Name: _____

Final Opportunity — Fall '14

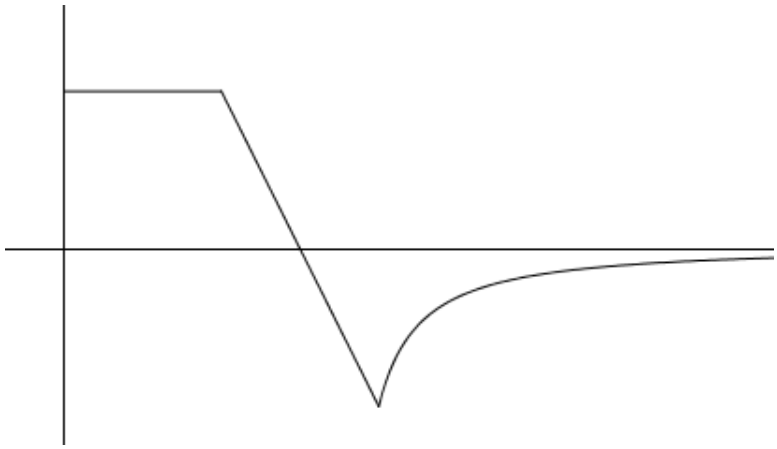
No calculators or cell phones are allowed — please turn them off and put them away. And please, please stay off of YikYak during the final. You may not get help from anyone else, in any way. If you have any questions, please ask Dave. Explaining your reasoning will help you earn partial credit if your answer isn't entirely correct. Please write clearly and legibly; scratch paper will be available, but you should only turn in this exam. Remember to **check your work** whenever possible.

1. Compute the derivatives of the functions below, using derivative rules. Do not simplify.
   (a) $f(x) = \cos(x + 2)$
   (b) $g(x) = x\sqrt{3 - x^2}$
   (c) $h(x) = \dfrac{\tan x}{\sin x}$
2. Write the definition of $\displaystyle\int_0^1 \tan x \, dx$ as a limit, using right endpoints in the Riemann sum.
3. (a) State the mathematical definition of the *derivative* of a function $f(x)$ at $x = 3$.

   (b) Write down the **definition** of the derivative of $g(x) = \cos(x^2)$, $g'(x)$.

   (c) Find $g'(x)$ (do NOT try to do this with the definition!)
4. The top axes shows the graphs $y = f(t)$.
   On the middle axes, sketch a graph of a possible function $g(x) = \int_0^x f(t)\, dt$.
   On the bottom axes, sketch a graph of $g'(x)$.

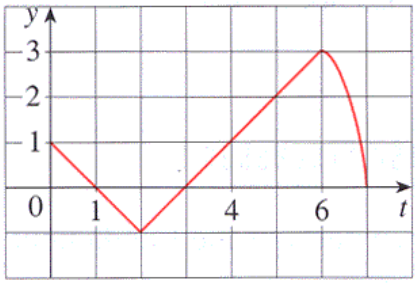
   $y = f(t)$



$g(x)$

$g'(x)$

5. Here is the graph of the function f:



Consider the function that accumulates the area under f,

$$g(x) = \int_0^x f(t)\, dt$$

Answer these questions about g:

(a) $g(4) =$

(b) $g'(4) =$

(c) g has a local max when $x =$

(d) At the point $x = 2$, g has ...

(e) Give the largest set on which g is concave up:

6. Name one thing you accomplished this semester that you're particularly proud of.

7. The answer to each of the following is a number. Find it. (You do not need to simplify.)

(a) $\displaystyle\int_0^2 x^3 - 4x\, dx =$

(b) $\displaystyle\int_0^3 \sqrt{9 - x^2}\, dx =$

(c) $\displaystyle\lim_{n\to\infty} \sum_{i=1}^{n} \left(\left(\frac{3i}{n} \right)^3 - \frac{3i}{n} \right) \frac{3}{n} =$

(d) $\displaystyle\int_0^2 \frac{x}{\sqrt{1 + x^2}}\, dx =$

(e) $\displaystyle\int_0^1 \frac{d}{dx}(x\sqrt{1 + x^3})\, dx$

8. The foundational concept of this course is the **limit**. Describe what a limit is and how it was used in two different key concepts from this semester's topics. Be as specific as you can.

If you were explaining to a friend who had never studied calculus exactly what the FTC means, what would you say? Write 3-4 sentences that would help a non-Calculus student understand the importance of the FTC.

Extra Credit: Last Saturday, over 30 SMCM students joined a protest in Washington DC. The protest ended outside of a branch of the Smithsonian designed by a famous Chinese architect. For one point each, name the point of the protest, the museum next to it, and the architect.