Section 1.1
Limits and Graphs

Function Notation $f(x) = x^2 + 3x + 5$
f is the name of the function

f(x) indicates that x is the variable

f(x) is another name for y

f(2) means to plug in 2 for the variable x

$f(2) =$

f(2) is the y-value when x-value is 2

the point on the graph is

Limit Notation
$\rightarrow$ means approaches, gets closer to

$x \rightarrow 3$ means as x approaches 3

$x \rightarrow 3^+$ means as x approaches 3 from the _______________

$x \rightarrow 3^-$ means as x approaches 3 from the _______________

Definition
As x approaches a, the limit of f(x) is L written

If all values of f(x) are close to L for all values of x that are sufficiently close to a. The limit L, if it exists, must be a unique real number.

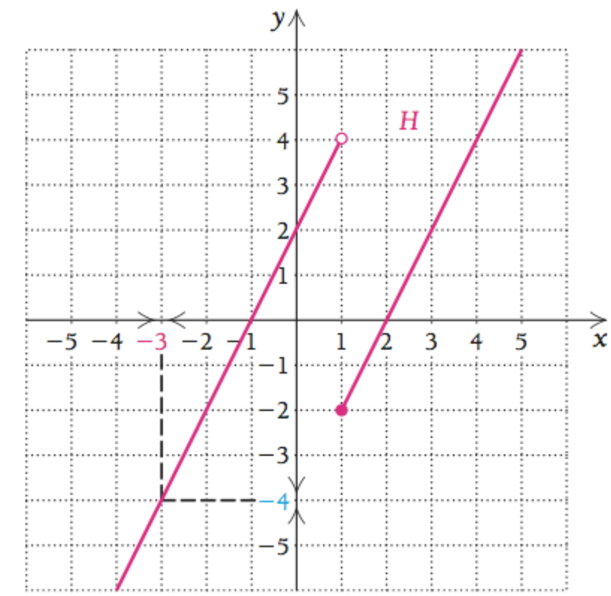
Theorem
As x approaches a, the limit of f(x) is L if the limit from the ____________________ exists and the limit from the _____________ exists and both numbers are equal.

If the right and left limits are not the same, THE limit________________________________

If f(x) is increasing without bound, limit is _______________.

If f(x) is decreasing without bound, limit is _______________.

Limits can also be used to describe behavior on the extreme ____________ and _______________ ends of graph.



Example 1:
Using the graph, find the following.

$f(-3)$

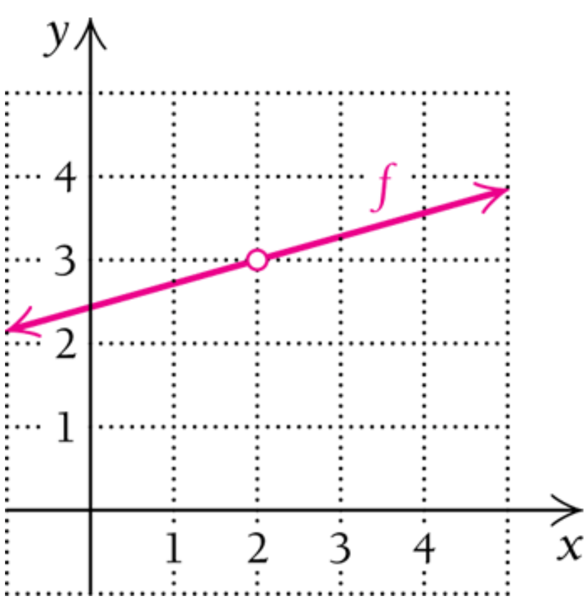
$f(0)$

$f(1)$

$\lim_{x\to 1^+} f(x)$

$\lim_{x\to 1^-} f(x)$

$\lim_{x\to 1} f(x)$



Example 2:
Using the graph, find the following.

$f(2)$

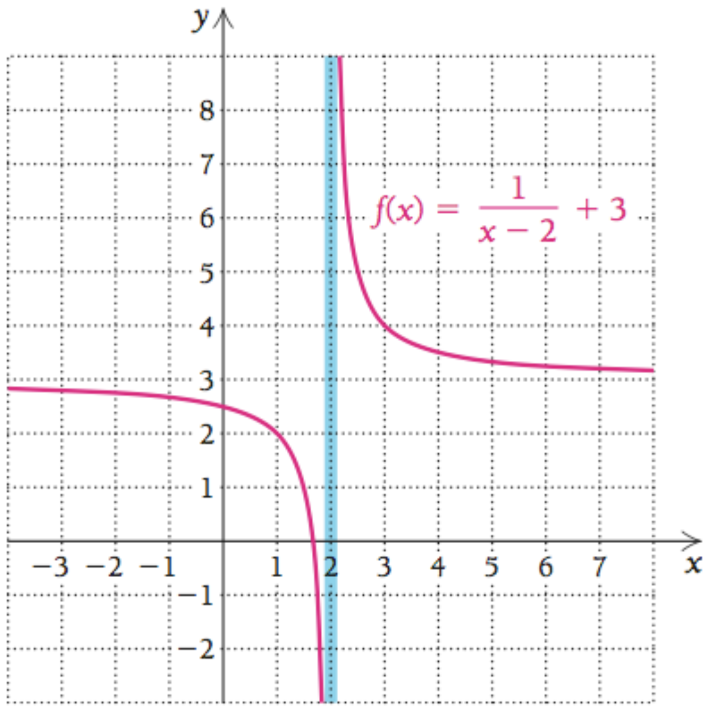
$\lim_{x\to 2^+} f(x)$

$\lim_{x\to 2^-} f(x)$

$\lim_{x\to 2} f(x)$

$\lim_{x\to -\infty} f(x)$

$\lim_{x\to +\infty} f(x)$



Example 3:
Using the graph, find the following.

$\lim_{x \to 3} f(x)$

$f(2)$

$\lim_{x \to 2^+} f(x)$

$\lim_{x \to 2^-} f(x)$

$\lim_{x \to 2} f(x)$

$\lim_{x \to -\infty} f(x)$

$\lim_{x \to \infty} f(x)$

Section 1.1
Limits and Graphs

Function Notation $f(x) = x^2 + 3x + 5$
f is the name of the function

f(x) indicates that x is the variable

f(x) is another name for y ☆

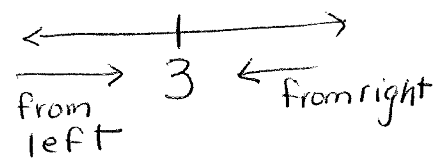
f(2) means to plug in 2 for the variable x

$f(2) = 2^2 + 3(2) + 5 = 4 + 6 + 5 = 15$

f(2) is the y-value when x-value is 2

the point on the graph is $(2, 15)$

Limit Notation
$\rightarrow$ means approaches, gets closer to



$x \rightarrow 3$ means as x approaches 3

$x \rightarrow 3^+$ means as x approaches 3 from the right

$x \rightarrow 3^-$ means as x approaches 3 from the left

Definition
As x approaches a, the limit of f(x) is L written $\lim_{x \to a} f(x) = L$

If all values of f(x) are close to L for all values of x that are sufficiently close to a. The limit L, if it exists, must be a unique real number.

Theorem
As x approaches a, the limit of f(x) is L if the limit from the left exists and the limit from the right exists and both numbers are equal.

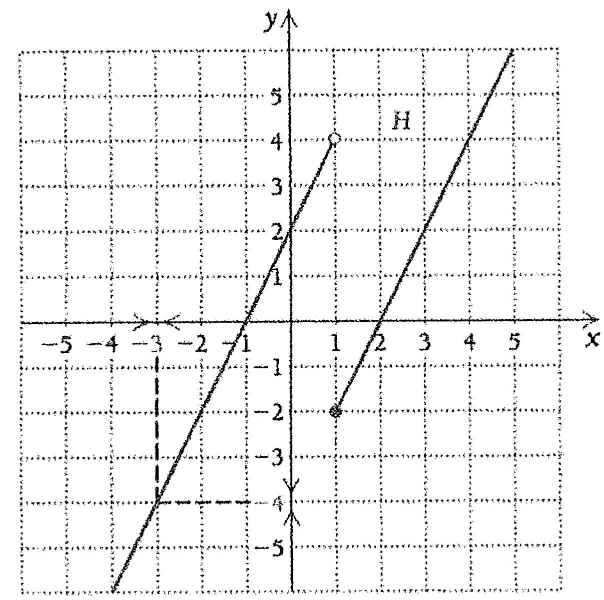
If the right and left limits are not the same, THE limit does not exist (DNE)

If f(x) is increasing without bound, limit is $+\infty$.

If f(x) is decreasing without bound, limit is $-\infty$.

Limits can also be used to describe behavior on the extreme left and right ends of graph.

$\lim_{x \to -\infty} f(x)$ $\lim_{x \to \infty} f(x)$



Example 1:
Using the graph, find the following.

$f(-3) = 4$

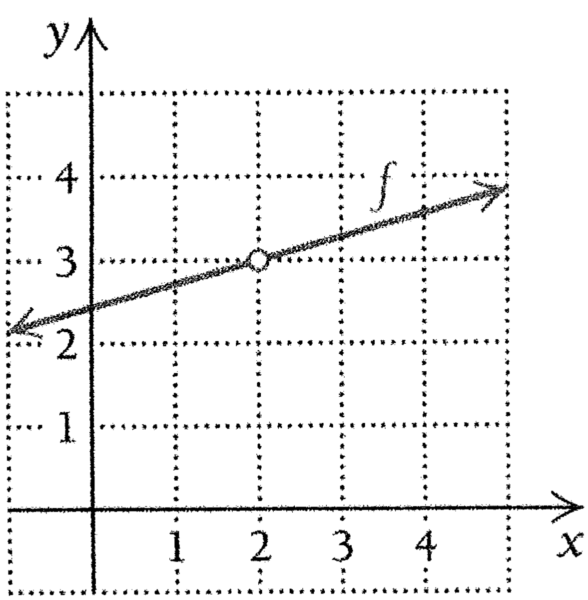
$f(0) = 2$

$f(1) = -2$

$\lim_{x \to 1^+} f(x) = -2$

$\lim_{x \to 1^-} f(x) = 4$

$\lim_{x \to 1} f(x)$ Does Not Exist



Example 2:
Using the graph, find the following.

$f(2)$ undefined

$\lim_{x \to 2^+} f(x) = 3$

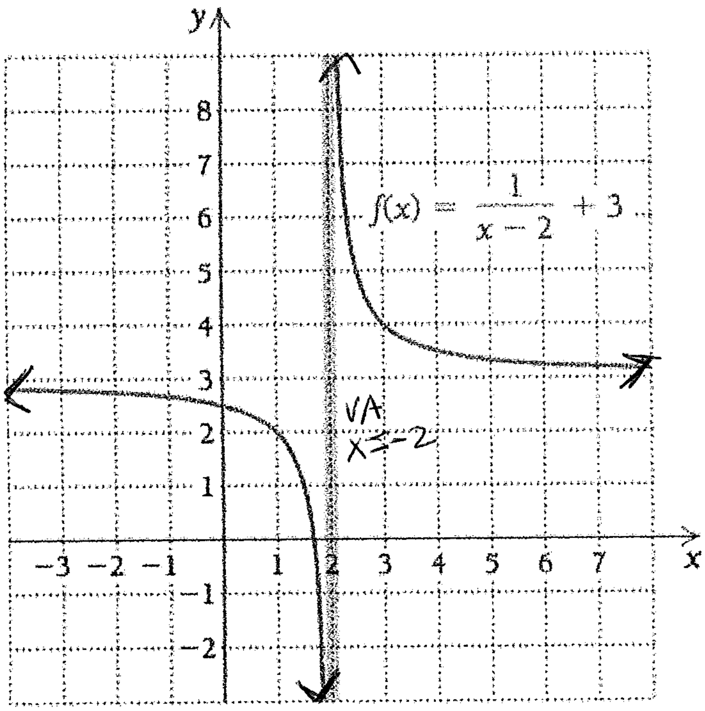
$\lim_{x \to 2^-} f(x) = 3$

$\lim_{x \to 2} f(x) = 3$

$\lim_{x \to -\infty} f(x) = -\infty$

$\lim_{x \to +\infty} f(x) = +\infty$

Example 3:
Using the graph, find the following.



$\lim_{x\to 3} f(x) = 4$

$f(2)$ undefined

$\lim_{x\to 2^+} f(x) = +\infty$

$\lim_{x\to 2^-} f(x) = -\infty$

$\lim_{x\to 2} f(x)$ Does not Exist

$\lim_{x\to -\infty} f(x) = 3$

$\lim_{x\to \infty} f(x) = 3$