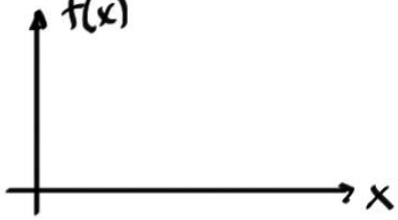
Course: Calculus AB Unit 3/Day 3: Rules for Differentiation	Hangzhou International School Mr. Weinberg

Warm Up:

1. The difference quotient $\lim_{h\to 0}\frac{(x+h)^3-5-x^3+5}{h}$ represents a value for $f'(x)$.
   a) What is $f(x)$?
   b) Evaluate the limit.

Derivative of a constant function $f(x)=C$

what does the graph look like? sketch it!



what should $\frac{d}{dx}(C)$ equal?

use the limit definition of the derivative to prove it. (fill in what is missing)

$$\lim_{x\to a} \frac{\qquad}{\qquad - a} = \frac{K-}{\qquad} =$$

Derivative of a constant times a function

$k\cdot f(x)$

$$\frac{d}{dx}\left[k\cdot f(x)\right] = \lim_{h\to 0} \frac{\qquad}{\qquad}$$

now factor out k from the numerator.

$$= \lim_{h\to 0} k\left(\frac{\qquad}{\qquad}\right)$$

$$= k\cdot \lim_{h\to 0}\left(\frac{\qquad}{\qquad}\right)$$

what is this limit?

$$= k\cdot \_\_\_\_$$

Derivative of a monomial: $\frac{d}{dx}[x^n]$ with $n \in \mathbb{N}$

$$\frac{d}{dx}[x^n] = \lim_{h \to 0} \_\_\_\_\_$$

trick: substitute $h = ax - x$

What is $\lim_{h \to 0} a$?

$$\lim_{a \to 1} \frac{(ax)^n - x^n}{ax - x}$$

$$= \lim_{a \to 1} \frac{a^n x^n - x^n}{ax - x}$$

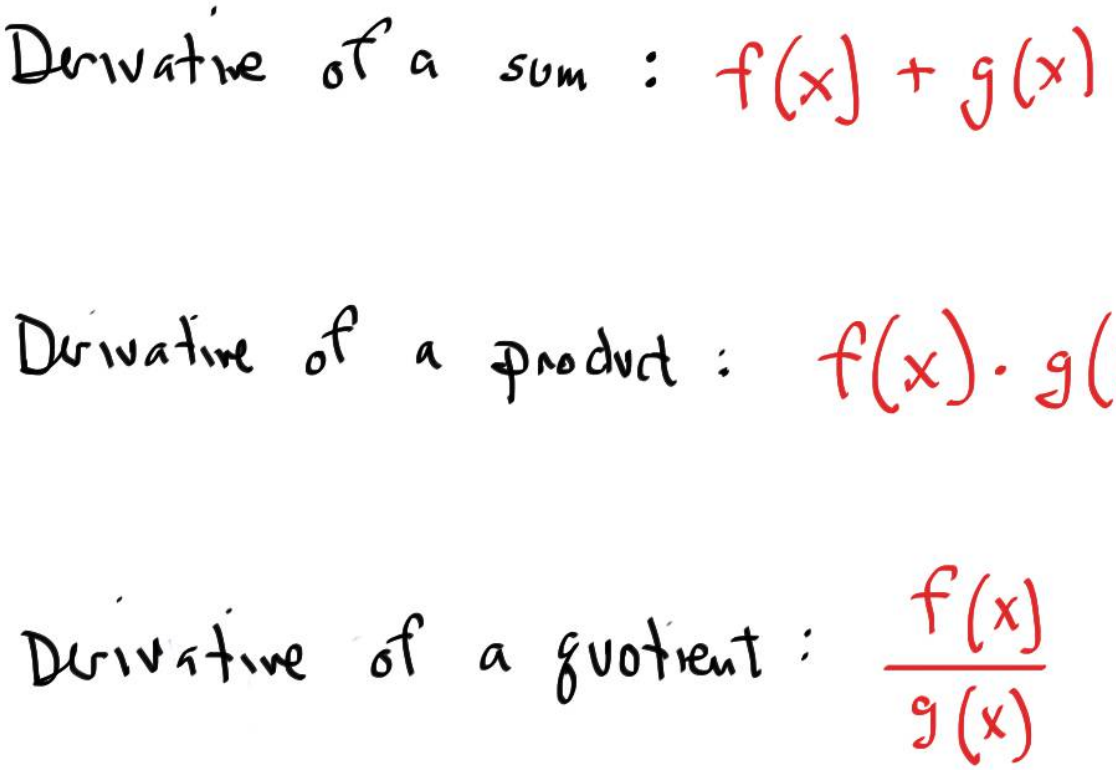
$$= \lim_{a \to 1} \frac{x^n(\quad)}{x(\quad)}$$ ← fill in what is missing!

$$= \lim_{a \to 1} \frac{x^n}{x} \cdot \lim_{a \to 1} \frac{(\quad)}{(\quad)}$$ ← use division to find another form of this. Try $n = 1, 2, \ldots$

$\lim_{a \to 1} \frac{x^n}{x}$: what is this limit? Evaluate and simplify.

so $\frac{d}{dx}[x^n] =$ ____

- Write an equation for the tangent line to $f(x)=3x^3$ at $x = 1$.



- For $f(x)=\frac{1}{4}x^4-2x^2$, find all x values for which the tangent line is horizontal.

- Find $\frac{dy}{dx}$ if $y=(x^2+1)(x^3-2)$.
- The following table for functions g(x) and f(x) is given:

x	-1	0	1	2
$f(x)$	3	4	5	6
$g(x)$	2	1	2	5
$f'(x)$	1	2	3	4
$g'(x)$	3	1	2	3

Evaluate h'(1) if...

- h(x) = $f(x) * g(x)$
- h(x) = $\frac{f(x)}{g(x)}$