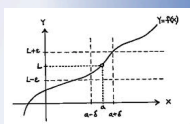
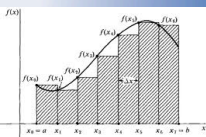


13 Higher Order Derivatives



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

$$\frac{d}{dx} \int_a^x f(t) dt = f(x)$$



$$\lim_{\max \Delta x_i \rightarrow 0} \sum_{i=1}^n f(x_i) \Delta x_i = \int_a^b f(x) dx$$

$$\int_a^b f(x) dx = F(b) - F(a)$$

Higher Order Derivatives

$$f'(x), f''(x), f'''(x), f^{iv}(x)$$

$$\frac{dy}{dx}, \frac{d^2y}{dx^2}, \frac{d^3y}{dx^3}, \frac{d^4y}{dx^4}$$

$$y', y'', y''', y^{(4)}$$

$$D_x(y), D_x^2(y), D_x^3(y), D_x^4(y)$$

Note that $\frac{d^2y}{dx^2} = \frac{d}{dx} \left(\frac{dy}{dx} \right)$ or $\frac{dy'}{dx}$

Higher Order Derivatives

Derivative	f' notation	y' notation	D_x notation	Leibniz notation
First				
Second				
Third				
Fourth				
Fifth				
n^{th}				

EX 1 Find $f'''(x)$ for $f(x) = (3-5x)^5$

13 Higher Order Derivatives

Ex 2 Find $\frac{dy}{dx}$ for $y = \sin\left(\frac{\pi}{x}\right)$.

Ex 3 What is $D_x^5(3x^4 - 2x^3 + x^2 - 4)$?

Ex 4 Find a formula for $D_x^n\left(\frac{1}{x}\right)$.

We know $v(t) = s'(t)$
 $a(t) = v'(t) = s''(t)$

EX 5 An object moves along a horizontal coordinate line according to $s(t) = t^3 - 6t^2$.
 s is the directed distance from the origin (in ft.) t is the time (in seconds.)

- What are $v(t)$ and $a(t)$?
- When is the object moving to the right?
- When is it moving to the left?
- When is its acceleration negative?
- Draw a schematic diagram that shows the motion of the object.

13 Higher Order Derivatives

$$f'(x), f''(x), f'''(x), f^{iv}(x)$$

$$\frac{dy}{dx}, \frac{d^2y}{dx^2}, \frac{d^3y}{dx^3}, \frac{d^4y}{dx^4}$$

$$y', y'', y''', y^{(4)}$$

$$D_x(y), D_x^2(y), D_x^3(y), D_x^4(y)$$

$$\text{Note that } \frac{d^2y}{dx^2} = \frac{d}{dx} \left(\frac{dy}{dx} \right) \text{ or } \frac{dy'}{dx}$$