1a.

$$\boxed{m\left(\frac{dv}{dt}\right) = mg - c(v)^2 \quad ; \quad v(0) = 0} \sim \frac{dv}{dt} = 0 \text{ @ } v_s$$

$$\frac{dv}{dt} = g - \frac{c(v)^2}{m}$$

Variables: v, t
parameters: g, c, m

$$\tilde{v} = \frac{v - v_r}{v_s} \qquad \tilde{t} = \frac{t - t_r}{t_s}$$

$_r$ = reference value
$_s$ = scaling factor

$$\tilde{v}\, v_s = v \qquad \tilde{t}\, t_s = t \qquad v(0) = 0 \rightarrow v_r, t_r = 0$$

@ Velocity - Terminal $\quad \frac{dv}{dt} = 0 \quad mg = c(v_s)^2 \quad v_s = \sqrt{\frac{mg}{c}}$

$$\frac{d(\tilde{v}\, v_s)}{d(\tilde{t}\, t_s)} = g - \frac{c(\tilde{v}\, v_s)^2}{m}$$

$$\frac{v_s}{t_s}\left(\frac{d\tilde{v}}{d\tilde{t}}\right) = g - \frac{c v_s^2}{m}\left(\tilde{v}^2\right)$$

When v_s is reached $\frac{d\tilde{v}}{d\tilde{t}} = 1 \rightarrow \left(\frac{v_s}{t_s} = 1\right)$

$$\frac{d\tilde{v}}{d\tilde{t}} = 1 \cdot \frac{t_s}{v_s}$$

$$\left(\frac{d\tilde{v}}{d\tilde{t}}\right) = g - g\left(\tilde{v}\right)^2$$

1b. solve numerically with runge-kutta

1c. set $\tilde{v} = 0.95 \rightarrow$ double check $\left.\frac{d\tilde{v}}{dt}\right|_{t \rightarrow 1} = 0$