29. We designate the given velocity $\vec{v} = 7.6\,\hat{\mathrm{i}} + 6.1\,\hat{\mathrm{j}}$ (SI units understood) as $\vec{v}_1$ – as opposed to the velocity when it reaches the max height $\vec{v}_2$ or the velocity when it returns to the ground $\vec{v}_3$ – and take $\vec{v}_0$ as the launch velocity, as usual. The origin is at its launch point on the ground.

(a) Different approaches are available, but since it will be useful (for the rest of the problem) to first find the initial y velocity, that is how we will proceed. Using Eq. 2-16, we have

$$\begin{aligned} v_{1\,y}^2 &= v_{0\,y}^2 - 2g\Delta y \\ 6.1^2 &= v_{0\,y}^2 - 2(9.8)(9.1) \end{aligned}$$

which yields $v_{0\,y} = 14.7$ m/s. Knowing that $v_{2\,y}$ must equal 0, we use Eq. 2-16 again but now with $\Delta y = h$ for the maximum height:

$$\begin{aligned} v_{2\,y}^2 &= v_{0\,y}^2 - 2gh \\ 0 &= 14.7^2 - 2(9.8)h \end{aligned}$$

which yields $h = 11$ m.

(b) Recalling the derivation of Eq. 4-26, but using $v_{0\,y}$ for $v_0 \sin\theta_0$ and $v_{0\,x}$ for $v_0 \cos\theta_0$, we have

$$\begin{aligned} 0 &= v_{0\,y}t - \frac{1}{2}gt^2 \\ R &= v_{0\,x}t \end{aligned}$$

which leads to $R = \frac{2\,v_{0\,x}\,v_{0\,y}}{g}$. Noting that $v_{0\,x} = v_{1\,x} = 7.6$ m/s, we plug in values and obtain $R = 2(7.6)(14.7)/9.8 = 23$ m.

(c) Since $v_{3\,x} = v_{1\,x} = 7.6$ m/s and $v_{3\,y} = -v_{0\,y} = -14.7$ m/s, we have

$$v_3 = \sqrt{v_{3\,x}^2 + v_{3\,y}^2} = \sqrt{(-14.7)^2 + 7.6^2} = 17 \text{ m/s} .$$

(d) The angle (measured from horizontal) for $\vec{v}_3$ is one of these possibilities:

$$\tan^{-1}\left(\frac{-14.7}{7.6}\right) = -63^\circ \quad \text{or} \quad 117^\circ$$

where we settle on the first choice (-63°, which is equivalent to 297°) since the signs of its components imply that it is in the fourth quadrant.