Warm Up

1. If a colony of bacteria with a population of 1 million grows at an average rate of 5% per hour, how many bacteria will there be in 2 days (how many hours?)?

2. Use a table: If their environment can only support 100 million, about how long will it be until the population reaches that point?

Mon. Oct. 12

Objective: SWBAT solve exponential & logarithmic equations

Agenda:
- Warm Up
- Notes
- Practice
- Reflection

HW: 7-5G
13-43, choose a column

How did we solve non-exponential equations (like linear ones)?

How will we solve exponential & logarithmic equations

Notes: Logs & Exponentials

Logarithmic & exponential expressions are inverses of each other. so if we see

$\ln(5) = x$ or $\log(y) = 2.5$

We know that means

$e^x = 5$ or $10^{2.5} = y$

Notes: Exponential Equations

1. Isolate the exponential piece (there may be one on both sides)
2. Take the (common or natural) log of both sides
3. Solve for the variable

ex) $8^{x+4} = 32^{3x}$

Examples

1. $e^{2x} + 5 = 16$

2. $5^{3x+1} = 4^{x+1}$

Warm Up

Solve the equation $5e^{2x} + 1 = 11$

$-1 \quad -1$

$\frac{5e^{2x}}{5} = \frac{10}{5}$

$e^{2x} = 2$

$\ln(e^{2x}) = \ln 2$

$2x \ln e = \ln 2$ ($\ln e = 1$)

$\frac{2x}{2} = \frac{\ln 2}{2}$

$x \approx 0.35$

Notes: Logarithmic Equations

1. Isolate the log; identify the base
2. Undo the log by raising both sides as a power of the base
3. Solve for the variable

ex) $\frac{6\ln(x + 3)}{6} = \frac{24}{6}$

$\ln(x+3) = 4$ base $= e$

$e^{\ln(x+3)} = e^4$

$x + 3 = e^4$

$-3 \quad -3$

$x \approx 51.6$

Examples

1. $6 + 2\log(5x) = 18$

$-6 \quad -6$

$\frac{2\log 5x}{2} = \frac{12}{2}$

base $= 10$

$10^{\log 5x} = 10^6$

$\frac{5x}{5} = \frac{1{,}000{,}000}{5}$

$x = 200{,}000$

2. $\log_8(x^3) = 12$

base $= 8$

$\log_8(x^3) = 12$

$8^{\log x^3} = 8^{12}$

$x^3 = 8^{12}$

$\sqrt[3]{x^3} = \sqrt[3]{8^{12}}$

$x = 4096$

Note about Inverses

Finding an inverse to an exponential/log function is the same as solving it, except that there are 2 variables.

ex) $y = 3^{x-2} + 1$

$x = 3^{y-2} + 1$

$-1 \quad -1$

base $= 3$

$x - 1 = 3^{y-2}$

$\log_3(x-1) = \log_3(3^{y-2})$

$\log_3(x-1) = y - 2$

$+2 \quad +2$

$y = \log_3(x-1) + 2$

ex) $y = \log_4(x + 1) - 4$

$x = \log_4(y+1) - 4$

$+4 \quad +4$

base $= 4$

$x + 4 = \log_4(y+1)$

$4^{x+4} = 4^{\log_4(y+1)}$

$4^{x+4} = y + 1$

$-1 \quad -1$

$y = 4^{x+4} - 1$

Practice

Precalculus pg. 196: 11-15, 28-32

Reflection

What is an advantage of solving with logarithms instead of using a table?