NOTES

Integral Exponents

Summary of Exponent Rules

for any integers m and n		Examples
Exponent of 1	$a^1 = a$	$5^1 = 5$; $(-7)^1 = -7$
Exponent of 0	$a^0 = 1, a \neq 0$,	$5^0 = 1$; $(-7)^0 = 1$
Product Rule	$(a^m)(a^n) = a^{m+n}$	$(2^2)(2^4) = 2^{2+4} = 2^6$ $(4)(16) = 64 = 2^6$
Quotient Rule	$\frac{a^m}{a^n} = a^{m-n}, a \neq 0$	$\frac{5^3}{5^2} = 5^{3-2} = 5^1 = 5$
Power Rules	$(a^m)^n = a^{mn}$ $(ab)^m = (a^m)(b^m)$ $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}, b \neq 0$	$(2^4)^2 = 2^{4\times 2} = 2^8$ $(3\cdot 7)^2 = 3^2 \cdot 7^2 = 9 \cdot 49 = 441 = 21^2 = 441$ $\left(\frac{x}{7}\right)^2 = \frac{x^2}{7^2} = \frac{x^2}{49} = \frac{1}{49} \cdot x^2$
Negative Exponents	$a^{-n} = \frac{1}{a^n}, a \neq 0$ $\frac{1}{a^{-n}} = a^n$ $\left(\frac{a}{b}\right)^{-n} = \left(\frac{b}{a}\right)^n$ $a \neq 0, b \neq 0$	$5^{-1} = \frac{1}{5^1} = \frac{1}{5}$ $\frac{1}{3^{-4}} = 3^{+4} = 81$ $\left(\frac{x}{3}\right)^{-5} = \left(\frac{3}{x}\right)^5$
Rational Exponents	$\sqrt[n]{a} = a^{\frac{1}{n}}$ $\sqrt[n]{a^m} = a^{\frac{m}{n}}$	$\sqrt{x} = x^{\frac{1}{2}}$ $\sqrt[3]{x^6} = x^{\frac{6}{3}} = x^2$

new !

extra !!

↑ Flower-Power Rule

Simplifying Integral Exponents

1. Simplify.

a) $(5^8)(5^{-3}) = 5^{8+(-3)} = 5^{8-3} = \boxed{5^5}$

Simply using positive exponents.

$(5^8)(5^{-3}) = \frac{5^8}{1} \cdot \frac{1}{5^3} = \frac{5^8}{5^3} = 5^{8-3} = \boxed{5^5}$

b) $(0.8^{-2})(0.8)^{-4}$

$= 0.8^{-2+(-4)} = \boxed{0.8^{-6}}$

$(0.8^{-2})(0.8)^{-4} = \left(\frac{8}{10}\right)^{-2}\left(\frac{8}{10}\right)^{-4}$

$= \left(\frac{5}{4}\right)^{2}\left(\frac{5}{4}\right)^{4} = \left(\frac{5}{4}\right)^{2+4}$

$= \left(\frac{5}{4}\right)^{6}$

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

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

Your Turn:

a) $(2^{-3})(2)^5$

b) $\frac{7^{-5}}{7^3}$

c) $\frac{(-3.5)^4}{(-3.5)^{-3}}$

2. Simplify to a power with a single, positive exponent; evaluate where possible.

a) $\left(4^3\right)^{-2}$

b) $\left[\left(a^{-2}\right)\left(a^0\right)\right]^{-1}$

c) $\left(\frac{2^4}{2^6}\right)^{-3}$

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

Your Turn:

a) $\left[\left(0.6^3\right)(0.6)^{-3}\right]^{-5}$

b) $\left(\frac{x^6}{x^4}\right)^{-2}$

c) $\left[\frac{\left(y^2\right)^0}{y^3}\right]^{-3}$

3. A culture bacteria in a lab contains 2000 bacterium cells. The number of cells doubles every day. This relationship can be modeled by the equation $N = 2000(2)^t$, where **N** is the estimated number of bacteria cells and ***t*** is the time in days. How many cells were present after two days?

$N = 2000(2)^2$
$N = 8000$

There will be 8000 bacterium cells after 2 days of growth.

How many cells were present after one week? How many cells were present 2 days ago?

7 days

$N = 2000(2)^7$
$N = 256\,000$

-2

$N = 2000(2)^{-2}$
$N = 500$

4. A mountain pine beetle population can triple every year. If the population in Jasper National Park is 10,000 the formula for the population would be $P=10{,}000(3)^n$, n being the # of years.

How many beetles will there be 2 years from now?

$P = 10000(3)^2$
$P = 90000$

How many beetles were there 4 years ago?

$P = 10000(3)^{-4}$
$P \doteq 123$

5. There are ~ 117 billion grasshoppers in an area of 39,000 km². How many are there per square kilometer? Use exponents to solve.

$$\frac{117 \times 10^9}{3.9 \times 10^4} = \frac{117}{3.9} \times 10^{9-4} = 30 \times 10^5$$

$$= 3000000$$

$$= 3.0 \times 10^6 \text{ grasshoppers}$$