Derivatives of Trigonometric Functions

Calculus Worksheet · Grade 11-12

Name: _____ Date: _____ Score: / 10

Learning Objectives

- Apply derivative formulas for the six trigonometric functions
- Use the product and quotient rules with trigonometric functions
- Simplify derivative expressions by factoring common terms

Find the derivative of each function and simplify your answer completely.

1. Find the derivative of the function.

$y = 2\csc x + 5\cos x$

Answer: _____

2. Find the derivative using the product rule.

$y = e^{x}\tan x$

Answer: _____

3. Find the derivative using the quotient rule.

$y = \frac{\sin x + 1}{-3\cos x}$

Answer: _____

4. Find the derivative of the function.

$y = 3\sin x - 4\sec x$

Answer: _____

5. Find the derivative using the product rule.

$y = x^{2}\cos x$

Answer: _____

6. Find the derivative of the function.

$y = \cot x + 7\tan x$

Answer: _____

7. Find the derivative using the quotient rule.

$y = \frac{\cos x}{x}$

Answer: _____

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8. Find the derivative using the product rule.

$y = \sin x \cos x$

Answer: _____

9. Find the derivative of the function.

$y = 4\csc x - 2\cot x$

Answer: _____

10. Find the derivative using the product rule.

$y = e^x \sin x$

Answer: _____

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ANSWER KEY & SOLUTIONS

Students should memorize the six trig derivative formulas before attempting the product and quotient rule problems.

Solutions

1. Find the derivative of the function.

$y = 2\csc x + 5\cos x$

→ *Apply the constant multiple rule to each term*
→ *The derivative of cosecant x is negative cosecant x times cotangent x*
→ *The derivative of cosine x is negative sine x*
→ *Multiply by the constants and combine the results*

Answer: $y' = -2\csc x\cot x - 5\sin x$

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2. Find the derivative using the product rule.

$y = e^x \tan x$

→ *Identify the two factors as e to the x and tangent x*
→ *Apply the product rule: derivative of first times second plus first times derivative of second*
→ *The derivative of e to the x is e to the x and the derivative of tangent x is secant squared x*
→ *Factor out the greatest common factor e to the x to simplify*

Answer: $y' = e^x(\tan x + \sec^2 x)$

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3. Find the derivative using the quotient rule.

$y = \frac{\sin x + 1}{-3\cos x}$

→ *Identify the numerator as sine x plus one and the denominator as negative three cosine x*
→ *Apply the quotient rule: low times derivative of high minus high times derivative of low all over low squared*
→ *The derivative of sine x is cosine x and the derivative of negative three cosine x is three sine x*
→ *Expand the numerator and simplify using the Pythagorean identity if possible*

Answer: $y' = \frac{-3 - 3\sin x}{-3\cos^2 x}$

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4. Find the derivative of the function.

$y = 3\sin x - 4\sec x$

→ *Take the derivative of each term separately using the constant multiple rule*
→ *The derivative of sine x is cosine x*
→ *The derivative of secant x is secant x times tangent x*
→ *Combine the terms with their constants*

Answer: $y' = 3\cos x - 4\sec x\tan x$

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5. Find the derivative using the product rule.

$y = x^2 \cos x$

→ *Identify the two factors as x squared and cosine x*
→ *Apply the product rule formula*
→ *The derivative of x squared is two x and the derivative of cosine x is negative sine x*
→ *Write out the resulting expression*

Answer: $y' = 2x\cos x - x^2 \sin x$

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6. Find the derivative of the function.

$y = \cot x + 7\tan x$

→ *Differentiate each term separately*
→ *The derivative of cotangent x is negative cosecant squared x*
→ *The derivative of tangent x is secant squared x*
→ *Multiply by the constants and combine*

Answer: $y' = -\csc^2 x + 7\sec^2 x$

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7. Find the derivative using the quotient rule.

$y = \frac{\cos x}{x}$

→ *Identify the numerator as cosine x and the denominator as x*
→ *Apply the quotient rule formula*
→ *The derivative of cosine x is negative sine x and the derivative of x is one*
→ *Simplify the numerator by combining like terms*

Answer: $y' = \frac{-x\sin x - \cos x}{x^2}$

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8. Find the derivative using the product rule.

$y = \sin x \cos x$

→ *Identify the two factors as sine x and cosine x*
→ *Apply the product rule formula*
→ *The derivative of sine x is cosine x and the derivative of cosine x is negative sine x*
→ *Combine the terms to form the difference of squares*

Answer: $y' = \cos^2 x - \sin^2 x$

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9. Find the derivative of the function.

$y = 4\csc x - 2\cot x$

→ *Differentiate each term using the constant multiple rule*
→ *The derivative of cosecant x is negative cosecant x times cotangent x*
→ *The derivative of cotangent x is negative cosecant squared x*
→ *Apply the negative sign from the second term and combine*

Answer: $y' = -4\csc x \cot x + 2\csc^2 x$

10. Find the derivative using the product rule.

$y = e^x \sin x$

→ *Identify the two factors as e to the x and sine x*
→ *Apply the product rule formula*
→ *The derivative of e to the x is e to the x and the derivative of sine x is cosine x*
→ *Factor out the greatest common factor e to the x*

Answer: $y' = e^x(\sin x + \cos x)$