

Six pages, six questions, 70 points total.

Some problem-solving hints:

1. Don't panic.
2. If you're stuck, at least try *something*.
3. If you can't do something, don't.
4. If things gets weird, there's probably a mistake.
5. If you can't solve a problem, solve an easier problem first.
6. When in doubt, write it out.
7. Remember: $(a + b)^2 \neq a^2 + b^2$.
8. If a method doesn't help, admit it.

Problem 1 (5 points each). *Compute the following derivatives, but don't simplify:*

(a) $\frac{d}{dx} \frac{5x^{17} + x - 7}{x + 1}$

(b) $\frac{d}{dx} e^x \log x$

(c) $\frac{d}{dx} x^{2x}$

Problem 2 (10 points). *Find the equation for the tangent line to the curve $x^2 - y^2 = -7$ at the point $(3, 4)$.*

Problem 3 (10 points). Use *two* steps of Newton's Method to approximate $\sqrt{2}$, starting with $x_1 = 2$. Make sure to say what function you are using and what your x_2 and x_3 are. Your final answer should be a decimal (no fractions!).

Problem 4 (10 points). *Sketch a function $f(x)$ so that*

1. $f'(x) < 0$ for $x < 2$,
2. $f'(x) > 0$ for $x > 2$,
3. $f''(x) > 0$ everywhere.

Problem 5 (10 points). *Suppose you drove from Urbana to Chicago (139 miles) in two hours. The speed limit is 65 miles/hour. Did you go over the speed limit? Explain.*

Problem 6 (15 points). *Bob's Electronics sells televisions at \$400 each, and sells 1000 of them each week. Bob decides to lower the price by x dollars, expecting to sell $2x$ more TVs each week as a result. If he does this, ...*

(a) *How many TVs will he sell each week?*

(b) *How much money will he collect each week?*

(c) *Suppose it takes \$100,000 per week to operate the business, and \$100 to replace each TV. What will be the total expenses?*

(d) *What value of x will maximize Bob's profits?*