$f(x) = \frac{\sqrt{x^2+12}-2}{x^2}$ determine the following.

1) f(2) = $\frac{2}{4} = \frac{1}{2}$

2) f(0) = $\frac{\sqrt{12}-2}{0} = \emptyset$

---

d out what is happening to the graph of a function when we cannot evaluate it at
ve use a limit.

d of asking what does f(x) equal when x is a certain value,

we ask *what does f(x) approach as x approaches a certain value.*

Limit Notation

$$\lim_{x \to a} f(x) = L$$

One Sided Limits

Left Hand Side: $\lim_{x \to a^-} f(x)$

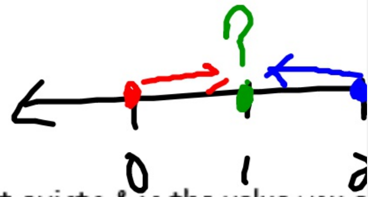
Right Hand Side: $\lim_{x \to a^+} f(x)$

For a limit to exist:

The left hand side must equal the right hand

Example 2: Find the following limit using a **table of values**:

$$\lim_{x\to 1}\frac{\sqrt[3]{x}-1}{\sqrt{x}-1} = \frac{\sqrt[3]{1}-1}{\sqrt{1}-1} = \frac{1-1}{1-1} = \frac{0}{0}$$



First, find the left & right hand side limits... if they are equal then the limit exists & is the value you g

$$\lim_{x\to 1^-}\frac{\sqrt[3]{x}-1}{\sqrt{x}-1} =$$

x	0	.5	.9	.99
f(x)	1	.7044	.6725	.6672

$$\lim_{x\to 1^+}\frac{\sqrt[3]{x}-1}{\sqrt{x}-1} =$$

x	2	1.5	1.1	1.01
f(x)	.6275	.6439	.6613	.6661

$2/3$

You can also find limits by looking at the graph of a function.
Given the graph of f(x), find the following limits if they exist.

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

b) $\lim_{x \to 1^+} f(x) =$ 3

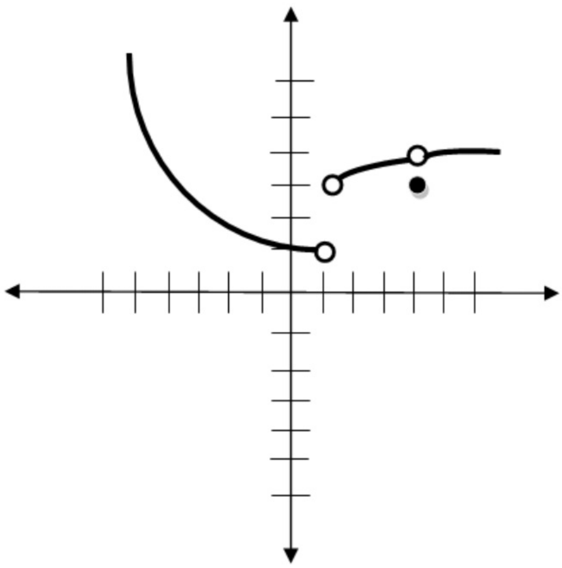
c) $\lim_{x \to 1} f(x) =$ DNE

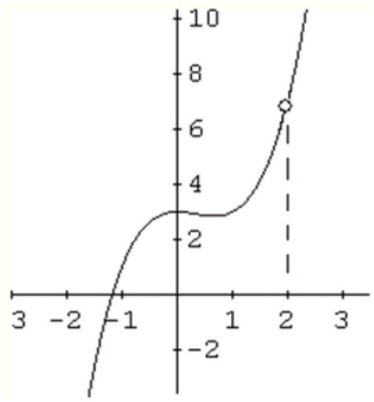
d) $\lim_{x \to 4^-} f(x) =$ 4

e) $\lim_{x \to 4^+} f(x) =$ 4

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

g) $f(4) =$ 3



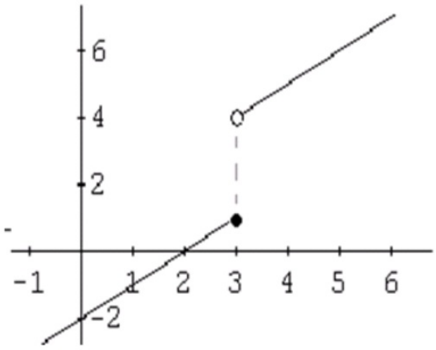


$\lim_{x \to 2^-} f(x) =$ 7

$\lim_{x \to 2^+} f(x) =$ 7

$\lim_{x \to 2} f(x) =$ 7

$f(2) =$ DNE

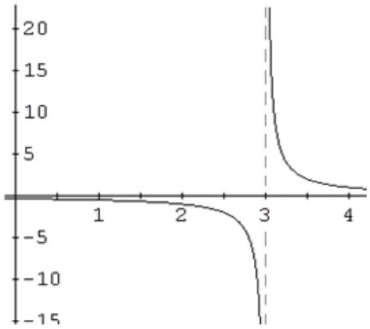


$\lim_{x \to 3^-} g(x) =$ 1

$\lim_{x \to 3^+} g(x) =$ 4

$\lim_{x \to 3} g(x) =$ DNE

$g(3) =$ 1



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

$\lim_{x \to 3^+} h(x) =$ ∞

$\lim_{x \to 3} h(x) =$ DNE

$h(3) =$ DNE

If a graph is continuous you can simply plug in the value to find the limit.

1) $\lim_{x \to 2} 2x + 3x =$

2) $\lim_{x \to -3} x^2 - 5 =$

3) $\lim_{\theta \to \pi} \sin \theta =$

4) $\lim_{x \to 4} \frac{3}{x+2}$

5) $\lim_{x \to \frac{1}{2}} \left(3x^2 - 2\right) = =$

6) $\lim_{\theta \to \frac{5\pi}{4}} \tan\theta =$

The indeterminate form:

When direct substitution gives you $\frac{0}{0}$, simplify the function algebraically and substitution again.

Algebraic methods for finding limits:

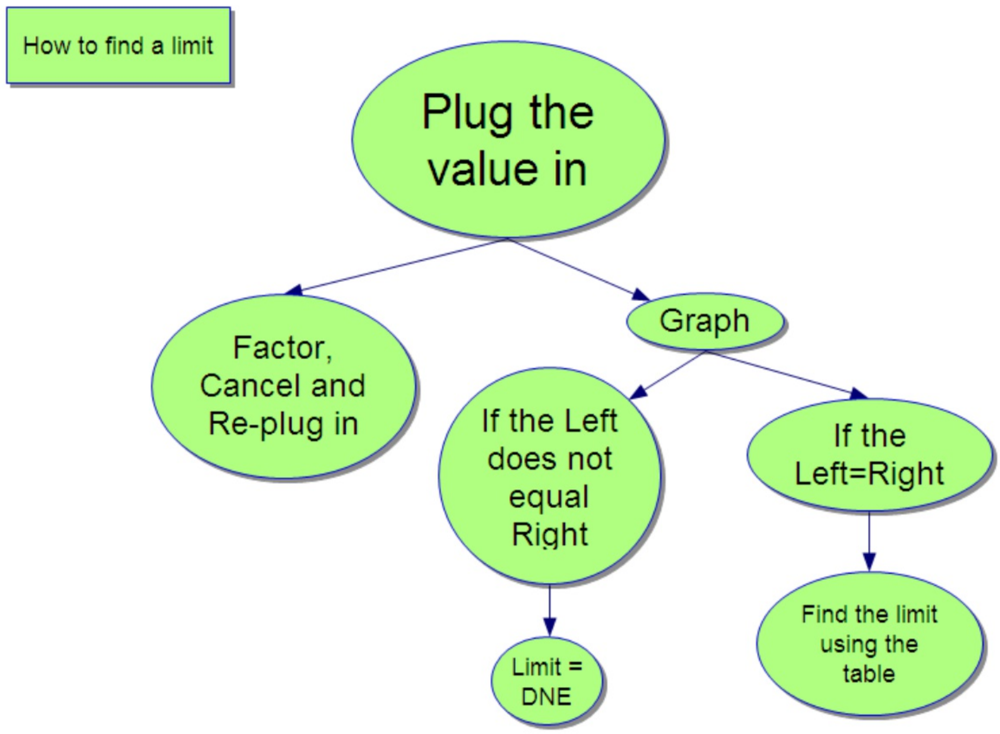
1. Direct substitution

2. Simplify expressions

7) $\lim_{x\to -3}\frac{x^2-9}{x+3}$ =

8) $\lim_{x\to 1}\frac{x^2+x-2}{x^2-1}$ =

9) $\lim_{x\to 4}\frac{x^2-7x+12}{x^2+8x-48}$ =


How to find a limit
Plug the value in
Factor, Cancel and Re-plug in
Graph
If the Left does not equal Right
Limit = DNE
If the Left=Right
Find the limit using the table