1. Solve the differential equation
\[ ye^{xy} + 2x \cos y + (xe^{xy} - x^2 \sin y + y^2)y' = 0 \]

2. Solve the initial value problem
\[ 2y'' + 3y' - 2y = 0, \quad y(0) = -1, \quad y'(0) = \beta, \]
and find the value of \( \beta \) for which the solution tends to 0 as \( t \to \infty \).

3. Find the value of \( \alpha \) such that the differential equation
\[ y'' + (\alpha + 1)y' + \alpha y = 0 \]
has general solution of the form \( y = C_1 e^{rt} + C_2 te^{rt} \). Then determine \( r \).

4. Solve the initial value problem
\[ y'' + 2y' + 4y = 0, \quad y(0) = 0, \quad y'(0) = \sqrt{3}, \]
and describe the behavior of the solution as \( t \) increases.

5. Consider the general Euler equation
\[ t^2 y'' + \alpha t y' + \beta y = 0, \quad t > 0. \]  
\[ \text{(1)} \]

a) Show that the substitution \( x = \ln t \) transforms (1) into
\[ \frac{d^2 y}{dx^2} + (\alpha - 1) \frac{dy}{dx} + \beta y = 0. \]

b) Use the finding from a) to solve the differential equation
\[ t^2 y'' - 3ty' + 4y = 0. \]

6. Find the general solution of
\[ y'' + 5y' + 6y = e^{-t} + t. \]

7. Find the general solution of
\[ y'' + 9y = \cos 3t. \]

8. Consider the differential equation
\[ y'' + p(t)y' + q(t)y = 0, \]
where \( p(t) \) and \( q(t) \) are continuous functions. Can \( y = \tan(t^2) \) be a solution of this DE on some open interval about \( t = 0 \)? Why or why not?