NAME

Module 13 Solving Quadratic Equations of One Variable

Lesson 6 Solving Problems Using Quadratic Equations of One Variable

Solve.

1. The area of the floor in James' rectangular storage rental locker is 144 square feet. The length of the locker is 30 feet less than six times the width. What are the dimensions of the floor?

   $144 = (6w - 30)w$; $w = 8$; The floor dimensions are 8 feet by 18 feet.

2. The area of a square gymnastics mat is 81 square feet. What is the length of a side of the mat?

   $81 = s^2$; $s = 9$; Each side of the mat is 9 feet long.

3. The area of a rectangular wall hanging in Elizabeth's room is 240 square inches. The width of the hanging is four inches less than twice the length. What are the dimensions of the wall hanging?

   $240 = L(2L - 4)$; $L = 12$; The rectangular wall hanging has length 12 inches and width 20 inches.

4. The area of Joshua's rectangular shaped garden is 169 square feet. The length of the garden is 13 feet less than twice the width. What are the dimensions of the garden?

   $169 = (2w - 13)w$; $w = 13$ Because the length and width are both 13 feet, the rectangular garden is actually a square.

5. The area of a carpet runner in Nick's house is 10.5 square feet. The length of the carpet is one foot more than four times the width. What are the dimensions of the carpet runner?

   $10.5 = (4w + 1)w$; $w = 1.5$; The dimensions of the carpet runner are 1.5 feet by 7 feet.

6. A rectangular playground in Lucas' neighborhood is 6,000 square feet. The length of the playground is twenty feet less than two times the width. What are the dimensions of the playground?

   $6{,}000 = (2w - 20)w$; $w = 60$; The dimensions of the playground are 60 feet by 100 feet.

7. The height, in feet, of a rock thrown from a point 65 feet above the ground is given by the equation $h = -16t^2 + 7t + 65$, where t is time in seconds. How many seconds will have elapsed when the rock is 20 feet above the ground?

$20 = -16t^2 + 7t + 65$; $t \approx 1.91$; The rock is 20 feet above the ground after approximately 1.91 seconds.

8. The height, in feet, of a baseball thrown into the air from 12 feet above the ground is given by the equation $h = -16t^2 + 28t + 12$, where t is time in seconds. If the baseball is thrown, how many seconds will have elapsed when the ball is again 12 feet above the ground?

$12 = -16t^2 + 28t + 12$; $t = 1.75$; The baseball is again 12 feet above the ground 1.75 seconds after the throw.

9. The height, in feet, of a tennis ball thrown into the air from 60 feet above the ground is given by the equation $h = -16t^2 + 12t + 60$, where t is time in seconds. How many seconds will have elapsed when the ball is 40 feet above the ground?

$40 = -16t^2 + 12t + 60$; $t \approx 1.55$; The tennis ball is 40 feet above the ground after about 1.55 seconds.

10. The height, in feet, of a flare fired into the air from a point 300 feet above the ground is given by the equation $h = -16t^2 + 3t + 300$, where t is time in seconds. How many seconds will have elapsed when the flare is 50 feet above the ground?

$50 = -16t^2 + 3t + 300$; $t \approx 4.05$; The flare will be 50 feet above the ground after about 4.05 seconds.

11. The height, in feet, of a discus thrown from a point five feet above the ground is given by the equation $h = -16t^2 + 60t + 5$, where t is time in seconds. How long will it be until the discus hits the ground?

$0 = -16t^2 + 60t + 5$; $t \approx 3.83$; The discus hits the ground after approximately 3.83 seconds.

Solve the following problems by using the techniques learned in the lesson for solving word problems using quadratic equation of one variable. The scenarios, however, differ from those presented in the lesson.

12. The recommended amount A (in milligrams) of a cancer medicine is determined by the patient's weight w (in kilograms) according to the formula $A = 4w + 0.1w^2$. An oncologist ordered a 1,100 milligram dosage of this medicine. For what weight patient is this amount appropriate?

$1{,}100 = 4w + 0.1w^2$; $w \approx 86.8$; A 1,100 milligram dosage is appropriate for a patient weighing approximately 86.8 kilograms.

13. In the human body, a nerve speeds up its firing rate after stimulation, and then slows down. A physical therapist's model for the number of impulses fired after a nerve in the fingertip is stimulated is: $I = -t^2 + 16t - 58$. I is the number of impulses per millisecond, and t is time in milliseconds since the fingertip was stimulated. After how many milliseconds will the nerve have an impulse firing rate of two impulses per millisecond?

$2 = -t^2 + 16t - 58$; $t = 6$ or $t = 10$; The nerve will have a firing rate of two impulses per millisecond at six milliseconds and again at 10 milliseconds.

14. Use the nerve firing information of Problem 13 to find the firing rate after eight milliseconds.

$I = -(8^2) + 16(8) - 58 = 6$; After eight milliseconds, the firing rate is six impulses per millisecond.

15. A beach t-shirt stand owner estimates her profit P from selling x number of t-shirts as $P = x^2 - 20x - 300$, where P is measured in dollars. How many t-shirts must be sold in order to break even?

$0 = x^2 - 20x - 300$; $x = 30$; She must sell 30 t-shirts in order to break even.

16. Use the t-shirt business information of Problem 15 to find the profits if no t-shirts are sold. Interpret this answer.

$P = 0^2 - 20(0) - 300 = -300$. If no t-shirts are sold, $300 is lost (perhaps as overhead costs).

17. An internet company sells six DVD's each day for twenty-five dollars each. Market research shows that for every dollar decrease in price, they will sell three more DVD's per day. Find the price that makes the company's daily revenue \$540. Hint: revenue = price × number sold.

x is the dollar decrease;

$R = (25 - x)(6 + 3x)$;

$540 = -3x^2 + 69x + 150$; A decrease of either \$10 or \$13 will produce \$540 in daily revenue. So the price is either \$15 or \$12.

18. Use the DVD information of Problem 17 to find the price that makes the company's daily revenue \$900.

$900 = -3x^2 + 69x + 150$; It is not possible to make \$900 daily revenue with the given market research model.