RULE OF LOGARITHMIC FUNCTION

Goal:

- to find the rule of a logarithmic function given its graph
- to find the rule of a logarithmic function or exponential function as the inverse of the other

When finding the rule of a logarithmic function from a graph we use the form:

$$y = \log_c [b(x-h)]$$

simplified from

$$f(x) = a\log_c [b(x-h)] + k$$

In this form the following properties are true:

$\boxed{\text{vertical asymptote: } x = h}$

$\boxed{x\text{-int} = \frac{1}{b} + h}$

x-int: $0 = \log_c [b(x-h)]$

$c^0 = b(x-h)$

$1 = b(x-h)$

$\frac{1}{b} = x - h$

$x = \frac{1}{b} + h$

Find the rule of a logarithmic function that has a domain of]-∞,4[and passes through the point (3.5,0) and (-9.5,27).

$h = 4$

$y = \log_c [b(x-4)]$

$x\text{-int} = \frac{1}{b} + h$

$3.5 = \frac{1}{b} + 4$

$-0.5 = \frac{1}{b}$

$b = \frac{1}{-0.5}$

$b = -2$

$y = \log_c [-2(x-4)]$

$27 = \log_c (-2(-9.5-4))$

$27 = \log_c (27)$

$c^{27} = 27$

$c = \sqrt[27]{27}$

≈ 1.13

$$y = \log_{\sqrt[27]{27}} [-2(x-4)]$$

More frequently, we determine the rule for a logarithmic function as the inverse of an exponential function.

Given the exponential function, $y = 3\left(\frac{1}{2}\right)^{-(x-1)} - 6$

find the inverse, logarithmic function.

$$x = 3\left(\frac{1}{2}\right)^{y-1} - 6$$

$$x+6 = 3\left(\frac{1}{2}\right)^{y-1}$$

$$\frac{x+6}{3} = \left(\frac{1}{2}\right)^{\underline{y-1}}$$

switch to logarithmic form

$$y-1 = \log_{\frac{1}{2}}\left(\frac{x+6}{3}\right)$$

$$y = \log_{\frac{1}{2}}\left(\frac{x+6}{3}\right) + 1$$

$$f^{-1}(x) = \log_{\frac{1}{2}}\left(\frac{1}{3}(x+6)\right) + 1$$

Given the logarithmic function $y = -\log_6\left(2\left(x+8\right)\right)+4$

find the inverse exponential function.

p. 185 #7, 8

p. 186 #12

$$x = -\log_6(2(y+8))+4$$

$$x-4 = -\log_6(2(y+8))$$

$$-x+4 = \log_6(2(y+8))$$

$$6^{-x+4} = 2(y+8)$$

$$\frac{1}{2}(6)^{-x+4} = y+8$$

$$y^{-1} = \frac{1}{2}(6)^{-(x-4)} - 8$$

Compound Interest Handout

$(3, 4504.65)$
$(1, 4161.60)$

#5. $A = P\left(1+\frac{i}{n}\right)^{nt}$

$4504.65 = P\left(1+\frac{i}{2}\right)^{2(3)}$

$4504.65 = P\left(1+\frac{i}{2}\right)^{6}$ ①

$\div$

$4161.60 = P\left(1+\frac{i}{2}\right)^{2}$ ②

$1.082432 = \left(1+\frac{i}{2}\right)^{4}$

$\sqrt[4]{1.082432} = 1+\frac{i}{2}$

$1.02 = 1+\frac{i}{2}$

$0.02 = \frac{i}{2}$

$0.04 = i$ Interest rate = 4%