Conveyor Design. A moving conveyor is built to rise 1 meter for each 3 meters of horizontal change.
(a) Find the slope of the conveyor.
(b) Suppose the conveyor runs between two floors in a factory. Find the length of the conveyor if the vertical distance between floors is 10ft.

Rate of Change. Each of the following is the slope of a line representing daily revenue y in terms of time x in days. Use the slope to interpret any change in daily revenue for a one day increase in time.
a) m=800 b) m=250 c) m=0

Temperature conversion. Find a linear equation that expresses the relationship between the temperature in degrees Celsius C and the temperature in degrees Fahrenheit F. Use the fact that water freezes at 0°C (32°F) and boils at 100°C (212°F). Use the equation to convert 72°F to degrees Celsius.

Reimbursed Expences. A company reimburses its sales representatives at $175 per day for meals and lodging, plus $0.48 per mile driven. Write a linear function that gives the daily cost C in terms of the number x of miles driven. How much does it cost the company if a sales representative drives 136 miles on a given day?

Career Choice. An employee has two options for positions in a large corporation. One position pays $12.50 per hour plus and additional unit rate of $0.75 per unit produced. The other pays $9.20 per hour plus a unit rate of $1.30.
a) Find linear equations for the hourly wages W in terms of *x*, the number of units produced per hour, for each option.
b) Use a graphing utility to graph both equations and find the point of intersection.
c) Interpret the meaning of the point of intersection of the graph in part (b). How would you use this information to select the correct option if the goal were to obtain the highest hourly wage?

Rate of Change. You are given the dollar value of a product in 2008 and the rate at which the value of the product is expected to change the nest 5 years. Write a linear equation that gives the dollar value V of the product in terms of the year t. (let t= 0 represent 2000.)

Straight-Line Depreciation. A small business purchases a piece of equipment for $875. After 5 years, the equipment is outdated, having no value.
(a) Write a linear equation giving the value y of the equipment in terms of the time x, $0 \le x \le 5$.
(b) Find the value of the equipment when x = 2.
(c) Estimate (to two-decimal-place accuracy) the time when the value of the equipment is $200.

Tangent line. Find an equation of the line tangent to the circle $x^2 + y^2 = 25$ at the point (4, –3).

Apartment Rental A real estate office handles an apartment complex with 50 units. When the rent is $580 per month, all 50 units are occupied. However, when the rent is $625, the average number of occupied units drops to 47. Assume that the relationship between the monthly rent p and the demand x is linear. (*Note:* The term *demand* refers to the number of occupied units.)
(a) Write a linear equation giving the demand x in terms of the rent p.
(b) *Linear extrapolation* Use a graphing utility to graph the demand equation and use the *trace* feature to predict the number of units occupied if the rent is raised to $655.
(c) *Linear interpolation* Predict the number of units occupied if the rent is lowered to $595. Verify graphically.

Prove that the figure formed by connecting consecutive midpoints of the sides of any quadrilateral is a parallelogram.

Water runs into a vase of height 30 centimeters at a constant rate. The vase is full after 5 seconds. Use this information and the shape of the vase shown to answer the questions if d is the depth of the water in centimeters and t is the time in seconds (see figure).
(a) Explain why d is a function of t.
(b) Determine the domain and range of the function.
(c) Sketch a possible graph of the function.

Automobile Aerodynamics. The horsepower H required to overcome wind drag on a certain automobile is approximated by
$H(x) = 0.002x^2 + 0.005x – 0.029$
where x is the speed of the car in miles per hour.
(a) Use a graphing utility to graph H.
(b) Rewrite the power function so that x represents the speed in kilometers per hour.

Think About It Write the function $f(x) = |x| + |x – 2|$ without using absolute value signs.

Prove that the product of an odd function and an even function is odd.

Volume An open box of maximum volume is to be made from a square piece of material 24 centimeters on a side by cutting equal squares from the corners and turning up the sides (see figure).
(a) Write the volume V as a function of x, the length of the corner squares. What is the domain of the function?
(b) Use a graphing utility to graph the volume function and approximate the dimensions of the box that yield a maximum volume.
(c) Use the table feature of a graphing utility to verify your answer in part (b). (The first two rows of the table are shown.)

Length A right triangle is formed in the first quadrant by the x- and y-axes and a line through the point (3,2)(see figure). Write the length L of the hypotenuse as a function of x.

Write an equation whose graph has intercepts at x = -2 and x=2 and is symmetric with respect to the origin.

For what value of k does the graph of $y=kx^3$ pass through the point (1,4)?

Rate of Change The purchase price of a new machine is $12,500, and its value will decrease by $850 per year. Use this information to write a linear equation that gives the value V of the machine t years after it is purchased. Find its value at the end of 3 years.

Break-Even Analysis A contractor purchases a piece of equipment for $36,500 that costs an average of $9.25 per hour for fuel and maintenance. The equipment operator is paid $13.50 per hour, and customers are charged $30 per hour.
(a) Write an equation for the cost C of operating this equipment for t hours.
(b) Write an equation for the revenue R derived from t hours of use.
(c) Find the break-even point for this equipment by finding the time at which R = C.

A rancher plans to fence a rectangular pasture adjacent to a river. The rancher has 100 meters of fence, and no fencing is needed along the river (see figure).
(a) Write the area A of the pasture as a function of x, the length of the side parallel to the river. What is the domain of A?
(b) Graph the area function A(x) and estimate the dimensions that yield the maximum amount of area for the pasture.

(c) Find the dimensions that yield the maximum amount of area for the pasture by completing the square.

A rancher has 300 feet of fence to enclose two adjacent pastures.
(a) Write the total area A of the two pastures as a function of x (see figure). What is the domain of A?
(b) Graph the area function and estimate the dimensions that yield the maximum amount of area for the pastures.
(c) Find the dimensions that yield the maximum amount of area for the pastures by completing the square.

You are in a boat 2 miles from the nearest point on the coast. You are to go to a point Q located 3 miles down the coast and 1 mile inland (see figure). You can row at 2 miles per hour and walk at 4 miles per hour. Write the total time T of the trip as a function of x.

You drive to the beach at a rate of 120 kilometers per hour. On the return trip, you drive at a rate of 60 kilometers per hour. What is your average speed for the entire trip? Explain your reasoning.

Find the distance traveled in 15 seconds by an object traveling at a constant velocity of 20 feet per second.

Find the distance traveled in 15 seconds by an object moving with a velocity of $v(t) = 20 + 7\cos t$ feet per second.

A bicyclist is riding on a path modeled by the function $f(x)0.04(8x - x^2)$, where x and f(x) are measured in miles. Find the rate of change of elevation when x = 2.

A bicyclist is riding on a path modeled by the function $f(x)=0.08x$, where x and f(x) are measured in miles. Find the rate of change of elevation when x = 2.

Find the area of the shaded region.

Secant Lines Consider the function $f(x)=4x - x^2$ and the point P(1,3) on the graph of f.
(a) Graph f and the secant lines passing through P(1,3) and Q(x,f(x) for x-values of 2, 1.5, and 0.5.
(b) Find the slope of each secant line.
(c) Use the results of part (b) to estimate the slope of the tangent line of at P(1,3). Describe how to improve your approximation of the slope.

9. (a) Use the rectangles in each graph to approximate the area of the region bounded by $y=5/x$, $y = 0$, $x=1$, and $x=5$.
(b) Describe how you could continue this process to obtain a more accurate approximation of the area.

Complete the table and use the result to estimate the limit. Use a graphing utility to graph the function to confirm your result.

Verify that the Intermediate Value Theorem applies to the indicated interval and find the value of guaranteed by the theorem.
$f(x) = x^2 + x - 1$, [0,5], f(c)=11

Telephone Charges A dial-direct long distance call between two cities costs $1.04 for the first 2 minutes and $0.36 for each additional minute or fraction thereof. Use the greatest integer function to write the cost C of a call in terms of time t (in minutes). Sketch the graph of this function and discuss its continuity.

Volume Use the Intermediate Value Theorem to show that for all spheres with radii in the interval [1,5] there is one with a volume of 275 cubic centimeters.

Determine whether the graph of the function has a vertical asymptote or a removable discontinuity at x=-1. Graph the function using a graphing utility to confirm your answer.

Delivery Charges The cost of sending an overnight package from New York to Atlanta is $9.80 for the first pound and $2.50 for each additional pound or fraction thereof. Use the greatest integer function to create a model for the cost C of overnight delivery of a package weighing x pounds. Use a graphing utility to graph the function and discuss its continuity.

The tangent line to the graph of y=g(x) at the point (5,2) passes through the point (9,0). Find g(5) and g ′(5).

A silver dollar is dropped from the top of a building that is 1362 feet tall.
(a) Determine the position and velocity functions for the coin.
(b) Determine the average velocity on the interval [1,2].
(c) Find the instantaneous velocities when t =1 and t=2.
(d) Find the time required for the coin to reach ground level.
(e) Find the velocity of the coin at impact.

A ball is thrown straight down from the top of a 220-foot building with an initial velocity of –22 feet per second. What is its velocity after 3 seconds? What is its velocity after falling 108 feet?

A projectile is shot upward from the surface of Earth with an initial velocity of 120 meters per second. What is its velocity after 5 seconds? After 10 seconds?

To estimate the height of a building, a stone is dropped from the top of the building into a pool of water at ground level. How high is the building if the splash is seen 6.8 seconds after the stone is dropped?

Newton's Law of Cooling This law states that the rate of change of the temperature of an object is proportional to the difference between the object's temperature T and the temperature T_a of the surrounding medium. Write an equation for this law.

Find an equation of the parabola $y = ax^2 + bx + c$ that passes through (0,1) and is tangent to the line y=x – 1 at (1,0).

Tangent Lines Find equations of the tangent lines to the graph of $f(x)=\frac{x+1}{x-1}$ that are parallel to the line 2y + x = 6. Then graph the function and the tangent lines.

Area The length of a rectangle is given by 2t+1 and its height is $\sqrt{t}$ where t is time in seconds and the dimensions are in centimeters. Find the rate of change of the area with respect to time.

Volume The radius of a right circular cylinder is given by $\sqrt{t+2}$ and its height is $\frac{1}{2}\sqrt{t}$ where t is time in seconds and the dimensions are in inches. Find the rate of change of the volume with respect to time.

Rate of Change Determine whether there exist any values of x in the interval [0,2π] such that the rate of change of f(x) = sec x and the rate of change of g(x) = csc x are equal.

Acceleration The velocity of an object in meters per second is $v(t) = 36 - t^2$, $0 \le t \le 6$. Find the velocity and acceleration of the object when t = 3. What can be said about the speed of the object when the velocity and acceleration have opposite signs?