9-4 Solving Quadratic Equations Using Square Roots

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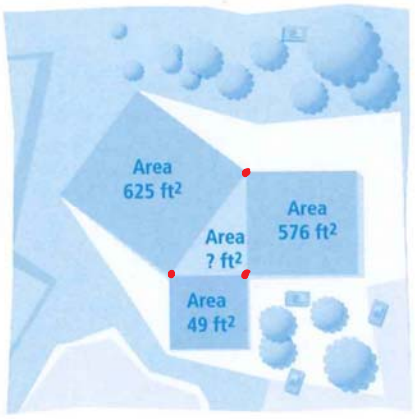
Activity

1, 4, 9, 25, 36, 49, 64, 81, 100, 121, 144, 169, 196, 225, 256, 289, 324, ...

EXPLORE & REASON

A developer is building 3 recreation square areas on a parcel of land. He has not decided what to do with the enclosed triangular area in the center.



A. How can you determine the side lengths of the triangle in the center?

√ the areas of each square ...

$\sqrt{625} = 25$ ft

$\sqrt{576} = 24$ ft.

$\sqrt{49} = 7$ ft

B. What relationships do you notice among the areas of the squares?

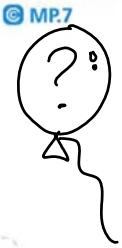
$49 + 576 = 625$

$7^2 + 24^2 = 25^2$

$a^2 + b^2 = c^2$

Pythagorean Thm

C. **Look for Relationships** How can the developer adjust this plan so that each recreation area covers less area but still has a similar triangular section in the middle? Explain. MP.7



HABITS OF MIND

Make Sense and Persevere The Product Property of Square Roots states that $\sqrt{ab} = \sqrt{a} \cdot \sqrt{b}$ when both a and b are greater than or equal to 0. Explain why it is essential that a and b are greater than or equal to 0. MP.1

$\sqrt{ab} = \sqrt{a} \cdot \sqrt{b}$

Notes

Assess

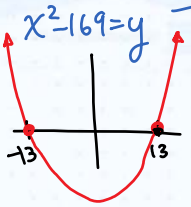
EXAMPLE 1 **Try It! Solve Equations of the Form $x^2 = a$**

1. Solve each equation by inspection.

a. $x^2 = 169$

$\sqrt{x^2} \pm \sqrt{169}$

$x = \pm 13$

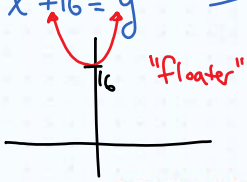


b. $x^2 = -16$

$\sqrt{x^2} \pm \sqrt{-16}$

cannot square root a negative #.

$x =$ no real solutions



EXAMPLE 2 **Try It! Solve Equations of the Form $ax^2 = c$**

2. What are the solutions for each equation? If the solution is not a perfect square, state what two integers the solution is between.

a. $\frac{5x^2}{5} = \frac{125}{5}$

$x^2 = 25$

$\sqrt{x^2} \pm \sqrt{25}$

$x = \pm 5$

b. $-\frac{1}{2}x^2 = -36$

$\left(-\frac{2}{1}\right)\left(-\frac{1}{2}x^2\right) = \left(-\frac{2}{1}\right)(-36)$

$x^2 = 72$

$\sqrt{x^2} \pm \sqrt{72}$

$x = \pm 6\sqrt{2}$

ex2c)

blah

$x^2 = \frac{3}{2}$

$\sqrt{x^2} \pm \sqrt{\frac{3}{2}}$

$x = \pm \frac{\sqrt{3}}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \pm \frac{\sqrt{6}}{2}$

rationalize

$\frac{8}{1} \cdot 2 \Rightarrow \frac{16}{2}$

$\Rightarrow \frac{80}{10}$ $\cdot 16$ $\cdot 16$

HABITS OF MIND

Construct Arguments What is an advantage of solving a quadratic equation using square roots? What is a disadvantage? Explain your reasoning. MP.3

- graphing, factoring, square roots

$x = \pm\frac{\sqrt{3}}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \pm\frac{\sqrt{6}}{2}$

rationalize the denominator

• graphing, factoring, square roots

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Notes

Assess

EXAMPLE 3 **Try It! Solve Equations of the Form $ax^2 + b = c$**

PE
MD
AS
SOLVE

3. Solve the quadratic equations.

a. $-5x^2 - 19 = 144$

$+19 \quad +19$

$\frac{-5x^2}{-5} = \frac{163}{-5}$

$x^2 = \frac{163}{-5}$

$\sqrt{x^2} \quad \pm\sqrt{\frac{163}{-5}}$

$x =$

$\sqrt{\text{negative \#}}$

$x =$ no solution

b. $3x^2 + 17 = 209$

$-17 \quad -17$

$\frac{3x^2}{3} = \frac{192}{3}$

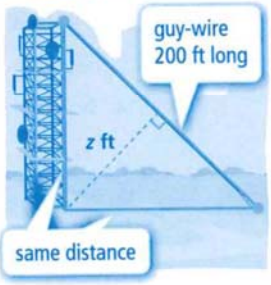
$x^2 = 64$

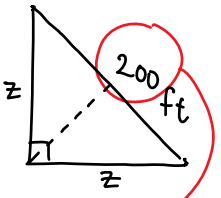
$\sqrt{x^2} = \pm\sqrt{64}$

$x = \pm 8$

EXAMPLE 4 **Try It! Determine a Reasonable Solution**

4. Find the distance from the base of the tower to the midpoint of the guy-wire.





$a^2 + b^2 = c^2$ Pythagorean Thm

$z^2 + z^2 = 200^2$

$\frac{2z^2}{2} = \frac{40000}{2}$

$z^2 = 20000$

$\sqrt{z^2} \quad \sqrt{20000}$

$z \approx 141.4$ ft

HABITS OF MIND

Communicate Precisely When is the negative square root not a reasonable

HABITS OF MIND

Communicate Precisely When is the negative square root not a reasonable solution? Explain and give an example. MP.6

For real-world problems ...

Assess

Do You UNDERSTAND?

1. ESSENTIAL QUESTION How can square roots be used to solve quadratic equations?

2. **Construct Arguments** How many solutions does $ax^2 = c$ have if a and c have different signs? Explain. MP.3

3. **Reason** How do you decide when to use the ± symbol when solving a quadratic equation? MP.2

4. **Error Analysis** Trey solved $2x^2 = 98$ and said that the solution in 7. Is he correct? Why or why not? MP.3

5. **Communicate Precisely** How is solving an equation in the form $ax^2 = c$ similar to solving an equation in the form $ax^2 + b = c$? How are they different?

Do You KNOW HOW?

Solve each equation by inspection.

6. $x^2 = 400$ $x = \pm 20$

7. $x^2 = -25$ no solution

Solve each equation.

8. $\frac{3x^2}{3} = \frac{400}{3}$ $x = \pm\frac{20\sqrt{3}}{3}$

9. $\frac{-15x^2}{-15} = \frac{-90}{-15}$ $x = \pm\sqrt{6}$

10. $2x^2 + 7 = 31$ $x = \pm 2\sqrt{3}$

11. $2x^2 - 7 = 38$ $x = \pm\frac{3\sqrt{5}}{\sqrt{2}}$

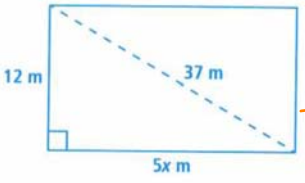
12. $-4x^2 - 1 = 48$ no solution

13. $-4x^2 + 50 = 1$ $x = \pm\frac{7}{2}$

14. $3x^2 + 2x^2 = 150$ $x = \pm\sqrt{30}$

15. $3x^2 + 18 = 5x^2$ $x = \pm 3$

Solve for x.

16. 

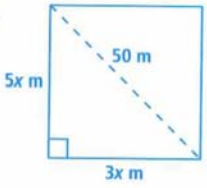
$12^2 + (5x)^2 = 37^2$

$144 + 25x^2 = 1369$

$25x^2 = 1225$

$x^2 = 49$

$x = \sqrt{49} = 7$

17. 

$(5x)^2 + (3x)^2 = 50^2$

$25x^2 + 9x^2 = 2500$

$34x^2 = 2500$

$x^2 = 73.52941176$

$x = \sqrt{\ldots}$

$x = 8.57$

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