1.4 Laws of Exponents and Scientific Notation

Definition For any real number x and any positive integer a,

$$x^a =$$

where x is the _____ and a is the _____.

Exponent of 1: For any real number x, $x^1 =$

Exponent of 0: For any non zero real number x, $x^0 =$

Ex 1) Find the indicated value of the expression.

a. $-3y^1$ **b.** $-(2x)^0$ **c.** $5x^0$ **d.** $(-7a+b)^1$

Product Rule of Exponents
For any nonzero real number x and for any positive integers a and b $$x^a \cdot x^b =$$

Ex 2) Express in terms of a base raised to a single power if possible.

a. $n^3 \cdot n^7$ **b.** $(-4x)^3 \cdot (-4x)$ **c.** $(y+3)^5 \cdot (y+5)^0$ **d.** $p^6 \cdot q^3$

Quotient Rule of Exponents
For any nonzero real number x and for any positive integers a and b $$\frac{x^a}{x^b} =$$

Ex 3) Rewrite each expression as a base to a power if possible.

a. $\dfrac{s^8}{s^2}$

b. $\dfrac{(-3r)^{10}}{(-3r)^9}$

c. $\dfrac{(t-2)^6}{(t-2)^4}$

d. $\dfrac{a^4}{b}$

Negative Exponents
For any nonzero real number x and for any integer a $$x^{-a} =$$

Ex 4) Rewrite with a positive exponent.

a. a^{-9} **b.** $(-4y)^{-1}$ **c.** $(-5+x)^{-3}$

d. $\dfrac{1}{p^{-4}}$

Reciprocal of x^{-a}
For any nonzero real number x and for any positive integer a $$\frac{1}{x^{-a}} =$$

Ex 5) Rewrite as expressions as using only positive exponents.

a. $\dfrac{1}{y^{-3}}$ **b.** $\dfrac{5}{x^{-2}}$

c. $\dfrac{m}{n^{-3}}$ **d.** $\dfrac{4r^3}{s^{-3}}$

Power Rule of Exponents
For any nonzero real number x and for any integers a and b $$\left(x^a\right)^b =$$

Ex 6) Simplify.

a. $(y^7)^2$ **b.** $-(n^{-1})^5$ **c.** $(p^{-3})^{-3}$

Raising a Product to a Power
For any nonzero real numbers x and y and any integer a
$$(xy)^a =$$

Ex 7) Simplify.

a. $(-4x)^2$ **b.** $(5a^9)^2$ **c.** $(-q^7r^8)^2$

d. $-6(a^5b^3)^3$ **e.** $(7x^{-4}y^{-1})^{-2}$

Raising a Quotient to a Power
For any nonzero real numbers x and y and any integer a
$$\left(\frac{x}{y}\right)^a =$$

Ex 8) Simplify.

a. $\left(\frac{y}{2}\right)^5$ **b.** $\left(\frac{u^4}{v^6}\right)^2$

c. $\left(\frac{-5a^5}{2b^2}\right)^3$ **d.** $\left(\frac{v^6}{u^4}\right)^{-2}$

Raising a Quotient to a Negative Power
For any nonzero real numbers x and y and any integer a $$\left(\frac{x}{y}\right)^{-a} =$$

Ex 9) Simplify. $\left(\frac{3x^3}{2y^2}\right)^{-4}$

Definition A number is in _____ if it is written in the form

$$a \times 10^n$$

where n is an integer and a is greater than or equal to 1 but less than 10 $(1 \leq a < 10)$

Note: With scientific notation, positive powers represent _____ numbers while negative powers represent _____ numbers.

Note: When converting a number from scientific notation to standard notation, move the decimal point to the _____ if the power of 10 is *positive* and to the _____ if the power of 10 is *negative*.

Ex 10) Express in standard notation.

a. 5.193×10^8 **b.** 4.82×10^{-7}

Ex 11) Write each number in scientific notation.

a. $4,000,000,000,000$ **b.** 0.000000000067

Ex 12) Carry out the computation. Express the result in scientific notation.

a. $(4 \times 10^4)(7 \times 10^3)$ **b.** $(1.32 \times 10^4) \div (6 \times 10^{-4})$