

### Math 111 EXAM 1, September 24, 2008

Read each problem carefully. Show all your work for each problem!  
Use only the methods discussed in class. No calculators!

1. (20 points) Find the limit if it exists. If the limit does not exist, explain why.

a)  $\lim_{x \rightarrow -3} \frac{x^2 - 2x - 15}{x^2 + 4x + 3}$     b)  $\lim_{t \rightarrow 4} \frac{t-4}{\sqrt{t+5}-3}$     c)  $\lim_{x \rightarrow 2} \frac{(x+3)|x-2|}{x-2}$     d)  $\lim_{\theta \rightarrow 0} \frac{\tan(5\theta)}{\sin(2\theta)}$

2. (14 points) Use the definition of the derivative (as the limit of a difference quotient) to

find the derivative of  $y = \sqrt{2x + 1}$ .

3. (15 points) Evaluate the following (include  $+\infty$  and  $-\infty$  as possible values of a limit). If the limit does not exist, explain why.

a)  $\lim_{y \rightarrow -2^+} \frac{y^2 + y - 6}{y^2 + 5y + 6}$     b)  $\lim_{t \rightarrow 1^+} \frac{t^2 + 3t + 1}{t-1}$     c)  $\lim_{\theta \rightarrow \infty} \frac{\sin \theta}{\theta^2}$

4. (12 points) Find the horizontal, vertical and oblique (slant) asymptotes, if they exist.

a)  $y = \frac{-2x^2 + 5x - 1}{3x^2 + 1}$     b)  $y = \frac{x^2 + 3x + 1}{x + 1}$

5. (15 points) Find  $\frac{dy}{dx}$  using the product and quotient rules as appropriate (do not simplify).

a)  $y = (5x^3 + 2x - 1)\left(\frac{2}{x^2} + \frac{3}{x^4}\right)$     b)  $z = \frac{t^3 + 2e^t}{5e^t - 1}$     c)  $w = \frac{(2x-1)(3x^2+5)}{x^3+1}$

6. (12 points) Find the equations of all lines having slope  $-1$  that are tangent to  $y = \frac{1}{x-1}$ .

7. (12 points) Given the function  $f(x) = \frac{x^2 + x - 6}{x^2 - x - 2}$

a) Find the values of  $x$  at which  $f(x)$  is discontinuous.

b) For each  $x$  at which there is a discontinuity define, if possible, a new function,  $g(x)$ , which extends  $f(x)$  to be continuous at  $x$ . If a continuous extension does not exist for a discontinuity explain why.