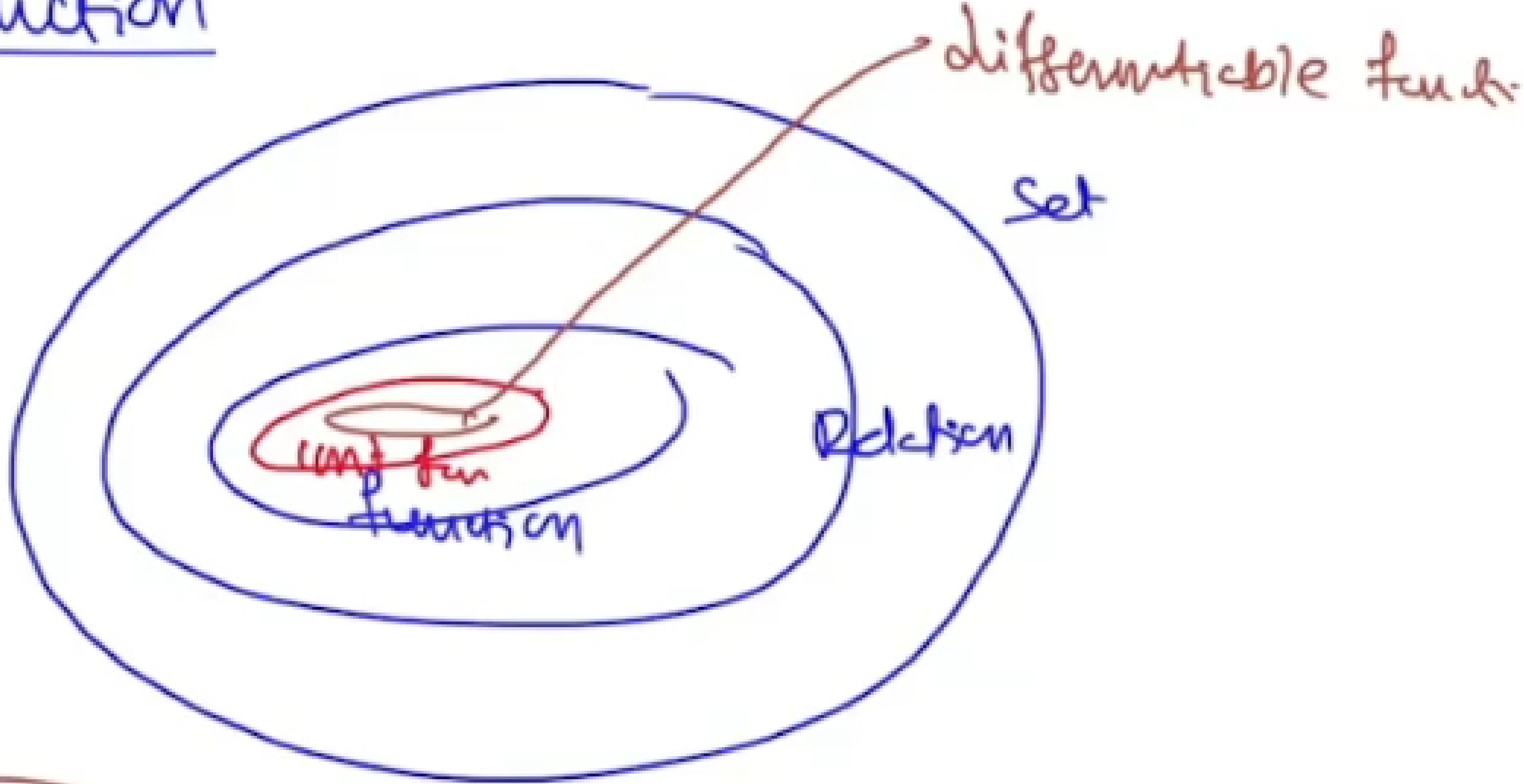
① Function



$$f(x) = x$$

x is the independent variab.

$f(x) = x$ x is the independent variable.

$$y = f(x) \begin{cases} x \\ x^2 \\ 2 \end{cases}$$

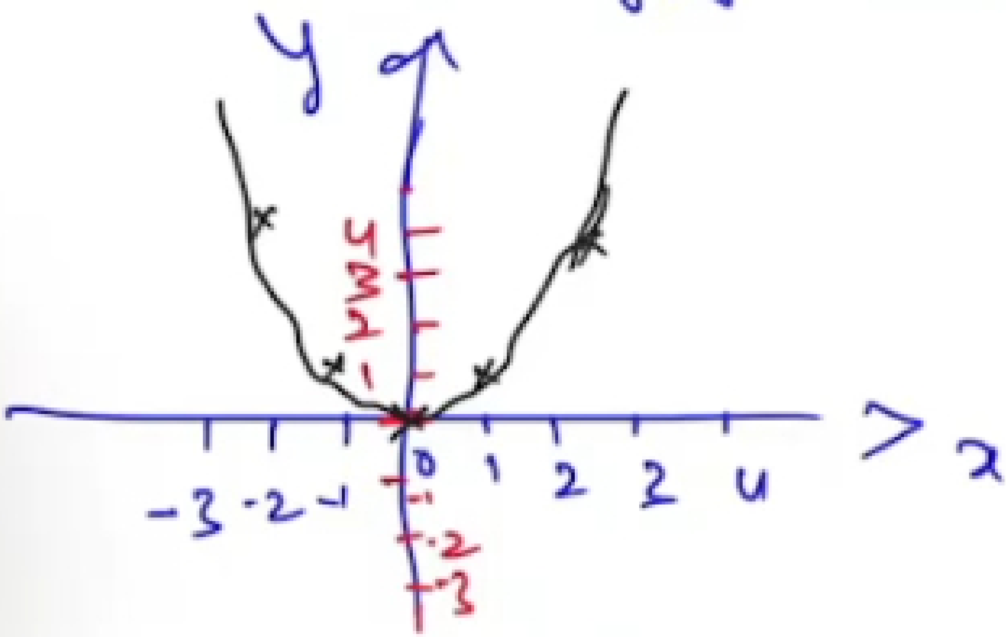
for a given value of 'x' we try to find y value or in other words we say f(x)

the input is the independent variable

for a given value of 'x' we try to find y value or in other words we say $f(x)$

the input is the independent variable

the output is the dependent variable.



$$\boxed{y = x^2}$$

$x = 0$

$x = 1$

x	0	1	2	3	4	5	-1	-2	-3
y	0	1	4	9	16	25	1	4	9

$y = x^2$

Constant function $f(x)$ i.e whatever is the input we get a constant (same) output for all 'x'

$$f(x) = 2 \quad \forall\, x \in N$$

→ natural number set domain

$f(1) = 2$ $\quad$ $f(2) = 2$ $\quad$ $f(3) = 2$

$f(1) = 2 \qquad f(2) = 2 \qquad f(3) = 2$

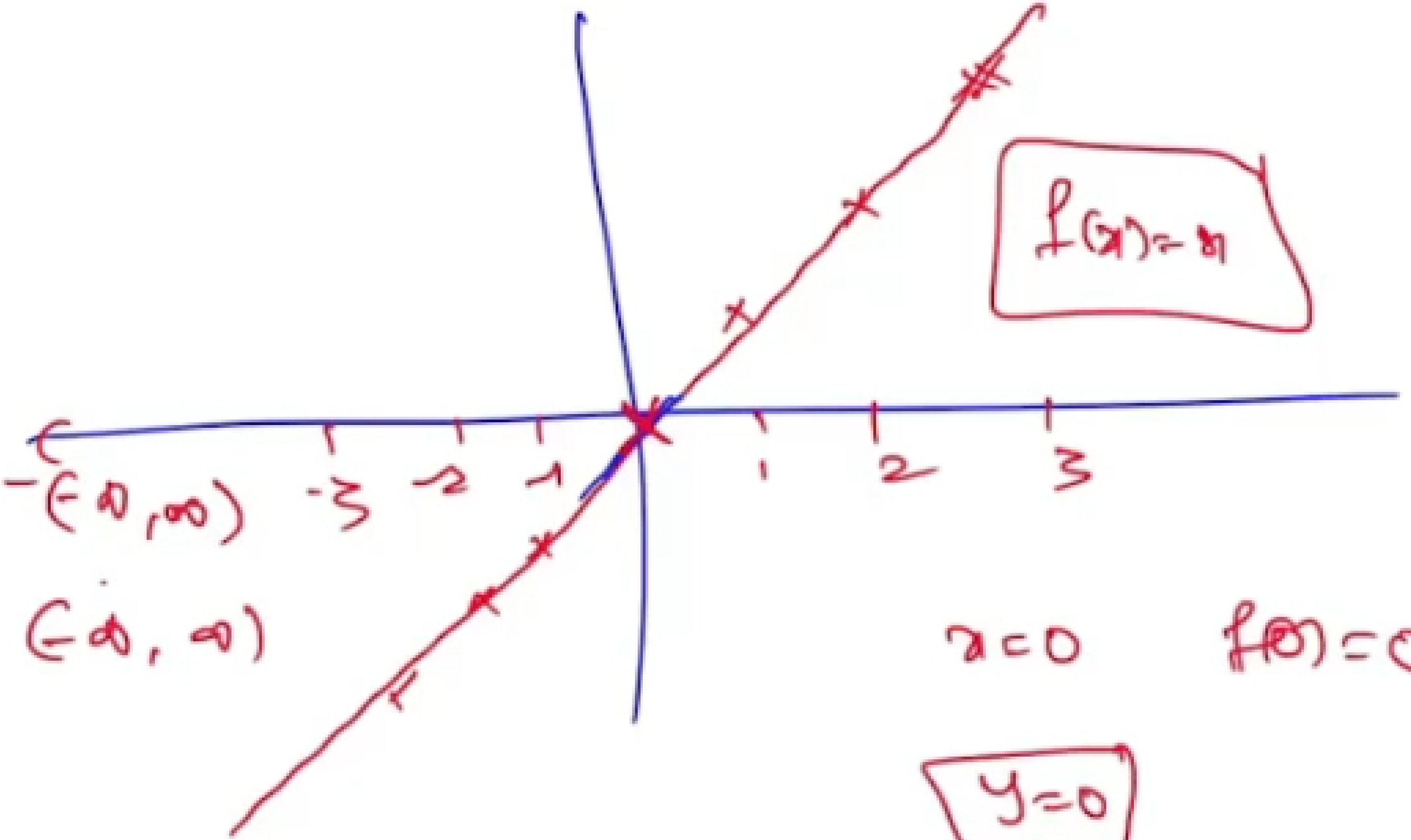
x	1	2	3	4	5	6	.	- - —
$f(x)$	2	2	2	2	2	2		- - —

x	1	2	3	4	5	6	. . . —
$f(x)$	2	2	2	2	2	2	2 2 2 —

→ Indentity $f(x) = x$ * $x \in N$

$x \in \mathbb{R} \rightarrow$ Real num

$f(x)=x$



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

$(-\infty, \infty)$

$(-\infty, \infty)$

$x=0 \quad f(0)=0.$

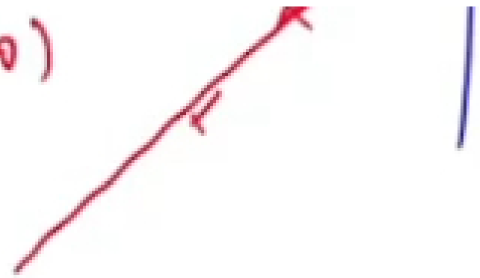
$\boxed{y=0}$

$\boxed{y \quad . \quad f(x)}$

$(x, f(x)) \rightarrow$ represent (x, y)

x is input vari

$(-\infty, \infty)$



$x=0$ $\quad f(0)=0.$

$\boxed{y=0}$

$\boxed{y \quad , \quad f(x)}$

(independant variable) $\quad (x, f(x)) \to$ represent (x, y)

x is input variable

y output variable

(Dependent variable)

y output variable
(dependent variable)

Linear / nonlinear

quadratic
cubic, higher

types of functions

polynomials

nth degree polynomial $P_n(x) = a_0 + a_1 x + a_2 x^2 + \dots + a_n x^{\boxed{n}}$

degree of

$+ a_n x^{\boxed{n}}$

degree of

Trigonometric functions

$\underline{\sin(x)}$, $\sin(2x)$, $\underline{\cos(x)}$, $\cos(nx)$, $\tan x$ etc.

$\tan x = \frac{\sin x}{\cos x}$; $\cot x = \frac{\cos x}{\sin x}$

17:52

hyperbolic functions $\sinh(x)$, $\cosh(x)$,

exponential functions e^{ax}, a^x,

log functions $\log x$,

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polynomial functions

Linear $y = mx + c$

non Linear

parabolic

cubic

polynomial functions

Linear

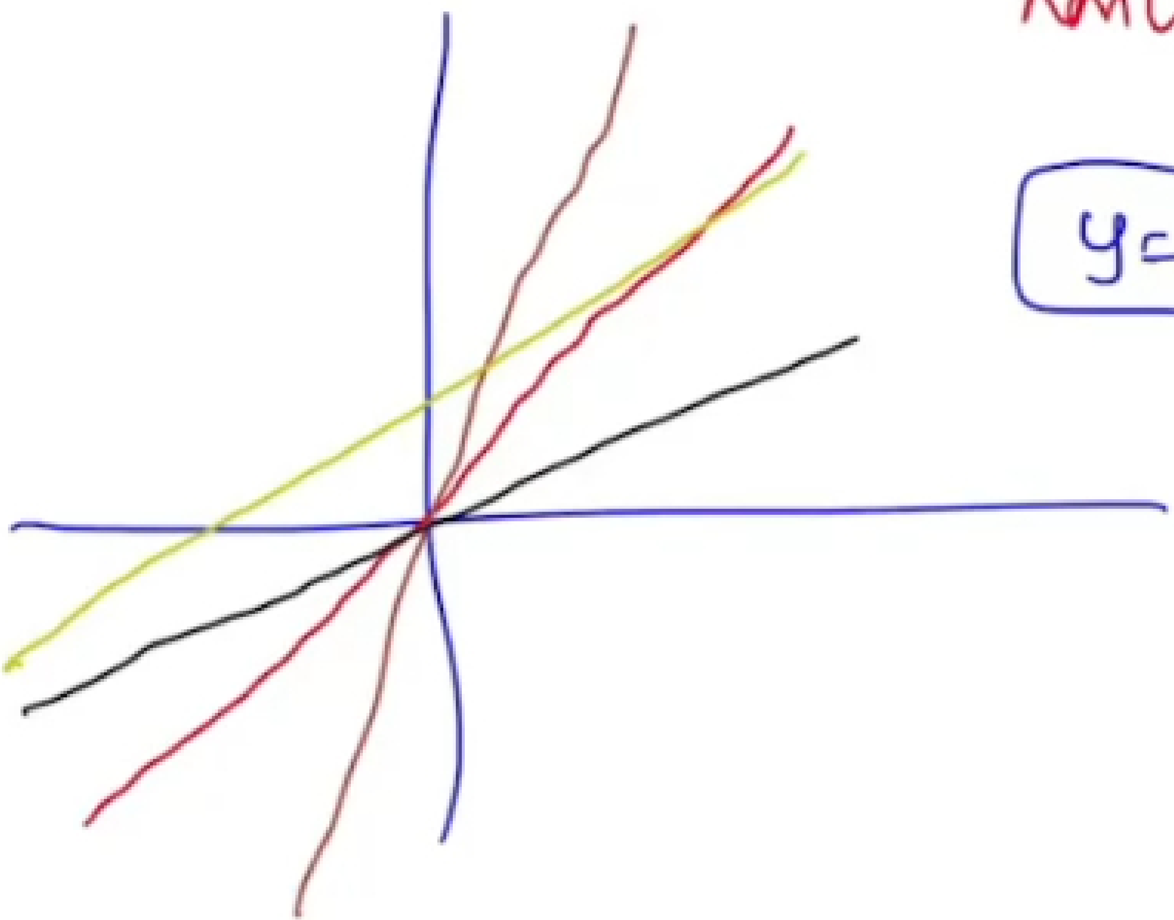
$y = mx + c$

non linear

parabolic

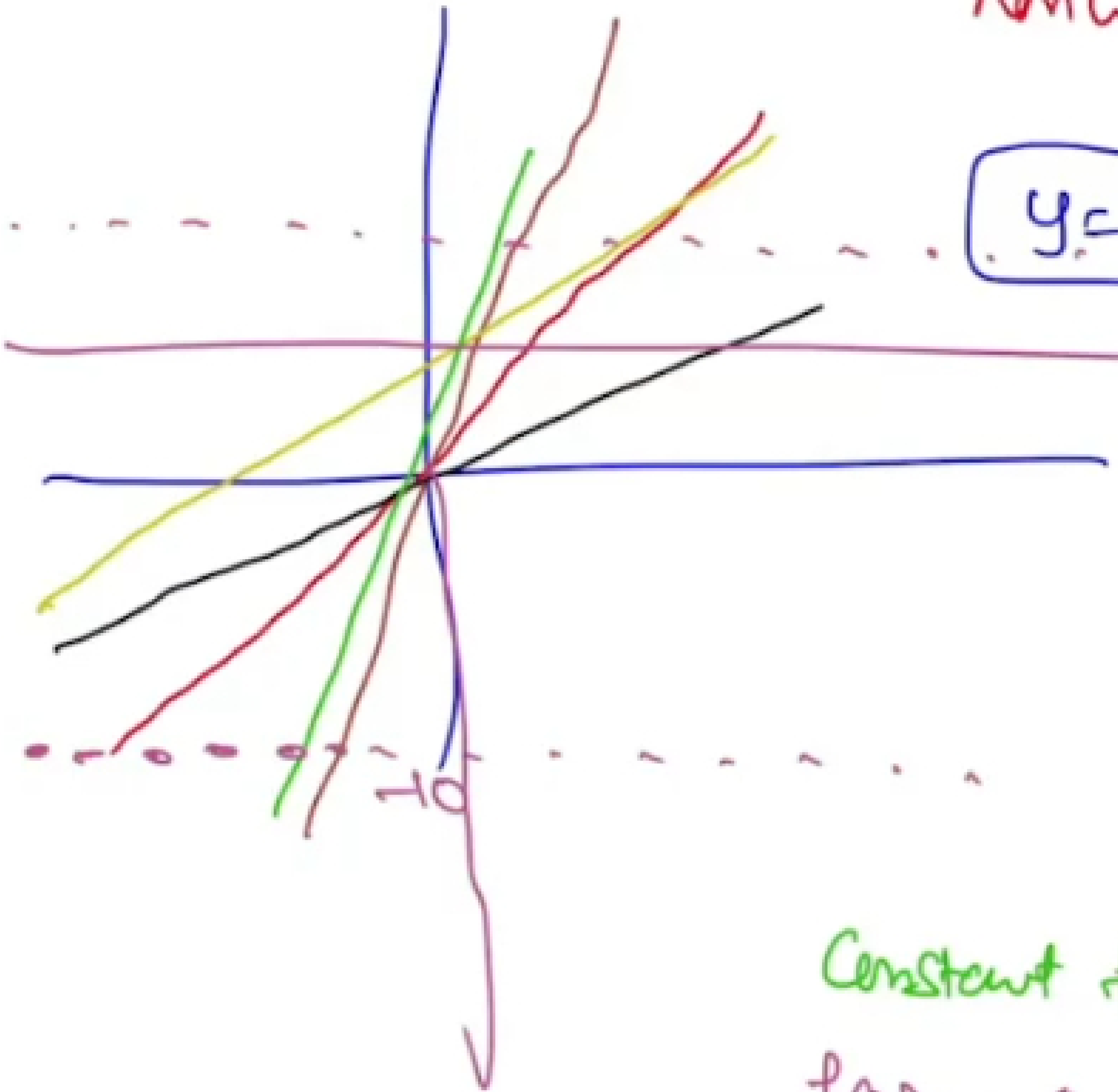
cubic

$y = mx$



$y = mx + \boxed{c}$

non linear
- parabolic
- cubic



$\boxed{y = mx}$

constant function

$y = mx + \boxed{c}$

not passing through the origin.

Constant function

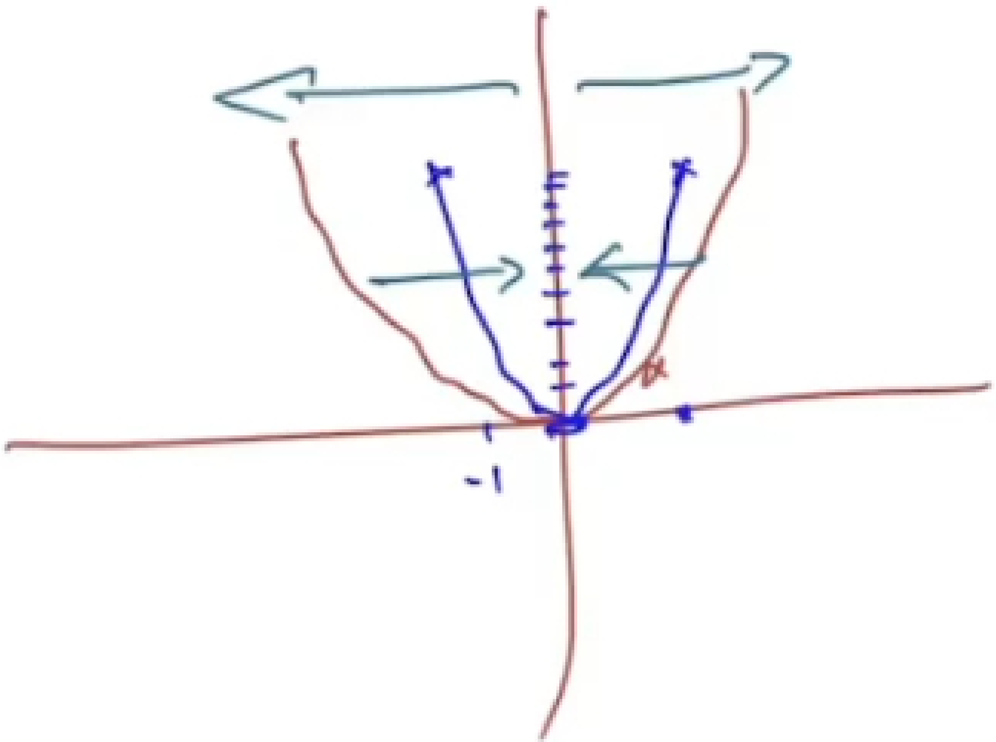
$f(x) = a \in \mathbb{R}$

based on 'a' value.

quadratic function $y = ax^2 + bx + c$

a, b, c are the coefficients.

for example take $y = ax^2$ only let $b, c = 0$



$y = x^2$ when $a = 1$

$y = 10x^2$

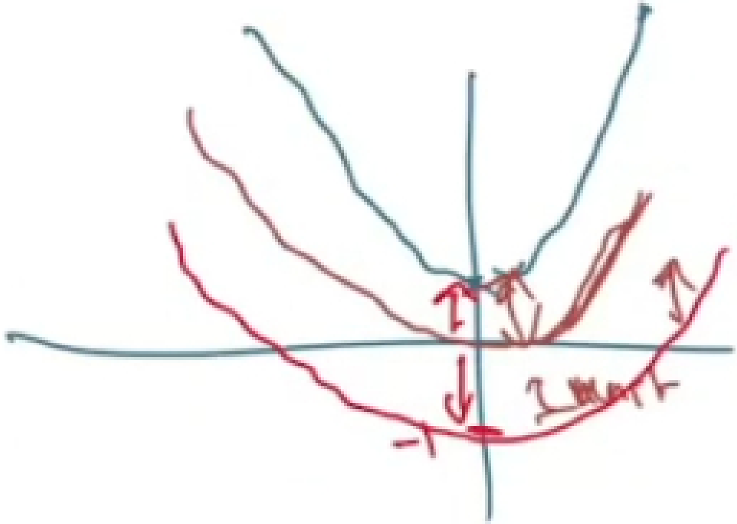
$x = 0 \quad y = 10 \times 0 = 0$

$x = 1 \quad y = 10 \times 1 = 10$

a-value is contraction expansion parameter.

/ expansion parameter.

c = constant $\quad y = ax^2 + c.$



$c > 0$ precisely assume

$c = 1$

Suppose $c = -1$

$y = ax^2 + \boxed{bx} + c$

→ one-one function | onto function

$f : D_1 \longrightarrow D_2 \qquad D_1, D = \mathbb{R}$

$f(x) = x^2 \quad \forall$

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

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

$f : D_1 \longrightarrow D_2$

~~f~~ for all natural numbers that are having images in D_2. but what about the pre-images for the entries / numbers in D_2

for example if you take $1/5$ in D_2

Do you have a pre-image?

$f(x) = x$ You see that $1/5 \notin N$.

You cannot find pre-image in the domain.

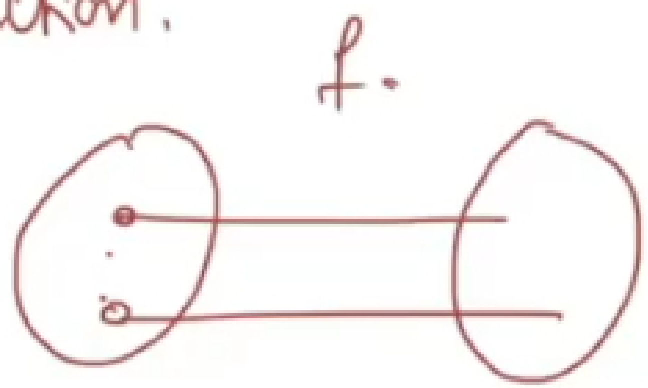
he

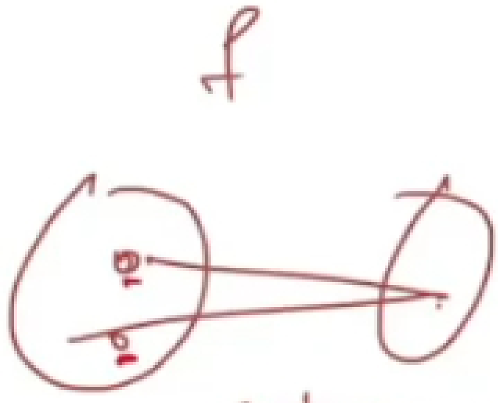
$f(x) = x$ You see that $\frac{1}{5} \notin N$.

You cannot find pre-image in the domain.

hence it is not an onto function.

A function is bijective if it is one-one and onto function.

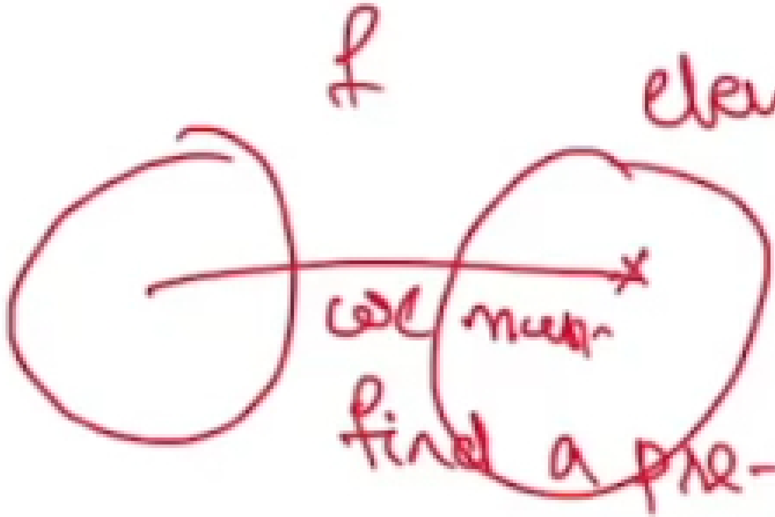




not one-one.

whenever $f(a) = f(b) \Rightarrow \boxed{a = b}$

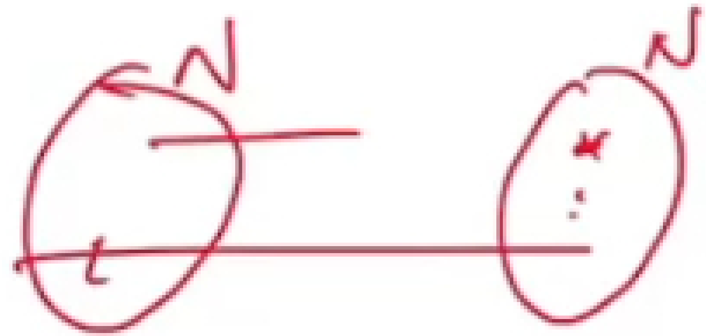
For example $f(x) = x^2$ $f(-1) = f($



element in the co-domain

find a pre-image in the domain.

$f(x) = x$



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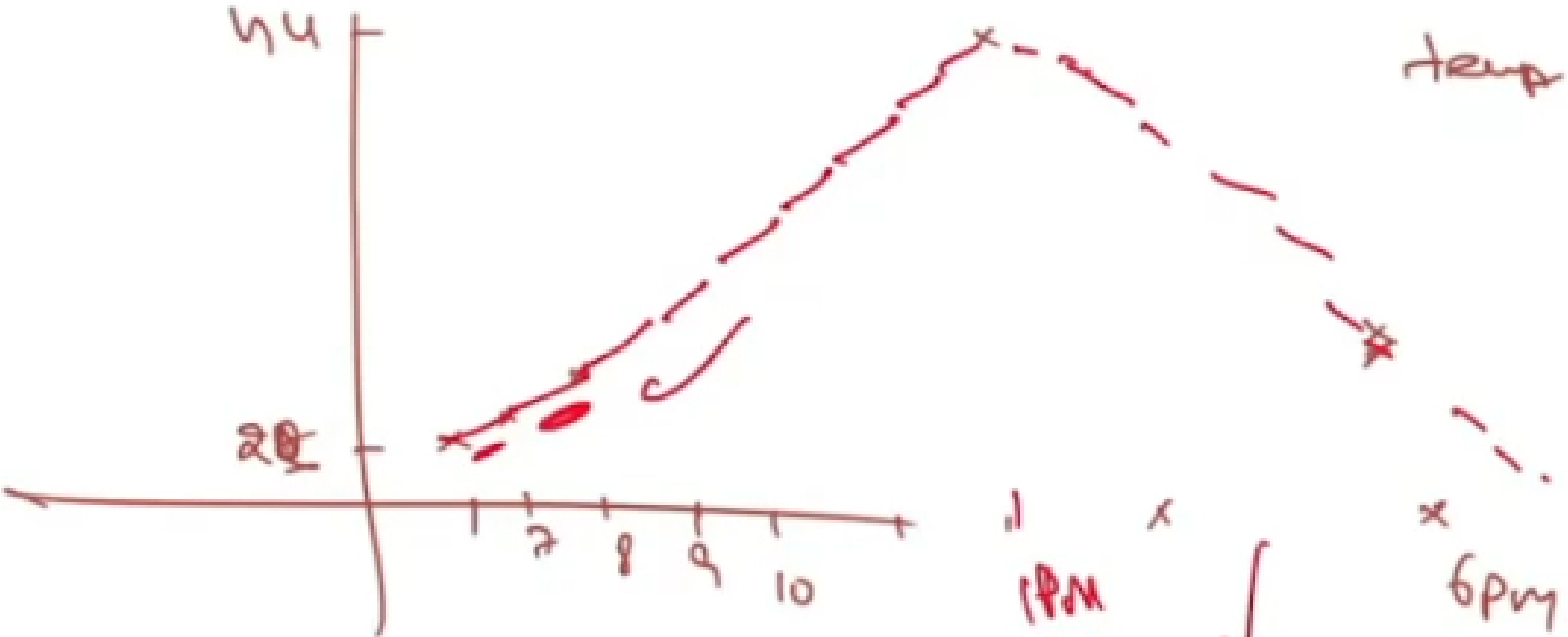
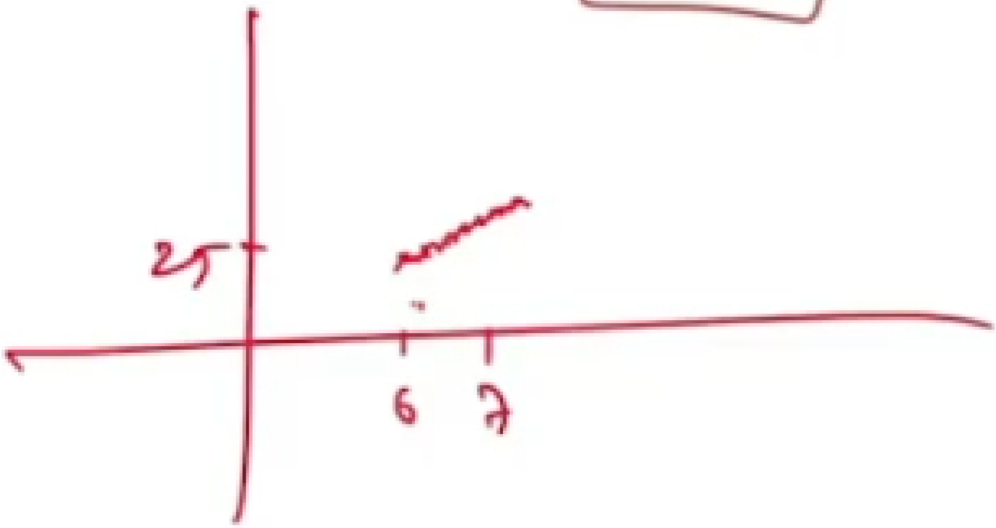
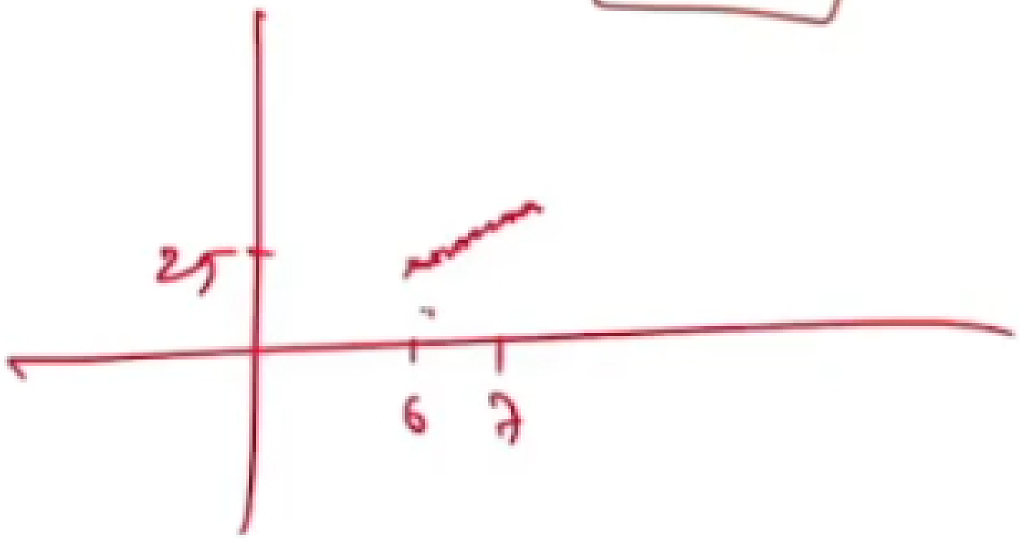


You don't have a function

$\boxed{6 \text{ to } 7}$



$\boxed{6 \text{ to } 7}$



↓

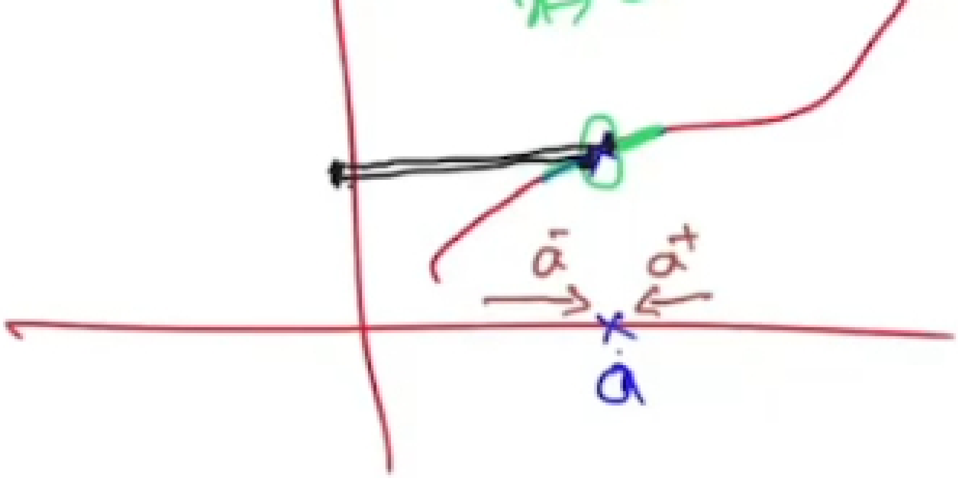
You don't have a function

-) Limit of function

about a function

after finding every location in the domain we are generalizing over the domain

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



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

$$\lim_{x \to a^+} f(x) = ?$$

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

$$f(x)\Big|_{x=a} = f(a) = ?$$

if the limits like left limit and Right limits exists and equal we say the limit of a function at that point exists.

the limit ...
at that point exists.

$f(a)$ | $= f(a) = ?$

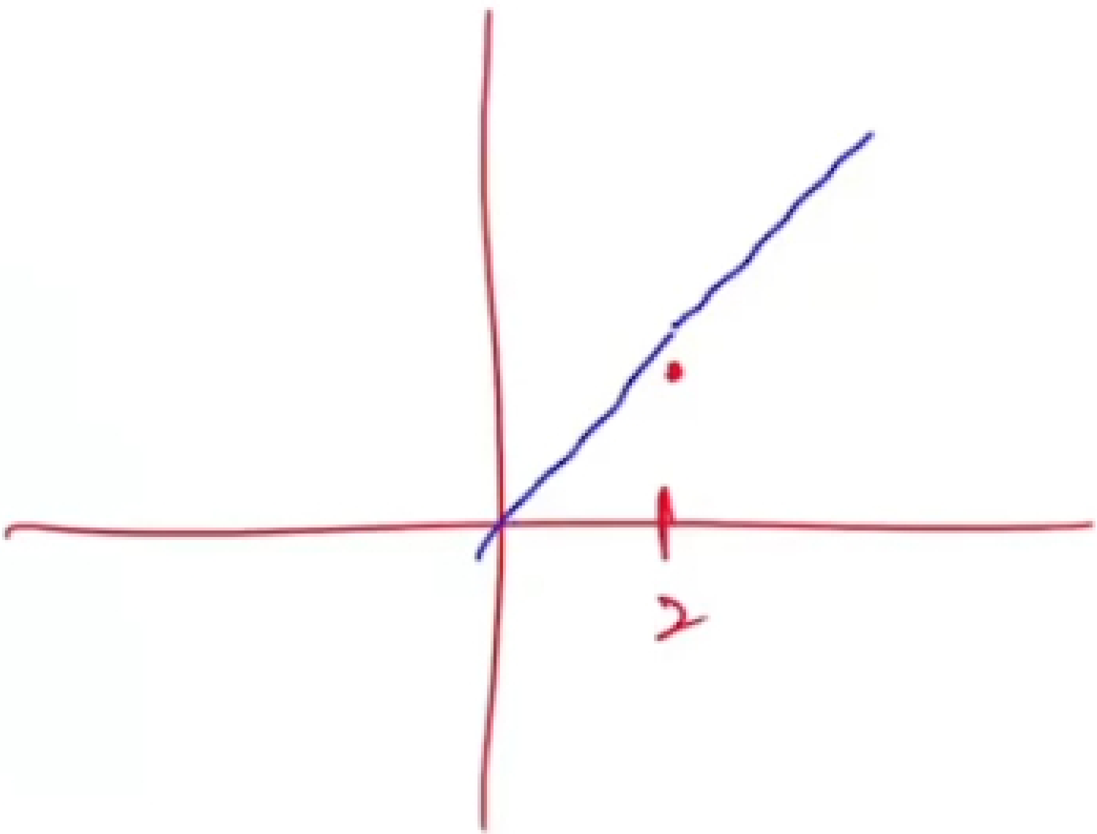
$x = a$

$$\lim_{x \to a^+} f(x) = \lim_{x \to a^-} f(x)$$ we say the limit of the function at 'a' exists.

If the above concept is valid on entire domain then we say limits ~~exists on~~ of the function exists on the domain

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

we say the function is continuous on D.



$$f(x) = \begin{cases} x & \forall x \neq 2 \\ 1 & x = 2 \end{cases}$$

$$f(x) = \begin{cases} x & \forall x \neq 2 \\ 1.5, & x = 2 \end{cases}$$

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