# Discontinuidad

**Cálculo I**
**Proyecto Primer Parcial**

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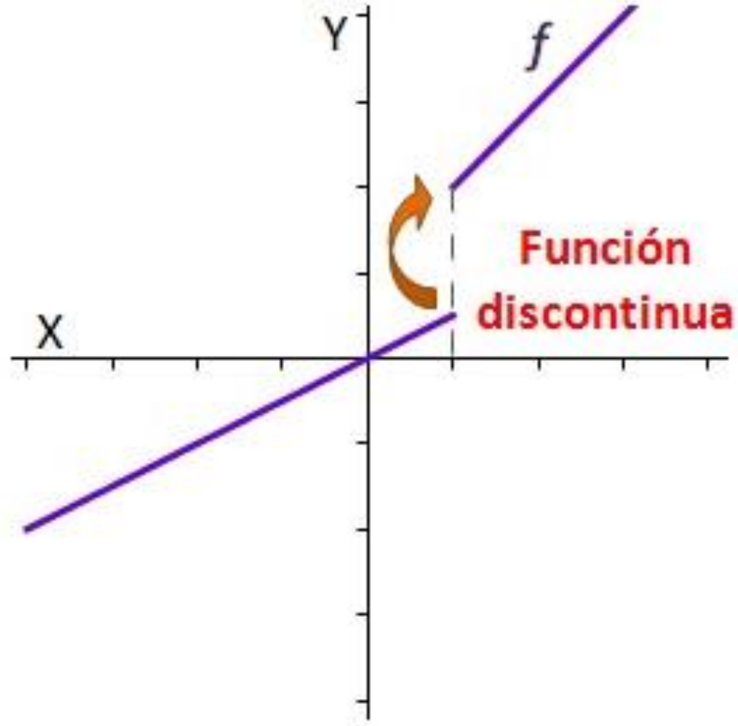
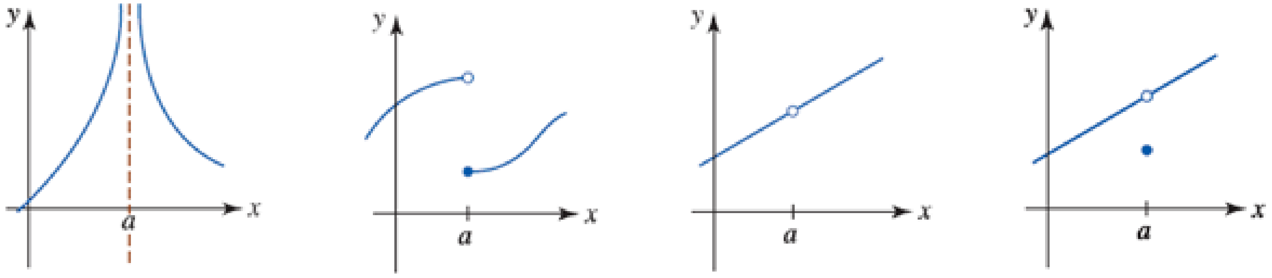
# ¿Qué es una discontinuidad?

- Es cuando se presenta un brusco cambio de valor en una gráfica, es decir que la línea de los valores es alterada al ser interrumpida o presentar un salto.



# *4 tipos discontinuidades*

- Infinite discontinuity.
- Jump discontinuity.
- Removable discontinuity.
- Endpoint discontinuity.




a) $\lim_{x \to a} f(x)$ no existe y $f(a)$ no está definida

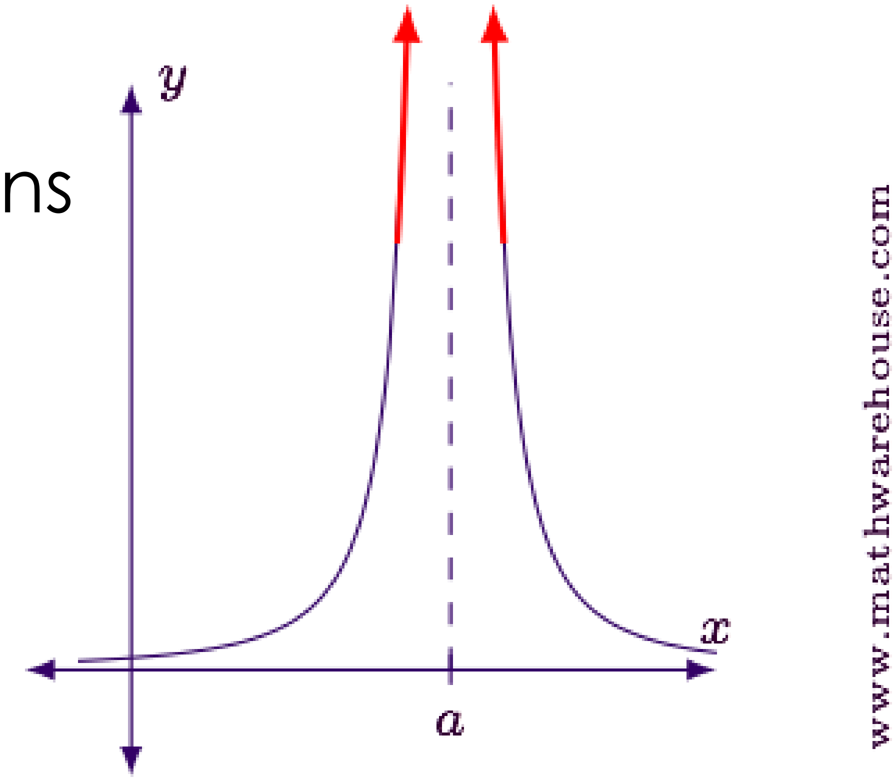
b) $\lim_{x \to a} f(x)$ no existe pero $f(a)$ está definida

c) $\lim_{x \to a} f(x)$ existe pero $f(a)$ no está definida

d) $\lim_{x \to a} f(x)$ existe, $f(a)$ está definida, pero $\lim_{x \to a} f(x) \neq f(a)$

# Infinite discontinuity.

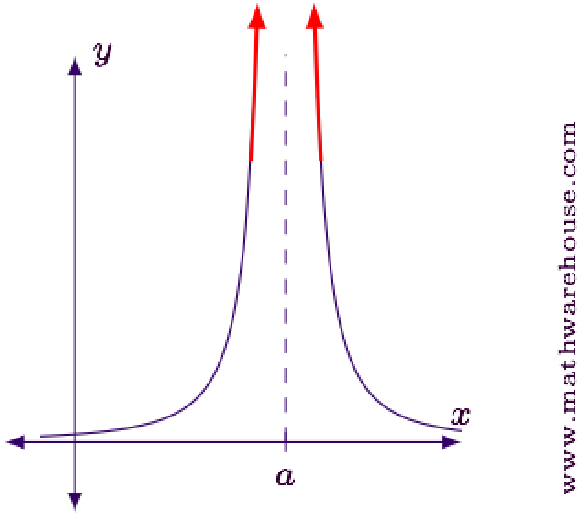
- The function at the singular point goes to infinity in different directions on the two sides.




Example of an Infinite Discontinuity

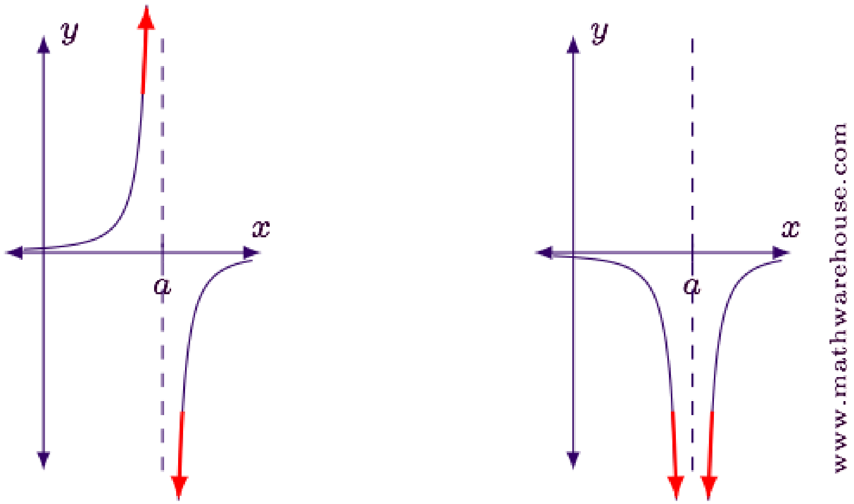
# Ejemplo 1

- La grafica muestra que la función es discontinua en x= ax=a
- Las flechas en la función indican que crecerá infinitamente positivo como xx se va aproximando a aa. Como la función no se aproxima a un valor  en particular definido el limite no existe. Esto es una discontinuidad infinita.




Example of an Infinite Discontinuity

*Los gráficos siguientes también son ejemplos de discontinuidades positivas y negativas.



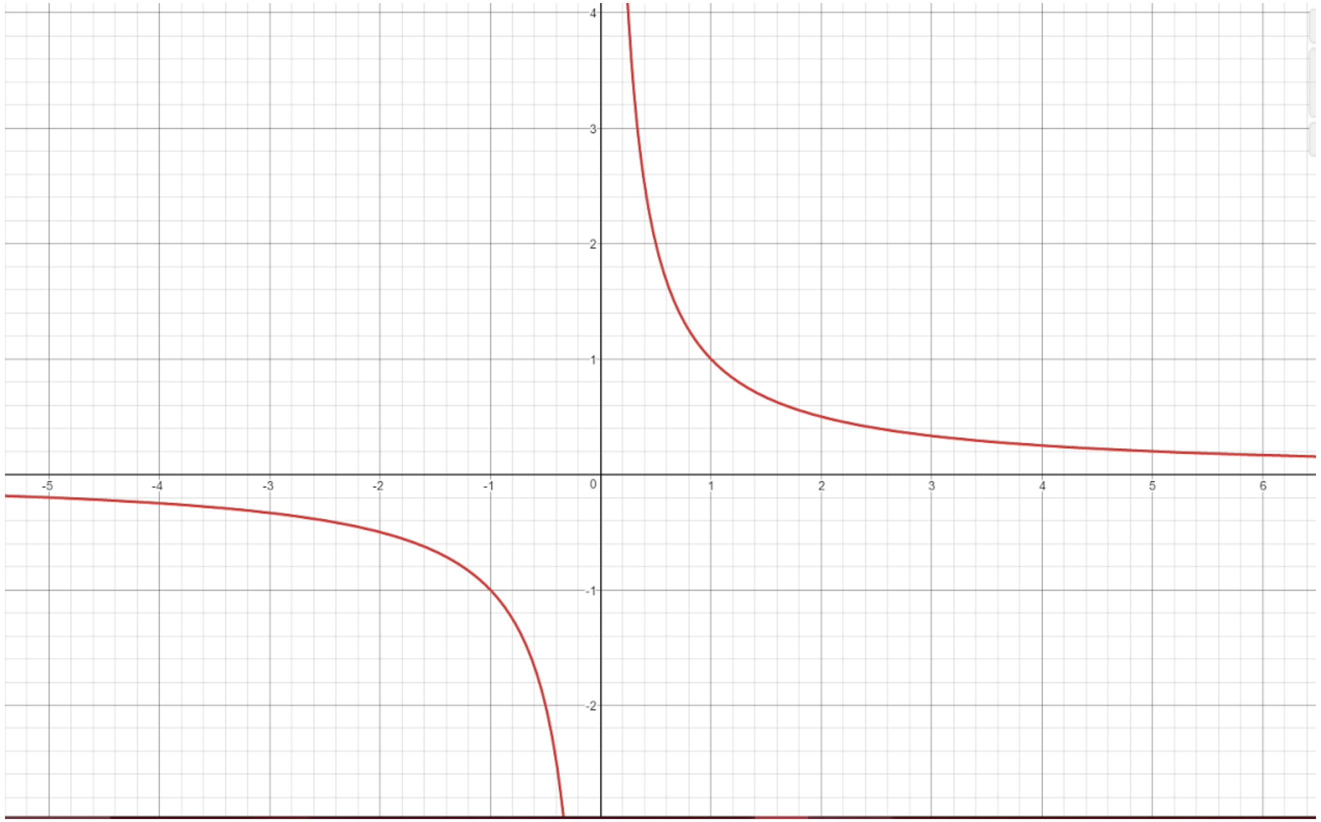

Other Examples of Infinite Discontinuities

# Ejemplo 2

$$f(x) = \frac{1}{x}$$

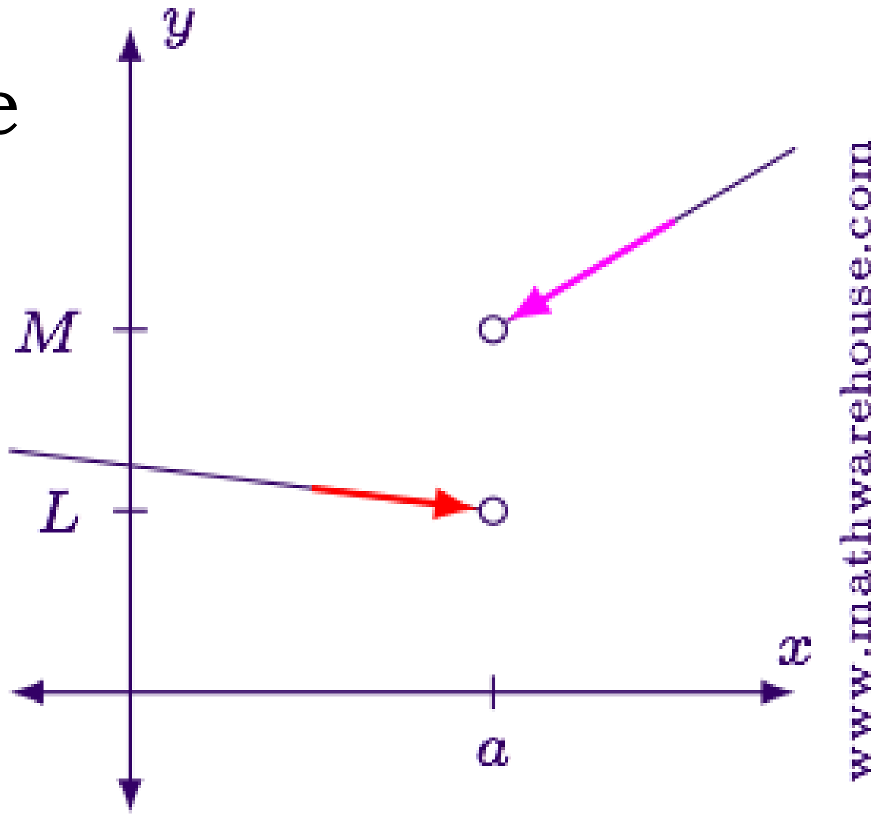
$$\lim_{x \to 0^-} \frac{1}{x} = -\infty$$

$$\lim_{x \to 0^+} \frac{1}{x} = +\infty$$



# Jump discontinuity

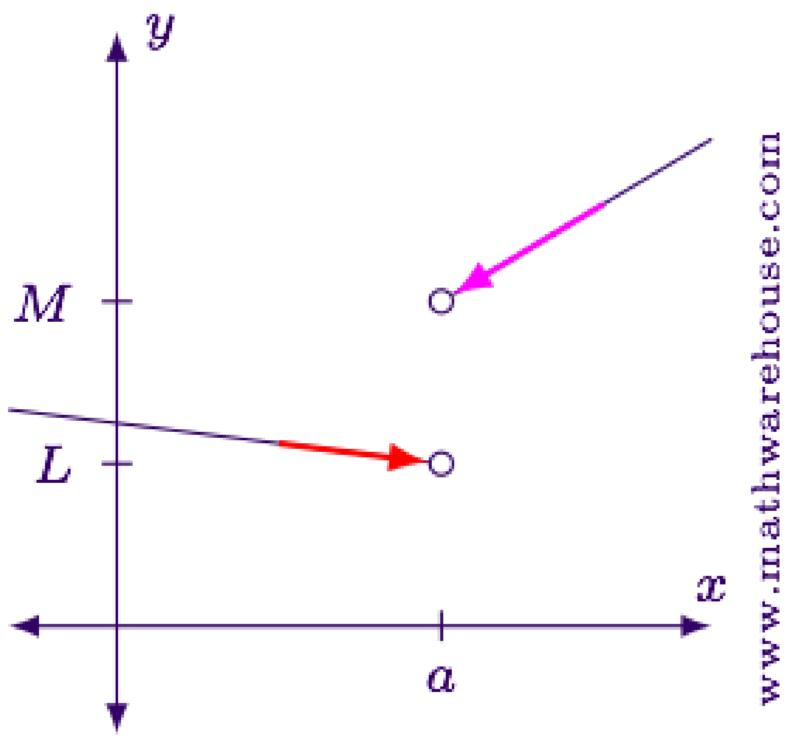
- Una función que brinca de un punto a otro.



Example of a Jump Discontinuity

# Ejemplo 1

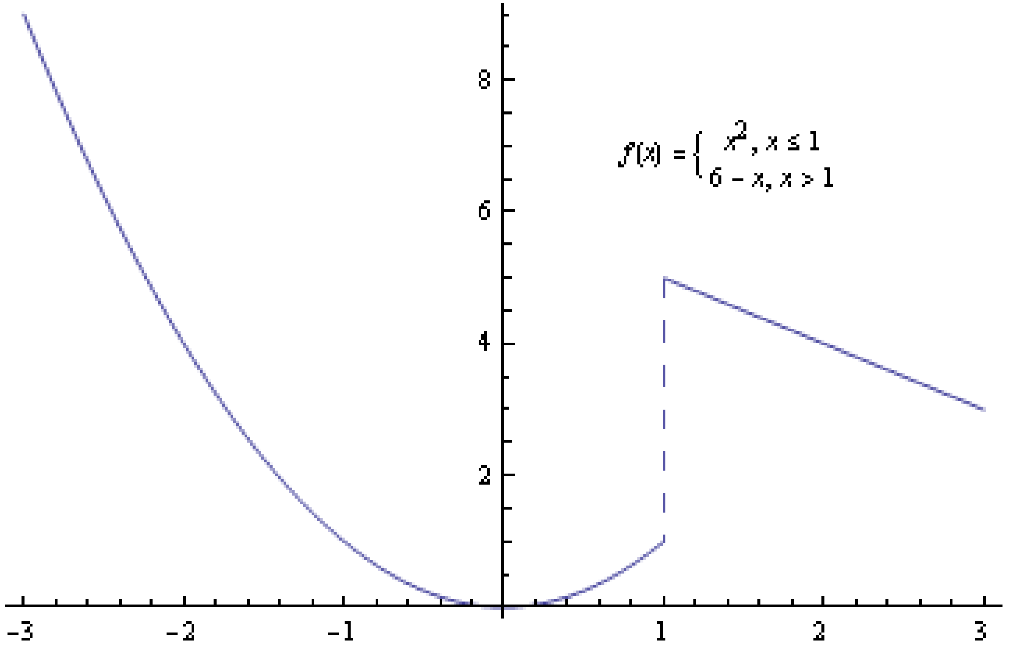
- En esta gráfica, se puede ver fácilmente que el límite **limx→a−f(x)=L** y **limx→a+f(x)=M.**
- La función se aproxima à puntos diferentes dependiendo de donde venga la dirección de Xx. Cuando esto sucede, decimos que la función tiene un brinco de discontinuidad en at *x*=*a*x=a.




Example of a Jump Discontinuity

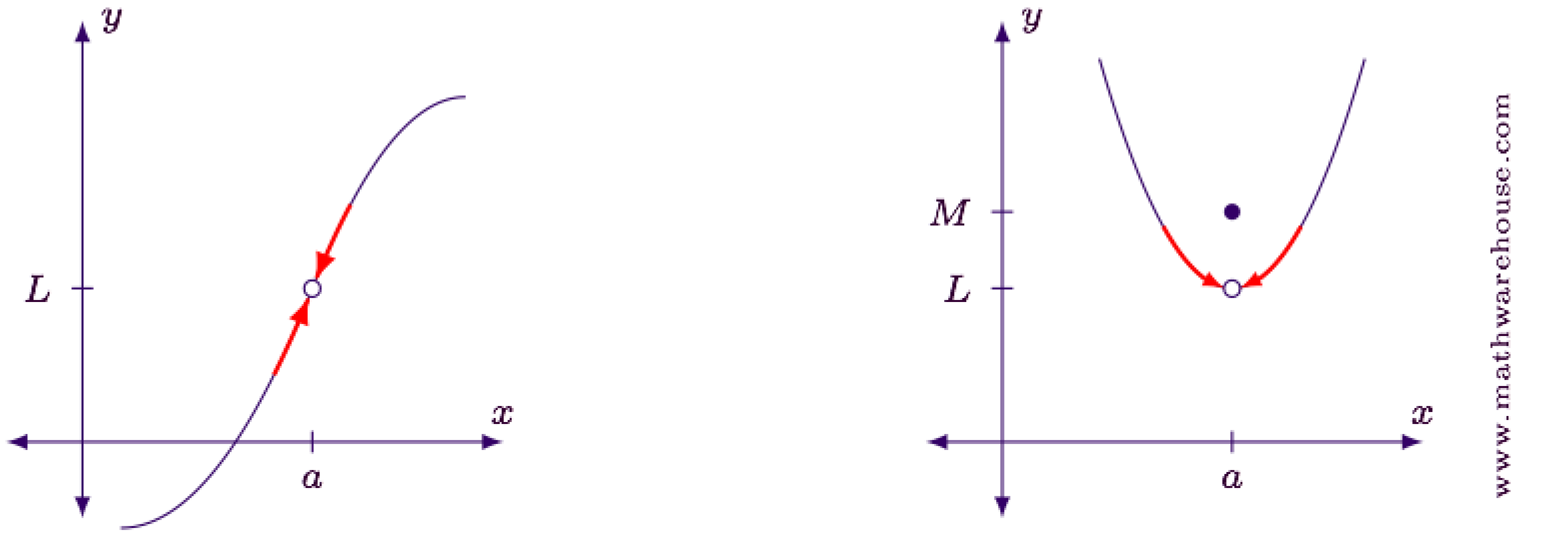
# Ejemplo 2

- Las dos funciones tienen un valor diferente en x = 1 y podemos ver que en la gráfica f brinca de una rama à otra. Notase que el brinco hace à la función



# Removable discontinuity

- Es cuando un punto en la gráfica es indefinido, es decir que hay un hueco.




Examples of Removable Discontinuities

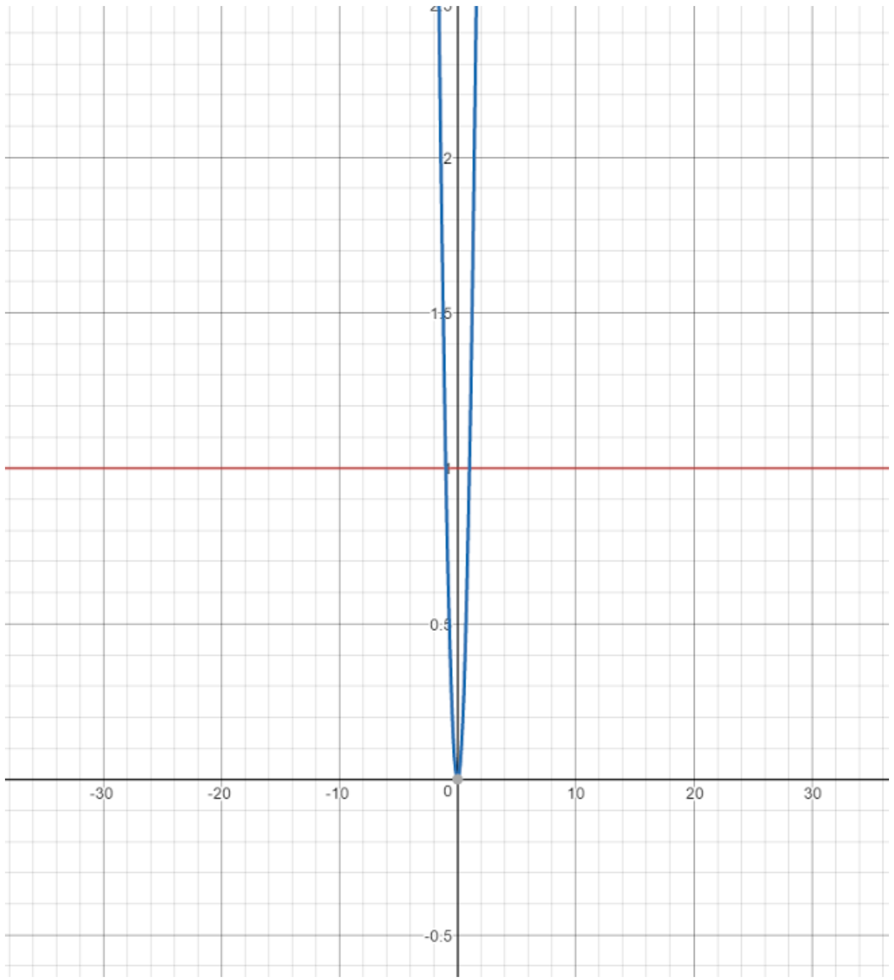
Notice that for both graphs, even though there are holes at x=ax=a, the limit value at x=ax=a exists.

# Ejemplo 1

Considerando la función

$$f(x) = \begin{cases} 1, & x = 3 \\ x^2, & all\ other\ real\ x - values \end{cases}$$

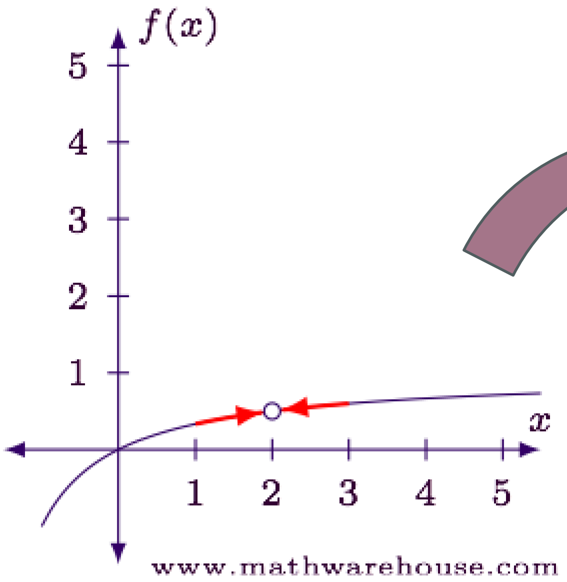
We defined the value of the function to be 1 at the point x = 3, yet, the rest of the function is dictated by $f(x) = x^2$. We can see in the graph that the function is continuous except for the tiny hole in the curve at x = 1.

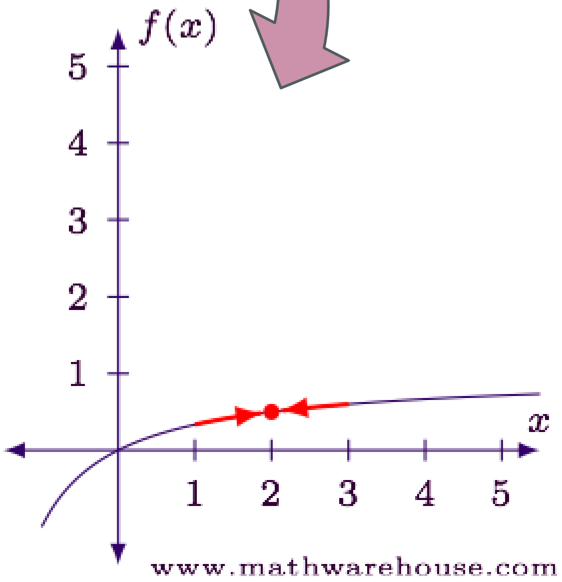


# Ejemplo 2

$$f(x) = \frac{x^2-2x}{x^2-4}$$

Redefine the equation so it becomes continous at x=2




$$\lim_{x\to 2} \frac{x^2-2x}{x^2-4} = \frac{(2)^2-2(2)}{(2)^2-4} = \frac{0}{0}$$

We need to know Y value to find the hole.The división in tell us there´s a discontinuity

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

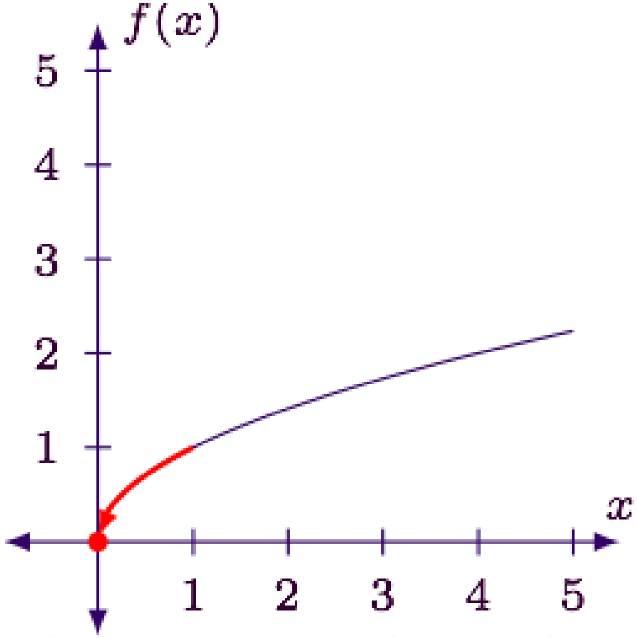
So we redefine it into a piecewise function

$$f(x) = \begin{cases} \frac{x^2-2x}{x^2-4}, & \text{for all } x \neq 2 \\ \frac{1}{2}, & \text{for } x = 2 \end{cases}$$

The first piece preserves the overall behavior of the function, while the second piece plugs the hole.

# Endpoint discontinuity

- When a function is defined on an interval with a closed endpoint, the limit cannot exist at that endpoint. This is because the limit has to examine the function values as $x$x approaches from both sides.
- For example, consider finding lim$x$→0$x$√limx→0x (see the graph below).

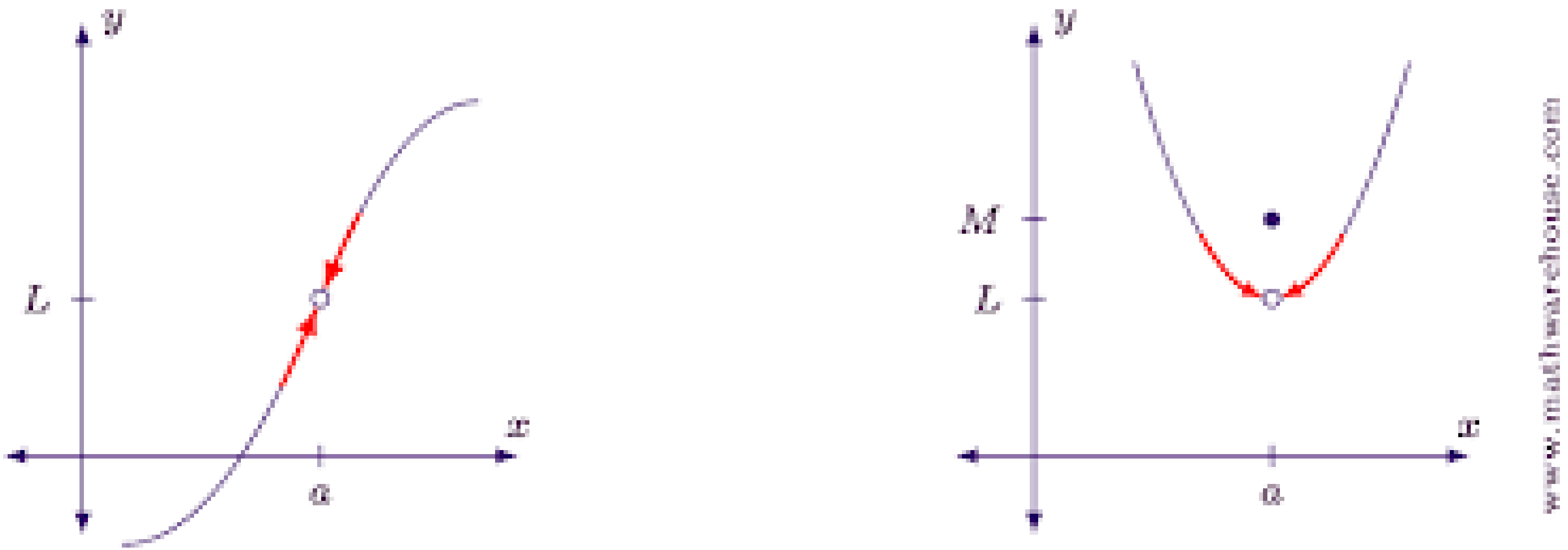



Note that $x$=0x=0 is the left-endpoint of the functions domain: [0,∞)[0,∞), and the function is technically not continuous there because the limit doesn't exist (because $x$x can't approach from both sides).

We should note that the function *is* right-hand continuous at $x$=0x=0 which is why we don't see

# Ejemplo 1

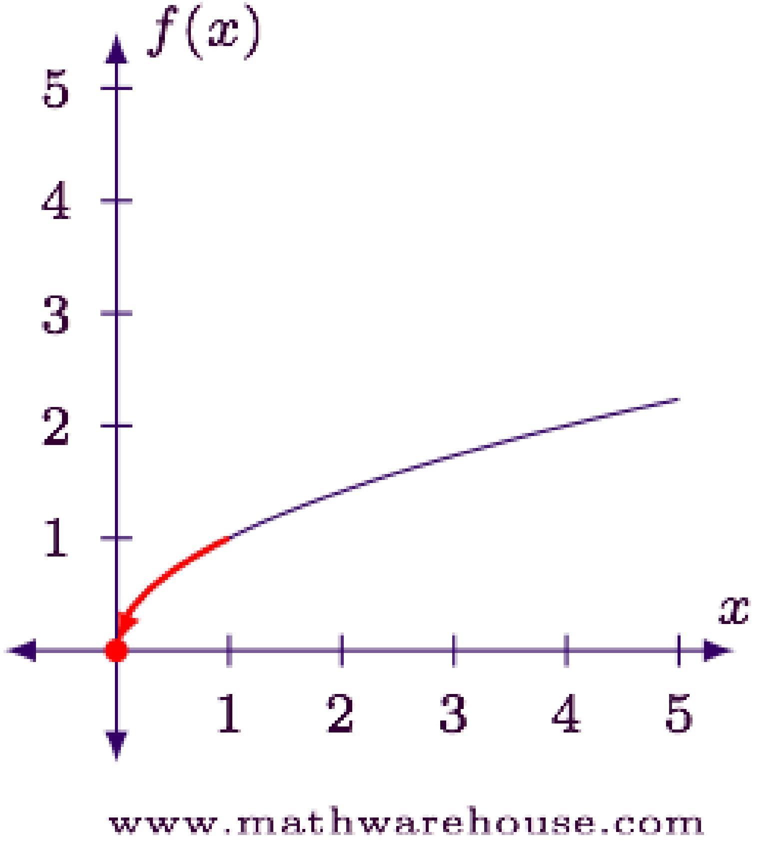
- We have a limit since the (a,infinit] from both sides of (a), but never touching it.




Examples of Removable Discontinuities

# Ejemplo 2

- consider finding lim*x*→0*x*√limx→0x (see the graph below)




Note that *x*=0x=0 is the left-endpoint of the functions domain: [0,∞)[0,∞), and the function is technically not continuous there because the limit doesn't exist (because *x*x can't approach from both sides).

We should note that the function *is* right-hand continuous at *x*=0x=0 which is why we don't see any jumps, or holes at the endpoint.

# Referencias: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