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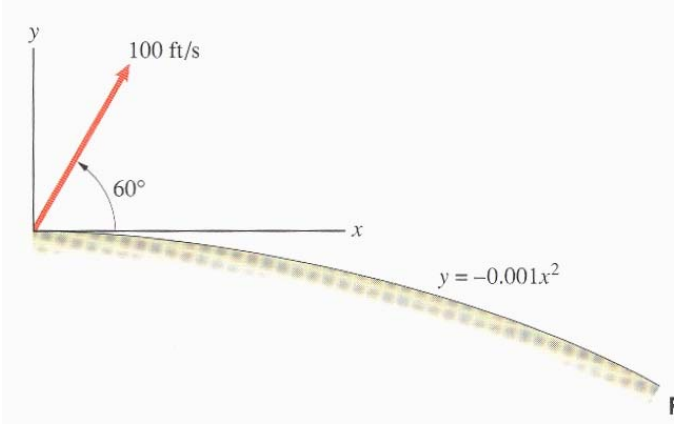
سایت آموزش مهندسی مکانیک ایران

Example 3.1

A projectile is launched at 100 ft/s at 60° above the horizontal. The surface on which it lands is described by the equation $y = -0.001x^2$ as shown. Determine the x and y coordinates of impact.



Solution:

According to Eqn. 3.11 the path of a projectile in two-dimensional space is described by the curve:

$$y = (\tan\theta_0)x - \frac{g}{2v_0^2\cos^2\theta_0}x^2$$

In this case $\theta_0 = 60°$ and $v_0 = 100$ ft/s. Substituting these values in the equation above the path of this projectile can be obtained as:

$$y = 1.732x - 0.00644x^2$$

The projectile impacts the ground when this curve intersects the curve that describes the landing surface defined in the problem. This happens at an x when the y values of the two curves are equal. Thus:

$$1.732x - 0.00644x^2 = -0.001x^2$$

Solving this equation for x we obtain:

$$x = 0 \qquad \text{or} \qquad x = 318.4 \text{ ft}$$

The first value of x corresponds to the starting conditions (when the two curves again intersect). The second value is the horizontal distance the projectile travels to the impact point. The value of y at that instant can be obtained by substituting this value of x in the equation for either curve:

$$y = -0.001(318.4)^2 = -101.4 \text{ ft}$$

Click to see an animation of the trajectory of this projectile