

SQUARE ROOT ARITHMETIC
N-GEN MATH[®] ALGEBRA I



There are times when you will need to be able to do some basic operations involving square roots of number or algebraic expressions. We have already seen and used the **multiplication property of square roots**.

MULTIPLICATION PROPERTY OF SQUARE ROOTS

$$1. \sqrt{a} \cdot \sqrt{b} = \sqrt{a \cdot b}$$

likewise

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

Exercise #1: Find each product below. Write each answer in simplest radical form.

(a) $\sqrt{8} \cdot \sqrt{5} =$

(b) $\sqrt{6} \cdot \sqrt{15} =$

(c) $\sqrt{10} \cdot \sqrt{10} =$

One major consequence of the multiplication property of square roots can be seen in Exercise #1(c). Make sure you understand this important idea in the next exercise.

Exercise #2: Write each of the following products in simplest form.

(a) $\sqrt{5} \cdot \sqrt{5} =$

(b) $\sqrt{8} \cdot \sqrt{8} =$

(c) $\sqrt{11} \cdot \sqrt{11} =$

(d) $\sqrt{a} \cdot \sqrt{a} =$

For historical reasons, many times a fraction is not considered simplified if there is a square root in its denominator (although it is fine to have one in its numerator). We can “remove” the square root from its denominator using a process known as **rationalizing the denominator**.

Exercise #3: Consider the fraction $\frac{2}{\sqrt{3}}$, which has an irrational denominator.

(a) Using your calculator, write the value of this fraction using every decimal possible.

(b) Does the fraction appear to be a rational or irrational number? Explain.

(c) Find the following product $\frac{2}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}}$ in simplest form. Then, find its decimal value.

(d) Why is the fraction in (c) equivalent to the original one?



Notice that in Exercise #3, we took a fraction with an **irrational denominator** and converted it into an equivalent fraction with a **rational denominator** by simply doing what we always do when writing equivalent fractions.

Exercise #4: Write each of the following fractions as equivalent fractions with rational denominators. Express all fractions in simplest form.

(a) $\frac{1}{\sqrt{3}}$

(b) $\frac{7}{\sqrt{2}}$

(c) $\frac{5}{\sqrt{10}}$

(d) $\frac{6}{\sqrt{14}}$

(e) $\frac{-24}{\sqrt{8}}$

(f) $\frac{15}{\sqrt{6}}$

(g) $\frac{20}{\sqrt{5}}$

(h) $\frac{-3}{\sqrt{12}}$

The final issue we will look at is **adding** and **subtracting expressions involving square roots**.

Exercise #5: Simplify each of the following expressions.

(a) $3x + 5x =$

(b) $8y - 2y$

(c) $9t + 2t - 6t$

(d) $3\sqrt{2} + 5\sqrt{2}$

(e) $8\sqrt{5} - 2\sqrt{5}$

(f) $9\sqrt{3} + 2\sqrt{3} - 6\sqrt{3}$

We can **only** add and subtract quantities with square roots that have the same **radicand** (the number under the square root). This is similar to combining like terms, as Exercise #5 illustrates. Sometimes, we may need to write a square root in **simplest radical form** in order to add or subtract.

Exercise #6: Write each of the following sums or differences in simplest radical form.

(a) $\sqrt{8} + 5\sqrt{2}$

(b) $2\sqrt{27} - \sqrt{3}$

(c) $\sqrt{20} + 9\sqrt{5} - \sqrt{45}$



Name: _____

Date: _____

SQUARE ROOT ARITHMETIC
N-GEN MATH[®] ALGEBRA I HOMEWORK

FLUENCY1. Which of the following is equivalent to the product $\sqrt{2} \cdot \sqrt{6}$?

(1) $3\sqrt{2}$

(2) $2\sqrt{6}$

(3) $2\sqrt{3}$

(4) $6\sqrt{2}$ _____

2. Which product below gives a rational number as a result?

(1) $\sqrt{6} \cdot \sqrt{9}$

(2) $\sqrt{5} \cdot \sqrt{20}$

(3) $\sqrt{3} \cdot \sqrt{10}$

(4) $\sqrt{8} \cdot \sqrt{4}$ _____

3. Which of the following is the value of the expression $\sqrt{17} \cdot \sqrt{17} - \sqrt{3} \cdot \sqrt{3}$?

(1) $\sqrt{8}$

(2) 16

(3) $\sqrt{11}$

(4) 14 _____

4. Which expression below is equivalent to $\frac{2}{\sqrt{6}}$?

(1) $\frac{\sqrt{6}}{3}$

(3) $\frac{\sqrt{6}}{2}$

(2) $\frac{\sqrt{3}}{2}$

(4) $\frac{\sqrt{3}}{6}$ _____

5. Which of the following is the result of the difference $5\sqrt{8} - \sqrt{32}$?

(1) $3\sqrt{3}$

(2) $6\sqrt{2}$

(3) $7\sqrt{3}$

(4) $5\sqrt{2}$ _____



6. Write each of the following as equivalent fractions with rational denominators. Simplify your fractions and square roots when possible.

(a) $\frac{1}{\sqrt{6}}$

(b) $\frac{2}{\sqrt{10}}$

(c) $\frac{-14}{\sqrt{2}}$

(d) $\frac{5}{\sqrt{20}}$

(e) $\frac{3}{\sqrt{8}}$

(f) $\frac{-4}{\sqrt{12}}$

7. Find each of the following sums in simplest form. You will need to write some of the square roots in simplest radical form in order to perform the addition.

(a) $8\sqrt{5} + 2\sqrt{5}$

(b) $-6\sqrt{3} + 10\sqrt{3} - \sqrt{3}$

(c) $\sqrt{12} + \sqrt{27}$

(d) $3\sqrt{80} - 2\sqrt{20}$

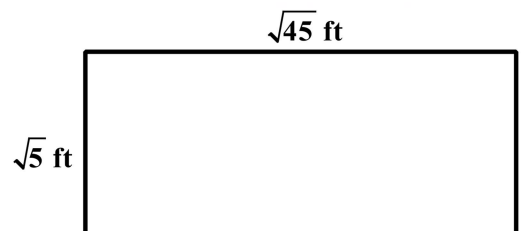
(e) $\sqrt{54} - 7\sqrt{6}$

(f) $\sqrt{28} + 3\sqrt{175} - \sqrt{700}$

APPLICATIONS

8. A rectangle has a width of $\sqrt{5}$ feet and a length of $\sqrt{45}$ feet as shown in the diagram.

(a) Is the area of the rectangle a rational or irrational number? Justify.



(b) How many times greater is the perimeter of the rectangle than its width? Explain how you determined your answer.

