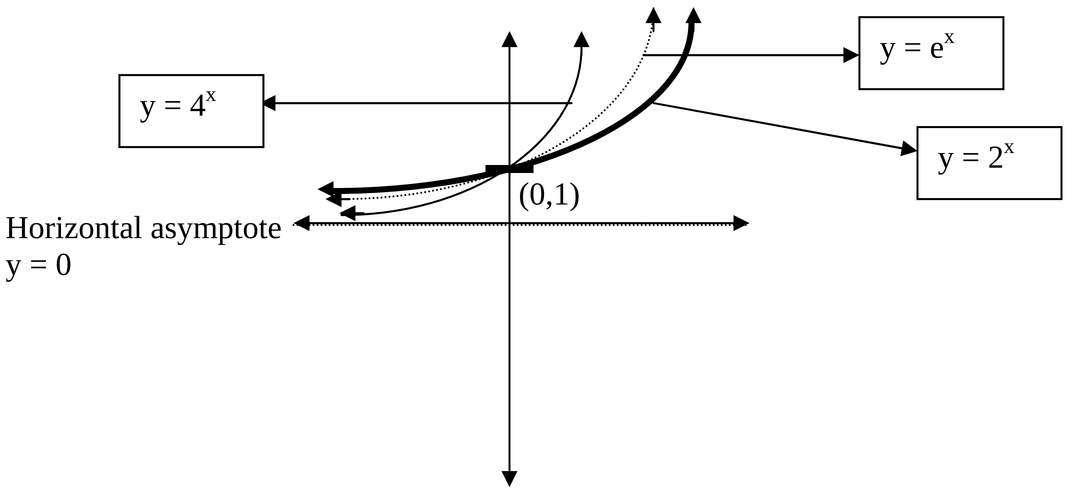
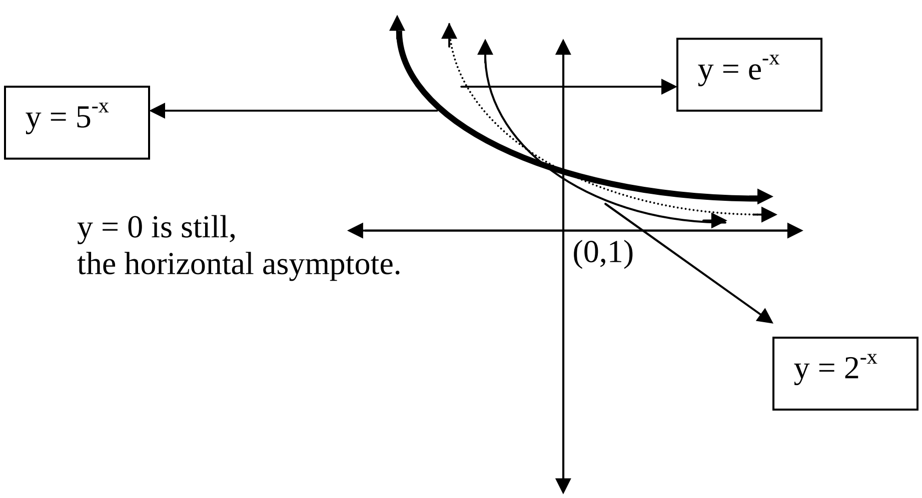
<u>Exponential Functions</u>

- Increasing functions typically has form of $y = \#^{x}$.
- Graphically, increasing function look like the graph below.



- The smaller the base, the slower the increase.
- The larger the number of the base, the quicker the increase.
- Note: e^x → behaves like these functions because e is a just a number with a value close to 2.71…
- The transformation rules still apply, so if you don't know them, please begin by practicing those first.

Decreasing functions,



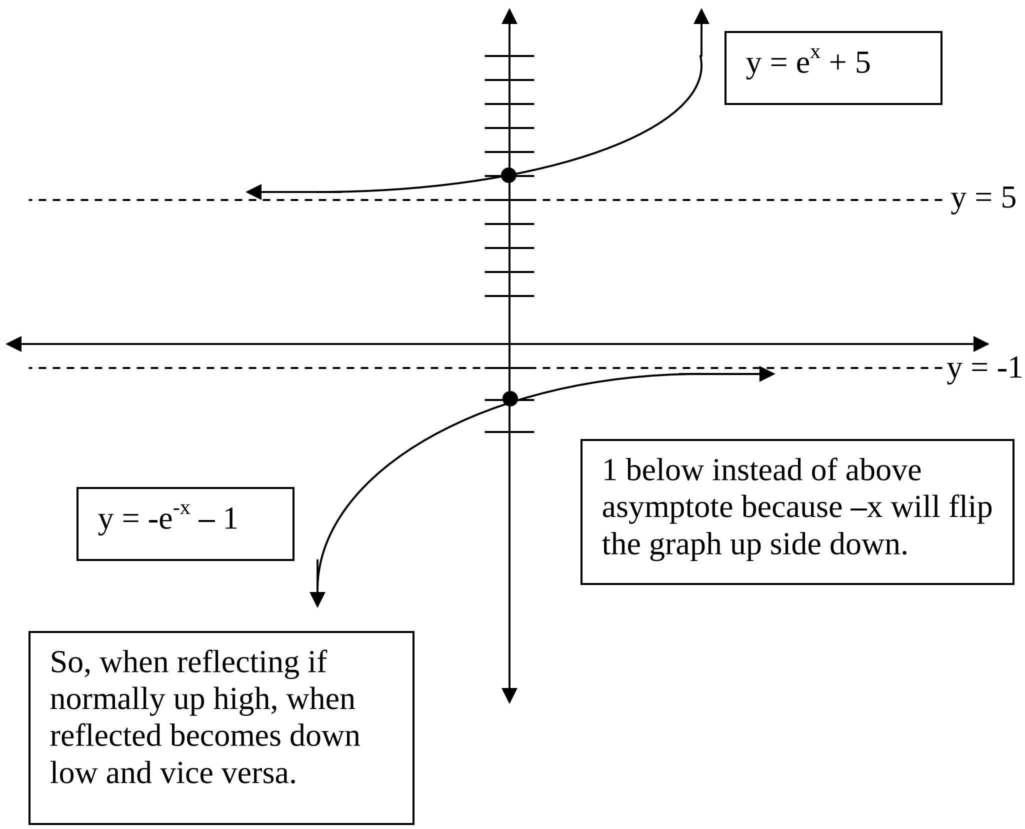
For decreasing functions, the smaller the base, the quicker the decrease, and the larger the base, the slower the descent.

Graph $y = -e^{-x} - 1$ and $y = e^{x} + 5$

Reflect about asymptote

Move everything down 1 unit

Move e^{x} graph up 5 units & asymptote & y – intercept.



<u>**Solving exponential equation**</u>

A. Same base required:

<u>Example</u>: $2^{x-1} = 8$

Steps:

1) Rewrite the 8 with a base of 2.

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

2) When bases are equal, set the exponents equal to each other and solve.

   $x - 1 = 3$
   $x = 4$

<u>Example</u>: $\left(\frac{1}{3}\right)^{(x+1)} = 9$

Steps:

1) Rewrite the 9 with a base of 3.

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

2) When a power is raised to another power, multiply the exponents.

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

3) Set the exponents equal to each other and solve for x.

   $-x-1 = 2$
   $-x = 3$
   $x = -3$

Logarithms

A. Exponent to log conversion and vice versa.

$\mathbf{\log_x y = z \leftrightarrow x^z = y}$

- Use this relationship to go either way.

Example: Solve without a calculator.

$\log_2 4$

Solution:

- Set equal to x → $\log_2 4 = x$
- Then, apply rule and solve.
- $2^x = 4$
- $2^x = 2^2$
- $x = 2$

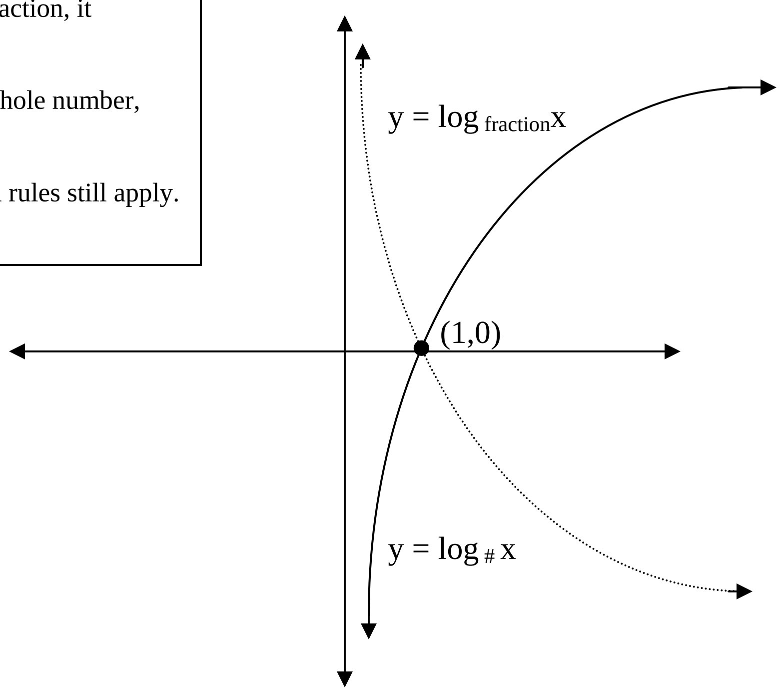
Graph

Vertical asymptote @ x = 0 (y – axis). Therefore, never negative and the domain is (-∞,∞).

If base of log is a fraction, it decreases.

If base of log is a whole number, then it increases.

*** Transformation rules still apply.



Special log rules:

$$\log_b xy = \log_b x + \log_b y$$

$$\log_b \frac{x}{y} = \log_b x - \log_b y$$

$$\log_b x^y = y \log_b x$$

$$\log_b b^x = x \log_b b = x$$

$$b^{\log_b x} = x$$

These rules can be used to simplify and solve equations by expanding or condensing when necessary.

Expanding…

$$\log_3 \sqrt{\frac{27r^5s}{t^3}}$$

1) Rewrite: $\log_3 \left(\frac{27r^5s}{t^3}\right)^{\frac{1}{2}}$

2) Bring down power.

$$\frac{1}{2}\log \frac{27r^5s}{t^3}$$

3) Separate top & bottom.

$$\frac{1}{2}\left[\log_3 27r^5s - \log_3 t^3\right]$$

4) Separate those that are multiplied: r and s.

$$\frac{1}{2}\left[\log_3 27 + \log_3 r^5 + \log_3 s - \log_3 t^3\right]$$

$$\frac{1}{2}\left[\log_3 27 + 5\log_3 r + \log_3 s - 3\log_3 t\right]$$

$$\frac{1}{2}\ \log_3 27 + \frac{5}{2}\log_3 r + \frac{1}{2}\log_3 s - 3\log_3 t$$

$$\frac{3}{2} + \frac{5}{2}\log_3 r + \frac{1}{2}\log_3 s - 3\log_3 t$$

Condensing…

$$\frac{1}{3}\log_5 x + 2\log_5 y - \frac{3}{2}\log_5 z$$

1) Move coefficients back up to powers: $a\log x = \log x^a$

$$\log_5 x^{\frac{1}{3}} + \log_5 y^2 - \log_5 z^{\frac{3}{2}}$$

2) Combine using rules:

$$\log_5 x^{\frac{1}{3}} y^2 - \log_5 z^{\frac{3}{2}}$$

$$\log_5 \frac{x^{\frac{1}{3}} y^2}{z^{\frac{3}{2}}}$$