You bail out of a helicopter and pull the ripcord of your parachute such that your downward velocity satisfies the initial value problem:

\[ \frac{dv}{dt} = 32 - 1.6v \quad \text{where } v(0) = 0. \]

Construct a slope field and sketch the solution curve. How long will it take you to reach 19 ft/second.

\[ \frac{dv}{dt} = 32 - 1.6v \quad \text{(1)} \]
\[ \frac{dv}{32 - 1.6v} = dt \quad \text{(2)} \]
\[ \int_{v_1}^{v_2} \frac{dv}{32 - 1.6v} = \int_{t_1}^{t_2} dt \quad \text{(3)} \]
\[ \int_{v_1}^{v_2} \frac{dv}{32 - 1.6v} = t_2 - t_1 \quad \text{(4)} \]

Let

\[ u = 32 - 1.6v \quad \text{(5)} \]
\[ du = -1.6 \, dv \quad \text{(6)} \]
\[ \frac{-1}{1.6} \int_{u_1}^{u_2} \frac{du}{u} = t_2 - t_1 \quad \text{(8)} \]
\[
\frac{-1}{1.6} \ln[u]^{u_2}_{u_1} = t_2 - t_1 \quad (9)
\]
\[
\frac{-1}{1.6} \ln[32 - 1.6v]^{v_2}_{v_1} = t_2 - t_1 \quad (10)
\]
\[
\frac{-1}{1.6} \{ \ln[32 - 1.6v_2] - \ln[32 - 1.6v_1] \} = t_2 - t_1 \quad (11)
\]
\[
v_1 = 0 \quad (12)
\]
\[
t_1 = 0 \quad (13)
\]

Let
\[
t = t_2 \quad (14)
\]
\[
v = v_2 \quad (15)
\]
\[
\frac{-1}{1.6} \{ \ln[32 - 1.6v] - \ln[32] \} = t \quad (16)
\]
\[
\frac{-1}{1.6} \left\{ \ln \left[ \frac{32 - 1.6v}{32} \right] \right\} = t \quad (17)
\]

The problem statement can be solved using equation (17). Now solve for the velocity as a function of time.

\[
\left\{ \ln \left[ \frac{32 - 1.6v}{32} \right] \right\} = -1.6t \quad (18)
\]
\[
\left[ \frac{32 - 1.6v}{32} \right] = \exp[-1.6t] \quad (19)
\]
\[ 32 - 1.6v = 32 \exp[-1.6t] \]  \hspace{1cm} (20)\

\[ -1.6v = 32\{\exp[-1.6t] - 1\} \]  \hspace{1cm} (21)\

\[ v(t) = 20\{1 - \exp[-1.6t]\} \]  \hspace{1cm} (22)