OCT 18

✓ $\frac{d}{dx}(a+b) = \frac{d}{dx}a + \frac{d}{dx}b$

✗ $\frac{d}{dx}(ab) = \frac{d}{dx}a \times \frac{d}{dx}b$

let $r(x) = f(x)g(x)$

$$\frac{d}{dx}(f(x)g(x))$$

$$= \frac{d}{dx}r(x)$$

$$= \lim_{h\to 0} \frac{r(x+h)-r(x)}{h}$$

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

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

factor

$$= \lim_{h\to 0} \frac{f(x+h)\left(g(x+h)-g(x)\right)+g(x)\left(f(x+h)-f(x)\right)}{h}$$

$$= \lim_{h\to 0} f(x+h)\underbrace{\left(\frac{g(x+h)-g(x)}{h}\right)}_{g'(x)=\lim_{h\to 0}\frac{g(x+h)-g(x)}{h}}+g(x)\underbrace{\left(\frac{f(x+h)-f(x)}{h}\right)}_{f'(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}}$$

$$= \lim_{h\to 0} f(x+h)g'(x)+g(x)f'(x)$$

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

Product Rule

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

leave alone

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

derivative

THEN:

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

$$\frac{d}{dx} x^7(2x-1)^3$$

$$= \frac{d}{dx}x^7 \cdot (2x-1)^3 + x^7 \cdot \frac{d}{dx}(2x-1)^3$$

$$= 7x^6 \cdot (2x-1)^3 + x^7 \cdot 3(2x-1)^2 \cdot \frac{d}{dx}(2x-1)$$

$$= 7x^6 \cdot (2x-1)^3 + x^7 \cdot 3(2x-1)^2 \cdot 2$$ #

to clean up

$$= x^6(2x-1)^2\left(7(2x-1)+6x\right)$$

$$= x^6(2x-1)^3(20x-7)$$

$$= (2x-1)^3(20x^7-7x^6)$$

OCT 25

$g'(x)$ inverse $[g(x)]^{-1}$ reciprocal

$\sin^{-1}x = \arcsin x$ $(\sin x)^{-1} = \csc x$

$$\frac{d}{dx}\frac{f(x)}{g(x)}$$

$$= \frac{d}{dx} f(x)[g(x)]^{-1}$$

$$= f'(x)[g(x)]^{-1} + f(x)\frac{d}{dx}[g(x)]^{-1}$$

$$= \left(f'(x)[g(x)]^{-1} + f(x)(-1)[g(x)]^{-2}g'(x)\right) \cdot \frac{[g(x)]^2}{[g(x)]^2}$$

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

Quotient Rule

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

$$\frac{d}{dx}\frac{(x+3)^4}{(x-1)^5}$$

$$= \frac{\frac{d}{dx}(x+3)^4 \times (x-1)^5 - (x+3)^4 \times \frac{d}{dx}(x-1)^5}{(x-1)^{5\times 2}}$$

$$= \frac{4(x+3)^3(1)(x-1)^5 - (x+3)^4(5)(x-1)^4(1)}{(x-1)^{10}}$$

$$= \frac{4(x+3)^3(x-1)^5 - 5(x+3)^4(x-1)^4}{(x-1)^{10}}$$

$$= \frac{(x+3)^3(x-1)^4\left(4(x-1) - 5(x+3)\right)}{(x-1)^{10}}$$

$$= \frac{(x+3)^3(4x-4-5x-15)}{(x-1)^6}$$

$$= \frac{(x+3)^3(-x-19)}{(x-1)^6}$$ #

$$\frac{d}{dx}\frac{(x^2+1)^7}{(1-x)^3}$$

$$= \frac{\frac{d}{dx}(x^2+1)^7 \cdot (1-x)^3 - (x^2+1)^7 \cdot \frac{d}{dx}(1-x)^3}{(1-x)^{3\times 2}}$$

$$= \frac{7(x^2+1)^6(2x)(1-x)^3 - (x^2+1)^7(3)(1-x)^2(-1)}{(1-x)^6}$$

$$= \frac{(x^2+1)^6(1-x)^2\left(14x(1-x)+3(x^2+1)\right)}{(1-x)^6}$$

$$= \frac{(x^2+1)^6(14x-14x^2+3x^2+3)}{(1-x)^4}$$

$$= \frac{(x^2+1)^6(-11x^2+14x+3)}{(1-x)^4} \quad \#$$