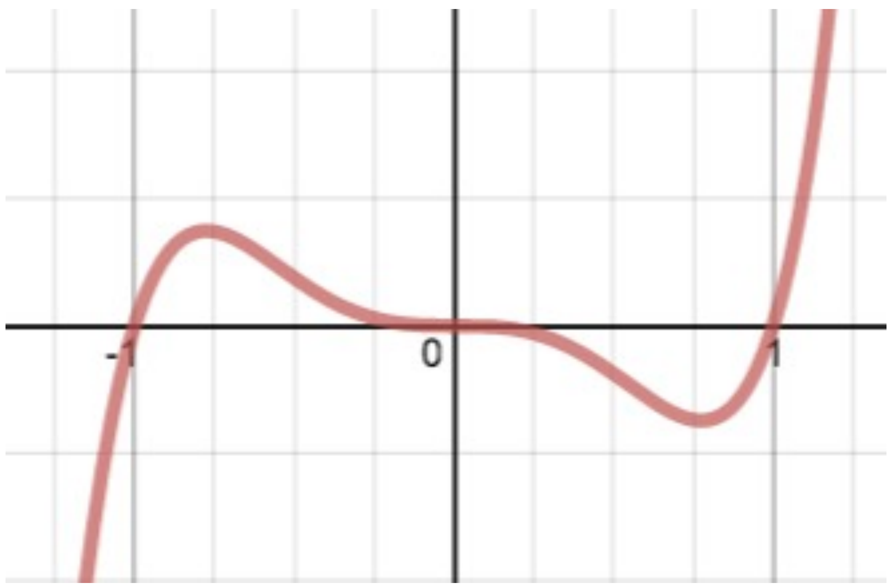
Today...

- Clicker questions on graphing simple polynomials.
- Hill functions.
- Introduction to the derivative (if there’s time).

Which is the graph of the function

$$f(x) = x^5 - x^3 \text{ ?}$$

(A)



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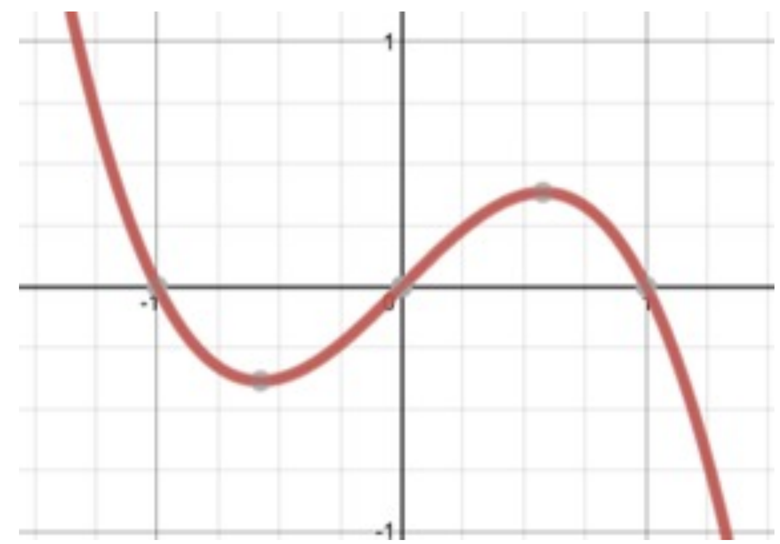

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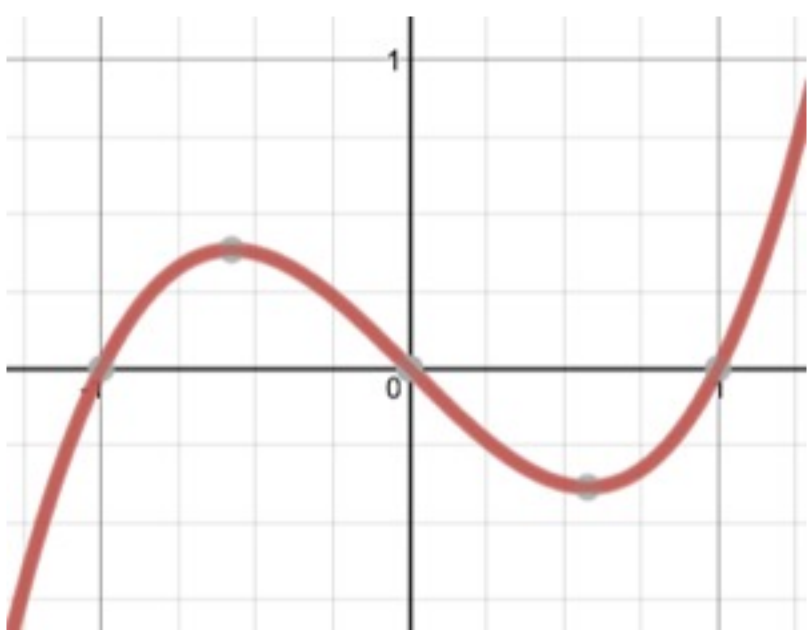
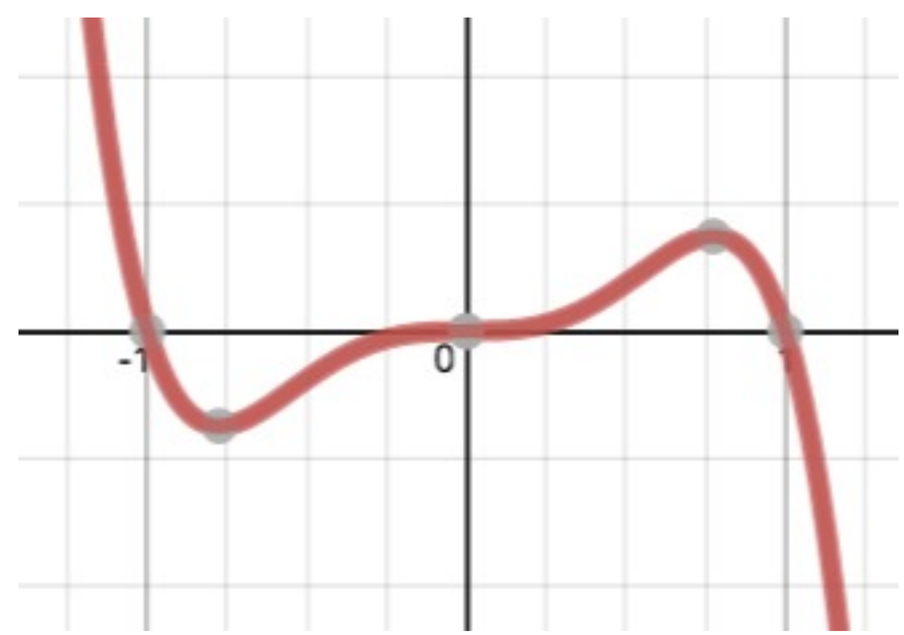


(D)



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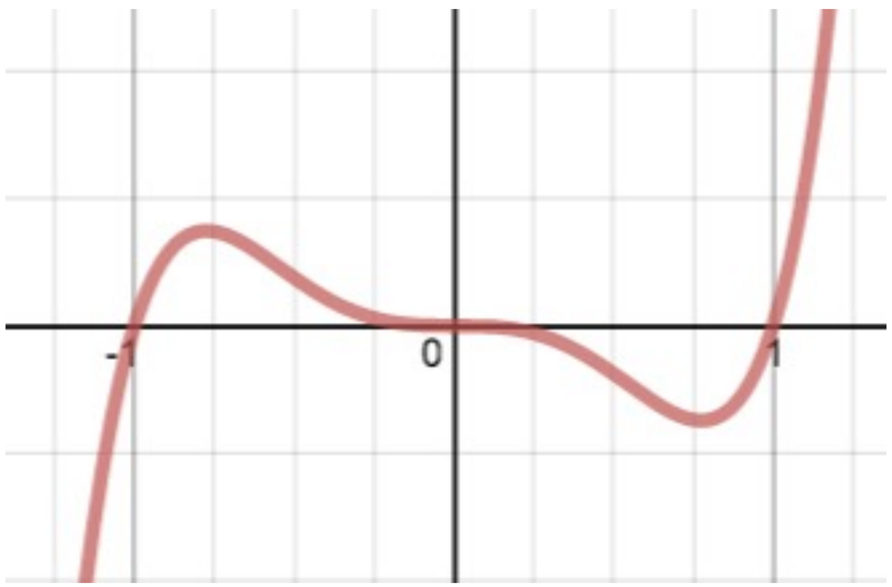

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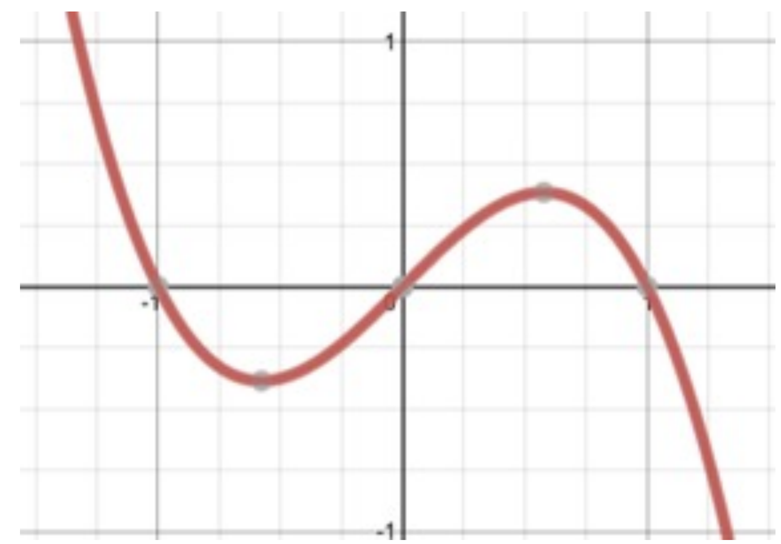

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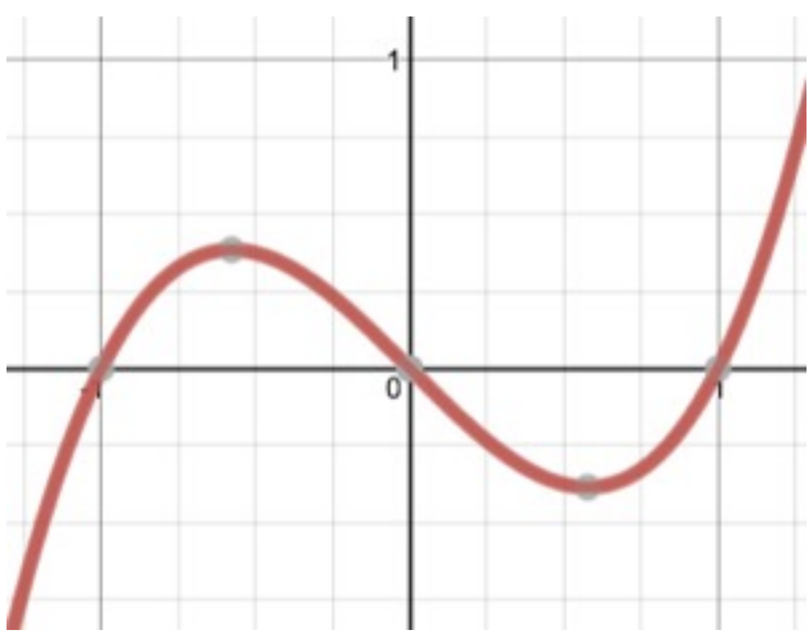

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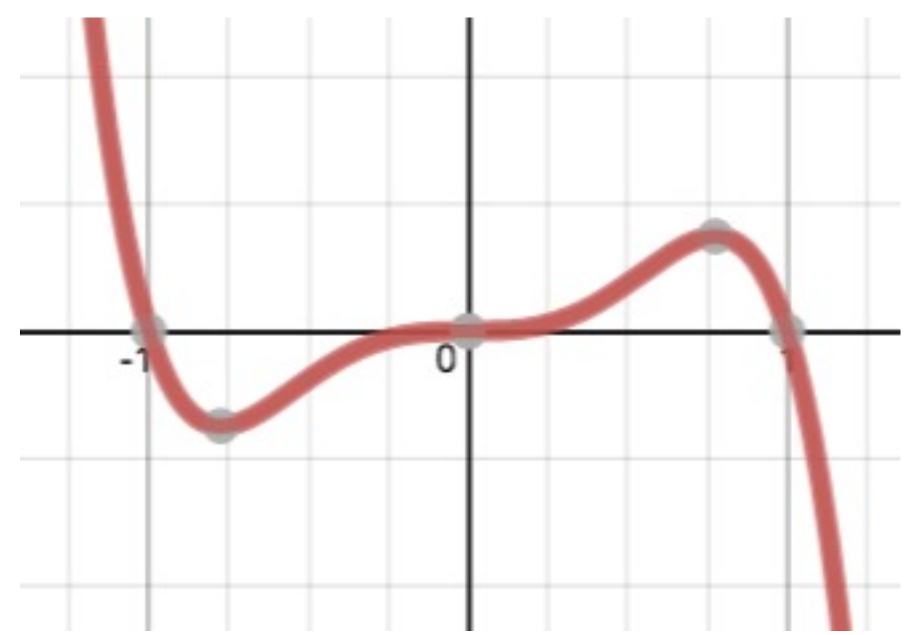

Which is the graph of the function $g(x) = x^5 - x^2$?

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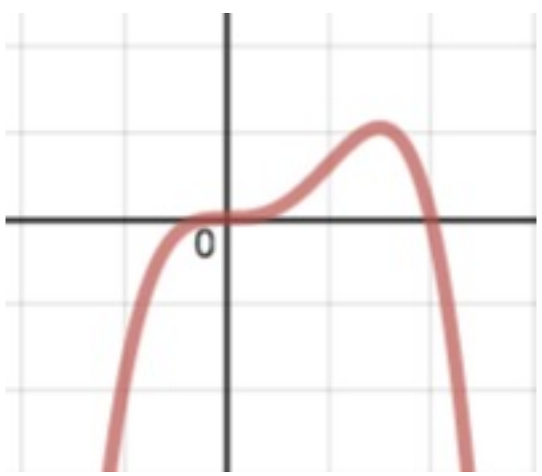

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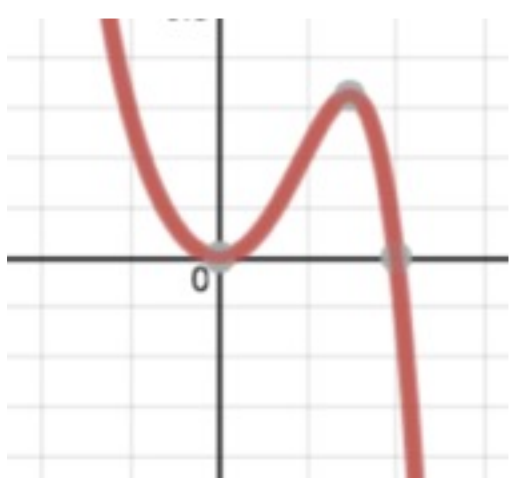

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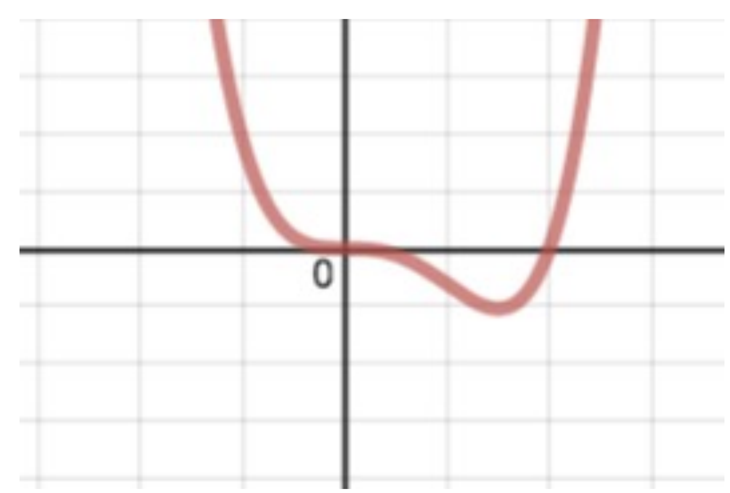

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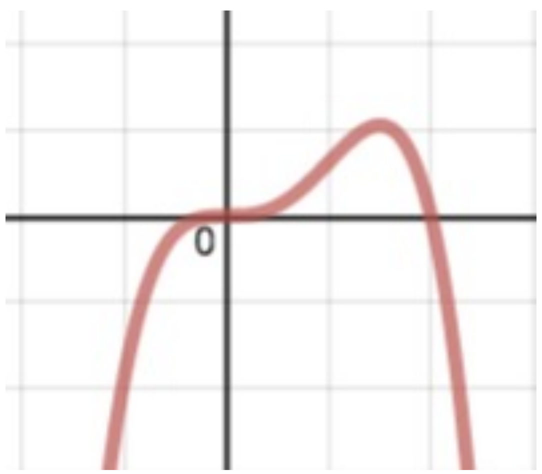

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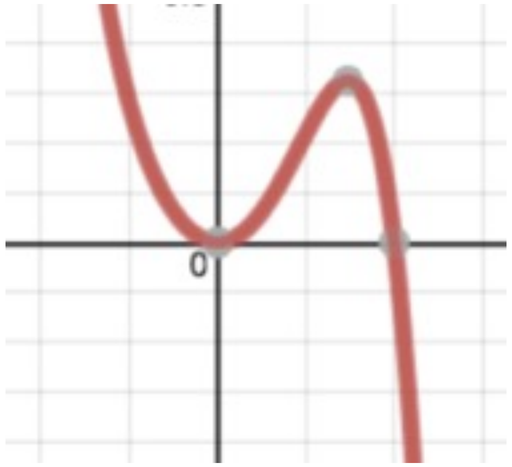

(D)

Hill functions

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- A useful function for studying saturating phenomena.

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- A useful function for studying saturating phenomena.
- Important functions in biochemistry - Michaelis-Menten kinetics
- We will see these several times this semester.

When |x| << b, then $f(x) = \dfrac{ax^n}{b^n + x^n}$

can be approximated by...

(A) a

(B) $\dfrac{a}{b^n}$

(C) $a\left(\dfrac{x}{b}\right)^n$

(D) 0

(E) 1

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Implications for graphing

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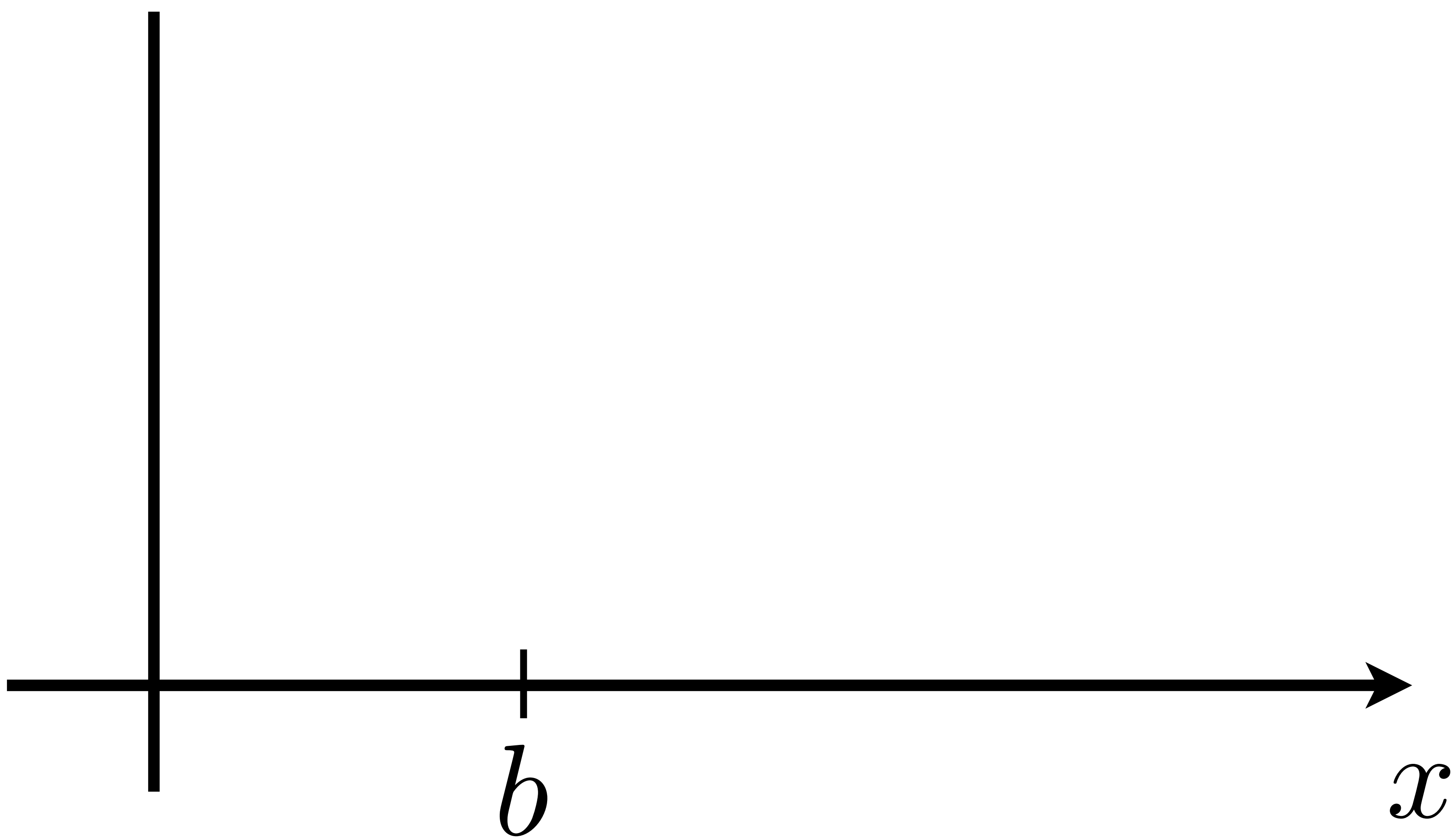

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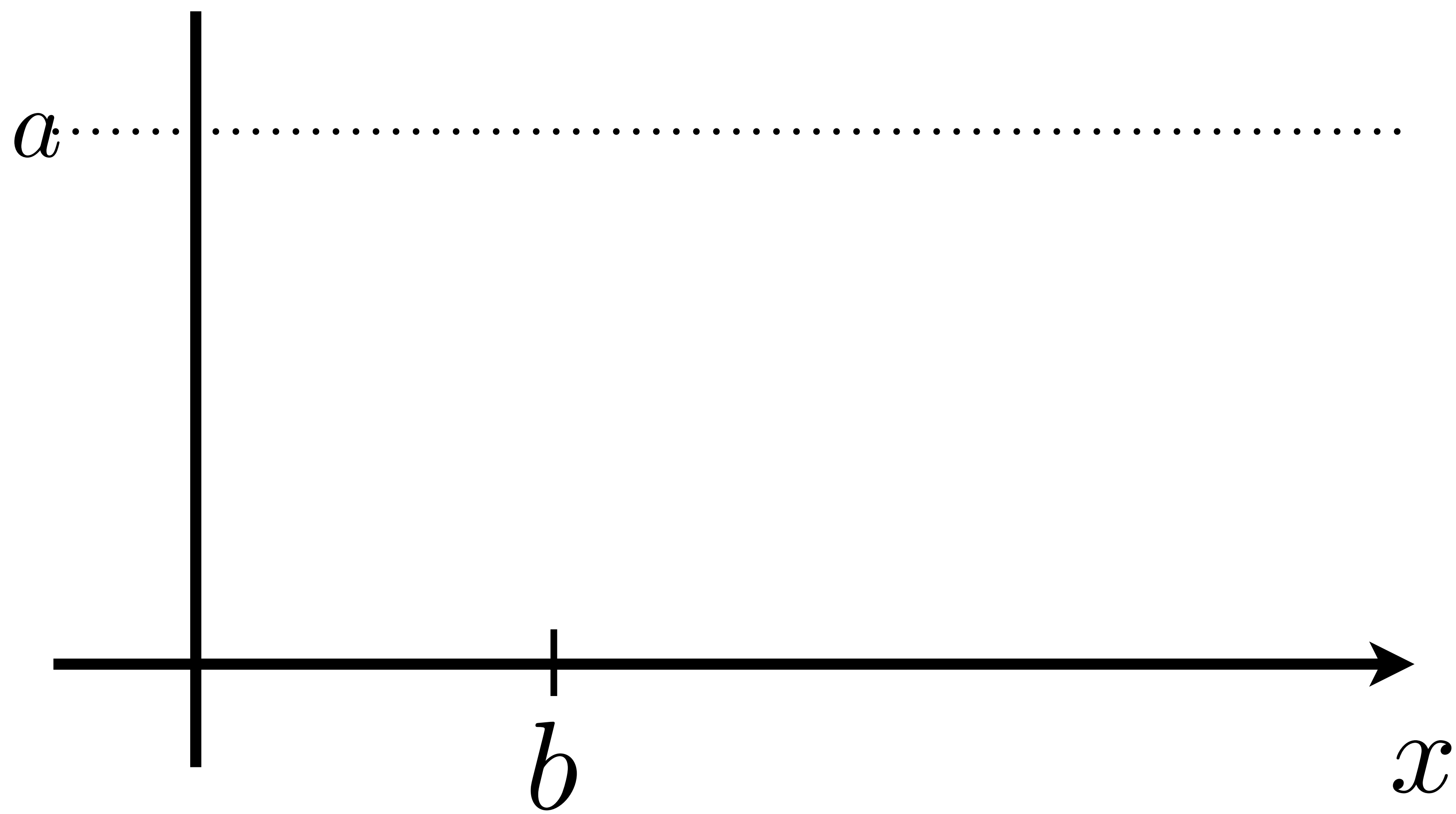

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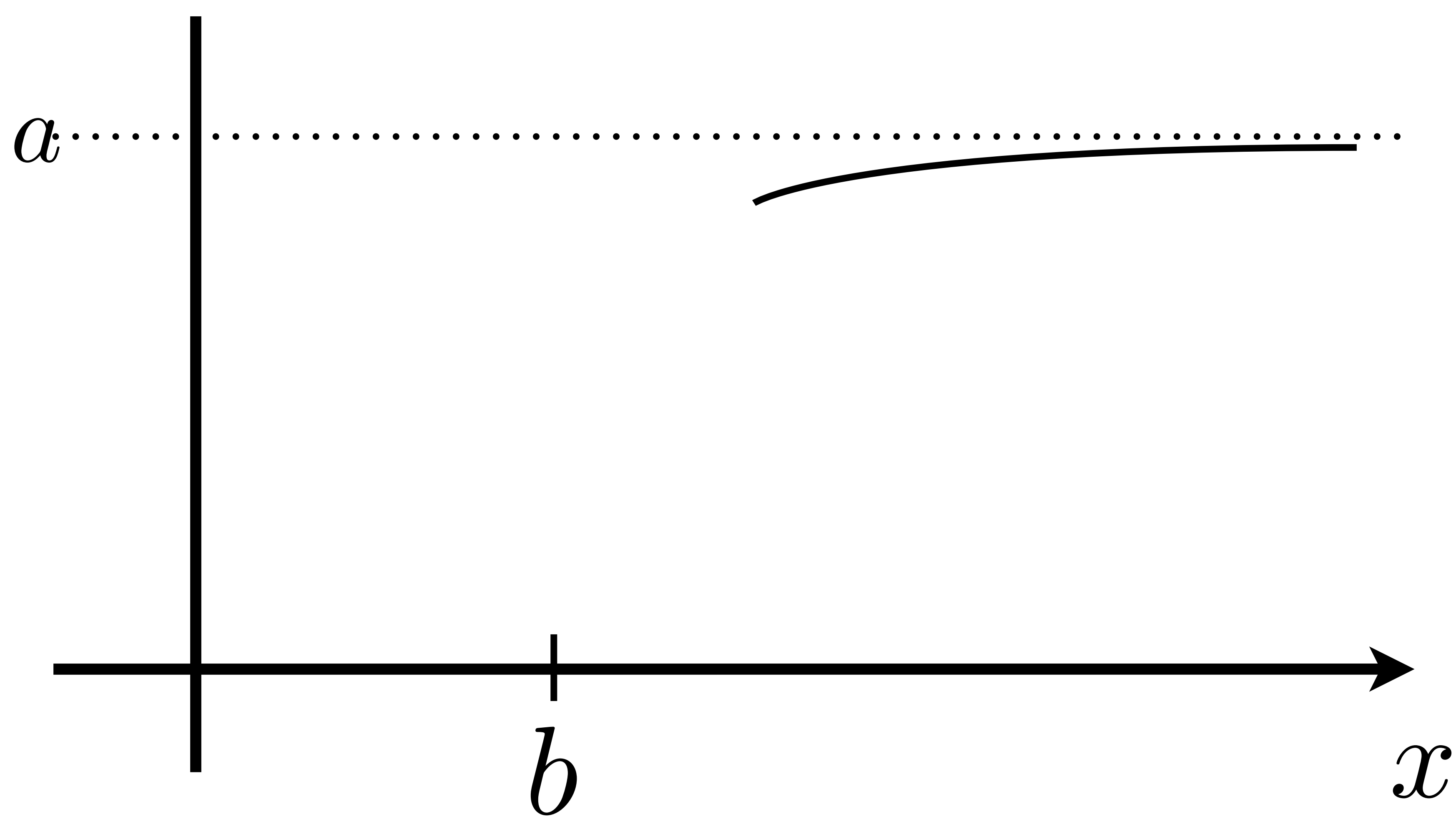

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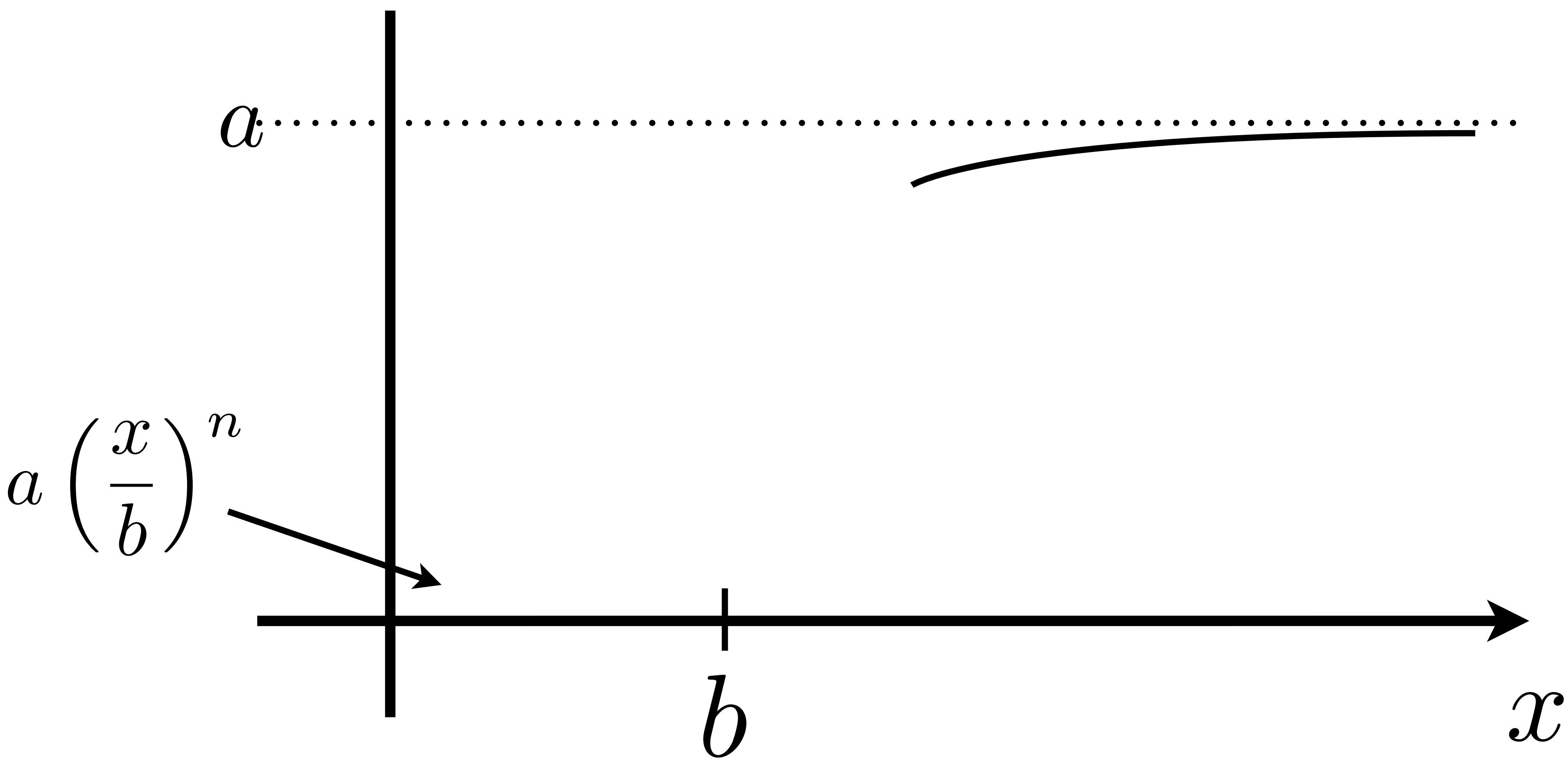

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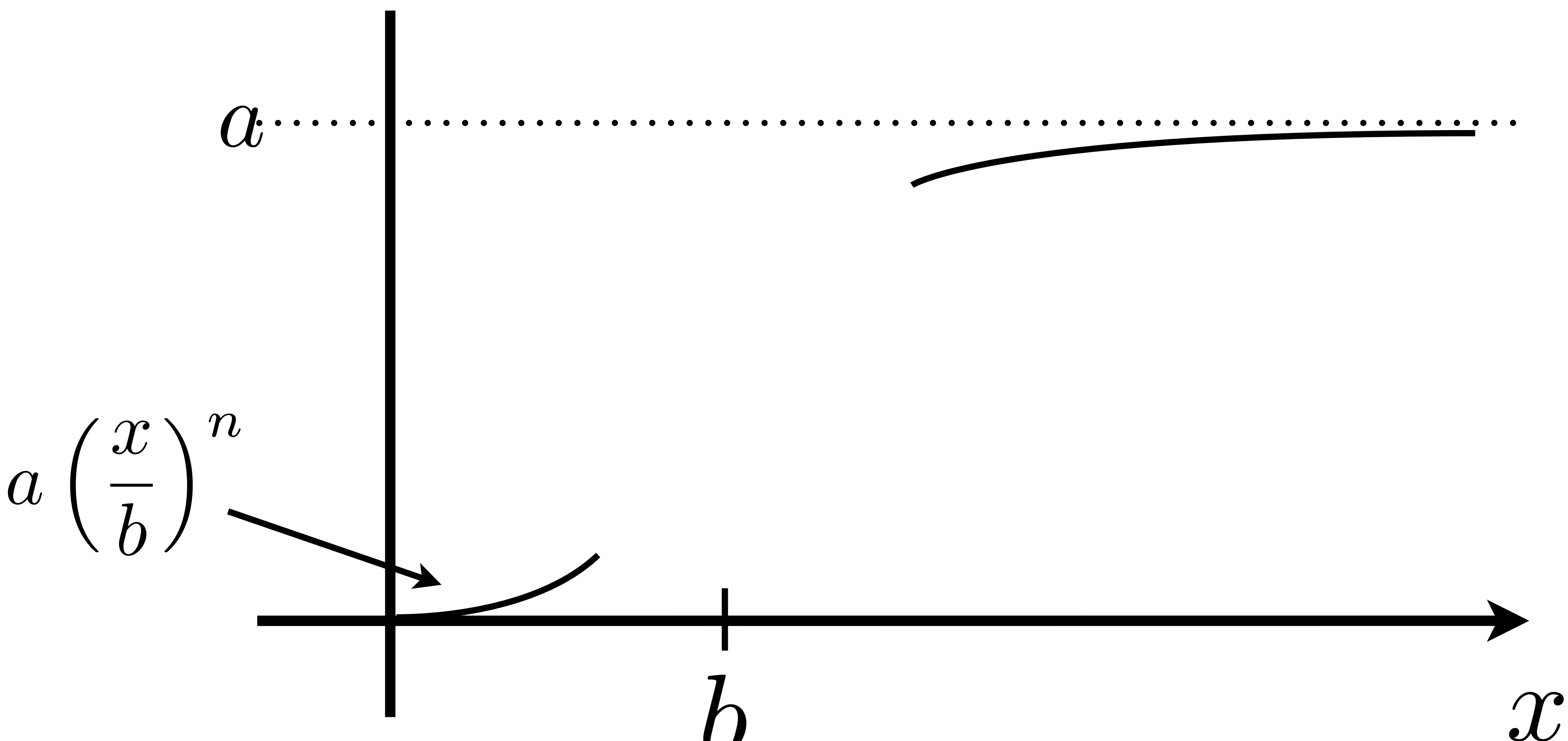

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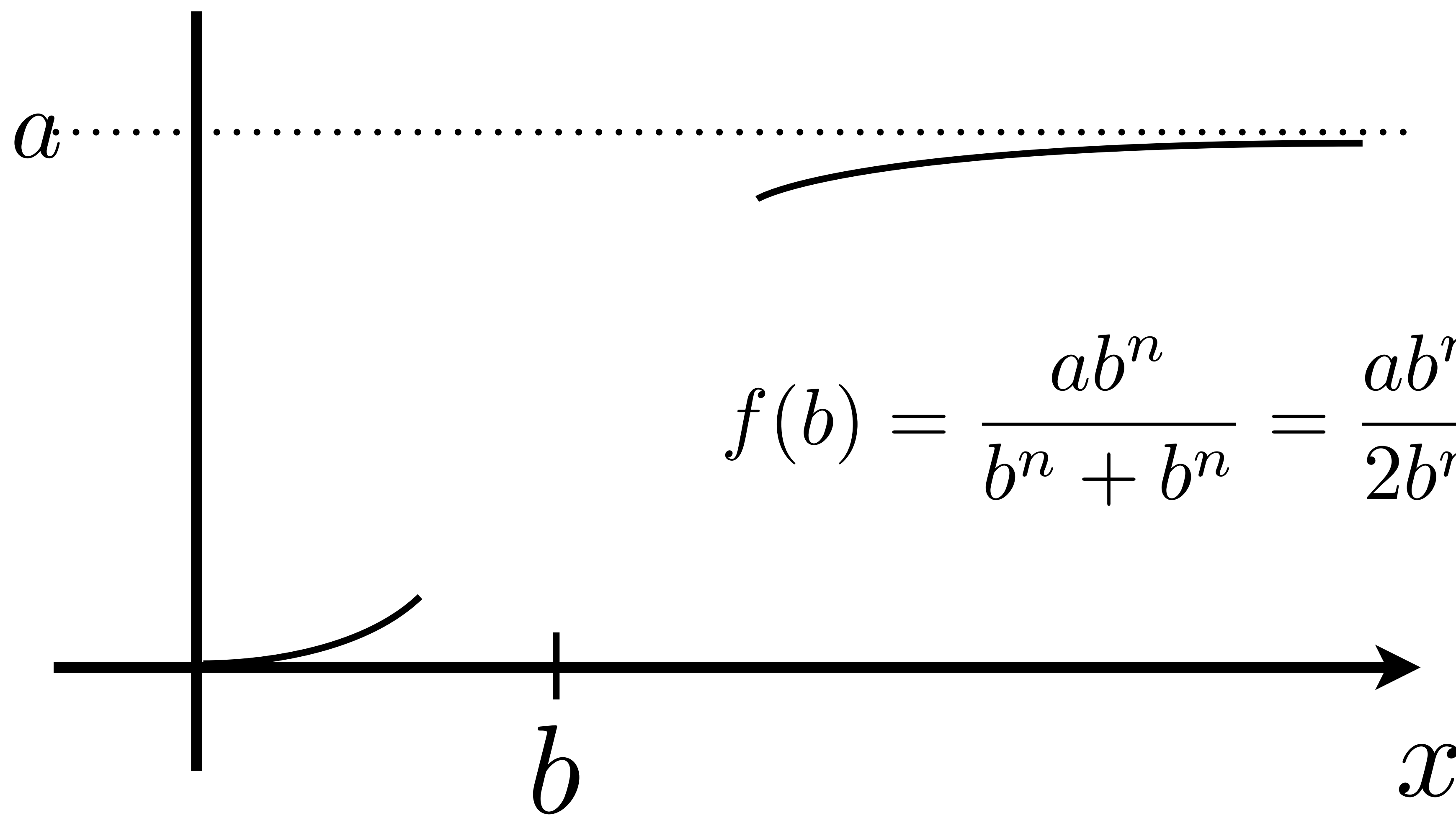

$$f(b) = \frac{ab^n}{b^n + b^n} = \frac{ab^n}{2b^n} = \frac{a}{2}$$

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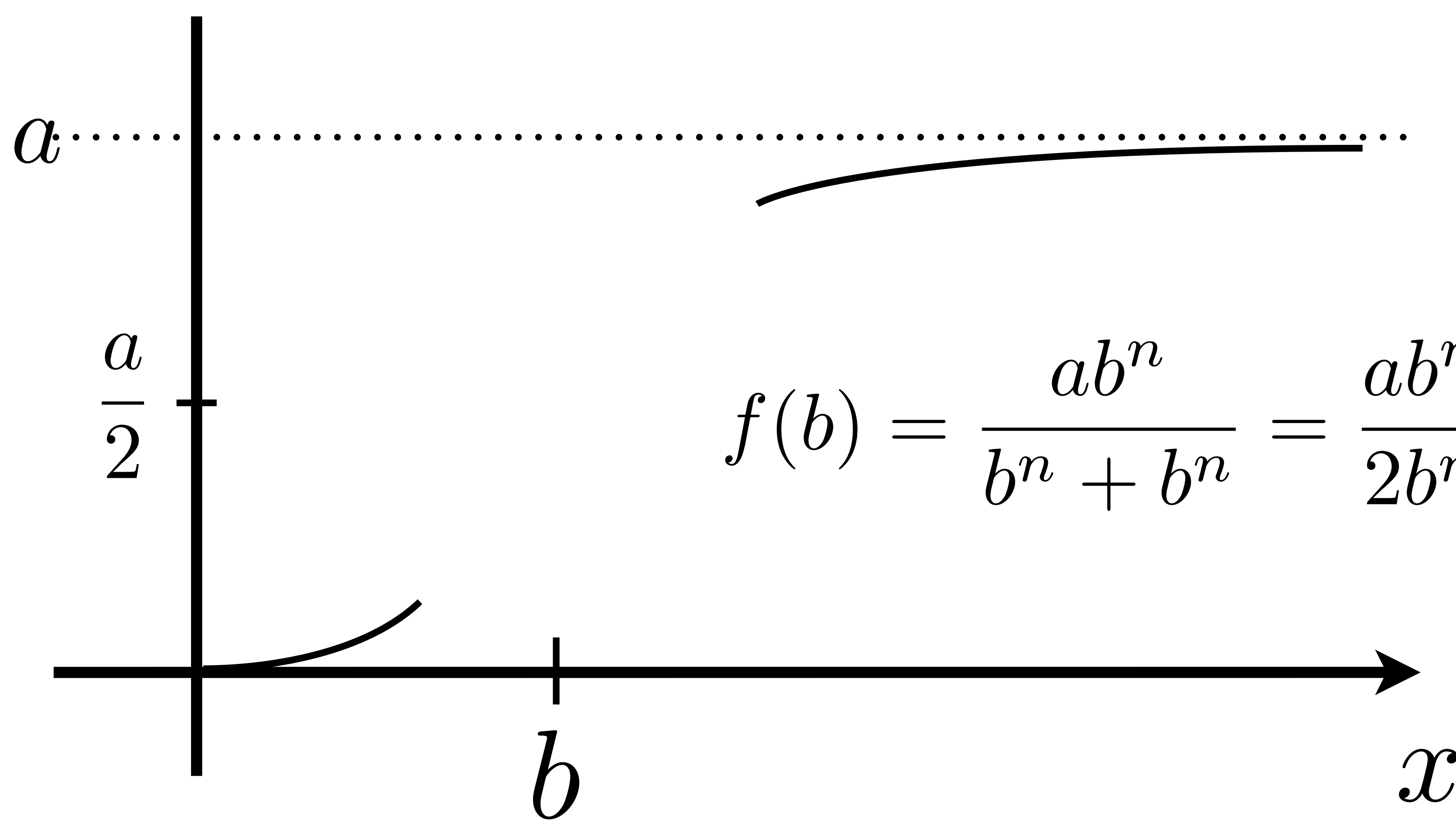

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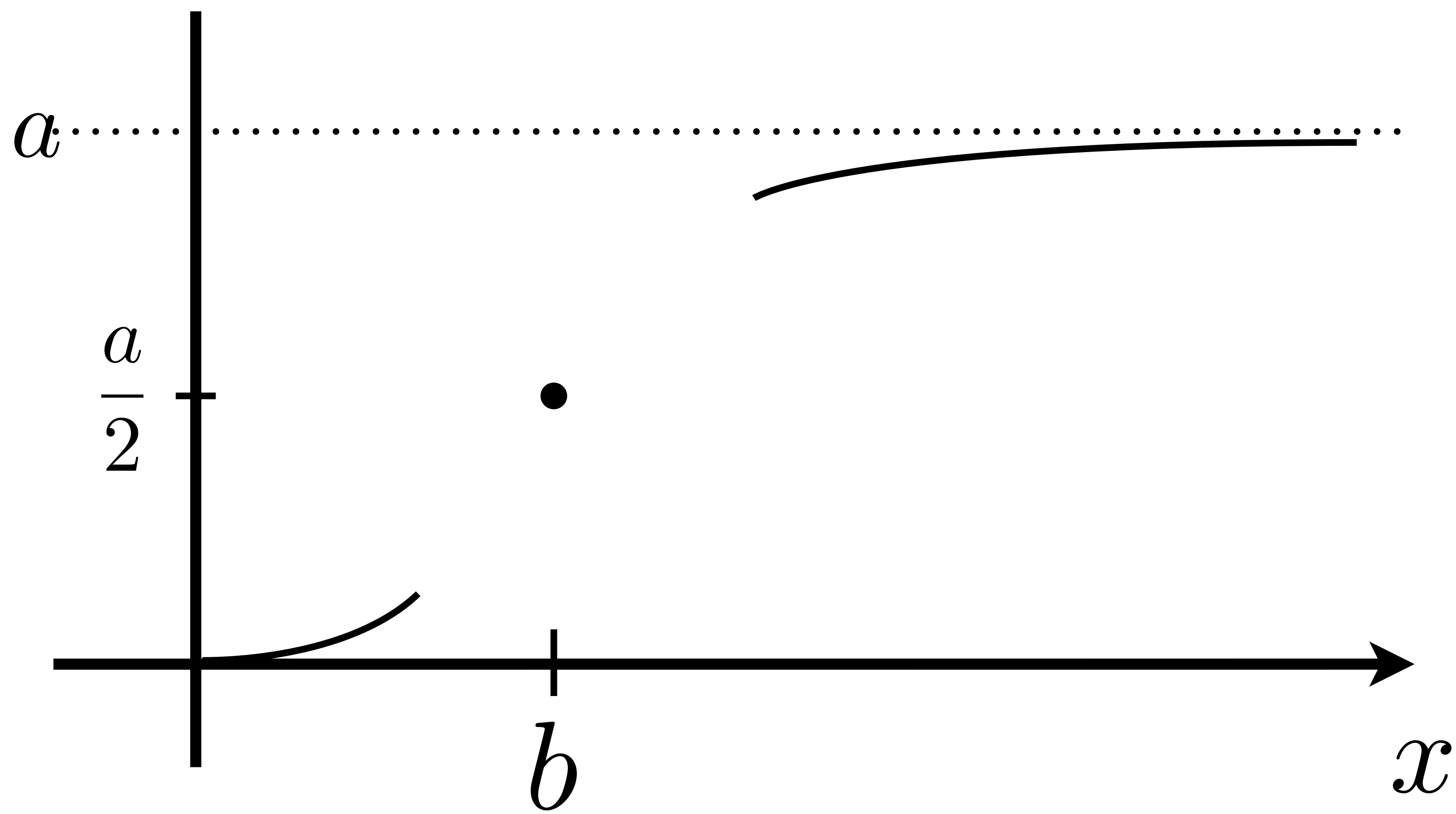

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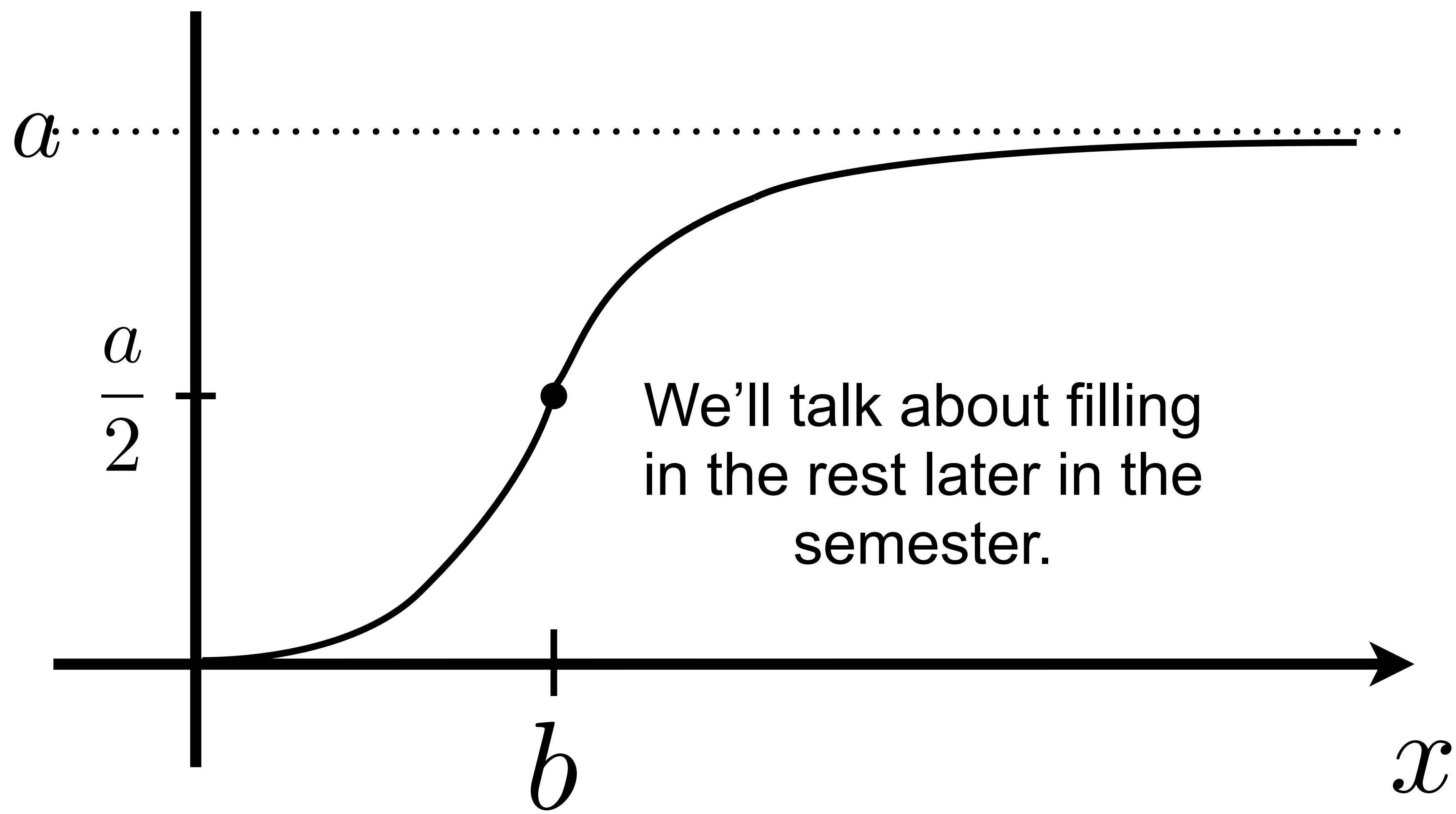


Comparing Hill functions with different n values

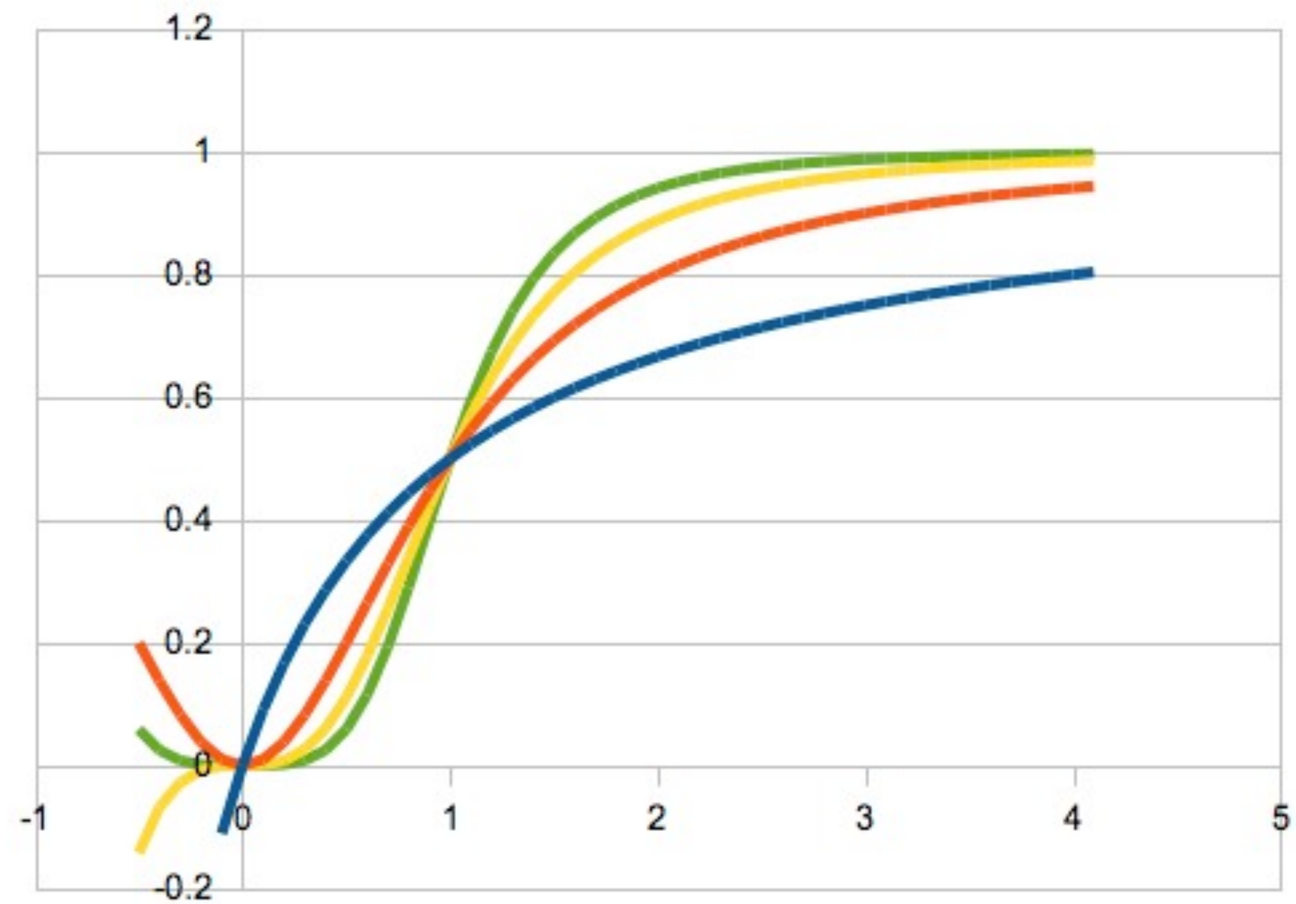
$$f(x) = \frac{ax^n}{b^n + x^n}$$

(A) Green: n=2, yellow: n=3, red: n=4, blue: n=5.

(B) Green: n=4, yellow: n=3, red: n=2, blue: n=1.

(C) Green: n=5, yellow: n=4, red: n=3, blue: n=2.

(D) Either (B) or (C) (not enough info).



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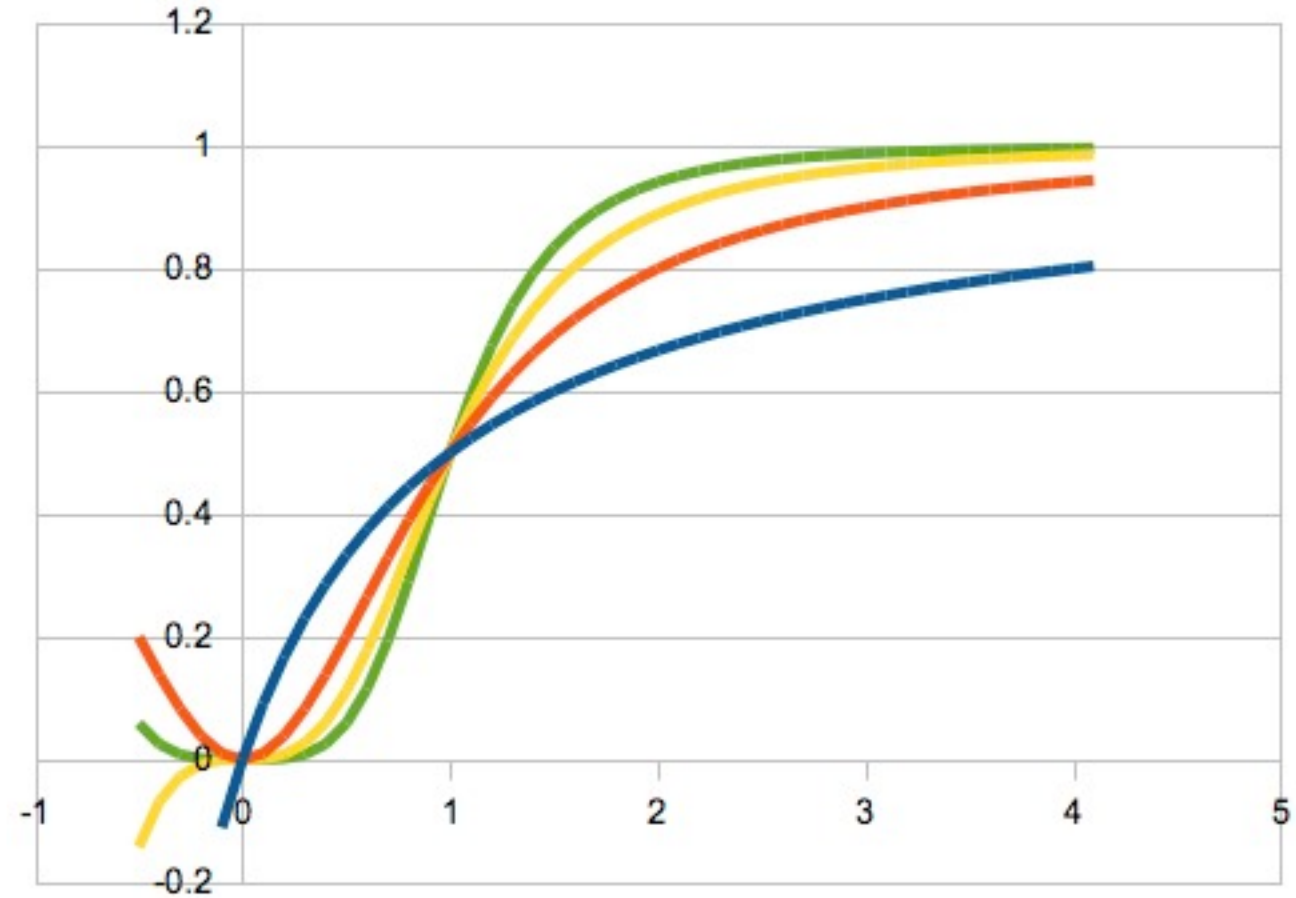

What is the slope of the line connecting the points?

(A) $m=(x_1-x_2)/(y_1-y_2)$

(B) $m=(x_2-x_1)/(y_1-y_2)$

(C) $m=(y_1-y_2)/(x_1-x_2)$

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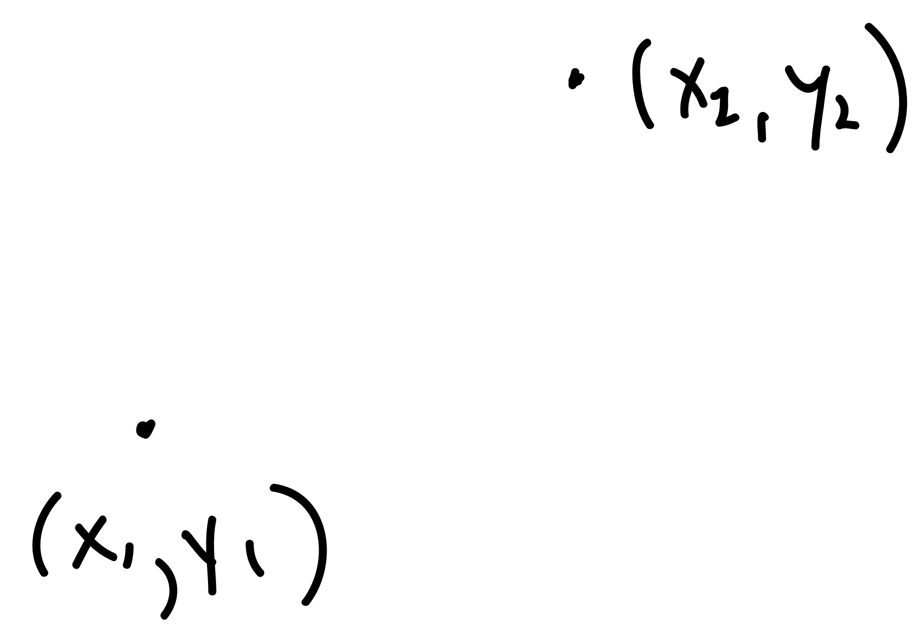

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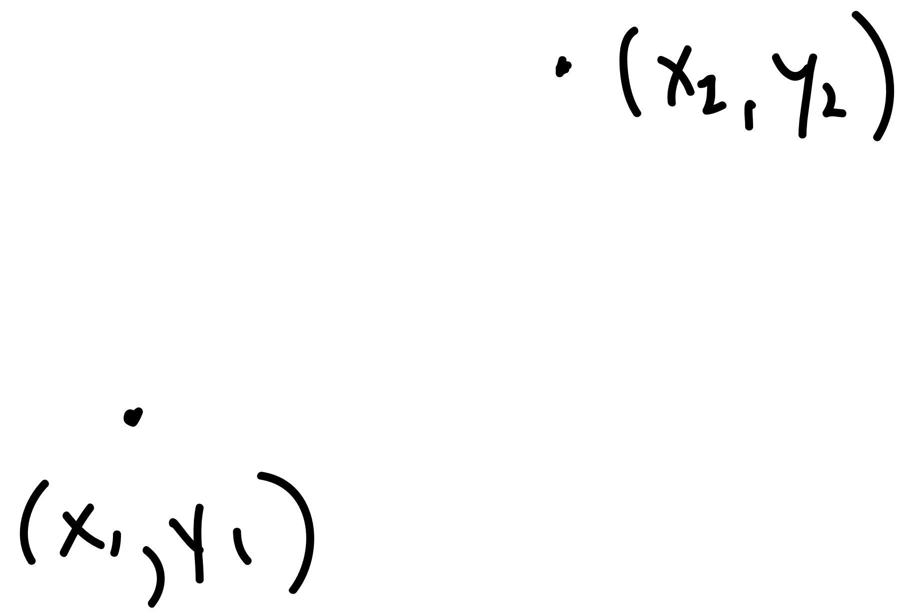

What is the slope of the secant line to the graph of f(x)?

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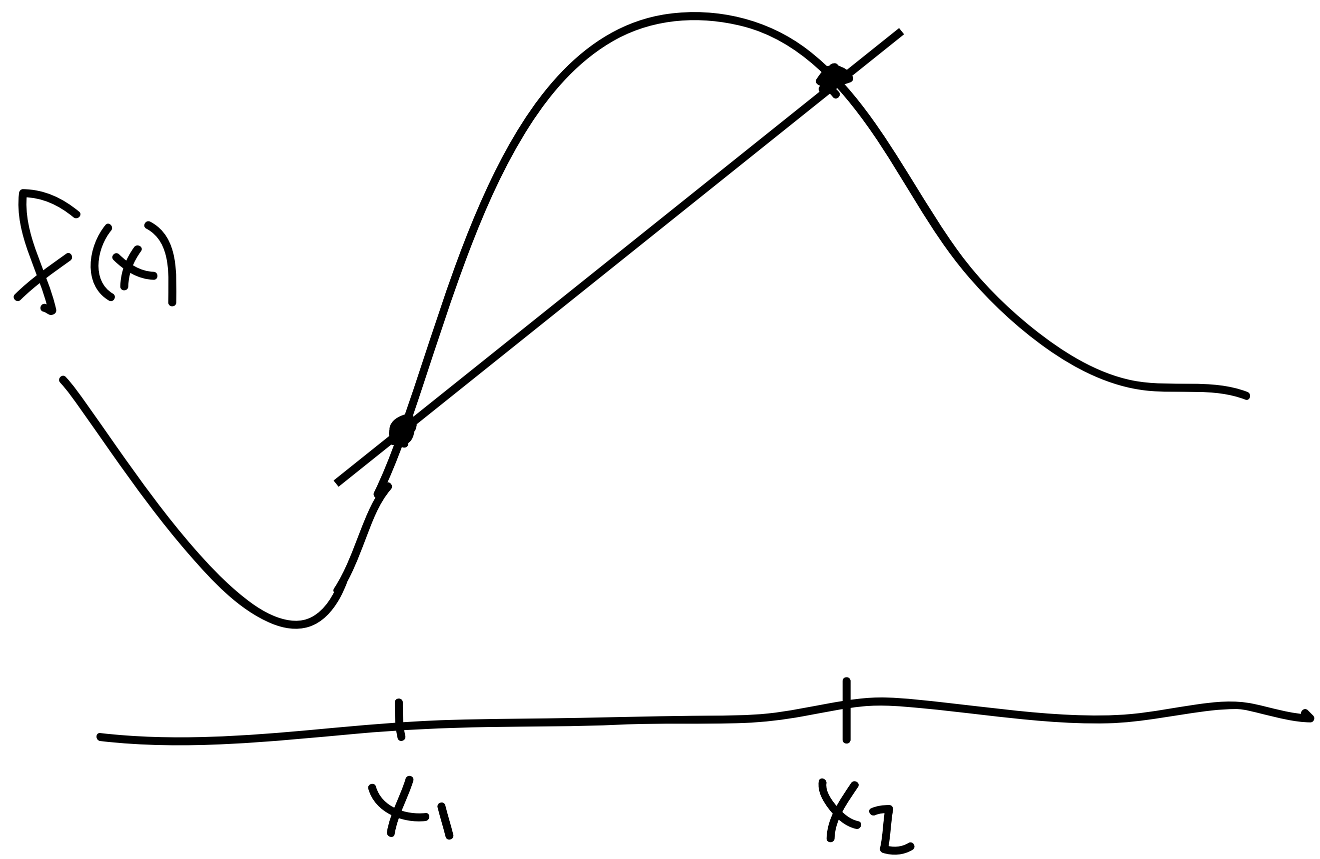

Slope of secant line = average rate of change from x_1 to x_2.

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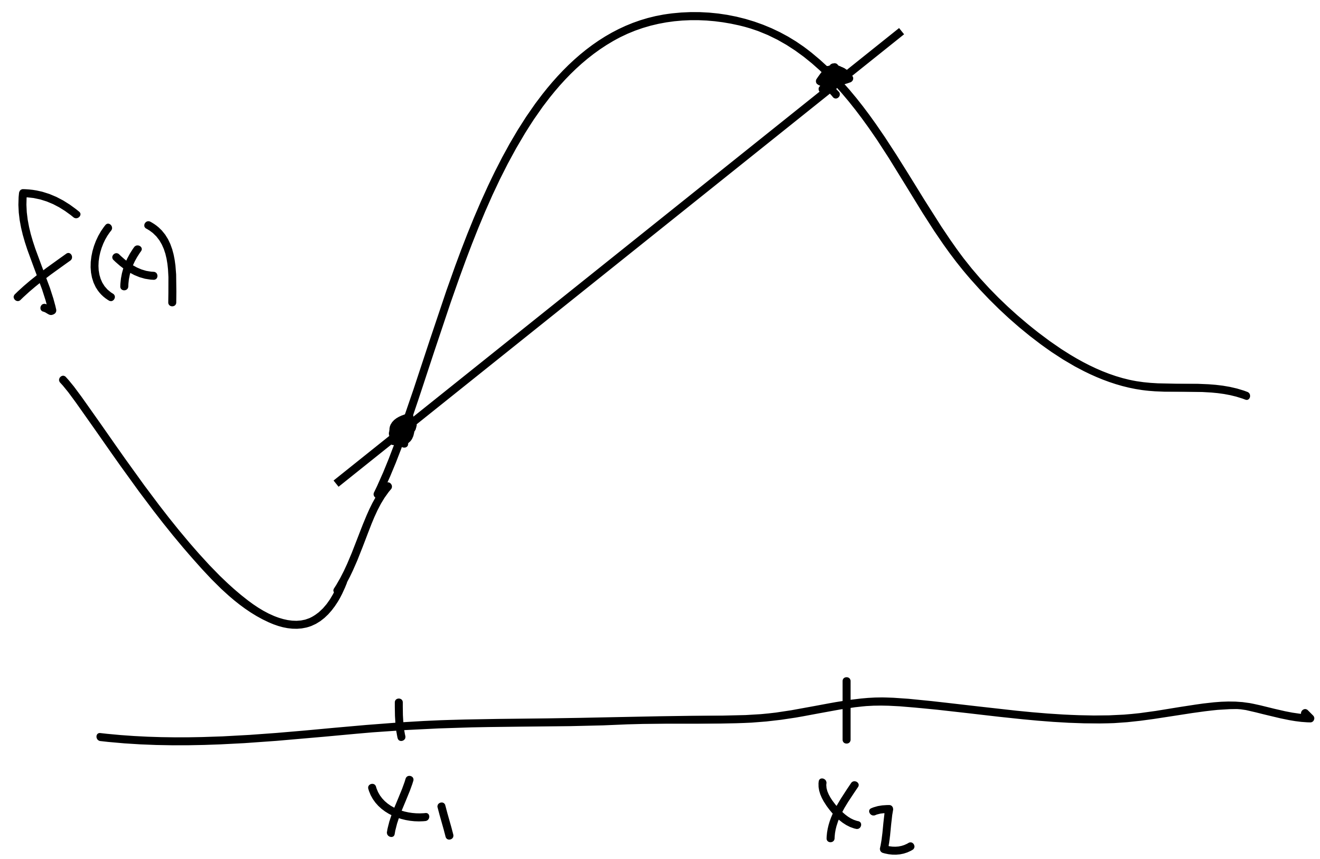

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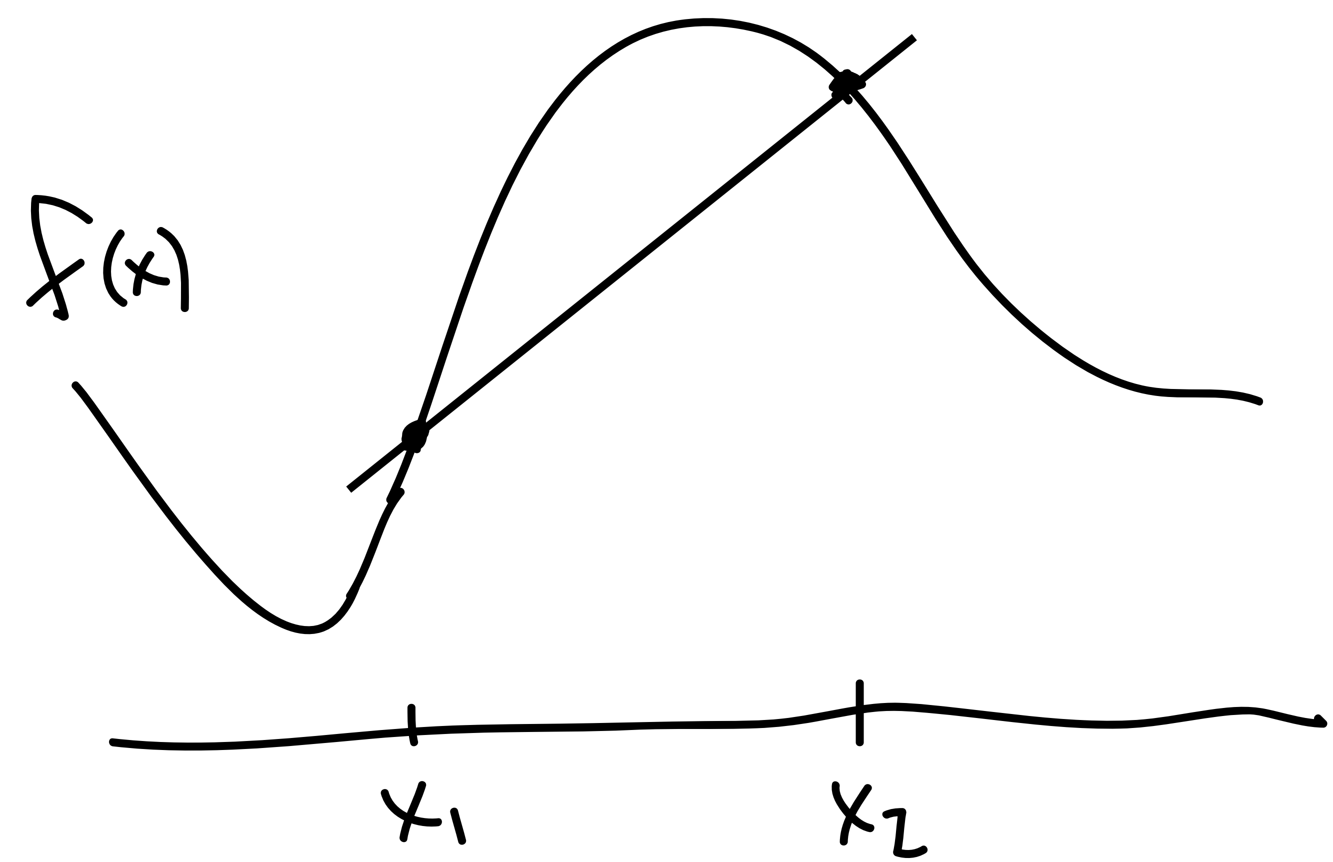
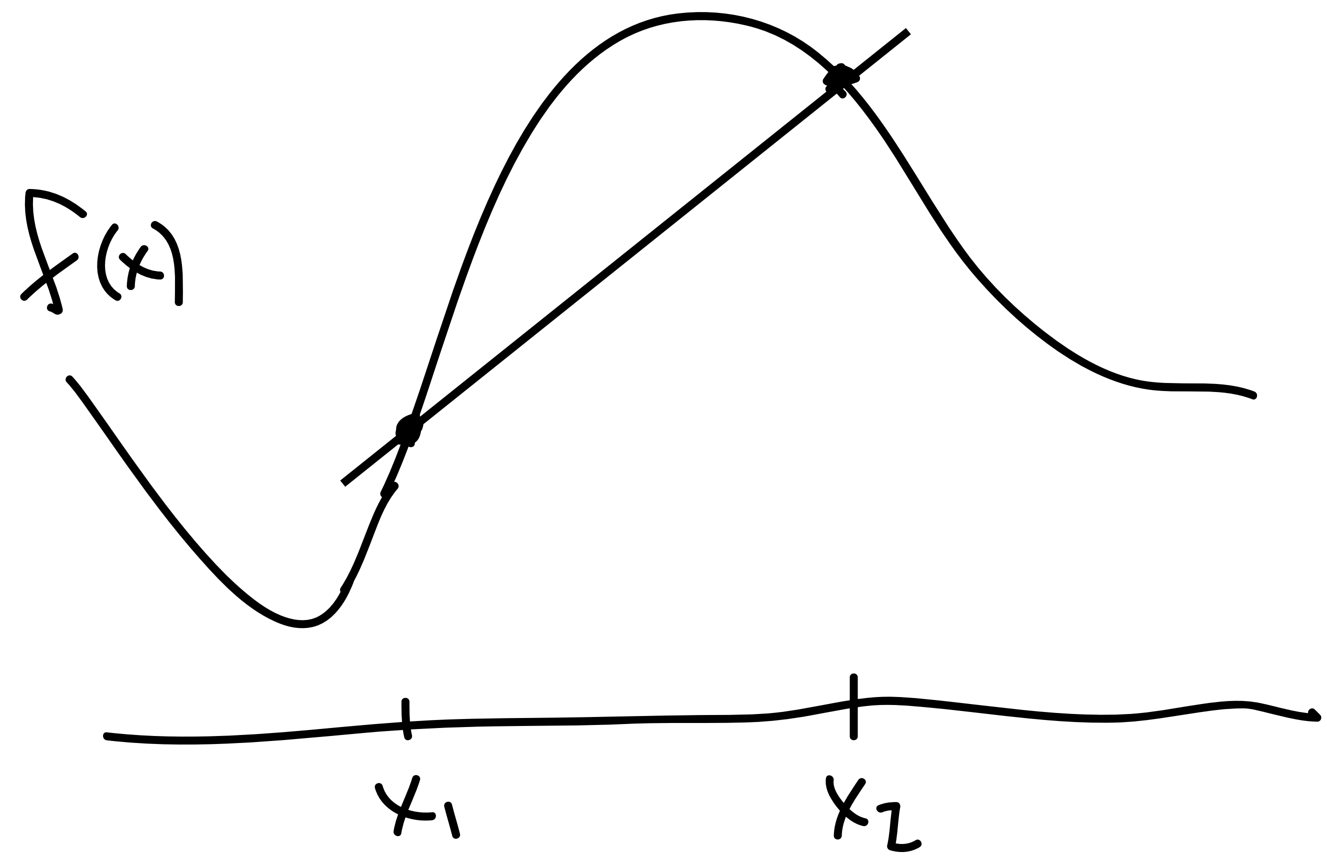


What if you want the rate of change AT x_1?

Take a point x_2 so that the secant line is closer to the "secant line" AT x_1.



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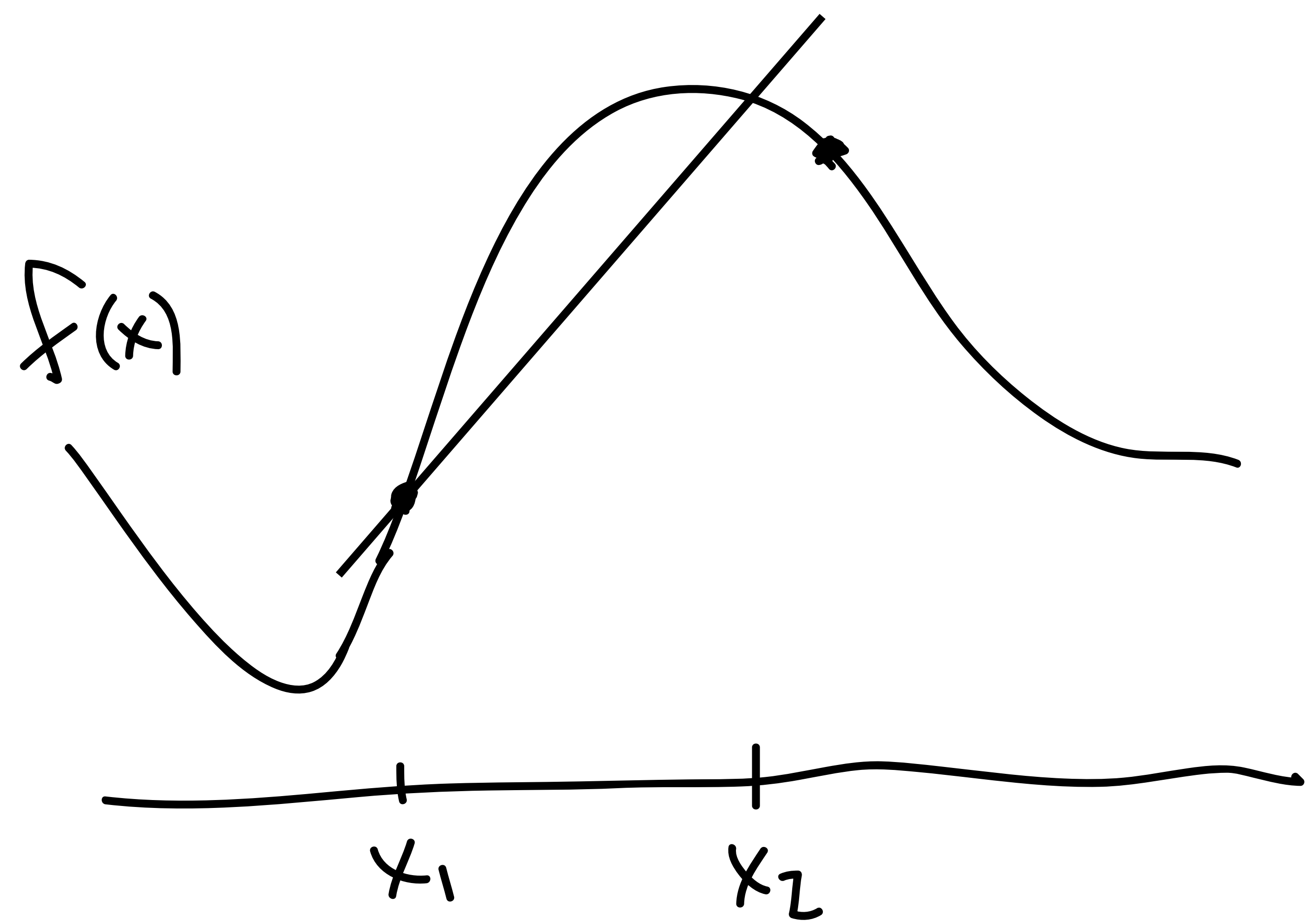

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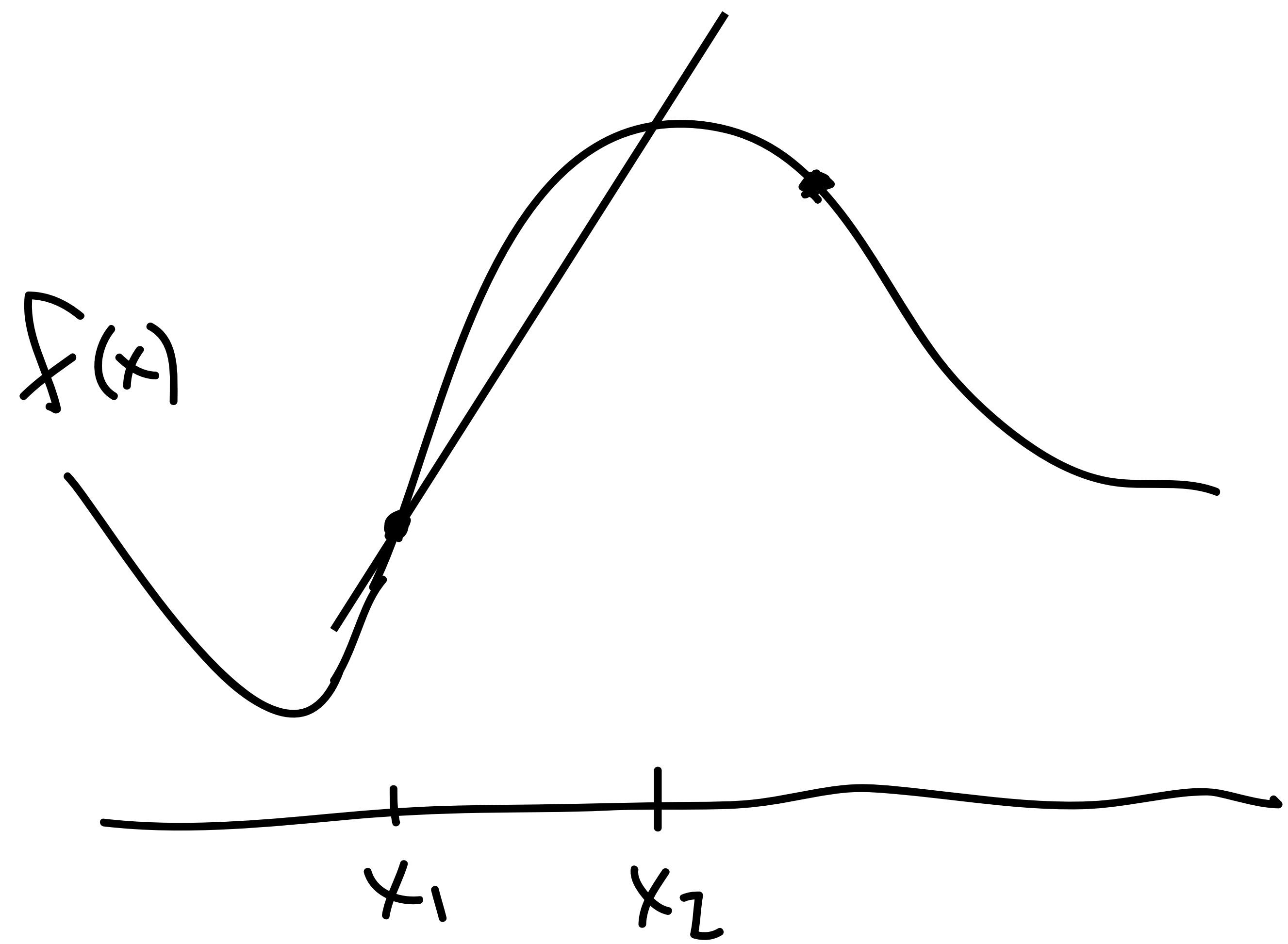

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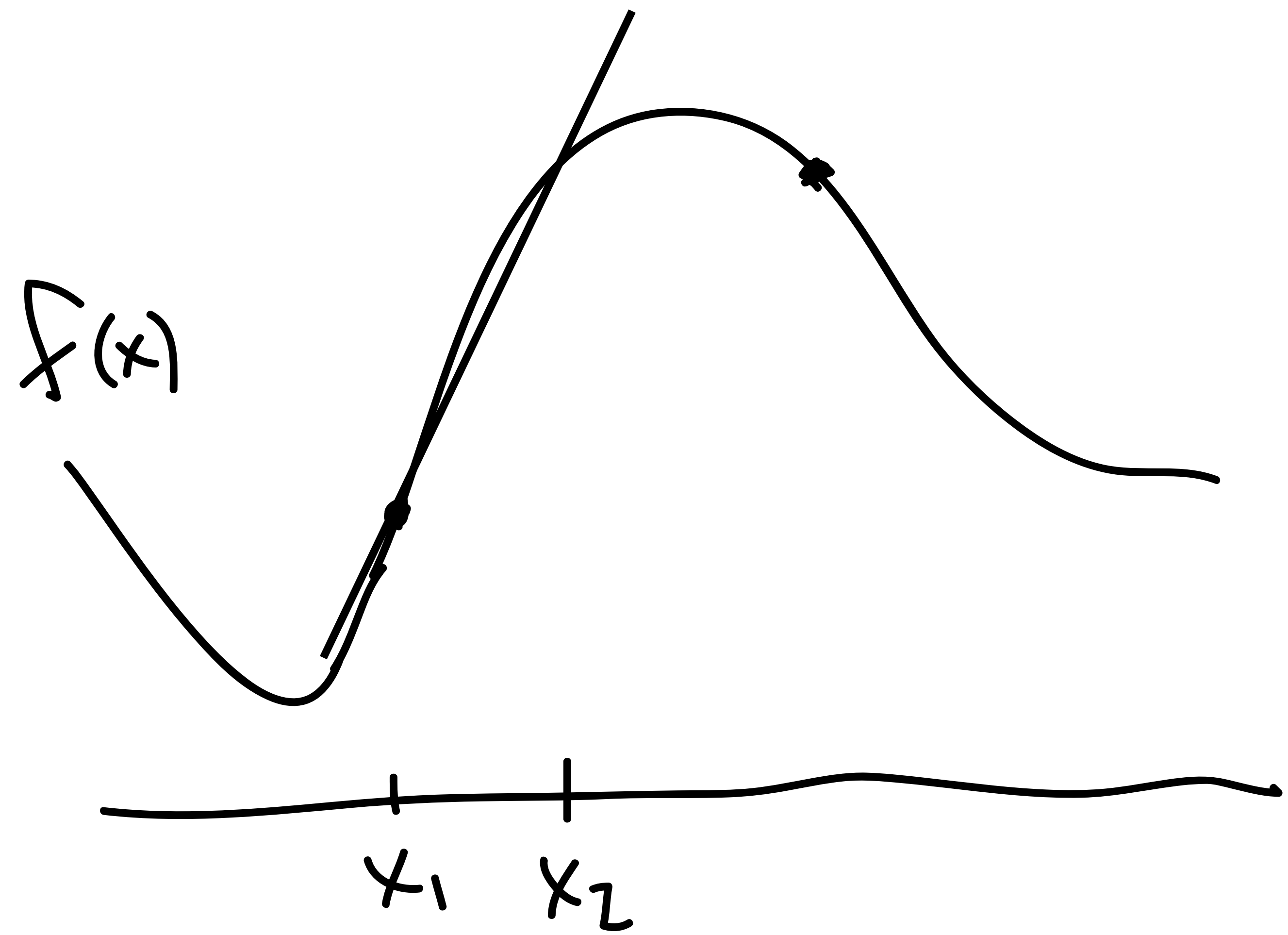

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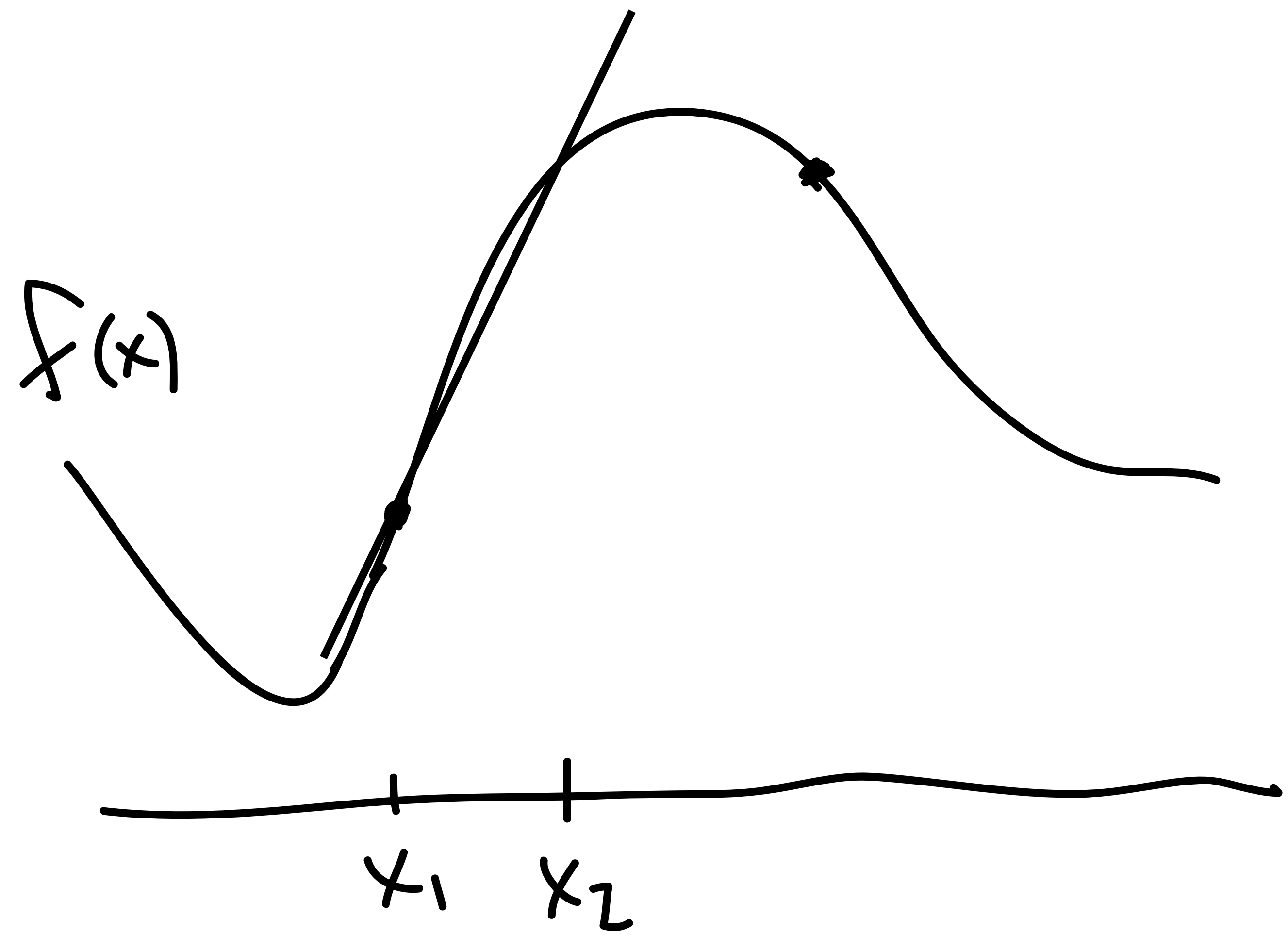

Alternate notation: let $x_2 = x_1 + h$ so that

$$m = \frac{f(x_2) - f(x_1)}{x_2 - x_1}$$

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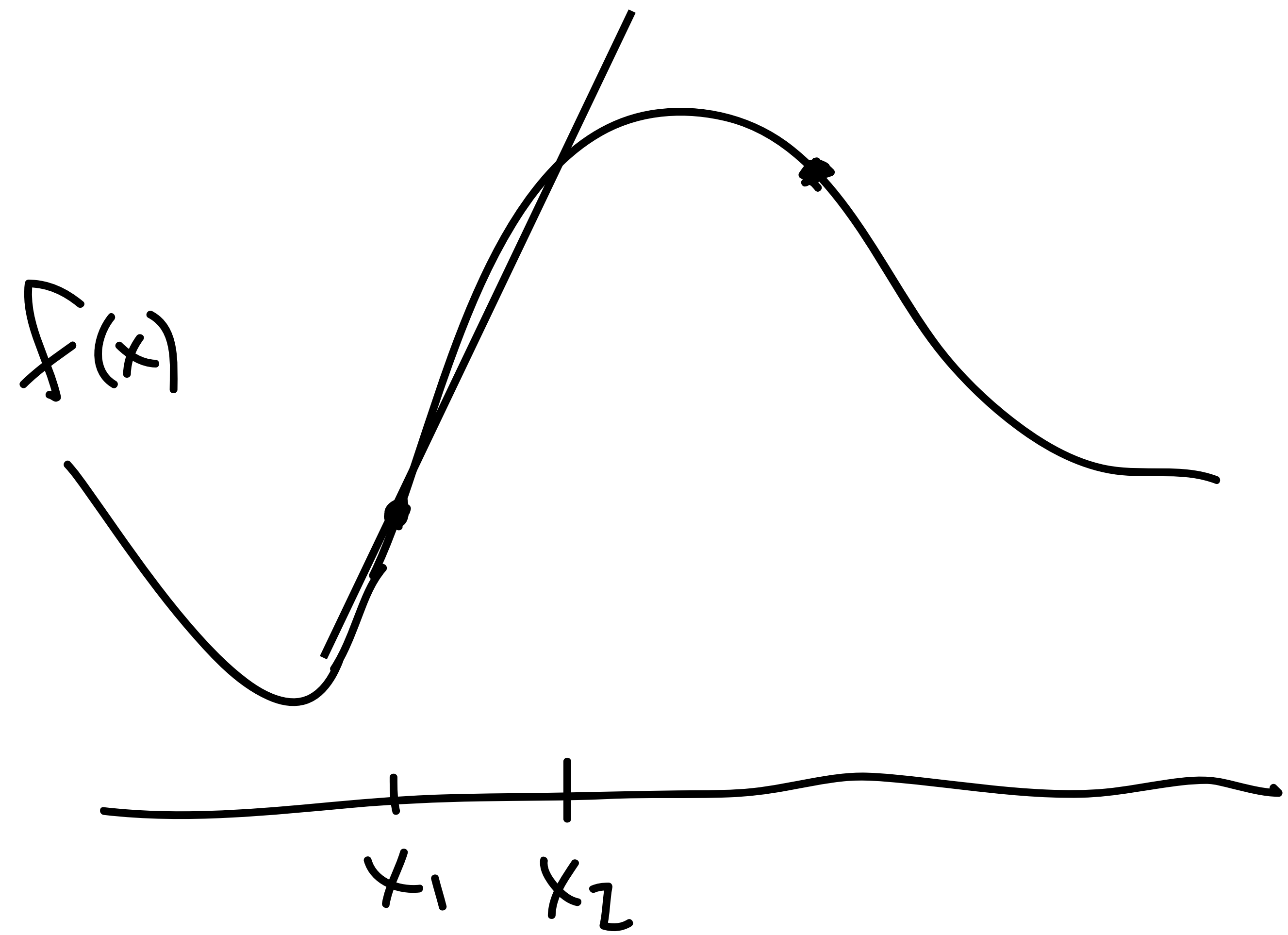

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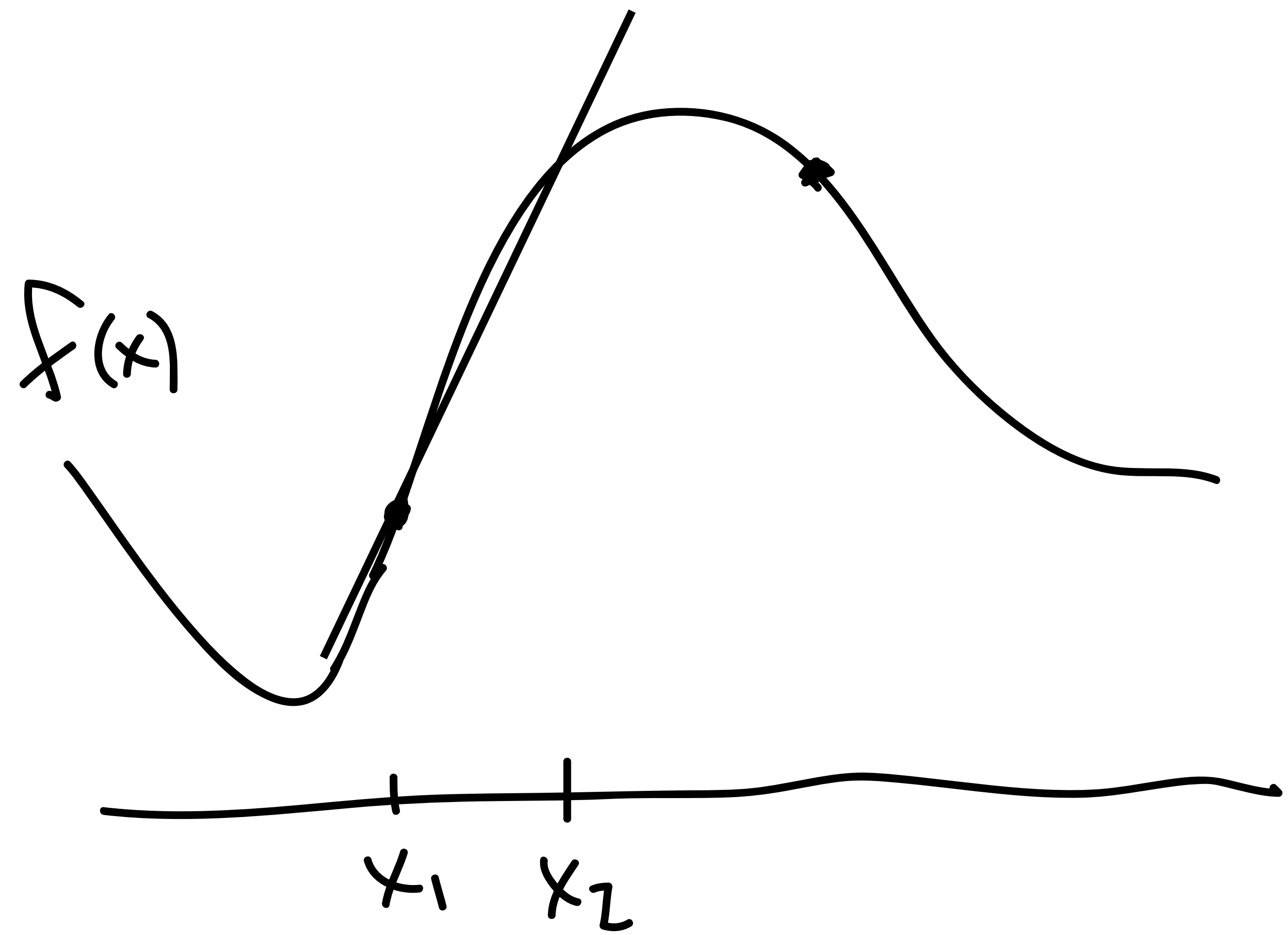

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$$m = \frac{f(x_2) - f(x_1)}{x_2 - x_1} = \frac{f(x_1 + h) - f(x_1)}{h}$$

If we take h values closer and closer to 0...

- The secant line approaches the tangent line.
- The slope of the secant line approaches the slope of the tangent line.
- We call the resulting slope the derivative at x_1.
- We now have to learn how to take limits!

$$\text{slope at } x_1 = f'(x_1) = \lim_{h \to 0} \frac{f(x_1 + h) - f(x_1)}{h}$$