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ENUGO 2 Assignment 1

1a A differential equation is a relationship between an independent variable, a dependent variable  $y$ , and one or more derivatives of  $y$  with respect to  $x$ .

Examples of differential equations:

$$x^2 \frac{dy}{dx} = y \sin x = 0$$

$$x^2 \frac{dy}{dx} + y \frac{dx}{dx} + e^x = 0$$

$$y = Ae^{-4x} + Be^{6x}$$

This is a second order differentiation

It has two constants  $A$  and  $B$

Let  $A = -4x$  be  $R$   
 and let  $B = 6x$  be  $S$

$$\therefore y = Ae^{-4x} + Be^{6x}$$

$$\frac{dy}{dx} = -4Ae^{-4x} + 6Be^{6x}$$

$$\frac{d^2y}{dx^2} = 16Ae^{-4x} + 36Be^{6x}$$

$$\therefore y = R + S$$

$$\frac{dy}{dx} = -4R - 6S \dots (i)$$

$$\frac{d^2y}{dx^2} = 16R + 36S \dots (ii)$$

From equation (ii)

$$R = \left( \frac{dy + 6S}{dx} \right) \dots (iii)$$

$$\frac{d^2y}{dx^2} = -4\frac{dy}{dx} - 24y + 36y$$

$$\frac{d^2y}{dx^2} + 4\frac{dy}{dx} = 12y$$

$$D = \left( \frac{d^2y}{dx^2} + 4\frac{dy}{dx} \right) \frac{1}{12} \dots (V)$$

Pot equation (V) in equation (i)

$$R = \left[ \frac{dy}{dx} + 6 \left( \frac{d^2y}{dx^2} + 4\frac{dy}{dx} \right) \frac{1}{12} \right] x - \frac{1}{4}$$

$$R = \left( \frac{dy}{dx} + \frac{1}{2} \frac{d^2y}{dx^2} + 2\frac{dy}{dx} \right) x - \frac{1}{4}$$

$$R = \left[ \frac{3dy}{dx} + \frac{1}{2} \frac{d^2y}{dx^2} \right] x - \frac{1}{4} \dots (VI)$$

Pot equation V and VI in equation (i)

$$y = \left( \frac{d^2y}{dx^2} + 4\frac{dy}{dx} \right) \frac{1}{12} + \left[ \left( \frac{3dy}{dx} + \frac{1}{2} \frac{d^2y}{dx^2} \right) x - \frac{1}{4} \right]$$

$$y = \frac{1}{12} \frac{d^2y}{dx^2} + \frac{1}{3} \frac{dy}{dx} - \frac{3}{4} \frac{dy}{dx} - \frac{1}{8} \frac{d^2y}{dx^2}$$

$$y = \frac{-1}{24} \frac{d^2y}{dx^2} - \frac{5}{12} \frac{dy}{dx}$$

$$y + \frac{1}{24} \frac{d^2y}{dx^2} + \frac{5}{12} \frac{dy}{dx} = 0$$

Multiply through by 24

$$24y + \frac{d^2y}{dx^2} + 10\frac{dy}{dx} = 0$$