1 Positive Integer Exponents

$9 = 3 \cdot 3 = 3^2$

$27 = 3 \cdot 3 \cdot 3 = 3^3$

$81 = 3 \cdot 3 \cdot 3 \cdot 3 = 3^4$

Exponents count how many times factors repeat in a number. 3^4 is pronounced "three to the fourth power" or "three to the fourth."

Example

$248,832 = 12 \cdot 12 \cdot 12 \cdot 12 \cdot 12 = 12^5$

A note on pronunciation $4\ 4 = 4^2$ can be pronounced "four to the second"—but also "four squared." Similarly, $4\ 4\ 4 = 4^3$ can be pronounced "four to the third"—but also "four cubed."

2 Zero as an Exponent

$1^0 = 1$

$2^0 = 1$

$3^0 = 1$

$(2\pi)^0 = 1$

$\frac{x^1}{x^1} = 1$

Definition By the definition of exponents, any number, except for zero, raised to the zeroth power is one. Note that 0^0 is undefined.

3 Negative Integer Exponents

$2^{-1} = \frac{1}{2} = \frac{1}{2^1}$

$2^{-2} = \frac{1}{4} = \frac{1}{2^2}$

$2^{-3} = \frac{1}{8} = \frac{1}{2^3}$

$= 2^1 = 2$ $= 2^2 = 4$ $= 2^3 = 8$

General rule

$$x^{-n} = \frac{1}{x^n}$$

$$\frac{1}{x^{-n}} = x^n$$

4 Scientific Notation

Mass of the Earth (kg)

$$5,\,972,\,000,\,000,\,000,\,000,\,000,\,000,\,000$$

$$= 5.972 \times 10^{24}$$

Mass of an electron (kg)

$$0.00000000000000000000000000009109$$

$$= 9.109 \times 10^{-31}$$

Keep the significant digits, and there is always one digit to the left of the decimal.