

Chap 3 Differentiation

(1)

$$* f'(x_0) = \lim_{h \rightarrow 0} \frac{f(x_0+h) - f(x_0)}{h}$$

* If f is diff at $x=c$ Then f is cont at $x=c$

• Diff Rules :-

$$1- (f(x) \pm g(x))' = f'(x) \pm g'(x)$$

$$2- (f(x) \cdot g(x))' = f(x)g'(x) + g(x)f'(x)$$

$$3- \left(\frac{f(x)}{g(x)}\right)' = \frac{g(x)f'(x) - g'(x)f(x)}{[g(x)]^2} \quad g(x) \neq 0$$

$$4- (f \circ g)'(x) = f'(g(x)) \times g'(x)$$

$$\boxed{4} (f \circ g)'(x) = f'(g(x)) \times g'(x)$$

• Derivative & Trigonometric

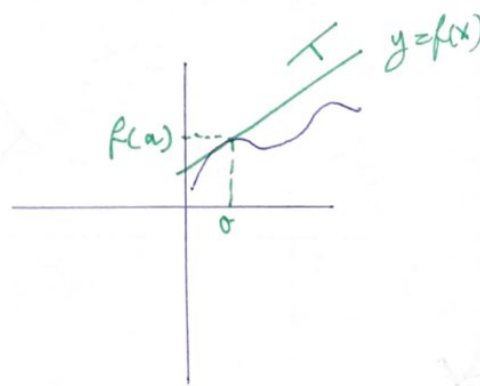
- $(\sin x)' = \cos x$
- $(\cos x)' = -\sin x$
- $(\tan x)' = \sec^2 x$
- $(\cot x)' = -\csc^2 x$
- $(\sec x)' = \sec x \tan x$
- $(\csc x)' = -\csc x \cot x$

Tangent & Normal

• Tangent

$$y - y_0 = m(x - x_0)$$

$$(x_0, y_0) = (a, f(a)) / m = f'(a)$$



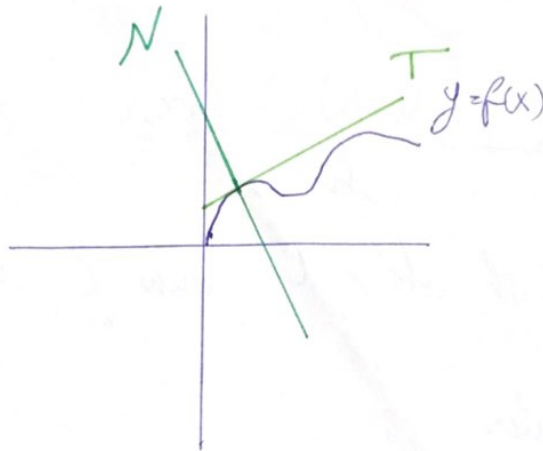
Normal

$$y - y_0 = n(x - x_0)$$

$$(x_0, y_0) = (a, f(a))$$

$$n = \frac{-1}{m}$$

$$mn = -1$$



Implicit differentiation

$\frac{dy}{dx} \rightarrow$ dependant on x so we diff \rightarrow respect to x
 $\frac{dx}{dx} \rightarrow$ Independent

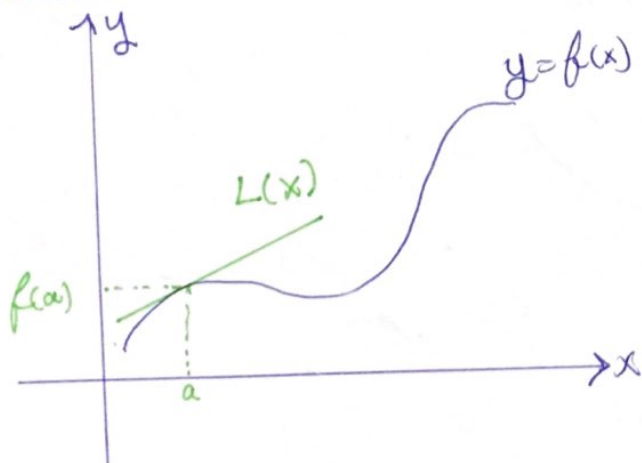
linearization

If f is diff function at $x=a$
 Then The linearization of f at $x=a$ is

linearization

If f is diff function at $x=a$
 Then The linearization of f at $x=a$ is defined by:-

$$L(x) = f(a) + f'(a)(x-a)$$



خط L هو تقريب
 (النقطة القريبة من a) $L(x)$ approximate $f(a)$ near
 by $x=a$
 (Prove) i-
 $y - y_0 = m(x - x_0)$
 $(x_0, y_0) = (a, f(a))$
 $f'(a) = m$
 $y - f(a) = f'(a)(x - a)$
 $y = f'(a)(x - a) + f(a)$
 #

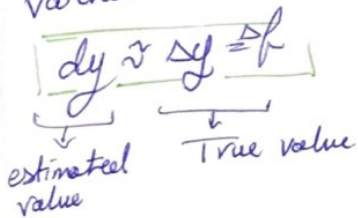
$L(x)$ is the standard linear approximation of $f(x)$ near $x=a$

* if $y=f(x)$ is diff at $x=a$ Then $\frac{dy}{dx} = f'(x) \Big|_{x=a} = f'(a)$

$\rightarrow dy = f'(a) dx$

• dependant variable

• Independent variable
 $dx = \Delta x$



$\Delta L \approx \Delta y$

• result: we use the differential dy to estimate the true change Δy

Error = $|T - E|$

