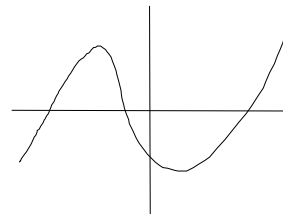


Show all your work. Justify all your answers. Do the problems in order in your bluebook.

1. Find the equation of the line tangent to $y = \sqrt{x^2 + 7}$ at $x = 3$. On a single graph sketch both the original function and the tangent line.
2. Using the left-hand rule with 4 evenly-spaced rectangles set up (but do not compute) the Riemann sum for $\int_1^2 \ln(x) dx$. Sketch a graph showing the rectangles.
3. Suppose $f(5) = 119.1$ and $f(25) = 31.7$. Find two possible values for $f(45)$, one if f is linear and the other if f is exponential. Explain your calculation.
4. A population of rabbits are introduced to an island. Suppose initially there are 3000 rabbits and that the population grows at an annual rate of 20.25%. Using a non-logistic exponential model, find the time it takes for the population to reach 100,000. Why would a logistic model be better to use ?
5. A frozen pizza takes a trip from the freezer, to the oven, and then to your plate. Let $T(t)$ be its average internal temperature. On a single graph, sketch the curves $y = T(t)$ and $y = T'(t)$. Be sure to label which is which, as well as the relevant sections of the graphs.
6. Find the *inflection points* of $f(x)$ given the graph of $f'(x)$ below. (Be sure to copy the graph into your bluebook). Explain your reasoning.



7. Suppose demand for zombiepills is given by the equation $q = 500 - 10p$. Is demand elastic or inelastic at $p = \$30$? How should you change the price if you want to increase revenue ?
8. A driver of a car steps on the brakes. Let $v(t)$ denote its speed in feet per second, t seconds after the brakes are applied. If $v(0) = 100$, $v(1) = 60$, $v(1.75) = 20$ and $v(2) = 0$, then give an underestimate and an overestimate for how far the car travels as it comes to a stop. What integral would give the exact stopping distance ?
9. The depth of water in a tank oscillates once every 9 hours, with the smallest depth being 2 feet and the largest being 16 feet. Using the sine function, find a possible formula for depth as a function of time.
10. Find the average value of $y = x^2$ over $[-1, 3]$. Sketch a graph representing it. What does Goldilocks and the 3 Bears have to do with average values ?
11. Use the second derivative test to classify the critical points of $y = x^3 - 75x - 231$.
12. At a price of \$1, sales for math-cola are 1500 per week. An increase in price of a dime causes a drop of 100 sales. If the equilibrium price is \$1, find the consumer surplus (assume a linear demand).