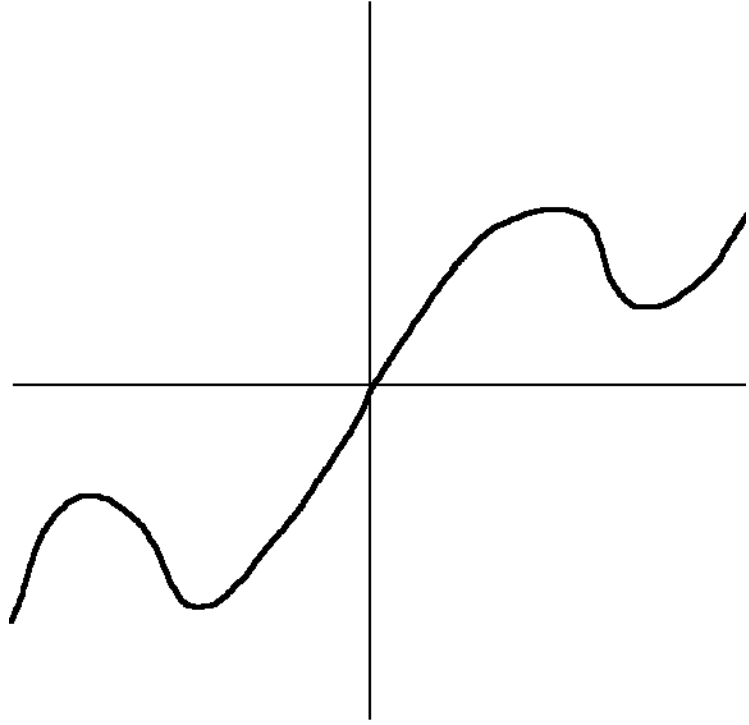


1. A car starts out slowly, then goes faster and faster until it gets a flat tire which must be fixed before proceeding. Sketch a graph of the distance traveled as a function of time.
2. You decide to make Math T-shirts. You have fixed costs of \$166 and variable costs of \$5 per shirt. Find the cost equation. If you sell the shirts for nine dollars each, what is your break-even point ?
3. The depth of water in a tank oscillates once every 5 hours. The smallest depth is 4.6 feet and the largest is 9.3 feet. Find a formula for the depth as a function of time.
4. You are selling iced cappuccino's. If you charge one dollar, you end up making 600 sales every week. Each dime increase in price results in 20 fewer sales. Find the optimal price.
5. You have a budget for textbooks and social events of \$1200. Textbooks cost \$100 each. A night out costs \$30. Find and graph the equation of your budget constraint.
6. Which function eventually gets larger $y_1 = 1000x^3$ or $y_2 = .001x^{3.1}$? Why ?
7. The population of Podunk grows at an annual rate of 6.5%. If initially there were 180,000 inhabitants, how long before the population reaches one million ?
8. The half-life of Mobiliium is six hours. How long before 15 grams decays into 10 grams
9. You want to give your newborn nephew one million dollars, in the form of mutual funds, on his 18st birthday. Assuming that the mutual funds return at a continuous rate of 9.25%, how much should you invest now ?
10. How is the graph of $y = 3f(x - 2) + 5$ gotten from that of $y = f(x)$?
11. A polynomial $f(x)$ has 3 local maximums (points that look like the top of a mountain). What is the least possible degree of $f(x)$?
12. You win 6 million dollars in the lottery. You can receive the money in three equal annual payments, the first today, the second one year from today and the third two years from today. or a lump sum payment. Or you can get it a lump sum payment right now. Assuming a continuous annual return from investments of 8.5%, what would a fair lump sum payment be ?
13. Estimate $f'(2)$ is $f(x) = \sqrt{x}$.
14. Suppose $f'(x) = x^2 - 12$ and $f(3) = -2$. Find the tangent line at $x = 3$.
15. Given a graph of some function (see the book), sketch the graph of $f'(x)$.
16. Suppose investing \$1000 for ten years at annual interest of $r\%$ compounded continuously yields a balance of $g(r)$ dollars. What does $g(5) = 1649$ and $g'(5) = 165$ tell you ?
17. Sketch a graph of a function whose derivative is always positive but whose derivative is always decreasing.

Applied Calculus Exam 1

Do the problems in order in your bluebook. Show your work. Explain and justify your answers.

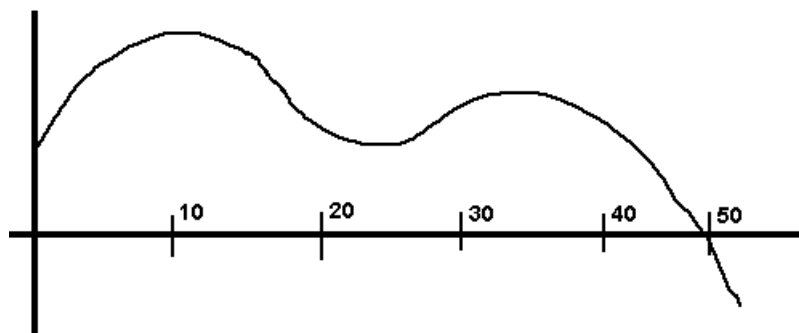
1. You are driving to your favorite class – Math 120, of course – when you realize that you have forgotten your plate of brownies. You turn around and drive very fast back home, where you very quickly get the brownies. Then you hop in your car and start back towards school. But in your excitement over another Calculus class, you drive way too fast and get pulled over for speeding. But you manage to use Calculus to convince the policeman to refrain from giving you a ticket, though it does take you some time. Let $f(t)$ be the distance you are from your favorite place in the world: your Calculus class, where t is time. Sketch a graph of $f(t)$ for the aforementioned trip.
2. You want to give your newborn niece one million dollars, in the form of mutual funds, on her 24th birthday, provided she does well in Calculus. Assuming that the mutual funds return at a continuous rate of 12.65%, how much should you invest now ?
3. To make money for your next Calculus party, you decide to sell iced cappuccino's during lunchtime. If you charge one dollar, you end up making 600 sales every week. Each dime increase in price results in 20 fewer sales. Find the price that will bring in the most money.
4. Suppose for $x \geq 3$ that the rate of change of $f(x)$ is three times that of $g(x)$. Assume that the $5x - 3y = 9$ is the tangent line to $y = g(x)$ at $x = 4$. Given that $f(4) = -8$, find the equation of the line tangent to $y = f(x)$ at $x = 4$.
5. The depth of water in a tank oscillates once every 2 hours. The smallest depth is 2.6 feet and the largest is 8.7 feet. Find a formula for the depth as a function of time.
6. The population of WeLoveMath grows at an annual rate of 8.25%. If initially there were 73,000 inhabitants, how long before the population reaches a quarter of a million ?
7. You have a budget for textbooks and social events of \$1200. Textbooks cost \$100 each. A night out costs \$40. Find and graph the equation of your budget constraint. Explain in English what the intercepts represent non-mathematically.
8. Sketch a graph of $y = f'(x)$ given that the graph of $y = f(x)$ is pictured below (on the following page).



Applied Calculus Exam 2

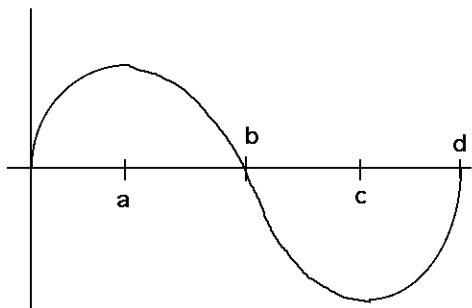
Do the problems in order in your bluebook. Show your work. Explain and justify your answers.

1. The graph pictured below is that of $y = f'(x)$, the derivative of some unknown function $f(x)$. Find any and all critical points of $f(x)$, and classify them as min, max or neither. Explain your reasoning.



2. Find the equation of the line tangent to $y = \sqrt{x^2 + 7}$ at $x = 3$. Draw a graph showing the function and the tangent line.
3. Set up (but do not compute) a Riemann sum using 4 rectangles and the left hand endpoint rule for the area bounded by $y = \sqrt{x}$ from $x = 2$ to $x = 3$. Draw a graph showing the rectangles.
4. Draw a graph showing what $\int_{\frac{1}{2}}^2 \ln(x) dx$ represents. Explain in words. Be brief but concise. You need not compute anything.
5. Find the derivative of $y = \frac{x^3 + \sin(x) + (x^3 + 1)^{12}}{x^2 + 2^x + \pi^5}$. Do not simplify.
6. Sketch a graph of a function $y = f(x)$ for which the derivative $y = f'(x)$ is positive for $x < 0$, undefined at $x = 0$, positive for $0 < x < 4$, zero at $x = 4$, negative for $4 < x < 10$, undefined at $x = 10$, and positive for $10 < x$. Find and classify (as min or max or neither) the critical points.
7. Suppose investing \$1000 for ten years at annual interest of $r\%$ compounded continuously yields a balance of $g(r)$ dollars. What does $g(5) = 1649$ and $g'(5) = 165$ tell you ?
8. At a production level of 5000, marginal revenue is less than marginal cost. Should you decrease or increase capacity in order to maximize profit ? Why ?

1. You decide to make Math T-shirts. You have fixed costs of \$147.53 and variable costs of \$6.37 per shirt. Find the cost equation. If you sell the shirts for 8.99 dollars each, what is your break-even point ?
2. You are selling iced cappuccino's. If you charge one dollar, you end up making 500 sales every week. Each dime increase in price results in 30 fewer sales. Find the optimal price.
3. The population of Podunk grows at an annual rate of 5.5%. If initially there were 97,000 inhabitants, how long before the population reaches a half of a million ?
4. You want to give your newborn nephew one million dollars, in the form of mutual funds, on his 21st birthday. Assuming that the mutual funds return at a continuous rate of 12.25%, how much should you invest now ?
5. How is the graph of $y = \frac{1}{2}f(x + 9) - 12$ gotten from that of $y = f(x)$?
6. Suppose investing \$1000 for ten years at annual interest of $r\%$ compounded continuously yields a balance of $g(r)$ dollars. What does $g(5) = 1649$ and $g'(5) = 165$ tell you ?
7. Let $P(t)$ be the price of a share of stock at time t . What does the statement "*the price of the stock is rising faster and faster*" tell us about the signs of $P'(t)$ and $P''(t)$?
8. Use the fundamental theorem of calculus to compute $\int_1^4 x^2 + \sqrt{x} dx$
9. The graph pictured below shows the velocity of a bicyclist as a function of time, where positive velocity indicates northward travel and negative velocity southern travel. When is the bicyclist furthest north ?



10. Find the inflection points of $y = e^{-x^2}$ using the second derivative.
11. At a production level of 5000, marginal revenue is less than marginal cost. Should you decrease or increase capacity in order to maximize profit ? Why ?
12. Sketch a graph of a function $y = f(x)$ for which the derivative $y = f'(x)$ is positive for $x \leq -4$, undefined at $x = -4$, positive for $-4 < x < 0$, zero at $x = 0$, negative for $0 < x < 3$, undefined at $x = 3$, and positive for $3 < x$. Find and classify (as min or max or neither) the critical points.
13. Draw a graph showing what $\int_{\frac{1}{2}}^2 \ln(x) dx$ represents.

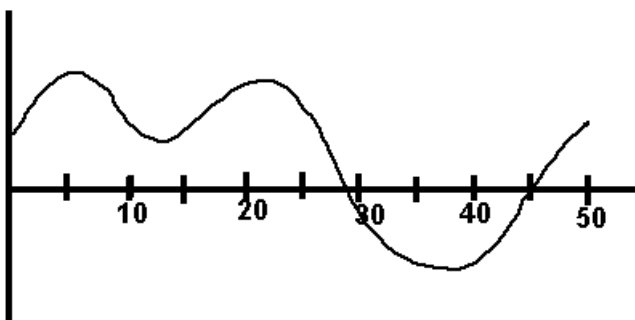
14. Find the global max and min of $y = \frac{1}{3}x^3 - x^2 - 8x$ over $[3,5]$.
15. A jazz group performs in a club that has a capacity of 200. At a price of \$ 10 per ticket, a jazz group can fill every seat in the house. Each two dollar increase results in five fewer sales. What price maximizes revenue ?
16. Find the average value of $y = \frac{1}{x}$ over $[1, 5]$.
17. Graphically describe the average cost, starting with the graph of a cost function.
18. Sketch the graph of a logistic function which describes the population of rabbits on an island with a carrying capacity of 3000 and an initial population of 500. What would happen if the initial population were 5000 ?
19. Review everything else, quizzes, homework, lectures, exams, review sheets, etc.

Applied Calculus Final Exam

1. You decide to make Math T-shirts. You have fixed costs of \$150 and variable costs of \$6 per shirt. Find the cost equation. If you sell the shirts for 12 dollars each, what is your break-even point ?
2. You are selling iced cappuccino's during lunch time. If you charge one dollar, you end up making 600 sales every lunch hour. Each dime increase in price results in 30 fewer sales. Find the demand curve and use a graph to find the optimal price (do not make a table).
3. You want to give your newborn nephew one million dollars, in the form of mutual funds, on his 21st birthday. Assuming that the mutual funds return at a continuous rate of 10.25%, how much should you invest now ?

4. Use the fundamental theorem of calculus to compute $\int_1^4 x + \sqrt{x} dx$

5. The graph pictured below is that of $y = f'(x)$, the derivative of some unknown function $f(x)$. Find any and all critical points of $f(x)$, and classify them as min, max or neither. Explain your reasoning.



6. At a production level of 2000, marginal revenue is greater than marginal cost. Should you decrease or increase capacity in order to maximize profit ? Why ?
7. Set up (but do not compute) a Riemann sum using 4 rectangles and the left hand endpoint rule for the area bounded by $y = e^x$ from $x = 0$ to $x = 1$. Draw a graph showing the rectangles.
8. Carefully draw a graph showing what $\int_{\frac{1}{2}}^2 \ln(x) dx$ represents.

9. For what value of b is the average value of $y = 3x^2$ over $[0, b]$ equal to 9 ? Draw a graph showing what the average value corresponds to.

10. Graphically describe the average cost, starting with the graph of a cost function.

11. Sketch the graph of a logistic function which describes the population of rabbits on an island with a carrying capacity of 3000 and an initial population of 500. Draw a second graph showing what would happen if the initial population were 5000.

12. Find the derivative of $y = \frac{x^3 + (x \cdot \sin(x))}{\pi^2 + 2^x}$