Logarithmic Functions

Evaluate + Estimate Logarithms

- A logarithm is an exponent: $y = \log_b x \iff b^y = x$
  (Logarithmic Form) (Exponential Form)

- Evaluate + Estimate logarithms

Mentally

- $\log_4 50 \approx \boxed{2.7}$

Change of Base Identity $\boxed{\log_a b = \frac{\log b}{\log a}}$

- $\log_4 50 = \frac{\log 50}{\log 4}$
  $\approx \boxed{2.8}$

Laws of Logarithms

Product Law - $\log_b (M \cdot N) = \log_b M + \log_b N$

Quotient Law - $\log_b \left(\frac{M}{N}\right) = \log_b M - \log_b N$

Power Law - $\log_b (M^n) = n \cdot \log_b M$

- Use laws to simplify or expand logarithmic expressions.

Solve Exponential Equations

Previously

Common Base

$2^x = 4$
$2^x = 2^2$
$x = 2$

Graphically

$2^x = 4$
$Y_1 = 2^x$
$Y_2 = 4$
} CALC INTERSECT

Using Logarithms

Change Form

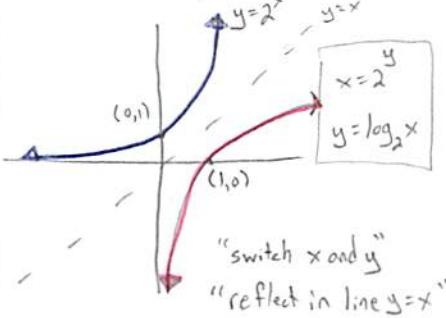
$2^x = 4$
$x = \log_2 4$
$x = \frac{\log 4}{\log 2}$

Log Both Sides

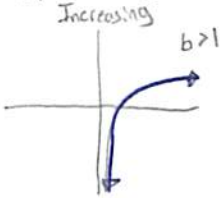
$2^x = 4$
$\log 2^x = \log 4$
$x \log 2 = \log 4$
$x = \frac{\log 4}{\log 2}$

Logarithmic Function - $y = \log_b x$

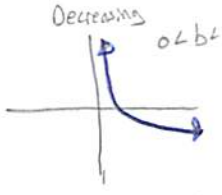
- Inverse of Exponential Function



- Types of Logarithmic Functions



D: $x > 0, x \in R$
R: $y \in R$



x-int: one (often x=1)
y-int: none

Modelling

- Perform a logarithmic regression with Graphing Calculator.

9: LnReg → $y = a + b \cdot \ln x$

$\ln x$ = natural logarithm
$= \log_e x$

- e is a special irrational #

Applications

- Earthquakes, Acidity, Loudness, ...
- Logarithmic Scale: an increase of 1 on the scale is 10 times the value.
- Types of Problems
  - ↳ Use given equation and variable to solve for unknown variable.
  - ↳ Comparison: $\frac{I_1}{I_2} = 10^{\text{difference on scale}}$