

Name:

Date:

3 – 5.4 The Derivatives of $y = \sin x$ and $y = \cos x$

Lesson Goals:

- Be able to determine the derivative of a function containing trigonometric operations

1) Derivative of Sinusoidal Functions

- Proof of the derivative of $f(x) = \sin x, f'(x) = \cos x$

- Proof of the derivative of $f(x) = \cos x, f'(x) = -\sin x$

Example 1: Differentiate.

a) $y = x \cos x$

b) $y = \sin 3x$

2) Derivative of Composite Sinusoidal Functions

- For $f(x) = \sin(g(x))$, $f'(x) = \cos(g(x))g'(x)$.
- For $f(x) = \cos(g(x))$, $f'(x) = -\sin(g(x))g'(x)$.

Example 2: Differentiate.

a) $y = \cos x^2$

b) $y = \cos^2 x$

c) $y = \sin\left(2x^2 + \frac{\pi}{2}\right)$

d) $y = \frac{\cos 3x}{x^2}$

Example 3: Determine the equation of the tangent to the graph of $f(x) = x^2 \sin x$ at $x = \pi$.

Example 4: Determine the values of x where the function $y = 2 \sin x \cos x$ has a horizontal tangent.

3) Higher Order Derivatives

- For $f(x)$,
 - The First Derivative is $f'(x)$
 - The Second Derivative is $f''(x)$
 - The Third Derivative is $f'''(x) = f^3(x)$

Example 5:

- a) Determine the 21st derivative for $f(x) = \sin x$.
- b) Determine $f^{(2002)}(x)$.

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