# Introduction

We have covered quadratic applications previously but were limited by numbers that resulted in factorable quadratics. This section starts with a question we have seen before. The resulting equation cannot be solved, not because the setup is wrong but because it cannot be factored – leading us to consider different methods for solving quadratic equations. I use this as a warm up before teaching the square root property, completing the square, and the quadratic formula.

# Activity for Connection – Rectangle Dimensions

## The Question

*The length of a rectangle is 2 feet greater than the width, and the area is 18 square feet. Find the width of the rectangle.*

Set up the equation. Can you solve it? Why not?[[1]](#footnote-1)

## The process:

1. Identify the variables (the unknown quantities)
2. Write mathematical expressions for descriptions given

*The length of a rectangle is 2 feet greater than the width:*

*area is 18 square feet:*

1. Substitute the algebraic expression for length into the equation for area
2. Solve the resulting equation.

## Materials list:

### For Each Student

* Quadratic Applications Revisited(see Appendix)

## Discussion Questions

If you were building a bridge or installing playground equipment would you be satisfied with this answer? Would your boss or client? There are other ways.

## The algebra behind the activity

As the students move through the known process of solving quadratics by the one method covered so far, they will find that the equation is not factorable.

There are no factors of that factor to . This does not mean there is no solution, it means we need to look for another way to solve this equation.

Method I – Solving by Completing the Square and using the Square Root Property

and

and

Method II – Solving using the Quadratic Formula

so , , and

So

and

and

## Conclusion

The dimensions must be positive, so the width is and the length is

# Extending the Lesson

## Photograph Cropping

A picture containing dog, indoor, mammal

Description automatically generated

An original a photographic image on a 10.5 centimeter by 8.2 centimeter background is to be reduced to 80% of its original area by cutting off (cropping) equal strips on all four sides.

## The Question:

What is the width of the strip that is cut from each side?

## The Process:

1. What is the original area of the picture?
2. What is area of the new (cropped) picture?
3. Find an algebraic expression for the length of the new (cropped) picture?
4. Find an algebraic expression for the width new (cropped) picture?
5. Define an equation that will help you determine the width of the strips that were cut off to give the cropped picture.
6. Solve the equation and interpret the results.[[2]](#footnote-2)

## Materials list:

### For Each Student

* Quadratic Applications Revisited page 2 (see Appendix)

## The algebra behind the activity

### Identifying the variables

* *x* is width of the strips to be cut

### Setting up the problem

1. of is
3. Using the quadratic Formula , ,

or

## Conclusion:

Since is larger than the original width of the photo, the width of the strip to be removed is or .

The new photo will be x

# Practice Exercises

Sewage treatment

In one step in waste treatment, sewage is exposed to air by placing it in circular aeration pools. One sewage processing plant has two such pools, with diameters of 38 and 44 meters.

1. Find the combined area of the pools.[[3]](#footnote-3)
2. To meet new clean-water standards the plant must double its capacity by building another pool. Find the radius of the circular pool that the engineering department should specify to double the plant’s capacity. Why isn’t the radius of the new pool the sum of the radii of the two pools we already have?

### Identifying the variables

* is the radius of the new pool

### Setting Up the problem

1. The combined area will be the sum of the area of the two pools. Area of the circular pools is so,

Area of combined pools

1. Double the capacity is .

Solution:

To find the radius of the new pool use the square root property to solve,

### Final Answer

The radius of the new pool should be . That is a diameter of This is not the sum of the two pools together because 845 is not the (sum of the radii) squared but the sum of the individual radii squared.

## Bridge Expansion

In practice, bridges are built with expansion spaces to avoid such buckling. Have you every noticed the “thawk, thawk” sound when you cross a bridge in a car? This sound is created when crossing an expansion space.

During the summer heat, a 2-mile bridge expands 2 ft in length. If we assume that the bulge occurs straight up the middle, how high is the bulge?[[4]](#footnote-4)

### Identifying the variables

* is the height of the bulge

### Setting Up the problem

Using the Pythagorean Theorem,

(½ of the road bed), height of the bulge, and (½ of the expansion)

One mile = so , and and

Solution:

To find the height of the bulge solve

### Final Answer

The height of the bulge would be 103 ft rounded to the nearest foot.

## Ramps for the Disabled

Laws regarding access ramps for the disabled state that a ramp must be in the form of a right triangle, where every vertical length of 1 ft has a horizontal length of 12 ft. Steps are typically 7” in height. If the entrance to a building has 5 steps, what must the length of a ramp be to access the building.[[5]](#footnote-5) (6 steps at 8” would result in a radical that could be simplified)

### Identifying the variables



**b**

**c**

**a**

* is the length of the ramp

### Setting Up the problem

Using the Pythagorean Theorem,

Solution:

### Final Answer

The length of the ramp should e 35.12 ft.

Driving Safety

Study research uses the model  to estimate the least number of feet, , in which a car can be stopped at various speeds, in miles per hour. If it took a car 550 feet to stop, estimate the car’s speed at the moment the brakes where applied.[[6]](#footnote-6)

### Identifying the variables

* is the distance in feet to stop at a given speed
* is the speed of the car in miles per hour

### Setting Up the problem

Using the Quadratic formula: , ,

or

### Final Answer

The car would be traveling 100 mph.

# appendix

Quadratics Revisited (2 pages)

Quadratics Revisited Practice (1page)

1. Rosemary M Karr, Marilyn B Massey, R. David Gusafson. Beginning Algebra: A Guided Approach. Cengage Learning. 2015. pg 350. [↑](#footnote-ref-1)
2. Modified from: Bittinger, Marvin L. Intermediate Algebra, tenth edition. Pearson/Addison Wesley. 2007. Pg 759. [↑](#footnote-ref-2)
3. Rosemary M Karr, Marilyn B Massey, R. David Gusafson. Beginning Algebra: A Guided Approach. Cengage Learning. 2015. (pg 350) [↑](#footnote-ref-3)
4. Bittinger, Marvin L. Intermediate Algebra, tenth edition. Pearson/Addison Wesley. 2007. Pg 551. [↑](#footnote-ref-4)
5. Modified from: Bittinger, Marvin L. Intermediate Algebra, tenth edition. Pearson/Addison Wesley. 2007. Pg 548. [↑](#footnote-ref-5)
6. Blitzer, Robert. Introductory Algebra for Collete Students, seond edition. Prentice Hall. 1997. Pg 719. [↑](#footnote-ref-6)