Intro to College Math: Chapter 11.1
Simplifying Radical Expressions

* Rational Exponent Property: the quantity of $x^{1/n}$ is the nth root of x.

ex.) $x^{1/n} = \sqrt[n]{x}$

*Properties of Exponents:

* $a^r \cdot a^s = a^{r+s}$
* $(a^r)^s = a^{r \cdot s}$
* $(ab)^r = a^r b^r$
* $a^{-r} = \frac{1}{a^r}$
* $\left(\frac{a}{b}\right)^r = \frac{a^r}{b^r}$
* $\frac{a^r}{a^s} = a^{r-s}$
* $a^{1/r} = \sqrt[r]{a}$

1. Simplify using absolute values if necessary. $\sqrt{64x^4}$

$\sqrt{64x^4}$

$\sqrt{64} \cdot \sqrt[2]{x^4}$

$8 \cdot x^{\frac{4}{2}}$

$8 \cdot x^{4 \div 2}$ ← Divide

$8x^2$

* First, rewrite the problem separating the number from the variable.
* Then take the square root of the number.
* For the variable, make a fraction for the exponent.
  - The exponent that was under $\sqrt{\ }$ goes on top.
  - Little exponent outside $\sqrt{\ }$ goes on bottom. (If no number outside, use "2")

2. Simplify. $-\sqrt{49x^8}$

$-\sqrt{49x^8}$

$-\sqrt{49} \cdot \sqrt[2]{x^8}$

$-7 \cdot x^{\frac{8}{2}}$

$-7 \cdot x^{8 \div 2}$ ← Divide

$-7x^4$

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3. Assume all variables are positive, and find the following root. $\sqrt[3]{343x^3}$

$\sqrt[3]{343x^3}$

$\sqrt[3]{343} \cdot \sqrt[3]{x^3}$

$7 \cdot x^{\frac{3}{3}}$

$7 \cdot x^{3 \div 3}$

$7x$

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* For the variable, make a fraction for the exponent.
  - The exponent that was under $\sqrt{}$ goes on top.
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To type into calculator:
* type the little number outside the $\sqrt{}$ first.
* then press the "2nd" button
* then press the "^" button
* then typed in the number under the $\sqrt{}$
* then press enter.

4. Assume all variables are positive, and find the following root. $\sqrt[5]{32x^{15}y^{15}}$

$\sqrt[5]{32x^{15}y^{15}}$

$\sqrt[5]{32} \cdot \sqrt[5]{x^{15}} \cdot \sqrt[5]{y^{15}}$

$2 \cdot x^{\frac{15}{5}} \cdot y^{\frac{15}{5}}$

$2 \cdot x^{15\div 5} \cdot y^{15\div 5}$ ← Divide

$2x^3y^3$

* First, rewrite the problem seperating the number from the variable.
* Then take the square root of the number.
* For the variable, make a fraction for the exponent.
  - The exponent that was under $\sqrt{\ }$ goes on top.
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5. Assume all variables are positive, and find the following root. $\sqrt[4]{16x^8y^4}$

$\sqrt[4]{16x^8y^4}$

$\sqrt[4]{16} \cdot \sqrt[4]{x^8} \cdot \sqrt[4]{y^4}$

$2 \cdot x^{\frac{8}{4}} \cdot y^{\frac{4}{4}}$

$2 \cdot x^{8\div 4} \cdot y^{4\div 4}$ ← Divide

$2x^2y$

* First, rewrite the problem seperating the number from the variable.
* Then take the square root of the number.
* For the variable, make a fraction for the exponent.
  - The exponent that was under $\sqrt{\ }$ goes on top.
  - Little exponent outside $\sqrt{\ }$ goes on bottom. (If no number outside, use "2")

6. Assume all variables are positive, and find the following root. $\sqrt[3]{-8x^{15}y^{12}}$

$\sqrt[3]{-8x^{15}y^{12}}$

$\sqrt[3]{-8} \cdot \sqrt[3]{x^{15}} \cdot \sqrt[3]{y^{12}}$

$-2 \cdot x^{15/3} \cdot y^{12/3}$

$-2 \cdot x^{15\div 3} \cdot y^{12\div 3}$

$-2x^5y^4$

* First, rewrite the problem separating the number from the variable.
* Then take the square root of the number.
* For the variable, make a fraction for the exponent.
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7. Simplify. Assume variables are positive. $\sqrt{16u^7g^8}$

$\sqrt{16u^7g^8}$

$\sqrt{16} \cdot \sqrt{u^7} \cdot \sqrt{g^8}$

$4 \cdot u^{7/2} \cdot g^{8/2}$

$4 \cdot u^{7\div 2} \cdot g^{8\div 2}$

$4 \cdot u^{3.5} \cdot g^4$

cannot have as decimal in exponent. so....

Rethink $u^{7/2}$

$u \cdot u \mid u \cdot u \mid u \cdot u \mid u$

$u^3\sqrt{u}$

$4g^4u^3\sqrt{u}$

* First, rewrite the problem separating the number from the variable.
* Then take the square root of the number.
* For the variable, make a fraction for the exponent.
  - The exponent that was under $\sqrt{}$ goes on top.
  - Little exponent outside $\sqrt{}$ goes on bottom. (If no number outside, use "2")

← Rethink:

$u^{7/2}$

- Write down the variable the number of times the top # says.
- Then the bottom # tells you how many to put in a group + circle.
- Count the circled groups, + that number becomes exponent.
- Any left overs go back under the $\sqrt{}$.

8. Simplify. Assume all variables are nonnegative. $\sqrt{16a^{11}b^{15}}$

$\sqrt{16a^{11}b^{15}}$

$\sqrt{16} \cdot \sqrt[2]{a^{11}} \cdot \sqrt[2]{b^{15}}$

$4 \cdot a^{11/2} \cdot b^{15/2}$

$4 \cdot a^{11\div 2} \cdot b^{15\div 2}$

$4 \cdot a^{5.5} \cdot b^{7.5}$

cannot have as decimal in exponent. so.... Rethink

* First, rewrite the problem separating the number from the variable.
* Then take the square root of the number.
* For the variable, make as fraction for the exponents.
  - The exponent that was under $\sqrt{\ }$ goes on top.
  - Little exponent outside $\sqrt{\ }$ goes on bottom. (If no number outside, use "2")

$a^{\frac{11}{2}} =$

$a \cdot a \cdot a \cdot a \cdot a \cdot a \cdot a \cdot a \cdot a \cdot a \cdot a$

1 2 3 4 5

$a^5\sqrt{a}$

Rethink:

$a^{5\frac{1}{2}}$

- Write down the variable the number of times the top # says.
- Then the bottom # tells you how many to put in a group + circle.
- Count the circled groups, + that number becomes exponent.
- Any left overs go back under the $\sqrt{\ }$.

$b^{\frac{15}{2}} =$

$b \cdot b \cdot b \cdot b \cdot b \cdot b \cdot b \cdot b \cdot b \cdot b \cdot b \cdot b \cdot b \cdot b \cdot b$

1 2 3 4 5 6 7

$b^7\sqrt{b}$

$4 \cdot a^5\sqrt{a} \cdot b^7\sqrt{b}$

$4a^5b^7\sqrt{ab}$