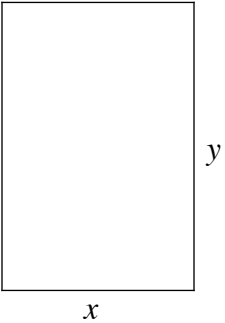
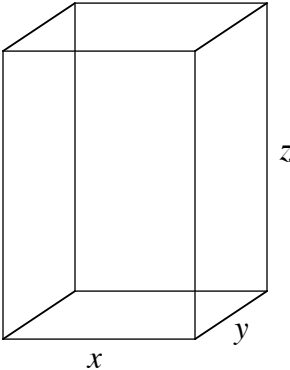
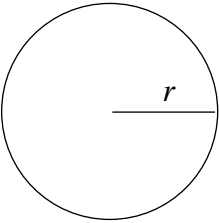
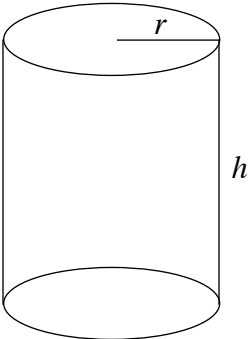


Guidelines for solving optimization problems:

1. Draw a picture, if possible.
2. Assign letters (variables) to quantities that may vary.
3. Decide what quantity is to be maximized or minimized.
4. Determine the *objective equation* that expresses your quantity as a function of your variables.
5. Find the *constraint equation* that relates the variables to each other and any constants that are given in the problem. Find the domain of the variables.
6. Use the constraint equation to simplify the objective equation in such a way that your quantity becomes a function of *only one variable*.
7. Find the first derivative, set it equal to zero and solve for your variables.
8. Use your graphing calculator to check that your answer makes sense and that it is the maximum or minimum as desired.

$\text{Area} = xy$ $\text{Perimeter} = 2x + 2y$			$\text{Volume} = xyz$ $\text{Surface Area} = 2xy + 2yz + 2xz$
$\text{Area} = \pi r^2$ $\text{Circumference} = 2\pi r$			$\text{Volume} = \pi r^2 h$ $\text{Surface Area} = 2\pi r^2 + 2\pi r h$

1. Finding two numbers...
 - a) Find two positive numbers such that their sum is 110 and their product is a maximum.
 - b) The product of two numbers is 192 and the sum is a minimum.
 - c) The product of two positive numbers is 288. Minimize the sum of the second number and twice the first number.

2. Find the minimum value of the function $f(x) = 2x^3 - 15x^2 + 24x + 19$ for $x > 0$.

3. Suppose a ball is thrown straight up into the air and its height after t seconds is

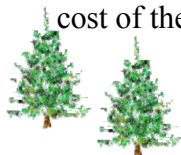
$$f(t) = 4 + 48t - 16t^2$$

Determine how long it will take for the ball to reach its maximum height and determine the maximum height.



4. U.S. parcel post regulations state that packages must have length plus girth of no more than 84 inches. Find the dimensions of the cylindrical package of greatest volume that is mailable by parcel post.

5. The manager of K-Mart wants to build a 600 square foot rectangular enclosure in the store's parking lot in order to hold Christmas trees for the season. Three sides of the enclosure will be built using redwood fencing which costs \$14 per running foot. The fourth side will be built using cement blocks which cost \$28 per running foot. Find the dimensions of the enclosure what will minimize the total cost of the building materials.



6. A swimming club offers membership at the rate of \$200, provided that a minimum of 100 people join. For each member in excess of 100, the membership fee will be reduced by \$1 per person (for each member). At most, 160 memberships will be sold. How many memberships should the club try to sell in order to maximize its revenue?

7. Foggy Optics, Inc. makes microscopes. Setting up each production run costs \$2500. Insurance costs, based on the average number of microscopes in the warehouse, amount to \$20 per microscope per year. Storage costs, based on the maximum number of microscopes in the warehouse, amount to \$15 per microscope per year. Suppose that the company expects to sell 1600 microscopes at a fairly uniform rate throughout the year. Determine the number of production runs that will minimize the company's overall expenses.

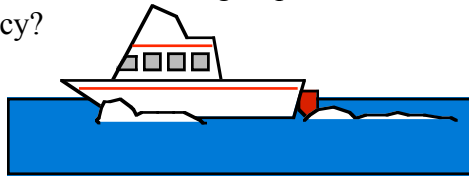


8. Find the point on the graph of $y = x^2$ that is closest to the point $(2, \frac{1}{2})$.

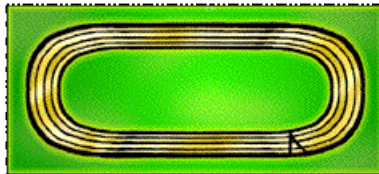
9. A bookstore is attempting to determine the economic order quantity for a popular book. The store sells 8000 copies of this book a year. The store figures that it costs \$40 to process each new order for books. The carrying cost (due primarily to interest payments) is \$2 per book, to be figured on the maximum inventory during an order-reorder period. How many times a year should orders be placed?



10. A travel agency offers a boat tour of several Caribbean islands for 3 days and 2 nights. For a group of 12 people, the cost per person is \$800. For each additional person above the 12 person minimum, the cost per person is reduced by \$20. The maximum tour group size is 25. What tour group size produces the greatest revenue for the travel agency?



11. An indoor physical fitness room consists of a rectangular region with a semicircle on each end. The perimeter of the room is to be a 200-meter running track. Find the dimensions that will make the area of the rectangular region as large as possible.



12. An apple orchard produces a profit of \$40 a tree when planted with 1000 trees. Because of overcrowding, the profit per tree (for each tree in the orchard) is reduced by 2 cents for each additional tree planted. How many trees should be planted in order to maximize the total profit from the orchard?



Answers:

1a. 55 and 55

1b. $8\sqrt{3}$ and $8\sqrt{3}$

1c. 12 and 24

2. $f(4) = 3$

3. $t = 1.5$ $f(1.5) = 40$

4. length = 28, radius = $28/\pi$, girth = 56

5. 20 by 30

6. 150 memberships

7. 4 runs of 400 microscopes each

8. (1, 1)

9. 20 orders of 40 books

10. 25 people

11. length = 50, radius = $50/\pi$

12. 1500 trees