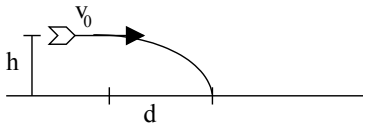
Chapter 3 Problem 36 [†]



Given
$d = 23\ m$
$\vec{v}_0 = 41\hat{i}\ m/s$
$\vec{a} = -9.8\hat{j}\ m/s^2$

Solution
Find the height, h, from which the arrow was fired.

The position vector is given by

$$\vec{r} = \vec{r}_0 + \vec{v}_0 t + \tfrac{1}{2}\vec{a}t^2$$

$$\vec{r} = h\hat{j} + \left\{41\ m/s\ \hat{i}\right\} t + \tfrac{1}{2}\left\{-9.8\ m/s^2\ \hat{j}\right\} t^2$$

Regrouping gives

$$\vec{r} = \left\{(41\ m/s)t\ \hat{i} + (h - (4.9\ m/s^2)t^2)\ \hat{j}\right\}$$

Using the x-component and setting it equal to $23\ m$, the time becomes

$$(41\ m/s)t = 23\ m$$

$$t = 0.561\ s$$

At this time, the final height is zero. Setting the y-component equal to zero and substituting in for time gives

$$h - (4.9\ m/s^2)t^2 = 0$$

$$h = (4.9\ m/s^2)(0.561\ s)^2 = 1.54\ m$$

[†]Problem from Essential University Physics, Wolfson