## TRIGONOMETRIC RATIOS OF SOME SPECIFIC ANGLES

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## Introduction to Trig Ratios

The major functions of trigonometric ratios are sine, cosine, tangent, cosecant, secant and cotangent.

right angled triangle.

Some specific angles are:

- $0^{\circ}$ and $90^{\circ}$
- $45^{\circ}$
- $30^{\circ}$ and $60^{\circ}$


In ? ABC , right - angled at B , and $? \mathrm{BAC}=$ ?

So, from ?ABC, we have
Sin ? $=\mathrm{BC} / \mathrm{AC}$
$\operatorname{Cos} ?=\mathrm{AB} / \mathrm{AC}$
$\operatorname{Tan} ?=\mathrm{BC} / \mathrm{AB}$

## Case I: ?A is becoming small

If ? A is made smaller and smaller in the ?ABC, till it becomes zero. As ?A gets smaller and smaller, the length of the BC decreases. The point C gets closer to point B , and finally when A becomes very close to $0^{\circ}, \mathrm{AC}$ becomes almost the same as AB .

When ?A is very close to $0^{\circ}, \mathrm{BC}$ gets very close to 0 and so the value of
$\operatorname{Sin} A=B C / A C$ is very close to 0 .

Also, when A is very close to $0^{\circ}, \mathrm{AC}$ is same as AB and so the value of $\operatorname{Cos} \mathrm{A}=\mathrm{AB} / \mathrm{AC}$ is very close to 1 .

From the above discussion, we have
$\operatorname{Sin} 0^{\circ}=0$
$\operatorname{Cosec} 0^{\circ}=1 / \operatorname{Sin} 0^{\circ}=1 / 0=$ not defined
$\operatorname{Cosec} 0^{\circ}=$ ?
$\operatorname{Cos} 0^{\circ}=1$
$\operatorname{Sec} 0^{\circ}=1 / \operatorname{Cos} 0^{\circ}=1 / 1=1$
$\operatorname{Sec} 0^{\circ}=1$

Using Sin and Cos values, we can find Tan $0^{\circ}$
$\operatorname{Tan} 0^{\circ}=\operatorname{Sin} 0^{\circ} / \operatorname{Cos} 0^{\circ}=0$
$\operatorname{Tan} 0^{\circ}=0$

Also, $\operatorname{Cot} 0^{\circ}=1 / \operatorname{Tan} 0^{\circ}=1 / 0=$ not defined
$\operatorname{Cot} 0^{\circ}=$ ?

## Case II: ?A is becoming large

Now, let's see when ?A is made larger and larger in ?ABC till it becomes $90^{\circ}$. As ?A gets larger and larger, ?C gets smaller and smaller. So, the length of the side AB goes on decreasing. The point A gets closer to point B. Finally when ?A is very close to $90^{\circ}$, ? C becomes very close to $0^{\circ}$ and the side AC almost coincides with side BC .

When ?C is very close to $0^{\circ}, \mathrm{A}$ is very close to $90^{\circ}$, side AC is nearly the same as side BC .

So, $\operatorname{Sin}$ A is very close to 1 .

From above discussion we get,
$\operatorname{Sin} 90^{\circ}=1$
Cosec $90^{\circ}=1$
$\operatorname{Cos} 90^{\circ}=0$
$\operatorname{Sec} 90^{\circ}=$ ?
Tan $90^{\circ}=$ ?
$\operatorname{Cot} 90^{\circ}=0$


## Trigonometric Ratios of $\mathbf{4 5}^{\circ}$

In $? \mathrm{ABC}$, right angled at B , if one angle is 45 , then the other angle by angle sum property of triangle will also be 45 .
? $\mathrm{A}=? \mathrm{C}=45^{\circ}$

So, $\mathrm{BC}=\mathrm{AB}$ (Isosceles triangle property)

Let, $\mathrm{AB}=\mathrm{BC}={ }^{\prime} \mathrm{a}$ '

Then byPythagoras theorem, $\mathrm{AC} 2=\mathrm{AB} 2+\mathrm{BC} 2$
$\mathrm{AC} 2=\mathrm{a} 2+\mathrm{a} 2=2 \mathrm{a} 2$
$\mathrm{AC}=\mathrm{a} ? 2$.

Using formulas fortrigonometric ratios:
$\operatorname{Sin} 45^{\circ}=\underline{\text { Side opposite to angle } 45^{\circ}}=\mathrm{a} / \mathrm{a} ? 2=1 / ? 2$
Hypotenuse

Hypotenuse
$\operatorname{Tan} 45^{\circ}=\underline{\text { Side opposite to angle } 45^{\circ}}=\mathrm{a} / \mathrm{a}=1$
Side adjacent to angle $45^{\circ}$

Also, $\operatorname{Cosec} 45^{\circ}=? 2, \operatorname{Sec} 45^{\circ}=? 2, \operatorname{Cot} 45^{\circ}=1$

## Trigonometric Ratios of $30^{\circ}$ and $60^{\circ}$

Let ? ABC , be anequilateral triangle. So, ? $\mathrm{A}=? \mathrm{~B}=? \mathrm{C}=60^{\circ}$


Drawperpendicular AD from A to the side BC .

Now, ?ABD ? ?ACD (by ASA)

Therefore, $\mathrm{BD}=\mathrm{DC}$
?BAD $=$ ?CAD $($ by CPCT $)$

Consider, ?ABD
$A=30, B=60, D=90$

Let $A B=x$

So, BD = $\mathrm{x} / 2$

And we will find the length of AD by Pythagoras theorem.
$\mathrm{AB} 2=\mathrm{AD} 2+\mathrm{BD} 2$
$\mathrm{AB} 2-\mathrm{BD} 2=\mathrm{AD} 2$
$\mathrm{x} 2-\mathrm{x} 2 / 4=\mathrm{AD} 2$
$\mathrm{AD} 2=3 \times 2 / 4$
$\mathrm{AD}=\mathrm{x} ? 3 / 2$

Using formulas for trigonometric ratios:

Hypotenuse
$\operatorname{Cos} 30^{\circ}=\underline{\text { Side adjacent to angle } 30^{\circ}}=x ? 3 / 2 / x=? 3 / 2$
Hypotenuse
$\operatorname{Tan} 30^{\circ}=\underline{\text { Side opposite to angle } 30^{\circ}}=x / 2 / x ? 3 / 2=1 / ? 3$
Side adjacent to angle $30^{\circ}$

Also, $\operatorname{Cosec} 30^{\circ}=2, \operatorname{Sec} 30^{\circ}=2 / ? 3, \operatorname{Cot} 30^{\circ}=? 3$

Similarly,
$\operatorname{Sin} 60^{\circ}=? 3 / 2$
$\operatorname{Cosec} 60^{\circ}=2 / ? 3$
$\operatorname{Cos} 60^{\circ}=1 / 2$
$\operatorname{Sec} 60^{\circ} 2$
$\operatorname{Tan} 60^{\circ}=? 3$
$\operatorname{Cot} 60^{\circ}=1 / ? 3$

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## Reference Links:

http://www.purplemath.com/modules/basirati.htm

- http://en.wikipedia.org/wiki/Right triangle
- http://en.wikipedia.org/wiki/Triangle\#Trigonometric_ratios_in_right_triangles
- http://en.wikipedia.org/wiki/Pythagorean_theorem
- http://en.wikipedia.org/wiki/Equilateral triangle
- http://en.wikipedia.org/wiki/Equilateral triangle

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