

4 Given that  $y = (1 + 3x)e^{3x}$ , find the value of the constant  $k$  such that

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SST P1 Q4 2020 Preliminary

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$$y = (1 + 3x)e^{3x}$$

$$\frac{dy}{dx} = (1 + 3x)(3)e^{3x} + e^{3x} \cdot (3) \quad \text{Product Rule}$$

$$= 3e^{3x} [1 + 3x + 1] \quad \text{Factorise}$$

$$= 3e^{3x} (3x + 2) \quad \text{Ans.}$$

$$\frac{d^2y}{dx^2} = 3e^{3x} \cdot (3) + (3x + 2) \cdot 9e^{3x} \quad \text{Product Rule}$$

$$= 9e^{3x} (3x + 3) \quad \text{Factorise}$$

$$= 27e^{3x} (x + 1) \quad \text{Ans.}$$

$$\frac{d^2y}{dx^2} - 3\left(\frac{dy}{dx}\right) - 9y = kxe^{3x}.$$

$$27e^{3x}(x+1) - 3[3e^{3x}(3x+2)] - 9(1+3x)e^{3x} = kxe^{3x}$$

$$27x \cdot e^{3x} + 27e^{3x} - 27xe^{3x} - 18e^{3x} - 9e^{3x} - 27xe^{3x} = kxe^{3x}$$

$$-27xe^{3x} = kxe^{3x}$$

By comparison,

$$k = -27, \text{ Ans}$$