

Trigonometric substitution is a technique used to simplify the integration of certain types of functions that involve trigonometric functions. The basic idea is to use trigonometric identities to transform the integral into a form that can be easily integrated.

For example, consider the integral of the function $f(x) = \sqrt{x^2 + 4}$. We can simplify this integral by making the substitution $x = 2\tan\theta$. Using the identity $1 + \tan^2\theta = \sec^2\theta$, we can simplify the integrand to:

$$\sqrt{x^2 + 4} = \sqrt{4\tan^2\theta + 4} = 2\sec\theta$$

Substituting this into the integral and using the fact that $dx = 2\sec^2\theta d\theta$, we get:

$$\int \sqrt{x^2 + 4} dx = \int 2\sec\theta (2\sec^2\theta d\theta) = 4 \int \sec^3\theta d\theta$$

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