Math 2 Unit 3.1 Simplifying, Multiplying, and Dividing Radicals Name: * Honors *

Basic Radical Property → If have $a^n = b$, then "a is the nth root of b" or $a = \sqrt[n]{b}$
where *b is the called the radicand*, *n is the index number (degree of root)*, and $\sqrt{\ }$ *is the radical symbol.*

Ex:
- If $6^2 = 36$, then 6 is the Square Root of 36 (in words) or $6 = \sqrt[2]{36}$ (radical form)
- If $(a^2)^3 = a^6$, then a^2 is the Cube Root of a^6 (in words) or $a^2 = \sqrt[3]{a^6}$ (radical form)
- If $(b^3)^4 = b^{12}$, then b^3 is the 4^{th} Root of b^{12} (in words) or $b^3 = \sqrt[4]{b^{12}}$ (radical form)

- To simplify radical expressions, do the following
  1.) Split the radicand apart (using a factor tree or the common powers chart) into factors.
  2.) Goal of splitting the radicand apart is to get factor's power to match the index number.
  3.) Pull out of radical → factors that match the index (exponent will be a understood 1 when pulled out)
  Remain in radical → factors that do NOT match the index (exponent will be lower than the index)

Example 1: Simplify each radical expression. * SEE SEPARATE NOTEBOOK PAPER FOR WORK! *

a.) $\sqrt{16x^2}$	b.) $\sqrt[3]{27x^6}$	c.) $\sqrt[4]{256y^{12}}$	d.) $\sqrt{75a^3}$	e.) $\sqrt[3]{320a^2b^7}$	f.) $\sqrt[4]{48a^8b^{10}}$
$4\|x\|$	$3x^2$	$4\|y^3\|$	$5\|a\|\sqrt{3a}$	$4b^2\sqrt[3]{5a^2b}$	$2a^2b^2\sqrt[4]{3b^2}$

g.) $3\sqrt{72m^5n^6}$	h.) $-4\sqrt[3]{96m^4n^8}$	i.) $5\sqrt[4]{405m^6n^{11}}$
$18m^2\|n^3\|\sqrt{2m}$	$-8mn^2\sqrt[3]{12mn^2}$	$15\|m\|n^2\sqrt[4]{5m^2n^3}$

Multiplying Radicals → If have $\sqrt[n]{a} \cdot \sqrt[n]{b}$, then $\sqrt[n]{ab}$ (Note: index numbers must equal!)

Example 2: Multiply and then simplify the product.

a.) $\sqrt{18x^2} \cdot \sqrt{2x^4}$	b.) $\sqrt[3]{4a^4} \cdot 2\sqrt[4]{4a^5}$	c.) $4\sqrt{12x^3y} \cdot \sqrt{5xy^4}$	d.) $2\sqrt[3]{9a^2b^4} \cdot -5a\sqrt[3]{6a^4b}$
$\sqrt{36x^6}$ $\quad x^6 \to \frac{6}{2} = 3$ $6\|x^3\|$	Not Possible b/c index is not the same.	$4\sqrt{60x^4y^5}$ $\quad x^4 \to \frac{4}{2} = 2$ $\quad y^5 \to \frac{5}{2} = 2 r 1$ 2 30 2 15 3 5 $4 \cdot 2x^2y^2\sqrt{3 \cdot 5y}$ $8x^2y^2\sqrt{15y}$	$-10a\sqrt[3]{54a^6b^5}$ 2 27 3 9 3 3 $a^6 \to \frac{6}{3} = 2$ $\quad b^5 \to \frac{5}{3} = 1 r$ $-10a \cdot 3a^2 \cdot b \cdot \sqrt[3]{2b^2}$ $-30a^3b\sqrt[3]{2b^2}$

* Honors *

$\sqrt[5]{x^5 y^6 z^{12}}$

Groupings by index

(xxxxx) (yyyyy) y (zzzzz)(zzzzz) zz

x y z z

$xyz^2 \sqrt[5]{yz^2}$

Matching index x^5 $y^5 \cdot y$ $z^5 \, z^5 \cdot z^2$

x y z z

$xyz^2 \sqrt[5]{yz^2}$

$x^5 \to \frac{5}{5} = 1$ $y^6 \to \frac{6}{5}$ 1 r 1 $z^{12} \to \frac{12}{5}$ 2 r 2

$xyz^2 \sqrt[5]{yz^2}$

$\sqrt[4]{x^2 y^5 z}$ $x^2 \to \cancel{\frac{2}{4}}$ $y^5 \to \frac{5}{4}$ 1 r 1 $z^1 \to \cancel{\frac{1}{4}}$

$|y| \sqrt[4]{x^2 y z}$

When taking the <u>even</u> root of a variable and you get an odd power out, must use | | absolute value!

$\sqrt{x^2} \to |x|$ $\sqrt[4]{a^5 b^4 c^8} \to |ab| c^2 \sqrt[4]{a}$

<u>Ex. 1</u>

Index is 2

power / index

a) $\sqrt{16x^2}$ $x^2 \to \frac{2}{2} = 1$

2 · 8, 2 · 4, 2 · 2 → 2, 2

$2 \cdot 2\, x \to \boxed{4|x|}$

b) $\sqrt[3]{27x^6}$ $x^3 \, x^3$ → x x $x^6 \to \frac{6}{3} = 2$

3 · 9, 3 · 3 → 3

$3 \cdot x \cdot x \to \boxed{3x^2}$

c) $\sqrt[4]{256y^{12}}$

2 128, 2 64, 2 32, 2 16, 2 8, 2 4, 2 2

2, 2

$y^{12} \to \frac{12}{4} = 3$

$2 \cdot 2\ y \cdot y \cdot y \to 4|y^3|$

d) $\sqrt{75a^3}$

$\boxed{3}$ 25, 5 5

5

$a^3 \to \frac{3}{2} = 1\ r\ 1$

$5 \cdot a\sqrt{3a}$

$5|a|\sqrt{3a}$

e) $\sqrt[3]{320a^2b^7}$

2 160, 2 80, 2 40, 2 20, 2 10, 2 $\boxed{5}$

2, 2

$a^2 \to$ Power is less than index, nothing comes out!

$b^7 \to \frac{7}{3} = 2\ r\ 1$

$2 \cdot 2 \cdot b \cdot b\sqrt[3]{5a^2b}$

$4b^2\sqrt[3]{5a^2b}$

f) $\sqrt[4]{48a^8b^{10}}$

2 24, 2 12, 2 6, 2 $\boxed{3}$

2

$a^8 \to \frac{8}{4} = 2$

$b^{10} \to \frac{10}{4} = 2\ r\ 2$

$2 \cdot a \cdot a \cdot b \cdot b\sqrt[4]{3b^2}$

$2a^2b^2\sqrt[4]{3b^2}$

g) $3\sqrt{72m^5n^6}$

2 36, 2 18, $\boxed{2}$ 9, 3 3

2, 3

$m^5 \to \frac{5}{2} = 2\ r\ 1$

$m^6 \to \frac{6}{2} = 3$

$3 \cdot 2 \cdot 3\ m^2 n^3\sqrt{2m}$

$18m^2|n^3|\sqrt{2m}$

h) $-4\sqrt[3]{96m^4n^8}$

2 48, 2 24, 2 12, $\boxed{2}$ 6, $\boxed{2}$ $\boxed{3}$

$m^4 \to \frac{4}{3} = 1\ r\ 1$

$n^8 \to \frac{8}{3} = 2\ r\ 2$

$-4 \cdot 2 \cdot m \cdot n^2\sqrt[3]{2 \cdot 2 \cdot 3mn^2}$

$-8mn^2\sqrt[3]{12mn^2}$

* Honors *

i) $5\sqrt[4]{405m^6n^{11}}$

3, 135

3, 45

3^4 3, 15

3, 5

$5\cdot 3mn^2\sqrt[4]{5m^2n^3}$

$15|m|n^2\sqrt[4]{5m^2n^3}$