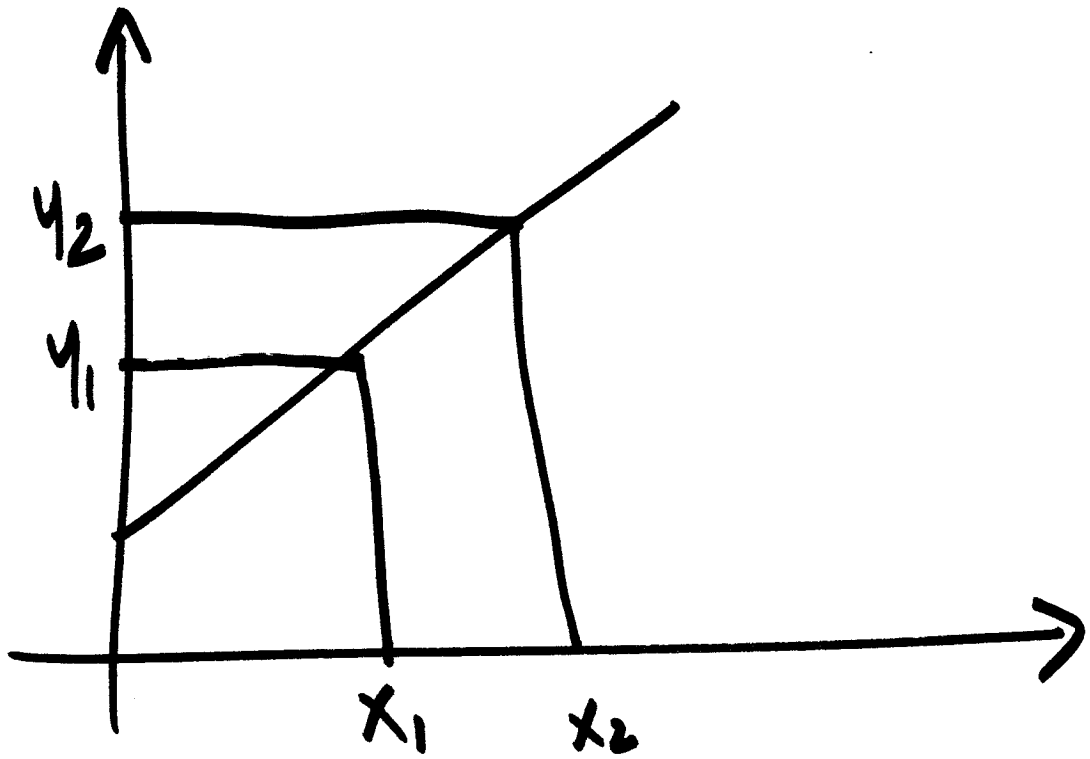
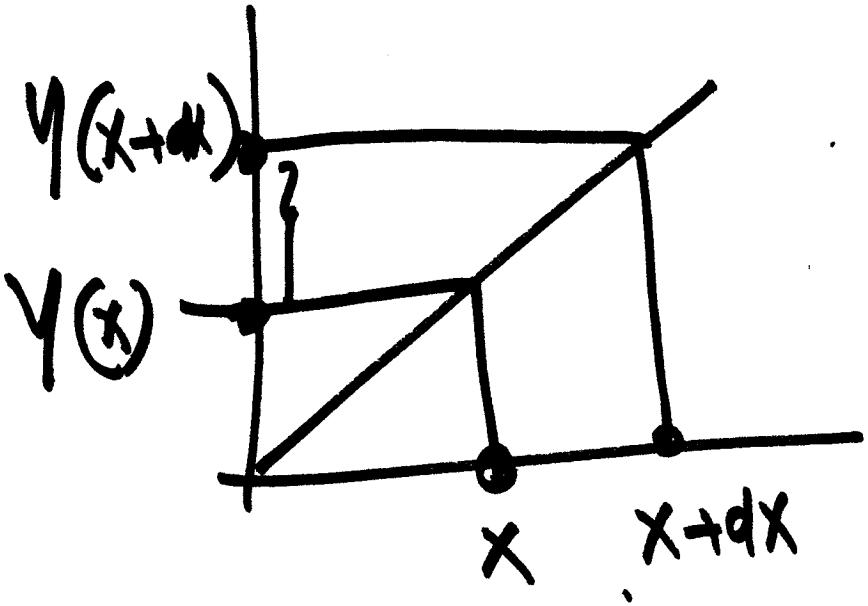


$$\frac{dy}{dx} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{y(x_2) - y(x_1)}{x_2 - x_1}$$

$$\frac{dy}{dx} = \frac{y(x_2) - y(x_1)}{x_2 - x_1} \qquad (2)$$

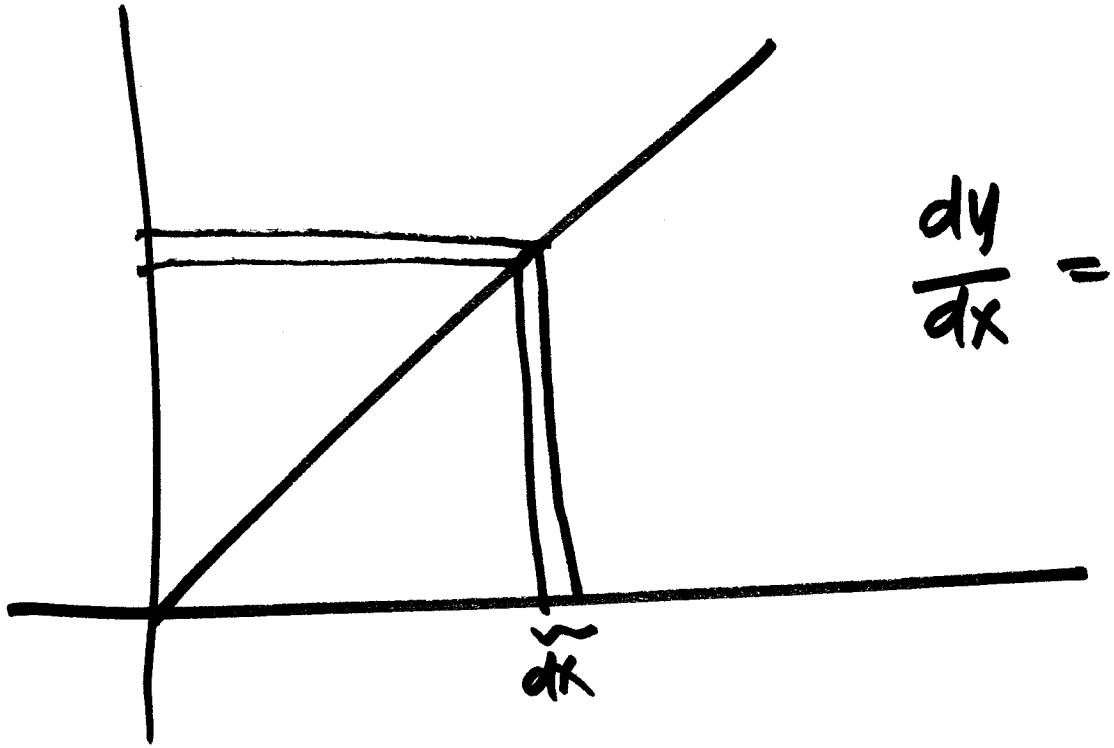
Let me call $x_2 - x_1 = dx$



$$\frac{dy}{dx} = \frac{y(x+dx) - y(x)}{(x+dx) - x}$$

$$\frac{dy}{dx} = \frac{y(x+dx) - y(x)}{dx}$$ when dx is small

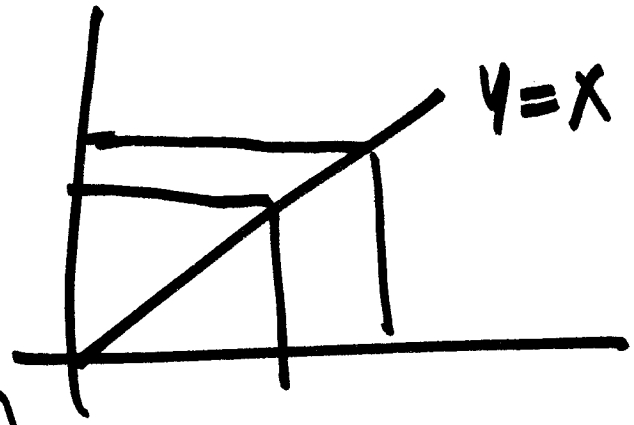
$$\frac{dy}{dx} = \lim_{dx \to 0} \frac{Y(x+dx) - Y(x)}{dx}$$



$\frac{dy}{dx}$ = slope = derivative

$n = 1$

$y = x^n \Rightarrow x$ for $n = 1$



$$\frac{dy}{dx} = \frac{dx}{dx} = 1$$

$$\boxed{\frac{d}{dx} x^n = n x^{n-1}}$$

When $n=1 \Rightarrow n x^{n-1} = 1 x^{1-1} = 1 x^0$

$= 1$

$$y = x^2$$

$$\frac{dy}{dx} = n x^{n-1}$$

$\underline{\underline{n=2}}$

$$\frac{dy}{dx} = 2x^{2-1} = 2x^1 = 2x$$

$$\boxed{\frac{d}{dx}(x^2) = 2x}$$

$$n = 3$$

$$y = x^3$$

$$\frac{dy}{dx} = n x^{n-1}$$

$$= 3 x^{3-1}$$

$$= 3x^2$$

$$\boxed{\frac{d}{dx} x^3 = 3x^2}$$

$n = 0$

$y = x^0$

$y = 1$

$\frac{dy}{dx} = n x^{n-1} = 0 ( )$

$= 0$

$\frac{d\,k}{dx} = 0$, where k = any constant

$$y = kx^n$$

$$\frac{dy}{dx} = k\boxed{\frac{d}{dx}x^n}$$

$$= knx^{n-1}$$

$$y = kx^n$$

$$\frac{dy}{dx} = k\,n\,x^{n-1}$$

$$y = \underbrace{x^2}_{f(x)} + \underbrace{x^7}_{g(x)}$$

$$\frac{dy}{dx} = \left(\frac{dx^2}{dx}\right) + \left(\frac{dx^7}{dx}\right)$$

Rule 1: $$\frac{d}{dx} x^n = n x^{n-1}$$

Rule 2: $$\frac{d}{dx}\left[x^7 + x^9\right] = \underbrace{\frac{dx^7}{dx}} + \underbrace{\frac{dx^9}{dx}}$$

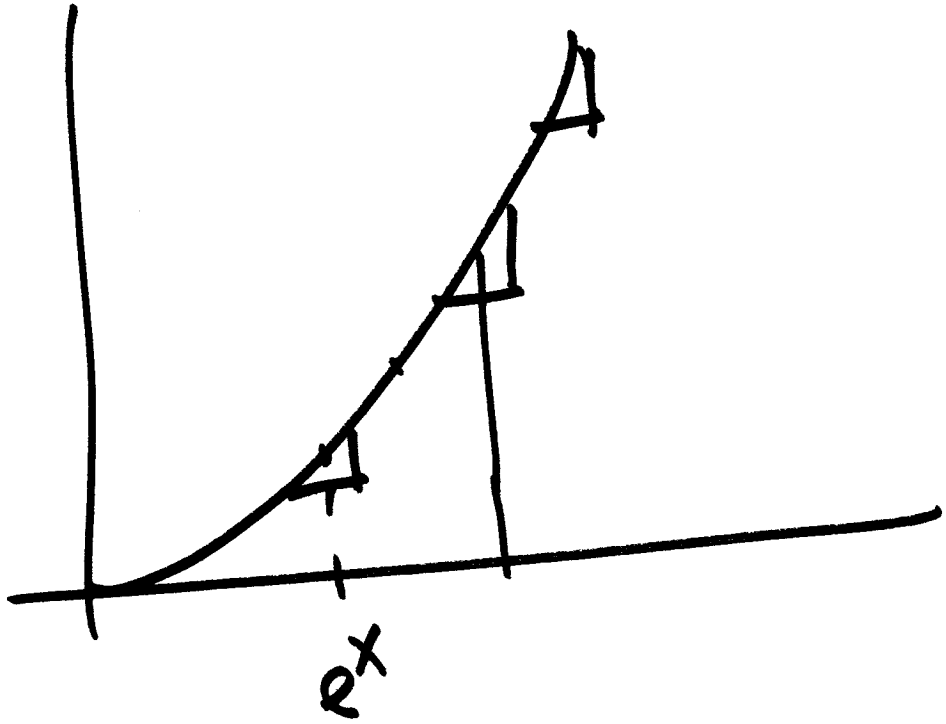
: Derivative of sum of two functions is equal to ~~the~~ sum of their derivatives

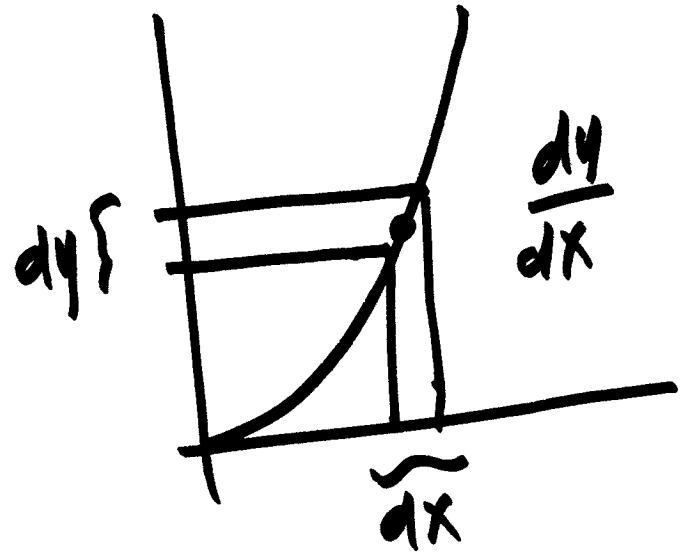
$$e^x = 1 + x + \frac{x^2}{2} + \frac{x^3}{2\times3} + \frac{x^4}{2\times3\times4} + \cdots$$

$$\frac{d}{dx}(e^x) = 0 + 1 + \frac{1}{2}2x + \frac{3x^2}{2\times3} + \frac{4x^3}{2\times3\times4} \cdots \quad \left| \frac{d}{dx}x^n = n\times n^{-1} \right.$$

$$= 1 + x + \frac{x^2}{2} + \frac{x^3}{2\times3} + \cdots$$

$$\frac{d}{dx}x^n = n x^{n-1} \quad \left| \quad \frac{d}{dx}e^x = e^x \right.$$


e^x


dy
$\frac{dy}{dx}$
$\widetilde{dx}$

$$e^{-x} = 1 - x + \frac{x^2}{2} - \frac{x^3}{2\cdot 3} + \frac{x^4}{2\cdot 3\cdot 4} - \frac{x^5}{120}$$

$$\frac{d}{dx}\left(e^{-x}\right) = 0 - 1 + \frac{2x}{2} - \frac{3x^2}{2\cdot 3} + \frac{4x^3}{2\cdot 3\cdot 4} + \cdots$$

$$= -1 + x - \frac{x^2}{2} + \frac{x^3}{2\cdot 3} + \cdots$$

$$\frac{d}{dx}e^{-x} = -e^{-x}$$

$$y = e^{kx}$$

$$\frac{dy}{dx} = ke^{kx}$$

$$\frac{d}{dx}e^{2x} = 2e^{2x}$$