



Assignment 1

Problem 1: Classify the following equations as ordinary or partial differential equations, state the order and degree of each equation and determine whether the equation is linear or nonlinear.

a. $\frac{\partial^3 u}{\partial x^3} + \frac{\partial^2 u}{\partial y^2} + \left(\frac{\partial u}{\partial z}\right)^2 + ux^3 + uy^2 + uz = 0$

b. $\left(\frac{dy}{dx}\right)^2 = \left(\frac{d^2 y}{dx^2} + y\right)^{\frac{3}{2}}$

Problem 2: Verify that the indicated function is the solutions given differential equation and solve the following initial/boundary value problems.

a. $\frac{d^2 y}{dx^2} - \frac{dy}{dx} - 12y = 0; y(0) = -2, y'(0) = 6$

where $y = c_1 e^{4x} + c_2 e^{-3x}$ is the general solution of the given differential equation.

b. $x^3 \frac{d^3 y}{dx^3} - 3x^2 \frac{d^2 y}{dx^2} + 6x \frac{dy}{dx} - 6y = 0; y(2) = 0, y'(2) = 2, y''(2) = 6$

where $y = c_1 x + c_2 x^2 + c_3 x^3$ is the general solution of the given differential equation.

c. $\frac{d^2 y}{dx^2} + y = 0; y(0) = 1, y'\left(\frac{\pi}{2}\right) = -1$

Where $y = c_1 \sin x + c_2 \cos x$ is the general solution of the given differential equation.

Problem 3: Give an interval I of definition of each solution. Use a graphing utility to obtain the graph of an explicit solution.

a. $x \frac{dy}{dx} + (1 + x \cot x)y = x, y = -\cot x + \frac{1}{x} + \frac{c_1}{x} \csc x$

b. $(x^2 + 1) \frac{dy}{dx} + 2xy = 4x^2, 3y = \frac{4x^3}{(x^2+1)} + \frac{3c}{(x^2+1)}$

Bonus Problem 4: Identify the differential equation and find the solution.

a. $(xy + 2x + y + 2)dx + (x^2 + 2x)dy = 0$

b. $\frac{dy}{dx} + \frac{y}{x \ln x} = \frac{3x^2}{\ln x}$

c. $e^x[y - 3(e^x + 1)^2]dx + (e^x + 1)dy = 0, \quad y(0) = 4$