103. (Second problem in **Cluster 1**)
Using the coordinate system employed in §4-5 and §4-6, we have $v_{0x} = v_0 \cos 30° > 0$ and $v_{0y} = v_0 \sin 30° > 0$. Also, $y_0 = 0$ (corresponding to the dashed line in the figure), $x_0 = 0$, $y = h > 0$ (where it lands at $t = 3.00$), and $x = 100$, with lengths in meters and time in seconds.

(a) The x-equation determines v_0

$$x - x_0 = v_0 \cos(30)t \quad \Longrightarrow \quad 100 = v_0(0.866)(3.00)$$

which leads to $v_0 = 38.5$ m/s. The y-equation $y - y_0 = v_{0y}t - \frac{1}{2}gt^2$ becomes $h = (38.5)(\sin 30)(3.00) - \frac{1}{2}(9.8)(3.00)^2 = 13.6$ m.

(b) As a byproduct of part (a)'s computation, we found $v_0 = 38.5$ m/s.

(c) 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. We have $v_x = v_{0x} = 38.5 \cos 30 = 33.3$ m/s. And $v_y = v_{0y} - gt = 38.5 \sin 30 - (9.8)(3.00) = -10.2$ m/s. Therefore,

$$|\vec{v}| = \sqrt{v_x^2 + v_y^2} = \sqrt{(33.3)^2 + (-10.2)^2} = 34.8 \text{ m/s} .$$