

Warm Up

1.  $\lim_{x \rightarrow 4} \left( \frac{x^2 - 9x + 20}{x - 4} \right)$

2. Discuss the continuity of each function

a)  $y = \frac{x+1}{x^2-4x+3}$

b)  $f(x) = \begin{cases} 3-x, & x < 2 \\ \frac{x}{2} + 1, & x > 2 \end{cases}$

3. Find the asymptotes of 2.a above

Average Rate of Change

Find the average rate of change of

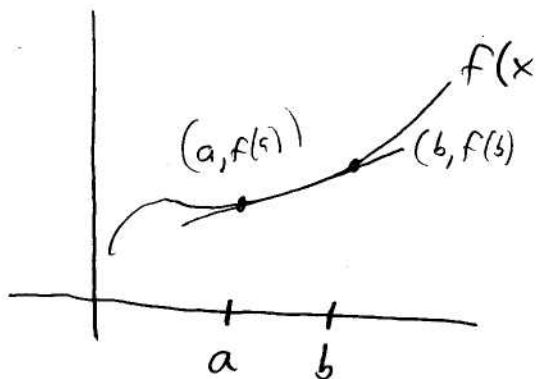
$f(x) = x^2 - 3x$  over the interval  $[3, 5]$ .

$$\text{Avg change} = \frac{\Delta Y}{\Delta X} = \frac{f(5) - f(3)}{5 - 3} = \frac{10 - 0}{2}$$

$$f(3) = 0$$

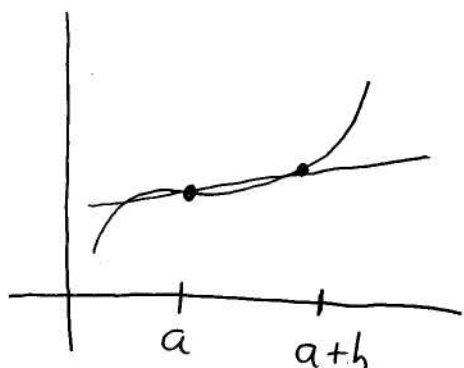
$$f(5) = 25 - 15 = 10$$

Slope of a tangent line from a secant



Slope of secant line

$$\text{Slope} = \frac{f(b) - f(a)}{b - a}$$



$$\text{slope} = \frac{f(a+h) - f(a)}{(a+h) - a}$$

$$\text{Slope} = \frac{f(a+h) - f(a)}{h}$$

If we make  $h$  very small our secant starts to look more like a tangent line

$$\text{Slope of tangent line} = \lim_{h \rightarrow 0} \frac{f(a+h) - f(a)}{h}$$

Find the slope of the line tangent to  $g(x) = x^2 - 2x$  at  $x = 3$

$$\text{Slope} = \lim_{h \rightarrow 0} \frac{g(3+h) - g(3)}{h}$$

$$\text{Slope} = \lim_{h \rightarrow 0} \frac{(3+h)^2 - 2(3+h) - (3^2 - 2(3))}{h}$$

$$= \lim_{h \rightarrow 0} \frac{\cancel{9} + 6h + h^2 - \cancel{6} - 2h - \cancel{9} + \cancel{6}}{h}$$

$$= \lim_{h \rightarrow 0} \frac{h^2 + 4h}{h} = \lim_{h \rightarrow 0} (h + 4) = \boxed{4}$$

### Normal Line

The line  $\perp$  to the tangent of a curve.

Ex

Find the eq. of the normal to  $y = x^2$  at  $x = 3$

$$\text{Slope of tangent} = \lim_{h \rightarrow 0} \frac{(3+h)^2 - 3^2}{h} =$$

$$\lim_{h \rightarrow 0} \frac{\cancel{9} + 6h + h^2 - \cancel{9}}{h} = 6$$

Slope of Normal line at  $x=3$  is  $-\frac{1}{6}$

point on curve :  $(3, 9)$

Eg of Normal

$$y - 9 = -\frac{1}{6}(x - 3)$$