Trig Identities and Formulas

Complete Trigonometry Formula Sheet

Basic Trigonometric Ratios

1. **Sine**: $\sin\theta = \frac{\text{Opposite}}{\text{Hypotenuse}}$
2. **Cosine**: $\cos\theta = \frac{\text{Adjacent}}{\text{Hypotenuse}}$
3. **Tangent**: $\tan\theta = \frac{\text{Opposite}}{\text{Adjacent}}$
4. **Cosecant**: $\csc\theta = \frac{1}{\sin\theta} = \frac{\text{Hypotenuse}}{\text{Opposite}}$
5. **Secant**: $\sec\theta = \frac{1}{\cos\theta} = \frac{\text{Hypotenuse}}{\text{Adjacent}}$
6. **Cotangent**: $\cot\theta = \frac{1}{\tan\theta} = \frac{\text{Adjacent}}{\text{Opposite}}$

Reciprocal Identities

1. $\csc\theta = \frac{1}{\sin\theta}$
2. $\sec\theta = \frac{1}{\cos\theta}$
3. $\cot\theta = \frac{1}{\tan\theta}$

Pythagorean Identities

1. $\sin^2\theta + \cos^2\theta = 1$
2. $1 + \tan^2\theta = \sec^2\theta$
3. $1 + \cot^2\theta = \csc^2\theta$

Angle Sum and Difference Identities

1. **Sine**:
   - $\sin(a+b) = \sin a\cos b + \cos a\sin b$
   - $\sin(a-b) = \sin a\cos b - \cos a\sin b$
2. **Cosine**:
   - $\cos(a+b) = \cos a\cos b - \sin a\sin b$
   - $\cos(a-b) = \cos a\cos b + \sin a\sin b$
3. **Tangent**:
   - $\tan(a+b) = \frac{\tan a+\tan b}{1-\tan a\tan b}$
   - $\tan(a-b) = \frac{\tan a-\tan b}{1+\tan a\tan b}$

Double Angle Identities

1. **Sine**: $\sin 2\theta = 2\sin\theta\cos\theta$
2. **Cosine**:
   - $\cos 2\theta = \cos^2\theta - \sin^2\theta$
   - $\cos 2\theta = 2\cos^2\theta - 1$

    - $\cos 2\theta = 1 - 2\sin^2\theta$
3. **Tangent**: $\tan 2\theta = \frac{2\tan\theta}{1-\tan^2\theta}$

Half Angle Identities

1. **Sine**: $\sin\frac{\theta}{2} = \pm\sqrt{\frac{1-\cos\theta}{2}}$
2. **Cosine**: $\cos\frac{\theta}{2} = \pm\sqrt{\frac{1+\cos\theta}{2}}$
3. **Tangent**: $\tan\frac{\theta}{2} = \pm\sqrt{\frac{1-\cos\theta}{1+\cos\theta}} = \frac{\sin\theta}{1+\cos\theta} = \frac{1-\cos\theta}{\sin\theta}$

Product-to-Sum and Sum-to-Product Identities

1. **Product-to-Sum**:
    - $\sin a\sin b = \frac{1}{2}[\cos(a-b) - \cos(a+b)]$
    - $\cos a\cos b = \frac{1}{2}[\cos(a+b) + \cos(a-b)]$
    - $\sin a\cos b = \frac{1}{2}[\sin(a+b) + \sin(a-b)]$
2. **Sum-to-Product**:
    - $\sin a + \sin b = 2\sin\left(\frac{a+b}{2}\right)\cos\left(\frac{a-b}{2}\right)$
    - $\sin a - \sin b = 2\cos\left(\frac{a+b}{2}\right)\sin\left(\frac{a-b}{2}\right)$
    - $\cos a + \cos b = 2\cos\left(\frac{a+b}{2}\right)\cos\left(\frac{a-b}{2}\right)$
    - $\cos a - \cos b = -2\sin\left(\frac{a+b}{2}\right)\sin\left(\frac{a-b}{2}\right)$

Inverse Trigonometric Functions

1. $\sin^{-1} x$
2. $\cos^{-1} x$
3. $\tan^{-1} x$
4. $\csc^{-1} x$
5. $\sec^{-1} x$
6. $\cot^{-1} x$

These formulas cover the essential aspects of trigonometry, including basic definitions, identities, and relationships between angles. This comprehensive list can be used as a quick reference for solving trigonometric problems.