Power Rule In Derivatives

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

$f(x) = x^2$

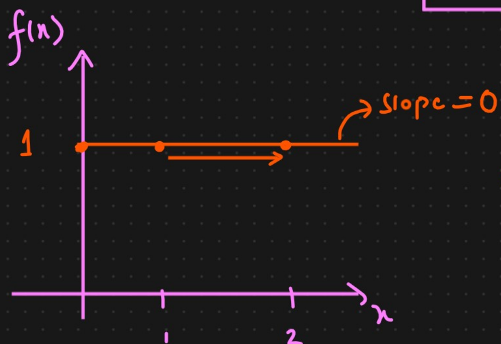
$f'(x) = 2x$

$f(x) = x^2 + 3$ $\quad$ $f(x) = x^3$ $\quad$ $f(x) = x^2 + 2x + 1$ $\Rightarrow$ polynomial Equation

$f(x) = x^n$, $n \neq 0$

if $n = 0$ $\quad$ $f(x) = x^0 = \underline{1}$ $\Rightarrow$ constant value

$$\boxed{f'(x) = 0}$$



$\Rightarrow$ $f(x) = c$

$$\boxed{f'(x) = 0}$$

$\boxed{\text{Derivative of Constant} = 0}$

$f(x) = x^n$ where $n \neq 0$

$$\boxed{f'(x) = n x^{n-1}}$$ $\Rightarrow$ Power Rule polynomial expression

$\Downarrow$

$$\frac{\partial(f(x))}{\partial x} = n x^{n-1} \Rightarrow \boxed{\frac{\partial(x^n)}{\partial x} = n x^{n-1}}$$

$n \neq 0$

at $x = 2$ $\quad$ $\frac{\partial(x^3)}{\partial x} = 3 \cdot x^{3-1} = 3x^2$

$= 3 \times (2)^2 = 3 \times 4 = 12$ //.

at $x=5$ $\quad \frac{\partial(3x^2)}{\partial x} = 3\frac{\partial(x^2)}{\partial x} = 3\times 2x^{2-1} \Rightarrow 6x \Rightarrow 6\times 5 = 30$ //.

x^n

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

Assignment

$f(x) = x^8 \quad \Rightarrow f'(x)$?

$f(x) = x^{-1} \quad \Rightarrow f'(x)$ at $x = -1$ //.

⊛ Derivative Rules: Constant, Sum, difference And Constant Multiple

$\frac{\partial(x^n)}{\partial x} = nx^{n-1}, \; n \neq 0$ {Power Rule} ⇒ polynomial

$\frac{\partial}{\partial x}(x^0) = \frac{\partial}{\partial x}[1] = 0$ ⇒ Derivative of a constant is 0.

$\frac{\partial}{\partial x}[\overset{\text{Constant}}{c}] = 0$

$$\frac{\partial[c\,f(x)]}{\partial x} = c\frac{\partial(f(x))}{\partial x} = c\,f'(x)$$

$$\frac{\partial(3x^4)}{\partial x} = 3\frac{\partial(x^4)}{\partial x} = 3\times 4x^{4-1} = 3\times 4x^3 = 12x^3$$

at $x=2$ $\quad \frac{\partial(3x^4)}{\partial x} = 12\times 2^3 = 12\times 8 = 96$ //.

Assignment

$$\frac{\partial[A\,f(x)]}{\partial x} = \frac{\partial[2x^5]}{\partial x}$$

⊛ Sum of 2 function $f(x), g(x)$

$$\frac{\partial}{\partial x}[f(x)+g(x)] \Rightarrow \frac{\partial(f(x))}{\partial x} + \frac{\partial(g(x))}{\partial x}$$

$$\frac{\partial}{\partial x}[x^4 + x^{-2}] = \frac{\partial(x^4)}{\partial x} + \frac{\partial(x^{-2})}{\partial x}$$

$$= 4x^3 + (-2x)$$

$$\boxed{\frac{\partial[x^4 + x^{-2}]}{\partial x} = 4x^3 - 2x}$$

Assignment

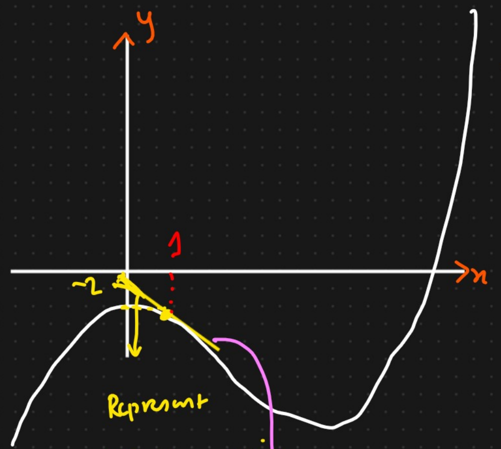
$$\frac{\partial(x^2+2)}{\partial x}$$

Answer $f'(x) = 2x$.

⊛ $$\frac{\partial}{\partial x}(\underbrace{4x^3 - 6x^2 + 2x + 100}_{f'(x)}) \Rightarrow 12x^2 - 12x + 2 + 0$$

$$\Rightarrow \boxed{12x^2 - 12x + 2}$$

Tangent of polynomials



Represent this line using some equation

$$\rightarrow f(x) = x^3 - 6x^2 + x - 7$$

$$y = f(1) = 1 - 6 + 1 - 7 = -11$$

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

$$= 2x^2 - 12x + 1 - 0$$

$$f'(x) = 2x^2 - 12x + 1$$

$$f'(1) = 2 \times (1) - 12 + 1$$

$$= 2 - 12 + 1 = \boxed{-9.} \Rightarrow \text{slope.}$$

$$y = mx + c$$

$$y = -9(x) + c$$

for $x = 1$

$$-11 = -9 + c$$

$$\boxed{c = -11 + 9} \Rightarrow \boxed{c = -2}$$

$$y = mx + c$$

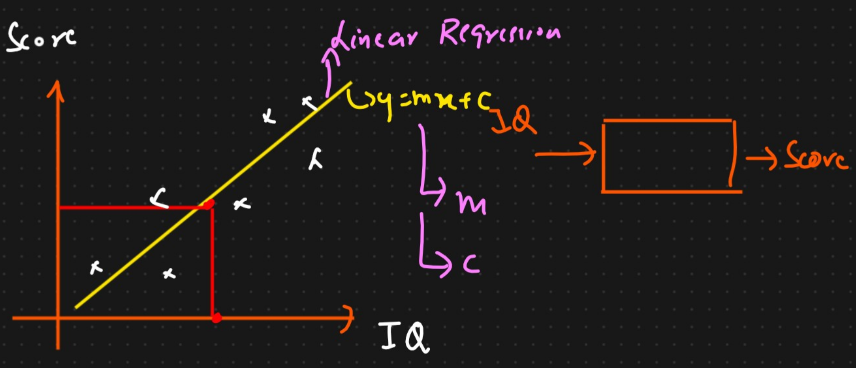
$$\boxed{y = -9x - 2}$$

$m = -9 \Rightarrow$ slope

$c = -2 \Rightarrow$ intercept

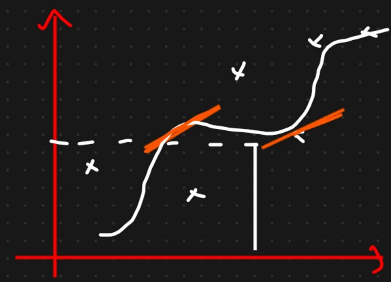
IQ Dataset

IQ	Score
100	98
90	97



85 90

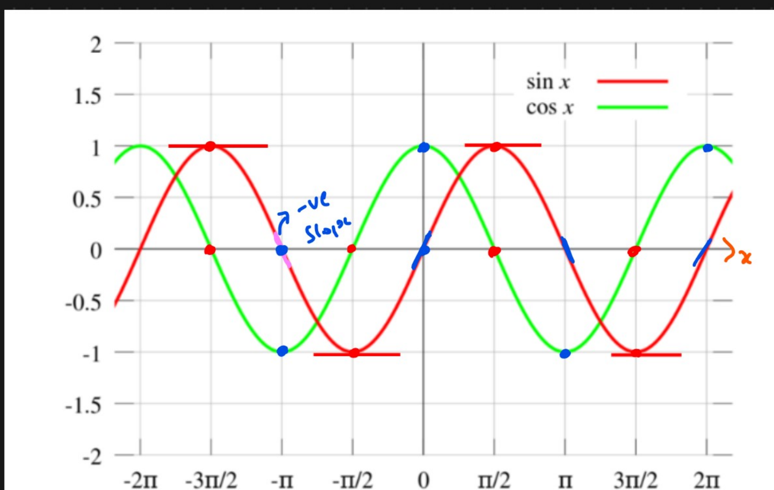
{ Optimization ⇐



⇒ Chain Rule

④ Derivatives for Trignometric, Logarithmic and Exponential function

Trignometric function



$f(x) = \sin x$

$f'(\sin x) = \cos x$

$f(x) = \cos x$

$f'(\cos x) = \sin x$

Logarithmic function

$f(x) = \ln(x)$ then

$$\boxed{f'(x) = \frac{1}{x}}$$

Exponential Function

$f(x) = e^x$

$$\boxed{f'(x) = e^x}$$

Costant

if $f(x) = c$

then $\boxed{f'(x) = 0}$

Power Rule

if $f(x) = x^n$

$$\boxed{f'(x) = nx^{n-1}}$$