

Properties of Exponents
Day 1

I. Exponents

In X^a : x is the base a is the exponent

Examples:

1) Which is the base and which is the exponent of 5^3 ? 5 is the base & 3 is the exponent

2) Evaluate the following: a) $2^4 = 16$ b) $6^4 = 1296$ c) $8^2 = 64$

(2) (1) (4)

II. Exponential vs. Expanded vs. Standard

$(4^3 = 4 \cdot 4 \cdot 4 = 64)$

Examples:

1) Write the following in expanded form

a) $2^6 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$ b) $x^3 = x \cdot x \cdot x$ c) $7^2 = 7 \cdot 7$

2) Write the following in exponential form

a) $3 \cdot 3 \cdot 3 \cdot 3 = 3^4$ b) $y \cdot y \cdot y = y^3$ c) $4 \cdot 4 \cdot 4 \cdot x \cdot x = 4^3 \cdot x^2$

III. Negative bases

*You have to be very careful when working with exponents whose bases are negative

* A negative base with an even exponent equals a positive number

$(-3)^2 = (-3) \cdot (-3) = 9$ $- \cdot - = +$

* A negative base with an odd exponent equals a negative number

$(-3)^3 = (-3) \cdot (-3) \cdot (-3) = -27$ $- \cdot - \cdot - = -$

* A base with a negative sign in front equals a negative number

$-3^3 = -(3 \cdot 3 \cdot 3) = -27$ $-9^2 = -(9 \cdot 9) = -81$
 $-1 \cdot 3^3 = -27$ $-1 \cdot 9^2 = -81$

$(-3)^2 = -3^2$
 $9 \neq -9$

Examples: Simplify the following

1) -5^2
 $-1 \cdot 5^2$
 $-1 \cdot 25$
 -25

2) $(-6)^2$
 $(-6)(-6)$
 36

3) $(-8)^3$
 $(-8)(-8)(-8)$
 -512

4) -2^4
 $-1 \cdot 2^4$
 $-1 \cdot 16$
 -16

or $-(2 \cdot 2 \cdot 2 \cdot 2)$

→ Exponential
IV. Zero & Negative exponents

| | | | | | | | | |
|-----------------------------|---------------------|-------------|----------|----------|---------------|-----------------|-----------------|-----------------|
| 5^4 | 5^3 | 5^2 | 5^1 | 5^0 | 5^{-1} | 5^{-2} | 5^{-3} | 5^{-4} |
| $5 \cdot 5 \cdot 5 \cdot 5$ | $5 \cdot 5 \cdot 5$ | $5 \cdot 5$ | 5 | 1 | $\frac{1}{5}$ | $\frac{1}{5^2}$ | $\frac{1}{5^3}$ | $\frac{1}{5^4}$ |
| 625 | 125 | 25 | 5 | 1 | $\frac{1}{5}$ | $\frac{1}{25}$ | $\frac{1}{125}$ | $\frac{1}{625}$ |
| Standard | $\div 5$ | $\div 5$ | $\div 5$ | $\div 5$ | $\div 5$ | $\div 5$ | $\div 5$ | $\div 5$ |

Reciprocal

| | | | | | | | | |
|-----------------------------|---------------------|-------------|----------|----------|---------------|-----------------|-----------------|-----------------|
| 2^4 | 2^3 | 2^2 | 2^1 | 2^0 | 2^{-1} | 2^{-2} | 2^{-3} | 2^{-4} |
| $2 \cdot 2 \cdot 2 \cdot 2$ | $2 \cdot 2 \cdot 2$ | $2 \cdot 2$ | 2 | 1 | $\frac{1}{2}$ | $\frac{1}{2^2}$ | $\frac{1}{2^3}$ | $\frac{1}{2^4}$ |
| 16 | 8 | 4 | 2 | 1 | $\frac{1}{2}$ | $\frac{1}{4}$ | $\frac{1}{8}$ | $\frac{1}{16}$ |
| $\div 2$ | $\div 2$ | $\div 2$ | $\div 2$ | $\div 2$ | $\div 2$ | $\div 2$ | $\div 2$ | $\div 2$ |

| The Zero Power | | |
|--|---|----------------------------|
| Words | Numbers | Algebra |
| The Zero powers of any number (except 0) is 1. | $10^0 = 1$ $5^0 = 1$ $-5^0 = -1$ $x^0 = 1$ | $a^0 = 1$ if $a \neq 0$ |

$(100)(\pi)(0) =$

Examples: Simplify the following

1) $7^0 = 1$

2) $15^0 = 1$

3) $8^0 = 1$

4) $x^0 = 1$

5) $(-10)^0 = 1$

6) $-10^0 = -1$

7) $(\frac{1}{3})^0 = 1$

8) $(4x)^0 = 1$

$-1 \cdot 10^0$
 $-1 \cdot 1$
 9) $4x^0 = 4$
 $4 \cdot x^0$
 $4 \cdot 1$

Negative Exponents

| Words | Numbers | Algebra |
|---|--|---|
| Any non-zero number raised to a negative power equals 1, divided by that number raised to the positive power (reciprocal) | $5^{-3} = \frac{1}{5^3} = \left(\frac{1}{125}\right)$ $2^{-2} = \frac{1}{2^2} = \left(\frac{1}{4}\right)$ | $b^{-n} = \frac{1}{b^n}$ if $b \neq 0$ |

Examples: Simplify

(5) (1) (-3) (2nd) (PRB)

1) $10^{-2} = \frac{1}{10^2} = \left(\frac{1}{100}\right)$

2) $x^{-7} = \left(\frac{1}{x^7}\right)$

3) $2^{-6} = \frac{1}{2^6} = \left(\frac{1}{64}\right)$

(10) (1) (-2) (2nd) (PRB)

4) $(-3)^{-4} = \frac{1}{(-3)^4} = \left(\frac{1}{81}\right)$

5) $y^{-3} = \left(\frac{1}{y^3}\right)$

6) $(-2)^{-5} = \frac{1}{(-2)^5} = \frac{1}{-32} = \left(-\frac{1}{32}\right)$

Mixed Examples

1) $6^{-4} = \frac{1}{6^4} = \left(\frac{1}{1296}\right)$

2) $12^0 = \left(1\right)$

3) $8^{-1} = \frac{1}{8^1} = \left(\frac{1}{8}\right)$

4) $b^{-3} = \left(\frac{1}{b^3}\right)$

5) $347^0 = \left(1\right)$

6) $15^{-2} = \frac{1}{15^2} = \left(\frac{1}{225}\right)$

7) $20^{-2} = \frac{1}{20^2} = \left(\frac{1}{400}\right)$

8) $a^{-5} = \left(\frac{1}{a^5}\right)$

9) $0^0 = \left(0\right)$

$7x^0 = 7$

$(7x)^0 = 1$

