Recall: The simplest quadratic relation is $y = x^2$

$x^2 = 5$

On rearranging, it is possible to get answers in the form $x = \pm\sqrt{y}$

$x = \pm\sqrt{5}$

With actual values, we might see results such as

$$\sqrt{5} \qquad 3\sqrt{2} \qquad \frac{\sqrt{3}}{2}$$

It is often required to keep answers in this <u>exact form</u>.

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<u>Working With Radicals</u>

Oct 9/2019

index understood to be 2

index of 3

$$\sqrt[2]{5} \qquad \text{radical sign} \qquad \sqrt[3]{5}$$

radicand

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A) Multiplying & Dividing Radicals

In general, $\sqrt{a} \times \sqrt{b} = \sqrt{ab}$

and $\dfrac{\sqrt{a}}{\sqrt{b}} = \sqrt{\dfrac{a}{b}}$ *where* $b \neq 0$

$\sqrt{144(625)}$

Ex.1 Simplify.

(a) $\sqrt{(4)(9)}$

$= \sqrt{4}\sqrt{9}$

$= 2(3)$

$= 6$

(b) $\sqrt{\dfrac{16}{9}} = \dfrac{\sqrt{16}}{\sqrt{9}}$

$= \dfrac{4}{3}$

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B) Simplifying Radicals

A radical is in its <u>simplest form</u> when:

- the radicand has no perfect square factors (other than 1) $\qquad \sqrt{8} = 2\sqrt{2}$

- the radicand contains no fractions $\qquad \sqrt{\dfrac{1}{4}} = \dfrac{1}{2}$

- no radical appears in the denominator $\qquad \dfrac{2}{\sqrt{3}} = \dfrac{2\sqrt{3}}{3}$

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Ex.2 Simplify

(a) $\sqrt{32} = \sqrt{16 \cdot 2}$

$= \sqrt{16}\sqrt{2}$

$= 4\sqrt{2}$

(b) $2\sqrt{75} = 2\sqrt{(25)(3)}$

$= 2\sqrt{25}\sqrt{3}$

$= 2(5)\sqrt{3}$

$= 10\sqrt{3}$

(c) $-3\sqrt{8}$

$= -3\sqrt{\underbrace{(2)(2)}(2)}$

$= -3(2)\sqrt{2}$

$= -6\sqrt{2}$

(d) $\frac{1}{2}\sqrt{\frac{72}{25}} = \frac{1}{2}\frac{\sqrt{72}}{\sqrt{25}}$

$= \frac{1}{2} \cdot \frac{\sqrt{36}\sqrt{2}}{5}$

$= \frac{1}{\cancel{2}_{1}} \cdot \frac{\cancel{6}^{3}\sqrt{2}}{5}$

$= \frac{3\sqrt{2}}{5}$

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C) Adding & Subtracting Radicals

- they must have the same <u>radicand</u>.
- simplify radicals to ensure like terms (same radicand) are revealed.

Ex.3 Simplify

(a) $4\sqrt{3} - 2\sqrt{5} + 6\sqrt{3} + 5\sqrt{5}$

$= 10\sqrt{3} + 3\sqrt{5}$

$4x - 2y + 6x + 5y$

$= 10x + 3y$

(b) $2\sqrt{12} - 5\sqrt{27} + 3\sqrt{48}$

$= 2\sqrt{4}\sqrt{3} - 5\sqrt{9}\sqrt{3} + 3\sqrt{16}\sqrt{3}$

$= 2(2)\sqrt{3} - 5(3)\sqrt{3} + 3(4)\sqrt{3}$

$= 4\sqrt{3} - 15\sqrt{3} + 12\sqrt{3}$

$= \sqrt{3}$

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D) Binomial Multiplication of Radicals

Recall: $(a+b)(c+d) = ac + ad + bc + bd$

FOIL

	a	$+b$
c	ac	bc
$+d$	ad	bd

Ex.4 Expand & Simplify

$$(3\sqrt{5}+2)(2\sqrt{5}-3)$$

$$=\underbrace{(3\sqrt{5})(2\sqrt{5})}_{F}+\underbrace{(3\sqrt{5})(-3)}_{O}+\underbrace{(2)(2\sqrt{5})}_{I}+\underbrace{2(-3)}_{L}$$

$$=6\sqrt{25}-9\sqrt{5}+4\sqrt{5}-6$$

$$=30-5\sqrt{5}-6$$

$$=24-5\sqrt{5}$$

$$(3x+2)(2x-3)$$

$$=6x^2+4x-9x-6$$

$$=6x^2-5x-6$$

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E) Rationalizing the Denominator

A radical is not permitted in the denominator. If the denominator is a binomial, multiply by the conjugate of the denominator.

Given $a\sqrt{b}+c\sqrt{d}$, the conjugate would be $a\sqrt{b}-c\sqrt{d}$

Given $a\sqrt{b}-c\sqrt{d}$, the conjugate would be $a\sqrt{b}+c\sqrt{d}$

Ex.5 ~~Find~~ State the conjugate of each radical

(a) $\sqrt{5}-\sqrt{2}$

conj: $\sqrt{5}+\sqrt{2}$

(b) $3\sqrt{5}+2\sqrt{10}$

conj: $3\sqrt{5}-2\sqrt{10}$

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Ex.6 Rationalize the denominator

$$\frac{(4\sqrt{3}-2\sqrt{2})}{(\sqrt{3}-\sqrt{2})} \times \frac{(\sqrt{3}+\sqrt{2})}{(\sqrt{3}+\sqrt{2})}$$

$$= \frac{(4\sqrt{3})(\sqrt{3}) + (4\sqrt{3})(\sqrt{2}) + (-2\sqrt{2})(\sqrt{3}) + (-2\sqrt{2})(\sqrt{2})}{(\sqrt{3})(\sqrt{3}) + (\sqrt{3})(\sqrt{2}) + (-\sqrt{2})(\sqrt{3}) + (-\sqrt{2})(\sqrt{2})}$$

$$= \frac{4\sqrt{9} + 4\sqrt{6} - 2\sqrt{6} - 2\sqrt{4}}{\sqrt{9} + \sqrt{6} - \sqrt{6} - \sqrt{4}}$$

$$= \frac{12 + 2\sqrt{6} - 4}{3 - 2}$$

$$= \frac{8 + 2\sqrt{6}}{1}$$

$$= 8 + 2\sqrt{6}$$

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Assigned Work:

p.167 # 1-7(odd), do even letters for extra practice
9, 10, 12, 15*, 16*

2b, 6e, 9, 12

2(b) $\sqrt{11}\sqrt{6} = \sqrt{66}$

6(e) $-5\sqrt{45} + \sqrt{52} + 3\sqrt{125}$

$= -5\sqrt{9}\sqrt{5} + \sqrt{4}\sqrt{13} + 3\sqrt{25}\sqrt{5}$

$= -15\sqrt{5} + 2\sqrt{13} + 15\sqrt{5}$

$= 2\sqrt{13}$

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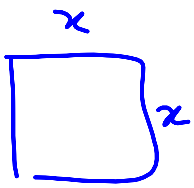
9.



$x^2 = 450$

$x = \sqrt{450}$, $x > 0$ length

$= \sqrt{25}\sqrt{18}$

$= 5\sqrt{18}$

$= 5\sqrt{9}\sqrt{2}$

$= 15\sqrt{2}$

$x = \sqrt{450}$

$= \sqrt{225}\sqrt{2}$

$= 15\sqrt{2}$

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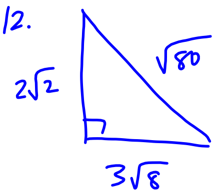
12.



$P = 2\sqrt{2} + 3\sqrt{8} + \sqrt{80}$

$= 2\sqrt{2} + 3\sqrt{4}\sqrt{2} + \sqrt{16}\sqrt{5}$

$= 2\sqrt{2} + 6\sqrt{2} + 4\sqrt{5}$

$= 8\sqrt{2} + 4\sqrt{5}$

$A = \frac{bh}{2}$

$= \frac{(3\sqrt{8})(\cancel{2}\sqrt{2})}{\cancel{2}}$

$= 3\sqrt{16}$

$= 12$

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