Elementary Algebra
Skill-Builder # SQRT – 3A
Multiplying Square Root Radicals: Single-Term Radicals

To multiply square root radicals, simply multiply the radicands. Thus,

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

Then simplify the product, if possible.

Examples Perform the multiplication.

1. $\sqrt{5}\cdot\sqrt{7}$

Solution: Applying the rule, we get $\sqrt{5}\cdot\sqrt{7}=\sqrt{5\cdot 7}=\sqrt{35}$.

What happens when the radical has a coefficient in front of it?

2. $\left(4\sqrt{2}\right)\left(7\sqrt{3}\right)$

Solution: Keep in mind that when there is no visible operation that the operation is multiplication so the problem really calls for multiplying four numbers: 4, $\sqrt{2}$, 7, and $\sqrt{3}$. Since multiplication is commutative (we can change the order of the factors) we have

$$\left(4\sqrt{2}\right)\left(7\sqrt{3}\right)=4\cdot 7\cdot\sqrt{2}\cdot\sqrt{3}=28\sqrt{2\cdot 3}=28\sqrt{6}\,.$$

Now, let's consider the case where we have variables. We will again assume that the variables represent positive real numbers.

3. $3x^2\sqrt{12x}\cdot 4\sqrt{8x^3}$

Solution: Applying the commutative property for multiplication, we see that

$$3x^2\sqrt{12x}\cdot 4\sqrt{8x^3}=3x^2\cdot 4\cdot\sqrt{12x}\cdot\sqrt{8x^3}=12x^2\sqrt{12\cdot 8\cdot x^4}\,.$$

Note that we can still simplify the radical as follows:

$$12x^2\sqrt{12\cdot 8\cdot x^4}=12x^2\sqrt{3\cdot\boxed{4\cdot 4}\cdot 2\cdot\boxed{x^4}}=12x^2\cdot 4\cdot x^2\sqrt{6}=48x^4\sqrt{6}\,.$$

Of course we can multiply three or more radical expressions.

4. $\left(-2a\sqrt{5ab}\right)\left(6b\sqrt{2a}\right)\left(3ab\sqrt{10b}\right)$

Solution: Once again let's apply the commutative property for multiplication to get

$$\left(-2a\sqrt{5ab}\right)\left(6b\sqrt{2a}\right)\left(3ab\sqrt{10b}\right)=-2a\cdot 6b\cdot 3ab\cdot\sqrt{5ab}\cdot\sqrt{2a}\cdot\sqrt{10b}=-36a^2b^2\sqrt{100a^2b^2}\,.$$

Note that the product can be simplified: $-36a^2b^2\sqrt{100a^2b^2}=-36a^2b^2\cdot 10ab=-360a^3b^3$

5. $\left(4\sqrt{3}\right)^3$

Solution: We can use the fact that exponentiation is repeated multiplication to get

$$\left(4\sqrt{3}\right)^3=4\sqrt{3}\cdot 4\sqrt{3}\cdot 4\sqrt{3}=4\cdot 4\cdot 4\cdot\sqrt{3}\cdot\sqrt{3}\cdot\sqrt{3}=4^3\sqrt{3^3}\,,$$

or we could have gone to the final step above by applying the distributive property of exponentiation over multiplication. Either way we do it, we get the answer

$$4^3\sqrt{3^3}=64\sqrt{3^2\cdot 3}=64\cdot 3\sqrt{3}=192\sqrt{3}\,.$$

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Find the following. Assume all variables represent positive real numbers.

1. $5\sqrt{3}\cdot 9\sqrt{7}$	**2.** $-2\sqrt{12}\left(8\sqrt{6}\right)$
3. $2\sqrt{5a}\cdot\left(-5\sqrt{10a}\right)$	**4.** $3x\sqrt{6xy}\cdot 4y\sqrt{15y}$
5. $2\sqrt{20n^2}\cdot 3n\sqrt{35n^5}$	**6.** $\left(-x\sqrt{24xy}\right)\left(3y\sqrt{54x^3y}\right)$
7. $\left(-2\sqrt{5a}\right)^2\left(-2b\sqrt{2b}\right)$	**8.** $\left(3\sqrt{2y}\right)^2\cdot\left(2y\sqrt{3}\right)^3$

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Answers

1. $45\sqrt{21}$	**2.** $-96\sqrt{2}$
3. $-50a\sqrt{2}$	**4.** $36xy^2\sqrt{10x}$
5. $60n^4\sqrt{7n}$	**6.** $-108x^3y^2$
7. $-40ab\sqrt{2b}$	**8.** $432y^4\sqrt{3}$

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