Chapter 4 – Exponential Functions 4.2 – Working With Integer Exponents

Laws of Exponents: (when bases are the same)

1. Product Rule (multiplying)

$$4^3 \times 4^2 =$$

 $a^m \times a^n =$

Law:

Laws of Exponents: (when bases are the same)

2. Quotient Rule (dividing)

$$\frac{5^6}{5^2} = \frac{a^m}{a^n} =$$

Law:

Laws of Exponents: (when bases are the same)

3. Power Law

 $(3^2)^4 =$

$$(a^{m})^{n} =$$

Law:

Laws of Exponents: (when bases are the same)

4. Zero Law

- $7^{0} =$
- $\frac{7^2}{7^2} = \frac{7^2}{7^2} =$

 $(2000^{1001})^0 =$

Law:

Laws of Exponents: (when bases are the same)

5. Negative Exponent Law

Law: A negative exponent means the reciprocal.

Exponent	-3	-2	-1	0	1	2	3	4	5
Base	4 ⁻³	4-2	4-1	4 ⁰	4 ¹	4 ²	4 ³	4^4	4 ⁵
Result				1	4	16	64	256	1024

$$4^{-4} = \frac{1}{4^4} = \frac{1}{256} \qquad \frac{1}{4^{-2}} = 4^2 = 16 \qquad \frac{3^{-3}}{4^{-2}} = \frac{4^2}{3^3} = \frac{16}{27}$$

Examples: Simplify, then evaluate.

$$\frac{(2^{3})(2^{4})}{2^{2}}$$
$$\frac{(3^{-1})^{2}}{3^{-3}}$$

 $\left[\frac{(4^6)(4^3)}{(4^2)(4^7)}\right]^{-2}$

4.3 – Working With Rational Exponents

Three questions... What exponent on 9 is equivalent to $\sqrt{9}$?

Why does
$$\sqrt{x^6} = x^3$$
?

How can you evaluate
$$4^{\frac{3}{2}}$$
?

Note:

A square root is \sqrt{x} or $\sqrt[2]{x}$, but we don't typically put the 2 in the "hook" because it is the lowest radical.

A cubic root is $\sqrt[3]{x}$, meaning "what number do you multiply by itself 3 times to get x". Ex: $\sqrt[3]{64} = 4$ because $4^3 = 64$.

A 4th root is $\sqrt[4]{x}$. Ex: $\sqrt[4]{16} = 2$ because $2^4 = 16$.

Let's make a mathematical leap of logic: If $\sqrt{x} = x^{\frac{1}{2}}$, then does $\sqrt[3]{x} = x^{\frac{1}{3}}$ and $\sqrt[4]{x} = x^{\frac{1}{4}}$?

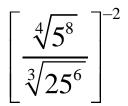
The "rule": $\sqrt[n]{x^m} = (x^m)^{\frac{1}{n}} = x^{\frac{m}{n}}$ ex: $\sqrt[5]{6^2} = 6^{\frac{2}{5}}$ Examples: Simplify, then evaluate.

81^{0.25}

 $\left(3^{\frac{2}{3}}\right)\!\left(3^{\frac{1}{3}}\right)$

 $\frac{64^{\frac{4}{3}}}{64}$

Examples: Simplify, then evaluate.



$$4^{-2} + \sqrt[3]{27^{-1}} - 8^0$$

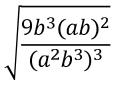
4.4 – Algebraic Expressions

$$\frac{(n^{-4})(n^{-6})}{(n^{-2})^7} \qquad \qquad \frac{(-2x^5)^3}{8x^{10}}$$

$$\frac{(4r^{-6})(-2r^2)^5}{(-2r)^4}$$



$$\frac{(mn^3)^{-\frac{1}{2}}}{m^{\frac{1}{2}}n^{-\frac{5}{2}}}$$



4.7 – Applications Involving Exponential Functions

The exponential function equation is:

 $f(x) = ab^x$

A population of 320 frogs grows at a rate of 4.5% per year. How many frogs will there be in 15 years?

A new car depreciates at a rate of 20% per year. Steve bought a new car for \$26,000. a) How much will Steve's car be worth in 3 years?

b) When will Steve's car be worth \$4000?

Unfortunately, its not always that simple....

A 200g sample of radio-active material has a halflife of 138 days. How much will be left in 5 years?