1. Answer the following statement "true" or "false": Let $p_1(t)$, $p_2(t)$, and $p_3(t)$ be continuous on $\mathbb{R}$. Then there is a unique solution on the interval $(-1, 1)$ to the following initial value problem:

$$\begin{aligned} ty''' + p_1(t)y'' + p_2(t)y' + p_3(t)y &= 0 \\ y(0) &= 1 \\ y'(0) &= 0 \\ y''(0) &= 0 \end{aligned}$$

   False. In order to apply the existence and uniqueness theorem to this initial value problem, we would have to divide by t, and the resulting differential equation could have coefficients which are discontinuous at $t = 0$.

2. Convert each of the following higher-order differential equations into systems of first-order linear differential equations.

   (a) $y'' - 4y' + 3y = 0$
   Let $u = y'$. Then
   $$u' = 4y' - 3y = -3y + 4u.$$
   The resulting system is
   $$\begin{aligned} y' &= u \\ u' &= -3y + 4u. \end{aligned}$$

   (b) $y''' + (\sin t)y'' - 4y' + ty = e^t$
   Let $u = y'$ and $v = u' = y''$. Then
   $$v' = e^t - (\sin t)y'' + 4y' - ty = e^t - (\sin t)v + 4u - ty.$$
   The resulting system is
   $$\begin{aligned} y' &= u \\ u' &= v \\ v' &= -ty + 4u - (\sin t)v + e^t. \end{aligned}$$