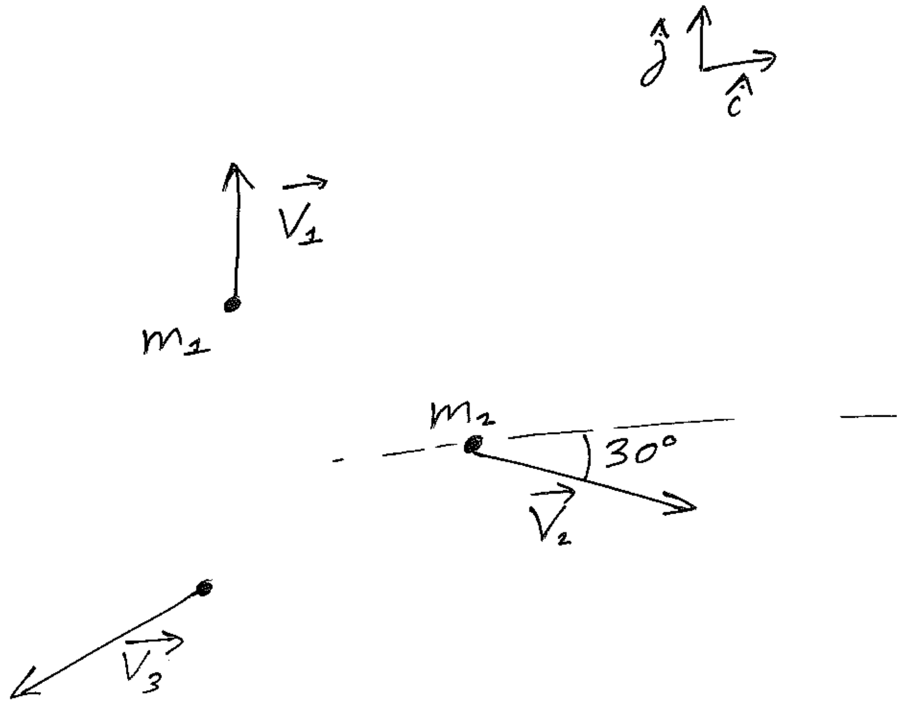
7.1



We have for the center of mass $\vec{R}$:

$$\vec{R} = \frac{m_1\vec{r_1} + m_2\vec{r_2} + m_3\vec{r_3}}{m_1 + m_2 + m_3}$$

and its velocity

$$\vec{V} = \frac{m_1\vec{V_1} + m_2\vec{V_2} + m_3\vec{V_3}}{m_1 + m_2 + m_3}$$

Its horizontal component is given by

$$V_x = \frac{1}{10}\left(3\times 0 + 2\times \sin(30°)\times 8 + 5V_{3x}\right)$$

$$= \frac{1}{10}\left(3\times 0 + 8\sqrt{3} + 5V_{3x}\right) \Rightarrow \boxed{V_{3x} = -\frac{8\sqrt{3}}{5}\,m/s \simeq -2.8\,m/s}$$

$$V_y = \frac{1}{10}\left(3\times 6 + (-2)\times\cos(30°)\times 8 + 5V_{3y}\right)$$

$$= \frac{1}{10}\left(18 - 8 + 5V_{3y}\right)$$

$$\Longrightarrow V_{3y} = -2\,m/s$$

4.6 $m_p = 450\ kg$

$V_0 = 140\ km/h$

$m_s = 100\ kg$

$\mu = 0.4$

System: plane + sandbag

External force:

friction $F_f = m_s g \mu$

brake $F_b = 300\ N$

Initial momentum:

$$P = m_p V_0$$

$$\Rightarrow \Delta t = \frac{P}{F_f + F_b} = \frac{m_p V_0}{m_s g \mu + F_b}$$

Velocity of center of mass at moment of landing

$$(m_p + m_s) V = m_p V_0$$

$$\Rightarrow V = \frac{m_p}{m_p + m_s} V_0$$

$$\Rightarrow \Delta x = \frac{1}{2} V \Delta t$$

$$= \frac{1}{2} \frac{m_p^2 V_0^2}{(m_p + m_s)(m_s g \mu + F_b)}$$

$$\approx 408\ m.$$