 # (EXERCISE = 11.1) pakcity.org

Find the periods of functions

(Question # 1)

Sin 3x

As sin is a periodic function and its period is 2π

$\sin 3x = \sin(3x + 2\pi)$

$\sin 3x = \sin 3\left(x + \frac{2\pi}{3}\right)$

$\sin 3x = \sin 3\left(x + \frac{2\pi}{3}\right)$

Hence, $\frac{2\pi}{3}$ is a period of $\sin 3x$.

(2)

Cos 2x

As cos is a periodic function and its period is 2π

$\cos 2x = \cos(2x + 2\pi)$

$\cos 2x = \cos 2\left(x + \frac{2\pi}{2}\right)$

$\cos 2x = \cos 2(x + \pi)$

Hence, π is a period of $\cos 2x$.

(3)

tan 4x

As tan is a periodic function and its period is π

$\tan 4x = \tan(4x + \pi)$

$\tan 4x = \tan 4\left(x + \frac{\pi}{4}\right)$.

Hence, $\frac{\pi}{4}$ is a period of $\tan 4x$.

(4)

cot x/2

As cot is a periodic function and its period is π

$\cot \frac{x}{2} = \cot\left(\frac{x}{2} + \pi\right)$

$\cot x/2 = \cot\left(\frac{x + 2\pi}{2}\right) \Rightarrow \cot \frac{1}{2}(x + 2\pi)$

Hence, 2π is a period of $\cot x/2$

(5)

sin x/3

As sin is a periodic function and its period is 2π

(6)

cosec x/4.

As cosec is a periodic function and its period is 2π

$\sin\frac{x}{3} = \sin\left(\frac{x}{3}+2\pi\right)$

$\sin\frac{x}{3} = \sin\left(\frac{x+6\pi}{3}\right)$

$\sin\frac{x}{3} = \sin\frac{1}{3}(x+6\pi)$

Hence, 6π is a period of $\sin\frac{x}{3}$

$\operatorname{cosec} x/4 = \operatorname{cosec}\left(\frac{x}{4}+2\pi\right)$

$\operatorname{cosec} x/4 = \operatorname{cosec}\left(\frac{x+8\pi}{4}\right)$

$\operatorname{coosec} = \operatorname{cosec}\frac{1}{4}(x+8\pi)$

Hence, 8π is a period of $\operatorname{cosec}\frac{x}{4}$

(7)

$\sin\frac{x}{5}$

As sin is a periodic function and its period is 2π

$\sin\frac{x}{5} = \sin\left(\frac{x}{5}+2\pi\right)$

$\sin\frac{x}{5} = \sin\left(\frac{x+10\pi}{5}\right)$

$\sin\frac{x}{5} = \sin\frac{1}{5}(x+10\pi)$

Hence, 10π is a period of $\sin\frac{x}{5}$

(8)

$\cos x/6$

As cos is a periodic function and its period is 2π

$\cos\frac{x}{6} = \cos\left(\frac{x}{6}+2\pi\right)$

$\cos\frac{x}{6} = \cos\left(\frac{x+12\pi}{6}\right)$

$\cos\frac{x}{6} = \cos\frac{1}{6}(x+12\pi)$

Hence, 12π is a period of $\cos x/6$

(9)

$\tan x/7$

As tan is periodic function and its period is π

$\tan\frac{x}{7} = \tan\left(\frac{x}{7}+\pi\right)$

$\tan\frac{x}{7} = \tan\frac{1}{7}(x+7\pi)$

Hence, 7π is a period of $\tan x/7$

(10)

$\cot 8x$.

As cot is a periodic function and its period is π

$\cot 8x = \cot(8x+\pi)$

$\cot 8x = \cot 8(x+\pi/8)$

Hence, $\pi/8$ is a period of $\cot 8x$.

(11)

$\sec 9x$

As sec is a periodic function and its period is 2π

$\sec 9x = \sec(9x+2\pi)$

$\sec 9x = \sec 9\left(x+\frac{2\pi}{9}\right)$

Hence, $\frac{2\pi}{9}$ is a period of $\sec 9x$.

(12)

$\operatorname{cosec} 10x$

As cosec is a periodic function and its period is 2π

$\operatorname{cosec} 10x = \operatorname{cosec}(10x+2\pi)$

$\operatorname{cosec} 10x = \operatorname{cosec} 10\left(x+\frac{\pi}{5}\right)$

Hence, $\frac{\pi}{5}$ is a period of $\pi/5$

(13)

$3\sin x$

As sin is a periodic function and its period is 2π.

$3\sin x = 3\sin(x+2\pi)$

Hence, 2π is a period of $3\sin x$.

(14)

$2\cos x$

As cos is a periodic function and its period is 2π.

$2\cos x = 2\cos(x+2\pi)$.

Hence, 2π is a period of $2\cos x$.

(15)

$3\cos x/5$

As cos is a periodic function and its period is 2π.

$3\cos\frac{x}{5} = 3\cos\left(\frac{x}{5}+2\pi\right)$.

$3\cos\frac{x}{5} = 3\cos\left(\frac{x+10\pi}{5}\right)$.

$3\cos\frac{x}{5} = 3\cos\frac{1}{5}(x+10\pi)$.

Hence, 10π is a period of $3\cos x/5$

(16)

$\cos x/5$

Hence, cos is a periodic function and its period is 2π.

$\cos x/5 = \cos\left(\frac{x}{5}+2\pi\right)$.

$\cos x/5 = \cos\left(\frac{x+10\pi}{5}\right)$.

$\cos x/5 = \cos\frac{1}{5}(x+10\pi)$.

Hence, 10π is a period of $\cos x/5$.

(17)

$3\sin\frac{2x}{5}$

As, sin is a periodic function and its period is 2π.

$3\sin\frac{2x}{5} = 3\sin\left(\frac{2x}{5}+2\pi\right)$.

$3\sin\frac{2x}{5} = 3\sin\left(\frac{2x+10\pi}{5}\right)$

$3\sin\frac{2x}{5} = 3\sin\frac{2}{5}(x+5\pi)$.

Hence, 5π is a period of $3\sin\frac{2x}{5}$

(18)

$\tan x/3$.

As tan is a periodic function and its period is π.

$\tan x/3 = \tan\left(\frac{x}{3}+\pi\right)$.

$\tan x/3 = \tan\left(\frac{x+3\pi}{3}\right)$.

$\tan x/3 = \tan\frac{1}{3}(x+3\pi)$.

Hence, 3π is a period of $\tan x/3$.

(19)

Write the Domain and Range:

$y=\sin x$

Domain $= -\infty < x < +\infty$

Range $= -1 \le y \le 1$.

(20)

$y=\cos x$

Domain $= -\infty < x < +\infty$

Range $= -1 \le y \le 1$.

(21)

$Y = \tan x$

Domain $= -\infty < x < +\infty, x \neq \frac{(2n+1)\pi}{2}, n \in Z.$

Range $= -\infty < y < +\infty.$

(22)

$Y = \operatorname{cosec} x$

Domain $= -\infty < x < +\infty, x \neq n\pi, n \in Z.$

Range $= y \geq 1$ or $y \leq -1.$

(23)

Define periodicity:

All the six trignonometric functions repeat their values for each increase or decrease of 2π in θ. This behaviour of trignometric function is called periodicity.

(24)

Define period of function:

Period of trigonometric function is a smallest positive number which, when added to the original circular measure of the angle give the same value of the function.

(25)

Find rang and period of $3\sin x$.

Period:- As sin is a periodic function so its period is 2π.

$3\sin x = 3\sin(x + 2\pi)$.

$3\sin x$ have 2π period.

Range: $3\sin x = -1 \leq y \leq 1.$

Domain of a function:

Domain is a set of all possible Input values of the function OR the values that x can taken is called domain of function.

Range of function:

Range is the set of the all possible outputs values OR The Values that y can tank is called range of a function.

Example:-

$y = x^2 + 1$

put $x = 1$

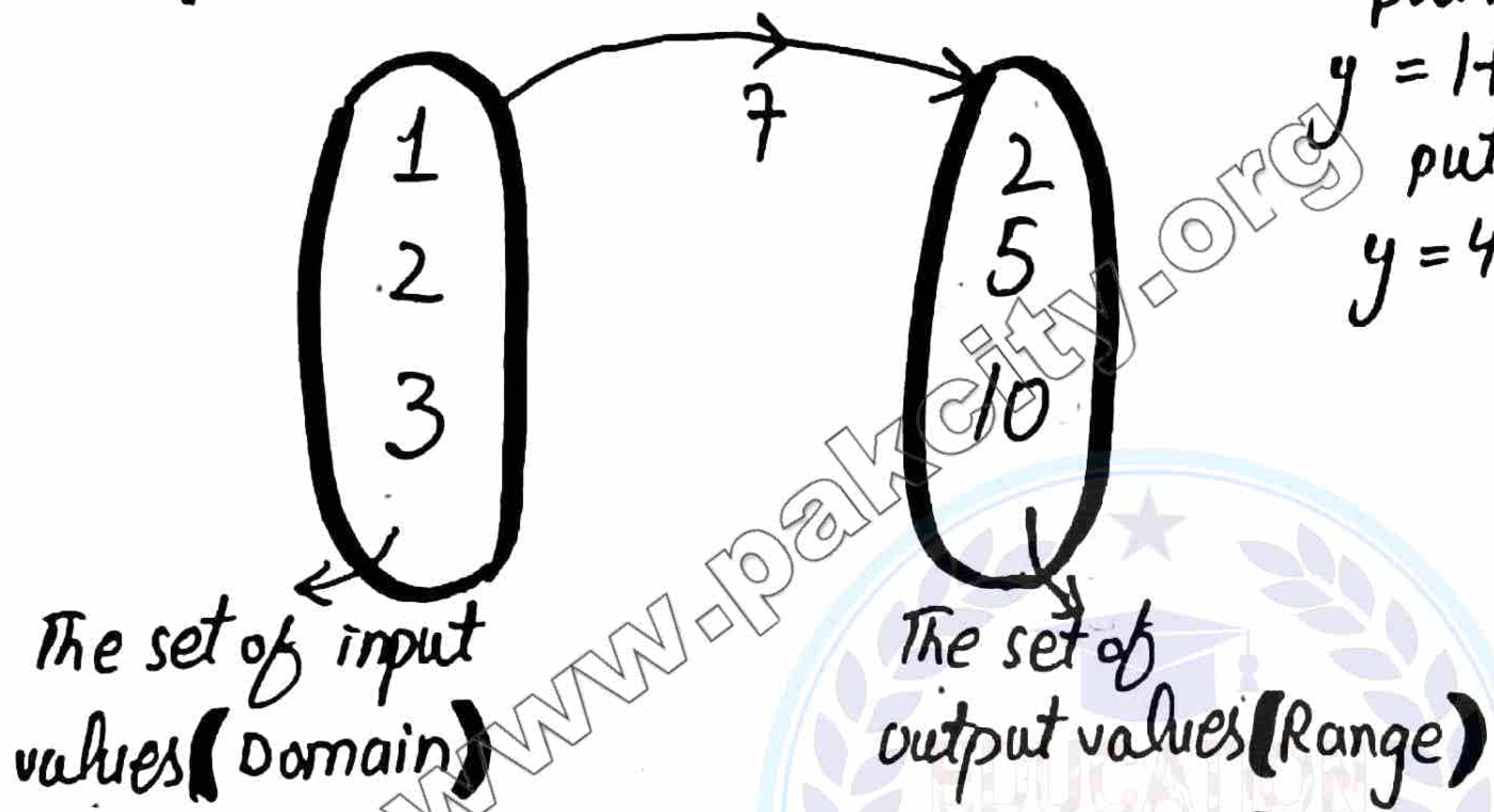
$y = 1 + 1 = 2$

put $x = 2$

$y = 4 + 1 = 5$

put $x = 3$

$y = 9 + 1 = 10$.



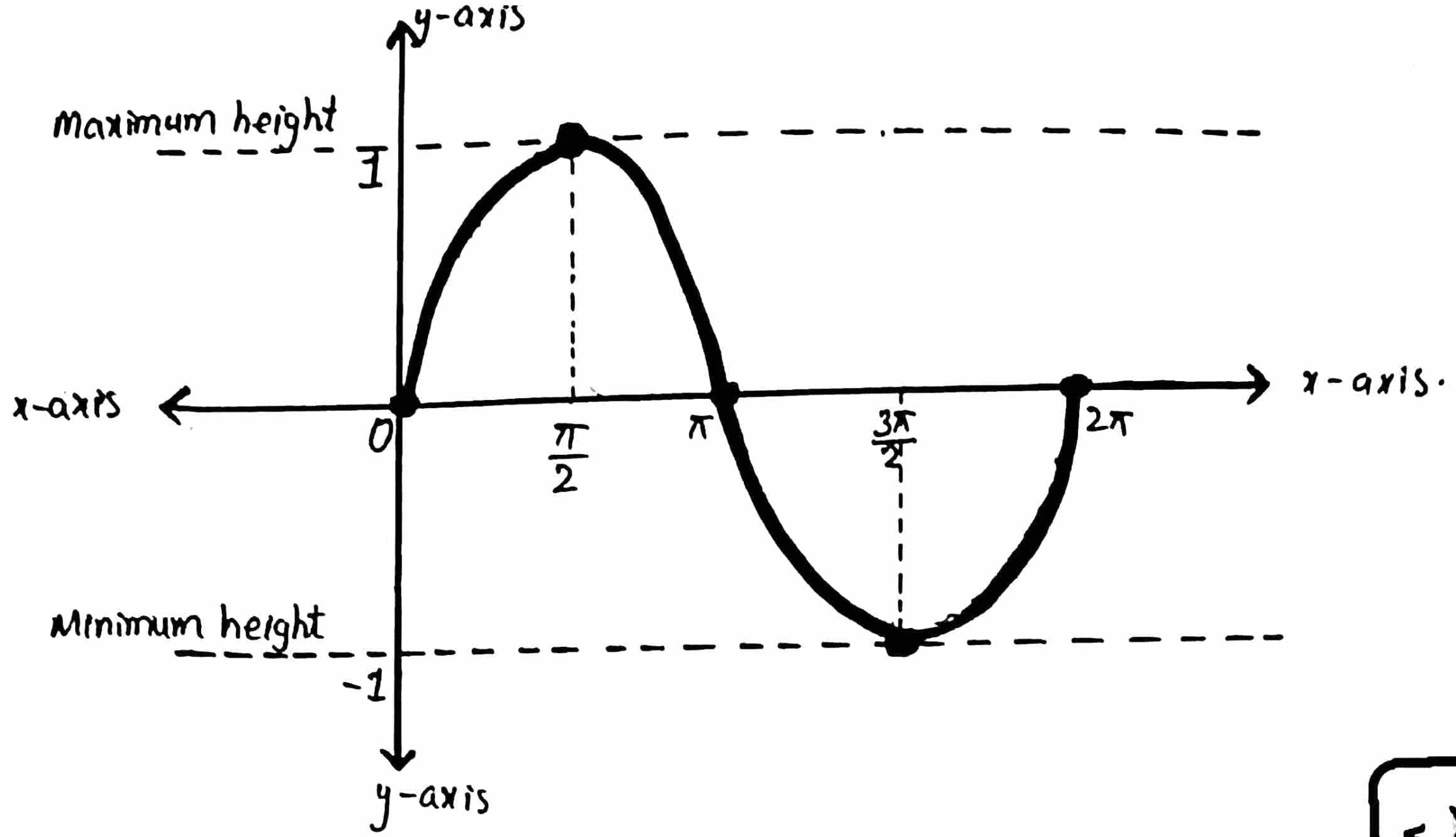
(Graph of sin function)

Graph of $y = \sin x$ from $0°$ To $360°$

x	0	90°	180°	270°	360°
y	0	1	0	-1	0

Domain = set of all real numbers $\mathbb{R}$ or $(-\infty, +\infty)$. → paranthesis

Range = $-1 \leq y \leq 1$ or $[-1, 1]$ → closed Bracket

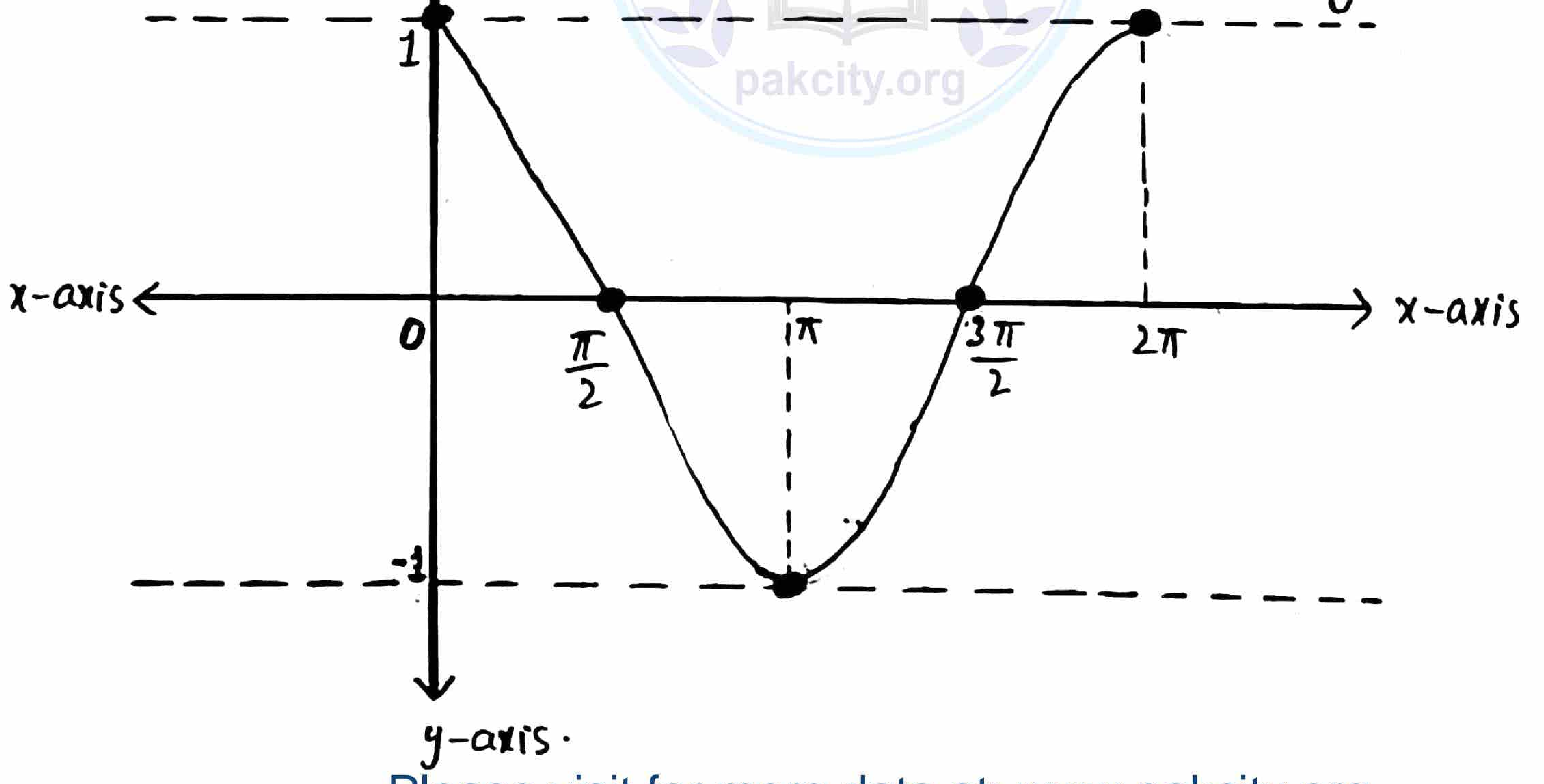


Graph of cosine function

Graph of $y = \cos x$ from $0°$ to $360°$.

x	0	$\pi/2$	π	$\frac{3\pi}{2}$	2π
y	1	0	-1	0	1

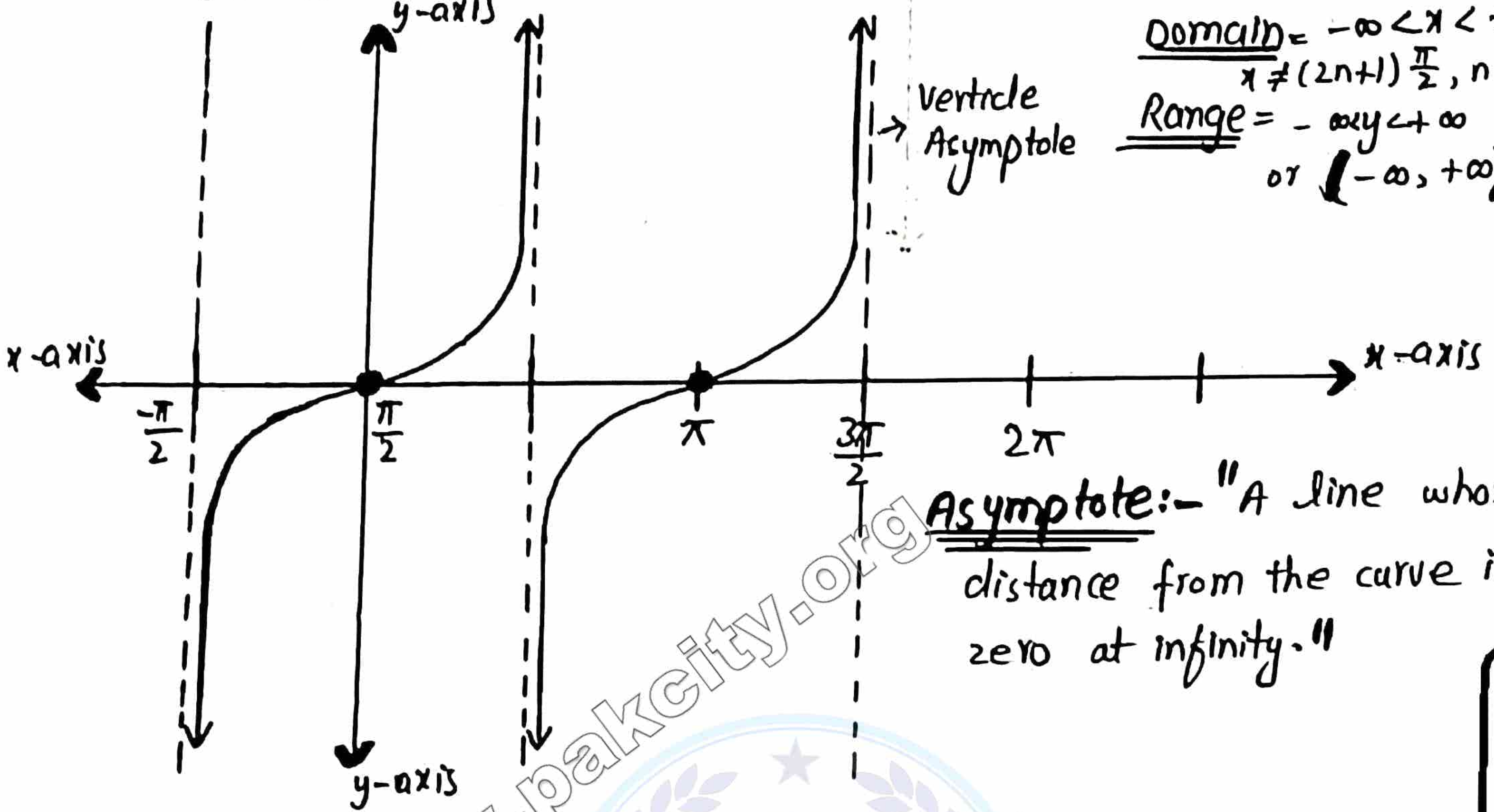
Domain = set of All Real numbers $\mathbb{R}$ or $(-\infty, +\infty)$.
Range = $-1 \le y \le 1$ or $[-1, 1]$



(Graph of Tangent function)

Graph of $y = \tan x$ from 0 to 360°.

x	0	$\pi/2$	π	$3\pi/2$	2π
y	0	∞	0	$-\infty$	0



<u>Domain</u> = $-\infty < x < +\infty$, $x \neq (2n+1)\frac{\pi}{2}$, $n \in Z$.

<u>Range</u> = $-\infty < y < +\infty$ or $(-\infty, +\infty)$.

Asymptote:– "A line whose distance from the curve is zero at infinity."

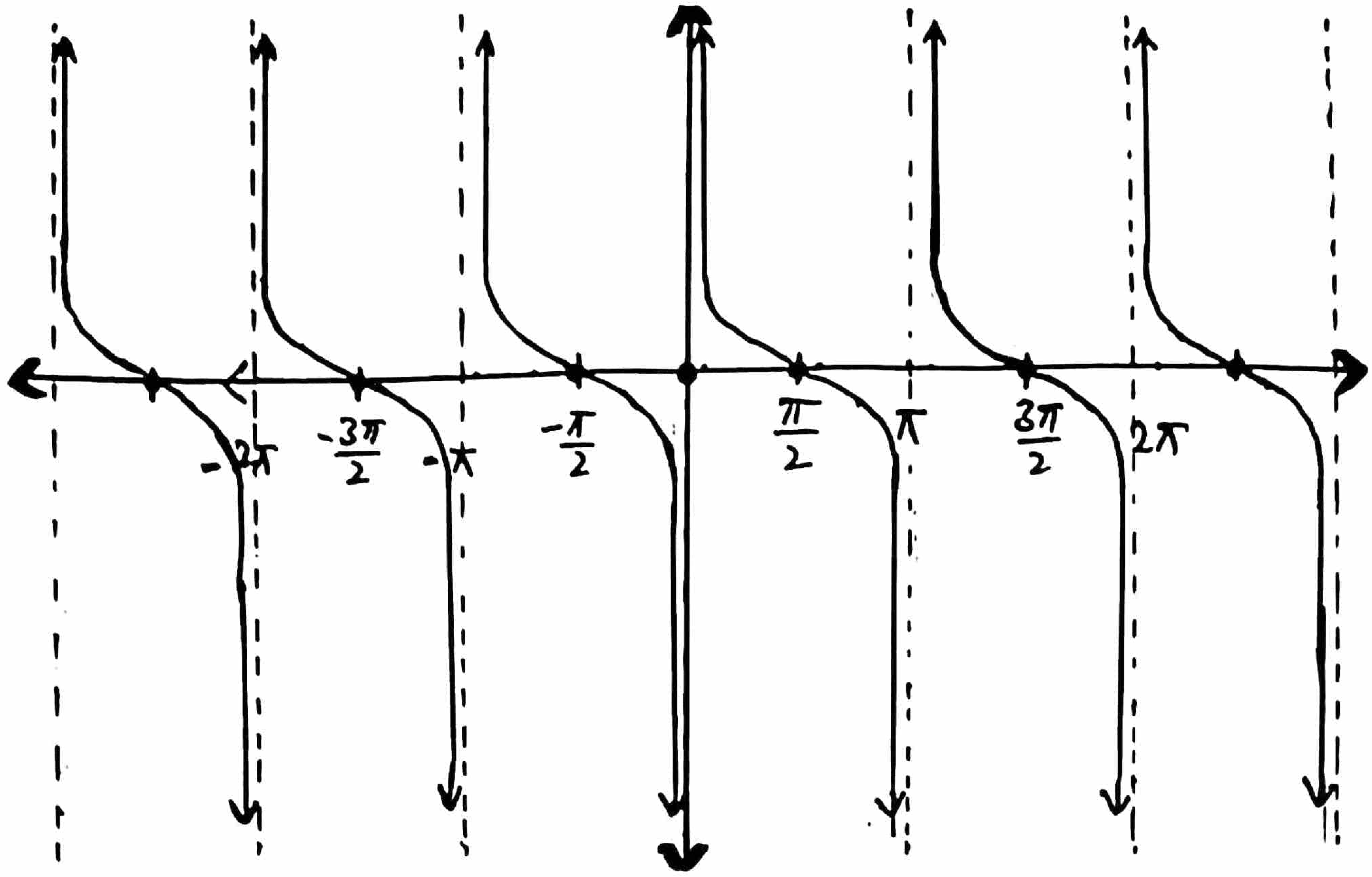
(Graph of Cotangent function)

Graph of $y = \cot x$ from -2π To 2π

x	0	$\pi/2$	π	$3\pi/2$	2π	$-\pi/2$	$-\pi$	$-\frac{3\pi}{2}$	-2π
y	∞	0	∞	0	∞	0	∞	0	∞

<u>Domain</u> = $-\infty < x < +\infty$, $x \neq n\pi$, $n \in Z$

<u>Range</u> = $-\infty < y < +\infty$ or $(-\infty, +\infty)$



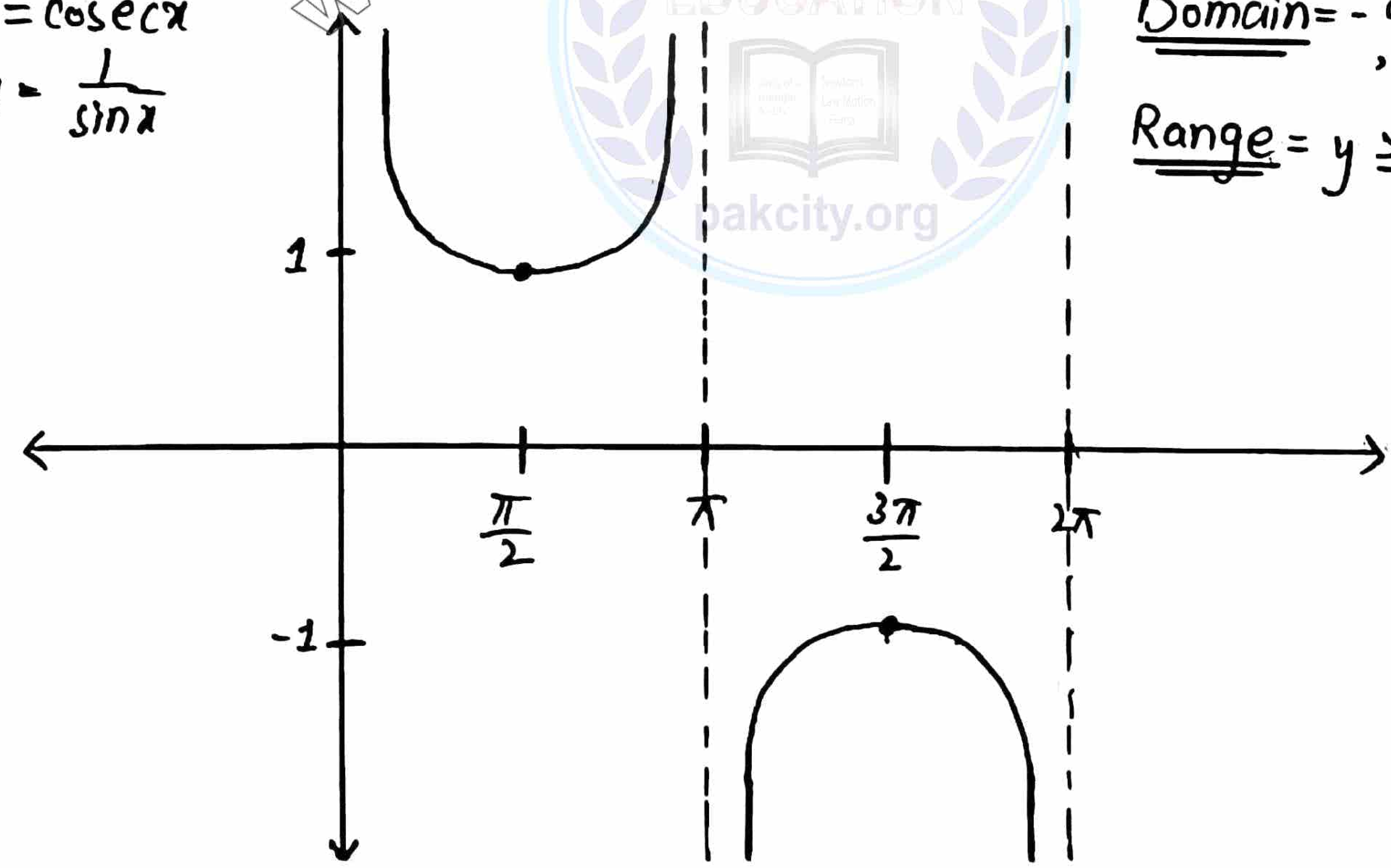
Graph of Cosecant function

Graph of $y = \operatorname{cosec} x$ from 0 to 2π

x	0	$\pi/2$	π	$3\pi/2$	2π
y	∞	1	∞	-1	∞

$y = \operatorname{cosec} x$

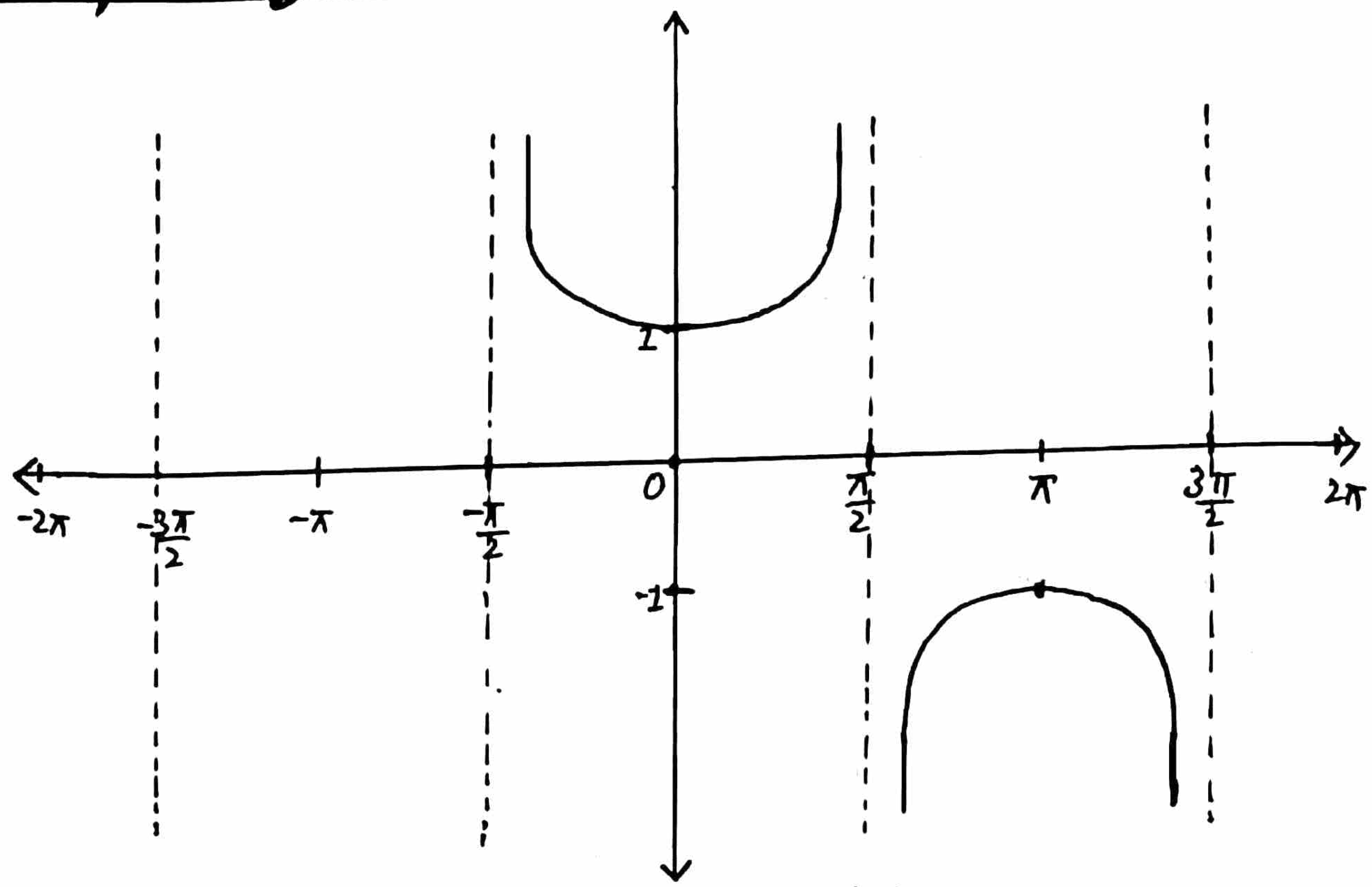
$y = \dfrac{1}{\sin x}$



<u>Domain</u> $= -\infty < x < +\infty$, $x \neq n\pi$, $n \in \mathbb{Z}$

<u>Range</u> $= y \geq 1$ or $y \leq -1$.

Graph of secant function:-



Domain:- $-\infty < x < +\infty$, $x \neq (2n+1)\frac{\pi}{2}$.

Range :- $y \geq 1$ or $y \leq -1$.

Note:-

- As we shell see the graphs of trignometric functions will be smooth curves and none of them will be line segments or will be have sharp corners or breaks within their domains. The behaviour of the curve is called continuity. It means that the trignometric functions are continuous wherever, they are defined Moreover, as the trignometric functions are periodic so their curves repeat after a fixed intervals.
- The dashed lines are verticle Asymptotes in the graphs of Tanx, Cotx, secx and cosecx.
- From the graphs of trignometric functions we can check

their domains and ranges

* Trignometric functions are periodic functions periodic functions because they repeat their values after fixed intervals.

(Function)

let A and B be two non-empty sets such that:

(i) Domain $f = A$.

(ii) First element of no two pairs of f are equal, then f is said to be a function from A to B.

Function of f is also written as: $f : A \to B$.

which is read a function from A to B.

Example:- $y = x^2$

put $x = 1$

$y = 1^2 = 1$

put $x = 2$.

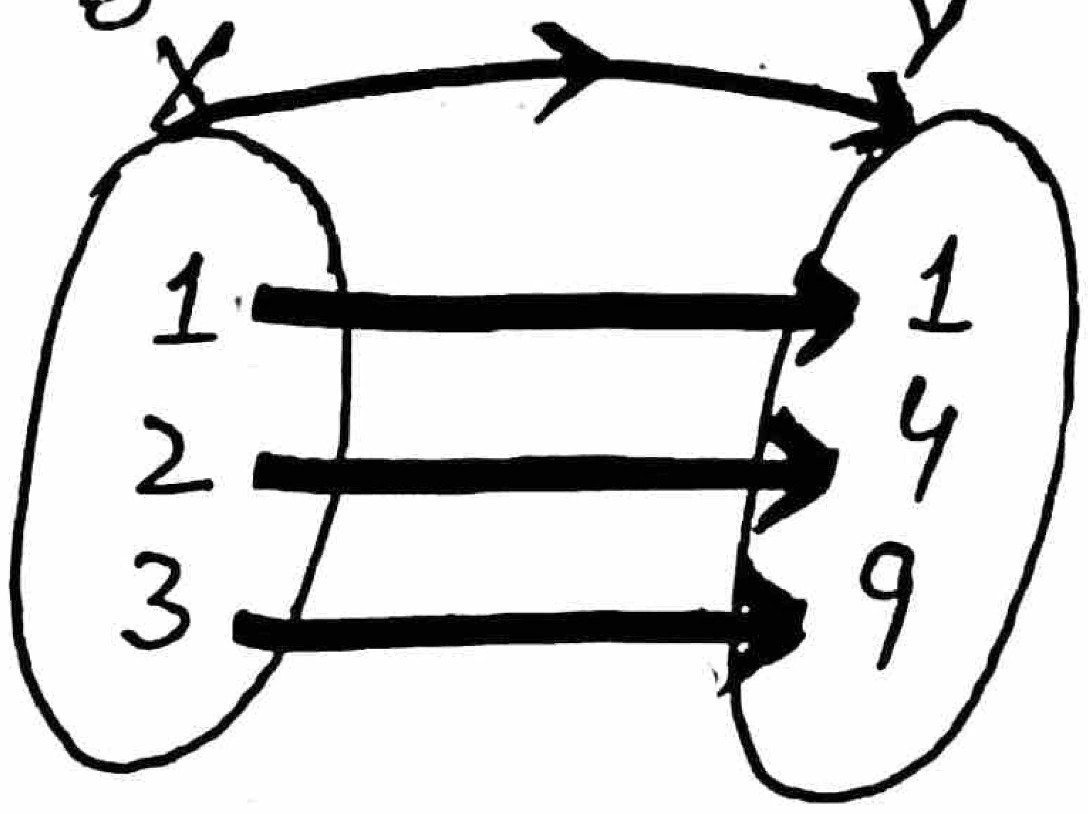
$y = 2^2 = 4$.

put $x = 3$

$y = 9$

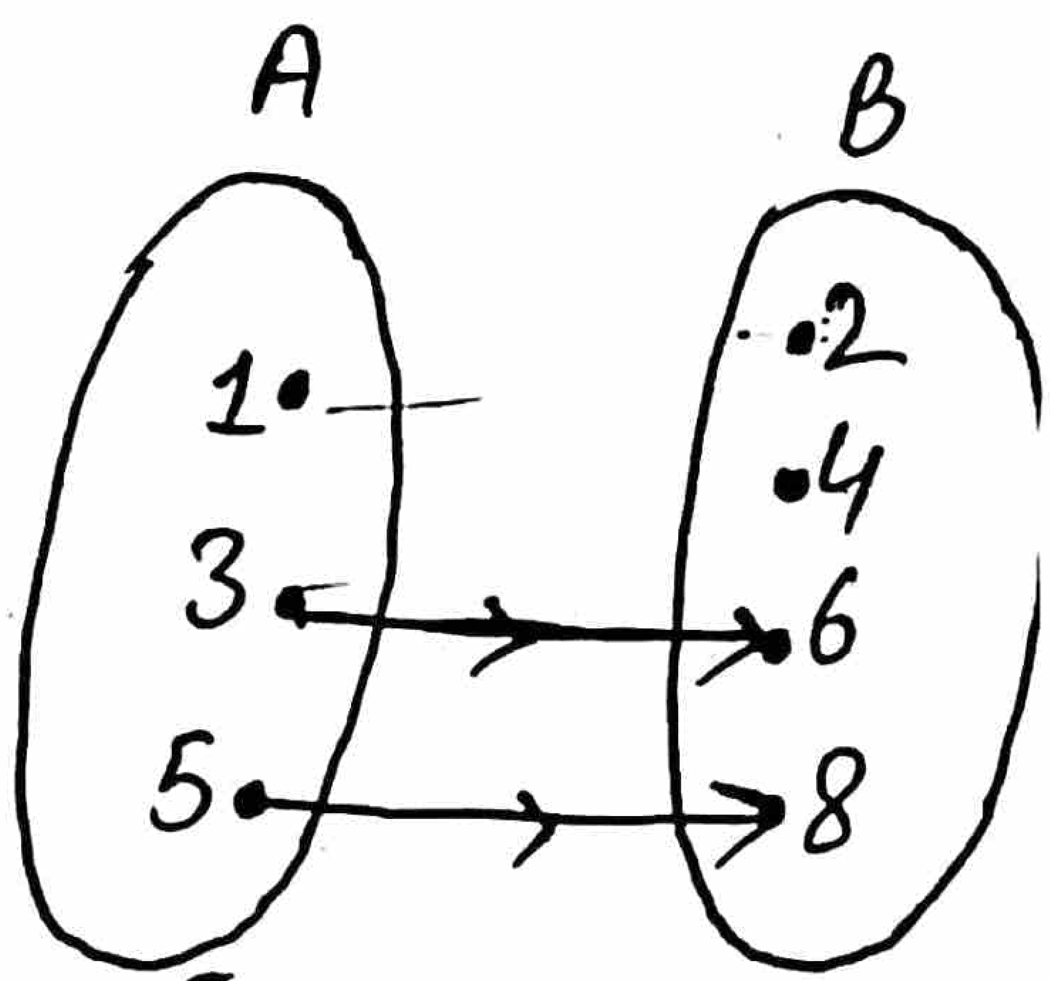
put $x = 4$

$y = 16$.



(i) Into Function:-

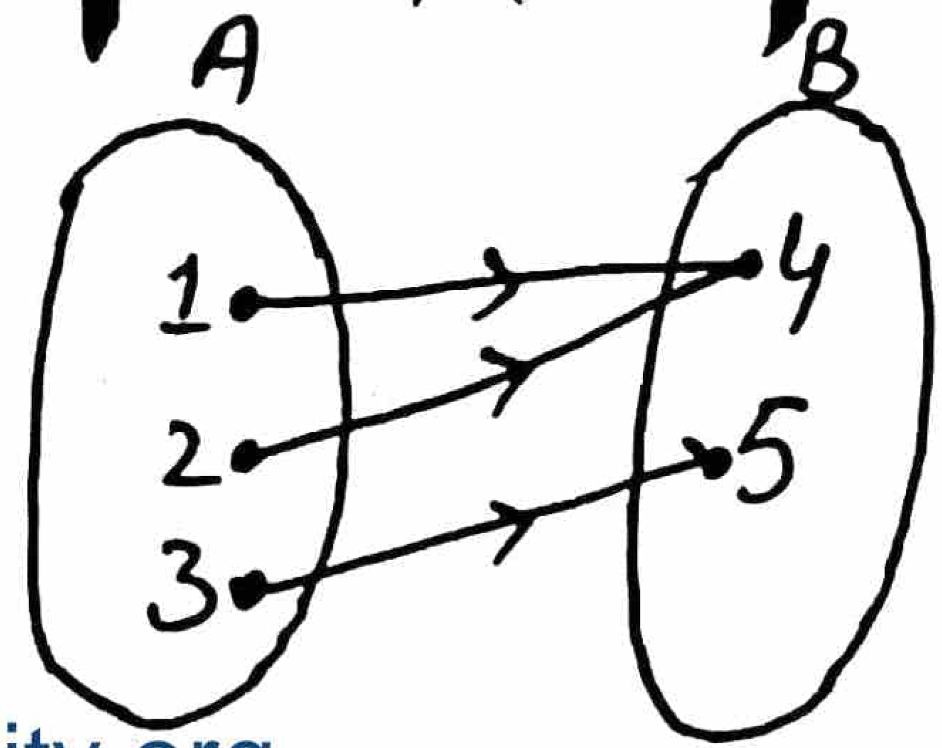
If a function $f : A \to B$ is such that $\text{Ran} f \subset B$ i-e $\text{Ran} f \neq B$, then f is said to be a function from A into B. In figure, f is clearly a function but $\text{Ran} f \neq B$ Therefore, f is a function from A into B.



$f = \{(3,6),(5,8)\}$

(ii) Onto (Surjective) Function:-

If a function $f : A \to B$ is such that $\text{Ran} f = B$ i.e every element of B is the image of the same elements of A, then

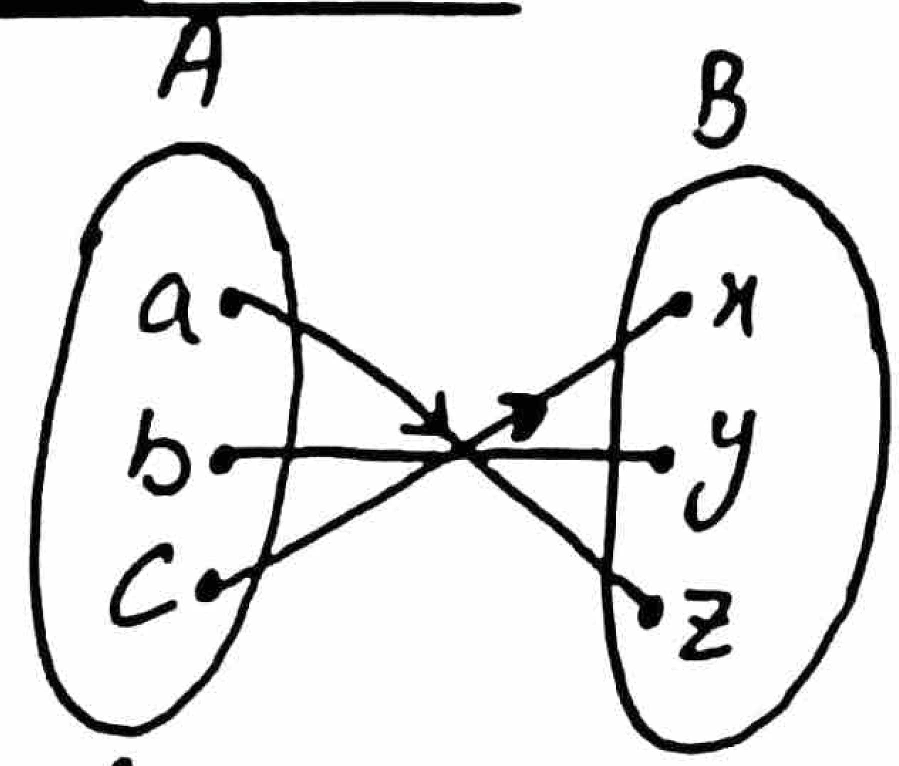


f is called Onto function or a surjective function.

$f = \{(1,4),(2,4),(3,5)\}$

(iii) 1-1 And Into (Injective) function:

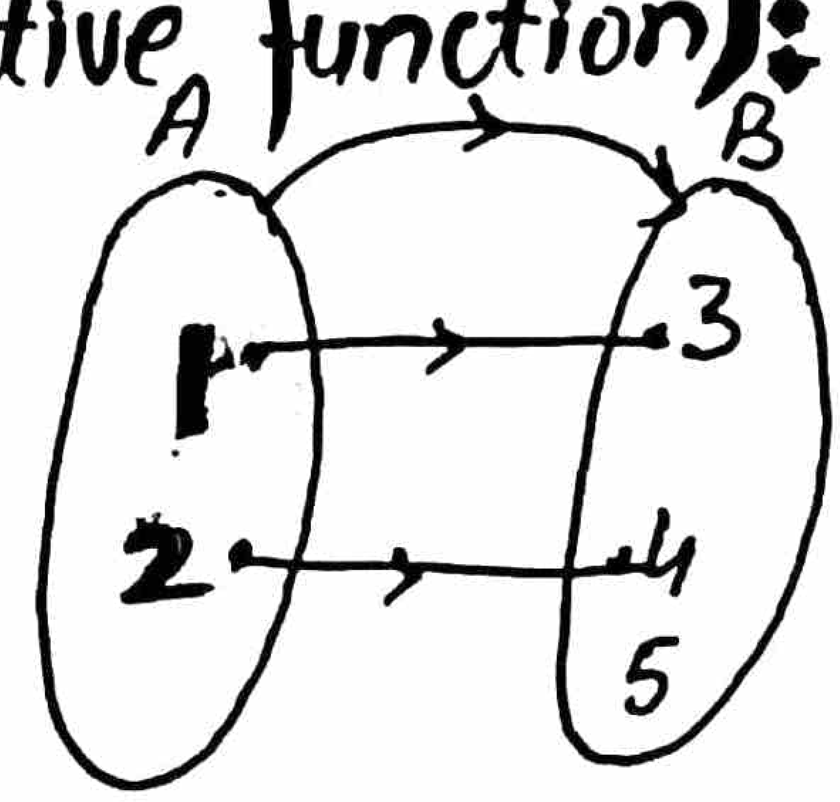
If a function f from A into B is such that second element of no two of its ordered pairs are equal, then it is called an Injective (1-1 and Into) function.



$f = \{(a,z),(c,x),(b,y)\}$

(IV) (1-1) and Onto Function (Bijective function):

If f is a function from A onto B such that second elements of no two of its ordered pairs are the same, then f is said to be (1-1) correspondance b/w A and B.



$f = \{(1,3),(2,4)\}$.

Function	Domain	Range.
$y = \sin x$	$-\infty < x < +\infty$	$-1 \le y \le 1$
$y = \cos x$	$-\infty < x < +\infty$	$-1 \le y \le 1$
$y = \tan x$	$-\infty < x < +\infty$, $x \ne \frac{(2n+1)\pi}{2}$	$-\infty < y < +\infty$
$y = \cot x$	$-\infty < x < +\infty$, $x \ne n\pi$	$-\infty < y < +\infty$
$y = \sec x$	$-\infty < x < +\infty$, $x \ne \frac{(2n+1)\pi}{2}$	$y \ge 1$ or $y \le -1$
$y = \operatorname{cosec} x$	$-\infty < x < +\infty$, $x \ne n\pi$	$y \ge 1$ or $y \le -1$.

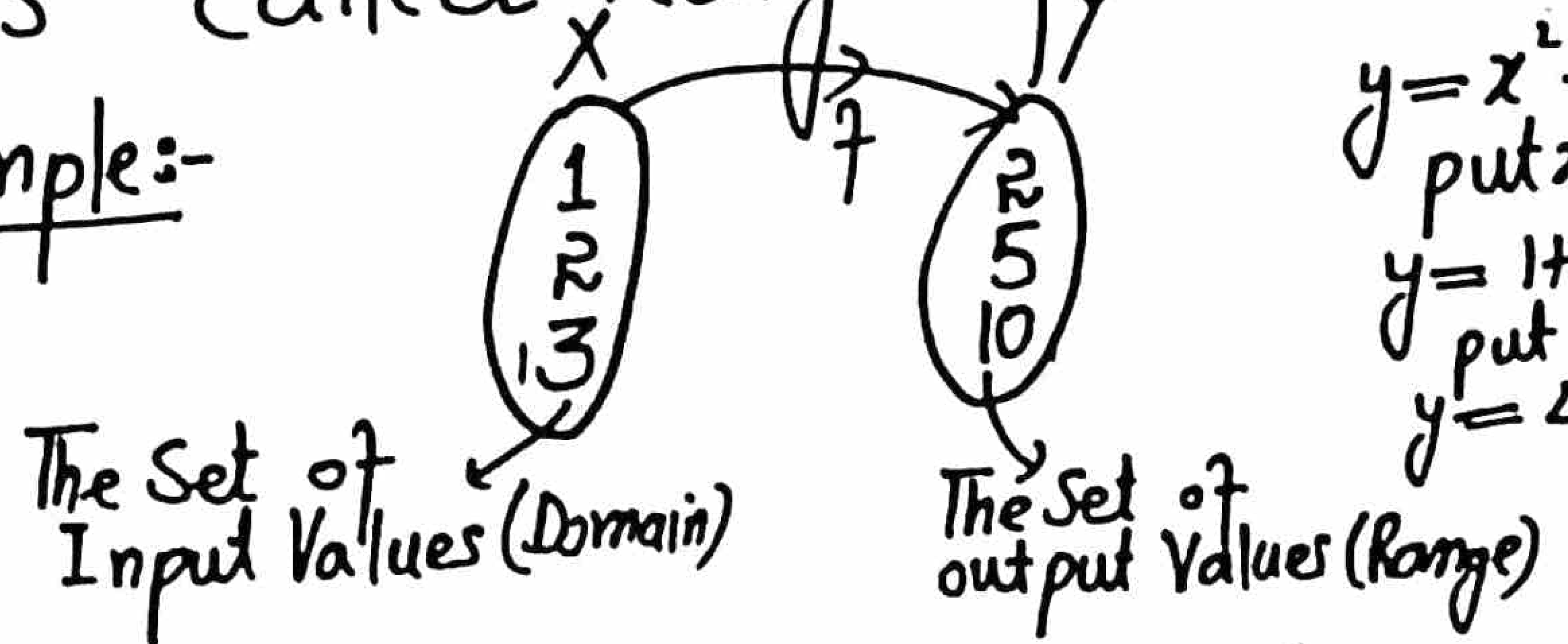
Chapter # 11
F.Sc Part-I

Trigonometric Functions And Their Graphs

Domain Of Function:- Domain is the Set of all possible Input Values of a function. OR The Values that x can take is called Domain of a Function.

Range Of Function:- Range is the Set of all possible output values of a function. OR The Values that y can take is called Range of a Function.

For Example:-



$y = x^2 + 1$
put $x = 1$
$y = 1 + 1 = 2$
put $x = 2$
$y = 4 + 1 = 5$
put $x = 3$
$y = 9 + 1 = 10$

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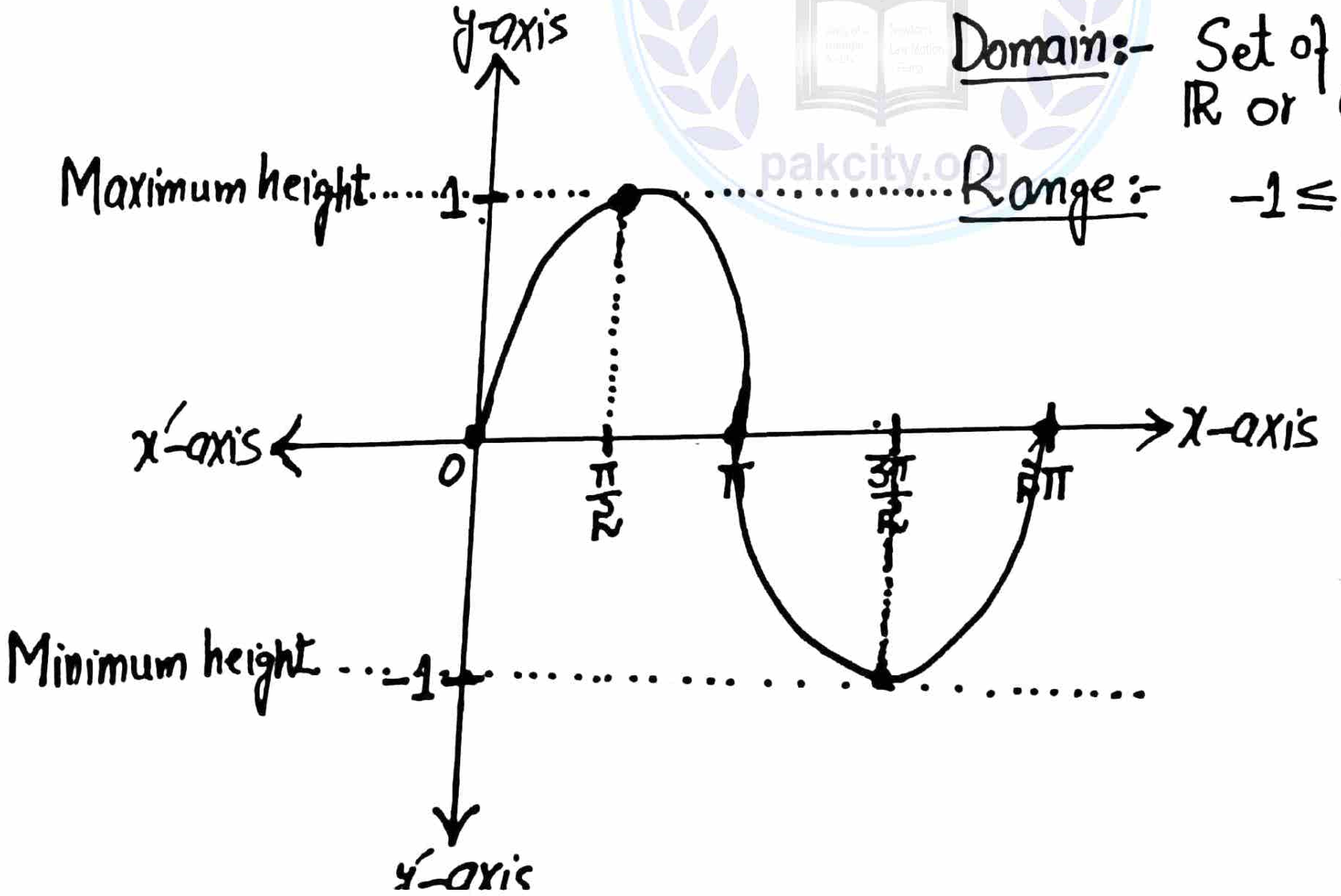
Graph Of Sin Function:

Graph of $y = \sin x$ from $0°$ To $360°$

x	0	$90°$	$180°$	$270°$	$360°$
y	0	1	0	-1	0



Domain:- Set of all Real Numbers $\mathbb{R}$ or $(-\infty, +\infty)$

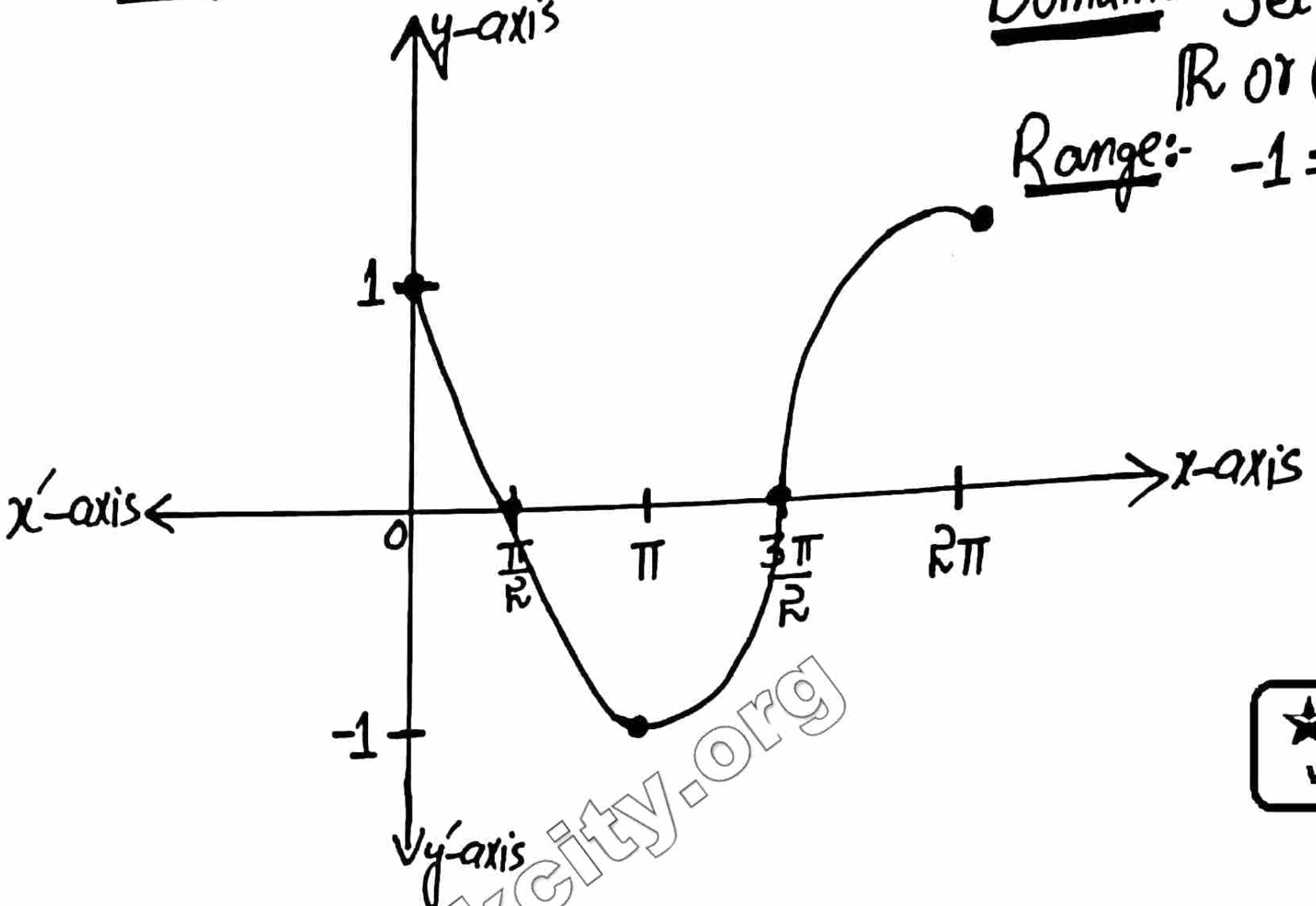
Range:- $-1 \le y \le 1$ or $[-1, 1]$

نوٹ:-

Graph OF Cosine Function:-

Graph of y=Cosx from 0° To 360°

x	0	$\pi/2$	π	$3\pi/2$	2π
y	1	0	-1	0	1



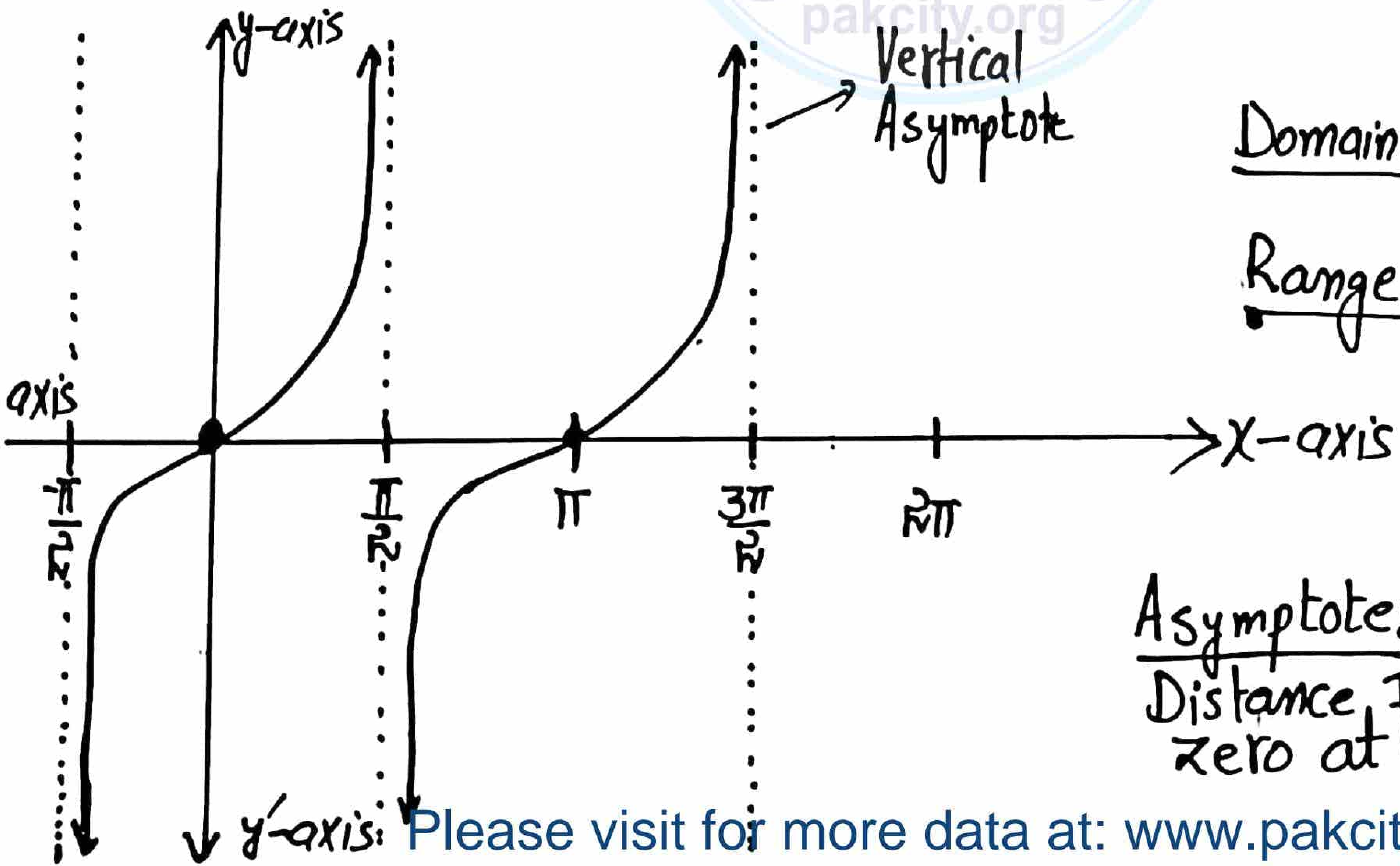
Domain:- Set of all Real Numbers $\mathbb{R}$ or $(-\infty, +\infty)$

Range:- $-1 \le y \le 1$ or $[-1, 1]$

Graph OF Tangent Function:-

Graph of y=Tanx from 0 To 360°

x	0	$\pi/2$	π	$3\pi/2$	2π
y	0	∞	0	$-\infty$	0



Domain:- $-\infty < x < +\infty$, $x \ne (2n+1)\frac{\pi}{2}$, $n \in \mathbb{Z}$

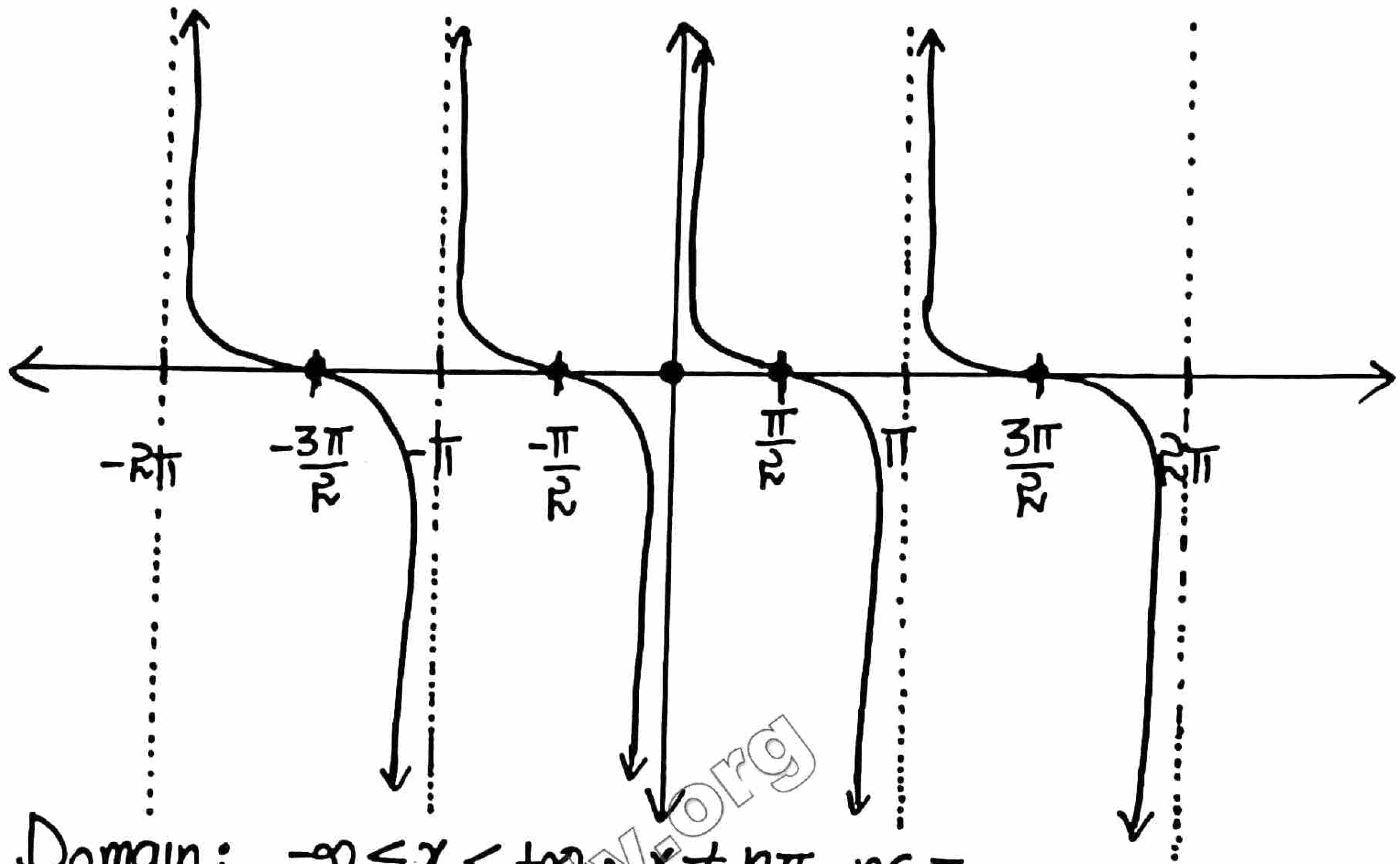
Range:- $-\infty < y < +\infty$ or $(-\infty, +\infty)$

Asymptote:- A Line whose Distance from the Curve is zero at Infinity.

Graph OF Cotagent Function:-

Graph of $y=\cot x$ from -2π To 2π

x	0	$\pi/2$	π	$3\pi/2$	2π	$-\pi/2$	$-\pi$	$-3\pi/2$	-2π
y	∞	0	∞	0	∞	0	∞	0	∞



Domain: $-\infty < x < +\infty,\ x \neq n\pi,\ n \in Z$

Range:- $-\infty < y < +\infty$ or $(-\infty, +\infty)$

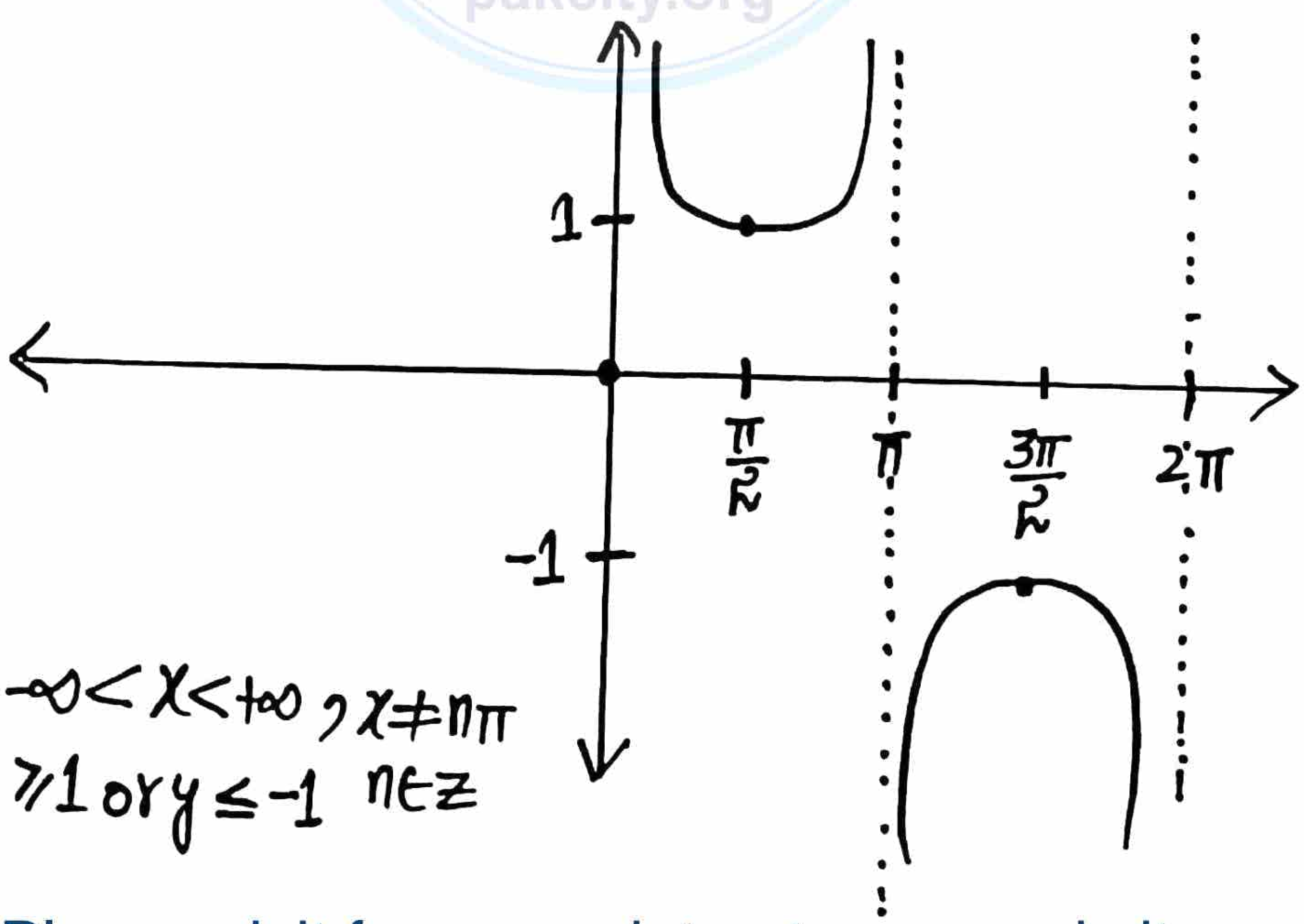
Graph OF Cosecant Function:-

Graph of $y=\operatorname{Cosec} x$ from 0 To 2π

$\boxed{y=\operatorname{Cosec} x}$

$y = \dfrac{1}{\sin x}$

x	0	$\pi/2$	π	$3\pi/2$	2π
y	∞	1	∞	-1	∞



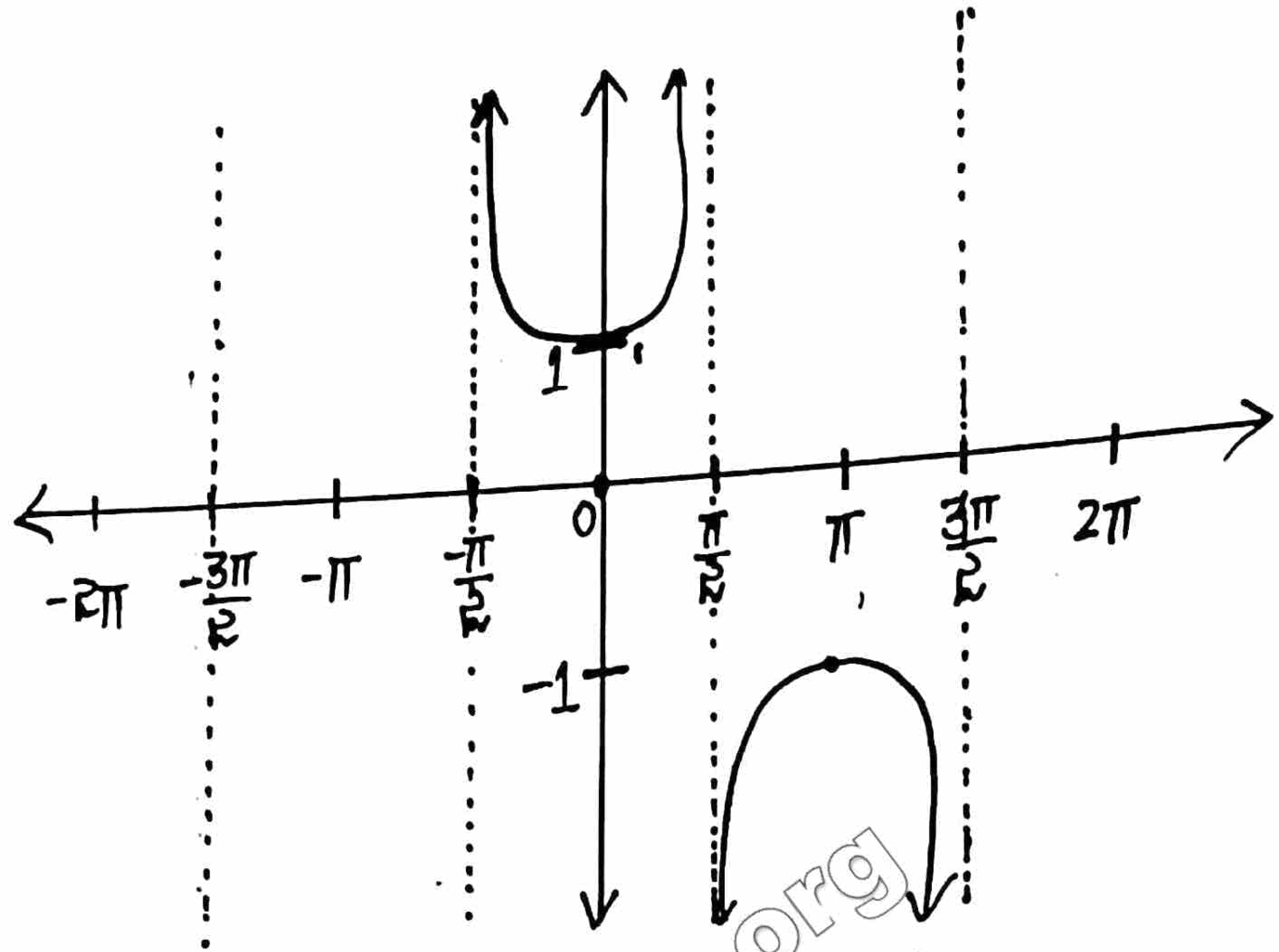
Domain: $-\infty < x < +\infty,\ x \neq n\pi$

Range: $y \geq 1$ or $y \leq -1$ $\quad n \in Z$

Graph Of Secant Function:-

Graph of $y = \sec x$ from -2π To 2π

x	0	$\pi/2$	π	$3\pi/2$	2π	$-\pi/2$	$-\pi$	$-3\pi/2$	-2π
y	1	∞	-1	∞	$+1$	$-\infty$			



Domain:- $-\infty < x < +\infty$, $x \neq (2n+1)\frac{\pi}{2}$

Range:- $y \geq 1$ or $y \leq -1$

Note:-

* As we shall see the graphs of Trigonometric functions will be smooth Curves and none of them will be line Segments or will be have sharp corners or breaks within their domains. The behaviour of the Curve is called Continuity. It means that the trigonometric functions are continuous, wherever they are defined. Moreover, as the Trigonometric functions are periodic so their Curves repeat after a fixed Intervals.
* The dashed lines are vertical Asymptotes in the graphs of Tanx, Cotx, Secx and Cosecx.
* From the graphs of Trigonometric functions we can check their domains and Ranges.
* Trigonometric Functions are Periodic Functions because They repeat their Values after fixed Interval.

↓ y-axis:

Function:- Let A and B be Two non-empty sets such that

(i) f is a relation from A to B that is, f is a Subset of $A \times B$.

(ii) $Dom f = A$

(iii) First element of no two pairs of f are equal, Then f is said to be a function from A to B.

The function f is also written as

$$f : A \longrightarrow B$$

which is read a function from A to B.

Example:-

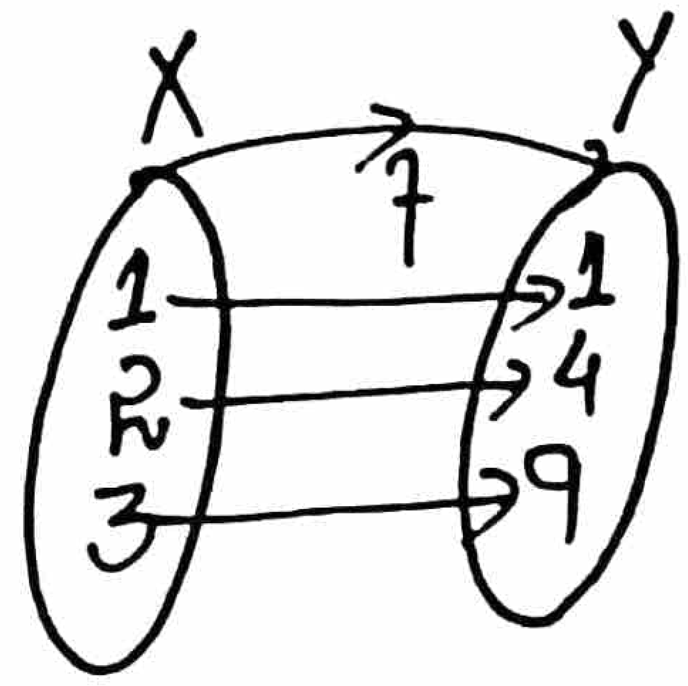
$$y = x^2$$

put $x = 1$
$y = (1)^2 = 1$

Put $x = 2$
$y = (2)^2 = 4$

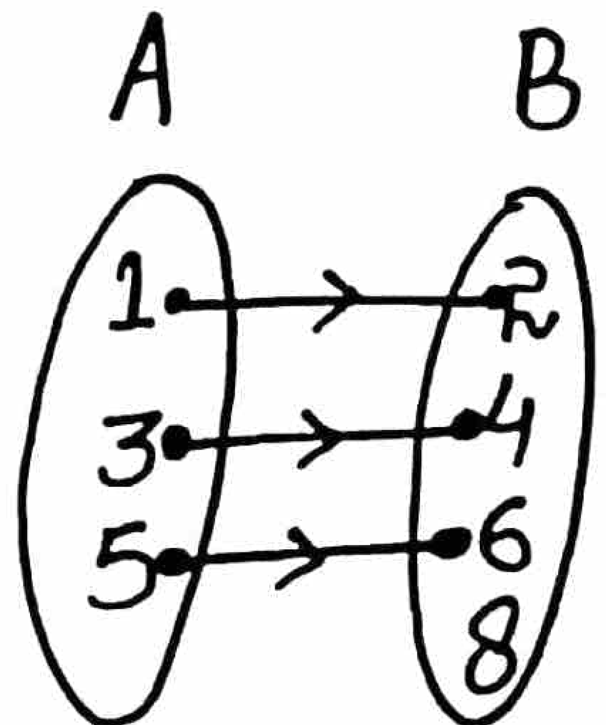
Put $x = 3$
$y = 9$

Put $x = 4$
$y = 16$



(i) Into Function:-

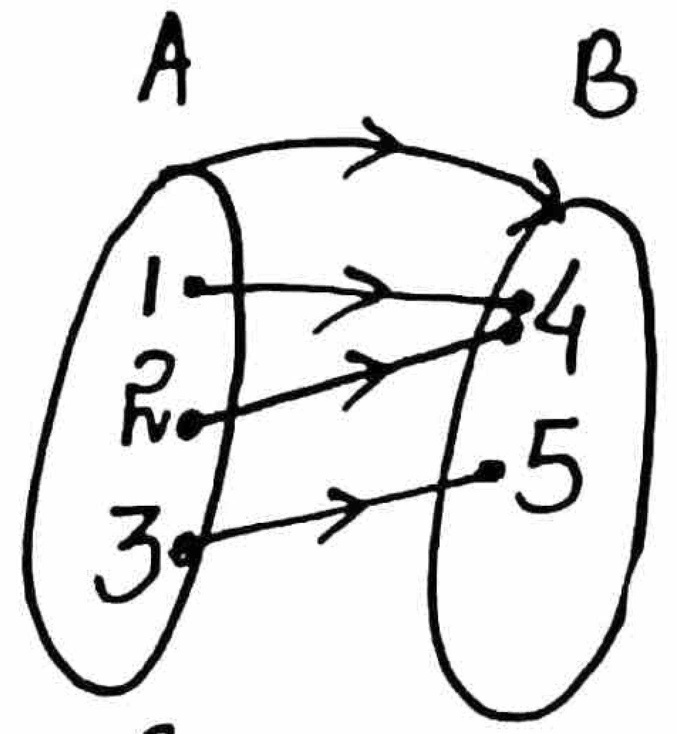
If a function $f : A \longrightarrow B$ is such that $Ran f \subseteq B$ i-e $Ran f \neq B$, Then f is said to be a function from A into B.
In figure, f is clearly a function But $Ran f \neq B$. Therefore, f is a function from A into B.



$f = \{(1,2), (3,4), (5,6)\}$

(ii) Onto (Surjective) Function:-

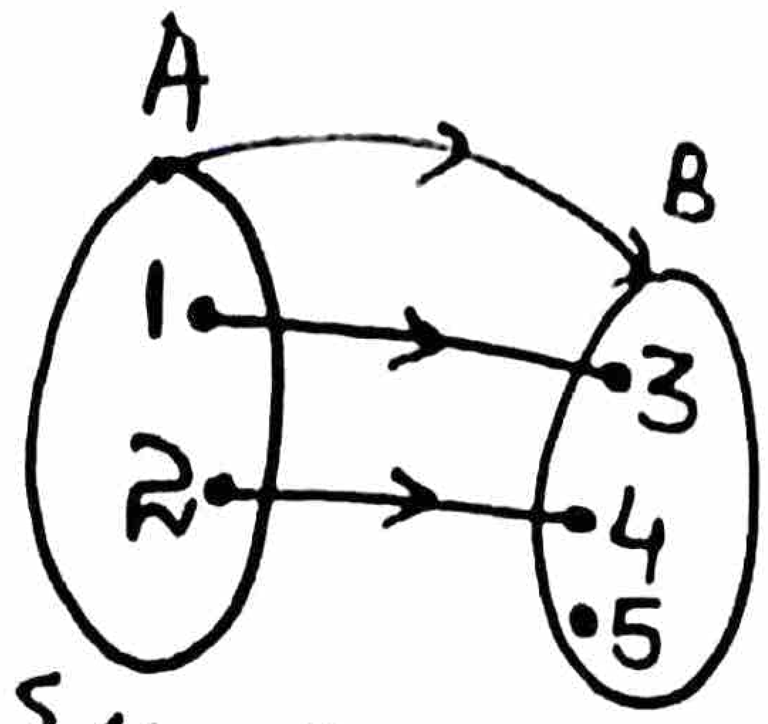
If a function $f : A \longrightarrow B$ is such that $Ran f = B$ i-e every element of B is the Image of Some elements of A, Then f is called Onto function or a Surjective function.



$f = \{(1,4), (2,4), (3,5)\}$

(iii) 1-1 And Into (Injective Function)

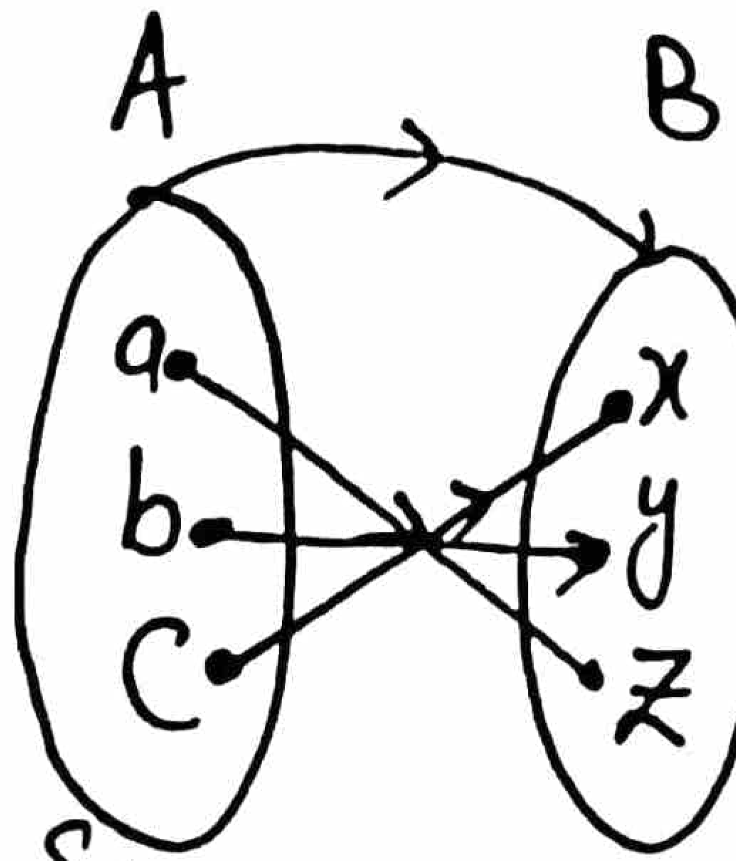
If a function f from A into B is such that second elements of no two of its ordered pairs are equal, Then it is called an Injective (1-1 and Into) function.



$f = \{(1,3),(2,4)\}$

(iv) (1-1) and Onto Function (Bijective Function):

If f is a function from A onto B Such that second elements of no two of its ordered pairs are the Same, Then f is said to be (1-1) function from A onto B. Such a function is also called a (1-1) Correspondance b/w A and B.



$f = \{(a,z),(c,x),(b,$

Functions	Domain	Range
$y = \sin x$	$-\infty < x < +\infty$	$-1 \le y \le 1$
$y = \cos x$	$-\infty < x < +\infty$	$-1 \le y \le 1$
$y = \tan x$	$-\infty < x < +\infty,\ x \ne \frac{(2n+1)\pi}{2}$	$-\infty < y < +\infty$
$y = \cot x$	$-\infty < x < +\infty,\ x \ne n\pi$	$-\infty < y < +\infty$
$y = \sec x$	$-\infty < x < +\infty,\ x \ne \frac{(2n+1)\pi}{2}$	$y \ge 1$ or $y \le -1$
$y = \csc x$	$-\infty < x < +\infty,\ x \ne n\pi$	$y \ge 1$ or $y \le -1$

Unit NO. 11:-

Trigonometric Functions and their graphs.

Definition

Period:-

Period of a trigonometric function is the smallest +ve number which, when added to the original circular measure of the angle, gives the same value of the function.

Exercise 11.1

Q.NO.1:-

$\sin 3x$

Period of sin is 2π

$= \sin(3x+2\pi)$

$= \sin 3\left(x+\frac{2\pi}{3}\right)$

Period of $\sin 3x$ is $\frac{2\pi}{3}$

Q.NO.2:-

$\cos 2x$

Period of cos is 2π

$= \cos(2x+2\pi)$

$= \cos 2(x+\pi)$

Period of $\cos 2x$ is π.

Q.NO.3:-

$\tan 4x$

Period of tan is π

$= \tan(4x+\pi)$

$= \tan 4\left(x+\frac{\pi}{4}\right)$

Period of $\tan 4x$ is $\frac{\pi}{4}$

Q.NO.4:-

$$\cot \frac{x}{2}$$

Period of cot is π

$$= \cot\left(\frac{x}{2} + \pi\right)$$

$$= \cot\left(\frac{x + 2\pi}{2}\right)$$

$$= \cot \frac{1}{2}\left(x + 2\pi\right)$$

Period of $\cot \frac{x}{2}$ is 2π

Q.NO.5:-

$$\sin \frac{x}{3}$$

Period of sin is 2π

$$= \sin\left(\frac{x}{3} + 2\pi\right)$$

$$= \sin\left(\frac{x+6\pi}{3}\right)$$

$$= \sin \frac{1}{3}\left(x + 6\pi\right)$$

Period of $\sin \frac{x}{3}$ is 6π.

Q.NO.6:-

$$\operatorname{cosec} \frac{x}{4}$$

Period of cosec is 2π

$$= \operatorname{cosec}\left(\frac{x}{4} + 2\pi\right)$$

$$= \operatorname{cosec}\left(\frac{x+8\pi}{4}\right)$$

$$= \operatorname{cosec} \frac{1}{4}\left(x+8\pi\right)$$

Period of $\operatorname{cosec} \frac{x}{4}$ is 8π.

Q.NO.7:-

$$\sin \frac{x}{5}$$

Period of sin is 2π

$$= \sin\left(\frac{x}{5} + 2\pi\right)$$

$$= \sin\left(\frac{x+10\pi}{5}\right)$$

$$= \sin \frac{1}{5}\left(x+10\pi\right)$$

Period of $\sin \frac{x}{5}$ is 10π.

Q.NO.8B-

$$\cos \frac{x}{6}$$

Period of cos is 2π.

$$= \cos\left(\frac{x}{6} + 2\pi\right)$$

$$= \cos\left(\frac{x + 12\pi}{6}\right)$$

$$= \cos \frac{1}{6}(x + 12\pi)$$

Period of $\cos \frac{x}{6}$ is 12π.

Q.NO.9:-

$$\tan \frac{x}{7}$$

Period of tan is π.

$$= \tan\left(\frac{x}{7} + \pi\right)$$

$$= \tan\left(\frac{x + 7\pi}{7}\right)$$

$$= \tan \frac{1}{7}(x + 7\pi)$$

Period of $\tan \frac{x}{7}$ is 7π.

Q.NO.10:-

$$\cot 8x$$

Period of cot is π.

$$= \cot(8x+\pi)$$

$$= \cot 8\left(x+\frac{\pi}{8}\right)$$

Period of $\cot 8x$ is $\frac{\pi}{8}$

Q.NO.11:-

$$\sec 9x$$

Period of sec is 2π

$$= \sec(9x+2\pi)$$

$$= \sec 9\left(x+\frac{2\pi}{9}\right)$$

Period of $\sec 9x$ is $\frac{2\pi}{9}$.

Q.NO.12:-

$$\operatorname{cosec} 10x$$

Period of cosec is 2π.

$$= \operatorname{cosec}(10+2\pi)$$

$$= \operatorname{cosec} 10\left(x+\frac{2\pi}{10}\right)$$

$= \operatorname{cosec} 10\left(x + \frac{\pi}{5}\right)$

Period of cosec $10x$ is $\frac{\pi}{5}$.

Q.NO.13:-

$3 \sin x$

Period of sin is 2π.

$= 3 \sin(x + 2\pi)$

Period of $3 \sin x$ is 2π.

Q.NO.14:-

$2 \cos x$

Period of cos is 2π

$= 2 \cos(x + 2\pi)$

Period of $2 \cos x$ is 2π.

Q.NO.15:-

$3 \cos \frac{x}{5}$

Period of cos is 2π.

$= 3 \cos\left(\frac{x}{5} + 2\pi\right)$

$= 3 \cos\left(\frac{x + 10\pi}{5}\right)$

$= 3 \cos \frac{1}{5}(x + 10\pi)$

Period of $3 \cos \frac{x}{5}$ is 10π.