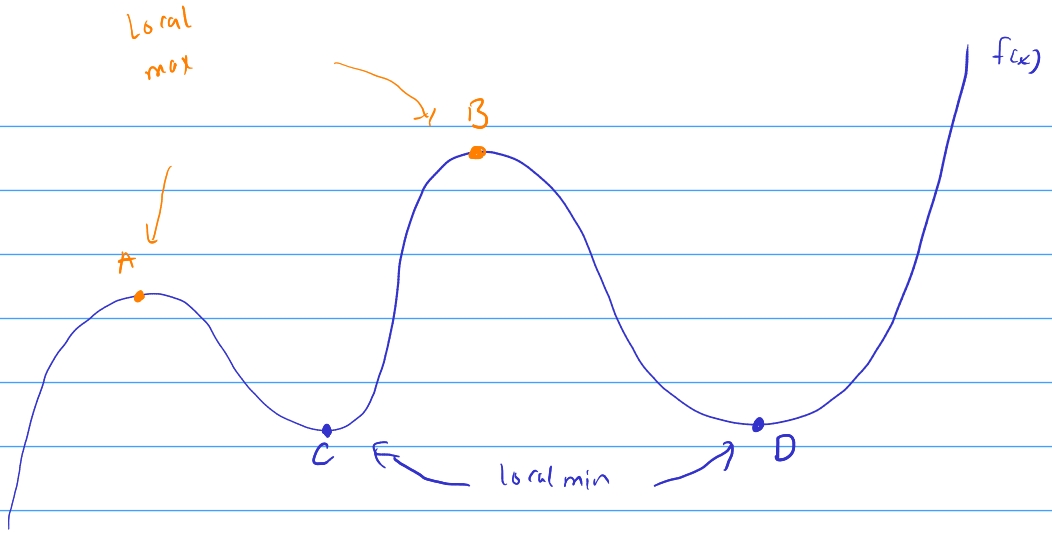


Given function $y = f(x)$. We want to know the locations of the points A, B, C, D

If we can graph $f(x)$, we can visually tell the location of these points.

what if we do not know the graph of $f(x)$?

For example:

$$f(x) = \sqrt{2e^x + x^2 + 2x + 1}$$

How do we find these points (local max, local min)?

we will use "Derivatives" to find these points.

Goal: Given ANY function $f(x)$, we want to find the derivative of $f(x)$.

(*) Derivative notation:

The derivative of a function $f(x)$ is denoted by $f'(x)$, reading as "f prime of x".

Notice: $f'(x)$ is a function of $x$.

(*) How to find $f'(x)$ ?

To find $f'(x)$ we will use several "rules".

For example: addition rule, quotient rule, chain rule ....

(*) Some basic rules:

(1) If $f(x) = C$ (constant)

$\Rightarrow f'(x) = 0$

OR we can write: $(C)' = 0$

(2) If $f(x) = x$

then $f'(x) = 1$

OR we can write: $(x)' = 1$

③ ( Power Rule )

If $f(x) = x^n$

$\Rightarrow f'(x) = n \cdot x^{n-1}$

OR we can write: $(x^n)' = n \cdot x^{n-1}$

Example :

Find $f'(x)$ :

① $f(x) = 2025 \Rightarrow f'(x) = 0$ (rule 1)

② $f(x) = x^{10} \Rightarrow f'(x) = \underline{10} \cdot x^{9}$

③ $f(x) = x^{1000} \Rightarrow f'(x) = \underline{1000} \cdot x^{999}$

④ $f(x) = \sqrt{x} = x^{1/2}$

$\Rightarrow f'(x) = \frac{1}{2} x^{1/2-1} = \boxed{\frac{1}{2} x^{-1/2}}$

In general, $\sqrt[K]{x} = x^{1/K}$

⑤ $f(x) = \sqrt[5]{x} = x^{1/5}$

$\Rightarrow f'(x) = \frac{1}{5} x^{1/5-1} = \frac{1}{5} x^{-4/5}$

(6) $f(x) = \frac{1}{x^{10}} = x^{-10}$

$\Rightarrow f'(x) = -10 \cdot x^{-10-1}$

$= \boxed{-10 \cdot x^{-11}}$

(7) $f(x) = \frac{1}{x} = x^{-1}$

$\Rightarrow f'(x) = -1 \cdot x^{-1-1}$

$= \boxed{-x^{-2}}$

Assignment: Find $f'(x)$

(1) $f(x) = 10000$

(2) $f(x) = x$

(3) $f(x) = x^{20}$

(4) $f(x) = \frac{1}{x^{100}}$

(5) $f(x) = \sqrt[7]{x}$

(6) $f(x) = x^{2025}$