

MTH 161: Calculus IA
Midterm 1
October 13, 2015
8:00 a.m.

Academic honesty statement:

With my signature, I affirm that I will not give or receive any unauthorized help on this exam, and that all work will be my own.

Signature: _____ Date: _____

Name (please print): _____

University ID number: _____

Please print your name and student ID again, and circle your instructor's name:

Name (please print): _____

University student ID: _____

Bobkova (TR 9:40) Bridy (MW 2:00) Doyle (MWF 10:25)

Hambrook (TR 3:25) Lubkin (MWF 9:00) Murphy (TR 4:50)

Please read the following instructions:

Only pens/pencils and a single 3 in. \times 5 in. index card with formulas are allowed. The presence of calculators, cell phones, iPods and other electronic devices at this exam is strictly forbidden.

Show your work and justify your answers. You may not receive full credit for a correct answer if insufficient work is shown or insufficient justification is given. Clearly circle or label your final answers.

1. (12 points) Let $f(x) = \sqrt{5 + x^2}$ and $g(x) = \frac{2x}{3x - 2}$.

(a) Evaluate $(f \circ g)(2)$.

(b) Evaluate $(g \circ f)(2)$.

(c) Find a formula for $g^{-1}(x)$, the inverse of g .

2. (18 points)

(a) Solve for x :

$$2 \ln(x) = \ln(2x - 1)$$

(b) Find all values of x in the interval $[0, 4\pi]$ that satisfy the following equation:

$$\sin(x) + \cos(x) = 0$$

(c) Find $\cos\left(\tan^{-1}\left(\frac{\sqrt{5}}{2}\right)\right)$.

3. (25 points) Compute the following limits. If the limit does not exist, write “DNE.” **When appropriate**, write ∞ or $-\infty$ instead of “DNE.” *You may only use methods discussed in this class thus far.*

(a) $\lim_{x \rightarrow 1} \frac{3x^2 - x + 1}{x^2 - 5} =$

(b) $\lim_{x \rightarrow 1^-} \frac{x^2 - 1}{x^2 - 2x + 1} =$

(c) $\lim_{x \rightarrow -2} \frac{x + 2}{|x + 2|} =$

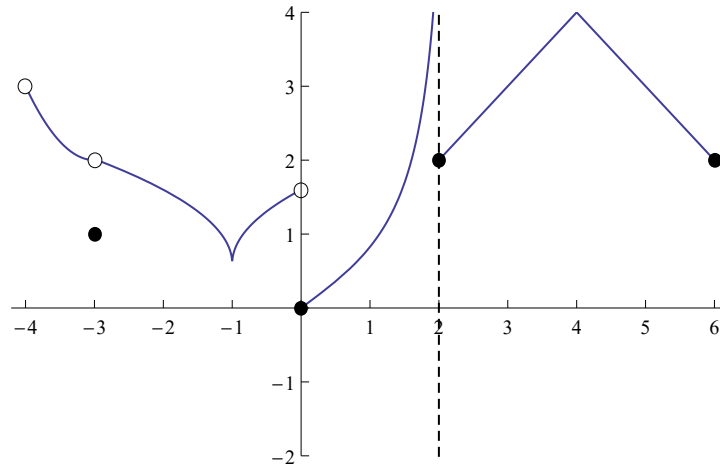
$$(d) \lim_{x \rightarrow \infty} \frac{3x^4 - 4x^2 + 3}{-2x^5 + 2x - 4} =$$

$$(e) \lim_{x \rightarrow \infty} \frac{4e^{2x} - 8}{2e^x + 8}$$

(f) Find all horizontal asymptotes of the function $f(x) = \frac{\sqrt{x^2 + 1} + x}{x}$.

4. (15 points)

Answer the following questions about the function $f(x)$ graphed below. You do not need to justify your answers.



- (a) For which values of x in the interval $[-4, 6]$ is $f(x)$ *not* continuous?
- (b) For which values of x in the interval $(-4, 6)$ is $f(x)$ *not* differentiable?
- (c) Sketch the graph of the function $g(x) = -f(x) + 4$ below. Label at least three points on the graph.

5. (20 points)

(a) State the limit definition of the derivative of a function $f(x)$:

(b) Use the definition of the derivative to show that the derivative of \sqrt{x} is $\frac{1}{2\sqrt{x}}$.

(c) Using that the derivative of \sqrt{x} is $\frac{1}{2\sqrt{x}}$, give an equation for the tangent line to the graph of $y = \sqrt{x}$ at $x = 4$.

6. (10 points)

(a) State the Intermediate Value Theorem.

(b) Show that the equation $e^x + 3x = x^2 + 2$ has a solution x between 0 and 1.

Bonus (5 pts): On the back of this page, prove that if f and g are differentiable, then

$$\frac{d}{dx}[f(x)g(x)] = f(x)\frac{d}{dx}g(x) + g(x)\frac{d}{dx}f(x).$$