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Higher Order Derivatives Ex 12.1 Q1(i)

We have $f(x) = x^3 + \tan x$

$\Rightarrow \quad f'(x) = 3x^2 + \sec^2 x$

$\Rightarrow \quad f''(x) = 6x + 2\sec x \times \sec x \tan x$

$\Rightarrow \quad f''(x) = 6x + 2\sec^2 x \tan x.$

Higher Order Derivatives Ex 12.1 Q1(ii)

Let $y = \sin(\log x)$

Then,

$$\frac{dy}{dx} = \frac{d}{dx}\left[\sin(\log x)\right] = \cos(\log x)\cdot\frac{d}{dx}(\log x) = \frac{\cos(\log x)}{x}$$

$$\therefore \frac{d^2y}{dx^2} = \frac{d}{dx}\left[\frac{\cos(\log x)}{x}\right]$$

$$= \frac{x\cdot\frac{d}{dx}\left[\cos(\log x)\right] - \cos(\log x)\cdot\frac{d}{dx}(x)}{x^2}$$

$$= \frac{x\cdot\left[-\sin(\log x)\cdot\frac{d}{dx}(\log x)\right] - \cos(\log x).1}{x^2}$$

$$= \frac{-x\sin(\log x).\frac{1}{x} - \cos(\log x)}{x^2}$$

$$= \frac{-\left[\sin(\log x) + \cos(\log x)\right]}{x^2}$$

Higher Order Derivatives Ex 12.1 Q1(iii)

Let $y=\log(\sin x)$

Differentiating with repect to x, *we get*,

$$\frac{dy}{dx}=\frac{\cos x}{\sin x}$$

Again differentiating with respect to x, *we get*,

$$\frac{d^2y}{dx^2}=\frac{-\sin x\times\sin x-\cos x\times\cos x}{\sin^2 x}$$

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

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

$$\Rightarrow\frac{d^2y}{dx^2}=\frac{-1}{\sin^2 x}$$

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

Higher Order Derivatives Ex 12.1 Q1(iv)

Let $y=e^x\sin 5x$

Then,

$$\frac{dy}{dx}=\frac{d}{dx}\left(e^x\sin 5x\right)=\sin 5x\cdot\frac{d}{dx}\left(e^x\right)+e^x\frac{d}{dx}\left(\sin 5x\right)$$

$$=\sin 5x\cdot e^x+e^x\cdot\cos 5x\cdot\frac{d}{dx}\left(5x\right)=e^x\sin 5x+e^x\cos 5x\cdot 5$$

$$=e^x\left(\sin 5x+5\cos 5x\right)$$

$$\therefore\frac{d^2y}{dx^2}=\frac{d}{dx}\left[e^x\left(\sin 5x+5\cos 5x\right)\right]$$

$$=\left(\sin 5x+5\cos 5x\right)\cdot\frac{d}{dx}\left(e^x\right)+e^x\cdot\frac{d}{dx}\left(\sin 5x+5\cos 5x\right)$$

$$=\left(\sin 5x+5\cos 5x\right)e^x+e^x\left[\cos 5x\cdot\frac{d}{dx}\left(5x\right)+5\left(-\sin 5x\right)\cdot\frac{d}{dx}\left(5x\right)\right]$$

$$=e^x\left(\sin 5x+5\cos 5x\right)+e^x\left(5\cos 5x-25\sin 5x\right)$$

$$=e^x\left(10\cos 5x-24\sin 5x\right)=2e^x\left(5\cos 5x-12\sin 5x\right)$$

Higher Order Derivatives Ex 12.1 Q1(v)

Let $y=e^{6x}\cos 3x$

Then,

$$\frac{dy}{dx}=\frac{d}{dx}\left(e^{6x}\cdot\cos 3x\right)=\cos 3x\cdot\frac{d}{dx}\left(e^{6x}\right)+e^{6x}\cdot\frac{d}{dx}\left(\cos 3x\right)$$

$$=\cos 3x\cdot e^{6x}\cdot\frac{d}{dx}\left(6x\right)+e^{6x}\cdot\left(-\sin 3x\right)\cdot\frac{d}{dx}\left(3x\right)$$

$$=6e^{6x}\cos 3x-3e^{6x}\sin 3x\qquad\ldots(1)$$

$$\therefore\frac{d^2y}{dx^2}=\frac{d}{dx}\left(6e^{6x}\cos 3x-3e^{6x}\sin 3x\right)=6\cdot\frac{d}{dx}\left(e^{6x}\cos 3x\right)-3\cdot\frac{d}{dx}\left(e^{6x}\sin 3x\right)$$

$$=6\cdot\left[6e^{6x}\cos 3x-3e^{6x}\sin 3x\right]-3\cdot\left[\sin 3x\cdot\frac{d}{dx}\left(e^{6x}\right)+e^{6x}\cdot\frac{d}{dx}\left(\sin 3x\right)\right]\qquad\left[\text{Using }(1)\right]$$

$$=36e^{6x}\cos 3x-18e^{6x}\sin 3x-3\left[\sin 3x\cdot e^{6x}\cdot 6+e^{6x}\cdot\cos 3x\cdot 3\right]$$

$$=36e^{6x}\cos 3x-18e^{6x}\sin 3x-18e^{6x}\sin 3x-9e^{6x}\cos 3x$$

$$=27e^{6x}\cos 3x-36e^{6x}\sin 3x$$

$$=9e^{6x}\left(3\cos 3x-4\sin 3x\right)$$

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