

Module 4: Radical Expressions

Topic 1 Content: Simplifying Square Roots of Whole Numbers

Introduction



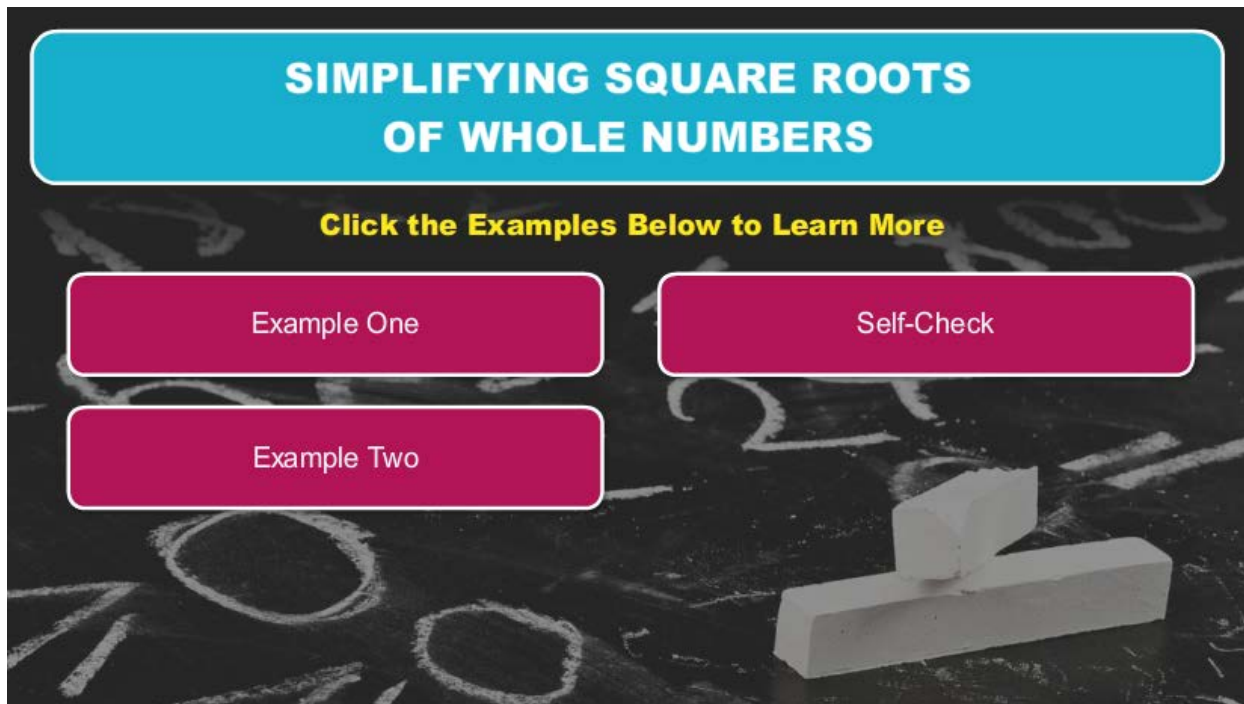
Today's Lesson

- You will apply the Product Property of Radicals to simplify square roots of whole numbers.
- You will use your factoring skills.

Hi there! I'm so glad you could join me for this lesson in Algebra I. In this lesson, you will apply the Product Property of Radicals to simplify square roots of whole numbers. Your factoring skills will be useful a resource during this lesson.

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Topic 1 Content: Simplifying Square Roots of Whole Numbers

Simplifying Square Roots of Whole Numbers



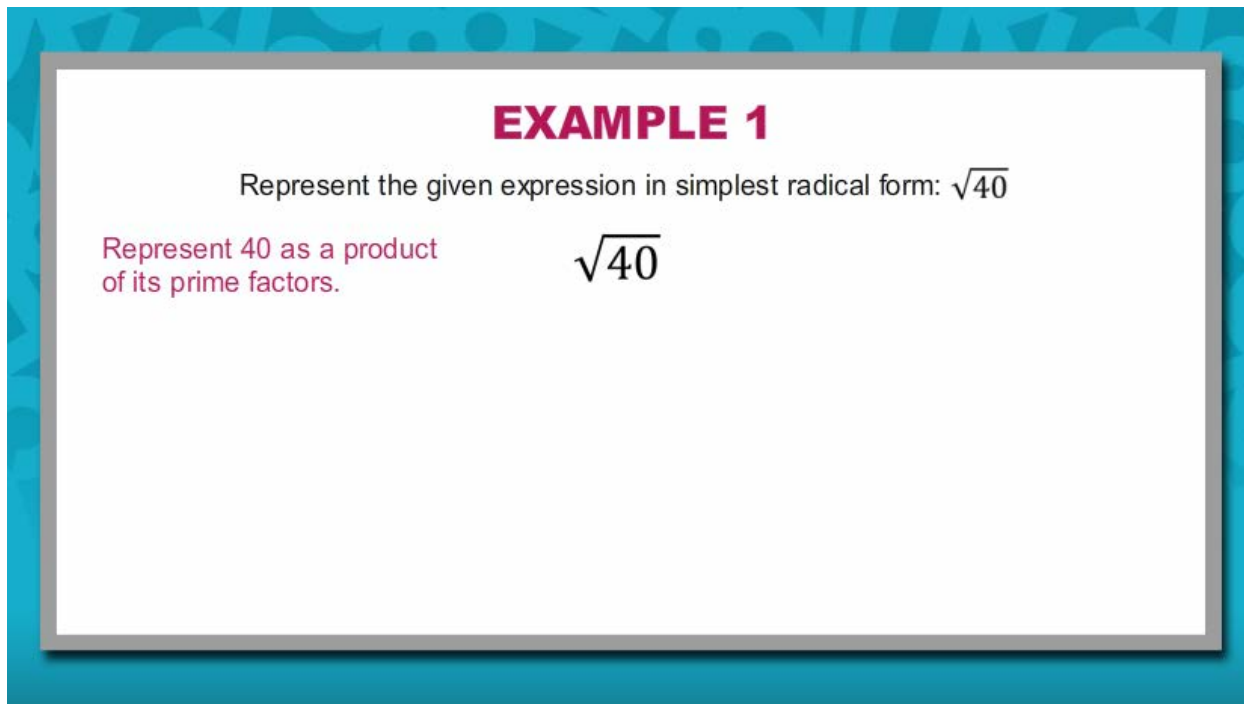
The graphic features a dark background with faint chalkboard-style drawings of numbers and arrows. At the top, a blue rounded rectangle contains the title "SIMPLIFYING SQUARE ROOTS OF WHOLE NUMBERS" in white, bold, uppercase letters. Below this, a yellow text prompt reads "Click the Examples Below to Learn More". Three pink rounded rectangular buttons are arranged: "Example One" and "Self-Check" are in the top row, and "Example Two" is centered below them. In the bottom right corner, there is a photograph of a white rectangular block with a smaller white cube resting on top of it.

Click the examples below to learn more.

- Example One
- Example Two
- Self-Check

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Example 1



EXAMPLE 1

Represent the given expression in simplest radical form: $\sqrt{40}$

Represent 40 as a product of its prime factors.

$\sqrt{40}$

Represent the given expression in simplest radical form.

$$\sqrt{40}$$

Recall that a square root expression is in simplest form when the radicand has no perfect square factors other than 1. To represent $\sqrt{40}$ in simplest radical form, start by completing the prime factorization of 40. In other words, represent 40 as a product of its prime factors.

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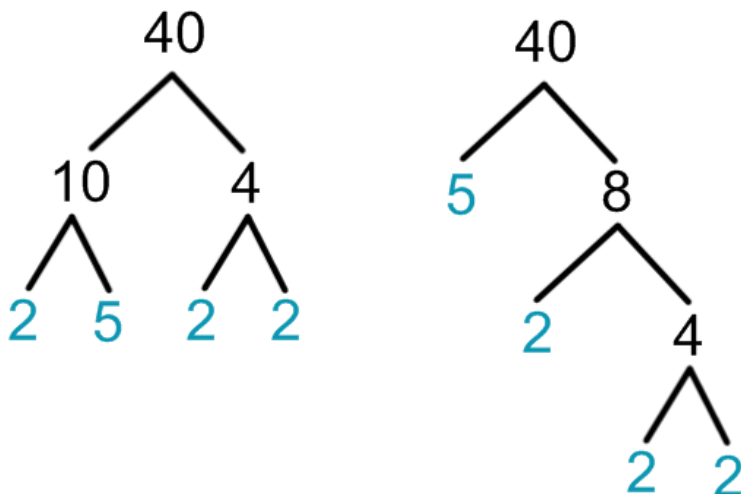
Topic 1 Content: Simplifying Square Roots of Whole Numbers

Example 1 (continued)

The image shows a piece of lined paper with the title "Factor Trees of 40" written in cursive. Two factor trees are drawn. The first tree starts with 40 at the top, branching into 10 and 4. 10 branches into 2 and 5, and 4 branches into 2 and 2. The second tree starts with 40 at the top, branching into 5 and 8. 8 branches into 2 and 4, and 4 branches into 2 and 2. The numbers 2, 5, 2, 2, 2, and 2 in both trees are written in pink. To the left of the paper, there is a vertical white box with the text "Represent of its prim" in pink.

You may find it helpful to use a factor tree. The branches of your factor tree will depend on the initial factors of 40 that you choose to start with. The prime factors, however, will be the same.

Two possible factor trees of 40:



The prime factorization of 40 is $2 \cdot 2 \cdot 2 \cdot 5$.

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Example 1 (continued)

EXAMPLE 1

Represent the given expression in simplest radical form: $\sqrt{40}$

Represent 40 as a product of its prime factors.	$\sqrt{40} = \sqrt{2 \cdot 2 \cdot 2 \cdot 5}$
Identify multiple factors.	$= \sqrt{2^2 \cdot 2 \cdot 5}$
Apply the Product Property of Radicals.	$= \sqrt{2^2} \cdot \sqrt{2 \cdot 5}$

The Product Property of Radicals states that the square root of a product can be represented as the product of the square roots of the factors.

Now that you know the prime factorization of 40, you can represent $\sqrt{40}$ as $\sqrt{2 \cdot 2 \cdot 2 \cdot 5}$.

$$\sqrt{40} = \sqrt{2 \cdot 2 \cdot 2 \cdot 5}$$

The next step is to identify any multiple factors. Because you are simplifying a square root expression, the goal is to identify multiple factors that can be rewritten as a square term. The factors $2 \cdot 2$ can be rewritten as 2^2 .

$$\sqrt{40} = \sqrt{2^2 \cdot 2 \cdot 5}$$

Recall that the Product Property of Radicals states that the square root of a product can be represented as the product of the square roots of the factors.

So $\sqrt{40}$ can be represented as $\sqrt{2^2} \cdot \sqrt{2 \cdot 5}$.

$$\sqrt{40} = \sqrt{2^2} \cdot \sqrt{2 \cdot 5}$$

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Example 1 (continued)

EXAMPLE 1

Represent the given expression in simplest radical form: $\sqrt{40}$

Represent 40 as a product of its prime factors.	$\sqrt{40} = \sqrt{2 \cdot 2 \cdot 2 \cdot 5}$
Identify multiple factors.	$= \sqrt{2^2 \cdot 2 \cdot 5}$
Apply the Product Property of Radicals.	$= \sqrt{2^2} \cdot \sqrt{2 \cdot 5}$
Simplify the expression.	$= 2 \cdot \sqrt{10}$
	$= \boxed{2\sqrt{10}}$

Now simplify the expression. Begin with the first square root factor. Recall that squaring a number and taking the square root of a number are inverse operations. This means that $\sqrt{2^2} = 2$.

$$\sqrt{40} = 2 \cdot \sqrt{2 \cdot 5}$$

Next, simplify the radicand of the second square root factor by multiplying 2 and 5, which equals 10.

$$\sqrt{40} = 2 \cdot \sqrt{10}$$

The final step is to simplify the resulting expression. Your work is complete. The simplest radical form of $\sqrt{40}$ is $2\sqrt{10}$.

$$\sqrt{40} = 2\sqrt{10}$$

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Example 2

EXAMPLE 2

Represent the given expression in simplest radical form: $\sqrt{450}$

$\sqrt{450} = \sqrt{\square \cdot \square \cdot \square \cdot \square \cdot \square}$

Enter the prime factors into the expression above, then click **SUBMIT**.
You may need to use a sheet of paper to create a factor tree.

Submit

Represent the given expression in simplest radical form.

$$\sqrt{450}$$

To simplify the expression, begin by representing the radicand as a product of its prime factors. What are the prime factors of the expression above? You may need to use a sheet of paper to create a factor tree.

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Example 2 (continued)

EXAMPLE 2

Represent the given expression in simplest radical form: $\sqrt{450}$

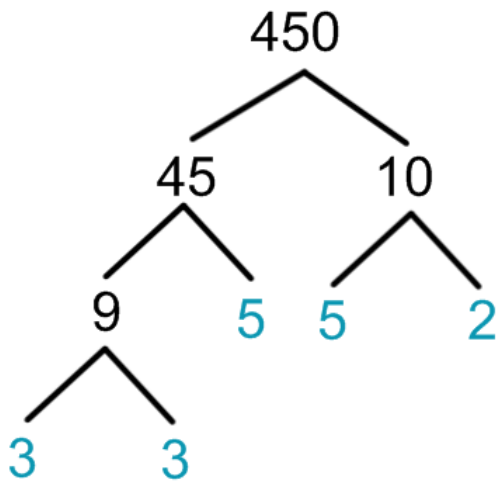
$$\sqrt{450} = \sqrt{2 \cdot 3 \cdot 3 \cdot 5 \cdot 5}$$

You can create a factor tree to complete the prime factorization of 450.
Click the button below to view an example of a factor tree created
where the initial factors of 450 were 45 and 10.

The prime factorization of 450 is $2 \cdot 3 \cdot 3 \cdot 5 \cdot 5$.

[View Tree](#) [Next](#)

You can create a factor tree to complete the prime factorization of 450. Take a look at the example of a factor tree created when the initial factors of 450 were 45 and 10.



The prime factorization of 450 is $2 \cdot 3 \cdot 3 \cdot 5 \cdot 5$.

$$\sqrt{450} = \sqrt{2 \cdot 3 \cdot 3 \cdot 5 \cdot 5}$$

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Example 2 (continued)

EXAMPLE 2

Represent the given expression in simplest radical form: $\sqrt{450}$

$$\sqrt{450} = \sqrt{2 \cdot 3 \cdot 3 \cdot 5 \cdot 5}$$

Click each of the factors above that can be rewritten as a square term.

Now identify multiple factors that can be rewritten as a square term.

$$\sqrt{450} = \sqrt{2 \cdot 3 \cdot 3 \cdot 5 \cdot 5}$$

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Example 2 (continued)

EXAMPLE 2

Represent the given expression in simplest radical form: $\sqrt{450}$

$$\sqrt{450} = \sqrt{2 \cdot 3 \cdot 3 \cdot 5 \cdot 5}$$

The radicand includes multiple factors of 3 and 5.

[Next](#)

The radicand includes multiple factors of 3 and 5.

$$\sqrt{450} = \sqrt{2 \cdot 3 \cdot 3 \cdot 5 \cdot 5}$$

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Example 2 (continued)

EXAMPLE 2

Represent the given expression in simplest radical form: $\sqrt{450}$

$$\begin{aligned}\sqrt{450} &= \sqrt{2 \cdot 3 \cdot 3 \cdot 5 \cdot 5} \\ &= \sqrt{2 \cdot 3 \square \cdot 5 \square}\end{aligned}$$

Enter the correct exponents above, then click ***SUBMIT***.

Submit

Next, represent the multiple factors as square terms.

$$\begin{aligned}\sqrt{450} &= \sqrt{2 \cdot 3 \cdot 3 \cdot 5 \cdot 5} \\ &= \sqrt{2 \cdot 3^? \cdot 5^?}\end{aligned}$$

What exponents should replace the "?" symbols above?

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Example 2 (continued)

EXAMPLE 2

Represent the given expression in simplest radical form: $\sqrt{450}$

$$\begin{aligned}\sqrt{450} &= \sqrt{2 \cdot 3 \cdot 3 \cdot 5 \cdot 5} \\ &= \sqrt{2 \cdot 3^2 \cdot 5^2}\end{aligned}$$

The multiple factors of 3 and 5 can be rewritten as 3^2 and 5^2 .

[Next](#)

The multiple factors of 3 and 5 can be rewritten as 3^2 and 5^2 .

$$\begin{aligned}\sqrt{450} &= \sqrt{2 \cdot 3 \cdot 3 \cdot 5 \cdot 5} \\ &= \sqrt{2 \cdot 3^2 \cdot 5^2}\end{aligned}$$

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Example 2 (continued)

EXAMPLE 2

Represent the given expression in simplest radical form: $\sqrt{450}$

$$\begin{aligned}\sqrt{450} &= \sqrt{2 \cdot 3 \cdot 3 \cdot 5 \cdot 5} \\ &= \sqrt{2 \cdot 3^2 \cdot 5^2}\end{aligned}$$

$$\sqrt{2 \cdot 3^2 \cdot 5^2} = \sqrt{2} \cdot \sqrt{3^2} \cdot \sqrt{5^2}$$

Is the statement above true or false?

TrueFalse

Now apply the Product Property of Radicals to represent the square root of the product as the product of the square roots of the factors.

$$\sqrt{2 \cdot 3^2 \cdot 5^2} = \sqrt{2} \cdot \sqrt{3^2} \cdot \sqrt{5^2}$$

Is the statement above true or false?

- A) True
- B) False

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Example 2 (continued)

EXAMPLE 2

Represent the given expression in simplest radical form: $\sqrt{450}$

$$\begin{aligned}\sqrt{450} &= \sqrt{2 \cdot 3 \cdot 3 \cdot 5 \cdot 5} \\ &= \sqrt{2 \cdot 3^2 \cdot 5^2} \\ &= \sqrt{2} \cdot \sqrt{3^2} \cdot \sqrt{5^2}\end{aligned}$$

The statement is true.
The square root of a product equals the product of the square roots of the factors.

TrueNext

The statement is true. The square root of a product equals the product of the square roots of the factors.

$$\sqrt{2 \cdot 3^2 \cdot 5^2} = \sqrt{2} \cdot \sqrt{3^2} \cdot \sqrt{5^2}$$

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Example 2 (continued)

EXAMPLE 2

Represent the given expression in simplest radical form: $\sqrt{450}$

$$\begin{aligned}\sqrt{450} &= \sqrt{2 \cdot 3 \cdot 3 \cdot 5 \cdot 5} \\ &= \sqrt{2 \cdot 3^2 \cdot 5^2} \\ &= \sqrt{2} \cdot \sqrt{3^2} \cdot \sqrt{5^2}\end{aligned}$$

$\sqrt{2}$ is in the simplest radical form.

Next, simplify the expression $\sqrt{2} \cdot \sqrt{3^2} \cdot \sqrt{5^2}$.

The radicand $\sqrt{2}$ is in simplest radical form.

Is the statement above true or false?

- A) True
- B) False

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Example 2 (continued)

EXAMPLE 2

Represent the given expression in simplest radical form: $\sqrt{450}$

$$\begin{aligned}\sqrt{450} &= \sqrt{2 \cdot 3 \cdot 3 \cdot 5 \cdot 5} \\ &= \sqrt{2 \cdot 3^2 \cdot 5^2} \\ &= \sqrt{2} \cdot \sqrt{3^2} \cdot \sqrt{5^2} \\ &= \sqrt{2}\end{aligned}$$

The radicand contains no perfect square factors other than 1. $\sqrt{2}$ is in simplest form.

TrueNext

The statement is true. The radicand contains no perfect square factors other than 1. Therefore, $\sqrt{2}$ is in simplest radical form.

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Example 2 (continued)

EXAMPLE 2

Represent the given expression in simplest radical form: $\sqrt{450}$

$$\begin{aligned}\sqrt{450} &= \sqrt{2 \cdot 3 \cdot 3 \cdot 5 \cdot 5} \\ &= \sqrt{2 \cdot 3^2 \cdot 5^2} \\ &= \sqrt{2} \cdot \sqrt{3^2} \cdot \sqrt{5^2} \\ &= \sqrt{2} \cdot \square \cdot \square\end{aligned}$$

Continue to simplify the expression above.
Enter the correct values and click **SUBMIT**.

Continue to simplify $\sqrt{3^2}$ and $\sqrt{5^2}$.

What do $\sqrt{3^2}$ and $\sqrt{5^2}$ simplify to?

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Example 2 (continued)

EXAMPLE 2

Represent the given expression in simplest radical form: $\sqrt{450}$

$$\begin{aligned}\sqrt{450} &= \sqrt{2 \cdot 3 \cdot 3 \cdot 5 \cdot 5} \\ &= \sqrt{2 \cdot 3^2 \cdot 5^2} \\ &= \sqrt{2} \cdot \sqrt{3^2} \cdot \sqrt{5^2} \\ &= \sqrt{2} \cdot 3 \cdot 5\end{aligned}$$

Squaring a number and taking the square root of a number are inverse operations. So, $\sqrt{3^2} = 3$, and $\sqrt{5^2} = 5$.

Next

Squaring a number and taking the square root of a number are inverse operations. So, $\sqrt{3^2} = 3$ and $\sqrt{5^2} = 5$.

$$\begin{aligned}\sqrt{450} &= \sqrt{2 \cdot 3 \cdot 3 \cdot 5 \cdot 5} \\ &= \sqrt{2 \cdot 3^2 \cdot 5^2} \\ &= \sqrt{2} \cdot \sqrt{3^2} \cdot \sqrt{5^2} \\ &= \sqrt{2} \cdot 3 \cdot 5\end{aligned}$$

In simplest radical form, $\sqrt{450}$ is equivalent to which of the following?

- A) $8\sqrt{2}$
- B) $15\sqrt{2}$
- C) 21.2

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Example 2 (continued)

EXAMPLE 2

Represent the given expression in simplest radical form: $\sqrt{450}$

$$\begin{aligned}\sqrt{450} &= \sqrt{2 \cdot 3 \cdot 3 \cdot 5 \cdot 5} \\ &= \sqrt{2 \cdot 3^2 \cdot 5^2} \\ &= \sqrt{2} \cdot \sqrt{3^2} \cdot \sqrt{5^2} \\ &= \sqrt{2} \cdot 3 \cdot 5\end{aligned}$$

The correct answer is $15\sqrt{2}$. Click next to review all of the steps.

$15\sqrt{2}$ Next

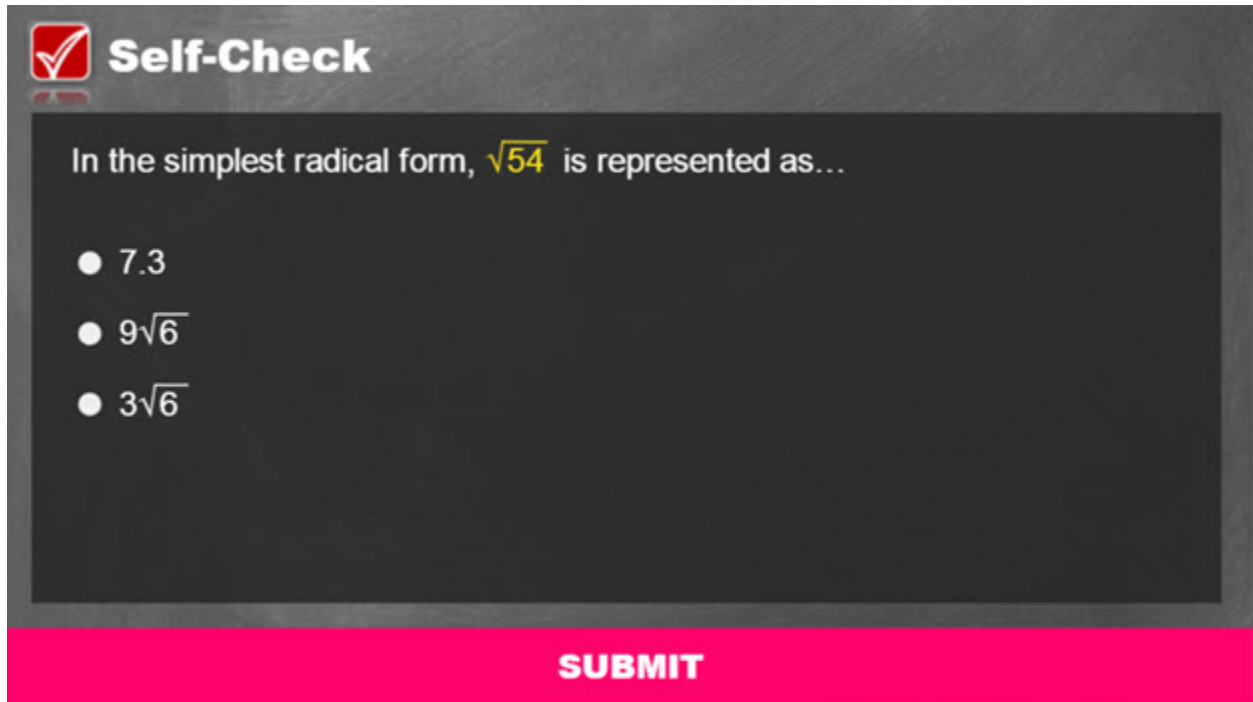
The correct answer is $15\sqrt{2}$. Review all the steps for representing the simplest radical form of $\sqrt{450}$.

$\sqrt{450} = \sqrt{2 \cdot 3 \cdot 3 \cdot 5 \cdot 5}$	Complete the prime factorization of 450
$= \sqrt{2 \cdot 3^2 \cdot 5^2}$	Represent multiple factors as square terms
$= \sqrt{2} \cdot \sqrt{3^2} \cdot \sqrt{5^2}$	Apply the Product Property of Radicals
$= \sqrt{2} \cdot 3 \cdot 5$	Simplify the perfect squares
$= \sqrt{2} \cdot 15$	Find the product of 5 and 3
$= 15\sqrt{2}$	Simplify the expression

Your work is complete. The simplest radical form of $\sqrt{450}$ is $15\sqrt{2}$.

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Self-Check



Self-Check

In the simplest radical form, $\sqrt{54}$ is represented as...

- 7.3
- $9\sqrt{6}$
- $3\sqrt{6}$

SUBMIT

Solve the problem in the image above to check your understanding of the content.

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Self-Check: Answer

The image shows a self-check interface with a grey background and a red checkmark icon in the top left corner. The text "Self Check" is partially visible. The main content is a white rounded rectangle with the following text and equations:

Correct

That's correct! Follow the steps below to simplify.

Complete the prime factorization of 54. $\sqrt{54} = \sqrt{3 \cdot 3 \cdot 3 \cdot 2}$

Represent multiple factors as square terms. $= \sqrt{3^2 \cdot 3 \cdot 2}$

Apply the Product Property of Radicals. $= \sqrt{3^2} \cdot \sqrt{3 \cdot 2}$

Simplify. $= 3\sqrt{6}$

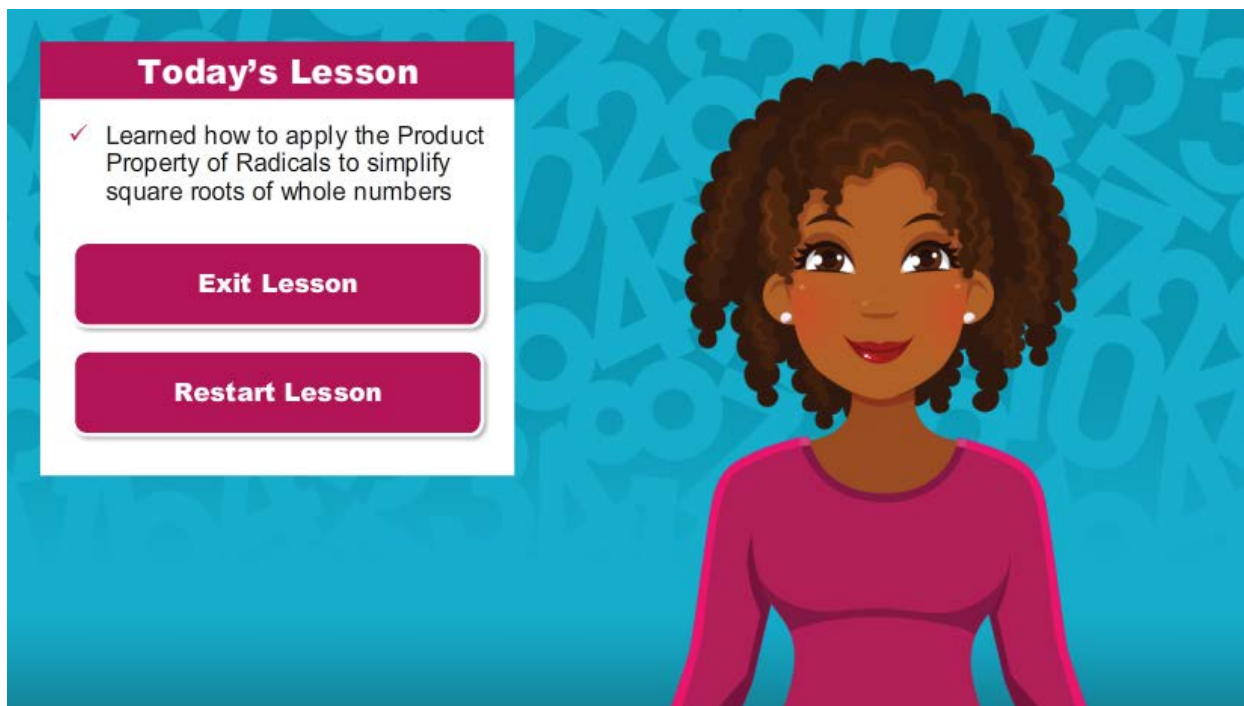
At the bottom of the white box is a "Continue" button. Below the white box, on a red background, is the word "SUBMIT" in white capital letters.

For your reference, the image above shows the correct solution to the self-check problem.

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Conclusion



The image shows a digital interface for a lesson conclusion. On the left, a white box with a pink header titled "Today's Lesson" contains a checkmark and the text: "Learned how to apply the Product Property of Radicals to simplify square roots of whole numbers". Below this text are two pink buttons: "Exit Lesson" and "Restart Lesson". To the right of the box is a cartoon illustration of a woman with dark curly hair, wearing a pink top, set against a blue background with faint mathematical symbols.

You have reached the conclusion of this lesson where you learned how to apply the Product Property of Radicals to simplify square roots of whole numbers.