Name: _____

Secondary 2H: UNIT 1
Lesson 3

Warm-up:

1. Write an equivalent expression $(x+4)(x-5) =$	**2.** Write an equivalent expression $(y-2)(y^2+3y-1) =$
3. Write an equivalent expression $(x-3)^2 =$	**4.** Write an equivalent expression $(x+6)(x-6) =$

By the end of this lesson, I can…

- define the meaning of a rational exponent and convert radical notation to rational exponent notation, and vice-versa
- extend the properties of integer exponents to rational exponents and use them to simplify expressions

Extending Properties of Exponents

What exactly *are* rational exponents? Let's use $4^{\frac{1}{2}}$ as an example:

$\Longrightarrow$ For any number, x, $x^{\frac{1}{2}} =$ _____, $x^{\frac{1}{3}} =$_____, and $x^{\frac{1}{n}} =$_____ (where n is an integer and $n \neq 0$).

A rational exponent does not have to have a numerator of 1. Let's use $8^{\frac{2}{3}}$ as an example.

$\Longrightarrow$ In general, $x^{\frac{m}{n}} =$_____ (where m and n are integers and $n \neq 0$).

Practice:

Rewrite each expression in radical form.

1. $8^{\frac{4}{3}}$ 2. $x^{\frac{3}{4}}$ 3. $k^{\frac{3}{2}}$ 4. $3a^{\frac{1}{2}}$ 5. $(4b)^{\frac{7}{5}}$

Rewrite each expression with rational exponents.

6. $\sqrt[3]{11}$ 7. $\left(\sqrt[7]{42}\right)^2$ 8. $\left(\sqrt[3]{-10}\right)^8$ 9. $4\left(\sqrt[4]{a}\right)^2$ 10. $\left(\sqrt[3]{4b}\right)^2$

Properties of Exponents

Product of Powers: $x^a x^b =$ _____

- $3^4 \cdot 3^7 =$
- $\left(\frac{2}{3}\right)^2 \cdot \left(\frac{2}{3}\right)^4 =$
- $x^6 \cdot x =$

Quotient of Powers: $\frac{x^a}{x^b} =$ _____

- $\frac{5^6}{5^2} =$
- $\frac{x^{11}}{x^8} =$

Power of a Product: $(xy)^a =$ _____

- $(2x)^3 =$
- $(xy)^7 =$

Power of a Quotient: $\left(\frac{x}{y}\right)^a =$ _____

- $\left(\frac{3}{4}\right)^3 =$
- $\left(\frac{2}{x}\right)^4 =$

Power of a Power: $\left(x^a\right)^b =$ _____

- $\left(2^3\right)^2 =$
- $\left(x^6\right)^3 =$

Zero Power Property: $x^0 =$ _____

- $15^0 =$
- $(7x)^0 =$
- $100x^0 =$

Practice:

1. $3a^2 \cdot a^5$
2. $\left(2x^2y\right)^3$
3. $5\left(\frac{3}{x}\right)^2$
4. $\left(\frac{-3a^2b}{2ab^4}\right)^3$

$\Rightarrow$ Zero and Negative Exponents

Complete the tables. Look for patterns!

x	$f(x) = 2^x$
4	
3	
2	
1	
0	
-1	
-2	
-3	

x	$f(x) = \left(\frac{1}{3}\right)^x$
3	
2	
1	
0	
-1	
-2	
-3	

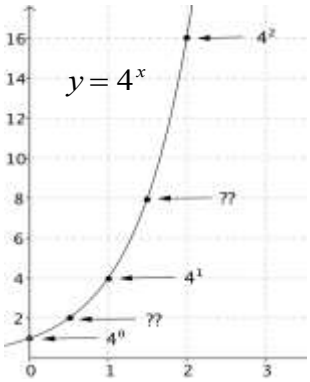
Practice:

Rewrite each expression using only positive exponents.

1. $3x^{-1}$
2. $\frac{1}{7}x^{-3}$
3. $(5x)^{-2}$
4. $\left(\frac{3x}{2^{-3}}\right)^{-1}$

$\Longrightarrow$ Rational Exponents

So far, we've only talked about *integer* exponents. If we graph the function $y = 4^x$, we can see that it is **continuous**, and that $4^{\frac{1}{2}}$ and $4^{\frac{7}{3}}$ and even $4^{\frac{1234}{4567}}$ appear on the graph.



Practice:

Simplify each expression. (Remember, no negative exponents!)

1. $4^{\frac{1}{3}} \cdot 4^{\frac{2}{3}}$
2. $3 \cdot 3^{\frac{1}{5}}$
3. $x^{\frac{1}{2}} \cdot x^{\frac{1}{3}}$
4. $\left(x^{-\frac{1}{3}}\right)^6$

5. $\frac{5}{5^{\frac{2}{3}}}$
6. $\frac{y^{\frac{2}{3}}}{y^{\frac{1}{5}}}$
7. $\left(x^3 \cdot x^{\frac{2}{3}}\right)^{-2}$
8. $\frac{3}{z^{-\frac{2}{5}}}$