Multiplying Square Roots

Objectives: 1. to multiply a monomial numerical radical expression by another monomial numerical radical expression
2. to multiply a monomial numerical radical expression by a binomial containing numerical radicals

Using the Product Property of Square Roots, we can multiply $\sqrt{2} \cdot \sqrt{3} = \sqrt{6}$

Since the number 6 does not contain any factor that is a perfect square other than “1,” this is simplified.

If we multiply $\sqrt{3} \cdot \sqrt{6}$, we get $\sqrt{18}$, which must then be simplified because 18 contains the factor 9, which is a perfect square. Continuing,

$$\sqrt{3} \cdot \sqrt{6} = \sqrt{18} = \sqrt{9} \cdot \sqrt{2} = 3\sqrt{2}$$

Example 1: $\sqrt{5} \cdot \sqrt{5} = \sqrt{25} = 5$

Also, keep in mind what a square root is. The square root of 5 is that number, which when multiplied by itself, yields 5. That is, $\sqrt{5} \cdot \sqrt{5} = 5$.

Example 2: $\sqrt{6} \cdot \sqrt{15} = \sqrt{90} = \sqrt{9} \cdot \sqrt{10} = 3\sqrt{10}$

Example 3: $\sqrt{7} \cdot \sqrt{28} = \sqrt{196} = 14$

When we multiply a monomial times a polynomial, we distribute the monomial to each term in the polynomial. Therefore,

$$\sqrt{2}(\sqrt{3} + \sqrt{6}) = \sqrt{2} \cdot \sqrt{3} + \sqrt{2} \cdot \sqrt{6} = \sqrt{6} + \sqrt{12} = \sqrt{6} + \sqrt{4 \cdot 3} = \sqrt{6} + 2\sqrt{3}$$

This is the simplified answer. Remember that you cannot add or subtract unlike radicals.

*This instructional aid was prepared by the Tallahassee Community College Learning Commons.*
Example 4: \( \sqrt{3}(\sqrt{21} + \sqrt{3}) = \sqrt{3}\sqrt{21} + \sqrt{3}\sqrt{3} \)
\[= \sqrt{63} + \sqrt{9} \]
\[= \sqrt{9}\sqrt{7} + \sqrt{9} \]
\[= 3\sqrt{7} + 3 \]

Example 5: \( \sqrt{2}(\sqrt{2} - \sqrt{5}) = \sqrt{2}\sqrt{2} - \sqrt{2}\sqrt{5} \)
\[= \sqrt{4} - \sqrt{10} \]
\[= 2 - \sqrt{10} \]

Example 6: \( \sqrt{3}(\sqrt{27} - \sqrt{12}) = \sqrt{3}\sqrt{27} - \sqrt{3}\sqrt{12} \)
\[= \sqrt{81} - \sqrt{36} \]
\[= 9 - 6 \]
\[= 3 \]

Exercises:

1. \( \sqrt{9}\sqrt{4} \)
2. \( \sqrt{8}\sqrt{32} \)
3. \( \sqrt{6}\sqrt{10} \)
4. \( \sqrt{27}\sqrt{50} \)
5. \( \sqrt{5}(\sqrt{3} + \sqrt{7}) \)
6. \( \sqrt{7}(\sqrt{10} + \sqrt{21}) \)
7. \( \sqrt{3}(\sqrt{24} - \sqrt{3}) \)
8. \( \sqrt{8}(\sqrt{6} + \sqrt{18}) \)
9. \( \sqrt{5}(\sqrt{15} - \sqrt{10}) \)
10. \( \sqrt{2}(\sqrt{8} - \sqrt{32}) \)

Answers:

1. 6
2. 16
3. 2\sqrt{15}
4. 15\sqrt{6}
5. \sqrt{15} + \sqrt{35}
6. \sqrt{70} + 7\sqrt{3}
7. 6\sqrt{2} - 3
8. 4\sqrt{3} + 12
9. 5\sqrt{3} - 5\sqrt{2}
10. -4