Using a definition of the derivative to find slope

A) Find the slope of $f(x) = x^2$ at the point (3,9)

B) Find the slope of $f(x) = \frac{2}{x}$ at x = 4

C) Find the slope of $f(x) = \frac{1}{x-4}$ at x = 7

$\left(7, \frac{1}{3}\right)$; a ; $f(a)$

$$\lim_{x \to a} \frac{f(x) - f(a)}{x - a}$$

$$f'(7) = \lim_{x \to 7} \frac{\frac{(3)}{(3)}\frac{1}{x-4} - \frac{1}{3}(x-4)}{x-7}$$

$$\lim_{x \to 7} \frac{\left(\frac{3 - (x-4)}{3(x-4)}\right)}{x-7} = \frac{3 - x + 4}{3(x-4)} = \frac{\left(\frac{7-x}{3(x-4)}\right)}{\left(\frac{x-7}{1}\right)}$$

$$f'(7) = -\frac{1}{9}$$

D) Find the slope of f(x) = 9 - x² at the point (-3,0)

a ; $f(a)$

$$f'(-3) = \lim_{x \to -3} \frac{9 - x^2 - 0}{x+3}$$

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

$$f'(-3) = 6$$

$$\lim_{x \to 7} \frac{(7-x)\cdot -1}{3(x-4)(x-7)}$$

$$\lim_{x \to 7} \frac{-1}{3(x-4)}$$

What you'll Learn About

- Definition of the derivative
- Notation

Use the substitution $h = x - a$ to create the definition of the derivative

A$_1$) Set-up a formula for the slope of $f(x) = x^2$ at $x = -1$

$$f'(-1) = \lim_{x \to -1} \frac{x^2 - 1}{x + 1} \longrightarrow \lim_{h \to 0} \frac{(h-1)^2 - 1}{h} = \frac{\Delta y}{\Delta x}$$

$h = x - a$, $h = x + 1$, $h - 1 = x$

$h - 1 \to -1$ ($+1$ $+1$), $h \to 0$

A$_2$) Use the substitution $h = x - a$ to set-up the definition of the derivative

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

B$_1$) Set-up a formula for the slope of $f(x) = \frac{1}{x-2}$ at $x = 4$ $\left(4, \frac{1}{2}\right)$

$$\lim_{x \to a} \frac{f(x) - f(a)}{x - a}$$

$$\lim_{x \to 4} \frac{\frac{1}{x-2} - \frac{1}{2}}{x - 4}$$

$\Delta x = h = x - a$

B$_2$) Use the substitution $h = x - a$ to set-up the definition of the derivative

$h = x - a$, $h = x - 4$, $h + 4 = x$

$$\lim_{h \to 0} \frac{\frac{1}{(h+4) - 2} - \frac{1}{2}}{h} = \frac{\frac{1}{h+2} - \frac{1}{2}}{h}$$

Given a definition of the derivative(slope) find the function that you are

	taking the derivative of and the point you are finding the derivative(slope) at A) $\lim_{x\to 4}\frac{\sqrt{x}-2}{x-4}$ B) $\lim_{x\to 2}\frac{\ln x-\ln 2}{x-2}$ C) $\lim_{h\to 0}\frac{(2+h)^3-8}{h}$ D) $\lim_{h\to 0}\frac{\frac{2}{3+h}-\frac{2}{3}}{h}$ Another Definition: $\lim_{h\to 0}\frac{f(x+h)-f(x-h)}{2h}$