104. (Third problem in **Cluster 1**)
Following the hint, we have the time-reversed problem with the ball thrown from the roof, towards the left, at 60° measured clockwise from a leftward axis. We see in this time-reversed situation that it is convenient to take $+x$ as *leftward* with positive angles measured clockwise. Lengths are in meters and time is in seconds.

(a) With $y_0 = 20.0$, and $y = 0$ at $t = 4.00$, we have $y - y_0 = v_{0y}t - \frac{1}{2}gt^2$ where $v_{0y} = v_0 \sin 60°$. This leads to $v_0 = 16.9$ m/s. This plugs into the x-equation (with $x_0 = 0$ and $x = d$) to produce $d = (16.9 \cos 60°)(4.00) = 33.7$ m.

(b) Although a somewhat easier method will be found in the energy chapter (especially Chapter 8), we will find the "final" velocity components with the methods of §4-6. Note that we're still working the time-reversed problem; this "final" $\vec{v}$ is actually the velocity with which it was thrown. We have $v_x = v_{0x} = 16.9 \cos 60° = 8.43$ m/s. And $v_y = v_{0y} - gt = 16.9 \sin 60° - (9.8)(4.00) = -24.6$ m/s. We convert from rectangular components to polar (that is, magnitude-angle) representation:

$$\vec{v} = (8.43, -24.6) \;\longrightarrow\; (26.0 \angle -71.1°) \; .$$

and we now interpret our result ("undoing" the time reversal) as an initial velocity of magnitude 26 m/s with angle (up from rightward) of 71°.