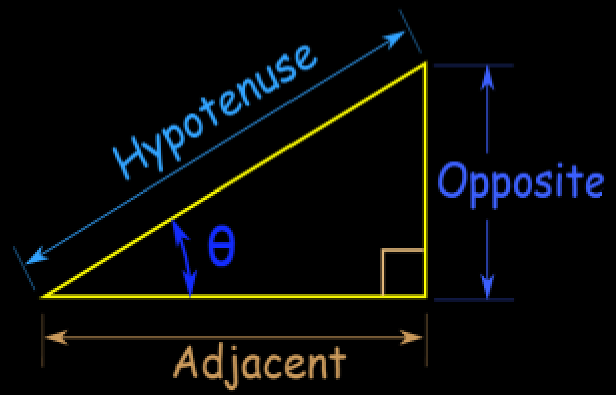
TRIGONOMETRIC IDENTITIES

When we are dealing with a **right triangle**, we say that

- $\sin(\Theta) = \frac{\text{opposite}}{\text{hypotenuse}} = \frac{1}{\csc(\Theta)}$
- $\cos(\Theta) = \frac{\text{adjacent}}{\text{hypotenuse}} = \frac{1}{\sec(\Theta)}$
- $\tan(\Theta) = \frac{\text{opposite}}{\text{adjacent}} = \frac{1}{\cot(\Theta)} = \frac{\sin(\Theta)}{\cos(\Theta)}$



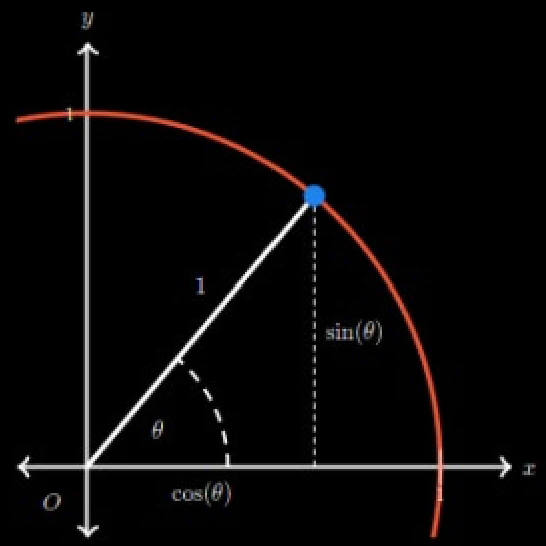
And their opposites

- $\csc(\Theta) = \frac{\text{hypotenuse}}{\text{opposite}} = \frac{1}{\sin(\Theta)}$
- $\sec(\Theta) = \frac{\text{hypotenuse}}{\text{adjacent}} = \frac{1}{\cos(\Theta)}$
- $\cot(\Theta) = \frac{\text{adjacent}}{\text{opposite}} = \frac{1}{\tan(\Theta)} = \frac{\cos(\Theta)}{\sin(\Theta)}$

PYTHAGOREAN IDENTITIES

when u are in a unit circle (circle with a radius of 1), you would use this equation

$$\mathbf{Sin(\Theta)^2 + Cos(\Theta)^2 = 1}$$



DIVIDING ALL BY COS	DIVIDING ALL BY SIN
Which when dividing everything by $\cos^2$ becomes $\frac{\sin(\theta)^2}{\cos(\theta)^2} + \frac{\cos(\theta)^2}{\cos(\theta)^2} = \frac{1}{\cos(\theta)^2}$ Which can be interpreted as	Which when dividing everything by $\sin^2$ becomes $\frac{\sin(\theta)^2}{\sin(\theta)^2} + \frac{\cos(\theta)^2}{\sin(\theta)^2} = \frac{1}{\sin(\theta)^2}$ Which can be interpreted as
$Tan(\Theta)^2 + 1 = Sec(\Theta)^2$	**$1 + Cot(\Theta)^2 = Csc(\Theta)^2$**

We have otherways to express the pythagorean identities

Other Variation(s)	
$\sin^2\theta = 1 - \cos^2\theta$	$\cos^2\theta = 1 - \sin^2\theta$
$\tan^2\theta = \sec^2\theta - 1$	
$\cot^2\theta = \csc^2\theta - 1$	

CONFUTATION IDENTITIES

Let's imagine two angles **y** and **x**

Alright so we that we can convert from sin to cos and what not, but let's actually look at what's happening, there is something called the **difference identity for cosine**, it is

Cos(x-y) = cos(x) cos (y) + sin(x) sin(y)

Now let us say that

- Cos (90 - y) = cos(90) cos(y) + sin(90) sin(y)
- Cos (90 - y) = 0 * cos(y) + 1 * sin(**y**)
- Cos(90 - y) = sin(y) -> **co-function identity for cosine**

we say that **90 in degrees** Equals $\frac{\pi}{2}$ **in radians**

Now if we replaced **y** with **(90-x)**

- Cos(90 – (90-x)) = sin(90-x)
- Cos(x) = sin(90-x)
- Sin(90 - x) = cos(x) -> **co-function identity for sin**

we have another thing called the

- Tan(90-x) = Cot(x) -> **co-function identity for tangent**

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SUM AND DIFFERENCE AND PRODUCT OF SINE AND COSINE FUNCTIONg

you should use these laws to either solve it directly or عوض

Sum to product

$$\sin A + \sin B = 2\sin\left(\frac{A+B}{2}\right)\cos\left(\frac{A-B}{2}\right)$$

$$\sin A - \sin B = 2\cos\left(\frac{A+B}{2}\right)\sin\left(\frac{A-B}{2}\right)$$

$$\cos A + \cos B = 2\cos\left(\frac{A+B}{2}\right)\cos\left(\frac{A-B}{2}\right)$$

$$\cos A - \cos B = -2\sin\left(\frac{A+B}{2}\right)\sin\left(\frac{A-B}{2}\right)$$

Sum and difference formulas for sines and cosines

$$\sin(\alpha+\beta) = \sin\alpha\cos\beta + \cos\alpha\sin\beta$$

$$\sin(\alpha-\beta) = \sin\alpha\cos\beta - \cos\alpha\sin\beta$$

$$\cos(\alpha+\beta) = \cos\alpha\cos\beta - \sin\alpha\sin\beta$$

$$\cos(\alpha-\beta) = \cos\alpha\cos\beta + \sin\alpha\sin\beta$$

Product to sum

$$\cos A\cos B = \frac{1}{2}[\cos(A+B) + \cos(A-B)]$$

$$\sin A\sin B = \frac{1}{2}[\cos(A-B) - \cos(A+B)]$$

$$\sin A\cos B = \frac{1}{2}[\sin(A+B) + \sin(A-B)]$$

$$\cos A\sin B = \frac{1}{2}[\sin(A+B) - \sin(A-B)]$$

DOUBLE ANGLES

It is called that because we are doubling the angle**,** so instead of cos(A) it is cos(2A), which is basically

- Cos(A+A) = cos(A)cos(A) – Sin(A)Sin(A)

which means that

- Cos(2A) = $\cos(A)^2 - \sin(A)^2$

Let's take a break and say that

We can take that double angle and put it in a trigonometric identity

- **$\text{Cos}(A)^2$ + $\text{Sin}(A)^2$** = 1

Now we can either move the sin or cos

Move cos	Move sin
• **$\text{Sin}(A)^2 = 1-\text{Cos}(A)^2$** Adding that to the equation returns • $\text{Cos}(2A) = \cos(A)^2 - (1 - \text{Cos}(A)^2)$ • $\text{Cos}(2A) = \cos(A)^2 - 1 + \text{Cos}(A)^2$	• **$\text{Cos}(A)^2 = 1-\text{Sin}(A)^2$** Adding that to the equation returns • $\text{Cos}(2A) = 1 - \text{Sin}(A)^2 - \text{Sin}(A)^2$
$\text{Cos}(2A) = 2\text{Cos}(A)^2 - 1$	**$\text{Cos}(2A) = 1 - 2\text{Sin}(A)^2$**

Here is the double angle formula

$$\text{Tan}(2A)=\frac{2\text{Tan}(A)}{1}-\text{Tan}(A)^2$$