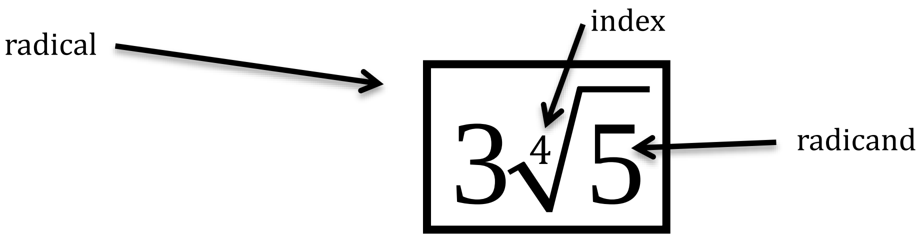
Math 2201 Date:____________________

4.2 Adding and Subtracting Radicals

Recall from Section 4.1A, radicals:



Radicals with the same index and radicand are called **Like Radicals.**

Like Radicals	**Unlike Radicals**
$5\sqrt{7}$ and $-2\sqrt{7}$	$2\sqrt{5}$ and $5\sqrt{3}$
$5\sqrt[3]{4}$ and $\sqrt[3]{4}$	$\sqrt[4]{5}$ and $\sqrt[5]{5}$

When adding and subtracting radicals, only like radicals can be combined. A good way to think about it, is to treat radicals like variables. For example:

$$4x + 3x = 7x$$

$$4\sqrt{5} + 3\sqrt{5} = 7\sqrt{5}$$

Unlike radicals cannot be added or subtracted. Think:

Simplest form

$$4x + 3y = 4x + 3y$$

$$4\sqrt{5} + 3\sqrt{6} = 4\sqrt{5} + 3\sqrt{6}$$

Example 1:
Simplify where possible:

(A) $5\sqrt{2} + 3\sqrt{2} = 8\sqrt{2}$

or

$= (5+3)\sqrt{2}$
$= 8\sqrt{2}$

(B) $6\sqrt{5} - 4\sqrt{5} = 2\sqrt{5}$

or

$= (6-4)\sqrt{5}$
$= 2\sqrt{5}$

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

already in simplest form.

(D) $-4\sqrt{2x} - 2\sqrt{2x} = -6\sqrt{2x}$

(E) $3\sqrt{2} + \sqrt[3]{2}$

already in simplest forms.

(F) $4\sqrt{x} + 2\sqrt{x} - 7\sqrt{x} = -\sqrt{x}$

(E) $2\sqrt{2xy} + 4\sqrt{2xy} - 7\sqrt{2xy} = -\sqrt{2xy}$

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

$= 3\sqrt{2} - 6\sqrt{2} + 4\sqrt{5} + 5\sqrt{5}$
$= -3\sqrt{2} + 9\sqrt{5}$

(G) $-5\sqrt{2} + 3\sqrt{7y} + 8\sqrt{2} + 3\sqrt{5} - 2\sqrt{7y}$

$= 3\sqrt{2} + \sqrt{7y} + 3\sqrt{5}$

(~~G~~H) $6\sqrt{2} - 3\sqrt[3]{2} + 11\sqrt{2} + 4\sqrt[3]{2}$

$= 17\sqrt{2} + \sqrt[3]{2}$

Sometimes like radicals can be hidden. By simplifying each radical to lowest terms, mixed radicals, we can then see which are like and which are unlike.

Example 2:

Simplify each radical expressions:

(A) $2\sqrt{27} - 4\sqrt{3} - \sqrt{12}$

$= 6\sqrt{3} - 4\sqrt{3} - 2\sqrt{3}$

$= 0\sqrt{3}$

$= 0$

① $2\sqrt{27}$
$2\sqrt{9}\sqrt{3}$
$2 \cdot 3\sqrt{3}$
$6\sqrt{3}$

② $4\sqrt{3}$

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

(B) $2\sqrt{24} - 4\sqrt{96} + \sqrt{432}$

$= 4\sqrt{6} - 16\sqrt{6} + 12\sqrt{3}$

$= -12\sqrt{6} + 12\sqrt{3}$

① $2\sqrt{24}$
$2\sqrt{4}\sqrt{6}$
$2 \cdot 2\sqrt{6}$
$4\sqrt{6}$

② $-4\sqrt{96}$
$-4\sqrt{16}\sqrt{6}$
$-4 \cdot 4\sqrt{6}$
$-16\sqrt{6}$

③ $\sqrt{432}$
$= \sqrt{144}\sqrt{3}$
$= 12\sqrt{3}$

(C) $2\sqrt{18} + 9\sqrt{7} - \sqrt{63}$

$= 6\sqrt{2} + 9\sqrt{7} - 3\sqrt{7}$

$= 6\sqrt{2} + 6\sqrt{7}$

① $2\sqrt{18}$
$2\sqrt{9}\sqrt{2}$
$2 \cdot 3\sqrt{2}$
$6\sqrt{2}$

② $9\sqrt{7}$

③ $-\sqrt{63}$
$= -\sqrt{9}\sqrt{7}$
$= -3\sqrt{7}$

Example 3:

The voltage V required for a circuit is given by $V = \sqrt{PR}$ where P is the power in watts and R is the resistance in ohms. How many more volts are needed to light a 100-W bulb than a 75-W bulb if the resistance for both is 100 ohms? Express your answer in exact value.

1. $V=\sqrt{PR}$

$V=\sqrt{100(100)}$

$V=\cancel{\sqrt{}}100^{\cancel{2}}$

$V=100$ volts

2. $V=\sqrt{PR}$

$V=\sqrt{75(100)}$

$V=\cancel{\sqrt{}}2^{\cancel{2}}\cdot5^{\cancel{2}}\cdot5^{\cancel{2}}\cdot3$

$V=2\cdot5\cdot5\sqrt{3}$

$V=50\sqrt{3}$ volts

7500

75 100

$3\cdot25$ $10\cdot10$

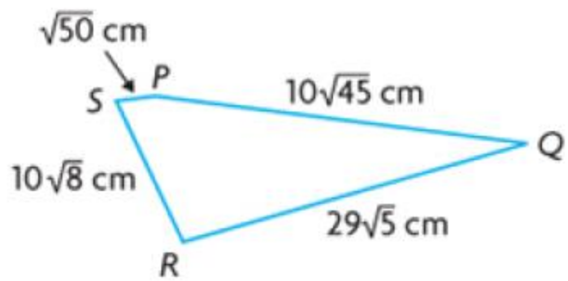
3 5 5 $2\cdot5$ $2\cdot5$

$(2\cdot2)\cdot3(5\cdot5)(5\cdot5)$

$100-50\sqrt{3}$ more volts are needed.

Example 4:

Determine the difference in length between each pair of sides.



(A) *PS* and *SR*

$10\sqrt{8}-\sqrt{50}$

$=10\sqrt{4}\sqrt{2}-\sqrt{25}\sqrt{2}$

$=10\cdot2\sqrt{2}-5\sqrt{2}$

$=20\sqrt{2}-5\sqrt{2}$

$=15\sqrt{2}$

(B) *RQ* and *PQ*

$10\sqrt{45}-29\sqrt{5}$

$=10\sqrt{9}\sqrt{5}-29\sqrt{5}$

$=10\cdot3\sqrt{5}-29\sqrt{5}$

$=30\sqrt{5}-29\sqrt{5}$

$=\sqrt{5}$

Example 5:
Identify and correct the error in the following solution:

$$25\sqrt{5} + 13\sqrt{5}$$

$$= 38\sqrt{10}$$ ← mistake

$$= 38\sqrt{5}$$

Textbook Questions: page 188 - 190 #1, 2, 4, 5, 6, 7, 9, 11, 12, 14, 15, 16, 18, 19