

What is a Limit???

<http://archives.math.utk.edu/visual.calculus/1/limits.16/tut1-flash.html>



Intuitive Definition. Let $y = f(x)$ be a function. Suppose that a and L are numbers such that:

- whenever x is close to a but not equal to a , $f(x)$ is close to L ;
- as x gets closer and closer to a but not equal to a , $f(x)$ gets closer and closer to L ;
and
- suppose that $f(x)$ can be made as close as we want to L by making x close to a but not equal to a .

Then we say that **the limit of $f(x)$ as x approaches a is L** and we write

$$\lim_{x \rightarrow c} f(x) = L$$

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y-value

Warm-up: 1.8.20

- 1) Pick up a textbook and two handouts on back table.
- 2) Get out HW and ck sheet.
- 3) Get a calculator if needed.
- 4) Normal Advisement/HR schedule today.

Evaluating a Limit Graphically and Numerically

a) Numerically

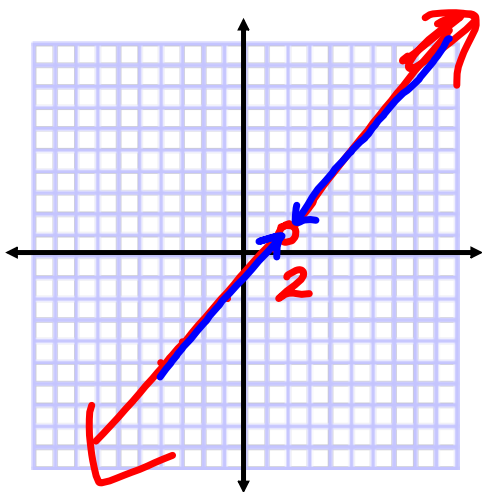
$$\frac{\cancel{(x-2)}(x-1)}{\cancel{x-2}}$$

$$\lim_{x \rightarrow 2} \frac{x^2 - 3x + 2}{x - 2} = 1$$

x	1.75	1.9	1.999	2	2.001	2.01	2.1
g(x)	.75	.90	.999	<u>und</u>	1.001	1.01	1.1

b) Graphically

$$\lim_{x \rightarrow 2} f(x) = 1$$



$$\frac{\cancel{(x-2)}(x-1)}{\cancel{x-2}}$$

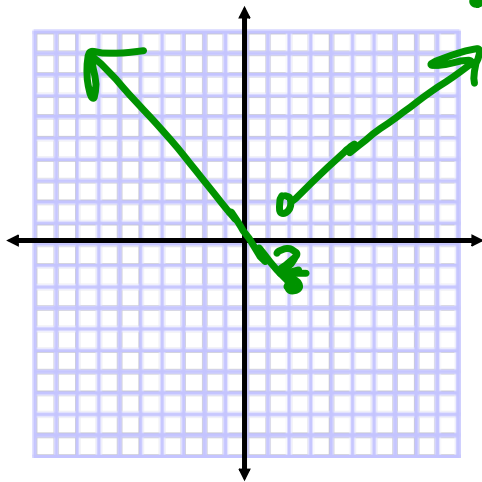
hole @ (2, 1)

Does not exist

$$\lim_{x \rightarrow 2} \frac{x|x-2|}{x-2} = \text{DNE}$$

x	1.99	1.999	1.9999	2	2.0001	2.001	2.01
$g(x)$	-1.99	-1.999	-1.999	und	2.0001	2.001	2.01

-2?
2?



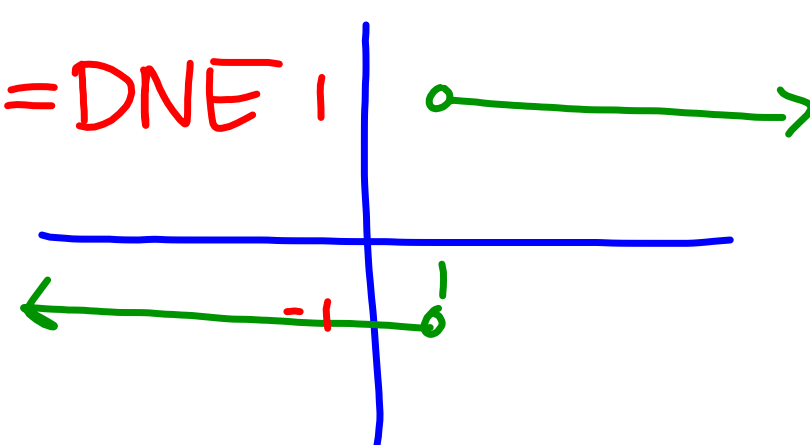
one-sided

$$\lim_{x \rightarrow 2^+} = 2$$

$$\lim_{x \rightarrow 2^-} = -2$$

Limits DO NOT EXIST when there is:

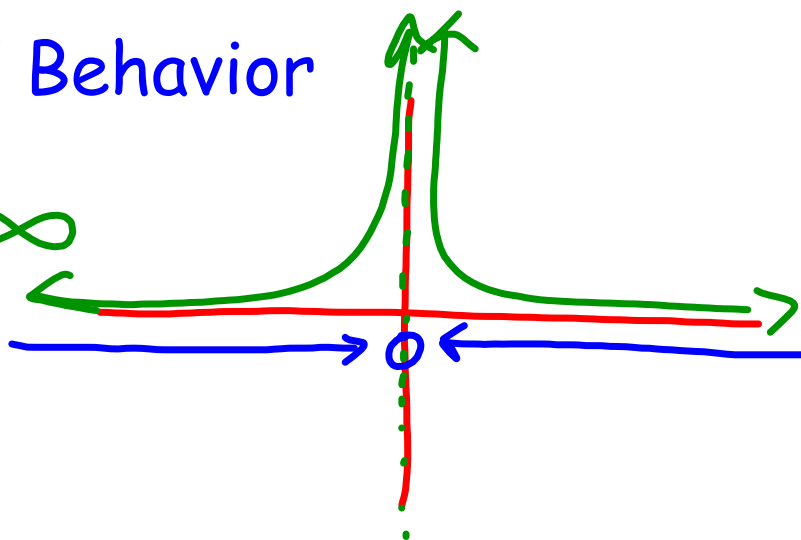
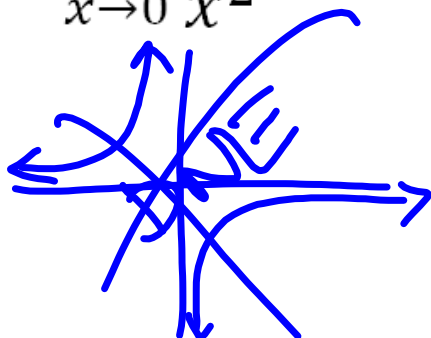
1. Behavior that differs from left to right...

$$\lim_{x \rightarrow 1} \frac{|x - 1|}{x - 1} = \text{DNE}$$


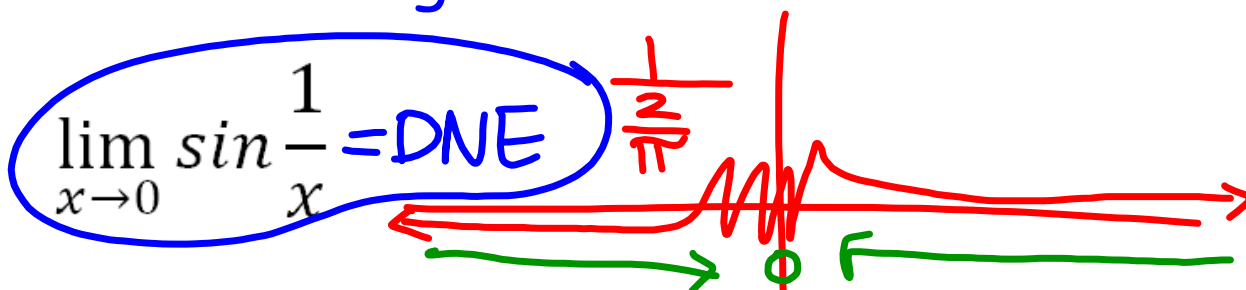
The graph shows a coordinate plane with a vertical y-axis and a horizontal x-axis. A vertical blue line is drawn at x=1. A horizontal blue line is drawn at y=1. A green arrow points from the right towards the vertical line at x=1, starting from an open circle at (1, 1). A green arrow points from the left towards the vertical line at x=1, starting from an open circle at (1, -1). A red tick mark is on the x-axis at x=1, with a small vertical line segment above it. The text "= DNE" is written in red next to the equation.

2. Unbounded Behavior

$$\lim_{x \rightarrow 0} \frac{2}{x^2} = +\infty$$

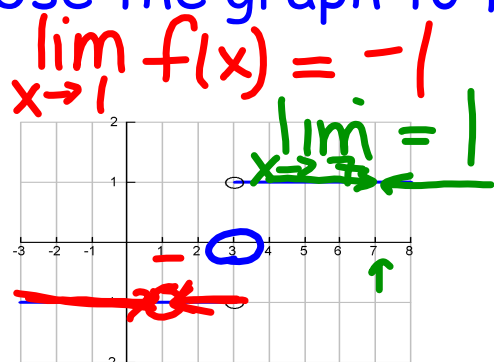


3. Oscillating Behavior

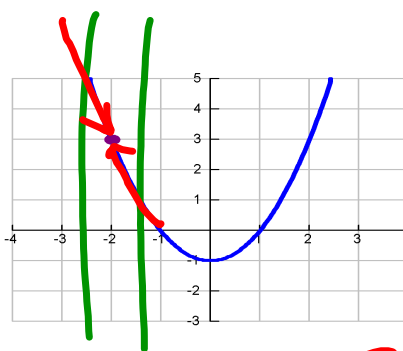


x	$\frac{2}{\pi}$	$\frac{2}{3}\pi$	$\frac{2}{5}\pi$	$\frac{2}{7}\pi$
y	+1	-1	+1	-1

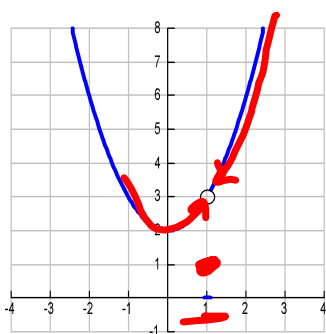
Use the graph to find the limit if it exists.



1. $\lim_{x \rightarrow 3} f(x) = \text{DNE}$

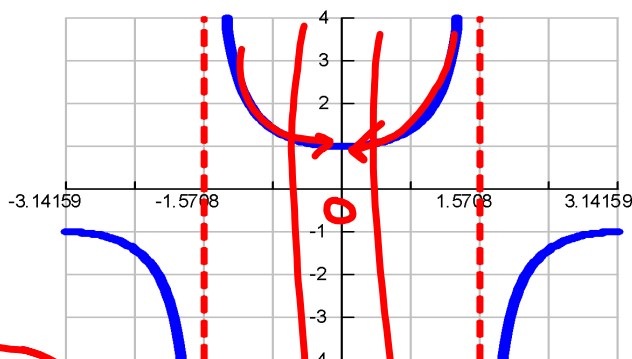


2. $\lim_{x \rightarrow -2} f(x) = 3$



3. $\lim_{x \rightarrow 1} f(x) = 3$

$f(1) = 1$



4. $\lim_{x \rightarrow 0} f(x) = 1$