

# Formula Sheet

## Double Angle Identities:

$$\sin 2\alpha = 2 \sin \alpha \cos \alpha$$

$$\sin^2 \alpha = \frac{1 - \cos 2\alpha}{2}$$

$$\cos 2\alpha = \cos^2 \alpha - \sin^2 \alpha$$

$$\cos^2 \alpha = \frac{1 + \cos 2\alpha}{2}$$

$$\cos 2\alpha = 1 - 2 \sin^2 \alpha$$

$$\cos 2\alpha = 2 \cos^2 \alpha - 1$$

$$\tan 2\alpha = \frac{2 \tan \alpha}{1 - \tan^2 \alpha}$$

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

## Product/Sum Identities:

$$\cos \alpha \cos \beta = \frac{1}{2} [\cos(\alpha - \beta) + \cos(\alpha + \beta)]$$

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

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

## Sum/Product Identities:

$$\sin \alpha + \sin \beta = 2 \sin \frac{\alpha + \beta}{2} \cos \frac{\alpha - \beta}{2}$$

$$\sin \alpha - \sin \beta = 2 \sin \frac{\alpha - \beta}{2} \cos \frac{\alpha + \beta}{2}$$

$$\cos \alpha + \cos \beta = 2 \cos \frac{\alpha + \beta}{2} \cos \frac{\alpha - \beta}{2}$$

$$\cos \alpha - \cos \beta = -2 \sin \frac{\alpha + \beta}{2} \sin \frac{\alpha - \beta}{2}$$

## Half Angles Identities:

$$\sin \frac{\alpha}{2} = \pm \sqrt{\frac{1 - \cos \alpha}{2}}$$

$$\cos \frac{\alpha}{2} = \pm \sqrt{\frac{1 + \cos \alpha}{2}}$$

$$\tan \frac{\alpha}{2} = \pm \sqrt{\frac{1 - \cos \alpha}{1 + \cos \alpha}}, \cos \alpha \neq -1$$

$$\tan \frac{\alpha}{2} = \frac{\sin \alpha}{1 + \cos \alpha}, \cos \alpha \neq -1$$

$$\tan \frac{\alpha}{2} = \frac{1 - \cos \alpha}{\sin \alpha}, \sin \alpha \neq 0$$

## Sum and Difference Formulas

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

$$\cos(\alpha \pm \beta) = \cos \alpha \cos \beta \mp \sin \alpha \sin \beta$$

$$\tan(\alpha \pm \beta) = \frac{\tan \alpha \pm \tan \beta}{1 \mp \tan \alpha \tan \beta}$$

**Law of Sines:**

$$\frac{\sin \alpha}{A} = \frac{\sin \beta}{B} = \frac{\sin \gamma}{C}$$

**Law of Cosines:**

$$\begin{aligned} a^2 &= b^2 + c^2 - 2bc \cos \alpha \\ b^2 &= a^2 + c^2 - 2ac \cos \beta \\ c^2 &= a^2 + b^2 - 2ab \cos \gamma \end{aligned}$$

**Area:**

$$\begin{aligned} \text{Area} &= \frac{1}{2} bc \sin \alpha \\ \text{Area} &= \frac{1}{2} ac \sin \beta \\ \text{Area} &= \frac{1}{2} ab \sin \gamma \end{aligned}$$

$$\text{Area} = \sqrt{s(s-a)(s-b)(s-c)}$$

**Law of Sines:**

$$\frac{\sin \alpha}{A} = \frac{\sin \beta}{B} = \frac{\sin \gamma}{C}$$

**Law of Cosines:**

$$\begin{aligned} a^2 &= b^2 + c^2 - 2bc \cos \alpha \\ b^2 &= a^2 + c^2 - 2ac \cos \beta \\ c^2 &= a^2 + b^2 - 2ab \cos \gamma \end{aligned}$$

**Area:**

$$\begin{aligned} \text{Area} &= \frac{1}{2} bc \sin \alpha \\ \text{Area} &= \frac{1}{2} ac \sin \beta \\ \text{Area} &= \frac{1}{2} ab \sin \gamma \end{aligned}$$

$$\text{Area} = \sqrt{s(s-a)(s-b)(s-c)}$$

**Law of Sines:**

$$\frac{\sin \alpha}{A} = \frac{\sin \beta}{B} = \frac{\sin \gamma}{C}$$

**Law of Cosines:**

$$\begin{aligned} a^2 &= b^2 + c^2 - 2bc \cos \alpha \\ b^2 &= a^2 + c^2 - 2ac \cos \beta \\ c^2 &= a^2 + b^2 - 2ab \cos \gamma \end{aligned}$$

**Area:**

$$\begin{aligned} \text{Area} &= \frac{1}{2} bc \sin \alpha \\ \text{Area} &= \frac{1}{2} ac \sin \beta \\ \text{Area} &= \frac{1}{2} ab \sin \gamma \end{aligned}$$

$$\text{Area} = \sqrt{s(s-a)(s-b)(s-c)}$$

**Law of Sines:**

$$\frac{\sin \alpha}{A} = \frac{\sin \beta}{B} = \frac{\sin \gamma}{C}$$

**Law of Cosines:**

$$\begin{aligned} a^2 &= b^2 + c^2 - 2bc \cos \alpha \\ b^2 &= a^2 + c^2 - 2ac \cos \beta \\ c^2 &= a^2 + b^2 - 2ab \cos \gamma \end{aligned}$$

**Area:**

$$\begin{aligned} \text{Area} &= \frac{1}{2} bc \sin \alpha \\ \text{Area} &= \frac{1}{2} ac \sin \beta \\ \text{Area} &= \frac{1}{2} ab \sin \gamma \end{aligned}$$

$$\text{Area} = \sqrt{s(s-a)(s-b)(s-c)}$$