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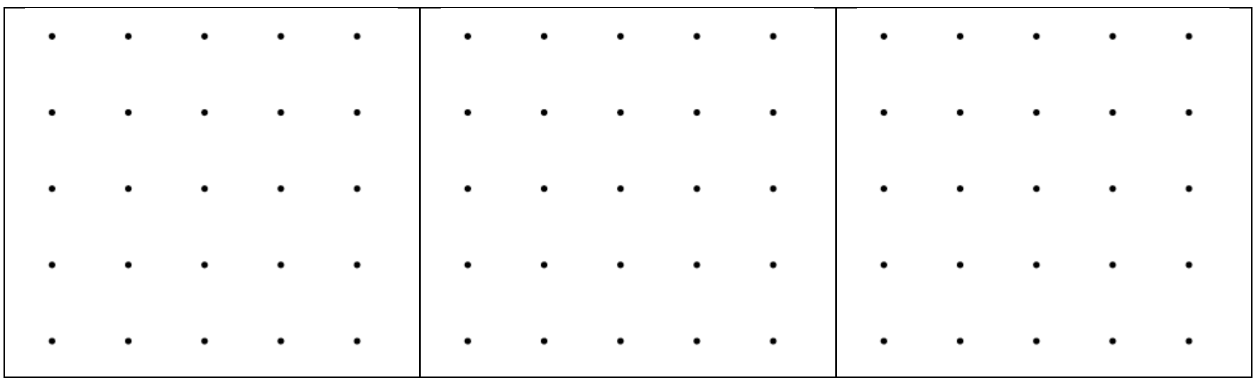
9.0 Simplifying Radicals

Square roots have played a key role in our understanding of mathematical systems since they were the door to the first *irrational* numbers discovered by the Greeks in the days of Pythagoras. In this lesson we will introduce the concept of square root, cube root, and n^{th} root expressions and functions.

Explore

Draw all the different possible lengths of lines that can be drawn in a 5x5 dot grid. Leave your answers as square roots



A square root that cannot be simplified to a whole number is called an **irrational number.** These are numbers like $\sqrt{13}$ and $\sqrt{21}$.

Find as many pairs of lengths above with one that is twice as long as the other.

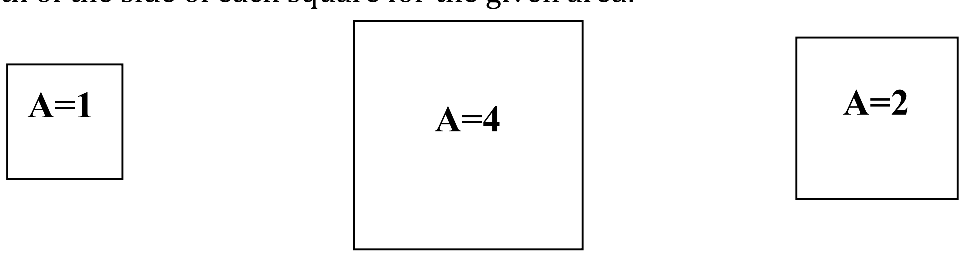
__________ $= 2\times$ __________ __________ $= 2\times$ __________

__________ $= 2\times$ __________ __________ $= 2\times$ __________

Square Roots

Example 1:

Find the length of the side of each square for the given area:



The Product Rule for Radicals

This shows us that two expressions with square roots could have the same value.

Try this: Compute each of the following on your calculator

$\sqrt{4} \cdot \sqrt{5} =$ $\sqrt{20} =$ $\sqrt{4} \cdot \sqrt{25} =$ $\sqrt{100} =$

Rule: Radical Product Rules

If $\sqrt{a}$ and $\sqrt{b}$ are real numbers, then

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

Example 1:

a. $\sqrt{2} \cdot \sqrt{5} =$ b. $\sqrt{2} \cdot \sqrt{32} =$

Using Factoring and the Product Rule to Simplifying Radicals

Consider this: What are all the positive numbers less than 100 that are perfect squares?

However, not all numbers are perfect squares, so we can't find their square root exactly. So, we need to simplify the radicals. A radical is **simplified** if the radicand has no factors that are perfect squares.

Example 2: Simplify $\sqrt{18}$

Steps:

1. Factor the radicand to include one perfect square
2. Use the product rule to write as 2 square roots
3. Find the *square* root of the perfect square.

Example 3: Use the Radical Product rule to simplify the radicals.

a) $\sqrt{50}$

b) $\sqrt{32}$

c) $\sqrt{12} \cdot \sqrt{2}$

Rationalizing the denominator. We don't like to leave radicals in the denominator, so we need to multiply fractions by a special form of one to get rid of the radicals in the denominator.

Example4: Simplify by rationalizing the denominator.

a. $\frac{6}{\sqrt{2}}$ b. $\frac{\sqrt{5}}{\sqrt{2}}$ c. $\frac{2}{\sqrt{6}}$

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Practice Assignment

Simplify these radicals completely. Multiply first if necessary. Rationalize the denominator.

1. $\sqrt{125}$

2. $\sqrt{40}$

3. $\sqrt{12}$

4. $\sqrt{98}$

5. $\sqrt{28}$

6. $\sqrt{54}$

7. $\sqrt{6} \cdot \sqrt{15}$

8. $\sqrt{3} \cdot \sqrt{12}$

9. $\sqrt{8} \cdot \sqrt{6}$

10. $\sqrt{5} \cdot \sqrt{10}$

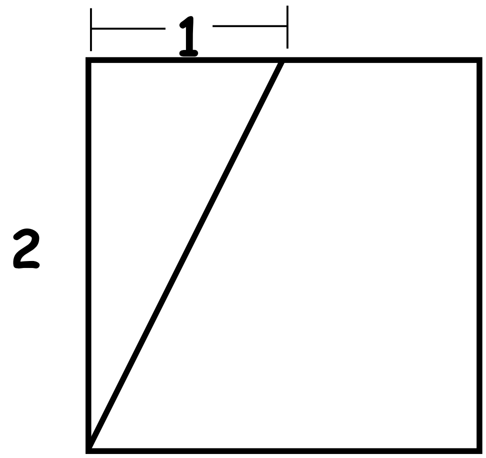
11. $\frac{12}{\sqrt{3}}$

12. $\frac{20}{\sqrt{10}}$

13. $\frac{3}{\sqrt{5}}$

14. $\frac{2}{\sqrt{3}}$

Five Square Puzzle



Object: Make a large square out of the pieces of the five small squares

<u>Answer the following questions to help you solve the puzzle;</u>

1. What is the area of the small square?

2. What is the total area of the five squares?

3. What will the area of the final, large square be?

4. What will the length of one side of the final square be?

5. What is the length of the hypotenuse of the triangle cut from the s

