Exponents & Radicals

Math 10-C
Chapter 4

Name:_________________
Class:_________________
**Big Ideas:**
When you have completed this chapter you will be able to ...

- Solve problems that involve square roots and cube roots
- Solve problems involving powers with integral and rational exponents.
- Represent, identify and simplify irrational numbers

## 4.1 Square Roots and Cube Roots

**Perfect Square:**

The number 81 is a perfect square. It is formed by __________ two factors of ____ together.

EX.

The square root of 81 is _____ or _______ = __________

= __________

= ___________
Perfect Cube:

Cube Root:

The number 27 is a perfect cube. It is formed by multiplying __________ factors of _______ together.

EX.

The cube root of 27 is ______ or ________ = ______________

= ______________

= ______________

Some numbers can be a perfect square and a perfect cube!

EX.
3 Methods to Determine the Square or Cube Roots

1.

2.

3.

Prime Factorization:
When finding the square root or cube root you can use the process of prime factorization.

Creating a _______________ _______________ helps to organize the prime factors.

Ex. 125

Diagrams:

V = 125 m³
**Calculator:**
Everyone’s calculator is a little different. Calculate the cube root of the following and in the box below indicate the calculator key strokes.

216

Assignment pg. 158-159 #1-10, 16 (Challenge)
### 4.2 Integral Exponents

Exponent Laws help simplify expressions with integral exponents.

<table>
<thead>
<tr>
<th>Exponent Laws</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note that $a$ and $b$ are rational or variable bases and $m$ and $n$ are integral exponents.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Product of Powers</th>
</tr>
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<table>
<thead>
<tr>
<th>Quotient of Powers</th>
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<table>
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<table>
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<tr>
<th>Zero Exponent</th>
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</table>

A Power with a negative exponent can be written as a power with a positive exponent

Ex.
Multiply or Divide Powers with the same base.

1. \((7^{-2})(7^7)\)

2. \((0.3^{-2})(0.3^{-5})\)

3. \(\frac{w^5}{w^{-3}}\)

4. \(\frac{(3t)^4}{(3t)^{-3}}\)
Powers of Powers

HINT:

\[(5^{-2})^4\]

HINT:

\[\left[ (2^{-2})(2^0) \right]^{-2}\]

HINT:

\[\left( \frac{3^3}{3^5} \right)^{-2}\]
HINT:

\[
\left( \frac{2}{5} \right)^{-3} \left( \frac{2}{5} \right)^{5} \]

Note: When performing the application of “exponent laws” there is multiple pathways/order of process. The focus therefore becomes on the accurate applications.

Which step/law do you like to apply 1st, why? Is it the most efficient order?

Watch For:

\[-3x^3 \text{ } vs \text{ } (-3x)^3\]

What are the differences and similarities? Are these equivalent?

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### 4.3 Rational Exponents

**Exponent Laws**

Note that $a$ and $b$ are rational or variable bases and $m$ and $n$ are integral exponents.

<table>
<thead>
<tr>
<th>Exponent Law</th>
<th>Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product of Powers</td>
<td>$(a^m)(a^n) = a^{m+n}$</td>
</tr>
<tr>
<td>Quotient of Powers</td>
<td>$\frac{a^m}{a^n} = a^{m-n}, a \neq 0$</td>
</tr>
<tr>
<td>Power of a Power</td>
<td>$(a^m)^n = a^{mn}$</td>
</tr>
<tr>
<td>Power of a Product</td>
<td>$(ab)^m = (a^m)(b^m)$</td>
</tr>
<tr>
<td>Power of a Quotient</td>
<td>$\left(\frac{a^n}{b^n}\right) = a^n, b \neq 0$</td>
</tr>
<tr>
<td>Zero Exponent</td>
<td>$a^0 = 1, a \neq 0$</td>
</tr>
</tbody>
</table>

A power with a ________________ _____________ can be written as a power with a ______________  ____________

Ex.
Multiply or Divide Powers

1. \((t^3)^4\)

2. \((7^3)(7^{-\frac{1}{2}})\)

3. \(4^{-\frac{3}{4}}\)

3. \(4^{0.5}\)

4. \(4^{1.6}\)

4. \(64^{0.4}\)
Simplify Powers with Rational Exponents

HINT:

\[(4x^4)^{0.5}\]

HINT:

\[\left(\left(x^2\right)^{\frac{1}{2}}\right)^{\frac{3}{2}}\]
HINT:

\[
\left( \frac{2^3}{27} \right)^{-\frac{1}{3}}
\]

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4.4 Irrational Numbers

What is an irrational number?

Golden Ratio (notes from the video clip)
Rational numbers include____________________,___________________ and__________________. These numbers and the irrational numbers form the set of ________________________.

**The Real Number System**

<table>
<thead>
<tr>
<th>Rational numbers</th>
<th>Irrational numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integers</td>
<td></td>
</tr>
<tr>
<td>Whole Numbers</td>
<td></td>
</tr>
<tr>
<td>Natural Numbers</td>
<td></td>
</tr>
</tbody>
</table>

Vocabulary Check:

\[ \sqrt[n]{x} \]
Radicals: are powers with fractional exponents

Ex.

A power can be expressed as a radical in the following form:

Ex.

A fractional exponent can be written in decimal form

Ex.

If the radicand is a number you can evaluate a power with a fractional or decimal exponent.

Ex.
**Convert from a Power to a Radical**

HINT:

\[ 72^{\frac{1}{2}} \]

\[ (9x^{-4})^{\frac{1}{4}} \]

**Convert from a Radical to a Power**

HINT:

\[ \sqrt[4]{2^3} \]

\[ \sqrt{3^5} \]
Vocabulary Check:

Mixed Radical:

Entire Radical:

*Convert Mixed Radicals to Entire Radicals*

\[ 9\sqrt[3]{4} \]

\[ 4.2\sqrt{18} \]

\[ \frac{1}{2}\sqrt{10} \]
Convert Entire Radicals to Mixed Radicals

\[ \sqrt{40} \]

\[ \sqrt{108} \]

\[ \sqrt[3]{32} \]

Order Irrational Numbers (least to greatest)

HINT:

\[ 2\sqrt{54} \]

\[ \sqrt{192} \]

\[ 5\sqrt{10} \]

Assignment pg. 192-193 #1-10, 12, 19(challenge)