

## 1. Negative Exponents

What is  $4^{-2}$ ?  $\frac{1}{4^2}$

What is  $8^{-7}$ ?  $\frac{1}{8^7}$

What is  $(-3)^{-5}$ ?  $\frac{1}{(-3)^5}$

A power to a negative exponent is equal to 1 over that power to the <sup>positive</sup> exponent.

## 2. The Product Rule

What is  $6^3 \times 6^4$ ?  $= 6^{3+4}$

What is  $4^6 \times 4^{-3}$ ?  $= 4^{6-3}$

What is  ~~$5^3 \times 4^{-8}$~~ ?  
bases different  $\rightarrow$

When multiplying two powers with the

same base, add the exponents

## 3. The Quotient Rule

$$\text{What is } 5^5 \div 5^2? = 5^3$$

$$\text{What is } 4^7 \div 4^{-3}? = 4^{10}$$

$$\text{What is } 6^{-9} \div 6^{-2}? = 6^{-7} = \frac{1}{6^7}$$

When dividing two powers with the same base,  
subtract the exponents

## 4. Zero Exponents

What is  $4^0$ ? |

What is  $(-36)^0$ ? |

What is  $(-0.25)^0$ ? |

Any power to the exponent 0 is 1!

## 5. Power of a Power Rule

What is  $(4^2)^3$ ?  $= 4^6$

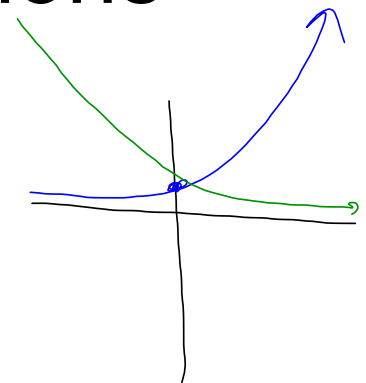
What is  $(-7^4)^5$ ?  $= +7^{20}$

What is  $(-3^6)^{-2}$ ?  $= 3^{-12}$

When you have a power raised to an exponent multiply the exponents.

# Exponential Functions

$$y = a \times b^x$$



"times"

**Initial Value**

**Base**

$$y = 0.01 \times 2^{30}$$

If  $b$  is greater than 1, the curve increases.

If  $b$  is less than 1, the curve decreases.

# Exponential Functions

$$y = 4 \times 2^x$$

$$y = 3 \times 0.5^x$$

Starts at 4 when  $x$  is 0

Each time  $x$  is increased by 1, it doubles!

# Exponential Growth and Decay

## Exponential Growth

An antique worth  $\$1,000$  is increasing in value by  $8.5\%$  per year.

$$y = 1000 \times (1 + 0.085)^x$$

$$y = 1000 \times (1.085)^x$$

Value in 30 yrs  $\Rightarrow x = 30$

Value 10 years ago  $\Rightarrow x = -10$

## Exponential Decay

A car worth  $\$25,000$  is decreasing in value by  $10\%$  each year.

$$y = 25000 \times (1 - 0.10)^x$$

$$y = 25000 \times (0.90)^x$$

Value in 5 years  $\Rightarrow x = 5$

Value 20 years ago  $\Rightarrow x = -20$



