What you will learn about:
Simplify and Use of Square Roots

Square Root of a Number:

If $n^2 = m$, then n is the square root of m

Radical - $\sqrt{}$

Radicand – Number under the radical

$\sqrt{m}$ is read as "the square root of m."

If $m = n^2$, then $\sqrt{m} = n$, for $n \geq 0$.

The square root of m, $\sqrt{m}$, is the positive number whose square is m.

$\sqrt{1}$	$\sqrt{4}$	$\sqrt{9}$	$\sqrt{16}$	$\sqrt{25}$	$\sqrt{36}$	$\sqrt{49}$	$\sqrt{64}$	$\sqrt{81}$	$\sqrt{100}$	$\sqrt{121}$	$\sqrt{144}$	$\sqrt{169}$	$\sqrt{196}$	$\sqrt{225}$
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Simplify

$\sqrt{36}$ 6

$\sqrt{196}$ 14

$-\sqrt{81}$ -9

$\sqrt{-121}$ No Real solutions

$\sqrt{a} + \sqrt{b} \neq \sqrt{a+b}$

$\sqrt{25} + \sqrt{144}$

$5 + 12$

17

$\sqrt{25 + 144}$

$\sqrt{169}$

13

$7 = \sqrt{49}$

$8 = \sqrt{64}$

$\sqrt{36} = 6$

$\sqrt{49} = 7$

Estimating Square Roots

Estimate $\sqrt{60}$ between two consectutive whole numbers.

between 7 and 8. Closer to 8.

Estimate $\sqrt{38}$ between two consectutive whole numbers.

between 6+7. Closer to 6.

Appoximate Square Roots

Use your calculator to find $\sqrt{5}$. Round to the nearest hundredth. 2.24

Round $\sqrt{58}$ to two decimal places.

7.62

Simplifying Variable Expressions with Square Roots

Find $\sqrt{9x^2}$ $= (3x)^2 = 9x^2$ $\sqrt{9x^2} = 3x$

$$(?)^2 = 9x^2$$
$$(3x)^2 = 9x^2, \qquad \text{so } \sqrt{9x^2} = 3x$$

$$\sqrt{25u^8} = 5u^4 \quad \text{because } \left(5u^4\right)^2 = 25u^8$$
$$\sqrt{16r^{20}} = 4r^{10} \quad \text{because } \left(4r^{10}\right)^2 = 16r^{20}$$
$$\sqrt{196q^{36}} = 14q^{18} \quad \text{because } \left(14q^{18}\right)^2 = 196q^{36}$$

Simplify:

$\sqrt{x^6} = x^3$

$(x^4)^2 = x^6$

$\sqrt{b^{10}} = b^5$

$\sqrt{64x^4}$

$8x^2$

$\sqrt{36x^2y^8}$

$6xy^4$

$-\sqrt{100a^{10}}$

$-10a^5$

$-\sqrt{225x^4y^2}$

$-15x^2y$

$\sqrt{49x^{30}}$

$7x^{15}$

$\sqrt{121w^{36}}$

$11w^{18}$

$\sqrt{169x^{10}y^{14}}$

$13x^5y^7$

$\sqrt{144a^{16}b^{20}c^8}$

$12a^8b^{10}c^4$

What you will learn about:
Simplify Square Roots

Product Property of Square Roots

If a, b are non-negative real numbers, then $\sqrt{ab} = \sqrt{a} \cdot \sqrt{b}$.

Simplify a square root using the Product property.

Step 1 – Find the largest perfect square of the radicand. Rewrite the radicand as a product using the perfect-square factor.

Step 2 – Use the product rule to rewrite the radical as the product of two radicals.

Step 3 – Simplify the square root of the prefect square.

$\sqrt{ab} = \sqrt{a} \cdot \sqrt{b}$

$\sqrt{72}$
$\sqrt{9} \cdot \sqrt{8}$
$3\sqrt{8}$
$3\sqrt{4} \cdot \sqrt{2}$
$3 \cdot 2 \cdot \sqrt{2}$

Simplify:

$\sqrt{50}$	$\sqrt{48}$	$\sqrt{45}$	$\sqrt{72}$
$\sqrt{25} \cdot \sqrt{2}$	$\sqrt{16 \cdot 3}$	$\sqrt{9} \cdot \sqrt{5}$	$\sqrt{36} \cdot \sqrt{2}$
$5\sqrt{2}$	$\sqrt{16} \cdot \sqrt{3}$	$3\sqrt{5}$	$6\sqrt{2}$
	$4\sqrt{3}$		

$\sqrt{500}$	$\sqrt{288}$	$\sqrt{432}$
$\sqrt{100} \cdot \sqrt{5}$	$\sqrt{144} \cdot \sqrt{2}$	$\sqrt{144} \cdot \sqrt{3}$
$10\sqrt{5}$	$12\sqrt{2}$	$12\sqrt{3}$

$\sqrt{x^3}$	$\sqrt{b^5}$	$\sqrt{p^9}$
$\sqrt{x^2} \cdot \sqrt{x}$	$\sqrt{b^4} \cdot \sqrt{b}$	$\sqrt{p^8} \cdot \sqrt{p}$
$x\sqrt{x}$	$b^2\sqrt{b}$	$p^4\sqrt{p}$

$\sqrt{16x^7}$	$\sqrt{25y^5}$	$\sqrt{144t^{11}}$
$\sqrt{16} \cdot \sqrt{x^7}$	$\sqrt{25} \cdot \sqrt{y^4} \cdot \sqrt{y}$	$\sqrt{144} \cdot \sqrt{t^{10}} \cdot \sqrt{t}$
$\sqrt{16} \cdot \sqrt{x^6} \cdot \sqrt{x}$	$5y^2\sqrt{y}$	$12t^5\sqrt{t}$
$4x^3\sqrt{x}$		

$\sqrt{32y^5}$	$\sqrt{75a^9}$	$\sqrt{63u^3v^5}$
$\sqrt{16} \cdot \sqrt{2} \cdot \sqrt{y^4} \cdot \sqrt{y}$	$\sqrt{25} \cdot \sqrt{3} \cdot \sqrt{a^8} \cdot \sqrt{a}$	$\sqrt{9} \cdot \sqrt{7} \cdot \sqrt{u^2}\sqrt{u} \cdot \sqrt{v^4} \cdot \sqrt{v}$
$4\sqrt{2} \cdot y^2 \cdot \sqrt{y}$	$5\sqrt{3} \cdot a^4\sqrt{a}$	$3\sqrt{7} \cdot u\sqrt{u} \cdot v\sqrt{v}$
$4y^2\sqrt{2y}$	$5a^4\sqrt{3a}$	$3uv^2\sqrt{7uv}$

$1^2 = 1$
$2^2 = 4$
$3^2 = 9$
$4^2 = 16$
$5^2 = 25$
$6^2 = 36$
$7^2 = 49$
$8^2 = 64$
$9^2 = 81$
$10^2 = 100$
$11^2 = 121$
$12^2 = 144$
$13^2 = 169$
$14^2 = 196$
$15^2 = 225$
$16^2 = 256$
$17^2 = 289$
$18^2 = 324$
$19^2 = 361$
$20^2 = 400$

mw

$1\sqrt{3} + 1\sqrt{3}$

$2\sqrt{3}$

$\sqrt{5} + \sqrt{2} \neq \sqrt{7}$

$\frac{\sqrt{48}}{2} \neq \sqrt{24}$

$\sqrt{48} = 4\sqrt{3}$

$\frac{4-4\sqrt{3}}{2}$

$\frac{4}{2} - \frac{4}{2}\sqrt{3}$

$\sqrt{\frac{a}{b}} \Leftrightarrow \frac{\sqrt{a}}{\sqrt{b}}$

$\frac{3\cancel{\sqrt{5}}}{4\cancel{\sqrt{5}}}$

Simplify:

$3+\sqrt{32}$	$5+\sqrt{75}$	$2-\sqrt{98}$
$3+\sqrt{16}\cdot\sqrt{2}$	$5+5\sqrt{3}$	$2-7\sqrt{2}$
$3+4\sqrt{2}$		
$\frac{4-\sqrt{48}}{2}$	$\frac{10-\sqrt{72}}{5}$	$\frac{6-\sqrt{45}}{3}$
$\frac{4-4\sqrt{3}}{2}$	$\frac{10-6\sqrt{2}}{5}$	$\frac{6-3\sqrt{5}}{3}$
$2-2\sqrt{3}$	$\frac{10}{5}-\frac{6}{5}\sqrt{2}$	$2-\sqrt{5}$
	$2-\frac{6}{5}\sqrt{2}$	

Using the Quotient Proptery to Simplify

$\sqrt{\frac{9}{16}} = \frac{\sqrt{9}}{\sqrt{16}} = \frac{3}{4}$	$\sqrt{\frac{25}{16}}$	$\sqrt{\frac{49}{81}}$
	$\frac{5}{4}$	$\frac{7}{9}$
$\sqrt{\frac{45}{80}} = \sqrt{\frac{9}{16}}$	$\sqrt{\frac{75}{48}} = \sqrt{\frac{25}{16}}$	$\sqrt{\frac{98}{162}} = \sqrt{\frac{49}{81}}$
$= \frac{3}{4}$	$= \frac{5}{4}$	$= \frac{7}{9}$
$\sqrt{\frac{m^6}{m^4}} = \sqrt{m^2}$	$\sqrt{\frac{x^{14}}{x^{10}}} = \sqrt{x^4}$	$\sqrt{\frac{48p^7}{3p^3}} = \sqrt{16p^4}$
$= m$	$= x^2$	$= 4p^2$

$\sqrt{\frac{75z^5}{3z}}$ $\sqrt{\frac{72b^{12}}{2b^{10}}}$

$5z^2$ $6b$

Quotient Property of Square Roots

If a, b are non-negative real numbers and $b \neq 0$, then

$$\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$$

Simplify

$\sqrt{\frac{21}{64}} = \frac{\sqrt{21}}{\sqrt{64}} = \frac{\sqrt{21}}{8}$

$\sqrt{\frac{19}{49}} = \frac{\sqrt{19}}{\sqrt{49}} = \frac{\sqrt{19}}{7}$

$\sqrt{\frac{28}{81}} = \frac{\sqrt{28}}{\sqrt{81}}$ $\frac{2\sqrt{7}}{9}$

$\sqrt{\frac{27m^3}{196}}$

$\sqrt{27} = 3\sqrt{3}$

$\sqrt{m^3} = m\sqrt{m}$

$\frac{3m\sqrt{3m}}{14}$

$\sqrt{\frac{48x^5}{100}}$

$\frac{4x^2\sqrt{3x}}{10}$

$\frac{2x^2\sqrt{3x}}{5}$

$\sqrt{\frac{45x^5}{y^4}}$

$\frac{3x^2\sqrt{5x}}{y^2}$

$\sqrt{\frac{81d^9}{25d^5}}$

$\sqrt{\frac{50x^5y^3}{72x^4y}}$

$\sqrt{\frac{48m^7n^2}{125m^5n^9}}$

$\sqrt{\frac{81d^4}{25}}$

$\frac{9d^2}{5}$

$\sqrt{\frac{25xy^2}{36}}$

$\frac{5y\sqrt{x}}{6}$

$\sqrt{\frac{48m^2}{125n^7}}$

$\frac{\sqrt{48m^2}}{\sqrt{125n^7}}$

$\frac{4m\sqrt{3}}{5n^3\sqrt{5n}}$