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1) Find the limit of the functions

Solution

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

$\sin^2 x \quad (\sin x)(\sin x)$

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

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

$\downarrow \qquad \downarrow$

$1 \qquad 0$

$= 0$ //

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

Solution

$y = -3\tan 7x\, e^{3x}$ Applying product rule $\frac{dy}{dx} = u\frac{dv}{dx} + v\frac{du}{dx}$

$\frac{du}{dx} = 7\sec^2 7x \qquad u = \tan 7x$

$\frac{dv}{dx} = 3e^{3x} \qquad v = e^{3x}$

$= 3e^{3x}(\tan 7x) + e^{3x}(7\sec^2 7x)$

$= 3e^{3x}\tan 7x + 7e^{3x}\sec^2 7x$

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

OR

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

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

Solution

$y = \cos 3x \qquad \cos u$

$u = 3x, \quad du = 3$

$y' = du - \sin x\, u$

$y' = -3\sin 3x$ //

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

Solution

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

$g(x) = -3x \qquad (f-g)(5) = F(x) - g(x)$

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

$= 2x^3 - 6x - 15x$ //

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

Solution

$Fog(x)$

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

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

$= 4(4x^2 + 16 + 12) + 2$

$= 16x^2 + 64x + 48 + 2$

$= 16x^2 + 64x + 50$ //

6) find the gradient of $x^2 + 2xy + y^2 = 1,020$

Solution

$\frac{d}{dx}(x^2 + 2xy + y^2) = \frac{d}{dx}(1020)$

$\frac{d}{dx}x^2 + \frac{d}{dx}2xy + \frac{d}{dx}y^2 = 0$

$A \rightarrow 2x + 2y + 0 = 0$

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

Add $A + B$

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

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

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

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

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