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Fundamental Trigonometry Laws and Identities

6 Trig Functions - *sohcahtoa*

$$\sin x = \frac{opp}{hyp} \quad \csc x = \frac{hyp}{opp}$$
$$\cos x = \frac{adj}{hyp} \quad \sec x = \frac{hyp}{adj}$$
$$\tan x = \frac{opp}{adj} \quad \cot x = \frac{adj}{opp}$$

Reciprocal Functions

$$\sin x = \frac{1}{\csc x} \quad \csc x = \frac{1}{\sin x}$$
$$\cos x = \frac{1}{\sec x} \quad \sec x = \frac{1}{\cos x}$$
$$\tan x = \frac{1}{\cot x} \quad \cot x = \frac{1}{\tan x}$$

Tangent Identities

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

Even/Odd Identities

$$\sin(-x) = -\sin x$$
$$\csc(-x) = -\csc x$$
$$\tan(-x) = -\tan x$$
$$\cot(-x) = -\cot x$$
$$\cos(-x) = \cos x$$
$$\sec(-x) = \sec x$$

Double Angle Identities

$$\sin(2x) = 2\sin x \cos x$$
$$\cos(2x) = \cos^2 x - \sin^2 x$$
$$\cos(2x) = 2\cos^2 x - 1$$
$$\cos(2x) = 1 - 2\sin^2 x$$
$$\tan(2x) = \frac{2\tan x}{1-\tan^2 x}$$

Sum and Difference Identities

$$\sin(x + y) = \sin x \cos y + \cos x \sin y$$
$$\sin(x - y) = \sin x \cos y - \cos x \sin y$$
$$\cos(x + y) = \cos x \cos y - \sin x \sin y$$
$$\cos(x - y) = \cos x \cos y + \sin x \sin y$$
$$\tan(x + y) = \frac{\tan x + \tan y}{1 - \tan x \tan y}$$
$$\tan(x - y) = \frac{\tan x - \tan y}{1 + \tan x \tan y}$$

Half Angle Identities

$$\sin\left(\frac{x}{2}\right) = \pm\sqrt{\frac{1-\cos x}{2}}$$
$$\cos\left(\frac{x}{2}\right) = \pm\sqrt{\frac{1+\cos x}{2}}$$
$$\tan\left(\frac{x}{2}\right) = \pm\sqrt{\frac{1-\cos x}{1+\cos x}} = \frac{1-\cos x}{\sin x}$$

Cofunction Identities

$$\sin\left(\frac{\pi}{2} - x\right) = \cos x \quad \csc\left(\frac{\pi}{2} - x\right) = \sec x$$
$$\cos\left(\frac{\pi}{2} - x\right) = \sin x \quad \sec\left(\frac{\pi}{2} - x\right) = \csc x$$
$$\tan\left(\frac{\pi}{2} - x\right) = \cot x \quad \cot\left(\frac{\pi}{2} - x\right) = \tan x$$

Power Reducing formulas

$$\sin^2 x = \frac{1-\cos 2x}{2}$$
$$\cos^2 x = \frac{1+\cos 2x}{2}$$
$$\tan^2 x = \frac{1-\cos 2x}{1+\cos 2x}$$

Pythagorean Identities

$$\sin^2 x + \cos^2 x = 1$$
$$\tan^2 x + 1 = \sec^2 x$$
$$\cot^2 x + 1 = \csc^2 x$$

Law of Sines

$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$$

Law of Cosines

$$a^2 = b^2 + c^2 - 2bc\cos A$$
$$b^2 = a^2 + c^2 - 2ac\cos B$$
$$c^2 = a^2 + b^2 - 2ab\cos C$$

Product to Sum Identities

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

Sum to Product Identities

$$\sin x + \sin y = 2\sin\left(\frac{x+y}{2}\right)\cos\left(\frac{x-y}{2}\right)$$
$$\sin x - \sin y = 2\cos\left(\frac{x+y}{2}\right)\sin\left(\frac{x-y}{2}\right)$$
$$\cos x + \cos y = 2\cos\left(\frac{x+y}{2}\right)\cos\left(\frac{x-y}{2}\right)$$
$$\cos x - \cos y = -2\sin\left(\frac{x+y}{2}\right)\sin\left(\frac{x-y}{2}\right)$$