Math in Living C O L O R !!

4.06 Quadratic Applications

Intermediate Algebra: One Step at a Time. Page 349 - 362

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See Section 4.06, with explanations, examples, and exercises, coming soon!

Extra Challenge Problem by Anthony in South Australia:

Given the area of a rectangle is 90m² and the perimeter of the rectangle is 40m, find the breadth of the rectangle.

Solution:

Let x = breadth (or width) of the rectangle. Since the perimeter of the rectangle is 40, you know that

$$2W + 2L = P$$

$$2x + 2L = 40$$

Now, solve for L in terms of x:, by dividing both sides by 2:

$$2x + 2L = 40$$

$$x + L = 20$$

Subtract L from each side:
$$L = 20 - x$$

Now, you can write the equation based upon the area of the rectangle:

$$L \bullet W = A$$

$$x \bullet (20 - x) = 90$$

$$20x - x^2 = 90$$

Set the equation equal to zero, by adding x^2 and subtracting $20x$ from each side:

$$0 = x^2 - 20x + 90$$

Since this does NOT seem to factor, you must now solve this quadratic equation by either completing the square or quadratic formula

$$0 = x^2 - 20x + 90$$

$$x^2 - 20x + 90 = 0$$

$$x^2 - 20x = -90$$

For completing the square method, see the end of this problem.

SOLUTION BY QUADRATIC FORMULA

To solve by the quadratic formula, remember that the solution to the quadratic equation:

$$ax^2 + bx + c = 0$$

is given by the formula: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

In the equation: $x^2 - 20x + 90 = 0$

Divide out the factor of 2:

The width (breadth) is the smaller of the dimensions

To find the length, remember

$$L = 10 + \sqrt{10}$$

Notice that the length is the larger of the dimensions obtained when you solved for _x_.

FINAL ANSWER: **meters by   meters**

Check: **Perimeter = 2W+2L**

$$=$$
$$= \; + \; 20 + 2$$
$$= \; 40 \text{ m.}$$

Area $$=$$
$$= \;)(\;)$$
$$=$$
$$= 90$$

SOLUTION BY COMPLETING THE SQUARE METHOD

When completing the square, you get the variables on the left side, and the number term on the right side of the equation. Also, the coefficient of the term must be 1. You need to add a number to each side of the equation in order to form a perfect square trinomial on the left side of the equation. This process is called "completing the square."

Do you know about the "Half and Square" Rule? In order to complete the square, assuming that the coefficient is **1**, you must take "**half**" of the coefficient of *x*, and "**square**".   Half of is , and =**100**. You must add **+100** to each side of the equation in order to express the left side as a perfect square trinomial.

Take the square root of each side. Don't forget the " "!!

Add +10 to each side of the equation:

The width (breadth) is the smaller of the dimensions

To find the length, remember

Notice that the length is the larger of the dimensions obtained when you solved for *x*.

FINAL ANSWER: meters by   meters

Check: **Perimeter = 2W+2L**

$$=$$

$$= \ + \ 20 + 2$$

$$= 40 \text{ m.}$$

Area $=$

$$= \ )(\ )$$

$$=$$

$$= 90$$