

Understanding by Design *Unit Template*

Course:	Math 10C
Unit of Study:	Chapter 4 - Roots and Powers

Step 1: Identify the Outcomes to Address

Guiding Questions:

- What do I want my students to learn?
- What can they currently understand and do?
- What do I want my students to be able to understand and do based on the big ideas and specific outcomes in the program of studies?

Outcome(s) from the Program of Studies:

Algebra and Number

S01. Demonstrate an understanding of factors of whole numbers by determining the:

- prime factors
- greatest common factor
- least common multiple
- square root
- cube root.

[CN, ME, R]

S02. Demonstrate an understanding of irrational numbers by:

- representing, identifying and simplifying irrational numbers
- ordering irrational numbers.

[CN, ME, R, V]

[ICT: C6-2.3]

S03. Demonstrate an understanding of powers with integral and rational exponents.

[C, CN, PS, R]

Step 2: Learning Trajectory

Prior Learning	Current Learning	Future Learning
Number Gr 5 SO 10 Gr 6 SO 3 Gr 7 SO 1, 5, 6, 7 Gr 8 SO 1, 2, 6, 7 Gr 9 SO 1, 2, 3, 4, 5, 6 P&R (E&V) Gr8 SO 1 Gr9 SO 7	Algebra and Number SO1. Demonstrate an understanding of factors of whole numbers by determining the: <ul style="list-style-type: none"> · prime factors · greatest common factor · least common multiple · square root · cube root. [CN, ME, R] SO2. Demonstrate an understanding of irrational numbers by: <ul style="list-style-type: none"> • representing, identifying and simplifying irrational numbers • ordering irrational numbers. [CN, ME, R, V] [ICT: C6-2.3] SO3. Demonstrate an understanding of powers with integral and rational exponents. [C, CN, PS, R]	Algebra & Number 10C 4, 5 20-1 SO 2, 3 Trigonometry 20-1 SO 2 Relations & Functions 20-1 SO 5, 6 30-1 SO 6, 7, 8, 10 20-2 SO 2 30-2 SO 4, 5 Number & Logic 20-2 SO 3, 4

Step 3: Necessary Pre-Requisites

Pre-Requisite Knowledge and Skills

- Operations (add, subtract, multiply, divide) with integers and fractions
- Ordering of decimals.
- Divisibility rules
- Approximate square roots of positive rational numbers
- Understand and apply exponent laws for whole number exponents.
- Number sets (natural, whole, integer, rational)

Pre-Requisite Vocabulary

- Factor
- Prime number
- Composite numbers
- Common factor
- Common multiple
- Square root
- Power
- Exponent
- Base
-

Step 4: Learning Development

Developing Knowledge and Skills

- Finding greatest common factor and least common multiple
- Estimate and calculate square roots and cube roots of real numbers
- Simplify irrational numbers
- What is a “root”?
- Working with negative and rational exponents
- Connecting rational exponents with radicals
-

Developing Vocabulary

- Irrational number
- Greatest common factor
- Least common multiple
- Cube root
- Root
- Radical

Predictable Misunderstandings and Errors

- Confusing factors and multiples
- Simplifying cube roots as perfect squares rather than cubed.
- Negative exponents do not affect the sign of the base or power
- Zero exponent results in 1, not 0.
- Confusing which part of rational exponent (numerator/denominator) determines index of the radical.
- Order of operations with multiplication and exponents (ex. $2(3)^2$)
- When to square a negative with or without brackets (ex. -2^2 v.s. $(-2)^2$)
- Power of a power – forget to apply to a numerical coefficient

Step 5: The Big Picture

Essential Understanding:

- Natural numbers can be represented as a product of factors and uniquely as a product of prime factors.
- Equivalency of decimal approximation of exact values
- Number sets, (including irrationals)
- Exponent laws

Big Ideas:

There are multiple representations of real numbers.

Essential Question:

What is the relationship between a power with a fractional exponent and a radical?

Write equivalent expressions to _____ (ex. Write different ways to express square root 20)

What is the difference between rational and irrational numbers?

Step 6: Learning Experiences

- Formative Assessment Tasks
- Explorations
- Investigations
- Open Ended Problems
- Opportunities for Multiple Representations
- Math Tasks with Multiple Entry Points
- Content Literacy Activity
- Multimedia & Technology
 - Applets
 - Virtual Manipulatives
 - Graphing Calculators
- Graphic Organizer
- Project
- Review Activity

Chapter 4 - Powers and Roots

Day 1 - Estimating Roots Section 4.1

We know the following from previous work.

$$\begin{array}{lll} \sqrt{4} = 2 & \sqrt{81} = 9 & \sqrt{225} = 15 \\ \sqrt[3]{8} = 2 & \sqrt[3]{216} = 6 & \sqrt[3]{1331} = 11 \end{array}$$

Remember, to do a cube root on the TI calculator, MATH Option 4.

The above answers are exact because the answers terminate.

$$\sqrt{\frac{16}{81}} = 0.4444 = 0.\bar{4} = \frac{4}{9} \quad \text{This is also exact because a repeating decimal can be written as a fraction.}$$

To type the above question into your calculator, type:

$$\sqrt{16/81}) \quad \text{The calculator opened a bracket about the root sign so you need to close it.}$$

Hit Enter and you will see 0.4444444444

Now hit MATH ENTER ENTER. This performs the FRAC function which turns a decimal into a fraction.

$$\sqrt[3]{\frac{343}{1728}} = 0.583333333 = 0.58\bar{3} = \frac{7}{12} \quad \text{Type MATH 4 343/1728) Close the bracket!}$$

MATH ENTER ENTER

The above two answers are still exact because they can be turned into fractions.

Rule: An answer is exact if it terminates and/or can be turned into a fraction.

Note: all terminating and repeating decimals can be turned into fractions.

Try these:

$$\sqrt{5} = 2.23 \quad \sqrt[3]{25} = 2.92 \quad \text{These answers are approximate since the decimals continue forever and the answer can not be turned into a fraction.}$$

Thus, an exact answer is NEVER rounded while an approximate answer must be rounded.

What does it mean to be a perfect square or a perfect cube?

Consider the numbers 4, 9, 16, 25, 36, 49, 64...

What is so special about them?

The square root of each is an whole number! 2, 3, 4, 5, 6, 7, 8, ...

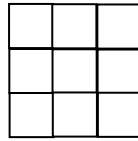
So a perfect square is a number whose square root is "nice". Bad math terminology but it works.

There is another way to look at a perfect square. The number can be made into a square.

Consider 4. We can make a square using four bricks.



Consider 9. We can make a square using nine bricks.



The pattern continues. 16 bricks make a square, 25 bricks make a square etc.

Now let's look at 8, 27, 64, 125...

Each of these is a perfect cube.

Take the cube root of each. MATH 4 2, 3, 4, 5....

A perfect cube is a number is answer is a whole number. Again, a "nice" answer.

If we look at 8, we can make a cube using eight bricks.



Consider 27 bricks, we can make a Rubik's Cube!



1. Taylor is building a slide in her back yard. She has chosen to use a ladder that is 12 feet high. Using any method, find the length of the slide if Taylor chooses to place the base of the slide

a) 9 feet from the base of the ladder.

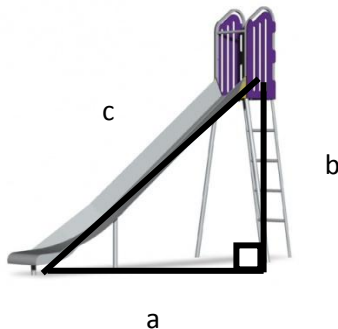
$$a^2 + b^2 = c^2$$

$$9^2 + 12^2 = c^2$$

$$225 = c^2$$

$$\sqrt{225} = c = 15$$

An exact answer.



b) 7 feet from the base of the ladder.

$$a^2 + b^2 = c^2$$

$$7^2 + 12^2 = c^2$$

$$193 = c^2$$

$$\sqrt{193} = c = 13.9$$

13.9 is approximate, $\sqrt{193}$ is exact.

c) 5 feet from the base of the ladder.

$$a^2 + b^2 = c^2$$

$$5^2 + 12^2 = c^2$$

$$169 = c^2$$

$$\sqrt{169} = c = 13$$

An exact answer.

Extension

To complete the following $\sqrt[4]{2401}$, type: 4 MATH 5 2401. MATH 5 gives this function $\sqrt[4]{}$

You or thus taking the 4th root of 2401 = 7.

$\sqrt[8]{390625}$ 8 MATH 5 390625 = 5. You are taking the 8th root of 390625.

Definitions: Section 4.2

Rational Number: a number that can be written as $\frac{m}{n}$ $n \neq 0$. All terminating and repeating decimals.

Irrational Number: a number that *can not* be written as $\frac{m}{n}$ $n \neq 0$. All non terminating and non repeating decimals. π is an irrational number. $\sqrt{5}, \sqrt[3]{36}$ are other examples.

1. Determine whether the following are rational or irrational.

a. $\sqrt{196}$

b. $\sqrt{\frac{1}{81}}$

c. $\sqrt[3]{144}$

d. $\sqrt[3]{0.125}$

e. $\sqrt[3]{0.9}$

ANS: R

R

I

R

I

Number Systems

Natural (N) – 1, 2, 3, ...

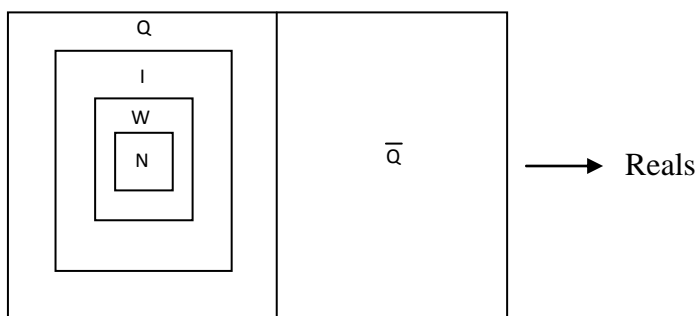
Whole (W) – 0, 1, 2, ...

Integers (I) – ... -3, -2, -1, 0, 1, 2, 3, ...

Rational (Q) – Can be written as $\frac{a}{b}$, $a, b \in \mathbb{I}$, $b \neq 0$ (i.e. terminating or repeating decimals)

Irrational \bar{Q} – Cannot be written as $\frac{a}{b}$, $a, b \in \mathbb{I}$, $b \neq 0$ (i.e. non-terminating, non-repeating decimals) Best example is π .

Real Numbers – the union of rational and irrational numbers. If the number exists, it is a Real Number.



Classify the following.

1. $\sqrt{49}$
2. $-\sqrt{2}$
3. $-0.\bar{5}$
4. $\sqrt{\frac{1}{4}}$
5. 0.358
6. 0.18283848...
7. π
8. $\frac{0}{2}$
9. $\frac{5}{0}$

1. N 2. \bar{Q} 3. Q 4. Q 5. Q 6. \bar{Q} 7. \bar{Q} 8. W 9. Non Real Answer

Assignment

4.1 page 206 #2, 3, 4a, 5, 6

4.2 page 211 #3-6, 10-12, 14, 15, 18ab, 20

Can Use Math-Vivor (Digging Up Roots)

Add some classifying number systems questions.

Can use M10C CH 4 W Number Systems.doc

$$1. \sqrt{a} \times \sqrt{b} = \sqrt{ab} \quad 2. \sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}} \quad \therefore \frac{\sqrt{ab}}{\sqrt{ac}} = \sqrt{\frac{ab}{ac}} = \sqrt{\frac{b}{c}} = \frac{\sqrt{b}}{\sqrt{c}}$$

I. Changing Form of Radicals (Entire (Pure) \longleftrightarrow Mixed).

Remember your perfect squares 4, 9, 16, 25, 36, 49, 64, 81, 100, 121, etc.
and perfect cubes 8, 27, 64, 125 etc.

A. Entire to Mixed

****Important****

$$\begin{aligned} 1. \sqrt{20} &= \sqrt{4 \times 5} = \sqrt{4} \sqrt{5} = 2\sqrt{5} \\ 2. \sqrt{72} &= \sqrt{36 \times 2} = \sqrt{36} \sqrt{2} = 6\sqrt{2} \\ 3. \sqrt{363} &= \sqrt{121 \times 3} = \sqrt{121} \sqrt{3} = 11\sqrt{3} \\ 4. \sqrt{98} &= \sqrt{49 \times 2} = \sqrt{49} \sqrt{2} = 7\sqrt{2} \\ 5. \sqrt{150} &= \sqrt{25 \times 6} = \sqrt{25} \sqrt{6} = 5\sqrt{6} \\ 6. \sqrt[3]{135} &= \sqrt[3]{27 \times 5} = \sqrt[3]{27} \sqrt[3]{5} = 3\sqrt[3]{5} \\ 7. 3\sqrt[3]{32} &= 3\sqrt[3]{8 \times 4} = 3\sqrt[3]{8} \sqrt[3]{4} = 3 \times 2\sqrt[3]{4} = 6\sqrt[3]{4} \end{aligned}$$

How can you confirm your answer is correct?

Type in the question into your calculator and hit enter. Type your answer into your calculator and hit enter.

If the answers are the same, your answer is correct!

B. Mixed to Entire

$$\begin{aligned} 1. 5\sqrt{2} &= \sqrt{25} \times \sqrt{2} = \sqrt{25 \times 2} = \sqrt{50} \\ 2. 6\sqrt{5} &= \sqrt{36} \times \sqrt{5} = \sqrt{36 \times 5} = \sqrt{180} \\ 3. 5\sqrt{200} &= \sqrt{25} \times \sqrt{200} = \sqrt{25 \times 200} = \sqrt{5000} \\ 4. 7\sqrt{18} &= \sqrt{49} \times \sqrt{18} = \sqrt{49 \times 18} = \sqrt{882} \\ 5. 2\sqrt[3]{2} &= \sqrt[3]{8} \times \sqrt[3]{2} = \sqrt[3]{8 \times 2} = \sqrt[3]{16} \\ 6. 4\sqrt[3]{56} &= \sqrt[3]{64} \times \sqrt[3]{56} = \sqrt[3]{64 \times 56} = \sqrt[3]{3584} \end{aligned}$$

C. Arrange in ascending order (Change to entire).

1. $5\sqrt{2}$, $\sqrt{51}$, $2\sqrt{13}$, 7, $3\sqrt{5}$.

2. $3\sqrt{10}$, $3\sqrt{8}$, $4\sqrt{6}$, 9

D. Simplifying radicals. (Divide) (OPTIONAL)

1. $\frac{\sqrt{10}}{\sqrt{2}} = \frac{\sqrt{2}\sqrt{5}}{\sqrt{2}} = \sqrt{5}$

2. $\sqrt{\frac{11}{4}} = \frac{\sqrt{11}}{\sqrt{4}} = \frac{\sqrt{11}}{2}$

3. $\frac{\sqrt{12}}{\sqrt{3}} = \frac{\sqrt{3}\sqrt{4}}{\sqrt{3}} = \sqrt{4} = 2$

4. $\frac{\sqrt{12}}{2} = \frac{\sqrt{4}\sqrt{3}}{2} = \frac{2\sqrt{3}}{2} = \sqrt{3}$

5. $\frac{\sqrt{6}}{\sqrt{2}} = \frac{\sqrt{3}\sqrt{2}}{\sqrt{2}} = \sqrt{3}$

6. $\sqrt{\frac{2}{9}} = \frac{\sqrt{2}}{\sqrt{9}} = \frac{\sqrt{2}}{3}$

7. $\frac{\sqrt{20}}{\sqrt{5}} = \frac{\sqrt{4}\sqrt{5}}{\sqrt{5}} = \sqrt{4} = 2$

8. $\frac{\sqrt{54}}{\sqrt{2}} = \frac{\sqrt{27}\sqrt{2}}{\sqrt{2}} = \sqrt{27} = \sqrt{9}\sqrt{3} = 3\sqrt{3}$

Assignment

4.3 page 218 #4, 5, 9, 10-12, 14-18, 20-22, 25

Can Use Math-Vivor (Finding Water) or (Forming Alliances)

or

10C Ch 4 W Radicals.doc

Day 3 Adding and Subtracting Radicals

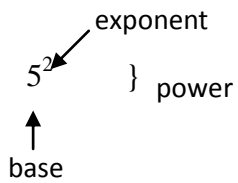
I. Addition and subtraction of Radicals. (Radicands must be the same to add or subtract).

In order to add or subtract, the numbers under the root signs must all be the same. In order to do this, change all entire radicals to mixed radicals.

- $\sqrt{2} + \sqrt{3} \neq \sqrt{5}$ There is nothing to be done.
- $2\sqrt{5} + 6\sqrt{5} = 8\sqrt{5}$ (2 apples + 6 apples = 8 apples)
- $3\sqrt{2} + 7\sqrt{2} = 10\sqrt{2}$
- $\sqrt{18} + 7\sqrt{2} - \sqrt{50}$
 $= \sqrt{9}\sqrt{2} + 7\sqrt{2} - \sqrt{25}\sqrt{2}$
 $= 3\sqrt{2} + 7\sqrt{2} - 5\sqrt{2} = 5\sqrt{2}$
- $5\sqrt{3} + \sqrt{12} - 2\sqrt{27} + 4\sqrt{75}$
 $= 5\sqrt{3} + \sqrt{4}\sqrt{3} - 2\sqrt{9}\sqrt{3} + 4\sqrt{25}\sqrt{3}$
 $= 5\sqrt{3} + 2\sqrt{3} - 2 \times 3\sqrt{3} + 4 \times 5\sqrt{3}$
 $= 5\sqrt{3} + 2\sqrt{3} - 6\sqrt{3} + 20\sqrt{3} = 21\sqrt{3}$
- $13\sqrt{2} - \sqrt{98} - 5\sqrt{8}$
 $= 13\sqrt{2} - \sqrt{49}\sqrt{2} - 5\sqrt{4}\sqrt{2}$
 $= 13\sqrt{2} - 7\sqrt{2} - 5 \times 2\sqrt{2}$
 $= 13\sqrt{2} - 7\sqrt{2} - 10\sqrt{2} = -4\sqrt{2}$
- $4\sqrt{3} - \sqrt{12} + 6\sqrt{75}$
 $= 4\sqrt{3} - \sqrt{4}\sqrt{3} + 6\sqrt{25}\sqrt{3}$
 $= 4\sqrt{3} - 2\sqrt{3} + 6 \times 5\sqrt{3}$
 $= 4\sqrt{3} - 2\sqrt{3} + 30\sqrt{3} = 32\sqrt{3}$
- $3\sqrt{48} + 4\sqrt{27} - 2\sqrt{147}$
 $= 3\sqrt{16}\sqrt{3} + 4\sqrt{9}\sqrt{3} - 2\sqrt{49}\sqrt{3}$
 $= 3 \times 4\sqrt{3} + 4 \times 3\sqrt{3} - 2 \times 7\sqrt{3}$
 $= 12\sqrt{3} + 12\sqrt{3} - 14\sqrt{3} = 10\sqrt{3}$
- $\sqrt{25} - \sqrt{100} + \sqrt{144}$
 $= 5 - 10 + 12 = 7$ Easy eh :-)
- $2\sqrt{192} - 7\sqrt{12} + 4\sqrt{108}$
 $= 2\sqrt{64}\sqrt{3} - 7\sqrt{4}\sqrt{3} + 4\sqrt{36}\sqrt{3}$
 $= 2 \times 8\sqrt{3} - 7 \times 2\sqrt{3} + 4 \times 6\sqrt{3}$
 $= 16\sqrt{3} - 14\sqrt{3} + 24\sqrt{3} = 26\sqrt{3}$

Assignment

M10C Ch 4 W Add Subtract Radicals.docx

Properties of Exponents.

Exponents show:

- repeated multiplication of the base.

$$5^3 = 5 \times 5 \times 5$$

- roots of a number (rational)

$$36^{\frac{1}{2}} = \sqrt{36} = 6$$

Rational exponents.

$$x^{\frac{m}{n}} = \sqrt[n]{x^m} \text{ or } \sqrt[n]{x}^m$$

$\sqrt{\quad}$ = radical sign

x = radicand

n = order or index (n = 2 is assumed if no index is given)

- the square root of a number is the inverse operation to squaring a number.
- a positive number has 2 square roots. The square roots of 9 are ± 3 .

I. Changing Forms.

As mentioned above, $x^{\frac{m}{n}} = \sqrt[n]{x^m}$ or $\sqrt[n]{x^m}$. One way to think of this is as follows: The numerator of the exponent (m) is like a wing man. A wing man never leaves his partners side. So notice how (m) stays with (x) even when we change forms.

1. Radical \longrightarrow Exponential

$$\text{a. } \sqrt[3]{x^5} = x^{\frac{5}{3}} \qquad \text{b. } \sqrt{y^5} = y^{\frac{5}{2}}$$

$$\text{c. } \sqrt{x} = x^{\frac{1}{2}} \qquad \text{d. } \sqrt[5]{y^3} = y^{\frac{3}{5}}$$

$$\text{f. } (\sqrt{x})^3 = \sqrt{x^3} = x^{\frac{3}{2}}$$

$$\text{g. } \sqrt[3]{8y^7} = (8y^7)^{\frac{1}{3}} = 8^{\frac{1}{3}} y^{\frac{7}{3}} = 2y^{\frac{7}{3}}$$

2. Exponential \longrightarrow Radical

Remember, the numerator of the exponent STAYS WITH THE BASE.

$$\text{a. } x^{\frac{2}{7}} = \sqrt[7]{x^2} \qquad \text{b. } y^{\frac{1}{5}} = \sqrt[5]{y^1} = \sqrt[5]{y}$$

$$\text{c. } y^{\frac{3}{2}} = \sqrt{y^3} \quad \text{The denominator of 2 is assumed in the square root.}$$

$$\text{d. } (2x)^{0.2} \quad \text{Change 0.2 to a fraction. MATH ENTER ENTER on your calculator.}$$
$$= (2x)^{\frac{1}{5}} = \sqrt[5]{2x}$$

$$\text{e. } (3x^3)^{\frac{2}{7}} = \sqrt[7]{(3x^3)^2} = \sqrt[7]{9x^6}$$

$$\text{f. } 7^{-\frac{1}{2}} = \sqrt{7^{-1}} = \sqrt{\frac{1}{7}} \quad \text{To convert } 7^{-1}, \text{ type it into CALC then MATH ENTER ENTER}$$

II. Evaluating Radicals and Exponents

Calculator Buttons

- $\sqrt{\quad}$ Hit 2nd x^2
 $\sqrt[3]{\quad}$ Hit MATH 4
Any root such as $\sqrt[4]{\quad}$ 4 MATH 5
 $\sqrt[5]{\quad}$ 5 MATH 5
 $\sqrt[6]{\quad}$ 6 MATH 5
etc.

A. Evaluate to the nearest tenth. Use your calculator. (Answers are in brackets.)

- $\sqrt[3]{73}$ (=4.18)
- $\sqrt[4]{25}$ (=2.24)
- $\sqrt[100]{15\,230}$ (=1.10)
- $(\sqrt[9]{55})^{-2}$ (=0.41)
- $4(\sqrt[5]{216})$ (=11.72)
- $-\sqrt[5]{231}$ (=−2.97)
- $-2\sqrt[3]{-58} - 3\sqrt[5]{21}$ (=2.23)

B. Evaluate. (Exact) Can all be done on your calculator.

After you get a decimal answer, hit **MATH ENTER ENTER** to convert to a fraction if possible.

- $8^{\frac{2}{3}}$ = $8^{(2/3)} = 4$
- $64^{\frac{3}{2}}$ = $64^{(3/2)} = 512$
- $(-27)^{\frac{1}{3}}$ = $(-27)^{(1/3)} = -3$
- $-4^{\frac{-3}{2}}$ = $-(4)^{(-3/2)} = \frac{-1}{8}$
- $81^{-1.25}$ = $81^{-1.25} = \frac{1}{243}$
- $(0.0009)^{\frac{1}{2}}$ = $0.0009^{(1/2)} = 0.03$
- $\left(\frac{27}{8}\right)^{\frac{2}{3}}$ = $(27/8)^{(2/3)} = 2.25$
- $\left(\frac{4}{9}\right)^{-1.5}$ = $(4/9)^{-1.5} = 3.375$
- $5^{\frac{2}{3}} \times 5^{\frac{1}{3}}$ = $5^{(2/3)} \times 5^{(1/3)} = 5$

$$10. \left(\sqrt[6]{25}\right)^3 \quad (6 \text{ MATH } 5 \ 25)^3 = 5$$

$$11. (0.008)^{\frac{-2}{3}} = (0.008)^{-2/3} = 25$$

$$12. 32^{0.4} = 32^{0.4} = 4$$

Assignment

page 227 #1-12, 15-21

Let's look at the following pairs of numbers:

$$5, \frac{1}{5} \quad 11, \frac{1}{11} \quad \frac{2}{3}, \frac{3}{2} \quad \frac{1}{15}, 15$$

What are so special about each pair of numbers? Each number is the **reciprocal** of the other.

The mathematical definition of a reciprocal is as follows: two numbers whose product is 1. That is to say, two numbers that multiply together to a value of 1.

$$5 \times \frac{1}{5} = 1 \quad 11 \times \frac{1}{11} = 1 \quad \frac{2}{3} \times \frac{3}{2} = 1 \quad \frac{1}{15} \times 15 = 1$$

An easier way to think of a reciprocal, the numerator and denominator switch spots :-)

What does this have to do with exponents? Well...

$$x^{-a} = \frac{1}{x^a} \quad \text{and} \quad \frac{1}{x^{-a}} = x^a$$

A negative exponent in numerator becomes a positive exponent in the denominator.

A negative exponent in denominator becomes a positive exponent in the numerator.

1. Rewrite the following with positive exponents only.

$$\text{a. } x^{-3} = \frac{1}{x^3} \quad \text{b. } \frac{1}{m^{-4}} = m^4$$

$$\text{c. } 4x^{-5} = \frac{4}{x^5} \quad \text{The constant 4 is not affected by the exponent!}$$

$$\text{d. } \frac{1}{7m^{-2}} = \frac{m^2}{7} \quad \text{The constant 7 is not affected by the exponent!}$$

$$\text{e. } 9^{-8} = \frac{1}{9^8}$$

$$\text{f. } (4n)^{-3} = \frac{1}{(4n)^3} \quad \text{The four is part of the base.}$$

$$g. \quad (3x)^{\frac{-4}{5}} = \frac{1}{(3x)^{\frac{4}{5}}}$$

The 3x is part of the base.

$$h. \quad \frac{5}{x^{\frac{-6}{7}}} = 5x^{\frac{6}{7}}$$

$$i. \quad \frac{1}{-3^{-2}} = \frac{3^2}{-1} = -3^2$$

2. Evaluate: Answers are in brackets. Be careful how you type!

$$a. \quad 2^{-1} + 3^{-1} = \left(\frac{5}{6}\right) \quad b. \quad (3^2 + 5^{-1})^0 = (1) \quad c. \quad \frac{2^{-1} + 6^{-1}}{3^{-1}} = (2)$$

$$d. \quad \frac{6 + 6^{-1}}{6 - 6^{-1}} = \left(\frac{37}{35}\right) \quad e. \quad \frac{3^{-2}}{3^{-1} - 3^{-2}} = \left(\frac{1}{2}\right)$$

3. Applications of exponents.

a. The formula $D = \sqrt[3]{830t^3}$ is used to describe violent storms where D is the diameter of the storm in kilometers and t is the number of hours the storm will last. If a storm lasts 4 hours, what is its diameter? (± 0.1)

$$D = \sqrt[3]{830t^3}$$

$$D = \sqrt[3]{830(4)^3}$$

$$D = 37.6km$$

- b. The skin area A , in square metres, of a person's body can be estimated from the formula $A = 0.025h^{0.42}w^{0.5}$, where h is the person's height in centimetres and w the mass in kilograms. Estimate the skin area of Mr. Lazaruk if he is 180 cm tall and has a mass of 70 kg to the nearest 100^{th} .

$$A = 0.025h^{0.42}w^{0.5}$$

$$A = 0.025(180)^{0.42}(70)^{0.5}$$

$$A = 1.85m^2$$

Assignment

page 233 #1-16, 19

Day 6 Exponent Laws**Section 4.6****I. Laws or properties of exponents.****(Not just good ideas, they're laws!)**

1. Product law: $x^a \cdot x^b = x^{a+b}$

http://www.youtube.com/watch?v=WBDczW_nvrl

2. Quotient law: $\frac{x^a}{x^b} = x^{a-b}$

http://www.youtube.com/watch?v=BcnYAWUT_Y8

3. Power laws:

<http://www.youtube.com/watch?v=FyhKX7W5hrE>

a. $(x^m)^n = x^{mn}$

b. $(x^a y^b)^c = x^{ac} y^{bc}$

c. $\left(\frac{x^a}{y^b}\right)^c = \frac{x^{ac}}{y^{bc}}$

4. Exponents of one and zero:

a. $x^0 = 1$

b. $x^1 = x$

5. Negative exponents: works on exponents only, not coefficients.

a. $x^{-a} = \frac{1}{x^a}$ Note: $-27 \neq \frac{1}{27}$

b. $\frac{1}{x^{-a}} = x^a$

c. $\left(\frac{x}{y}\right)^{-a} = \left(\frac{y}{x}\right)^a$

6. Notation:

a. $-x^2 = -(x)(x)$

b. $(-x)^2 = (-x)(-x)$

Examples: We hate negative exponents. Positive exponents only in answers!

1. $-2^4 = -16$

2. $(-3)^2 = 9$

3. $7^0 = 1$

4. $-5^0 = -1$

5. $(-3x^2)^0 = 1$

6. $7x^0 - 2^2 = 3$

7. $(3^{-7})(3^4) = 3^{-3} = \frac{1}{3^3} = \frac{1}{27}$

8. $\frac{x^5}{x^{-4}} = x^9$

9. $(3x^5y)(-2x^6y^{-4}) = \frac{-6x^{11}}{y^3}$ $3 \times -2 = -6$ $(x^5)(x^6) = x^{11}$ $(y)(y^{-4}) = y^{-3} = \frac{1}{y^3}$

10. $(-x^2)(5x^{-4}) = \frac{-5}{x^2}$ $-1 \times 5 = -5$ $(x^2)(x^{-4}) = x^{-2} = \frac{1}{x^2}$

11. $\left(\frac{3}{4}\right)^{-2} = \frac{16}{9}$ $(3/4)^{-2}$ MATH ENTER ENTER

12. $(-4p^3q^{-2})^3 = \frac{-64p^9}{q^6}$ $(-4)^3 = -64$ $(p^3)^3 = p^9$ $(q^{-2})^3 = q^{-6} = \frac{1}{q^6}$

13. $\frac{-15x^6y^4}{3x^3y^7} = \frac{-5x^3}{y^3}$ $-15 \div 3 = -5$ $\frac{x^6}{x^3} = x^3$ $\frac{y^4}{y^7} = y^{-3} = \frac{1}{y^3}$

14. $\left(\frac{10x^6y}{-2x^{-3}y^5}\right) = \frac{-5x^9}{y^4}$ $10 \div -2 = -5$ $\frac{x^6}{x^{-3}} = x^9$ $\frac{y}{y^5} = y^{-4} = \frac{1}{y^4}$

15. $\frac{(-6)^0}{(-2a^4)^{-3}} = -8a^{12}$ $(-6)^0 = 1$ $\left(\frac{1}{-2}\right)^{-3} = 8$ $\left(\frac{1}{a^4}\right)^{-3} = \frac{1}{a^{-12}} = a^{12}$

$$16. \left(\frac{45x^2y^3}{9xy^8} \right)^4 = \frac{625x^4}{y^{20}} \quad \text{Clean up bracket first } (5xy^{-5})^4 = \left(\frac{5x}{y^5} \right)^4$$

$$17. (-3x^{-1}y^2z)^{-3} = \frac{-x^3}{27y^6z^3}$$

$$(-3)^{-3} = \frac{-1}{27}$$

$$(x^{-1})^{-3} = x^3$$

$$(y^2)^{-3} = y^{-6} = \frac{1}{y^6}$$

$$(z)^{-3} = z^{-3} = \frac{1}{z^3}$$

$$18. \left(\frac{3}{5x} \right)^{-2} = \frac{25x^2}{9}$$

$$\left(\frac{3}{5} \right)^{-2} = \frac{25}{9}$$

$$\left(\frac{1}{x} \right)^{-2} = \left(\frac{1}{x^{-2}} \right) = x^2$$

Assignment

page 241 # 1 – 11, 14 – 17, 19, 21 – 23

Can Use Math-Vivor (Staying Focused)

Day 7 Mixed Exponent Laws and Practice

Today is a day to review sections 4.4, 4.5 and 4.6.

If Math-Vivor has not been used, it can be used in full or in part.
Otherwise M10C CH 4 Exponent Laws Worksheet.docx is available.

Day 8 Quiz

Day 9 Review

Day 10 Unit Exam

Textbook Review Questions

The textbook has very good questions that can be used for review. You will notice that each set of questions indicated what section of the text it covers. If you need help with a question, you may refer to the section in the text.

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<u>Questions</u>	<u>Section</u>
#1, 3-5	4.1 Estimating Roots
#6-10	4.2 Irrational Numbers
#11-15	4.3 Mixed and Entire Radicals
#17-22	4.4 Fractional Exponents and Radicals
#24-27	4.5 Negative Exponents and Reciprocals
#28-32	4.6 Exponent Laws