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MATH 104

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 $= 0$

2 Find dy/dx of $-3\tan 7x e^{3x}$

3 $\cos 3x$ First principle

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

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

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

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

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

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

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

$$= 3 - \sin 3x$$

4 $f(x) = 2x^3 - 7x \quad g(x) = -3x$ find $(f-g)(5)$

$(f-g)$

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

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

$$= 2x^3 - 4x$$

$x = 5$

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

$$250 - 20$$

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

Solution

$F(g)=4ax^2+2$ $g(ax)=2ax+3$

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

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

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

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

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

7) First derivative of $y=x^2\cos x$

Soul Solution

using product rule

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

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

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

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

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