



# C alculus

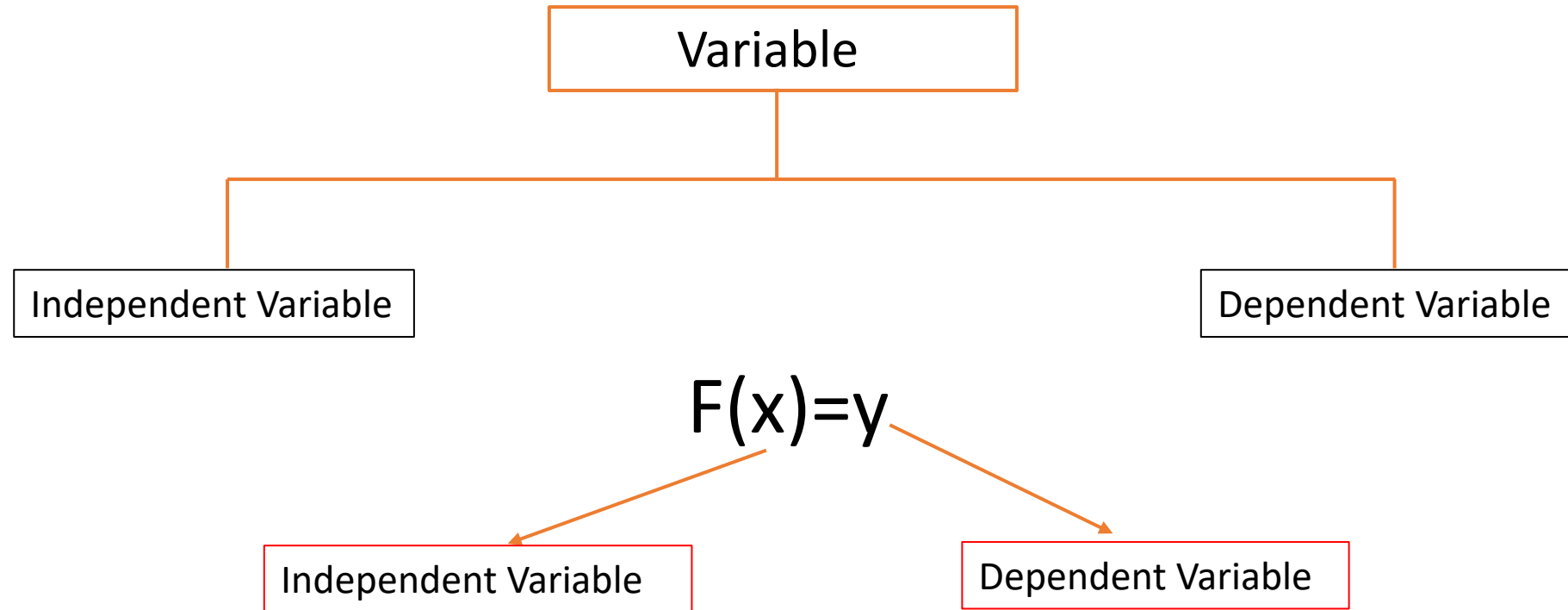
# Function

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- ➡ A function  $f$  is a rule that associates a unique output with each input.
- ➡ If a variable  $y$  depends on a variable  $x$  in such a way that each value of  $x$  determines exactly one value of  $y$ , then we say that  $y$  is a function of  $x$

# Variable

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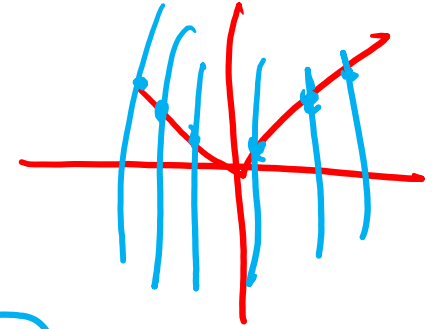
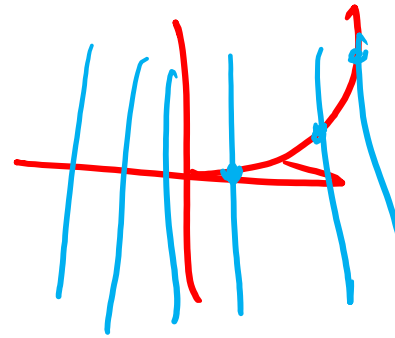
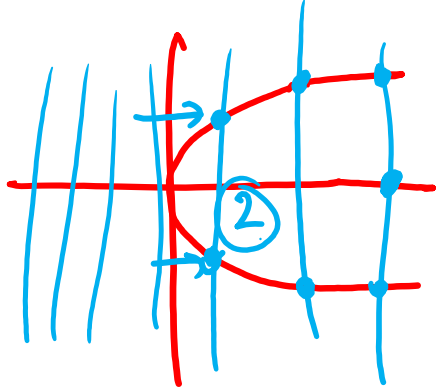
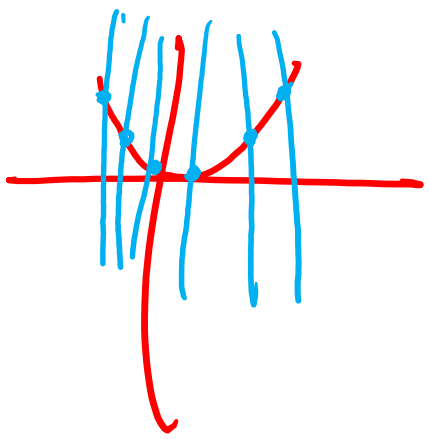


$$Y=F(x)=2x+4$$

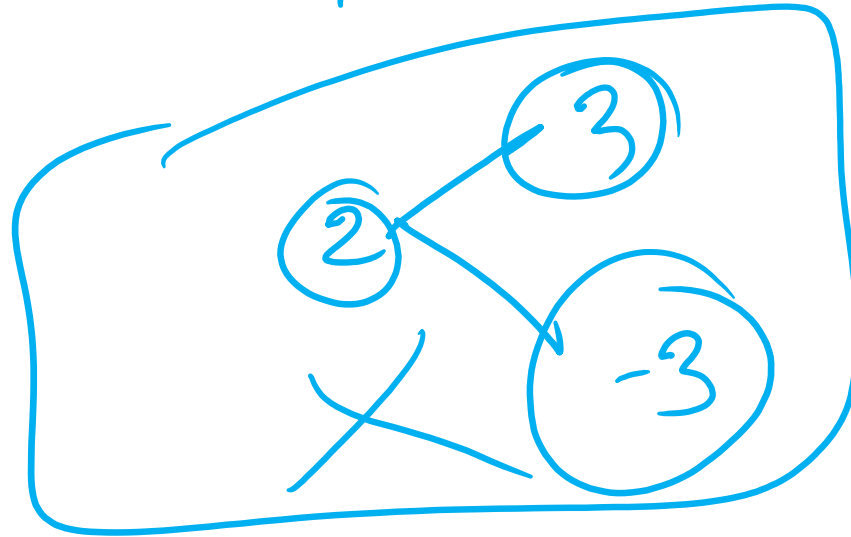
$X=1,2,3,4,5,6,7,66,54,2000,34456678\dots\dots\dots$

$Y$ =Depends on the value of  $x$

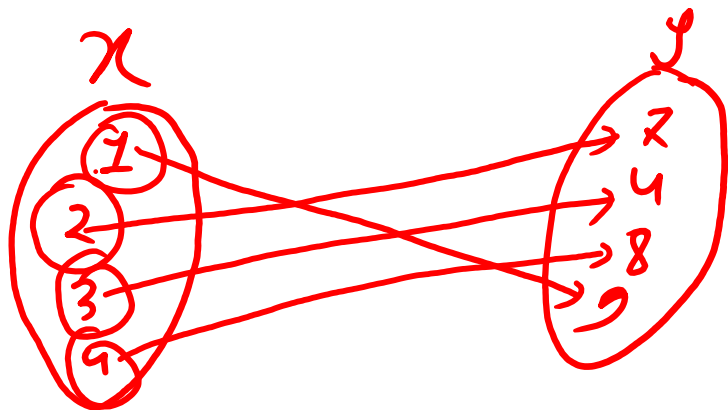
## Function or Not (Using Graph)



• Vertical line test



# One to one Function



$$f^{-1}$$
$$f(n) = 2n$$

1, 2, 3, ✓  
4

not

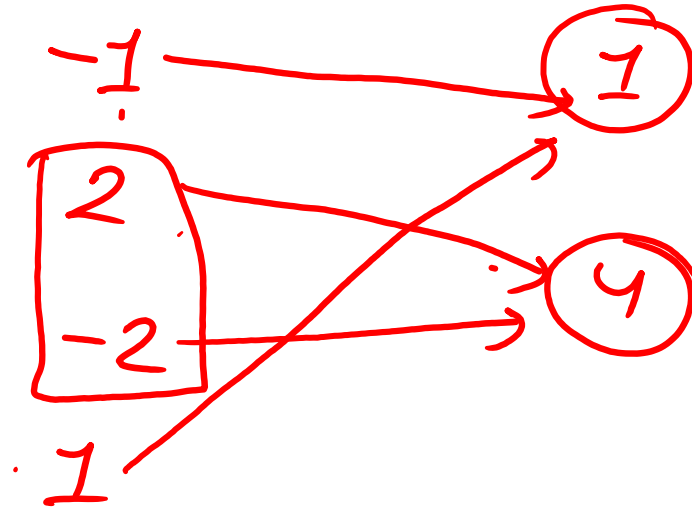
$$f(n) = n^2$$
$$-1 = (-1)^2 = 1$$
$$1 = (1)^2 = 1$$

# Many to One Function

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$$f(x) = x^2$$

-1	=	1
2	=	4
-2	=	4
1	=	1



## Undefined Function

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1. De-nominator can not be Zero.

2.  $\sqrt{-ve}$   $\otimes$

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

$$x = -2 = \frac{1}{2-2} = \frac{1}{0} = \infty$$

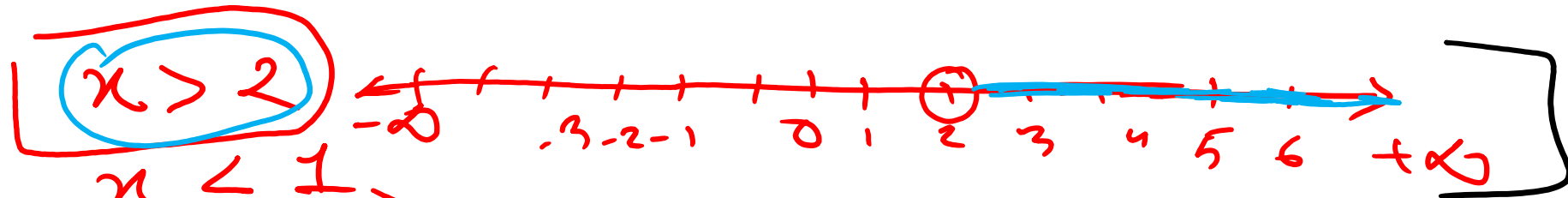
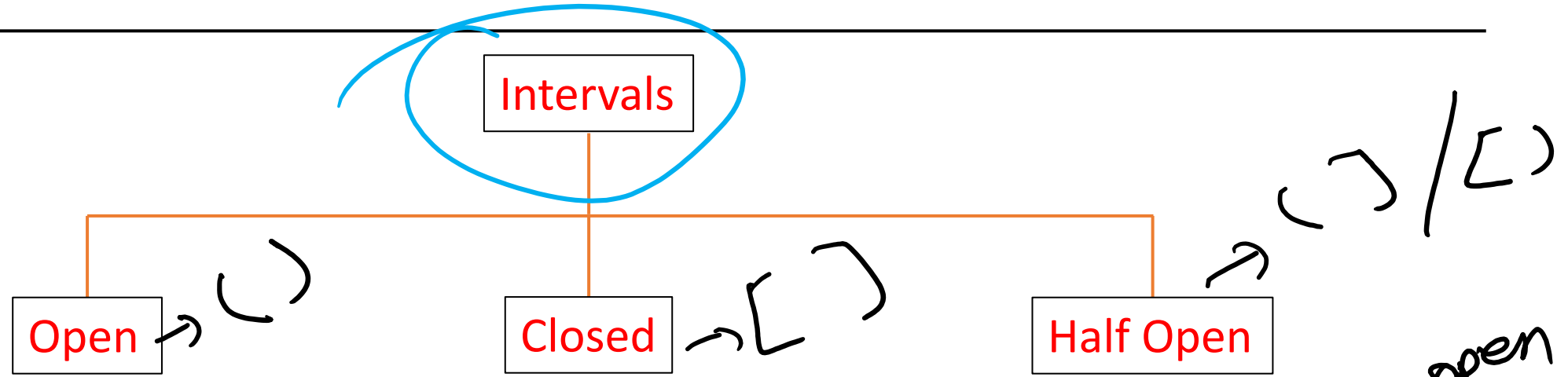
$$f(x) = \sqrt{5+x}$$

$\rightarrow -6,$   
 $\sqrt{-ve}$   
 $\leftarrow -5$

$$x < -5$$



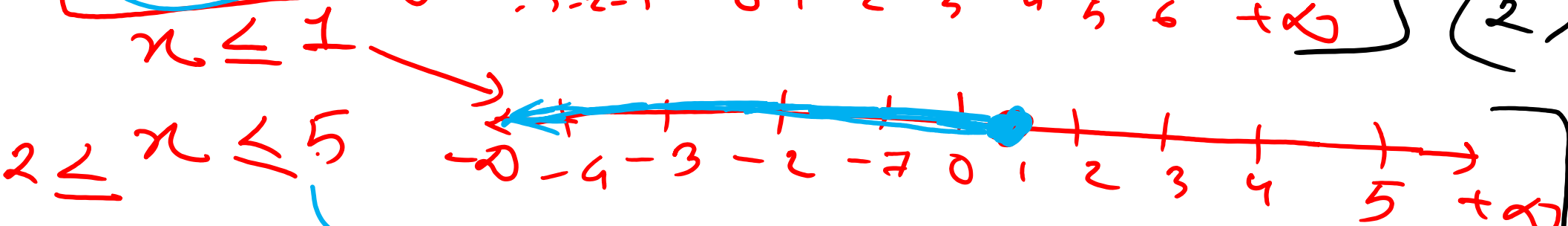
# Intervals



$x > 2$

$(2, \infty)$

open



$x \leq 1$

$[-2, 1]$

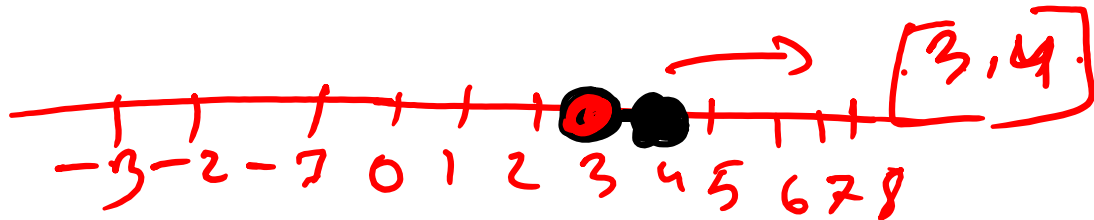
$2 \leq x \leq 5$

$[2, 5]$



$(2, 5]$

$3 \leq x \leq 4 \rightarrow$

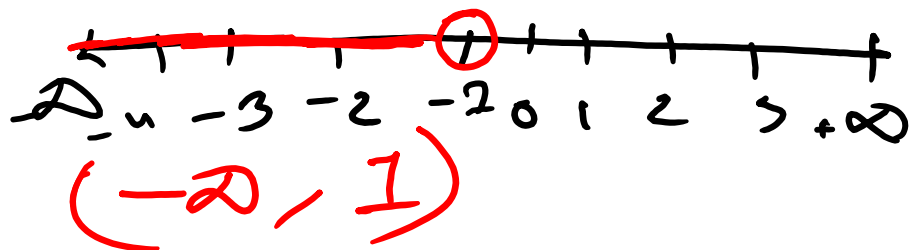


$( \rightarrow \text{without}$

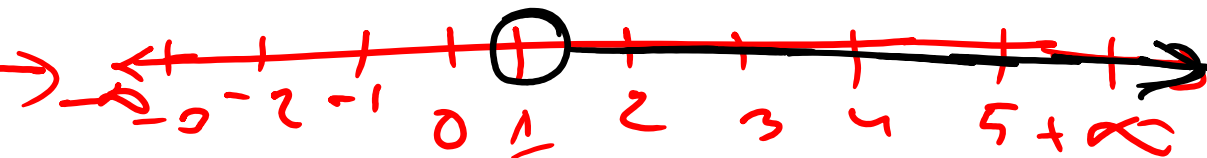
$[ \rightarrow \text{with}$

$x < -1$

$x > 1$



$(-\infty, 1)$



$(1, \infty)$

$$-2 < x < 5$$

$$(-2, 5)$$

$$-2 \leq x \leq 5$$

$$[-2, 5]$$

$$-2 < x \leq 5$$

$$(-2, 5]$$

(  $\rightarrow$  without

[  $\rightarrow$  with

$$+\infty, -\infty$$

$$\downarrow$$

$$( )$$

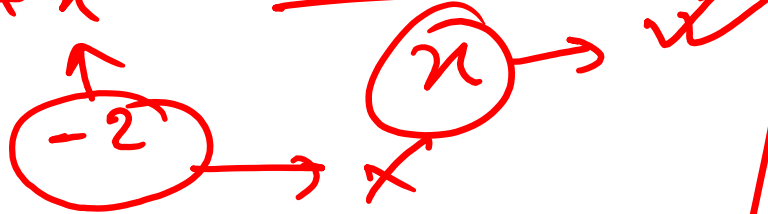




# Domain

Domain : Set of the value of  $x$  for which the function  $f(x)$  is defined.

$$f(x) = \frac{1}{2+x} \quad \text{Domain??}$$

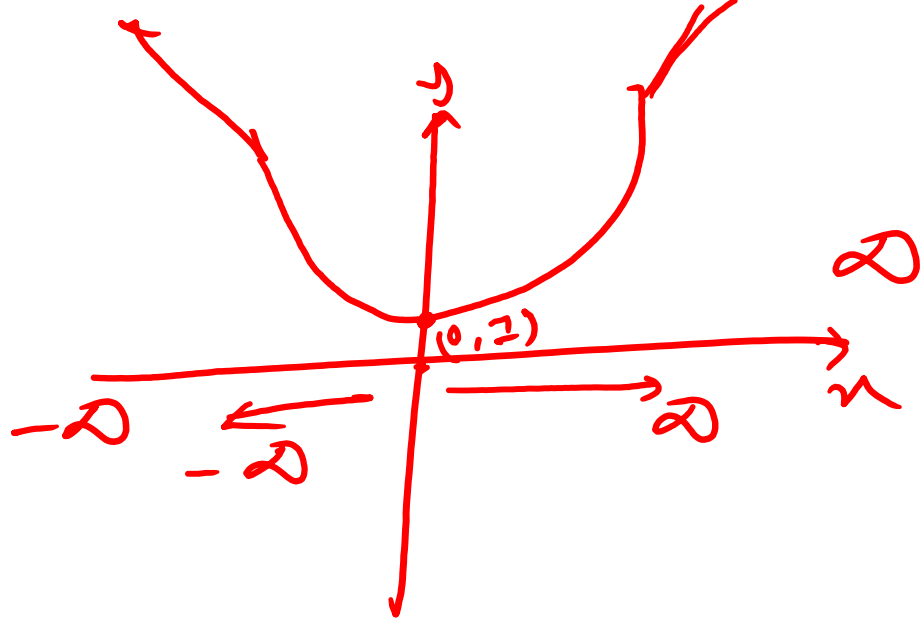


Domain :  $\mathbb{R} - \{-2\}$

$$f(x) = \sqrt{5+x} \quad \text{Domain??}$$

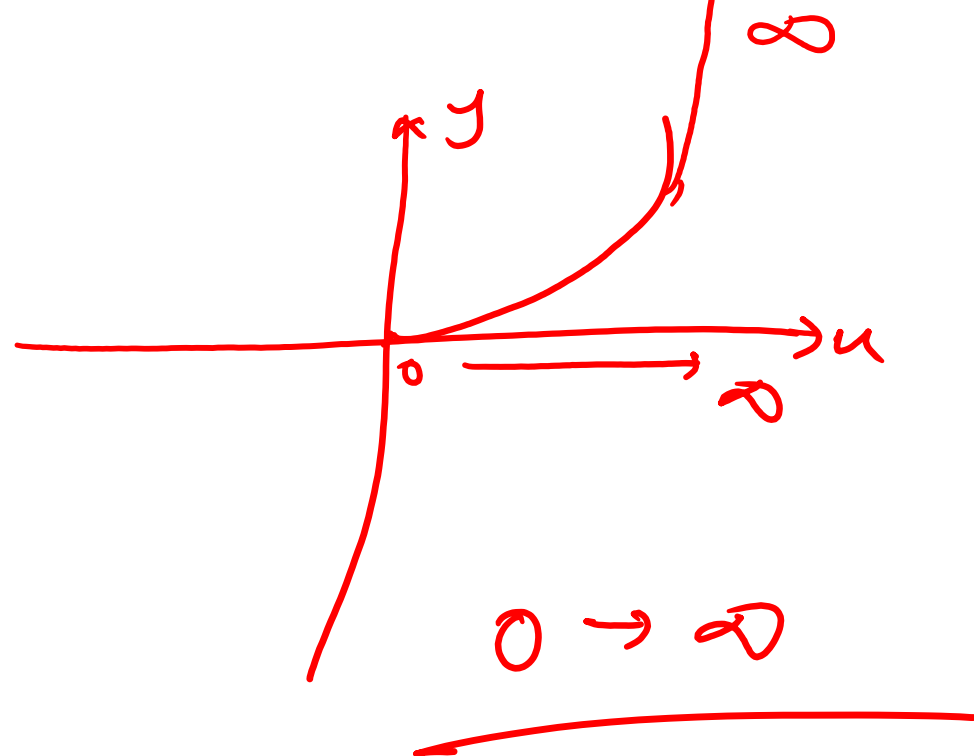
$$x \geq -5 \rightarrow \text{Domain}$$

$$\rightarrow [-5, \infty)$$



Domain:  $\mathbb{R}$ .

$(-\infty, \infty)$



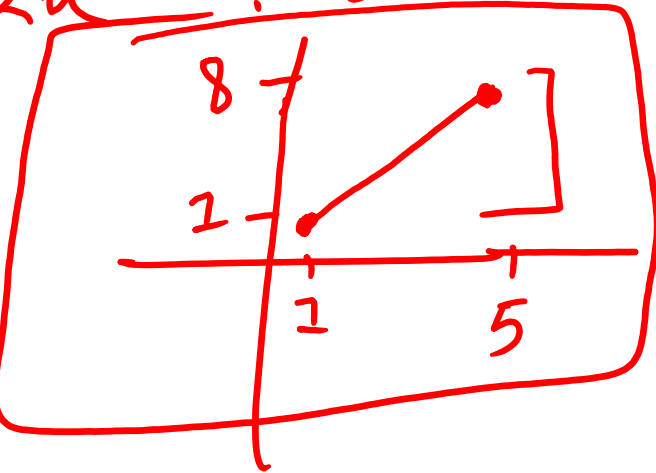
Domain:  $x \geq 0$

$[0, \infty)$

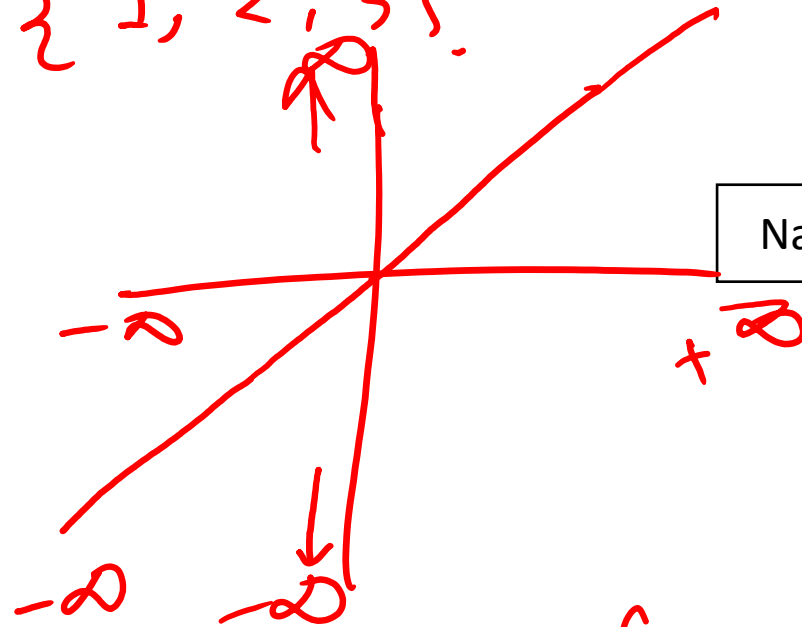
# Range

$$f(x) = 2x : \text{Domain} = \{1, 2, 3\}$$

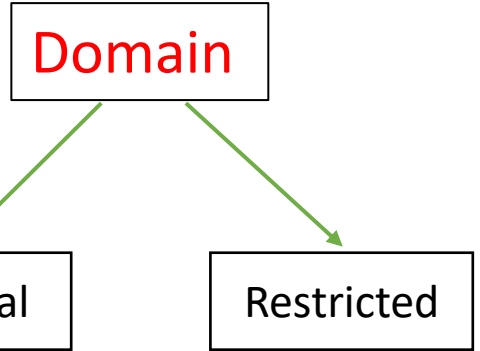
1  $\rightarrow$  2  
2  $\rightarrow$  4  
3  $\rightarrow$  6



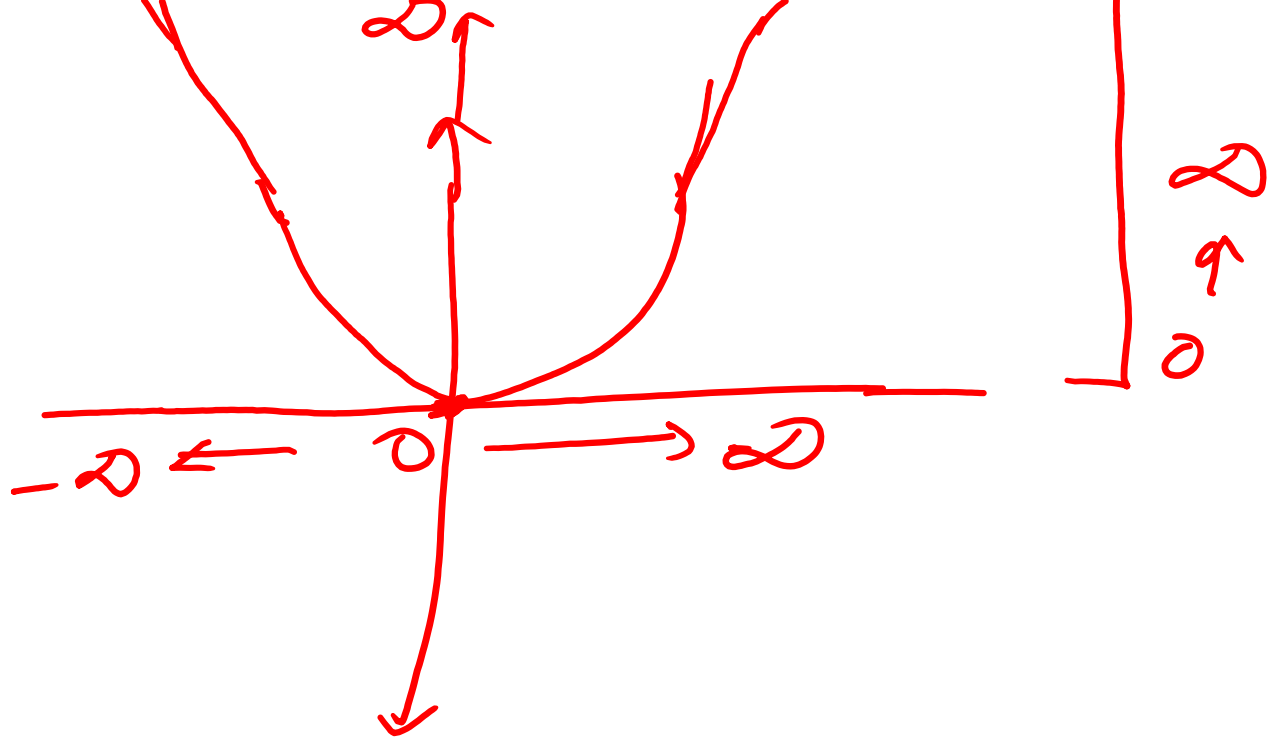
Domain:  $[1, 5]$   
Range:  $[1, 8]$



Domain:  $(-\infty, \infty)$   
Range:  $(-\infty, \infty)$







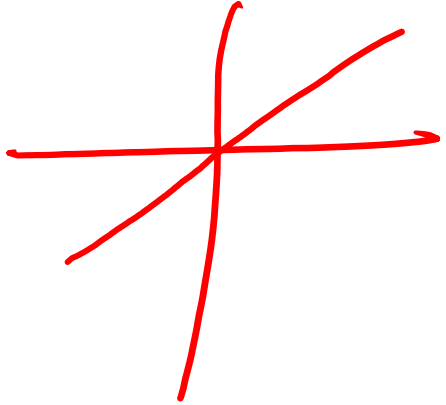
Domain:  $(-\infty, \infty)$

Range:  $[0, \infty)$

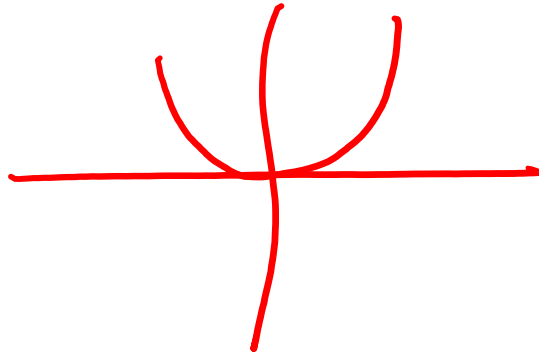
## Basic Graph

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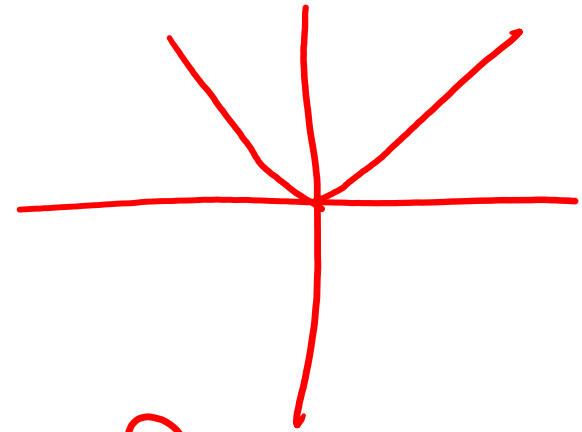
$$f(x) = x$$



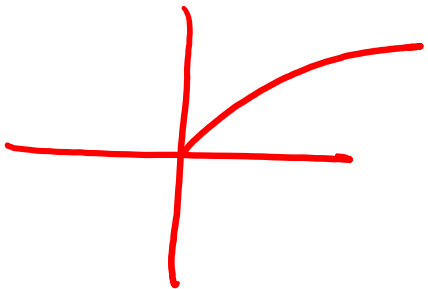
$$f(x) = x^2$$



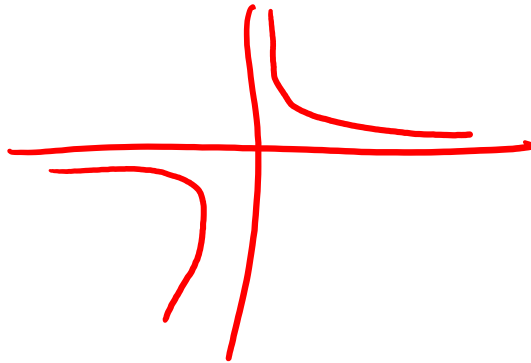
$$f(x) = |x|$$



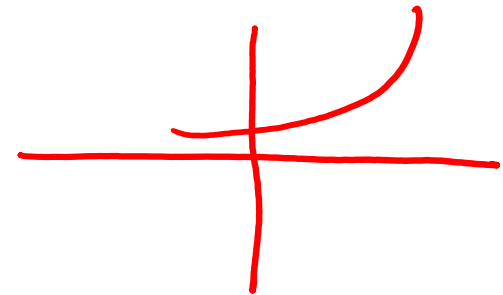
$$f(x) = \sqrt{x}$$



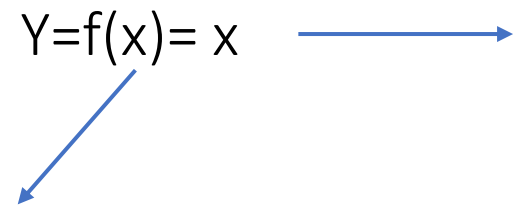
$$f(x) = \frac{1}{x}$$

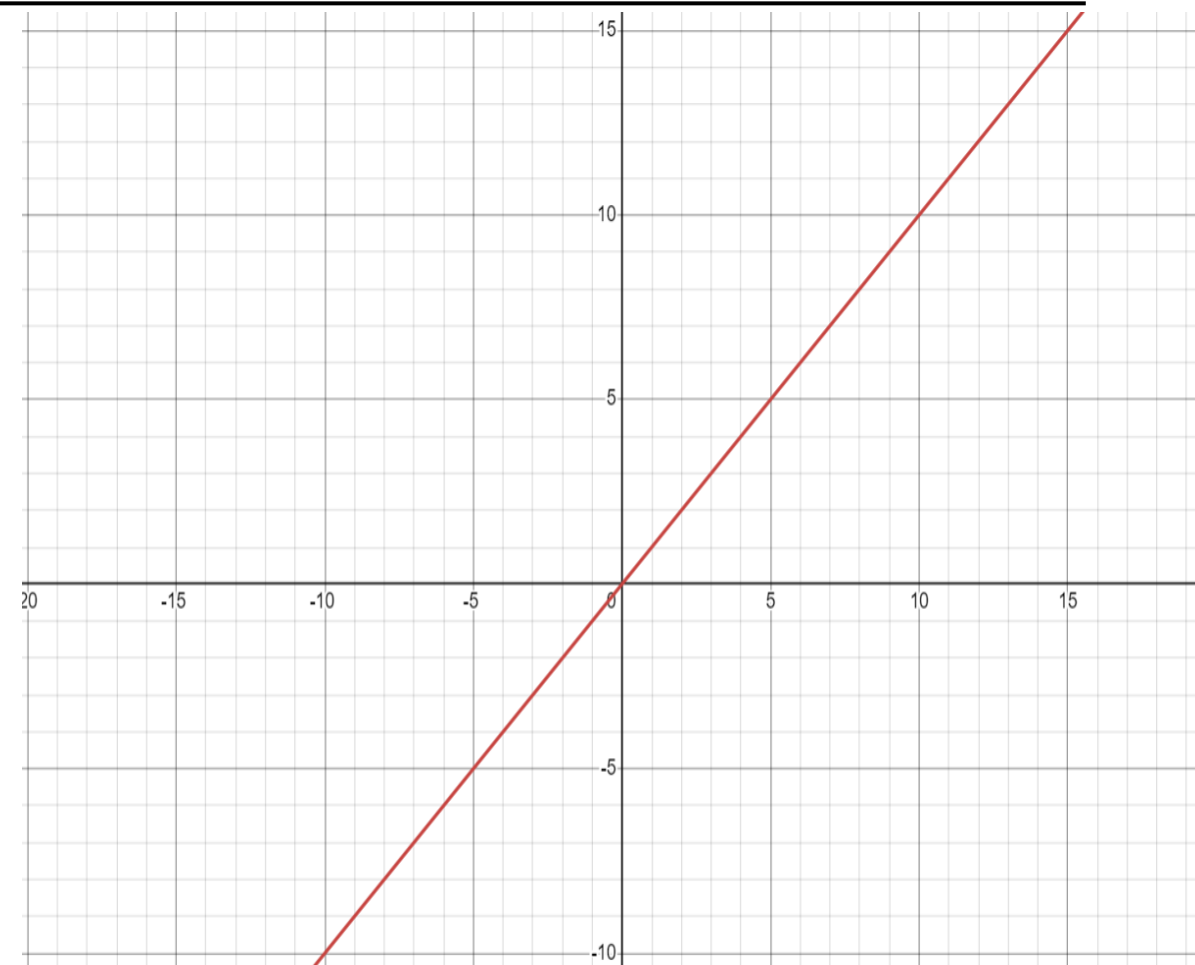


$$f(x) = e^x$$



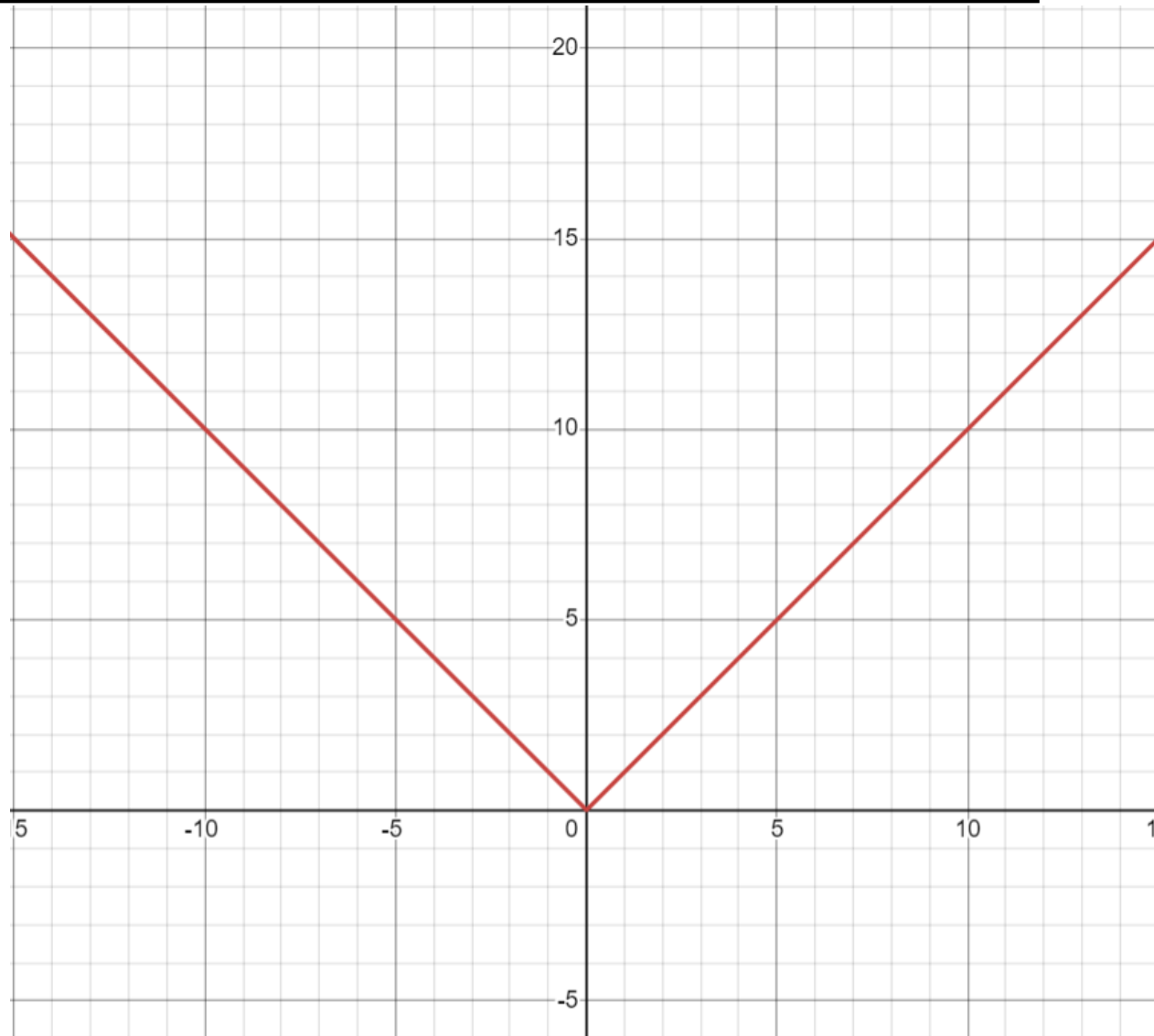
# Basic Graph

$$Y=f(x)=x$$


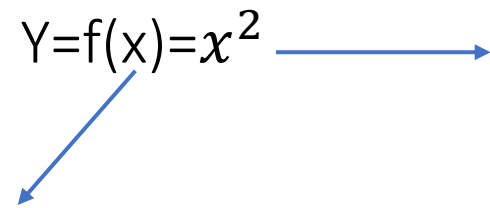


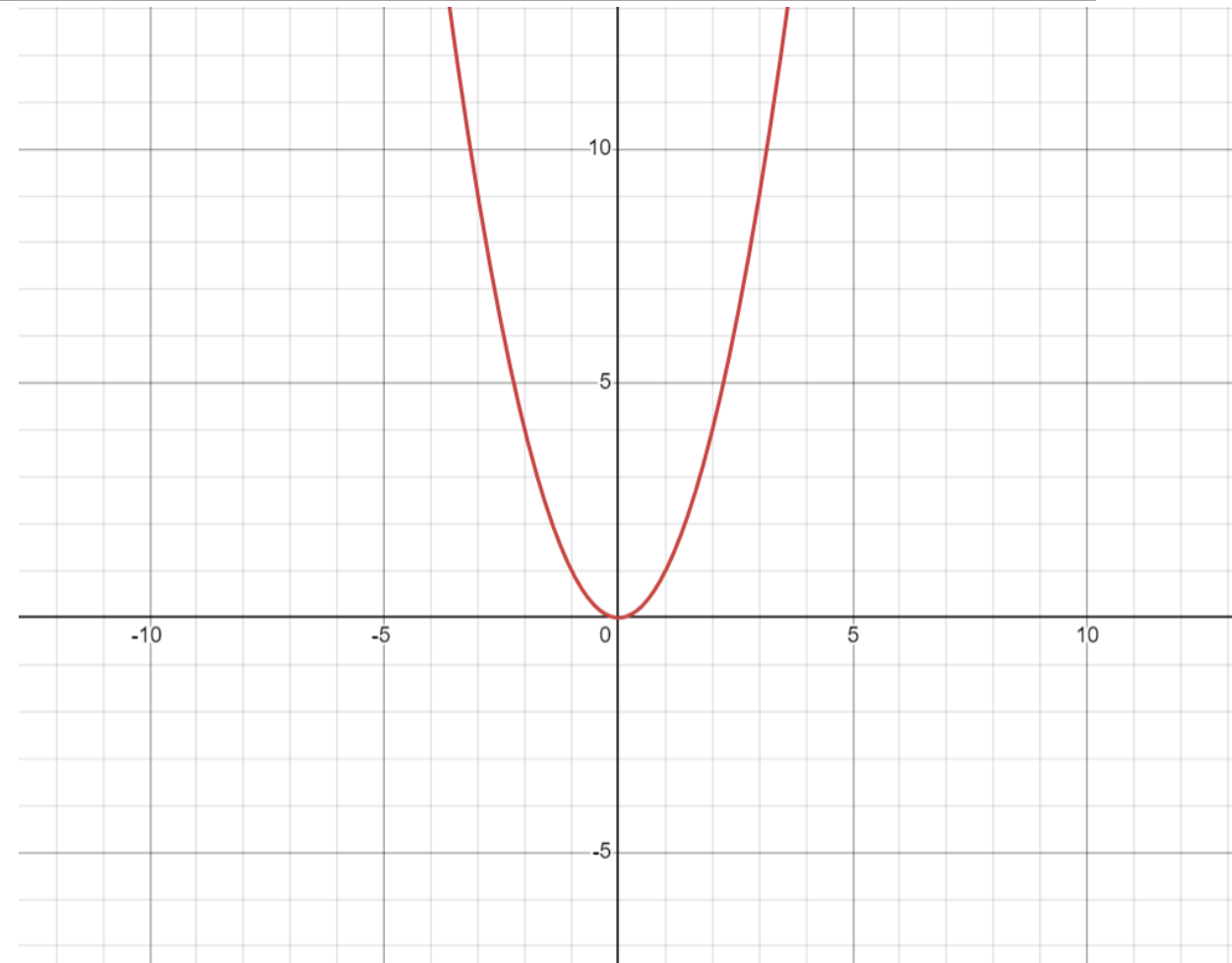
# Basic Graph

$$Y=f(x)=|x|$$



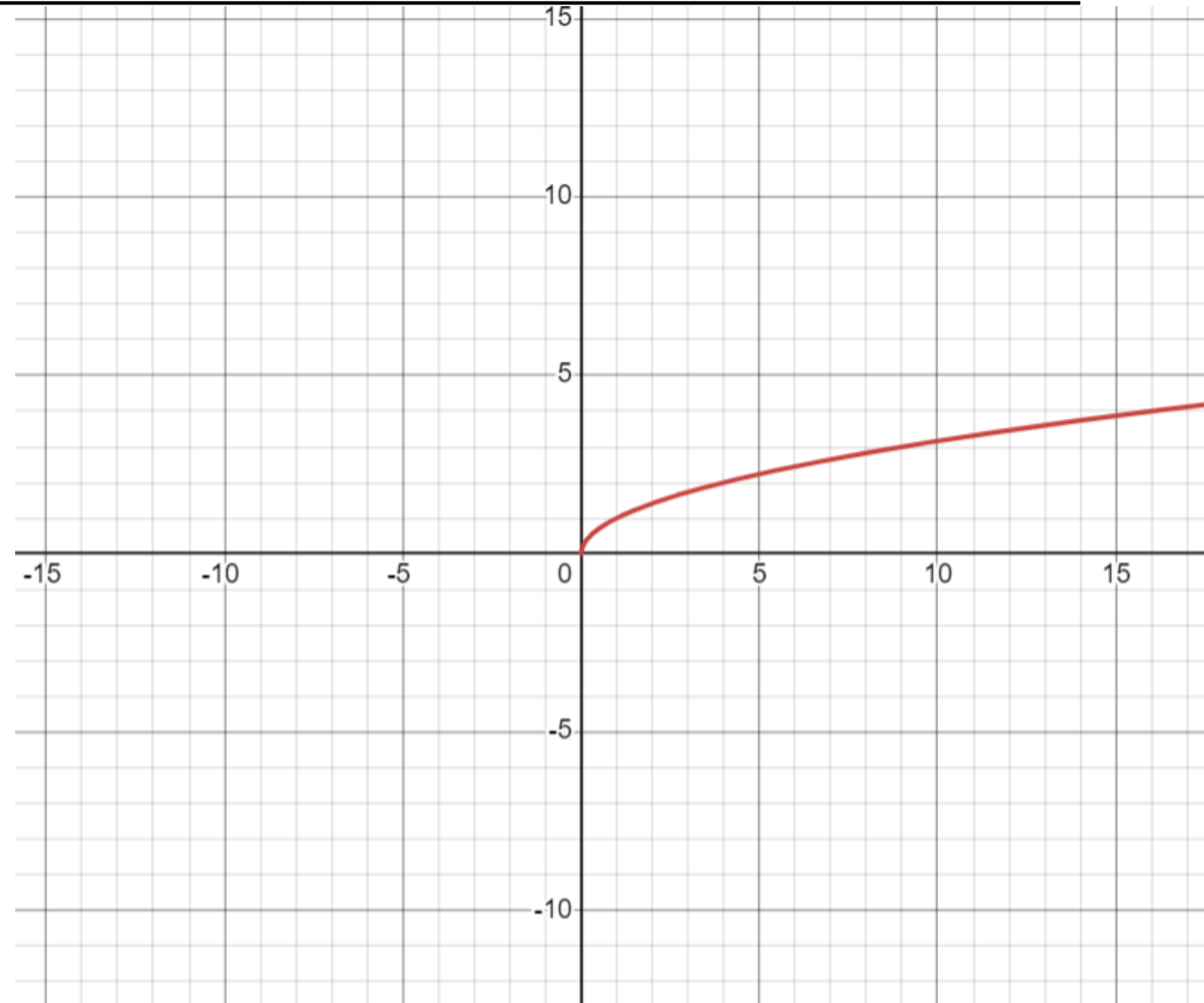
# Basic Graph

$$Y=f(x)=x^2$$


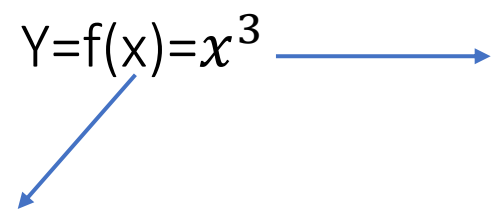


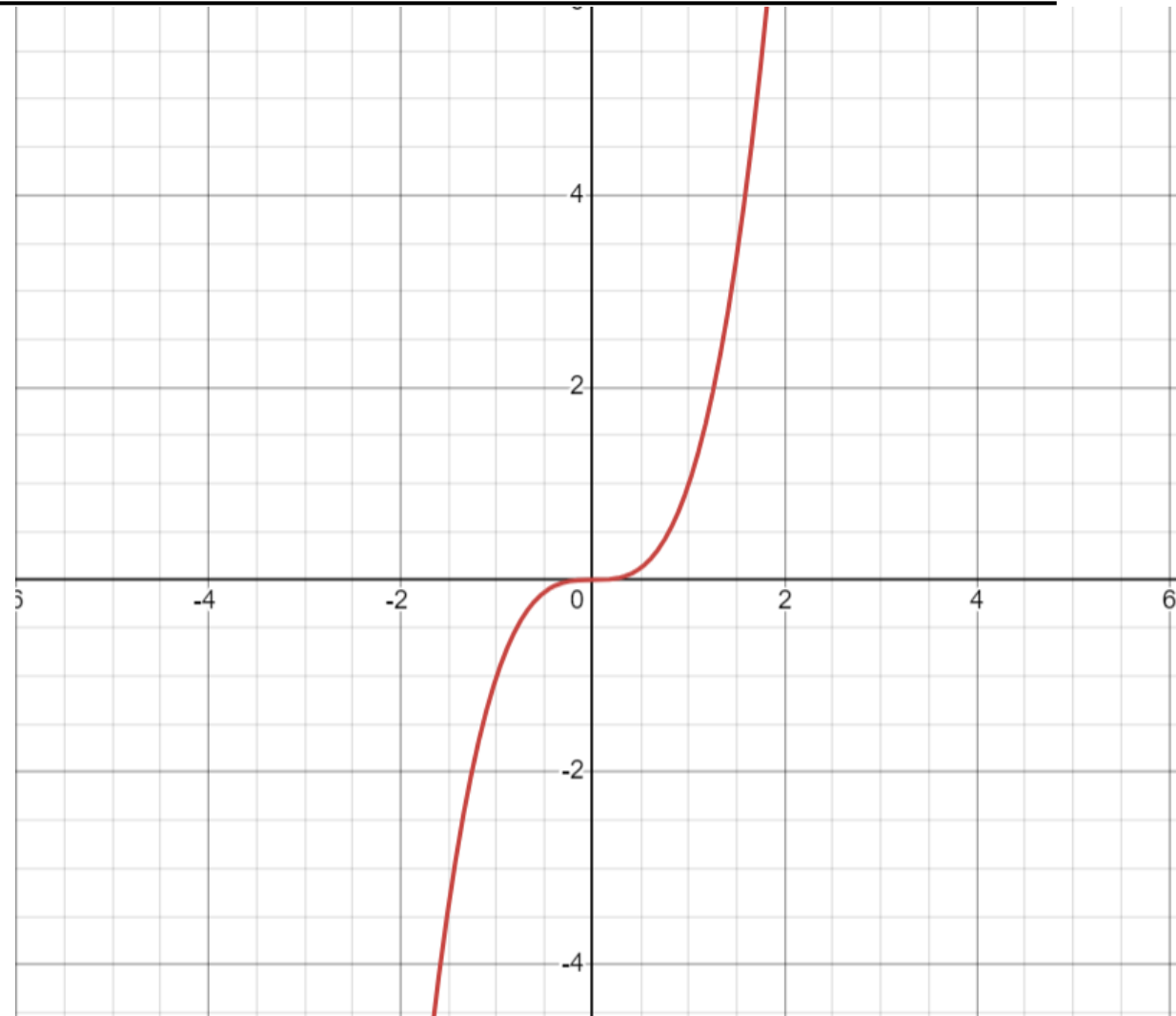
# Basic Graph

$$Y=f(x)=\sqrt{x}$$

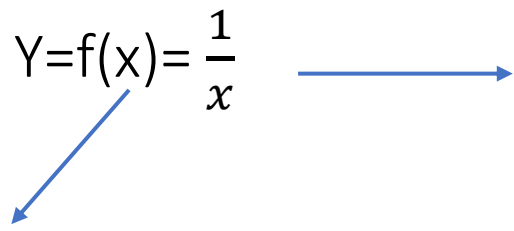


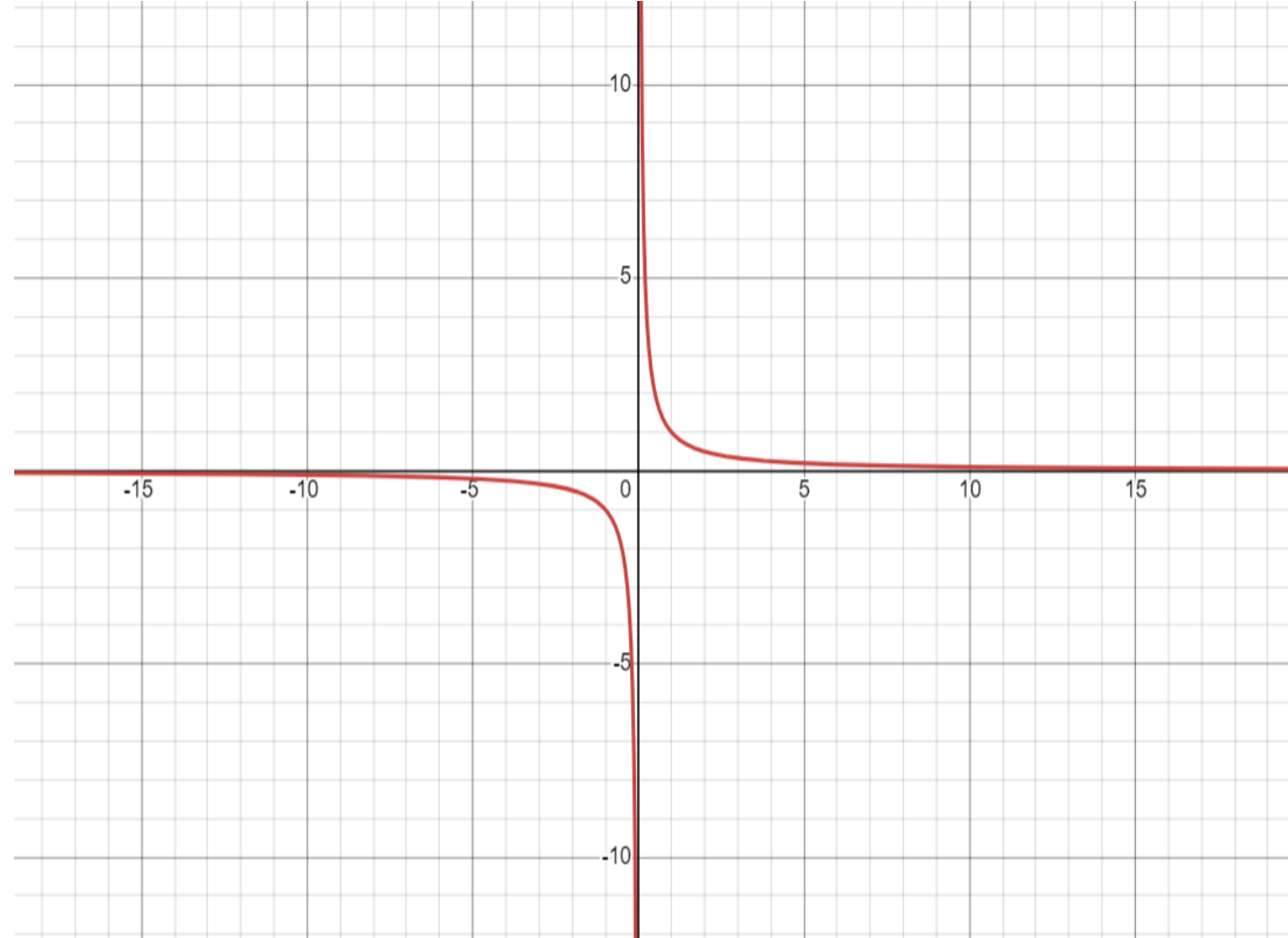
# Basic Graph

$$Y=f(x)=x^3$$




# Basic Graph

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






## Even Function

$$f(x) = 2x + 3$$

$$f(x) = x^2$$

$$-x$$

$$f(x) = \cos x$$

$$(-x) \Rightarrow \underline{f(x)}$$

even

$$f(-x) = \cos(-x) = \cos x = f(x),$$

even

$$f(x) = x^2$$

$$\therefore f(-x) = (-x)^2 = x^2 = f(x) \Rightarrow \underline{\text{even}}$$

## Odd Function

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$$f(x) = x^3 \rightarrow \text{odd}$$

$$\therefore f(-x) = -f(x)$$

$$f(x) = (-x)^3 = -x^3 \rightarrow \text{odd}$$

$$f(x) = x$$

$$f(-x) = -x$$

$$f(x) = \sin x$$

$$f(-x) = \sin(-x) = -\sin x \rightarrow \text{odd function}$$