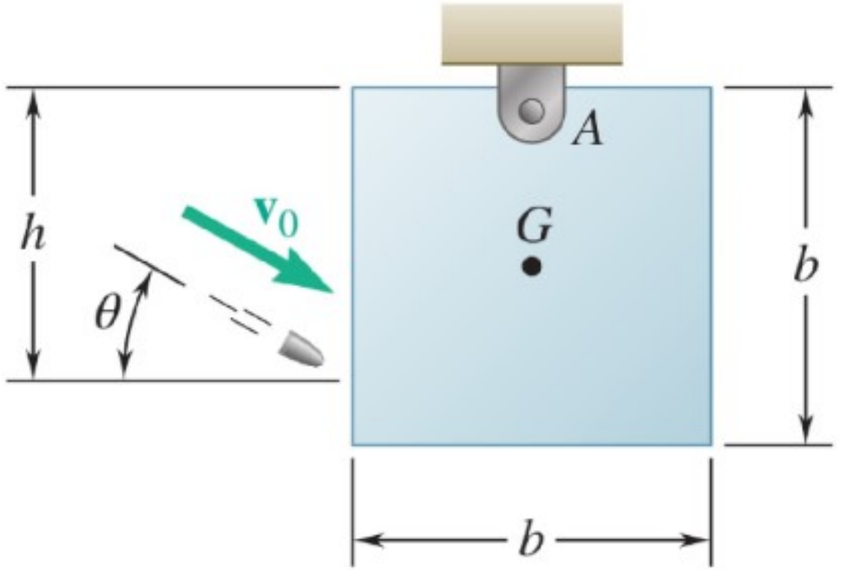
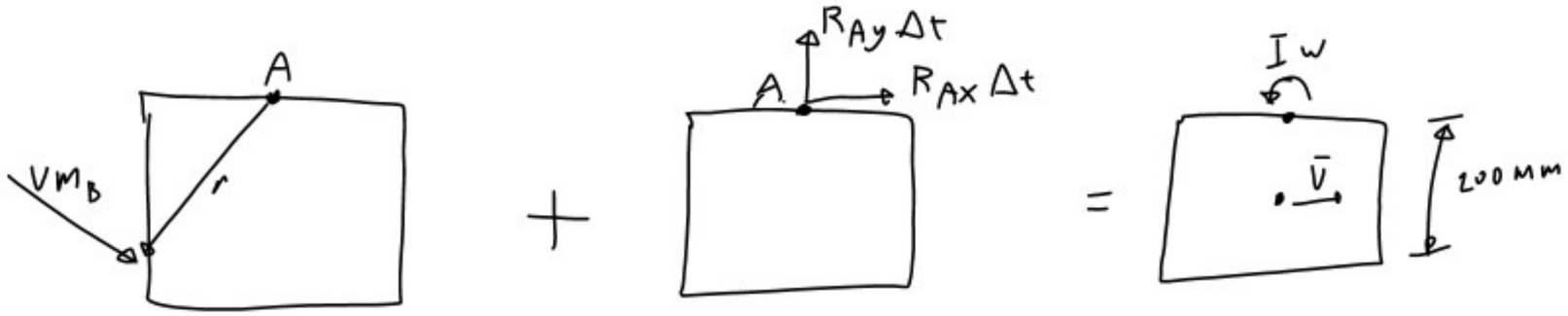
A 45-g bullet is fired with a velocity of 400 m/s at $\theta = 30°$ into a 9-kg square panel of side $b = 200$ mm. Knowing that $h = 150$ mm and that the panel is initially at rest, determine (*a*) the velocity of the center of the panel immediately after the bullet becomes embedded, (*b*) the impulsive reaction at *A*, assuming that the bullet becomes embedded in 2 ms.





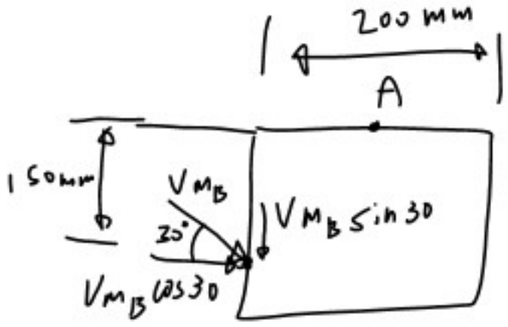
$$\bar{I} = \frac{1}{12} m (b^2 + b^2)$$

$$I_A = \bar{I} + m d^2$$

$$= \frac{1}{12} 9\,kg (0.2\,m^2 + 0.2\,m^2) + 9\,kg\,(0.1\,m)^2$$

$$= 0.15\ kg\,m^2$$

$$H_{A1} + \cancel{M\Delta t}^{\,0} = H_{A2} = \bar{I} w$$



$$H_{A1} = r \times V m_B = 100\,mm\ V m_B \sin 30 + 150\,mm\ V m_B \cos 30$$

$$= 100\,mm\,400\,m/s\ 9\,5\,g \sin 30 + 150\,mm\ 400\,m/s\ 9\,5\,g \cos 30$$

$$= 3.24 \times 10^6 \frac{mm\,g\,m}{s} \frac{1\,m}{1000\,mm} \frac{kg}{1000\,g} = 3.24 \frac{m^2 kg}{s} = \bar{I} w$$

$$\frac{3.24 \frac{m^2 kg}{s}}{0.15\ kg\,m^2} = 21.6 \frac{rad}{s} = w$$

$$\bar{V} = r w = 0.1\,m\ 21.6 \frac{rad}{s} = \boxed{2.16\ m/s}$$

$$L_{1x} + R_{Ax}\Delta t = L_{2x}$$

$$V m_B \cos 30 + R_{Ax}\Delta t = \bar{V} m$$

$$400\ m/s\ 45g \cos 30 + R_{Ax}\ 0.002\ s = 2.16\ m/s\ 9\ kg$$

$$R_{Ax}\ 0.002 = 2.16\ m/s\ 9K - 400\ m/s\ 45g \cos 30$$

$$R_{Ax} = \frac{2.16\ m/s\ 9kg - 400\ m/s\ 0.045\ kg \cos 30}{0.002\ s} = 1921\ N$$

$$L_{1y} + R_{Ay}\Delta t = L_{2y}$$

$$R_{Ay}\Delta t = -L_{1y}$$

$$R_{Ay} = \frac{-L_{1y}}{\Delta t} = \frac{-V m_B \sin 30}{\Delta t}$$

$$= \frac{-400\ m/s\ 0.045\ kg \sin 30}{0.002\ s} = 4500\ N$$

A bullet weighing 0.08 lb is fired with a horizontal velocity of 1800 ft/s into the lower end of a slender 15-lb bar of length $L = 30$ in. Knowing that $h = 12$ in. and that the bar is initially at rest, determine (*a*) the angular velocity of the bar immediately after the bullet becomes embedded, (*b*) the impulsive reaction at *C*, assuming that the bullet becomes embedded in 0.001 s.