GRADE 12

Calculus – First Principles

WEBSITE NOTES

TOPIC:

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

- First principles.

Example 1

To differentiate from first principles (definition) use the formula below

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

Determine $f'(x)$ from first principles if $f(x) = -3x^2$

$f(x+h) = -3(x+h)^2$

$= -3(x^2 + 2xh + h^2)$

$= -3x^2 - 6xh - 3h^2$ to get $f(x+h)$ we replace x with $x+h$ and get

$-3(x+h)^2$

Expand the brackets and Make sure you multiply the –3 with each term in the brackets

Substituting into $f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$ the definition of the derivative gives

$$f'(x) = \lim_{h \to 0} \frac{-3x^2 - 6xh - 3h^2 - (-3x^2)}{h}$$ $f(x) = -3x^2$ so

$$= \lim_{h \to 0} \frac{-3x^2 - 6xh - 3h^2 + 3x^2}{h}$$

Take out a common factor of h so you can cancel it with the h in the denominator.

As h goes to 0, $-6x - 3h$ goes to $-6x$.

$$= \lim_{h \to 0} \frac{h(-6x - 3h)}{h}$$

$$= \lim_{h \to 0} (-6x - 3h)$$

$$= -6x$$

You can always expect a question to determine the derivative (f'(x)) using first principles

Example 2 (Try Yourself)

1.	Determine $f'(x)$ from first principles if $f(x) = 5x^2 - 4x + 2$	(6)
2.	Determine $f'(x)$ from first principles if $f(x) = \frac{2}{x}$	(6)
		[12]