Trigonometry/Precalculus Name _____

§5.1 Using Fundamental Identities Date _____ Pd _____

Introduction

In chapter 4, 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

$$\sin(u)=\frac{1}{\csc(u)} \qquad \cos(u)=\frac{1}{\sec(u)} \qquad \tan(u)=\frac{1}{\cot(u)}$$

$$\csc(u)=\frac{1}{\sin(u)} \qquad \sec(u)=\frac{1}{\cos(u)} \qquad \cot(u)=\frac{1}{\tan(u)}$$

Quotient Identities

$$\tan(u)=\frac{\sin(u)}{\cos(u)} \qquad \cot(u)=\frac{\cos(u)}{\sin(u)}$$

Pythagorean Identities

$$\sin^2(u)+\cos^2(u)=1 \qquad 1+\tan^2(u)=\sec^2(u) \qquad 1+\cot^2(u)=\csc^2(u)$$

Example 1 (Simplifying a Trigonometric Expression)

Use the fundamental identities to simplify the expression $\sin(\theta)\left(\csc(\theta)-\sin(\theta)\right)$.

Example 2 (Verifying a Trigonometric Identity)

Verify the identity algebraically. Verify with a graphing calculator.

$\sin(\theta)+\cos(\theta)\cot(\theta)=\csc(\theta)$

Example 3 (Verifying a Trigonometric Identity)

Verify the identity algebraically. Verify with a graphing calculator.

$\csc(\theta)\tan(\theta)=\sec(\theta)$

Example 4 (Factoring a Trigonometric Expression)

Factor the expression $\cot^2(x) - \cot^2(x)\cos^2(x)$ and use the fundamental identities to simplify. Verify with a graphing calculator.

Example 5 (Factoring a Trigonometric Expression)

Factor the expression $\sin^4(x) - \cos^4(x)$ and use the fundamental identities to simplify. Verify with a graphing calculator.

Example 6 (Simplifying a Trigonometric Expression)

Perform the indicated operation and use the fundamental identities to simplify.

$$\tan(x) - \frac{\sec^2(x)}{\tan(x)}$$

Example 7 (Rewriting a Trigonometric Expression)

Rewrite the expression $\frac{\sin^2(y)}{1-\cos(y)}$ so that it is not in fractional form.

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In Exercises 1-2, use the fundamental identities to simplify the expression. Verify with a graphing calculator.

1. $\cot(x)\sin(x)$

2. $\dfrac{\sec(\theta)}{\csc(\theta)}$

In Exercises 3-4, verify the identity algebraically. Verify with a graphing calculator.

3. $\sin(\theta)\csc(\theta)-\sin^2(\theta)=\cos^2(\theta)$

4. $1-\dfrac{\sin^2(\theta)}{1-\cos(\theta)}=-\cos(\theta)$

In Exercises 5-6, factor the expression and use the fundamental identities to simplify. Verify with a graphing calculator.

5. $\sec^2(x)\tan^2(x)+\sec^2(x)$

6. $\dfrac{\cos^2(x)-4}{\cos(x)-2}$

In Exercises 7-8, perform the indicated operation and use the fundamental identities to simplify.

7. $(\sin(x)+\cos(x))^2$

8. $\dfrac{1}{1+\cos(x)}+\dfrac{1}{1-\cos(x)}$

In Exercises 9-10, rewrite the expression so that it is not in fractional form.

9. $\dfrac{5}{\tan(x)+\sec(x)}$

10. $\dfrac{\tan^2(x)}{\csc(x)+1}$