Elementary Algebra
Skill-Builder # SQRT – 1A
Simplifying Square Root Radicals: Radicand is a Positive Constant

The expression $\sqrt{a}$ is read as "the square root of *a*". It is a **radical expression** or simply a **radical**. A radical consists of three parts: the **radical sign** $\sqrt{\ }$, the **radicand** *a*, and the **index**. For square root expressions the index is 2 and we don't write this number, i.e. we don't write $\sqrt[2]{a}$. We do so for other radicals like cube roots which we write as $\sqrt[3]{a}$; fourth roots are written as $\sqrt[4]{a}$, etc.

We say that a number *b* is a square root of a positive number *a* if $b^2 = a$. A positive number has two square roots, a positive root and a negative root. For instance, 4 has two square roots: -2 and 2. When we see the expression $\sqrt{4}$, we mean the **principal square root** of 4 which is 2. Thus, the principal square root of a positive number is a positive number. Note that we cannot talk of the square root of a negative number since there is no way we can get a negative answer when we square a number.

Examples Find the following.

1. $\sqrt{25}$

Solution: Let us consider three ways of arriving at the answer.

(1) We can use a calculator and get the answer 5. Of course, maybe we just know the answer!

(2) We can also write 25 as 5^2 and get $\sqrt{25} = \sqrt{5^2} = 5$. Sometimes a good way to visualize how to get this answer is as follows: $\sqrt{5^2} = \sqrt[2]{5^2} = 5$.

(3) We can write 25 as $5 \cdot 5$ and get $\sqrt{25} = \sqrt{5 \cdot 5} = 5$.

We now consider the case when the radicand is not a perfect square.

2. $\sqrt{12}$

Solution: Let us again look at the three ways of getting the answer.
(1) If we use a calculator we will get the answer $\sqrt{12} = 3.464102...$ which is not an **exact answer**. We usually want exact answers so this method won't work.
(2) We can factor 12 into $12 = 4 \cdot 3$ and use the fact that $\sqrt{12} = \sqrt{4 \cdot 3} = \sqrt{4} \cdot \sqrt{3} = \sqrt[2]{2^2}\sqrt{3} = 2\sqrt{3}$.
(3) We can factor 12 into $12 = 4 \cdot 3$ and do the following: $\sqrt{12} = \sqrt{4 \cdot 3} = \sqrt{\boxed{2 \cdot 2} \cdot 3} = 2\sqrt{3}$.

The radicand could be a fraction.

3. $\sqrt{\dfrac{8}{49}}$

Solution: We use the fact that $\sqrt{\dfrac{8}{49}} = \dfrac{\sqrt{8}}{\sqrt{49}}$. Verify that the answer is $\dfrac{2\sqrt{2}}{7}$.

The radicand could, of course, be a decimal, but we will omit this case. ☺

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Find the following.

1. $\sqrt{36}$	**2.** $\sqrt{\frac{4}{49}}$
3. $\sqrt{18}$	**4.** $\sqrt{75}$
5. $\sqrt{28}$	**6.** $\sqrt{80}$
7. $\sqrt{108}$	**8.** $\sqrt{\frac{32}{81}}$

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Answers

1. 6	**2.** $\frac{2}{7}$
3. $3\sqrt{2}$	**4.** $5\sqrt{3}$
5. $2\sqrt{7}$	**6.** $4\sqrt{5}$
7. $6\sqrt{3}$	**8.** $\frac{4\sqrt{2}}{9}$

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