Definition 1.1. $f(x)$ has a vertical asymptote at $x = a$ if

Definition 1.2. $x = a$ is a horizontal asymptote of $f(x)$ if

Theorem 1.3 (Squeeze Theorem).

Example 1.4. Find all vertical asymptotes of the function $f(x) = \frac{x^2 - 9}{2x^2 - 10x + 12}$.

Example 1.5. Find all horizontal asymptotes of the function $f(x) = \frac{\cos^2 x}{x^2}$.

Example 1.6. Compute $\lim_{x \to \pi^-} \ln(\sin x)$. 

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**Definition 2.1.** \( f(x) \) is continuous at \( a \) if

**Theorem 2.2** (Intermediate Value Theorem).

**Example 2.3.** Find values of \( a \) and \( b \) that make \( f \) continuous everywhere, where

\[
f(x) = \begin{cases} 
\frac{x^2 - 4}{x - 2} & \text{if } x < 2 \\
ax^2 - bx + 3 & \text{if } 2 \leq x < 3 \\
2x - a + b & \text{if } x \geq 3
\end{cases}
\]

**Example 2.4.** Show that there is a root of the equation \( \cos(\sqrt{x}) = e^x - 2 \) in the interval \((0, 1)\).
Definition 3.1. \( f(x) \) is differentiable at \( a \) if

Theorem 3.2. If \( f(x) \) is \( a \), then \( f(x) \) is \( a \). The converse is not true: Consider, for example, the function .

Theorem 3.3 (Product Rule).

Example 3.4. Using the definition, find the derivative of \( f(x) = 3x - 4x^2 + 2 \).

Example 3.5. Find the derivative of \( f(x) = x^2 \cos x \).
Theorem 4.1 (Quotient Rule).

Theorem 4.2 (Chain Rule).

Example 4.3. Find the derivative of $f(x) = rac{xe^x}{2x + 7}$.

Example 4.4. Find the derivatives of $f(x) = \sqrt{\cos(x^2) + \ln x}$ and $g(x) = \arctan(2^x + 1)$. 
Example 5.1. Find the equation of the tangent line to the ellipse $x^2 + 2xy + 4y^2 = 12$ at the point $(2, 1)$.

Example 5.2. Compute $\frac{dy}{dx}$ where $y = (\sin x)^{\ln x}$. 