**Barron’s Let’s Review Regents – Algebra II**

# Chapter 4: Radical Expressions and Equations

## 4.1 Simplifying Radicals

**Key Ideas**

A *radical expression* is one that involves a sign (radical sign). Radical expressions are often involved in the solutions to polynomial equations. To work with radicals, you must know how to put them into simplified form and how to combine them.

**Definition of Radicals**

The square root of a number is the thing that must be multiplied by itself to get that number. The symbol for square root is , also called *the radical sign*. An example is because . Even though it is also true that , the symbol means just the positive number that when squared is equal to the number inside the radical sign. A number that is not a perfect square, like 7, still has a square root, although that square root is an irrational number. is between 2 and 3 since and . More precisely, is approximately 2.645751311.

If there is a small number outside the radical sign, it no longer indicates a square root. If there is a small 3 outside the radical sign, it becomes a cube root sign and is equal to the number that must be cubed to become the number under the radical sign. An example is , because . The small number outside the radical sign is called the *index*. When there is no index, it is implied to be a 2. So a radical sign with no index is called the *square root sign*.

**Multiplying Radicals**

Two radical expressions that have the same index can be multiplied by multiplying the numbers inside the radical sign. For example, . This is easily verified for this example since .

**Math Facts**

In general, . This rule also works in reverse for factoring radicals: .

**Simplifying Square Roots**

If the number inside a square root sign has a factor that is a perfect square, the radical can be *simplified*. The can be simplified since one of the factors of 50 is 25, which is a perfect square.

. The 5 in this expression is not an index but a coefficient in front of the radical sign. The multiplication sign between the coefficient and the radical sign is not necessary.

**Example 1**

Simplify the expression .

*Solution*: Since .

It is not always clear whether or not a large number has a factor that is a perfect square. By factoring the number into its *prime factors*, it is possible to group the matching factors into pairs and use the fact that .

Radical expressions that involve variables can also be simplified with this approach.

**Example 2**

Simplify the expression:

*Solution*:

**Adding and Subtracting Radicals**

Radicals can be added or subtracted only if they have the same index and the same number inside the radical sign. They are combined the same way that like terms are combined with polynomials. For example, . Subtraction works the same way: .

If two radical expressions have the same index but different numbers inside the radical sign, you cannot immediately add or subtract them. Sometimes after simplifying the expressions, they will have the same number inside the radical sign and can then be added or subtracted.

**Example 3**

Simplify the terms and combine if possible.

*Solution*: After simplifying: