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Civil Engineering

15/ENON3/019

ENON 202 assignment

Solution

The second order differential equation can be formed from the expression.

It is a second order differential equation because the function has two arbitrary constants which will give a second order equation

$$y = Ae^{-4x} + Be^{-6x} \quad \text{--- (i)}$$

$$\frac{dy}{dx} = -4Ae^{-4x} - 6Be^{-6x} \quad \text{--- (ii)}$$

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

Multiply through by -4 in eqn (i) --- (iv)

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

$$-4Ae^{-4x} = -4y + 4Be^{-6x} \quad \text{(iv)}$$

Sub eqn (iv) into eqn (iii)

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

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

$$\frac{d^2y}{dx^2} = -4y + 40Be^{-6x}$$

$$\frac{d^2y}{dx^2} + 4y = 40Be^{-6x}$$

divide through by 2

$$\frac{1}{2} \frac{dy}{dx} - 2y = Be^{-6x} \quad \text{--- (vi)}$$

multiply through by -6 in eqn (v)

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

$$-6Be^{-6x} = -6y + 6Ae^{-4x} \quad \text{--- (vii)}$$

sub eqn (vii) into eqn (vi)

$$\frac{dy}{dx} = -4Ae^{-4x} - 6y + 6Ae^{-4x} \quad \text{--- (viii)}$$

$$\frac{dy}{dx} = 2Ae^{-4x} - 6y$$

$$\frac{dy}{dx} + 6y = 2Ae^{-4x} \quad \text{--- (ix)}$$

divided through by 2

$$\frac{1}{2} \frac{dy}{dx} + 3y = Ae^{-4x} \quad \text{--- (x)}$$

$$\frac{d^2y}{dx^2} = 8 \frac{dy}{dx} + 48y - 10 \frac{dy}{dx} - 22y$$

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

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