IF WE WANT TO.. → DIFFERENTIATE (FIND THE DERIVATIVE), → THEN WE MUST TO: →

① SUBTRACT (FIND $x - x_0 = \Delta x$) THEN AND $t - t_0 = \Delta t$,

② DIVIDE $\frac{\Delta x}{\Delta t}$, AND FINALLY..

③ FIND THE LIMIT OF THE OBTAINED → $\boxed{\text{RATIO}}$: $\lim\limits_{\Delta t \to 0} \underbrace{\frac{\Delta x}{\Delta t}} = \frac{dx}{dt}$ ← DIFFERENTIALS

FINITE TIME INTERVAL

INFINITELY SMALL TIME INTERVAL

WE ARE APPLYING THE OPERATOR OF TIME DERIVATIVE $\frac{d}{dt}$ TO THE COORDINATE $x(t)$

IN THE PROCESS IN WHICH Δt DECREASES TO ZERO..

IF WE WANT TO.. → INTEGRATE (FIND THE INTEGRAL), → THEN WE MUST TO: →

① MULTIPLY [FIND $v(t) \cdot \Delta t$]

THEN

② ADD $\sum\limits_{i=0}^{n} v(t_i) \cdot \Delta t$

OR

FIND THE SUM

③ FIND THE LIMIT OF THE OBTAINED → $\boxed{\text{SUM}}$: $\lim\limits_{\substack{\Delta t \to 0 \\ n \to \infty}} \sum\limits_{i=0}^{n} \overbrace{v(t_i) \cdot \boxed{\Delta t}}^{\text{PRODUCTS}} = \int_0^{t'} v(t)\, dt$

THE SUM OF PRODUCTS

FIXED VALUE OF t = UPPER LIMIT OF THE INTEGRATION

FINITE

LOWER LIMIT

INFINITELY SMALL TIME INTERVAL

INTEGRATION IS THE SAME AS ADDITION BUT THE ADDITION OF ENDLESS NUMBER OF PRODUCTS THAT ARE INFINITELY SMALL.

$\frac{d}{dt}$ "COORDINATE" = "VELOCITY" OF THE CHANGE OF THIS "COORDINATE"

$\int_0^{t'}$ "VELOCITY" $\cdot\, dt$ = CHANGE OF THE "COORDINATE" DURING THE TIME "INTERVAL"

$\Delta t = t' - 0$

UPPER LOWER LIMITS OF THE INT.

WE ARE APPLYING THE OPERATOR OF THE DEFINED INTEGRAL OVER THE TIME t $\int_0^{t'} \left[\ \ \right] \cdot dt$ TO THE VELOCITY $v(t)$

$$v = \underbrace{v_0}_{\text{CONSTANT}} + at \xrightarrow[\text{GIVES}]{\text{DIFFERENTIATION}} a$$

$$x = \underbrace{x_0}_{x_0 \cdot t^0} + v_0 t^1 + \frac{at^2}{2} \xrightarrow[\text{GIVES}]{\text{DIFF.}} \underbrace{v_0}_{v_0 t^0} + \underbrace{at}$$

BY THE DIFFERENTIATION THE EXPONENT DECREASES BY 1 AND THE NEW POWER FUNCTION SHOULD BE MULTIPLIED BY OLD EXPONENT

$$\frac{d}{dt}\left(t^2\right) = 2t^1 \qquad \frac{a}{2} \cdot 2t^1 = \underbrace{at}$$

$$\frac{d}{dt}\left(v_0 t^1\right) = v_0 \underbrace{t^0}_{1} = v_0$$

THE COMMON RULE:

$$\frac{d}{dx}\left[\underbrace{c}_{\text{CONSTANT}} x^n\right] = c \cdot n x^{n-1} \quad \bigstar$$

FIXED VALUE x!

$$\int_0^x c x^n \, dx = c \cdot \frac{x^{n+1}}{n+1} - 0$$

$$\boxed{c \cdot \frac{0^{n+1}}{n+1}}$$

BY THE INTEGRATION THE EXPONENT INCREASES BY 1 AND THE NEW POWER FUNCTION SHOULD BE DIVIDED BY THE NEW EXPONENT

CHECK:

ACCORDING TO ★

$$\frac{d}{dx}\left[c \frac{x^{n+1}}{n+1}\right] = c\,\cancel{(n+1)} \frac{x^{(n+1)-1}}{\cancel{n+1}} = c \cdot x^n$$

THE SAME

OK!

WE GET THE INITIAL FORM OF THE FUNCTION [...]