Solving a Kinematics problem (2-59)

A hot-air balloon is ascending at the rate of $12 \text{ m/s}$ and is 80 m above the ground when a package is dropped over the side.

a) How long does it take the package to reach the ground?

Given:
- $V_0 = 12 \text{ m/s}$
- $a = -9.8 \text{ m/s}^2$
- $x_f = -80 \text{ m}$
- $x_0 = 0$

Find: time, $t$, for package to reach $x_f$

Solution:

Assumption stated

Acceleration is uniform, so we can select an appropriate dvat:

$$x_f = x_0 + V_0 t + \frac{1}{2} at^2$$

$$\frac{1}{2} at^2 + V_0 t - x_f = 0$$

$$t = -\frac{V_0 \pm \sqrt{V_0^2 + 2ax_f}}{a}$$

$$t = -\frac{12 \text{ m/s} \pm \sqrt{(12 \text{ m/s})^2 + 2(-9.8 \text{ m/s}^2)(-80 \text{ m})}}{-9.8 \text{ m/s}^2}$$

$$t = -3.00 \pm 5.45 \text{ s}$$