Midterm 3 preview, Applied Calculus, Spring 2014

Your name: _____

Your student number:_____

Showing work. Each answer must include step-by-step work on your page (except for # **??**). Even calculations which will be done in a calculator, should first appear as formulas on the page (here, "formulas" can mean function expressions, like $C(50) - C(49)$ or $f(100) + \Delta x$ or $-4(5^3) - e^5$).

Time management. Probably not everyone will have enough time to do every problem correctly. I think it is better, and that you will get a better score, if you (1) skip the hardest problems until later, (2) work carefully and write more complete steps so that you don't make mistakes and you get better partial credit, and you can see which part of your work is correct, etc.

Problem	Possible points	Points received
1	12	
2	13	
3	12	
4	13	
5	12	
6	13	
7	12	
8	13	
Total	100	

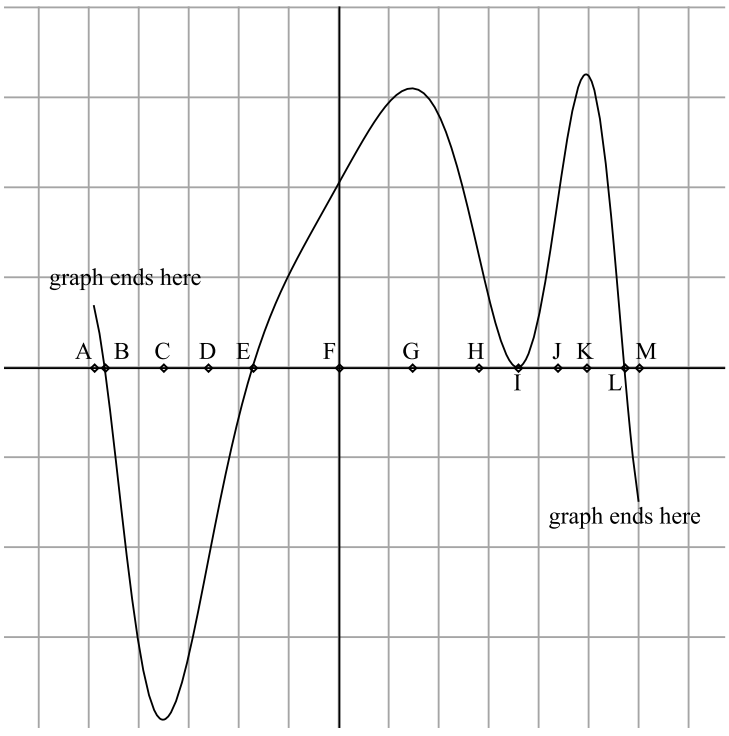
Please sign the following pledge:

On my honor I have neither given nor received any aid on this exam; I have upheld the ideals of the honor code.

Signature _____

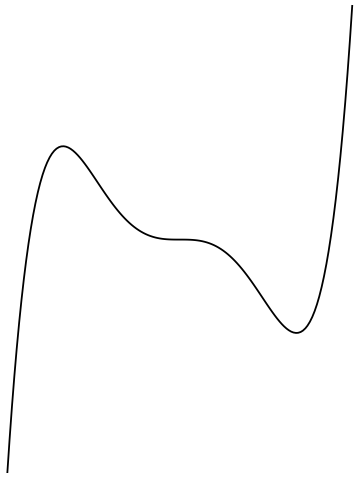
MA 151, Spring 2014, Midterm 3 preview:

1. Find the following derivatives
   (a) $\frac{d}{dx}x^7$
   (b) $\frac{d}{dx}\sqrt{x}$
   (c) $\frac{d}{dx}\frac{1}{x^3}$
   (d) $\frac{d}{dx}5e^x$
   (e) $\frac{d}{dx}\frac{1}{2}\ln(x)$
2. Find the equation of the tangent line to $f(x) = -x^4 - 32 \cdot \frac{1}{x^2}$ at the point $x = 4$. Simplify the numbers in your answer.
3. Find the following derivatives, do not simplify your answers.
   (a) $\frac{d}{dq}(23e^{3q+1} - 5\ln(5q+11))$
   (b) $\frac{d}{dx}(2x^2 - 5x)(3e^x + \ln(x))$
   (c) $\frac{d}{dx}\frac{5 - 4x + 9x^2}{2 + 10x + e^x}$
4. Assume that the following is a graph of $f(x)$.



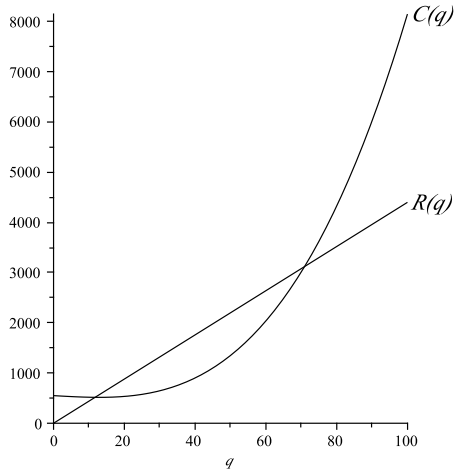
   List all the critical points of $f(x)$, and identify each as a local max/min/neither.
5. Let $f(x) = 3x^5 - 5x^3$.

   A plot of $f(x)$ is shown below (but somehow my computer seems to be broken: it doesn't show any of the axes, or numbers or tickmarks. Sorry.)



(a) Find the critical points of $f(x)$.
(b) Make a "1D# table" (1st Derivative Number Line Table) that shows the first derivative test and the conclusions that it gives you.

6. Let $f(x) = \frac{8}{3}x^3 - 36x^2 + 10000$.
   (a) Find the critical points of $f(x)$.
   (b) Apply the second derivative test to each of the the critical points and identify each critical point as a local max/min/neither. Be sure to write down the steps you use to apply the second derivative test.
7. Find the inflection points of $f(x) = x^5 - 5x^4 + 35$.
8. Let $f(x) = x^2\ln(x) - 10x\ln(x) + 5x$. Suppose that the only critical points are $x = e^{-1/2}$ and $x = 5$. Use the Global Max/Min test to find the Global maximum and minimum (both x-value and y-value) on the interval $0.1 \le x \le 10$. (Note: double and triple check that you've entered your function in the calculator correctly.)
9. Shown below are a cost and a revenue curve. Estimate the production level that maximizes profit and estimate the profit at that point.



10. Suppose that your T-shirt company makes a revenue of $R(q) = 10q$ and has a cost of $C(q) = 0.003q^3 + 5.6q + 3.4$. At what quantity is profit maximized? (Note: find this value algebraically, but don't bother applying a test to make sure that the q you find is a maximum as opposed to a minimum.)

11. Suppose a manufacturer is making 3000 units of some item. They are selling the item for \$15 per unit, the marginal cost is \$22, and the total cost is \$41,111. If we increase production above 3000, and assuming that we sell all the units we produce, which of the following would increase? Which would decrease? Which would be impossible to tell? Why?

    (a) Revenue.
    (b) Profit.
    (c) Total cost.
    (d) Marginal cost.
    (e) Marginal revenue.