

Math 180

Name (Print): _____

Exam #2

UIN: _____

10/21/2015

UIC Email: _____

Time Limit: 2 Hours

This exam contains 8 pages (including this cover page) and 8 problems. After starting the exam, check to see if any pages are missing. Enter all requested information on the top of this page.

The following rules apply:

- You may not open this exam until you are instructed to do so.
- You are expected to abide by the University's rules concerning Academic Honesty.
- You may *not* use your books, notes, calculators, or any electronic device including cell phones. Only pencils/pens allowed.
- You must show all of your work. An answer, right or wrong, without the proper justification will receive little to no credit.
- You *must* complete your work in the space provided. We will be scanning your answers into our grading system, so any work you do that is out of place, too close to the page border, or on the wrong page will *not* be graded!
- CHECK THAT THE NUMBER ON TOP OF EACH PAGE IS THE SAME! IF THEY ARE NOT THEN NOTIFY YOUR INSTRUCTOR OR TA RIGHT AWAY!

TA Name:_____

Circle your instructor.

- Bode
- Goldbring
- Hachtman
- Riedl
- Sinapova
- Steenbergen @ 11am
- Steenbergen @ 12pm
- Steenbergen @ 2pm

1. (12 points) Jack and Jill start riding their bikes from Jack's house at noon. Jack heads west at 6 miles per hour while Jill heads south at 8 miles per hour. How fast is the distance between them increasing at 2pm? Draw a picture modeling the situation. Don't forget to include the units in your answer.

2. (12 points) A water rocket is launched vertically upward from a platform 32 feet above the ground at an initial velocity of 64 feet per second. Its height at time t (seconds) is given by the equation $s(t) = -16t^2 + 64t + 32$ feet.

(a) (4 points) What is the velocity of the rocket after 2 seconds?

(b) (4 points) What is the acceleration of the rocket after 2 seconds?

(c) (4 points) What is the highest distance from the ground reached by the rocket?

3. (10 points) Find the equation of the tangent line to the curve

$$\sin(xy) = x - \pi$$

at the point $(\pi, 1)$.

4. (10 points) Let $f(x) = -x^3 + 3x^2 - 5$. Find the absolute maximum and minimum values of $f(x)$ on $[1, 3]$.

5. (20 points) Find the derivatives of the following functions. You do not need to simplify your answers!

(a) (6 points) $\sqrt{x} \ln(x^3)$

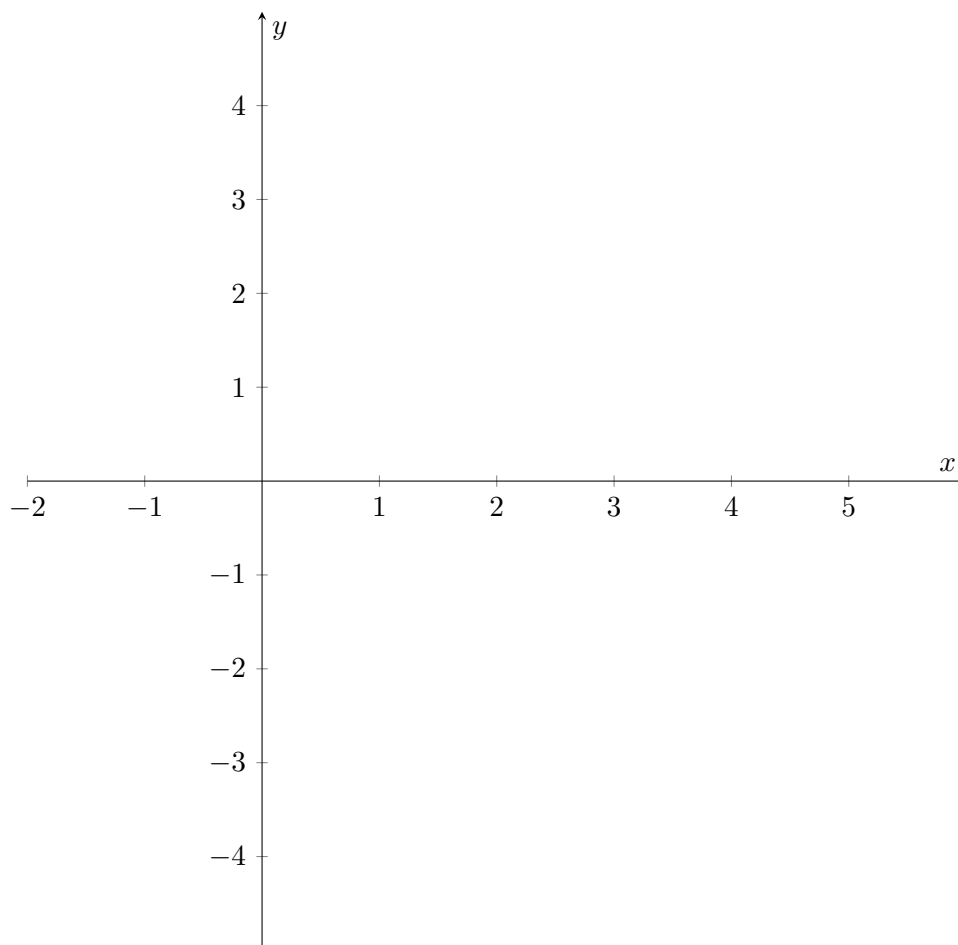
(b) (6 points) $\ln(\tan^{-1}(3^x))$

(c) (8 points) $(\cos x)^{x+1}$

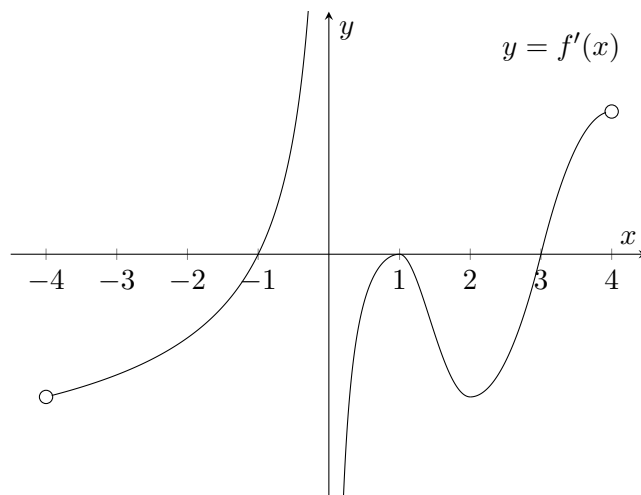
6. (10 points) Suppose f is a function that is continuous and differentiable on the interval $(-1, \infty)$. In addition f has the following properties:

- The domain of f is $(-1, \infty)$
- f has a vertical asymptote at $x = -1$, and a horizontal asymptote at $y = 1$.
- $f(0) = 0$.
- $f'(x) > 0$ on the interval $(-1, 2)$, $f'(2) = 0$, and $f'(x) < 0$ on the interval $(2, \infty)$.
- $f''(x) > 0$ on the interval $(3, \infty)$, $f''(3) = 0$, and $f''(x) < 0$ on the interval $(-1, 3)$.
- $f(2) = 3$ and $f(3) = 2$.

Sketch a possible graph of $y = f(x)$. Label all absolute maximum and minimum points, and all points of inflection if there are any.



7. (14 points) Below is a graph of the *derivative* of a continuous function.



Based on this graph of $y = f'(x)$, answer the following questions about the function $f(x)$.

- (a) (4 points) On what intervals is $f(x)$ increasing?

- (b) (4 points) On what intervals is $f(x)$ concave down?

- (c) (8 points) For which x does $f(x)$ have a local minimum? a local maximum?

8. (12 points) Consider the function $g(x) = xe^{-x}$, $g'(x) = -e^{-x}(x - 1)$, $g''(x) = e^{-x}(x - 2)$

(a) (4 points) Determine those intervals on which the function $g(x)$ is increasing and those on which it is decreasing.

(b) (2 points) Determine all local maxima, and all local minima of $g(x)$ (if there are any).

(c) (4 points) Determine those intervals on which the function $g(x)$ is concave up and those on which it is concave down.

(d) (2 points) Find all points of inflection of $g(x)$ (if there are any).