Fast Growth, Slow Growth: Using Integer Exponents

Video companion

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

2 Zero as an Exponent

$$1^{0} = 1$$
 $(2\pi)^{0} = 1$ $(\frac{1}{x^{3}})^{0} = 1$ $3^{0} = 1$

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

$$2^{-1} = \frac{1}{2^{1}} = \frac{1}{2}$$
$$2^{-2} = \frac{1}{2^{2}} = \frac{1}{4}$$
$$2^{-3} = \frac{1}{2^{3}} = \frac{1}{8}$$

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

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

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

General rule

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

4 Scientific Notation

Mass of the Earth (kg)

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

= 5.972×10^{24}

Mass of an electron (kg)

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