MCR3U **Operations with Radicals** Date: _____ Class # ____

Authored by: J. Hickey, Our Lady of the Lake Catholic College School

Q: What is a radical?

A: A radical is a value with a square root, cube root or nth root.

$\sqrt{\ }$ **is called the radical sign.**

Examples of radicals: $\sqrt{4}$, $\sqrt[3]{8}$, $\sqrt[4]{10}$

Q: What is a radicand?

A: the radicand is the number under the radical sign.

Ex: In $\sqrt{180}$, 180 is the radicand (or the number we are taking the square root value of).

Q: What is a mixed radical?

A: A mixed radical is any radical that has a coefficient other than 1.

Ex: $3\sqrt{5}$ is a mixed radical with 3 as a coefficient.

Ex: $-7\sqrt{28}$ is a mixed radical with -7 as a coefficient.

Q: What are "like radicals"?

A: Like radicals are terms or expressions which have the same radicands.

Ex: $5\sqrt{6}$ and $-3\sqrt{6}$ are like radicals.

KEY IDEAS:

- $\sqrt{a} * \sqrt{b} = \sqrt{ab}$ where a ≥0, b≥0.
- $c\sqrt{a} * d\sqrt{b} = cd\sqrt{ab}$ where a≥0, b≥0.
- Only like radicals can be added or subtracted.
- A mixed radical is in simplified form when the radicand has the smallest number possible.

Simplifying radicals:

- Factor the radicand. Check to see if one or both of the factors are perfect square numbers,

Ex: $\sqrt{8} = \sqrt{(4)(2)}$ Notice that the 4 is a perfect square number.

$= \sqrt{4} * \sqrt{2}$ (Other perfect square numbers are 9, 16, 25, 36…)

$= 2\sqrt{2}$

Ex:2 $\sqrt{27} = \sqrt{9 * 3}$

$= \sqrt{9} * \sqrt{3}$

$= 3\sqrt{3}$

Ex: 3 $\sqrt{175} = \sqrt{25 * 7}$

$= 5\sqrt{7}$

Multiplying radicals:

- Multiply the coefficients, then multiply the radicands of each radical.

Ex: $\sqrt{5} * \sqrt{6} = \sqrt{30}$

Ex: $2\sqrt{3} * 5\sqrt{7} = 10\sqrt{21}$

Ex: $-11\sqrt{2} * 3\sqrt{7} = -33\sqrt{14}$

Ex: $-8\sqrt{10} * -3\sqrt{8} = 24\sqrt{80}$

Can you simplify further? Look at radicand.

Adding/subtracting radicals:

- Only like radicals can be added or subtracted.
- The radicand stays the same while the coefficients are added or subtracted.

Ex: $7\sqrt{5} + 3\sqrt{5} = 10\sqrt{5}$

Ex: $12\sqrt{3} - 5\sqrt{3} = 7\sqrt{3}$

Ex: $8\sqrt{5} - 4\sqrt{6} = cannot\ be\ added$

Ex: $2\sqrt{15} - 9\sqrt{15} = -7\sqrt{15}$

MCR3U Radicals Practice:

Name: _____

Part 1: Simplify the following radicals.

$\sqrt{63}$	$\sqrt{40}$	$\sqrt{300}$	$\sqrt{112}$
$\sqrt{98}$	$\sqrt{180}$	$\sqrt{147}$	$\sqrt{108}$
$\sqrt{192}$	$\sqrt{270}$	$\sqrt{76}$	$\sqrt{375}$

Part 2: Multiply the following radicals, then simplify if possible.

$(\sqrt{12})(7\sqrt{8})$	$(7\sqrt{3})(8\sqrt{3})$	$(-2\sqrt{18})(5\sqrt{2})$
$(-11\sqrt{14})(\sqrt{20})$	$(-6\sqrt{3})(8\sqrt{5})(3\sqrt{10})$	$(-12\sqrt{3})(5\sqrt{2})(-2\sqrt{27})$

Part 3: Simplify by adding and/or subtracting. Check for any places you could make simplifications!

$-5\sqrt{3} + 14\sqrt{12}$	$71\sqrt{7} - 17\sqrt{28}$
$17\sqrt{6} + 7\sqrt{24}$	$8\sqrt{27} - 10\sqrt{27}$
$16\sqrt{200} - 17\sqrt{450} + 1\sqrt{50}$	$11\sqrt{63} - 4\sqrt{63} - 13\sqrt{20}$