2.1 - Simplifying Radicals

another name for a "root" symbol

Entire Radical: $\sqrt{72}$

Mixed Radical: $3\sqrt{2}$

Properties:

Multiplication

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

Division

$$\frac{\sqrt{a}}{\sqrt{b}} = \sqrt{\frac{a}{b}}, \quad b \neq 0$$

Squaring

$$(\sqrt{a})^2 = a \qquad (a^{\frac{1}{2}})^2 = a$$

A radical is in simplest form if:

* the radical has no perfect square factors other than 1 eg. $\sqrt{3}$, not $\sqrt{9}$
* there are no fractions under a $\sqrt{\ }$ eg. $\sqrt{\frac{2}{3}}$ ← NO!
* there are no $\sqrt{\ }$ in the denominator

eg. $\frac{3}{\sqrt{2}}$ ← NO!

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x	x^2
1	1
2	4
3	9
4	16
5	25

a) $\sqrt{27}$
$= \sqrt{3 \cdot 9}$
$= \sqrt{3}\sqrt{9}$
$= 3\sqrt{3}$

b) $\sqrt{48}$
$= \sqrt{16 \cdot 3}$
$= \sqrt{16} \cdot \sqrt{3}$ ✓
$= 4\sqrt{3}$

$= \sqrt{4}\sqrt{12}$
$= 2\sqrt{12}$
$= 2 \cdot \sqrt{4}\sqrt{3}$
$= 4\sqrt{3}$

c) $\sqrt{500}$
$= \sqrt{100}\sqrt{5}$
$= 10\sqrt{5}$

d) $\sqrt{180}$
$= \sqrt{9} \cdot \sqrt{20}$
$= 3 \cdot \sqrt{20}$
$= 3 \cdot \sqrt{4}\sqrt{5}$
$= 6\sqrt{5}$

✓ $= \sqrt{36} \cdot \sqrt{5}$
$= 6\sqrt{5}$

THINK OF...

e) $3\sqrt{6} \times \sqrt{2}$
$= 3\sqrt{6} \cdot \sqrt{2}$
$= 3\sqrt{12}$
$= 3 \cdot \sqrt{4}\sqrt{3}$
$= 6\sqrt{3}$

f) $\sqrt{5}\sqrt{7}$
$= \sqrt{35}$

g) $(5\sqrt{6})(2\sqrt{8})$
$= 5 \cdot 2 \cdot \sqrt{6} \cdot \sqrt{8}$
$= 10\sqrt{48}$
$= 10\sqrt{16}\sqrt{3}$
$= 40\sqrt{3}$

h) $(2\sqrt{6})(3\sqrt{2})(5\sqrt{6})$
$= 2 \cdot 3 \cdot 5\sqrt{6} \cdot \sqrt{2} \cdot \sqrt{6}$
$= 30\sqrt{6 \cdot 2 \cdot 6}$
$= 30 \cdot 6 \cdot \sqrt{2}$
$= 180\sqrt{2}$

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i) $\dfrac{\sqrt{18}}{\sqrt{3}}$

$= \sqrt{\dfrac{18}{3}}$

$= \sqrt{6}$

j) $\dfrac{\cancel{15}^{5}\sqrt{7}}{\cancel{3}\sqrt{4}}$

$= \dfrac{5\cdot\sqrt{7}}{\sqrt{4}}$

$= \dfrac{5\cdot\sqrt{7}}{2}$

$\dfrac{15a}{3b} = \dfrac{5a}{b}$

k) $\dfrac{5\sqrt{12}}{\sqrt{8}}$

$= \dfrac{5\cdot\cancel{\sqrt{4}}\sqrt{3}}{\cancel{\sqrt{4}}\sqrt{2}}$

$= \dfrac{5\sqrt{3}}{\sqrt{2}} \cdot \dfrac{\sqrt{2}}{\sqrt{2}}$

$= \dfrac{5\sqrt{3\cdot 2}}{2}$

$= \dfrac{5\sqrt{6}}{2}$

l) $\dfrac{\cancel{12}^{3}\sqrt{27}}{\cancel{4}\sqrt{45}}$

$= \dfrac{3\cancel{\sqrt{9}}\sqrt{3}}{\cancel{\sqrt{9}}\sqrt{5}}$

$= \dfrac{3\sqrt{3}}{\sqrt{5}} \cdot \dfrac{\sqrt{5}}{\sqrt{5}}$

$= \dfrac{3\sqrt{15}}{5}$

Rationalizing the Denominator
(from example k and l)

Multiply both the numerator and the denominator by the denominator so that there are no radicals in the denominator!

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m) $\dfrac{12+3\sqrt{12}}{4}$

$= \dfrac{12+3\sqrt{4}\sqrt{3}}{4}$

$= \dfrac{12+6\sqrt{3}}{4}$

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

$= \dfrac{3(2+\sqrt{3})}{2}$

$= \dfrac{6+3\sqrt{3}}{2}$

n) $\dfrac{15-\sqrt{27}}{3}$

$= \dfrac{15-3\sqrt{3}}{3}$

$= \dfrac{\cancel{3}(5-\sqrt{3})}{\cancel{3}}$

$= 5-\sqrt{3}$

$= 5-\sqrt{3}$

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Practice - p. 106 # 1adgjm, 2 & 3 eoo, 4, 10, 13, 18ab, 19ac

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