106. (Fifth problem in **Cluster 1**)

Let $y_0 = 1.0$ m at $x_0 = 0$ when the ball is hit. Let $y_1 = h$ (the height of the wall) and x_1 describe the point where it first rises above the wall one second after being hit; similarly, $y_2 = h$ and x_2 describe the point where it passes back down behind the wall four seconds later. And $y_f = 1.0$ m at $x_f = R$ is where it is caught. Lengths are in meters and time is in seconds.

(a) Keeping in mind that v_x is constant, we have $x_2 - x_1 = 50.0 = v_{1x}(4.00)$, which leads to $v_{1x} = 12.5$ m/s. Thus, applied to the full six seconds of motion: $x_f - x_0 = R = v_x(6.00) = 75.0$ m.

(b) We apply $y - y_0 = v_{0y}t - \frac{1}{2}gt^2$ to the motion above the wall.

$$y_2 - y_1 = 0 = v_{1y}(4.00) - \frac{1}{2}g(4.00)^2$$

leads to $v_{1y} = 19.6$ m/s. One second earlier, using $v_{1y} = v_{0y} - g(1.00)$, we find $v_{0y} = 29.4$ m/s. We convert from (x, y) to magnitude-angle (polar) representation:

$$\vec{v}_0 = (16.7, 14.2) \longrightarrow (31.9 \angle 66.9^\circ) .$$

We interpret this result as a velocity of magnitude 32 m/s, with angle (up from rightward) of 67°.

(c) During the first 1.00 s of motion, $y = y_0 + v_{0y}t - \frac{1}{2}gt^2$ yields $h = 1.0 + (29.4)(1.00) - \frac{1}{2}(9.8)(1.00)^2 = 25.5$ m.