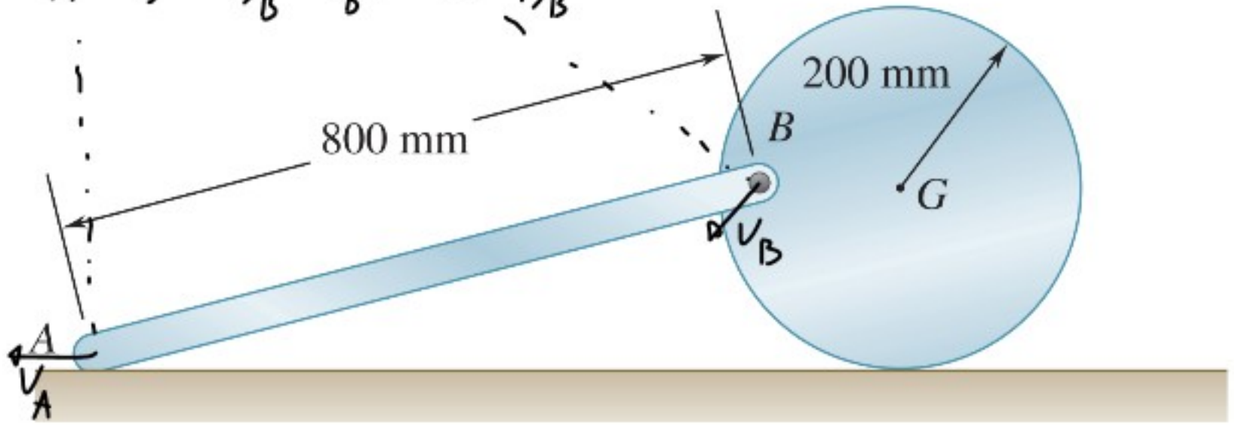
The 200-mm-radius disk rolls without sliding on the surface shown. Knowing that the distance BG is 160 mm and that at the instant shown the disk has an angular velocity of 8 rad/s counterclockwise and an angular acceleration of 2 rad/s^2 clockwise, determine the acceleration of A.



$$v_A = v_B + v_{A/B} = v_B + \omega k \times r_{A/B}$$

$$a_A = a_B + a_{B/A} = a_B + \alpha k \times r_{B/A} - \omega^2 r_{B/A}$$

1. v_G
2. a_G
3. $v_B = v_G + v_{B/G}$
4. $a_B = a_G + a_{B/G}$

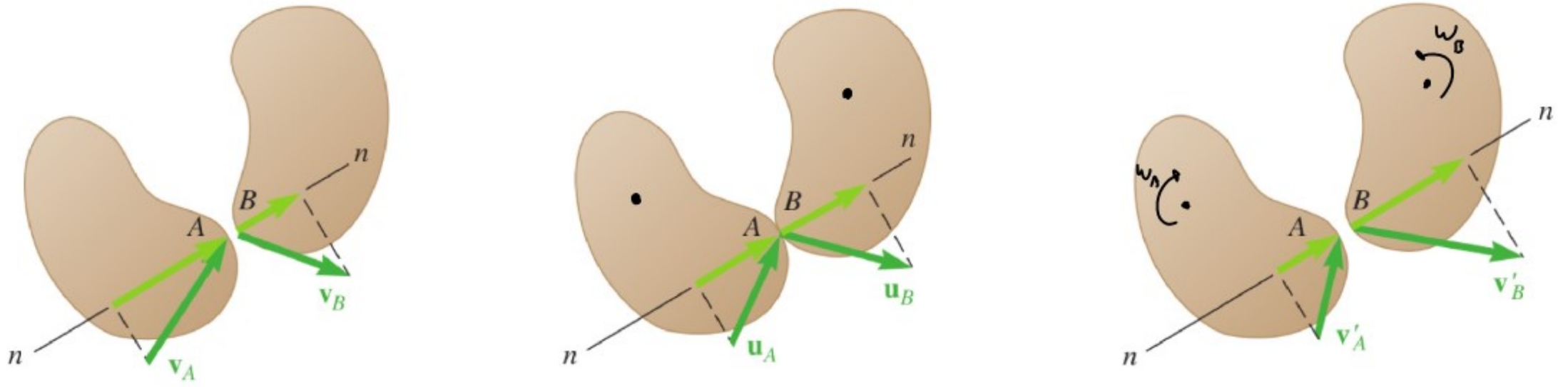
$$a_{B/G} = \alpha k \times r_{B/G} - \omega^2 r_{B/G}$$

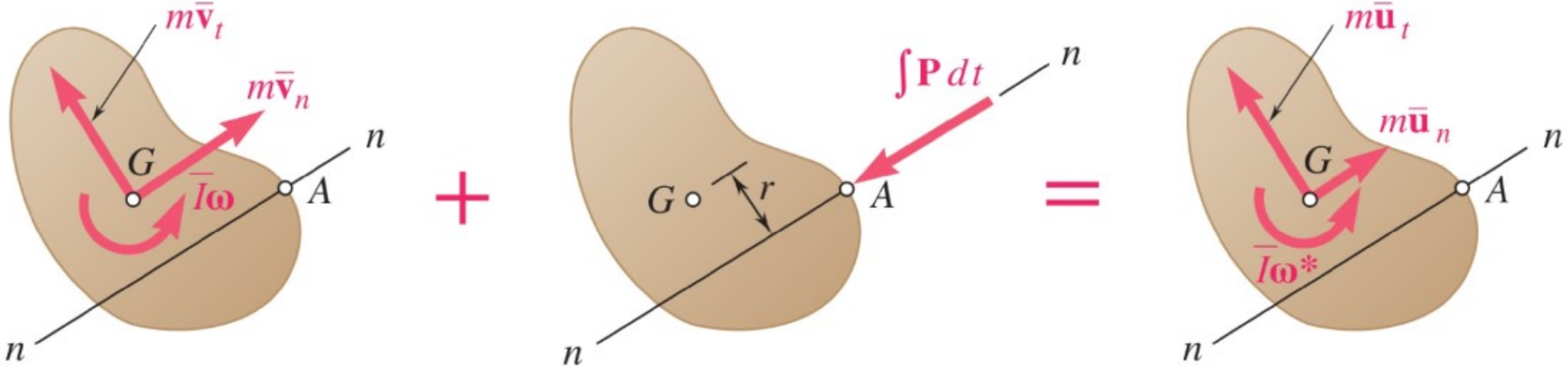
5. $\omega_{AB} = \dfrac{v_B}{BC}$
6. α_{AB}
7. $a_A = a_B + \alpha_{AB} k \times r_{B/A} - \omega_{AB}^2 r_{B/A}$

$$\alpha_{AB} = \frac{(a_B)_t}{BC}$$

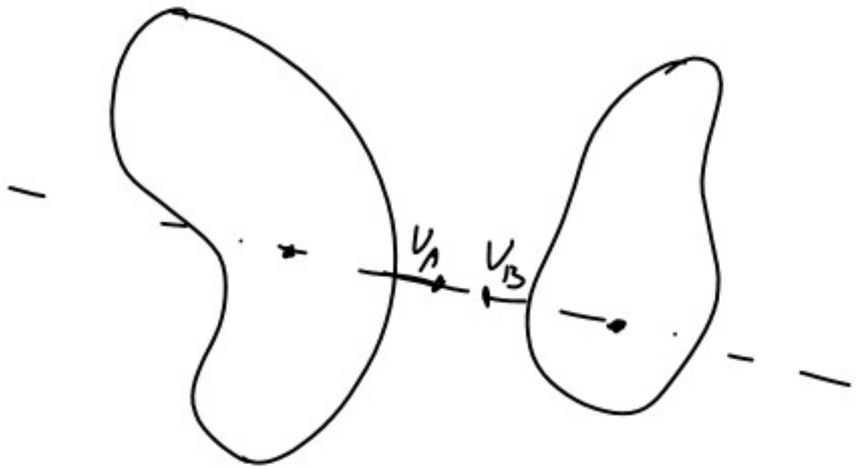
$(a_B)_t$: tangential to rotation about C

Eccentric Impact





$$(V_B')_n - (V_A')_n = e\left((V_A)_n - (V_B)_n\right)$$


V_A
V_B

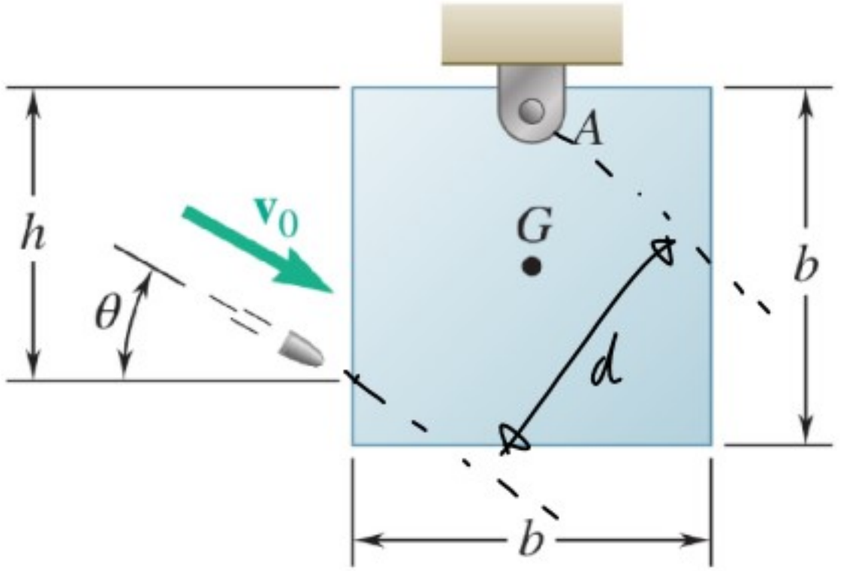
A 45-g bullet is fired with a velocity of 400 m/s at $\theta = 30°$ into a 9-kg square panel of side $b = 200$ mm. Knowing that $h = 150$ mm and that the panel is initially at rest, determine (*a*) the velocity of the center of the panel immediately after the bullet becomes embedded, (*b*) the impulsive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

$H_{A2} = I_A \omega$

$(V'_A)_n - (V'_B)_n = e((V_B)_n - (V_A)_n)$

$e = 0$

$(V'_A)_n = (V'_B)_n$



$L_B = mV = 45g\ 400\ m/s = 18000\ \frac{gm}{s}$

$= 18\ \frac{kg\,m}{s}$

$H_{A1} + \int_{t_1}^{t_2} M_A\, dt = H_{A2}$

$H_{A1} + \int_{t_1}^{t_2} F d\ dt = H_{A2}$

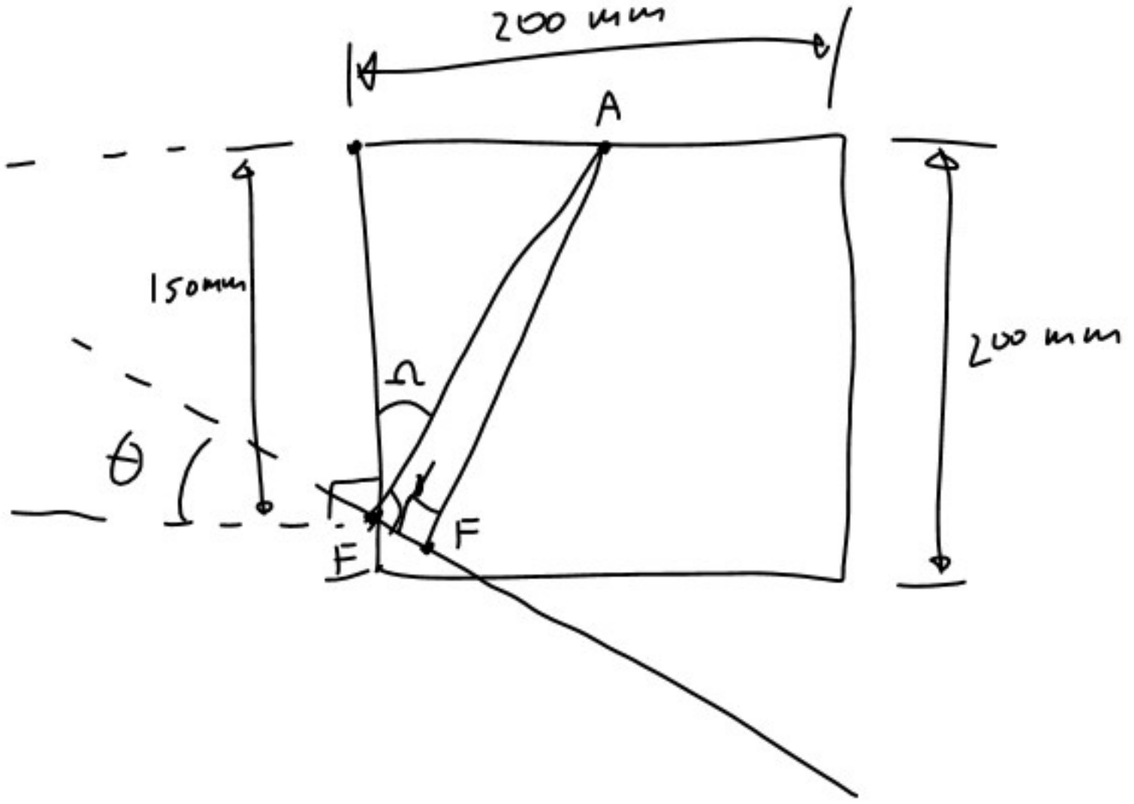
$H_{A1} + d\int_{t_1}^{t_2} F\, dt = H_{A2}$

$H_{A1} + d\,Imp_{1\to 2} = H_{A2}$

$H_{A1} = 0$

$d L_B = H_{A2}$

$0.0799\,m\ 18\ \frac{kg\,m}{s} = H_{A2} = 1.438\ \frac{kg\,m^2}{s}$



$\overline{AE} = \sqrt{100^2 + 150^2} = 180 \text{ mm}$

$\Omega = \tan^{-1}\left(\frac{100 \text{ mm}}{150 \text{ mm}}\right) = 33.7°$

$\Omega + \phi - \theta = 90$

$90 + \Omega + \phi - \theta = 0$

$90 + 33.7 + \phi - 30 = 0$

$\phi = 30 - 90 + 33.7 = -26.3$

$\overline{AF} = d = \overline{AE} \sin(26.3) = 79.9 \text{ mm} = 0.0799 \text{ m}$

$$I_G = \frac{1}{12}\left((200\,mm)^2 + (200\,mm)^2\right) 9\,kg = 30000\ \ kg\,mm^2$$