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.

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

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

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

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.

$81^{0.25}$

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

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

Examples: Simplify, then evaluate.

$\left[\dfrac{\sqrt[4]{5^8}}{\sqrt[3]{25^6}}\right]^{-2}$

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

4.4 – Algebraic Expressions

$$\frac{(n^{-4})(n^{-6})}{(n^{-2})^{7}}$$

$$\frac{(-2x^{5})^{3}}{8x^{10}}$$

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

$$\frac{\sqrt[6]{(8x^6)^2}}{\sqrt[4]{625x^8}}$$

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

$$\sqrt{\frac{9b^3(ab)^2}{(a^2b^3)^3}}$$

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 half-life of 138 days. How much will be left in 5 years?