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TOPIC - MATH 104

1) find the limit of the function $(x - \cos x)/x$ as $x \to 0$

Soln

$$\lim_{x \to 0} \frac{(x - \cos x}{x}$$

By L'Hopital's rule, we have

$$\lim_{x \to 0} \frac{(1 - (-\sin x))}{1}$$

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

$$= 1//$$

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

$u = -3 \quad v = 7x \quad w = e^{3x}$

$$\frac{dy}{dx} = y\left[\frac{1}{-3}(0) + \frac{1}{\tan 7x}(7\sec^2 7x + \frac{1}{e^{3x}}\right.$$

$$y = \left[0 + \frac{7\sec^2 7x + 3}{\tan 7x}\right.$$

$$\frac{dy}{dx} = \left[\frac{7\sec^2 7x + 3}{\tan 7x}\right]\left[-3 \tan 7x e^{3x}\right]$$

3) If $y = \cos 3x$, find dy/dx from the first principle

Soln

$y = \cos 3x$

$y + \Delta y = \cos(3x + \Delta x)$

$\Delta y = \cos(3x + \Delta x) - \cos 3x$ ——— (1)

Recall $\cos A - \cos B = 2 \sin \frac{A+B}{2} \sin \frac{A-B}{2}$

Comparing equ I and equ II

$A = 3x + \Delta x \quad B = 3x$

$$\frac{A+B}{2} = \frac{3x + \Delta x + 3x}{2} = \frac{6x + \Delta x}{2} = \frac{6x + \Delta x}{2}$$

$$\frac{A+B}{2} = \frac{3x+\Delta x+3x}{2} = \frac{6x+\Delta x}{2} = \frac{6x+\Delta x}{2}$$

And

$$\frac{A-B}{2} = \frac{3x+\Delta x-3x}{2} = \frac{\Delta x}{2}$$

Hence

$$\Delta y = \cos(3x+\Delta x) - \cos 3x$$

$$= -2\sin\left(\frac{6x+\Delta x}{2}\right)\sin\frac{\Delta x}{2}$$

Divide through by Δx

$$\frac{\Delta y}{\Delta x} = -2\sin\left(\frac{6x+\Delta x}{2}\right)\left(\frac{\sin\frac{\Delta x}{2}}{\Delta x}\right)$$

This value determines the number 1 is divided by

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

Not limited to 0 appl to Sin

$$\frac{\Delta y}{\Delta x} = -2\sin\left(\frac{6x+\Delta x}{2}\right)\left(\frac{\sin\frac{\Delta x}{2}}{3x \times \frac{1}{2}}\right) \times \frac{1}{2}$$

$$\lim_{\Delta x \to 0} \frac{\Delta y}{\Delta x} = -2\sin(6x+0)\lim_{\Delta x \to 0} \frac{\sin\left(\frac{\Delta x}{2}\right)}{\frac{3x}{2}}$$

Since $\lim_{x \to 0} \frac{\sin\left(\frac{\Delta x}{2}\right)}{\frac{3x}{2}} = 1$

Hence $\frac{dy}{dx} = -2\sin 6x$

$=$

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

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

$(f-g)(5) = f(5) - g(5)$

$(f-g)(5) = [2(5)^2 - 7(5)] - [-3(5)]$

$(f-g)(5) = [2(125) - 35] - [-15]$

$(f-g)(5) = 250 - 35 + 15$

$(f-g)(5) = 230$

$(f-g)(5) = 230$ //

6 Gradient $x^2 + 2xy + y^2 = 2$.

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

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

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

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

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

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

7 find first derivative of the function $y = x^2 \cos x$

$y = x^2 \cos x$

$y = x^2 \cos x$

1st derivative $= 2x - \sin x$