Good afternoon

Be sure to have your calculus foldable books with you today

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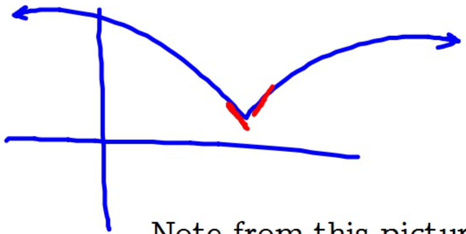
- If a function f(x) is differentiable on (a,b) then it is continuous on (a,b).

"a 'smooth' curve"



Note from this picture
that if f(x) is continuous, f(x) is not
necessarily differentiable.

Product Rule

$$\lim_{x \to c} f(x) \cdot g(x)$$

$$\boxed{\frac{d}{dx} f(x)g(x) = f'g + fg'}$$

$$= f'(x)g(x) + f(x)g'(x)$$

$$f'g + fg'$$

$$\frac{d}{dx} f(x)g(x)h(x) = f'gh + fg'h + fgh'$$

Quotient Rule

$$\frac{d}{dx}\,\frac{f(x)}{g(x)} = \frac{f'g - fg'}{[g(x)]^2}$$

Product & Quotient Rule

ex 1: If $y = 3x^2 \cdot \sin(x)$, find $\frac{dy}{dx}$.

$\frac{d}{dx} f \cdot g = f'g + fg'$

$f(x) = 3x^2$ $\quad g(x) = \sin(x)$

$f'(x) = 6x$ $\quad g'(x) = \cos(x)$

$$\boxed{6x \cdot \sin(x) + 3x^2 \cdot \cos(x)}$$

$$(3x)\left(2\sin(x) + x \cdot \cos(x)\right)$$

$$\frac{d}{dx}\left(-x^5 \cdot \cos(x)\right)$$

$$-5x^4 \cdot \cos(x) + \underbrace{-x^5}_{f} \cdot \underline{-\sin(x)}$$

$$+ \; x^5 \sin(x)$$

$$\boxed{x^4\left(-5\cos(x) + x \cdot \sin(x)\right)}$$

Q: $\frac{d}{dx}\left((3x^2+1)\cdot \csc(x)\right)$

Quotient rule example

~~sin x~~ $(3x^2+1)\cdot\frac{1}{\sin(x)}$

$$\frac{d}{dx}\left(\frac{3x^2+1}{\sin(x)}\right) = \frac{\overset{f'g}{6x\cdot\sin(x)} \overset{-}{-} \overset{fg'}{(3x^2+1)\cos(x)}}{\sin^2(x)}$$

$f(x) = 3x^2+1 \quad f'(x) = 6x$

$g(x) = \sin(x) \quad g'(x) = \cos(x)$

$$\frac{d}{dx}\sin(x) = \cos(x)$$

$$\frac{d}{dx}\cos(x) = -\sin(x)$$

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