1. Find the current $I(t)$ in an $RL$ circuit where $R = 10$ ohms, $L = 2$ henries, the applied voltage is an AC source with \( V(t) = \sin(2t) \) and \( I(0) = 0 \). Hint: you may want to use integration by parts twice.

2. Consider the initial value problem (IVP): \( ty' = y, y(t_0) = y_0 \). Find all pairs \( (t_0, y_0) \) such that the IVP has
   (a) no solution
   (b) more than one solution
   (c) a unique solution

3. Find all critical points of the following first order autonomous ODE’s and classify them as asymptotically stable, asymptotically unstable, or semi-stable. For each ODE, give rough sketches of the direction field and integral curves.
   (a) \( y' = y^4 + y^3 - 2y^2 \)
   (b) \( y' = e^y \sin(y) \)

4. Consider the ODE \( 2y'' + 4y' - 6y = 0 \).
   (a) Find the general solution of this ODE.
   (b) For this ODE, find the solution to the IVP with \( y(0) = 1, y'(0) = 1 \).