

Geometry (E)

Simplifying Radical Expressions

Name: _____

Period: _____

Perfect Squares

- 1 4 9 16 25 36 49 64 81
 100 121 144
 169 196 225

1. No perfect square factors in the radical

Rule: $\sqrt{a \cdot b} = \sqrt{a} \cdot \sqrt{b}$

Example: $\sqrt{20} = \sqrt{4} \cdot \sqrt{5} = 2\sqrt{5}$

$\begin{array}{l} \sqrt{27} \\ \sqrt{9 \cdot 3} \\ \sqrt{9} \cdot \sqrt{3} \\ 3\sqrt{3} \end{array}$	$\begin{array}{l} \sqrt{4 \cdot 12} \quad \sqrt{48} \quad \sqrt{16 \cdot 3} \\ \sqrt{4 \cdot 4 \cdot 3} \\ \sqrt{4} \cdot \sqrt{4} \cdot \sqrt{3} \\ 2 \cdot 2 \cdot \sqrt{3} \\ 4\sqrt{3} \end{array}$	$\sqrt{24}$
$\begin{array}{l} \sqrt{4 \cdot 24} \quad \sqrt{96} \quad \text{or} \quad \sqrt{16 \cdot 6} \\ \sqrt{4 \cdot 4 \cdot 6} \quad \begin{array}{l} 2 \cdot 2 \cdot 6 \\ 4 \cdot 6 \end{array} \\ \sqrt{4} \cdot \sqrt{4} \cdot \sqrt{6} \end{array}$	$\begin{array}{l} \sqrt{98} \\ \sqrt{49 \cdot 2} \\ \sqrt{49} \cdot \sqrt{2} \\ 7 \cdot \sqrt{2} \end{array}$	$\sqrt{80}$
$\begin{array}{l} \sqrt{117} \\ \sqrt{9 \cdot 13} \\ \sqrt{9} \cdot \sqrt{13} \\ 3\sqrt{13} \end{array}$	$\begin{array}{l} \sqrt{343} \\ \sqrt{49 \cdot 7} \\ \sqrt{49} \cdot \sqrt{7} \\ 7\sqrt{7} \end{array}$	$\sqrt{432}$

2. No fractions inside the radical

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

Example: $\sqrt{\frac{21}{16}} = \frac{\sqrt{21}}{4}$

$\sqrt{\frac{3}{4}} \rightarrow \frac{\sqrt{3}}{\sqrt{4}} \rightarrow \frac{\sqrt{3}}{2}$	$\sqrt{\frac{49}{25}} \rightarrow \frac{\sqrt{49}}{\sqrt{25}} \rightarrow \frac{7}{5}$
$\sqrt{\frac{8}{9}} = \frac{\sqrt{8}}{\sqrt{9}} = \frac{\sqrt{4 \cdot 2}}{3} \rightarrow \frac{2\sqrt{2}}{3}$	$\sqrt{\frac{75}{9}} \rightarrow \frac{\sqrt{75}}{\sqrt{9}} \rightarrow \frac{\sqrt{25 \cdot 3}}{3} \rightarrow \frac{5\sqrt{3}}{3}$
$\sqrt{\frac{289}{100}} \rightarrow \frac{\sqrt{289}}{\sqrt{100}} \rightarrow \frac{17}{10}$	$\sqrt{\frac{10}{5}} \rightarrow \sqrt{2}$

3. No radicals in the denominator of a fraction

~~★~~ Rationalize the denominator
 multiply by 1 multiply top and bottom by denominator

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

Example: $\frac{10}{\sqrt{5}} = \frac{10}{\sqrt{5}} \cdot \frac{\sqrt{5}}{\sqrt{5}} = \frac{10\sqrt{5}}{5} = 2\sqrt{5}$

$\frac{3}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} \rightarrow \frac{3\sqrt{3}}{\sqrt{9}} \rightarrow \frac{3\sqrt{3}}{3}$ $\frac{14}{\sqrt{7}} \cdot \frac{\sqrt{7}}{\sqrt{7}} = \frac{14\sqrt{7}}{\sqrt{49}} \rightarrow \frac{14\sqrt{7}}{7} \rightarrow 2\sqrt{7}$	$\frac{5}{\sqrt{15}} \cdot \frac{\sqrt{15}}{\sqrt{15}} \rightarrow \frac{5\sqrt{15}}{\sqrt{225}} \rightarrow \frac{5\sqrt{15}}{15} = \frac{1}{3}\sqrt{15}$
$\frac{10}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} \rightarrow \frac{10\sqrt{2}}{2} \rightarrow 5\sqrt{2}$ $\frac{11}{\sqrt{6}} \cdot \frac{\sqrt{6}}{\sqrt{6}} \rightarrow \frac{11\sqrt{6}}{6}$ $\frac{\sqrt{12}}{\sqrt{6}} \cdot \frac{\sqrt{6}}{\sqrt{6}} \rightarrow \frac{\sqrt{72}}{\sqrt{36}} = \frac{\sqrt{72}}{6}$ $\frac{\sqrt{36}\sqrt{2}}{6} \rightarrow \frac{6\sqrt{2}}{6} = \sqrt{2}$	$\frac{\sqrt{12}}{\sqrt{6}} \cdot \frac{\sqrt{6}}{\sqrt{6}} \rightarrow \frac{\sqrt{72}}{\sqrt{36}} = \frac{\sqrt{72}}{6}$ $\frac{\sqrt{36}\sqrt{2}}{6} \rightarrow \frac{6\sqrt{2}}{6} = \sqrt{2}$

★ why? $\sqrt{2} \cdot \sqrt{2} = \sqrt{4} = 2$

4. Mixed Radicals

$\sqrt{12} \cdot \sqrt{20}$ $\sqrt{4 \cdot 3} \cdot \sqrt{4 \cdot 5}$ $\sqrt{4} \cdot \sqrt{3} \cdot \sqrt{4} \cdot \sqrt{5}$ $2 \cdot \sqrt{3} \cdot 2 \cdot \sqrt{5}$ $4\sqrt{15}$	$\frac{\sqrt{18}}{\sqrt{5}} \cdot \frac{\sqrt{5}}{\sqrt{5}} \rightarrow \frac{\sqrt{90}}{\sqrt{25}} \rightarrow \frac{\sqrt{9 \cdot 10}}{5} = \frac{3\sqrt{10}}{5}$	$\frac{5\sqrt{12}}{2\sqrt{6}} \rightarrow \frac{\sqrt{4 \cdot 3}}{2\sqrt{6}} \rightarrow \frac{2\sqrt{3}}{2\sqrt{6}} = \frac{\sqrt{3}}{\sqrt{6}}$ $\frac{\sqrt{3}}{\sqrt{6}} \cdot \frac{\sqrt{6}}{\sqrt{6}} \rightarrow \frac{\sqrt{18}}{\sqrt{36}} = \frac{\sqrt{9 \cdot 2}}{6} = \frac{3\sqrt{2}}{6} = \frac{\sqrt{2}}{2}$
$\sqrt{12} + \sqrt{27}$ $\sqrt{4 \cdot 3} + \sqrt{9 \cdot 3}$ $2\sqrt{3} + 3\sqrt{3}$ $5\sqrt{3}$	$5\sqrt{18}$ $5 \cdot \sqrt{9 \cdot 2}$ $5 \cdot 3\sqrt{2}$ $15\sqrt{2}$	$\frac{5\sqrt{12}}{10\sqrt{8}} \rightarrow \frac{\sqrt{4 \cdot 3}}{2\sqrt{4 \cdot 2}} \rightarrow \frac{2\sqrt{3}}{2 \cdot 2\sqrt{2}} = \frac{\sqrt{3}}{2\sqrt{2}}$ $\frac{\sqrt{3}}{2\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} \rightarrow \frac{\sqrt{6}}{2 \cdot \sqrt{4}} = \frac{\sqrt{6}}{4}$
$14\sqrt{\frac{100}{7}} = \frac{14 \cdot \sqrt{100}}{\sqrt{7}} \cdot \frac{\sqrt{7}}{\sqrt{7}} \rightarrow \frac{14 \cdot 10 \cdot \sqrt{7}}{7} = \frac{140\sqrt{7}}{7} = 20\sqrt{7}$	$\frac{1}{3}\sqrt{\frac{10}{6}} \rightarrow \frac{1}{3}\sqrt{\frac{5}{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} \rightarrow \frac{1}{3} \cdot \frac{\sqrt{15}}{\sqrt{9}} \rightarrow \frac{\sqrt{15}}{3 \cdot 3} = \frac{\sqrt{15}}{9}$	$\frac{64}{\sqrt{10}} \rightarrow \frac{\sqrt{64}}{\sqrt{10}} \rightarrow \frac{8}{\sqrt{10}} \cdot \frac{\sqrt{10}}{\sqrt{10}} = \frac{8\sqrt{10}}{10} = \frac{4\sqrt{10}}{5}$
$\frac{3\sqrt{2}}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} \rightarrow \frac{3\sqrt{6}}{\sqrt{9}} = \frac{3\sqrt{6}}{3} = \sqrt{6}$	$5\sqrt{6} \cdot 4\sqrt{18}$ $20\sqrt{6 \cdot 18}$ $20\sqrt{6 \cdot 6 \cdot 3}$ $20 \cdot 6 \cdot \sqrt{3}$ $120\sqrt{3}$	$\sqrt{72} + \sqrt{75} - \sqrt{48}$ $\sqrt{36 \cdot 2} + \sqrt{25 \cdot 3} - \sqrt{16 \cdot 3}$ $6\sqrt{2} + 5\sqrt{3} - 4\sqrt{3}$ $6\sqrt{2} + 1\sqrt{3}$