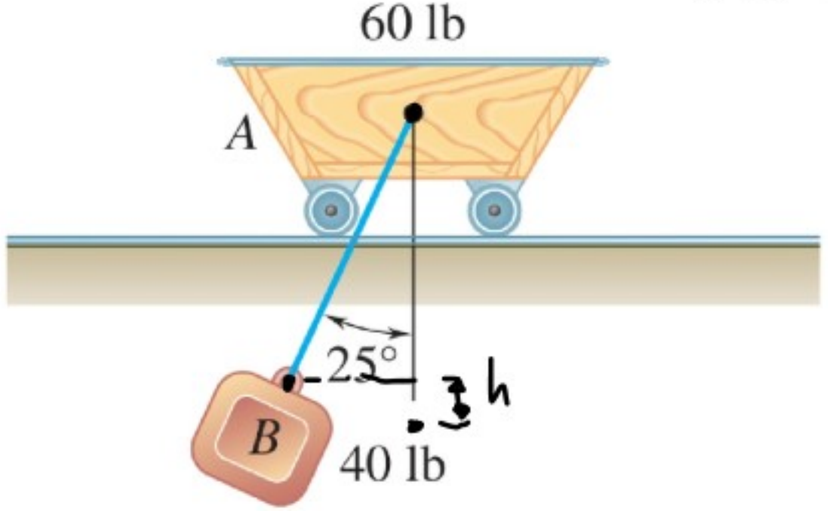
A 40-lb block B is suspended from a 6-ft cord attached to a 60-lb cart A, which may roll freely on a frictionless, horizontal track. If the system is released from rest in the position shown, determine the velocities of A and B as B passes directly under A.

$h = 6 - 6\cos 25 = 0.56\text{ ft}$



$$V_1 + T_1 = V_2 + T_2$$

$$V_{A1} + V_{B1} = V_{A2} + V_{B2} + T_{A2} + T_{B2}$$

$$m_B g h = \frac{1}{2} m_A v_A^2 + \frac{1}{2} m_B v_B^2$$

$$= \frac{1}{2} m_A v_A^2 + \frac{1}{2} m_B \left(-\frac{m_A}{m_B} v_A\right)^2$$

$$L_1 = L_2$$

$$0 = m_A v_A + m_B v_B$$

$$-m_A v_A = m_B v_B$$

$$v_B = -\frac{m_A}{m_B} v_A$$

$$m_B g h = \frac{1}{2} m_A V_A^2 + \frac{1}{2} m_B \left(\frac{-m_A}{m_B} V_A\right)^2$$

$$= \frac{1}{2} m_A V_A^2 + \frac{1}{2} \frac{m_B m_A^2}{m_B^2} V_A^2$$

$$m_B g h = V_A^2 \left(\frac{m_A}{2} + \frac{m_A^2}{2 m_B}\right)$$

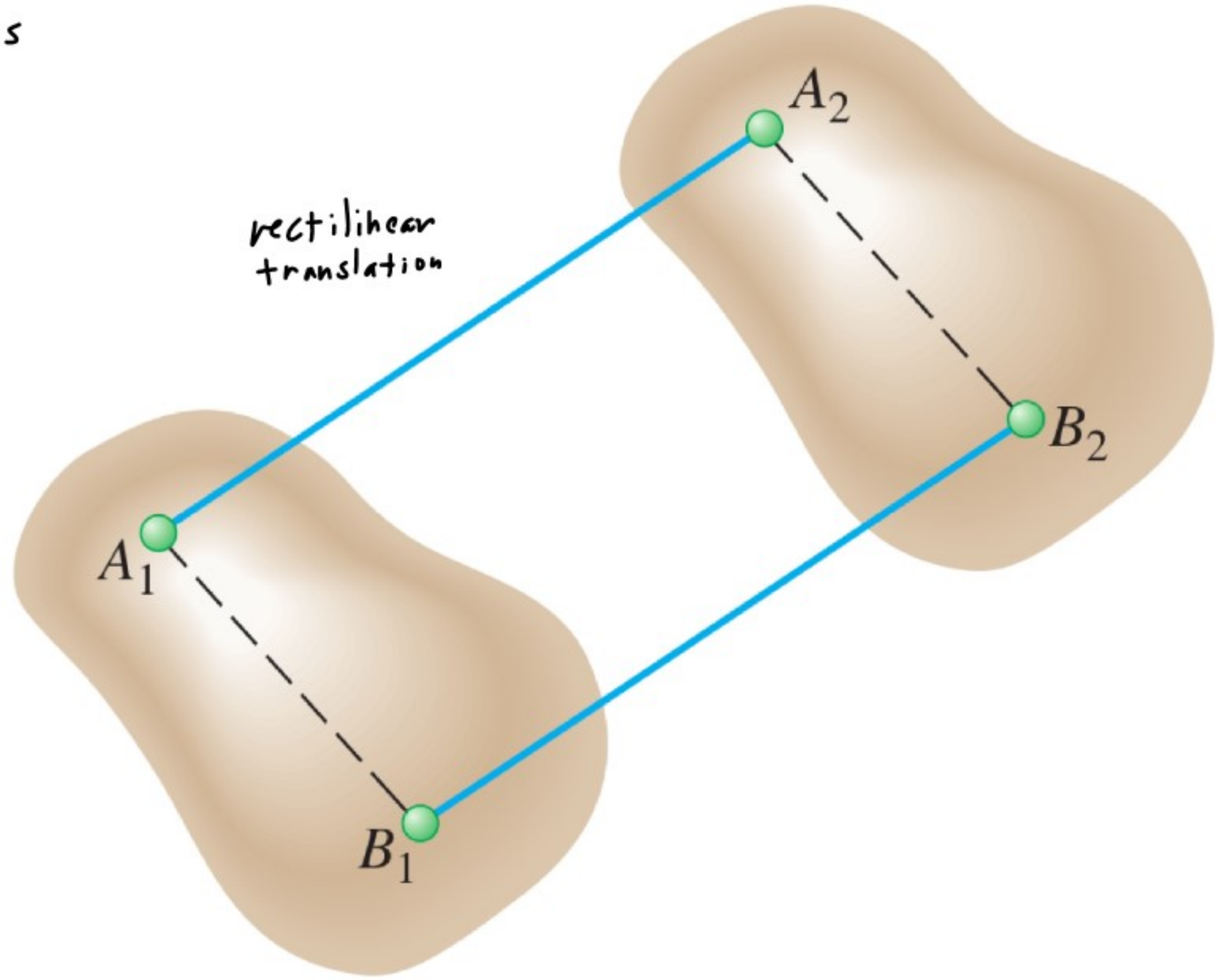
$$V_A^2 = \frac{m_B g h}{\frac{m_A}{2} + \frac{m_A^2}{2 m_B}}$$

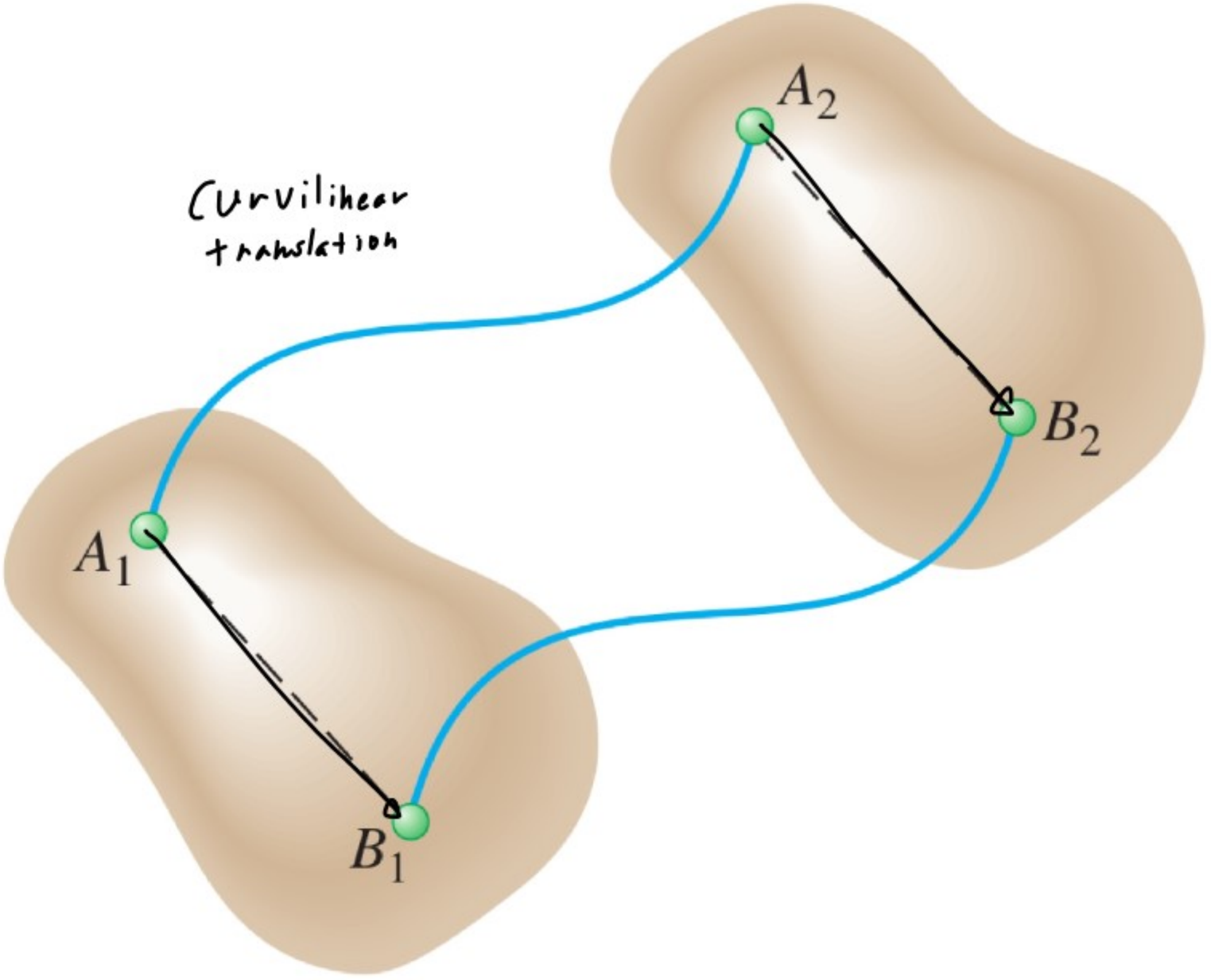
$$V_A = \sqrt{\frac{40 \cdot 0.56}{\frac{60/32.2}{2} + \frac{(60/32.2)^2}{2(40/32.2)}}} = 3.1 \text{ ft/s}$$

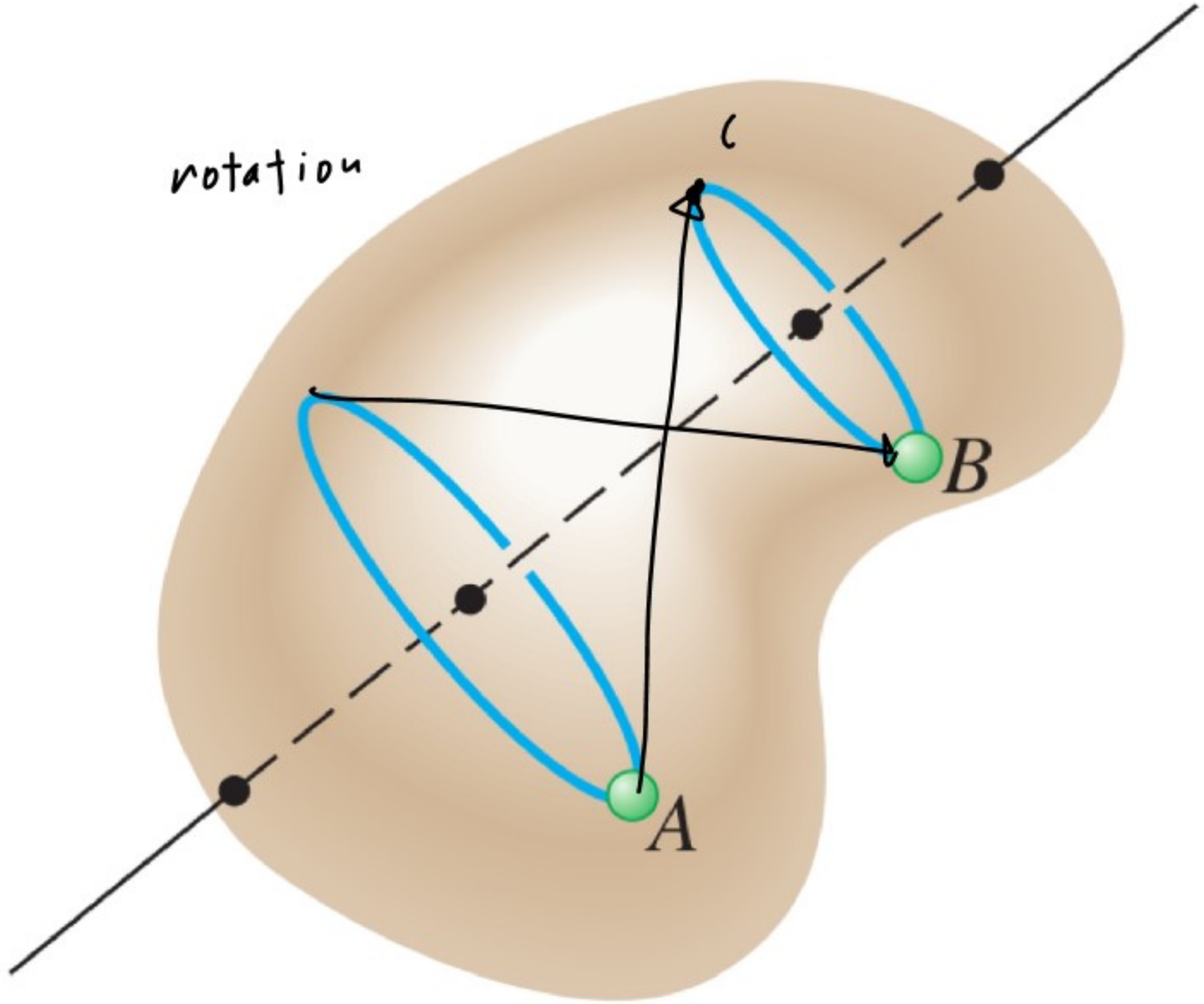
$$V_B = \frac{-m_A}{m_B} V_A = \frac{-60}{40} 3.1 = -4.7 \text{ ft/s}$$

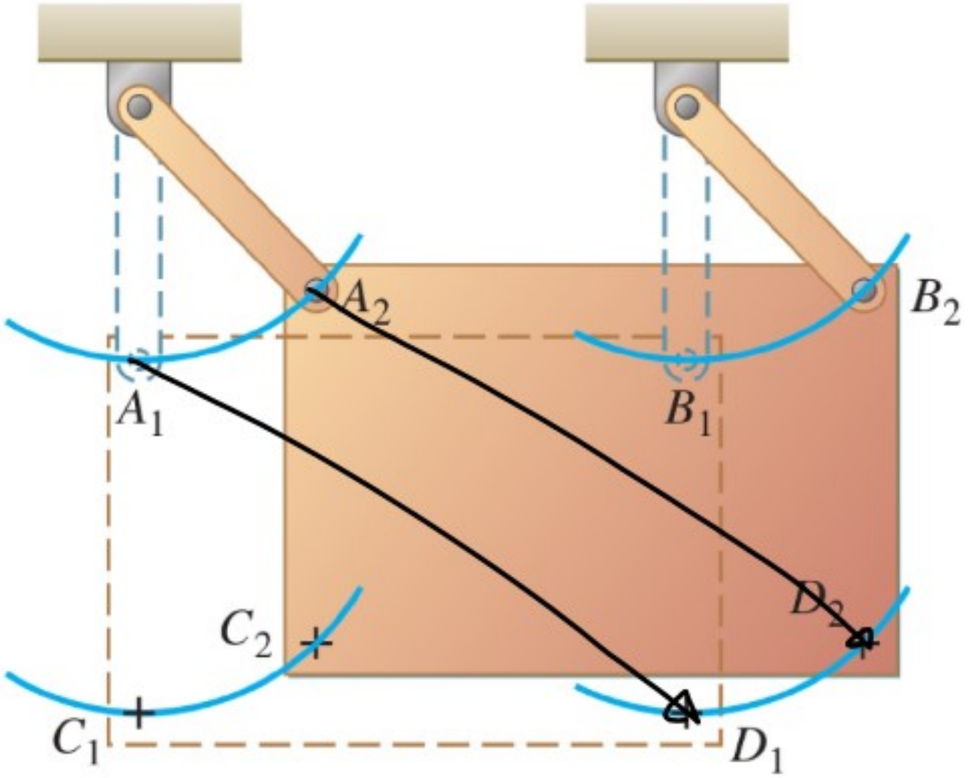
Rigid Bodies

Kinematics

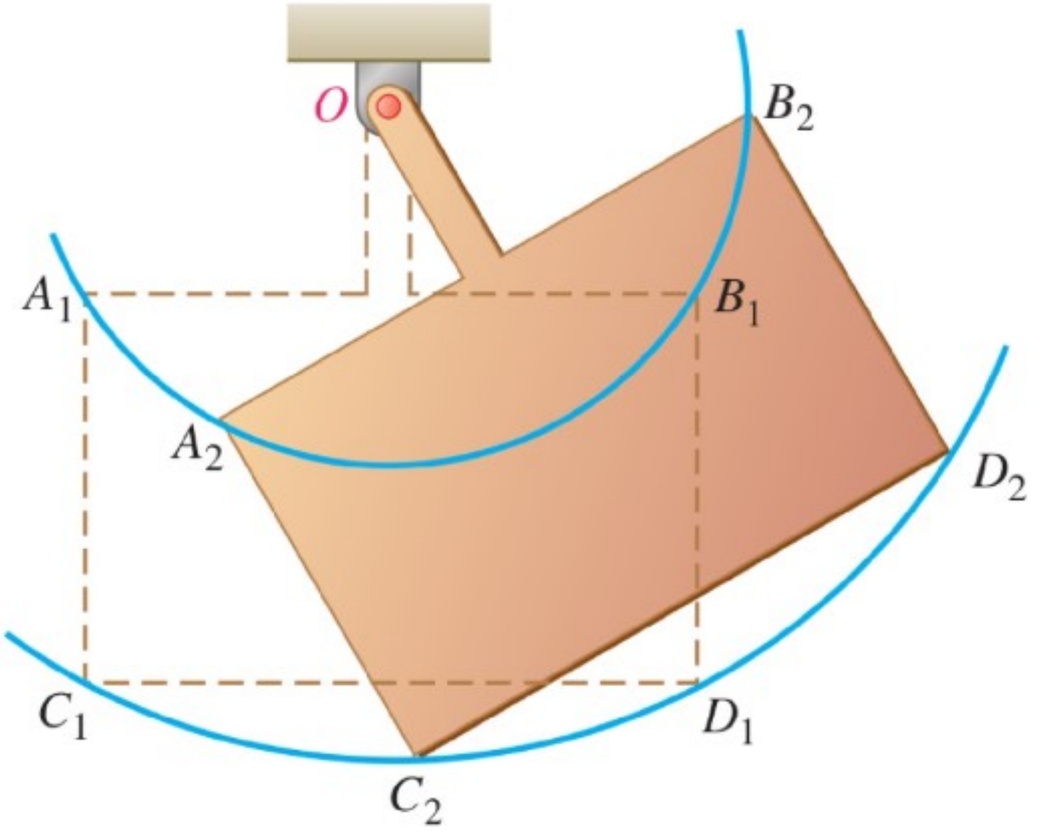



Curvilinear translation
A_2
B_2
A_1
B_1


rotation
C
B
A

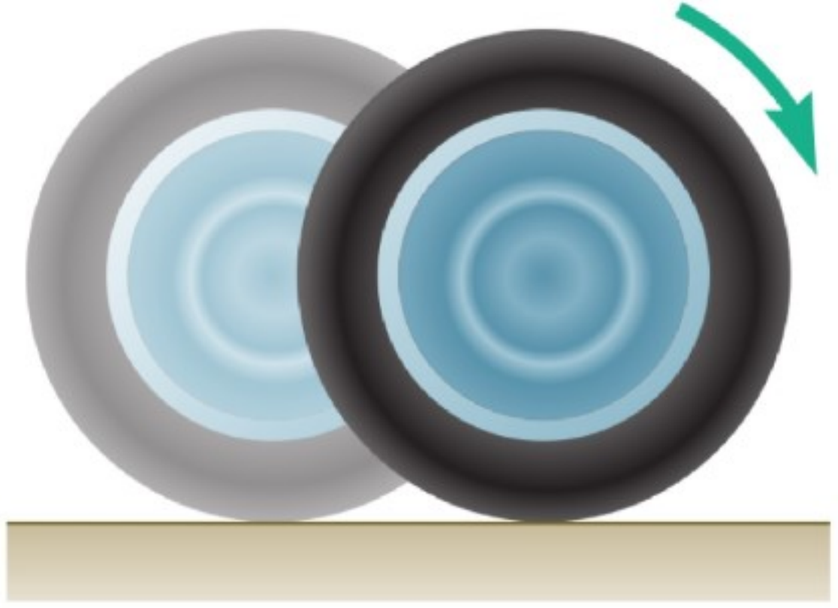


(*a*) Curvilinear translation



(*b*) Rotation

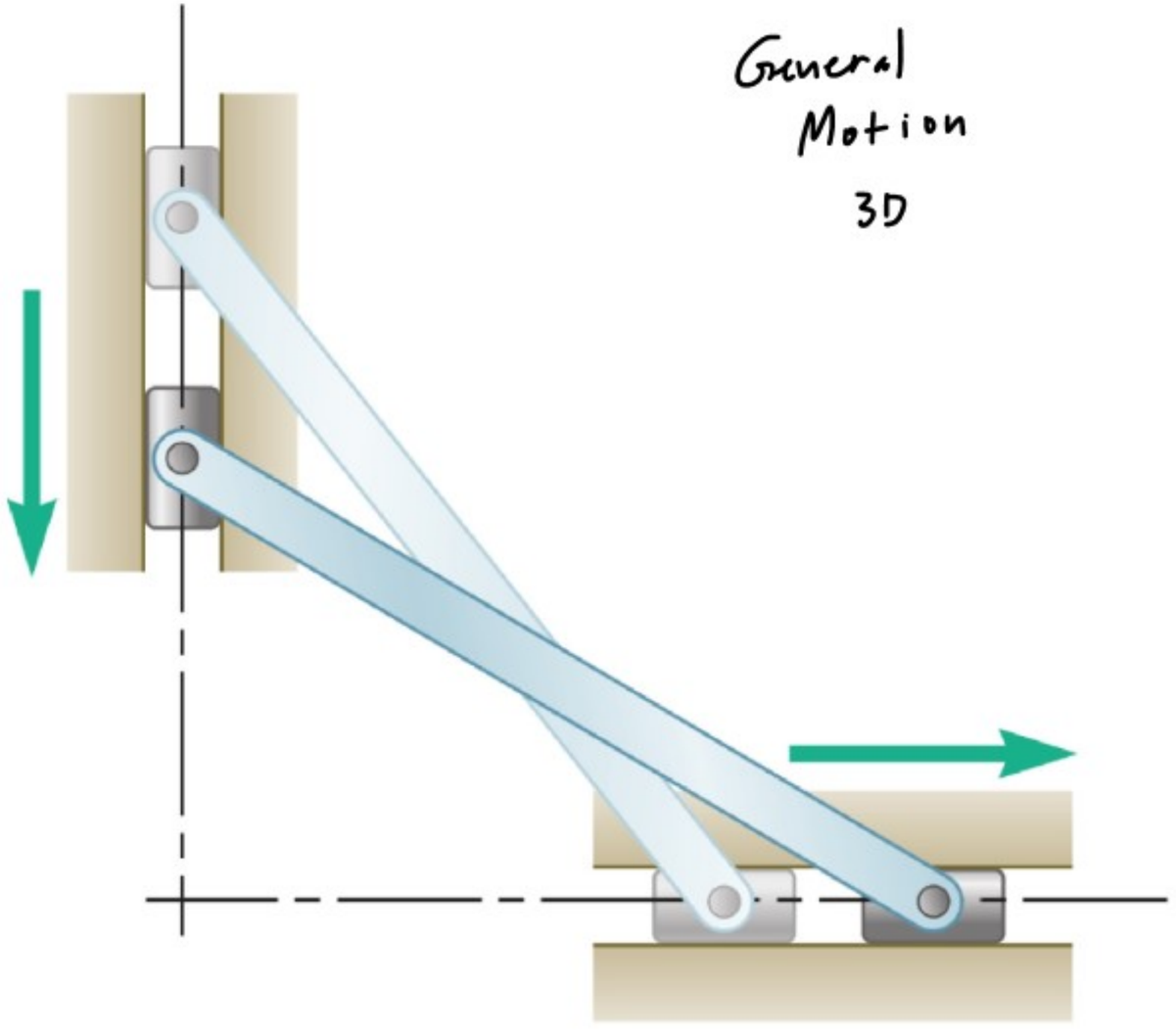
General Plane Motion



(*a*) Rolling wheel

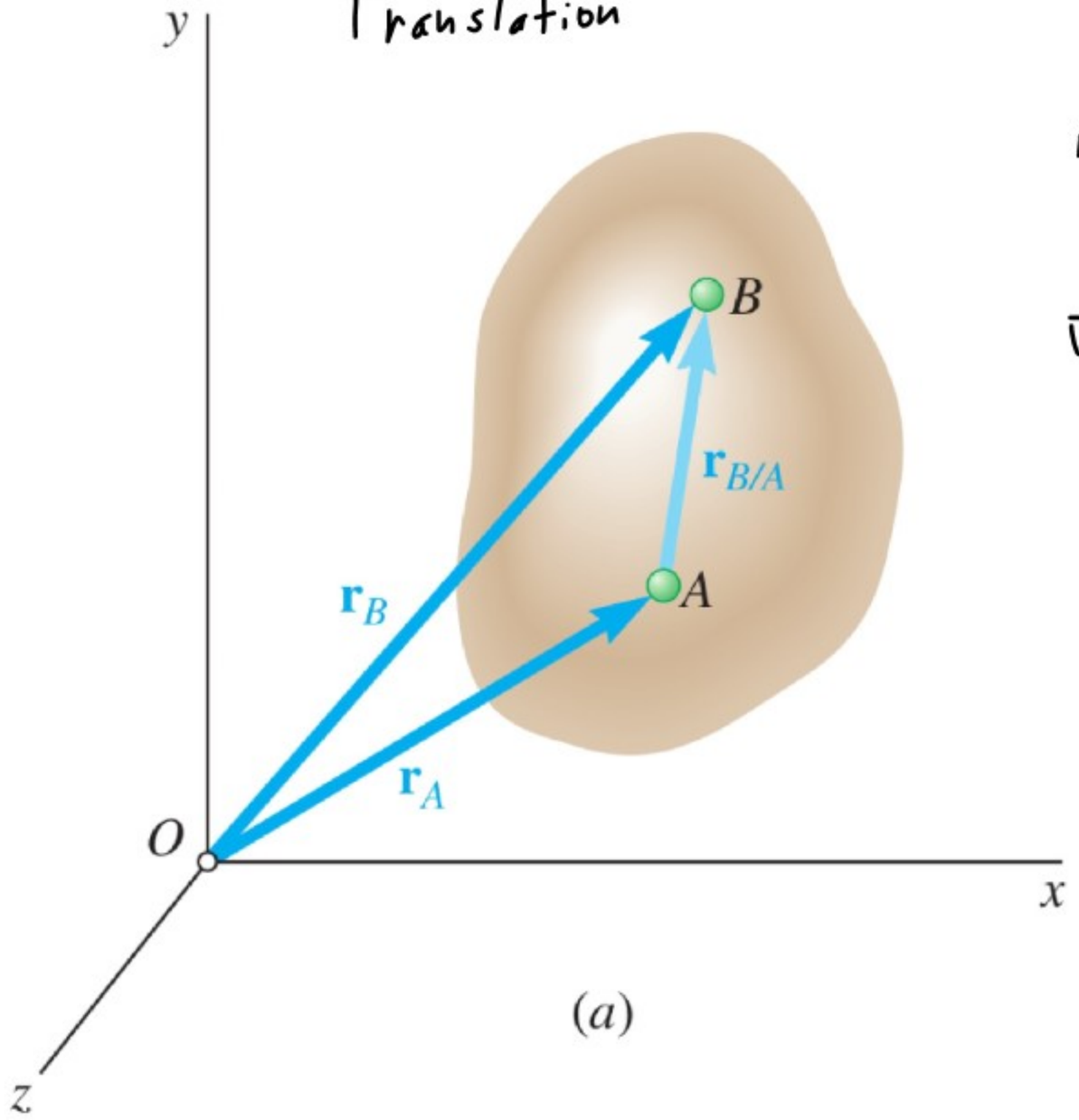
General Motion

3D



(*b*) Sliding rod

Translation



(a)

$\vec{r}_B = \vec{r}_A + \vec{r}_{B/A}$ $\quad\quad$ $\vec{r}_{B/A}$ constant

$\vec{v}_B = \frac{d\vec{r}_B}{dt} = \vec{v}_A$

$\vec{a}_B = \frac{d\vec{v}_B}{dt} = \vec{a}_A$