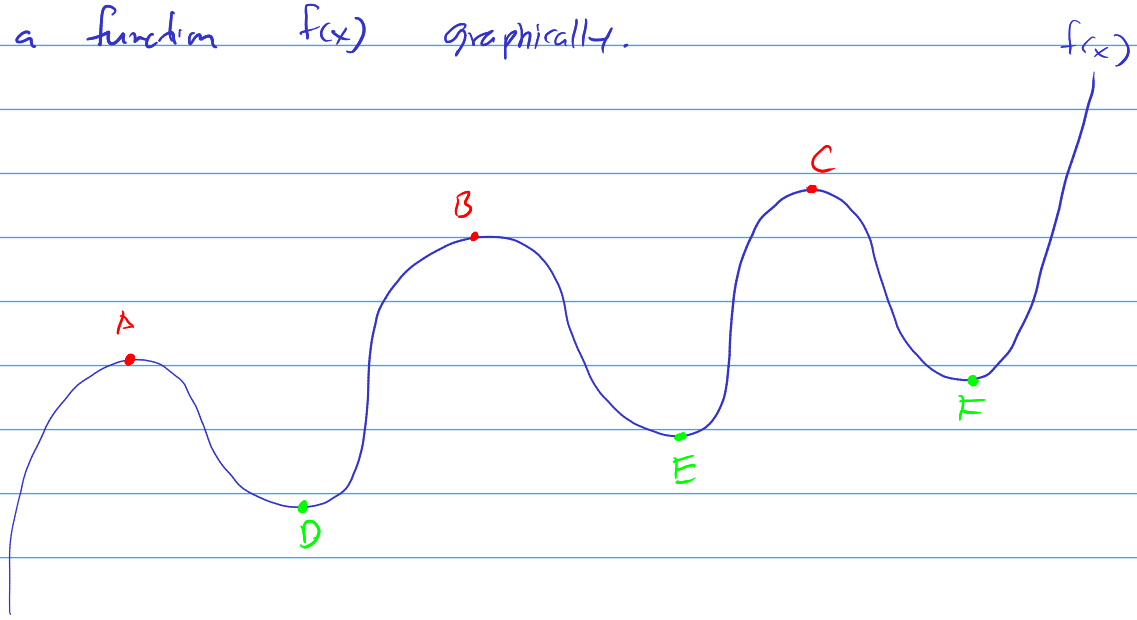
Given a function $f(x)$ graphically.



what are some important points of $f(x)$?

⊖ A, B, C are local maximum.

⊖ D, E, F are local minimum

Visually, we can find these points on the graph.

what if we don't know the graph of $f(x)$.

for example : $f(x) = \sqrt{2e^x + x^6 + \frac{1}{x} + 1}$

How can we find all important points of $f(x)$?

we will use "Derivatives" to find these points to understand about $f(x)$.

Goal: To be able to find the derivative of ANY functions.

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

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

* Some basic rules:

(1) If $f(x) = c$ (c is a constant)

$\Rightarrow f'(x) = 0$

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

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

$\Rightarrow f'(x) = 1$

(3) If $f(x) = x^n$ (power function) (Power rule)

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

Example: Find $f'(x)$.

① $f(x) = 2025$

$\Rightarrow f'(x) = 0$

② $f(x) = x^{10}$

$\Rightarrow f'(x) = 10\, x^{10-1} = 10\, x^{9}$

③ $f(x) = x^{50}$

$\Rightarrow f'(x) = 50 \cdot x^{50-1} = 50\, x^{49}$

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 $f(x) = \sqrt[3]{x} = x^{1/3}$

$\Rightarrow f'(x) = \frac{1}{3}\, x^{1/3-1} = \boxed{\frac{1}{3}\, x^{-2/3}}$

⑥ $f(x) = \frac{1}{x^{100}} = x^{-100}$

$\Rightarrow f'(x) = -100 \cdot x^{-100-1} = \boxed{-100\, x^{-101}}$

⑦ $f(x) = \frac{1}{x^1} = x^{-1}$

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

Assignment Find $f'(x)$

① $f(x) = 1000$

② $f(x) = x$

③ $f(x) = x^3$

④ $f(x) = x^7$

⑤ $f(x) = \sqrt[4]{x}$

⑥ $f(x) = \frac{1}{x^2}$

⑦ $f(x) = x^{2025}$