# Radicals Lesson 1
# Radical Expressions

## Important Note

For all braille examples, emboss the "L1-Radicals-Problems-Only.brf" file as a supplement to this lesson.

## Background

A **radical expression** is defined as any expression containing a **radical symbol**. In print, a horizontal bar or vinculum usually extends the radical symbol over an expression called the **radicand**. In print, a radical can also have an **index** placed to the left and slightly above the radical symbol.

To summarize, the **radical expression** read as the nth root of x has three major components:

1. the **radical symbol** (it looks like a check mark in print),
2. the **index** (the small n tucked outside the radical symbol in print), and
3. the **radicand** (x, the quantity written beneath the horizontal bar of the radical symbol in print).

$\sqrt[n]{x}$

An index of 5 means that we are looking for the fifth root. An index of 3 means that we are looking for the cube root. An index of 2 is the square root, and we usually don't show the 2.

The most common radical is the **square root.** A radical symbol with no indicated root index shown is understood to indicate the positive square root or **principal square root**. Whereas, to name the **negative square root** of a number, we would insert a negative sign in front of the radical symbol.

$-\sqrt{\ }$

For this lesson, we are going to concentrate on these simple radicals where the index is not shown, but they are understood to indicate principal square roots.

# Basic Rules for Writing a Square Root

When writing a square root, you follow three simple steps. You would braille:

1. The radical symbol (dots 3-4-5) ( $\sqrt{\ }$ ) 
2. The radicand, value inside/under a radical symbol, which you want to find the root of
3. The termination indicator (dots 1-2-4-5-6) 

The following steps outline how to write the principal square root of 4 in Nemeth Code:

1. Radical symbol (dots 3-4-5) ( $\sqrt{\ }$ ) 
2. Four (dots 2-5-6) 
3. Termination indicator (dots 1-2-4-5-6) 

$\sqrt{4}$

# Basic Rules for Reading a Square Root

To keep the terminology simple, from here on out "the square root" of a number refers ONLY to the principal square root. So, for most square roots you will just say “the square root of” and then read the radicand.

# Examples of Square Roots

1. the square root of twenty-five

   $\sqrt{25}$

2. the square root of x

   $\sqrt{x}$

3. the square root of one-fourth with a horizontal fraction line

$$\sqrt{\frac{1}{4}}$$

4. the square root of zero point four nine

$$\sqrt{0.49}$$

However, things get a bit more complicated when you have something following the termination indicator. Notice that when reading the next two examples we included the words "end root" to indicate where the radicand ends. Otherwise, it would be very difficult to tell whether the minus one was inside/under the radical or not.

5. the square root of y minus one end root

$$\sqrt{y-1}$$

6. the square root of y end root minus one

$$\sqrt{y}-1$$

## Activity Time for Square Roots

Write the radical expressions from Examples 1 to 6.

1. the square root of twenty-five
2. the square root of x
3. the square root of one-fourth
4. the square root of zero point four nine
5. the square root of y minus one end root
6. the square root of y end root minus one

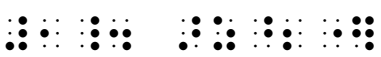
# Basic Rules for Square Roots with Superscripts

As we have already seen, the radicand doesn't always have to be a specific number. The radicand could contain one or more variables and these variables could even have **superscripts** or **exponents**. When the exponent is 2, we often say squared; and when the exponent is 3, we often say cubed. Notice below in Examples 1 to 5 that we need to use the **superscript indicator** (dots 4-5) to start the exponent and the **baseline indicator** (dot 5) in order to show that the exponent has ended and that we have returned to baseline. All fractions in these examples use a horizontal fraction line.

# Examples of Square Roots with Superscripts

1. the square root of z squared end root

   $\sqrt{z^2}$

2. the square root of z end root squared

   $\sqrt{z}^2$

3. the square root of x squared plus y squared end root

   $\sqrt{x^2 + y^2}$

4. the square root of one-ninth z squared end root

   $\sqrt{\frac{1}{9} z^2}$

5. the square root of open fraction eighty-one x to the fourth power over thirty-six y to the sixth power close fraction end root

$$\sqrt{\frac{81x^4}{36y^6}}$$

## Activity Time for Square Roots with Superscripts

Write the radical expressions from Examples 1 to 5.

1. the square root of z squared end root
2. the square root of z end root squared
3. the square root of x squared plus y squared end root
4. the square root of one-ninth z squared end root
5. the square root of open fraction eighty-one x to the fourth power over thirty-six y to the sixth power close fraction end root

## Basic Rules for Square Roots with Subscripts

The radicand could also contain one or more variables with **subscripts**, such as when using the **distance formula** to find the distance between two points on the coordinate plane. In Example 1 below, we also need to use the **superscript indicator** (dots 4-5) to start the exponent and the **baseline indicator** (dot 5) in order to show that the exponent has ended and that we have returned to baseline.

## Example of Square Roots with Subscripts

1. the square root of open parenthesis x sub one minus x sub two close parenthesis squared plus open parenthesis y sub one minus y sub two close parenthesis squared end root

$$\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

Please note that when a numeric subscript is used with a variable, the subscript indicator is not used, and subsequently the baseline indicator must not be used to return to the baseline after the subscript.

# Activity Time for Square Roots with Subscripts

Write the radical expression from Example 1.

1. the square root of open parenthesis x sub one minus x sub two close parenthesis squared plus open parenthesis y sub one minus y sub two close parenthesis squared end root