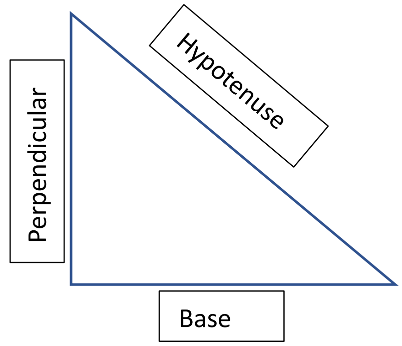
Chapter :- 01
Trigonometry

There are six trigonometric identities :-

(i) Sinθ
(ii) Cosθ
(iii) Tanθ
(iv) Cotθ
(v) Secθ
(vi) Cosecθ

Sinθ	**Cosθ**	**Tanθ**
P	B	P
H	H	B
Cosecθ	**Secθ**	**Cotθ**



By the observation of above box we can get the values of these trigonometric identities. Here P is perpendicular , B represents the base and H represents the Hypotenuse. For Sinθ theirs is P below it and an H below P. So the value of Sinθ is P/H or we can say Perpendicular/Base. Similarly we can get the values of above identities as follows :

$$sin\theta = \frac{P}{H} \qquad cos\theta = \frac{B}{H} \qquad tan\theta = \frac{P}{B}$$

Okay so now we are gonna getting the values of other remaining identities i.e. **Cotθ** , **Secθ** and **Cosecθ**. This is as simple as we get the above values. The only thing we have to do is just to make them opposite. Look at the box we draw above carefully, there you will find that Cotθ is written below **Tanθ** and similarly **Secθ** is below **Cosθ** and **Cosecθ** below **Sinθ.**

So their values are also opposite as following :

$$cot\theta = \frac{B}{H} \qquad sec\theta = \frac{H}{B} \qquad cosec\theta = \frac{H}{P}$$

By the help of above formulas can you reach the following conclusions ?

$$sin\theta = \frac{1}{cosec\theta} \qquad cot\theta = \frac{1}{tan\theta}$$

$$cos\theta = \frac{1}{sec\theta} \qquad sec\theta = \frac{1}{cos\theta}$$

$$tan\theta = \frac{1}{cot\theta} \qquad cosec\theta = \frac{1}{sin\theta}$$

Ok , so today we are also going to a new conclusion too , and believe us this is going to be interesting. Do you remember that,

$$sin\theta = \frac{P}{H} = \frac{P}{H} \qquad \& \qquad cos\theta = \frac{B}{H}$$

So we can get that ,

$$\frac{sin\theta}{cos\theta} = \frac{P}{B}$$

And now can you go up and check which identity represents P/B ?
Is that **Tanθ ?**

Well, exactly. We can say that,

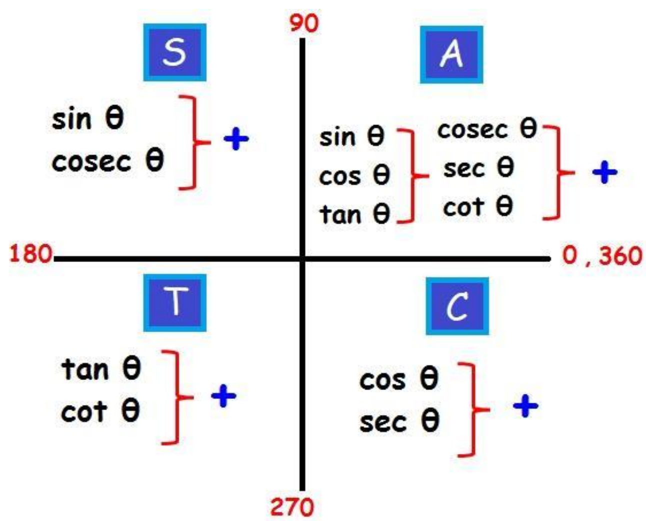
$$\frac{sin\theta}{cos\theta} = tan\theta$$

And oppositely,

$$\frac{cos\theta}{sin\theta} = cot\theta$$

Quadrant :

There are four quadrants :



This is called the **A – S – T – C** rule. Where **A** stands for **All positive , S** stands for **Sin** and its opposite **cosec** positive , **T** stands for **Tan** and its opposite **Cot** are only positive and in the last **C** stands for **Cos** and its opposite **Sec** are only positive.

Now if we talk about angles , there are two types of them , one which are the vertical angle i.e. 90°, 270° …. and the second are the horizontal angles i.e. 180°, 360° ,…. .

These angles decides if the identities have to change or not. For example : $\boldsymbol{Sin(90-\theta)}$

Can you tell , in which quadrant the angle (90 – θ) is falling ?
An angle which is less than even a single degree will always fall in the first quadrant. And in first quadrant all the identities are positive. So we can say that the value of **Sin(90-θ)** is positive.
Now look at the angle sin have. It's 90°. So sin will definitely change to cos. And we can say that

$$\boxed{\mathbf{sin(90-\theta) = cos\theta}}$$

Now take some another examples.

(I) $\sin(90 + \boldsymbol{\theta})$

Step 1. First of all, (90 + θ) falls in the second quadrant as it's greater than 90°.
Step 2. For second quadrant , sin is positive, as mentioned above.
Step 3. Now , because it's 90° so sin will change to cos.

As a result we can say that, $\mathbf{sin}(\mathbf{90} + \boldsymbol{\theta}) = \boldsymbol{cos\theta}$

(ii). $\cos(90 + \boldsymbol{\theta})$

Step 1. (90 + θ) means greater than 90° , which means second **quadrant.**
Step 2. Cos is negative in second quadrant. Remember ?
Step 3. For **90°** cos will change to sin.

As a result we can say that, $\boldsymbol{cos}(\mathbf{90} + \boldsymbol{\theta}) = -\boldsymbol{sin\theta}$

(iii). $\cot(180 + \boldsymbol{\theta})$

Step 1. (180 + θ) means more than 180° , and more than 180° means **third quadrant.**
Step 2. Tan and **cot** are **positive** in third quadrant.
Step 3. And because it's 180° , so cot won't to change.

As a result we can say that, $\boldsymbol{cot}(\mathbf{180} + \boldsymbol{\theta}) = \boldsymbol{cot\theta}$

(iv). $\tan(270 + \boldsymbol{\theta})$

Step 1. Falls in the fourth quadrant.
Step 2. Tan is negative in fourth quadrant. (Also **cot** too)
Step 3. For **270°, tan** will change to **cot.**

As a result we can say that, $\boldsymbol{tan}(\mathbf{270} + \boldsymbol{\theta}) = -\boldsymbol{cot\theta}$

(v). $\sec(360 - \boldsymbol{\theta})$

Falls in the fourth quadrant because it's lesser that 360° , if couldn't get it go up and check on the quadrants figure. In fourth quadrant **cos** is **positive** so **sec** is too. Because of 360° , sec will be sec, means unchanged ,

Here we go , $\boldsymbol{sec}(\mathbf{360} - \boldsymbol{\theta}) = \boldsymbol{sec\theta}$

Try to get the values of following trigonometric expressions ,

$\boldsymbol{cos}(\mathbf{270} - \boldsymbol{\theta})$, $\boldsymbol{cot}(\mathbf{360} + \boldsymbol{\theta})$, $\boldsymbol{sin}(\mathbf{180} - \boldsymbol{\theta})$, $\boldsymbol{tan}(\mathbf{270} + \boldsymbol{\theta})$, $\boldsymbol{cosec}(\mathbf{180} + \boldsymbol{\theta})$

<u>Trigonometric table with the value on different common angles</u> : -

First of all, there's no need to learn the table. The construction of that table is so simple that you only have to put your mind in it and you'll learn to construct the whole table quickly. So at first let's tell you that we're gonna get the value on **0° , 30° , 45° , 60°** and **90°.**

Following steps will help you ,

<u>Step 1 :</u> On the very above write the angles , i.e.

0°	**30°**	**45°**	**60°**	**90°**

<u>Step 2</u> : Now write numbers from 0 to 4 below the angles respectively.

0°	**30°**	**45°**	**60°**	**90°**
0	1	2	3	4

<u>Step 3</u> : Divide every number by 4. Because there are four quadrants.

0°	**30°**	**45°**	**60°**	**90°**
$\frac{0}{4}$	$\frac{1}{4}$	$\frac{2}{4}$	$\frac{3}{4}$	$\frac{4}{4}$

<u>Step 4</u> : Put an under root on the above fractions.

0°	**30°**	**45°**	**60°**	**90°**
$\sqrt{\frac{0}{4}}$	$\sqrt{\frac{1}{4}}$	$\sqrt{\frac{2}{4}}$	$\sqrt{\frac{3}{4}}$	$\sqrt{\frac{4}{4}}$

<u>Step 5</u> : Solve the above fractions and this will define the values of sine.

	0°	**30°**	**45°**	**60°**	**90°**
Sin	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1

<u>Step 4</u> : Write the above values of sine from right to left , we get the value of **cos.**

	0°	**30°**	**45°**	**60°**	**90°**
Sin	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	**1**
Cos	**1**	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	**0**

<u>Step 5</u> : For the value of **tan ,** we think that you know , **tan = sin/cos , apply…**

Tan	**0**	$\frac{1}{\sqrt{3}}$	**1**	$\sqrt{3}$	∞

<u>Step 6</u> : Now the three identities are remaining and we know that **cot = 1/tan , sec = 1/cos** and **cosec = 1/sin.**

So the whole table is here,

	0°	30°	45°	60°	90°
Sin	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
Cos	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
Tan	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	∞
Cot	∞	$\sqrt{3}$	1	$\frac{1}{\sqrt{3}}$	0
Sec	1	$\frac{2}{\sqrt{3}}$	$\sqrt{2}$	2	∞
Cosec	∞	2	$\sqrt{2}$	$\frac{2}{\sqrt{3}}$	1

Keep in mind that you never have to learn this table. When you do the questions using this table the value will automatically come to your mouth. But, yes you can practice the table , how to make it, 2 – 3 times.