

## Quadratic Word Problems Minimum Maximum

- Find the dimensions and the maximum area of a rectangle, if its perimeter is 24 inches.
- A rocket is shot upward with an initial velocity of 40 feet per second. Its height above the ground after  $t$  seconds is given by  $h(t) = 40t - 16t^2$ . What is its maximum height? When will it return to earth?
- Sally has 400 yards of fencing and wishes to enclose a rectangular area. Find the dimensions and the maximum area.
- Van has 120 feet of fence to make a rectangular pen for his rabbits. If a shed is used as one side of the pen, what would the length and width be for maximum area? (Only three sides are enclosed.)
- A farmer has 3000 feet of fencing to enclose a rectangular plot that borders a river. If the farmer does not fence the side bordering the river, what is the largest area that can be enclosed?
- The power in megawatts, produced between midnight and noon, is given by  $P(x) = h^2 - 12h + 210$ , where  $h$  is the hour of the day.
  - At what time does the minimum power production occur?
  - What is the minimum power production?
  - During what hour(s) is the power production 187 megawatts?
- Your factory produces lemon-scented widgets. You know that each unit is cheaper, the more you produce. But you also know that costs will eventually go up if you make too many widgets, due to the costs of storage of the overstock. The guy in account says that your cost for producing  $x$  thousands of units a day can be approximated by the formula  $C = 0.04x^2 - 8.504x + 25302$ . Find the daily production level that will minimize your costs.
- Skip
- Advertising revenue for newspapers in the United States for the years 1985 through 1999 is approximated by the model  $R = -1.03 + 7.11t - 0.38t^2$  where  $R$  is revenue in billions of dollars and  $t$  represents the year with  $t=5$  corresponding the year in 1985. In what year will revenue be maximum.
- The height in feet of a bottle rocket is given by  $h(t) = 160t - 16t^2$  where  $t$  is the time in seconds. How long will it take for the rocket to return to the ground? What is the maximum height attained by the rocket. How long will it take to reach its maximum height?
- The perimeter of a rectangle is 50 yards. What are the dimensions that will produce the maximum area of such a rectangle?
- Three hundred feet of fencing is available to enclose a rectangular yard along side of the St. John's River, which is one side of the rectangle. What dimensions will produce an area of 10,000 square feet. What is the maximum area that can be enclosed?
- Two rectangular pens are to be made from 200 yards of fencing as seen below. Determine the dimensions that will produce the maximum area.



- Two rectangular lots are to be made from 400 feet of fencing as seen below. Determine the dimensions that will produce the maximum area.



- 15 The profit (in thousands of dollars) of a company is given by  $P(x) = 5000 + 1000x - 5x^2$  where  $x$  is the amount (in thousands of dollars) the company spends on advertising. Find the amount,  $x$ , that the company has to spend to maximize its profit, and then find the maximum profit.
- 16 A rancher has 10,000 linear feet of fencing and wants to enclose a rectangular field and then divide it into two equal pastures with an internal fence parallel to one of the rectangular sides. What is the maximum area of each pasture? Round to the nearest square foot.
- 17 Jenn and Dash have just purchased a purebred Shiba Inu and need to fence in their backyard so the dog can run. What is the maximum rectangular area they can enclose with 200 feet of fencing, if (a) they use fencing material along all four sides? What are the dimensions of the rectangle? (b) What is the maximum area if they use the house as one of the sides? What are the dimensions of this rectangle?
- 18 A ball is thrown direct upward from a height of 6 feet with an initial velocity of 20 feet per second. The function  $s(t) = -16x^2 + 20t + 6$  gives the height of the ball, in feet,  $t$  seconds after it has been thrown. Determine the time at which the ball reaches its maximum height and find the maximum height.
- 19 A stone is thrown directly upward from a height of 30 feet with an initial velocity of 60 feet per second. The height of the stone, in feet,  $t$  seconds after it has been thrown is given by the function  $s(t) = -16x^2 + 60t + 30$ . Determine the time at which the stone reaches its maximum height and find the maximum height.
- 20 A model rocket is launched with an initial velocity of 120 feet per second, from a height of 80 feet. The height of the rocket, in feet,  $t$  seconds after it has been launched is given by the function  $s(t) = -16x^2 + 120t + 80$ . Determine the time at which the rocket reaches its maximum height and find the maximum height.
- 21 A model rocket is launched with an initial velocity of 150 feet per second, from a height of 40 feet. The function  $s(t) = -16x^2 + 150t + 40$  gives the height of the rocket, in feet,  $t$  seconds after it has been launched. Determine the time at which the rocket reaches its maximum height and find the maximum height.
- 22 A fourth-grade class decides to enclose a rectangular garden using the side of the school as one side of the rectangle. What is the maximum area that the class can enclose with 32 feet of fence? What should be the dimensions of the garden in order to yield this area?
- 23 The sum of the base and the height of a triangle is 20 cm. Find the dimensions for which the area is a maximum.
- 24 The sum of the base and the height of a parallelogram is 69 cm. Find the dimensions for which the area is a maximum.
- 25 Erika's Furniture Concepts has determined that when  $x$  hundred wooden chairs are built, the average cost per chair is given by  $C(x) = 0.1x^2 - 0.7x + 1.625$  where  $C(x)$  is in hundreds of dollars. How many chairs should be built in order to minimize the average cost per chair?

In business, profit is the difference between revenue and cost; that is

Total profit = Total Revenue - Total cost,

$$P(x) = R(x) - C(x)$$

Where  $x$  is the number of units sold. Find the maximum profit and the number of units that must be sold in order to yield the maximum profit for each of the following:

26  $R(x) = 5x$ ,  $C(x) = 0.001x^2 + 1.2x + 60$

27  $R(x) = 50x - 0.5x^2$ ,  $C(x) = 10x + 3$

28  $R(x) = 20x - 0.1x^2$ ,  $C(x) = 4x + 2$

- 29 A rancher needs to enclose two adjacent rectangular corrals, one for cattle and one for sheep. If a river forms one side of the corrals and 240 yards of fencing is available, what is the largest total area that can be enclosed?
- 30 A landscaper has enough bricks to enclose a rectangular flower box below the picture window of a house with 12 feet of brick wall. If the house forms one side of the rectangle what is the maximum area that the landscaper can enclose? What dimensions of the flower box will yield this area?
- 31 A model rocket is launched with an initial velocity of 100 feet per second from the top of a hill that is 20 feet high. Its height, in feet,  $t$  seconds after it has been launched is given by the function  $s(t) = -16x^2 + 100t + 20$ . Determine the time at which the rocket reaches its maximum height and find the maximum height.

### Answers

- 1 The dimensions of the maximum area are 6 inches by 6 inches and the maximum area is 36 square inches.
- 2 The maximum height is 25 feet and it will take  $2\frac{1}{2}$  seconds to return to earth.
- 3 The dimensions are 100 yards by 200 yards. The maximum area is 20,000 square yards.
- 4 The length would be 60 yards and the width would be 30 yards for the maximum area.
- 5 The largest area that can be enclosed with 3000 feet of fencing is 1,125,000 square feet.
- 6 Minimum power production will occur at 6 A.M. The minimum power production is 174 megawatts. The production of 187 megawatts will occur between 2 and 3 A.M. and between 9 and 10 A.M.
- 7 The daily production level that will minimize the costs is 106,300 widgets.
- 8 Skip
- 9 In 1983 revenue will be maximum revenue.
- 10 It will take 10 seconds for the rocket to return to the ground. The maximum height attained by the rocket is 400 feet. It takes 5 seconds to reach the maximum height.
- 11 To produce the maximum area of the rectangle the dimensions should be  $12\frac{1}{2}$  by  $12\frac{1}{2}$  yards.
- 12 The dimensions that produce the maximum area is 2,500 by 5,000 feet. The maximum area is 12,500,000 square feet.
- 13 The dimensions that produce the maximum area are  $33\frac{1}{3}$  by 50 yards.

- 14 The dimensions for the maximum area are  $66\frac{2}{3}$  by 100 feet.
- 15 In order to maximize the company's profit, it must spend \$100,000 on advertising. The maximum profit would be \$5,500,000.
- 16 Each pasture will have 2,083,333 square feet.
- 17 The dimensions if they use all four sides are 50 by 50 feet and the area is 2500 square feet. The maximum area if they use a side of the house is 5000 square feet and the dimensions are 50 by 100 feet.
- 18 It will take  $\frac{5}{8}$  of a second to reach its maximum height and its maximum height is 12.25 feet.
- 19 It will take  $1\frac{7}{8}$  seconds to reach the maximum height and the maximum height is 86.25 feet.
- 20 It will take  $3\frac{3}{4}$  seconds to reach the maximum height and the maximum height is 305 feet
- 21 It will take 4.6875 seconds for the rocket to reach its maximum height. The maximum height of the rocket is 391.5625 feet.
- 22 The maximum area of the garden is 128 square feet. The dimensions of the garden should be 8 feet by 16 feet.
- 23 In order to have a maximum area for the triangle the base should be 10 cm and the height should be 10 cm.
- 24 For the parallelogram to have a maximum area, the base should be 34.5 cm and the height should also be 34.5 cm.
- 25 350 chairs are needed to be built in order to minimize the average cost per chair.
- 26 The maximum profit is \$3550 and the number of units that must be sold is 1900 units.
- 27 The maximum profit is \$797 and the number of units that must be sold is 40 units.
- 28 The maximum profit is \$638 and the number of units that must be sold is 80 units.
- 29 The largest area that can be enclosed is 4800 square yards.
- 30 The maximum possible area is 18 square feet when the flower box is 3 feet wide and 6 feet long.
- 31 The rocket reaches a maximum height of 176.25 feet. This occurs 3.125 seconds after it has been launched.