

4.5 Logarithmic functions

→ To find an **inverse** of a function algebraically, switch x and y and then rearrange to make y the subject.

So let's try it with logs... * $\log_a 8 = 3$

$f(x) = \log_a x$
 $f^{-1}(x) = a^x$
 $y = \log_a x$
 $x = \log_a y$
 $a^x = y$

$f(x) = \log_a x$
 $f(8) = \log_a 8$
 $f(8) = 3$

→ Generally if $f: x \mapsto a^x$ then $f^{-1}: x \mapsto \log_a x$
 $y = \log_a x$ is the inverse of $f = a^x$.

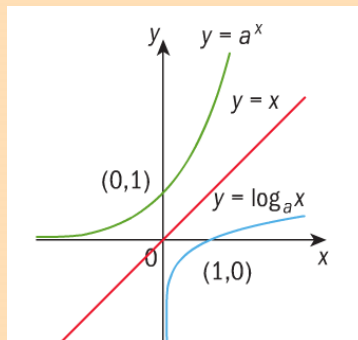
$f(x) = \log_{\text{crap}} x$
 $f^{-1}(x) = \text{crap}^x$

$f(x) = \log_{\text{!}}(x)$
 $f^{-1}(x) = \text{!}^x$

$g(x) = \log_{\text{fish}} x$
 $g^{-1}(x) = \text{fish}^x$

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The graph of $y = \log_a x$ is a reflection of $y = a^x$ in the line $y = x$.



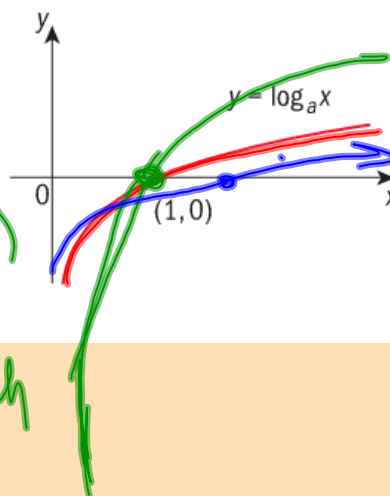
- A logarithmic function, $f(x) = \log_a x$, has these properties:
- the domain is the set of all positive real numbers
 - the range is the set of all real numbers
 - the curve does not intercept the y -axis
 - the y -axis is a vertical asymptote
 - the x -intercept is 1
 - the graph is continually increasing.

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Transformations of logarithmic functions

1 Given the function $f(x) = \log_a x$ describe the transformation required in each case to obtain the graph of $g(x)$

- a** $g(x) = \log_a(x) - 2$ down 2 • $(1, -2)$
- b** $g(x) = \log_a(x - 2)$ right 2 • $(3, 0)$
- c** $g(x) = 2\log_a x$



$g(x) = 2f(x)$ - vertical stretch $\times 2$

d $g(x) = \log_a\left(\frac{x}{2}\right)$



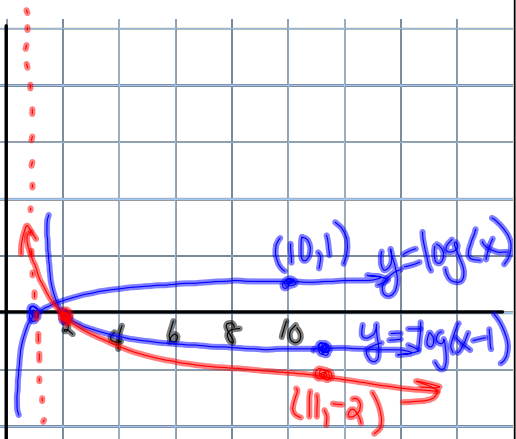
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EXAM-STYLE QUESTION

2 Sketch the graph of $y = -2\log(x - 1)$ without using a calculator. Include on your graph the intercepts with the two axes (if they exist).

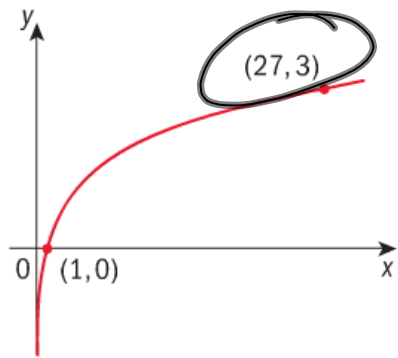
$y = \log(x)$

→ 1 space
flipped b/c -
v-stretch by 2



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- 4 The sketch shows the graph of $y = \log_a x$.
Find the value of a .



$$3 = \log_a(27)$$

$$a^3 = 27$$

$$a = 3$$

$$y = \log_3 x$$



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- 5 Given that $f(x) = \log_3 x$ find $f^{-1}(2)$

$$f^{-1}(x) = 3^x$$

$$f^{-1}(2) = 3^2$$
$$= 9$$



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