Trig Identities Name:_____ Period:_____

Trigonometric Identities

Students will learn to verify trigonometric identities

Precalculus/Honors Precalculus

FUNDAMENTAL IDENTITIES

Reciprocal Identities:

What are the reciprocal identities?

$$\csc\theta = \frac{1}{\sin\theta} \quad \sec\theta = \frac{1}{\cos\theta} \quad \cot\theta = \frac{1}{\tan\theta}$$

$$\sin\theta = \frac{1}{\csc\theta} \quad \cos\theta = \frac{1}{\sec\theta} \quad \tan\theta = \frac{1}{\cot\theta}$$

Quotient Identities:

What are the quotient identities?

(X, Y)
(COS, SIN)

$$\frac{Y}{X} = \tan\theta = \frac{\sin\theta}{\cos\theta} \qquad \frac{X}{Y} \cot\theta = \frac{\cos\theta}{\sin\theta}$$

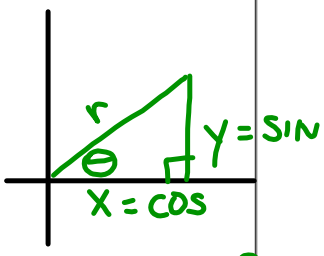
Pythagorean Identities:

What are the Pythagorean identities?

$\cos^2\theta + \sin^2\theta = 1$

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

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



$x^2 + y^2 = 1^2$

$\cos^2 x + \sin^2 x = 1$

$1 + \tan^2\theta = \sec^2\theta$

$\tan^2\theta = \sec^2\theta - 1$

$1 = \sec^2\theta - \tan^2\theta$

$\cot^2\theta + 1 = \csc^2\theta$

$\cot^2\theta = \csc^2\theta - 1$

$1 = \csc^2\theta - \cot^2\theta$

Even - Odd Identities

What are the Odd- Even Identites

$$\sin(-x) = -\sin x \quad \cos(-x) = \cos x \quad \tan(-x) = -\tan x$$

$$\csc(-x) = -\csc x \quad \sec(-x) = \sec x \quad \cot(-x) = -\cot x$$

Trig Identities Name:_____ Period:_____

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How do you verify identities?

Guidelines for Verifying Trigonometric Identities

- **Start with the more complicated side, work step-by step to transform it to the simpler side.**
- **Look for opportunities to apply the fundamental identities.**
- **Use one or more of the following techniques:**
  - **Rewrite the more complicated side in terms of *sinx* and *cosx*.**
  - **Factor out the greatest common factor.**
  - **Separate a single-term quotient terms:**

$$\frac{a+b}{c} = \frac{a}{c} + \frac{b}{c}$$

  - **Combine fractions using a common denominator.**

Don't be afraid to stop and start over if you are not getting anywhere. Strategies leading to dead ends often provide clues to the solution.

Trig Identities Name:_____ Period:_____

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Precalculus/Honors Precalculus

How do you verify an identity by replacing all terms with sinx or cosx?

Example 1: ***Verify the expression.***

$(cscx)(tanx) = secx$

$\frac{1}{SINX} \cdot \frac{SINX}{COSX} =$

$\frac{1}{COSX} = SECX$ ✓

Example 2: ***Verify the expression.***

$(sinx)tanx + (cosx) = secx$

$\left(\frac{SINX}{1} \cdot \frac{SINX}{COSX}\right) + \frac{COSX}{1} = \frac{SIN^2X}{COSX} + \frac{COSX}{1}\left(\frac{COSX}{COSX}\right)$

$\frac{SIN^2X}{COSX} + \frac{COS^2X}{COSX} = \frac{(SIN^2X + COS^2X)}{COSX} = \frac{1}{COSX} = SECX$ ✓

How do you use factoring to verify an identity?

Example 3: ***Verify the expression.***

$X - XY^2$

$sinx - sinxcos^2x = sin^3x$

$SINX(1 - COS^2X) =$

$SINX(SIN^2X) = SIN^3X$

Trig Identities Name:_____ Period:_____

Trigonometric Identities

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Precalculus/Honors
Precalculus

How do you use multiple steps to verify an identity?

Example 4: ***Verify the identity.***

$$\frac{1+\sin x}{\cos x} = \sec x + \tan x$$

$$\frac{1}{\cos x} + \frac{\sin x}{\cos x} = \sec x + \tan x \checkmark$$

How do you combine fractional expressions to verify an identity?

Example 5: ***Verify the identity.***

$$\frac{\sin x}{1+\cos x} + \frac{1+\cos x}{\sin x} = 2\csc x$$

$(1+x)(1+x)$

$1+1x+1x+x^2$

$1+2x+x^2$

$\frac{\sin x}{\sin x}$

$$\frac{\sin x}{1+\cos x} + \frac{(1+\cos x)}{\sin x}\left(\frac{1+\cos x}{1+\cos x}\right)$$

$$\frac{\sin^2 x + 1 + 2\cos x + \cos^2 x}{(1+\cos x)(\sin x)} =$$

$$\frac{\sin^2 x + \cos^2 x + 1 + 2\cos x}{(1+\cos x)(\sin x)} = \frac{1+1+2\cos x}{(\sin x)(1+\cos x)} =$$

$$\frac{2+2\cos x}{(\sin x)(1+\cos x)} = \frac{2(1+\cos x)}{\sin x(1+\cos x)} = \frac{2}{1}\cdot\frac{1}{\sin x}$$

$$= 2\csc x$$

Trig Identities Name:_____ Period:_____

Trigonometric Identities **Students will learn to verify trigonometric identities**	Precalculus/Honors Precalculus

How do you verify an identity by multiplying the numerator and the denominator by the same factor?

Example 6: ***Verify the identity.***

$$\frac{sinx}{1+cosx} = \frac{1-cosx}{sinx}$$

$$\frac{1-\cos x}{1-\cos x} \cdot \frac{\sin x}{1+\cos x} = \frac{(1-\cos x)(\sin x)}{1-\cos^2 x} =$$

$$\frac{(1-\cos x)(\sin x)}{\sin^2 x} = \frac{1-\cos x}{\sin x} \checkmark$$

Example 7: ***Verify the identity.***

$$\frac{secx + csc(-x)}{secxcscx} = sinx - cosx$$

$$\frac{\sec x - \csc x}{\sec x \csc x} = \frac{\sec x \cdot 1}{\sec x \csc x} - \frac{\csc x \cdot 1}{\sec x \csc x}$$

$$= \frac{1}{\csc x} - \frac{1}{\sec x}$$

$$\sin x - \cos x \checkmark$$

Trig Identities

Name:_____ Period:_____

Verify each identity.

1. $\sin x \sec x = \tan x$

2. $\cos x \csc x = \cot x$

3. $\tan x \cos x = \sin x$

4. $\cot x \sin x = \cos x$

5. $\sin x \tan x \cos x = \sin^2 x$

6. $\sin x \cot x \cos x = \cos^2 x$

7. $\sec x - \sec x \sin^2 x = \cos x$

8. $\csc x - \csc x \cos^2 x = \sin x$

Trig Identities Name:_____ Period:_____

9. $\cos^2 x - \sin^2 x = 1 - 2\sin^2 x$

10. $\csc\theta - \sin\theta = \cot\theta\cos\theta$

11. $\frac{\tan\theta\cot\theta}{\csc\theta} = \sin\theta$

12. $\sin^2 x\,(1 + \cot^2 x) = 1$

13. $\sin t \tan t = \frac{1-\cos^2 t}{\cos t}$

14. $\frac{\csc^2 t}{\cot t} = \csc t \sec t$

15. $\cos x(\tan x + \sin x \cot x) = \sin x + \cos^2 x$

16. $\frac{1-\sin\theta}{\cos\theta} = \sec\theta - \tan\theta$

Trig Identities Name:_____ Period:_____

17. $\frac{\sin t}{\tan t} + \frac{\cos t}{\cot t} = \sin t + \cos t$

18. $1 - \frac{\sin^2 x}{1+\cos x} = \cos x$

19. $\csc^2 x \sec x = \sec x + \csc x \cot x$

20. $\sin^2\beta(1 + cot^2\beta) = 1$

21. $(\sec\theta + 1)(\sec\theta - 1) = \tan^2\theta$

22. $\frac{(1-\cos u)(1+\cos u)}{\cos^2 u} = \tan^2 u$

23. $\frac{(1+\tan^2 x)}{\sin^2 x+\cos^2 x} = \sec^2 x$

24. $\tan^2\theta - \sin^2\theta = \tan^2\theta\sin^2\theta$

7. $\left(\frac{1}{\sin^2 A}\right) - \frac{1}{\tan^2 A} =$

$\frac{1}{\sin^2 A} - \frac{\cot^2 A}{1} =$

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

$\frac{(1 - \cos^2 A)}{\sin^2 A} = \frac{\sin^2 A}{\sin^2 A} = 1$

8. $1 - \frac{\sin^2\theta}{\tan^2\theta} \rightarrow 1 - \left(\frac{\sin^2\theta}{1} \cdot \frac{1}{\tan^2\theta}\right) =$

$1 - \frac{\sin^2\theta}{1} \cdot \frac{\cot^2\theta}{1} = 1 - \left[\frac{\sin^2\theta}{1}\left(\frac{\cos^2\theta}{\sin^2\theta}\right)\right]$

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