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1. Find the Limit of $(x-\cos x)/x$ $x \to 0$

Solution:

$$\lim_{x\to 0} = \frac{x-\cos x}{x} \qquad \lim_{x\to 0} = \frac{x-\cos x}{x} \times \frac{1+\cos x}{1+\cos x}$$

$$\lim_{x\to 0} = \frac{1-\cos^2 x}{(x)(1+\cos x)}$$

Since $1-\cos^2 x = \sin^2 x$

$$\lim x\to 0 = \frac{\sin^2 x}{(x)(1+\cos x)}$$

$$\lim x\to 0 = \frac{\sin x}{x} \cdot \frac{\sin x}{1+\cos x}$$

$$\lim x\to 0 = \frac{\sin x}{x} \qquad \lim x\to 0 \ \frac{\sin x}{1+\cos x}$$

$$\frac{\sin(0)}{0} \cdot \frac{\sin(0)}{1+(\cos(0)}$$

$$\frac{0}{0} \cdot \frac{0}{1+1} = 0$$

$\therefore$ Ans $= \underline{0}$.

2. Find dy/dx of $-3\tan 7x \cdot 3x$

3. $\cos 3x$ First principle.

$$f(3x) = \lim_{x \to 0} F(x+h) - f(x)$$

$$= \frac{\cos 3x\,(x+h) - \cos 3x}{h}$$

$$= \frac{\cos 3x \cos 3h - \sin 3x \sin 3h - \cos 3x}{h}$$

$$\frac{\cos 3x\,(\cos 3h - 1)}{h} - \lim_{h \to 0} \sin x \sin h$$

$$\cos 3x \lim_{h \to 0} (\cos h - 1)/h - \sin 3x \cdot \lim_{h \to 0} \frac{\sin 3h}{h}$$

$$= \cos 3x \times 0 - \sin 3x \times 5$$

Since $\lim_{h \to 0} \sin 3h / h = 1$ and $\lim_{h \to 0} \cos(3h) - 1 / 3h =$

$$= 3 - \sin 3x.$$

4. $F(x) = 2x^3 - 7x$, $g(x) = 2x + 3$. Find $(f-g)(5)$

$(f-g)$

$(2x^3 - 7x) - (-3x)$

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

$= 2x^3 - 4x$

$x = 5$

$2(5)^3 - 4(5)$

$250 - 20$

$= 230.$

5. $F(x) = 4x^2 + 2$, $g(x) = 2x + 3$. Find fog

Solution

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

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

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

$= 8x^3 + 12x^2 + 2$.

6. $x^2 + 2xy + y^2 = 1,020$

$x^2 + y^2 + 2xy = 1,020$.

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

Solution.

Using product rule.

$$\frac{dy}{dx} = u\frac{dv}{dx} + v\frac{du}{dx}$$

$y = x^2$ $\quad \frac{dv}{dx} = 2x$ $\quad u = \cos x$ $\quad \frac{du}{dx} = -\sin x$

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

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

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