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MATRIC NO. : 19/ENG05/1055 DEPT : Mechatronics

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Assignment

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

$= \lim_{x \to 0} \frac{d\left(1 - (\cos x)\right)}{dx} \Big/ \frac{dx}{dx} = \frac{\frac{d(1)}{dx} - \frac{d(\cos x)}{dx}}{dx/dx}$

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

$\therefore \lim_{x \to 0} \sin x = \sin 0 = 0$

$x \to 0$

2) $y = -3 \tan 2x e^{3x}$ Let $u = -3 \tan 2x$

$v = e^{3x}$

Product rule; $uv = u'v + v'u$

$u' = +2 1 \sec^2 2x \quad v' = 3e^{3x}$

$\therefore \frac{dy}{dx} = 2 1 \sec^2 2x\, e^{3x} - 9e^{3x} \tan 2x$

3) $y = \cos 3x \qquad f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$

$f'(x) = \lim_{h \to 0} \frac{\cos 3(x+h) - \cos 3x}{h}$ Recall $\cos A - \cos B = -2 \sin$

Recall; $\cos A - \cos B = -2 \sin\left(\frac{A+B}{2}\right) \sin\left(\frac{A-B}{2}\right)$

$A = 3(x+h) = 3x + 3h \qquad B = 3x$

$$\therefore f'(x) = \lim_{h\to 0} \frac{-2\sin\left(\frac{6x+3h}{2}\right)\sin\left(\frac{3h}{2}\right)}{h}$$

$$f'(x) = \lim_{h\to 0} \frac{-2\sin\left(\frac{3x+\frac{3h}{2}}{2}\right)\sin\left(\frac{3h}{2}\right)}{h}$$

$$f'(x) = \lim_{h\to 0} -2\sin\left(\frac{3x+\frac{3h}{2}}{2}\right) \times \frac{\sin\left(\frac{3h}{2}\right)}{h}$$

$$f'(x) = \lim_{h\to 0} -\sin\left(\frac{3x+\frac{3h}{2}}{2}\right) \times \frac{\sin(h/2)}{h/2}$$

Multiply each term by $\frac{3}{3}$

$$f'(x) = \lim_{h\to 0} -\frac{3}{3}\sin\left(\frac{3x+\frac{3h}{2}}{2}\right) \times 3\,\frac{\sin\left(\frac{3h}{2}\right)}{\frac{3h}{2}}$$

$$f'(x) = \lim_{h\to 0} -\sin\left(\frac{3x+\frac{3h}{2}}{2}\right) \times 3 = -(\sin 3x) \times 3$$

$$\therefore f'(x) = -3\sin 3x$$

(4) $g(x) = -3(x)$ $\quad \therefore g(5) = -3(5) = -15$

$f(5) = 2(5)^3 - 3(5) = 250 - 35 = 215$

$(f-g)(5) = 215 - 15 = 200$

(5) $g(x) = 2x+3$ $\quad f(x) = 4x^2 + 2$

$f(g(x)) = 4(2x+3)^2 + 2 = 4(4x^2+12x+9) + 2$

$= 16x^2 + 48x + 38$

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

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

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

$\frac{dy}{dx} = \frac{-(2x+2y)}{(2x+2y)} = -1$

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

(7) $y = x^2 \cos x$ let $u = x^2$ $u' = 2x$

$v = \cos x$ $v' = -\sin x$

Product rule; $u = x^2$ $v = \cos x$

$uv = u'v + v'u$

$\therefore \frac{dy}{dx} = 2x\cos x - x^2 \sin x$