Week 6: Asymptotes, Infinite Limits and Differentiation Rules

Welcome to the Weekly Review for MATH 2413. This week’s review talks about horizontal asymptotes, slant asymptotes, infinite limits, and taking derivatives using the product rule and quotient rule. We would like to thank Patrick Bourque and the Fall 2014 MATH 2413 students for allowing us to film the Weekly Reviews.

The following problems are presented in the Week 6 videos. Thank you!

Part A: Asymptotes and Infinite Limits

1. Find all horizontal asymptotes for \( f(x) = \frac{2x^2+3x}{x^3+y^2} \)

2. Find all horizontal asymptotes for \( f(x) = \frac{x^3\arctan(x)}{2x+y+1} \)
3. Find all horizontal asymptotes for $f(x) = \frac{x^3 + x}{\sqrt{4x^2 + 1}}$

4. Find $\lim_{x \to \infty} \left(\sqrt{4x^2 + x} - 2x\right) =$
5. Find $k$ so that \( \lim_{x \to -\infty} \left( \sqrt{x^2 + kx + x} \right) = 10 \)

6. Find all slant asymptotes for \( f(x) = \frac{4x^3 + 6x^2 + x}{x^2 + 4} \)
Part B: Finding Derivatives using Differentiation Rules

1. The Rules of Differentiation

2. For each of the following functions, find $f'(x)$:

   (a) $f(x) = (x^3 + 6x)(\sec(x))$

   (b) $f(x) = \frac{x^3 + 1}{x^2 + 1}$
(c) $f(x) = \frac{x \sin x}{x + \cos x}$

(d) $f(x) = \frac{x^3}{\sec(x) + \tan(x)}$

(e) $f(x) = x^3 \sin(x) \cos(x)$
3. Find \( \frac{d}{dx}(e^{kx}) \)

4. Find values of \( x \) where the tangent line to \( f(x) = 2x^2 + 12x \) is parallel to tangent line of \( g(x) = x^2 + \frac{20}{3}x^{3/2} \)

5. Patrick’s Interesting Problem!!!
Want some more practice? The following problems were provided to you by the Math Lab Learning Specialists. Please feel free to come and visit the UT Dallas Math Lab if you need any help. Thank you!!

1. Find all horizontal asymptotes for \( f(x) = \frac{x^3-8x+2}{3x^2-3x-1} \)

2. Find all horizontal asymptotes for \( f(x) = \frac{x-2}{\sqrt{x^2+3}} \)

3. Find the derivative of \( f(x) = (3x^2 - 2x^3)(5 + 4x) \)

4. Find the derivative of \( f(x) = 5x \tan(x) \).

5. Find the derivative of \( f(x) = \sec(x) - \frac{3x+1}{\sec(x)\csc(x)} \)

6. Find the derivative of \( f(x) = \cos(x) \cot(x)(3x + 2) \)

7. Find the derivative of \( f(x) = \frac{x^2-1}{\sqrt{x^2-3}} \)