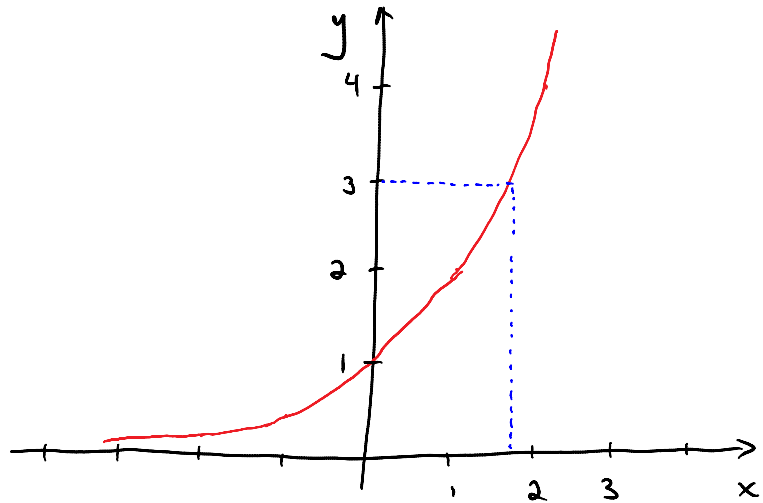


Section 5.2: Logarithmic Functions

Wednesday, November 19, 2014

8:32 AM

recall $y = 2^x$



for what value of x is $2^x = 3$?

from the graph, the answer is about 1.7 (ish)

but is there a procedure to find the exact value? yes!

let's start by examining base 10:

solve: $10^x = 7$

$$x = \log 7 \quad (\text{exact answer})$$

$$\approx 0.845098$$

logarithms allow you to get the variable out of the exponent

on calculator, calculate the following:

$$\begin{aligned}\log 1000 &= 3 \\ \log 100 &= 2 \\ \log 10 &= 1 \\ \log 1 &= 0 \\ \log 0.1 &= -1\end{aligned}$$

why?

$$\log 1000 = \log 10^3 = 3$$

↑
what exponent on 10 gives 10^3 ?

in general, logarithms are written as

$$\log_b x \leftarrow x \text{ is called the argument}$$

↑
b is the base

notation:

$$\text{common log: } \log_{10} x = \log x$$

$$\text{natural log: } \log_e x = \ln x$$

problem: many computer languages
use

$\log x$ to mean $\log_e x$

$\log_{10} x$ to mean $\log_{10} x$

practice: rewrite exponential equations in log form
and log equations in exponential form

$$m = 5^n$$

$$\log_5 m = n$$

base

$$p = \log_2 q$$

$$2^p = q$$

$$b^c = a$$

$$c = \log_b a$$

calculate without a calculator:

$$\log_3 9 = 2 \quad \text{because} \quad 9 = 3^2$$

$$\log_5 125 = \log_5 5^3 = 3$$

$$\log_2 32 = 5$$

$$\log_7 \frac{1}{7} = \log_7 7^{-1} = -1$$

$$\log_8 1 = 0$$

$$\log_4 2 = \log_4 4^{\frac{1}{2}} = \frac{1}{2}$$

note: $\log 0 = \text{DNE}$ or undefined

$\log -3 = \text{DNE}$ or undefined

Solve, giving an exact answer and a decimal approx to 3 decimal places

$$10^{x+2} = 0.2$$

$$x+2 = \log 0.2$$

$$x = \log 0.2 - 2$$

$$= -2 + \log 0.2$$

$$\approx -2.69897$$

$$\approx -2.699$$

~~$\log(-1.8)$~~

← exact answer

solve:

$$e^{5x} = 157$$

$$5x = \ln 157$$

$$x = \frac{1}{5} \ln 157$$

← exact

$$\approx 1.01125$$

$$\approx 1.011$$

solve

$$2e^x = 250$$

$$e^x = 125$$

$$x = \ln 125 \quad \leftarrow \text{exact}$$

$$\approx 4.82831$$

$$\approx 4.828$$