1.1.1
Let \( y(t) \) be the number of bacteria at time \( t \). The rate of change of the number of bacteria is \( y'(t) \). Since this rate of change is given to be proportional to \( y(t) \), the resulting differential equation is \( y'(t) = k y(t) \). Note that \( k \) is a positive constant since \( y'(t) \) must be positive (i.e., the number of bacteria is growing).

1.1.5
Let \( y(t) \) be the quantity of material at time \( t \), the resulting equation is \( y'(t) = -\frac{k}{y(t)} \) (\( k > 0 \)).

1.1.11
Let \( V(t) \) be the voltage drop across the inductor and \( I(t) \) be the current at time \( t \). The rate of change of the current is \( I'(t) \). We obtain the equation \( V(t) = L I'(t) \).

2.1.1
\[ \phi(t, y, y') = t^2 y^2 + (1+t)y = 0 \] must be solved for \( y' \). We get \[ y' = -1 \frac{(1+t)y}{t^2}. \]

2.1.3
\[ y'(t) = -C e^{-\frac{t^2}{2}} \text{ and } -ty(t) = -t (C e^{-\frac{t^2}{2}}), \] so \[ y' = -ty \].
2.1.13

The interval of existence is \((0, \infty)\).

\[ c = \frac{5}{3} \]

\[ y(t) = \frac{1}{3} t^2 + \frac{5}{3t} \]

2.1.15

The interval of existence is \((-\frac{\ln 3}{3}, \infty)\).

\[ c = \frac{1}{3} \]

\[ y(t) = \frac{2}{-1 + \frac{1}{3} e^{-3t}} \]

\[ -1 + \frac{1}{3} e^{-3t} = 0 \]

\[ t = -\frac{\ln 3}{3} \]