67. Choosing downward as the $+y$ direction and placing the coordinate origin at the top of the building, we apply the equations from Table 2-1 to this two-block system:

$$\begin{aligned} y_1 &= \frac{1}{2}gt^2 && \text{for} \quad 0 \le t \le 5 \\ y_2 &= \frac{1}{2}g(t-1)^2 && \text{for} \quad 1 \le t \le 6 \\ v_1 &= gt && \text{for} \quad 0 \le t \le 5 \\ v_2 &= g(t-1) && \text{for} \quad 1 \le t \le 6 \end{aligned}$$

with SI units understood.

(a) With $m_1 = 2.00$ kg and $m_2 = 3.00$ kg, Eq. 9-5 provides

$$y_{\text{com}} = \frac{m_1 y_1 + m_2 y_2}{m_1 + m_2} = \frac{1}{2}gt^2 - \frac{3}{5}gt + \frac{3}{10}g$$

while they are both in free fall ($1 \le t \le 5$). But during the interval when m_2 is "waiting" at the top of the building, we have

$$y_{\text{com}} = \frac{m_1 y_1 + m_2(0)}{m_1 + m_2} = \frac{1}{5}gt^2 \quad \text{for } 0 \le t \le 1$$

and during the interval where m_1 is sitting on the ground (at $y = \frac{1}{2}(9.8)(5)^2$) we have

$$y_{\text{com}} = \frac{m_1\left(\frac{25g}{2}\right) + m_2 y_2}{m_1 + m_2} = \frac{3}{10}gt^2 - \frac{3}{5}gt + \frac{53}{10}g$$

for $5 \le t \le 6$. This behavior is plotted below, with y_{com} in meters and t in seconds.