2.1 Using Fundamental Identities

Recognize and write the fundamental trigonometric identities.

Use the fundamental trigonometric identities to evaluate trigonometric functions, simplify trigonometric expressions, and rewrite trigonometric expressions.

Introduction

In Chapter 1, you studied the basic definitions, properties, graphs, and applications of the individual trigonometric functions. In this chapter, you will learn how to use the fundamental identities to do the following.

1. Evaluate trigonometric functions.
2. Simplify trigonometric expressions.
3. Develop additional trigonometric identities.
4. Solve trigonometric equations.

Fundamental Trigonometric Identities

Reciprocal Identities

\[
\begin{align*}
\sin u &= \frac{1}{\csc u} & \cos u &= \frac{1}{\sec u} & \tan u &= \frac{1}{\cot u} \\
\csc u &= \frac{1}{\sin u} & \sec u &= \frac{1}{\cos u} & \cot u &= \frac{1}{\tan u}
\end{align*}
\]

Quotient Identities

\[
\begin{align*}
\tan u &= \frac{\sin u}{\cos u} & \cot u &= \frac{\cos u}{\sin u}
\end{align*}
\]

Pythagorean Identities

\[
\begin{align*}
\sin^2 u + \cos^2 u &= 1 & 1 + \tan^2 u &= \sec^2 u & 1 + \cot^2 u &= \csc^2 u
\end{align*}
\]

Co-function Identities

\[
\begin{align*}
\sin\left(\frac{\pi}{2} - u\right) &= \cos u & \cos\left(\frac{\pi}{2} - u\right) &= \sin u \\
\tan\left(\frac{\pi}{2} - u\right) &= \cot u & \cot\left(\frac{\pi}{2} - u\right) &= \tan u \\
\sec\left(\frac{\pi}{2} - u\right) &= \csc u & \csc\left(\frac{\pi}{2} - u\right) &= \sec u
\end{align*}
\]

Even/Odd Identities

\[
\begin{align*}
\sin(-u) &= -\sin u & \cos(-u) &= \cos u & \tan(-u) &= -\tan u \\
\csc(-u) &= -\csc u & \sec(-u) &= \sec u & \cot(-u) &= -\cot u
\end{align*}
\]

Pythagorean identities are sometimes used in radical form such as

\[
\sin u = \pm \sqrt{1 - \cos^2 u}
\]

or

\[
\tan u = \pm \sqrt{\sec^2 u - 1}
\]

where the sign depends on the choice of $u$. 

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