Higher Order Derivatives Ex 12.1 Q3

$$y = x + \tan x$$

differentiating both sides w.r.t x

$$\Rightarrow \quad \frac{dy}{dx} = 1 + \sec^2 x$$

differentiating w.r.t x

$$\Rightarrow \quad \frac{d^2y}{dx^2} = 0 + 2\sec^2 x \tan x$$

$$\Rightarrow \quad \frac{d^2y}{dx^2} = \frac{2\sin x}{\cos^3 x}$$

$$\Rightarrow \quad \cos^2 x \frac{d^2y}{dx^2} = 2\tan x + 2x - 2x$$

$$\Rightarrow \quad \cos^2 x \frac{d^2y}{dx^2} = 2(x + \tan x) - 2x$$

$$\Rightarrow \quad \cos^2 x \frac{d^2y}{dx^2} = 2y - 2x$$

$$\Rightarrow \quad \cos^2 x \frac{d^2y}{dx^2} - 2y + 2x = 0$$

Higher Order Derivatives Ex 12.1 Q4

$$y = x^3 \log x$$

differentiating w.r.t x

$$\Rightarrow \quad \frac{dy}{dx} = 3x^2 \log x + \frac{x^3}{x}$$

$$\Rightarrow \quad \frac{dy}{dx} = 3x^2 \log x + x^2$$

differentiating w.r.t. x

$$\Rightarrow \quad \frac{d^2y}{dx^2} = (\log x)(3 \times 2x) + \frac{3x^2}{x} + 2x$$

$$\Rightarrow \quad \frac{d^2y}{dx^2} = 6x \log x + 5x$$

differentiating w.r.t x

$$\Rightarrow \quad \frac{d^3y}{dx^3} = \frac{6x}{x} + 6\log x + 5$$

$$\Rightarrow \quad \frac{d^3y}{dx^3} = 6\log x + 11$$

differentiating w.r.t x

$$\Rightarrow \quad \frac{d^4y}{dx^4} = \frac{6}{x} + 0$$

$$\Rightarrow \quad \frac{d^4y}{dx^4} = \frac{6}{x}$$

Higher Order Derivatives Ex 12.1 Q5

$y = log\left(sin\, x\right)$

differentiating w.r.t. x

$$\Rightarrow \quad \frac{dy}{dx} = \frac{d\left(log\left(sin\, x\right)\right)}{d\left(sin\, x\right)} \times \frac{d\left(sin\, x\right)}{dx} \text{(chain rule)}$$

$$\Rightarrow \quad \frac{dy}{dx} = \frac{1}{sin\, x} \times cos\, x = cot\, x$$

differentiating w.r.t. x

$$\Rightarrow \quad \frac{d^2y}{dx^2} = -cosec^2x$$

differentiating w.r.t x

$$\Rightarrow \quad \frac{d^3y}{dx^3} = \left(-2\, cosecx\right) \times \left(-cot\, x\, cosecx\right)$$

$$\Rightarrow \quad \frac{d^3y}{dx^3} = \frac{2\, cosec^2\, cos\, x}{sin\, x}$$

$$\Rightarrow \quad \frac{d^3y}{dx^3} = 2\, cosec^3x\, cos\, x$$

Higher Order Derivatives Ex 12.1 Q6

$y = 2\, sin\, x + 3\, cos\, x$

differentiating w.r.t. x

$$\Rightarrow \quad \frac{dy}{dx} = 2\, cos\, x + 3\left(-sin\, x\right) = 2\, cos\, x - 3\, sin\, x$$

differentiating w.r.t. x

$$\Rightarrow \quad \frac{d^2y}{dx^2} = 2\left(-sin\, x\right) - 3\, cos\, x = -\left(2\, sin\, x + 3\, cos\, x\right) = -y$$

$$\Rightarrow \quad \frac{d^2y}{dx^2} + y = 0$$

********** END **********