

Learning outcomes

After completing this section, you will inshaAllah be able to

1. explain the **definition of derivative** of a function
2. find **derivatives using definition**

- In the last section we saw that the derivative of $f(x)$ at a point ' a ' is given by

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

- Now we study the **concept of derivative of $f(x)$ at any point x as a function.**

Derivative of a function

The derivative of $f(x)$ is defined by

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

if the limit exists.

- Another notation: $\frac{dy}{dx}$
- $f'(a)$ means derivative at the point a

See examples 1, 2, 3 done in class

Geometric interpretation of derivative

See class explanation

Checking differentiability graphically

See class explanation

See example 4 done in class

Left/Right derivative of a function Existence of a derivative

The **left derivative of $f(x)$** is defined by

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

The **right derivative of $f(x)$** is defined by

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

See explanation given
above for geometric
interpretation of
derivative

The derivative $f'(a)$ exists if the left
and right derivatives are same.

i.e. the function will surely be not
differentiable at a point where it is
discontinuous

Also note the fact that
“if a function is
differentiable at a
point then it is
continuous at that
point”

- The next example uses all of these ideas.

See example 5 done in class