Section 2.8 *Derivatives*

Section 2.9 *The derivative as a function*

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 rate of change of *f(x)* at a point *'x'* is given by

$$\boxed{m=\lim_{h\to 0}\frac{f(a+h)-f(a)}{h}}$$

- Therefore such limits become very important.
- The study of important limit of above type leads to the concept of derivative, which we study here.

Derivative of a function

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

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

if the limit exists.

- Another notation: $\dfrac{dy}{dx}$
- $f'(a)$ 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

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

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

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

See explanation given above for geometric interpretation of derivative

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

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

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

- The next example uses all of these ideas.

See example 5 done in class

End of 2.8, 2.9