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Matric No ⇒ 19/ENG05/056

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Date submitted : 3rd April, 2020

1) $\left[\frac{(x - \cos x)}{x}\right] \quad x \to 0$

$$\lim_{x \to 0}\left[\frac{(x - \cos x)}{x}\right]$$

Applying l'hopital Rule

$$\lim_{x \to 0}\left[\frac{(x - \cos x)}{x}\right] = \lim_{x \to 0}\left[\frac{1 - (-\sin x)}{1}\right]$$

$$= \cancel{\lim_{x \to 0}} \quad 1 + \cancel{\sin(0)}$$

$$\lim_{x \to 0}\left[\frac{1 + \sin x}{1}\right]$$

$$\lim_{x \to 0}\left[\frac{1 + \sin(0)}{1}\right]$$

$$\lim_{x \to 0}\left[\frac{1 + 0}{1}\right]$$

$$= \frac{1}{1} = 1$$

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2) $y = -3\tan 7x\, e^{3x}$ find dy/dx

solving

$y = e^{3x} \times (-3\tan 7x)$

let $u = e^{3x}$ and $v = -3\tan 7x$

$du/dx = 3e^{3x}$ $dv/dx = -21\sec^2 7x$

$$\frac{dy}{dx} = v\left(\frac{du}{dx}\right) + u\left(\frac{dv}{dx}\right)$$

$$\frac{dy}{dx} = -3\tan(7x)\,(3e^{3x}) + e^{3x}\,(-21\sec^2(7x))$$

$= -3\tan 7x\, 3e^{3x} - 21\sec^2(7x)\, e^{3x}$

$= \underline{e^{3x}(-9\tan 7x - 21\sec^2 7x)}$

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3) $y = \cos 3x$

$f(3x) = \cos 3x$

$$f'(3x) = \lim_{\Delta x \to} \frac{f(3(x+\Delta x)) - f(3x)}{\Delta x}$$

$$= \lim_{\Delta x \to 0} \frac{\cos 3(x+\Delta x) - \cos(3x)}{\Delta x}$$

$$= \lim_{\Delta x \to 0} \frac{\cos(3x + 3\Delta x) - \cos(3x)}{\Delta x}$$

Using trig formular $\cos(A+B) = \cos A \cdot \cos B - \sin A \cdot \sin B$ wher $A = 3x$ and $B = 3\Delta x$

$$= \lim_{x \to 0} \frac{\cos(3x) \cdot \cos(3\Delta x) - \sin(3x) \cdot \sin 3\Delta x - \cos(3x)}{\Delta x}$$

$$= \lim_{x \to 0} \frac{\cos 3x \left(1 \cdot \cos(3\Delta x) - 1\right) - \sin(3x) \cdot \sin(3\Delta x)}{\Delta x}$$

Remember $\lim_{x \to a} (f(x) + g(x)) = \lim_{x \to a} f(x) + \lim_{x \to a} g(x)$

$$= \cos 3x \lim_{\Delta x \to 0} \frac{\cos 3\Delta x - 1}{\Delta x} - \sin 3x \lim_{\Delta x \to 0} \frac{\sin 3\Delta x}{\Delta x}$$

note: $\cos 3x$ and $-\sin 3x$ dont depend on Δx

$$= \cos 3x \cdot 3 \lim_{3\Delta x \to 0} \frac{\cos 3\Delta x - 1}{3\Delta x} - \sin 3x \cdot 3 \lim_{3\Delta x \to 0} \frac{\sin 3\Delta x}{3\Delta x}$$

$= \cos 3x \cdot 3 \cdot 0 - \sin 3x \cdot 3 \cdot 1$

$= -\sin 3x \cdot 3 = -3\sin 3x$

$f'(3x) = \frac{d}{dx}\left[\cos(3x)\right] = -3\sin 3x$

note: $\lim_{\theta \to 0} \frac{\cos\theta - 1}{\theta} = 0$

$\lim_{\theta \to 0} \frac{\sin\theta}{\theta} = 1$

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Given that $f(x) = 2x^3 - 7x$ and $g(x) = -3x$ find $(f-g)(5)$

A) $f(x) = 2x^3 - 7x$, $g(x) = -3x$

$(f-g) = 2x^3 - 7x - (-3x)$

$= 2x^3 - 7x + 3x$

$= 2x^3 + 10x$

$(f-g)5 = (2x^3 + 10x)5$

$= 10x^3 + 50x$

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5) $fog(x)$ if $f(x) = 4x^2 + 2$ and $g(x) = 2x + 3$

$= f(g(x)) = f(2x+3)$

$= 4(2x+3)^2 + 2$

$= 4(4x^2 + 12x + 9) + 2.$

$= 16x^2 + 48x + 36 + 2$

$fog(x) = 16x^2 + 48x + 38$

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6) $x^2 + 2xy + y^2 = 1020$

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

$\therefore 2x + 2y + dy/dx\,(2x + 2y) = 0$

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

$$\frac{dy}{dx} = \frac{-\cancel{2}(x + y)}{\cancel{2}(x+y)}$$

$$\frac{dy}{dx} = \frac{-\cancel{(x+y)}}{\cancel{(x+y)}}$$

$$\frac{dy}{dx} = -1$$

7) $f(x) = x^2 \cos x$

using product rule

$u = x^2 \quad v = \cos x$

$du/dx = 2x \quad dv/dx = -\sin x$

$$\frac{dy}{dx} = v\left(\frac{du}{dx}\right) + u\left(\frac{dv}{dx}\right)$$

$$\frac{dy}{dx} = \cos x(2x) + x^2(-\sin x)$$

$$= 2x\cos x + -x^2 \sin x$$

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