LOGARITHMS

Logarithmic Form	Exponential Form
$\log_a b = c$	$a^c = b$

Read a logarithm as: "log base a of b is c."

$$\log_4 16 = 2$$

The question you are answering is: "To what power do I raise 4 to get 16?"

Evaluate

$\log_6 36 =$

$\log_8 2 =$

$\log_3 \frac{1}{27} =$

$\log_4 8 =$

$\log 1000 =$

$\log_3 -9 =$

$\log_{32} 64 =$

$\log_7 7^{5.23} =$

$\log_{16} \frac{1}{2} =$

The value of $\log_3 56$ lies between which two consecutive integers?

A) 1 and 2

B) 2 and 3

C) 3 and 4

D) 4 and 5

The value of $\log_2 \square$ lies between 4 and 5. Find the missing integer so that this statement is true.

Base Change Formula

$$\log_a b = \frac{\log b}{\log a}$$

Evaluate using a calculator:

$\log_6 40 =$

$\log_3 19 =$

Properties of Logarithms

1) $\log_a 1 = 0$ because $a^0 = 1$

2) $\log_a a = 1$ because $a^1 = a$

3) $\log_a a^x = x$ because $a^x = a^x$

Also the inverse property

$$a^{\log_a x} = x \quad so \quad 4^{\log_4 17} = 17$$

4) The one-to-one property

If $\log_a x = \log_a y$

Then $x = y$

Example of one-to-one property

$$\log_2 (x-5) = \log_2 10$$

Solving logarithmic equations

Solve for x: $\log(5x+3) = \log 12$

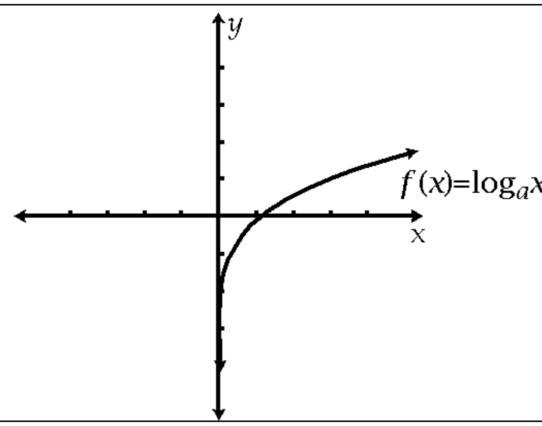
Solve for x: $\ln(x^2 - x) = \ln 6$

GRAPHING LOGARITHMIC FUNCTIONS

Standard Form: $y = a\log_n(bx - c) + d$

or

$y = a\ln(bx - c) + d$

Vertical Asymptote	Domain	Parent Function
To find the V.A., set bx-c=0 and solve for x. V.A.: x = #	To find the domain, set bx-c>0 and solve for x. Domain: x > #	

The Horizontal Axis (Not an Asymptote)

Given by: y = d

The Key Point

To find the x value of the key point, set bx-c=1 and solve for x. Then, substitute that value back into the equation to find the y value of the key point.

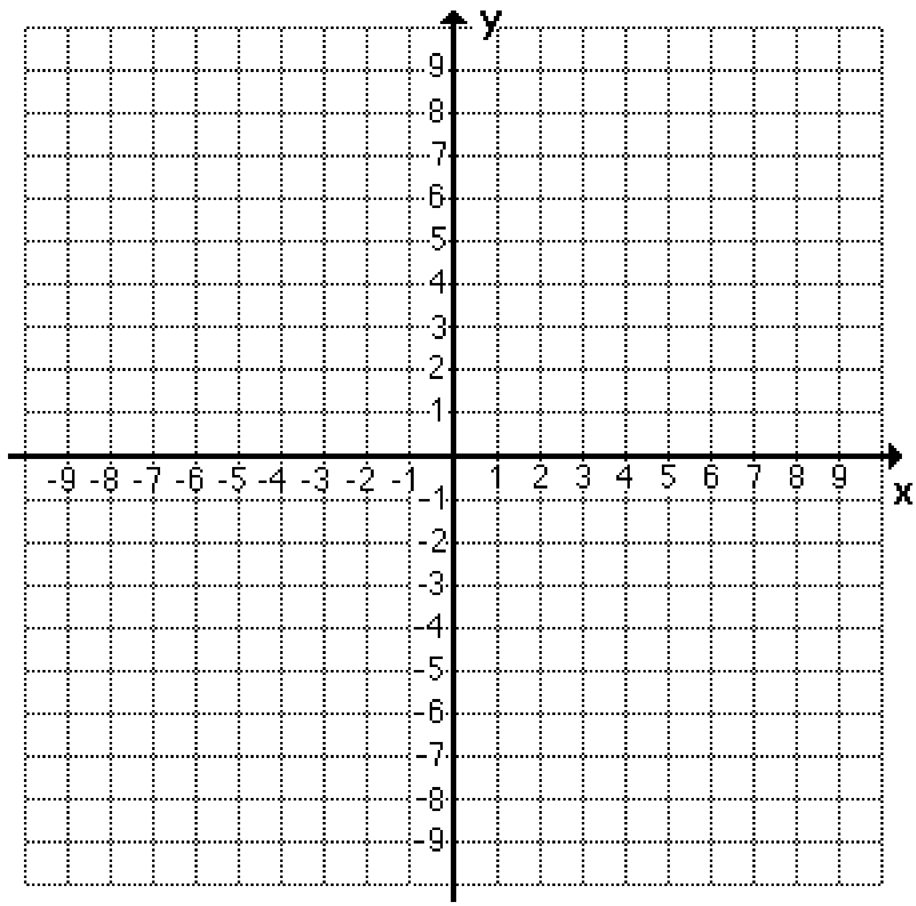
Example $y = 2\log_3(x+4) - 6$

The Shape of the Curve

When graphing logarithmic functions, you will move in terms of powers of the base.

For example, if the problem you are graphing is $y = \log_3 x$ **the movements, starting from the origin will be:**

- **Over 1, up 0.**
- **Over 3, up 1.**
- **Over 9, up 2.**
- **Over 27, up 3…etc.**



When dealing with transformations, we will find a "new origin."

Once we find the "new origin," all our movements will begin from that point.

Always remember, logarithmic functions have a tail end. You much draw that section for the graph to be complete.

Here are a couple of examples of transformations and using powers of the base to get the right curve.

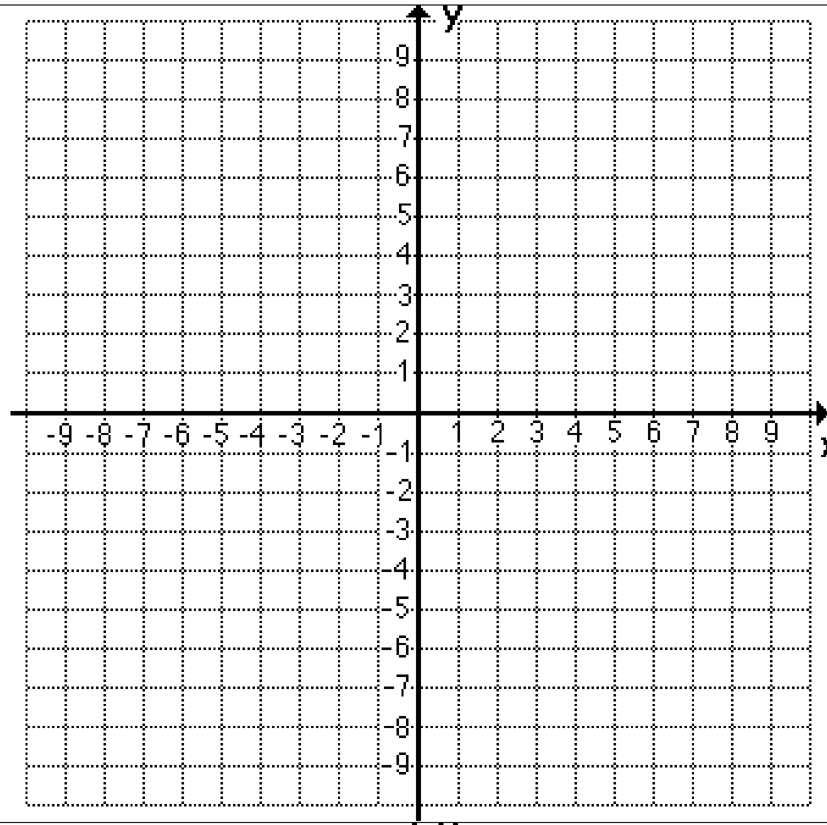
$y = \log_2(x+5)+2$

Vertical Asymptote:

Horizontal line of reference:

Movement

- **Over 1, up 0.**
- **Over 2, up 1.**
- **Over 4, up 2.**
- **Over 8, up 3.**
- **Over 16, up 4.**
- **…etc**



$y = 3\log_2(x+5)+2$

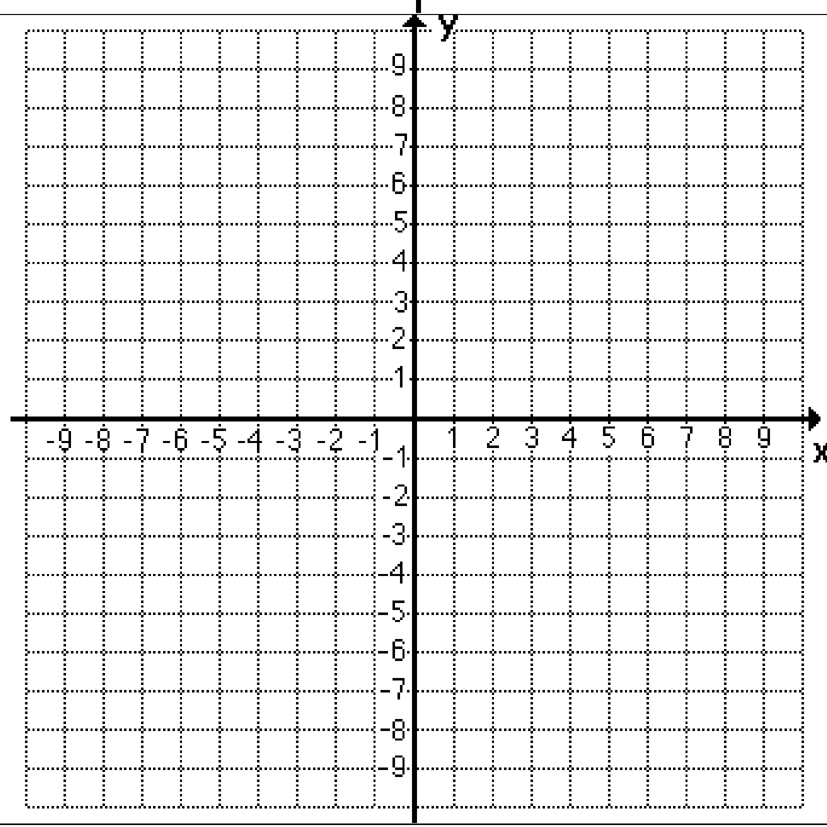
Vertical Asymptote:

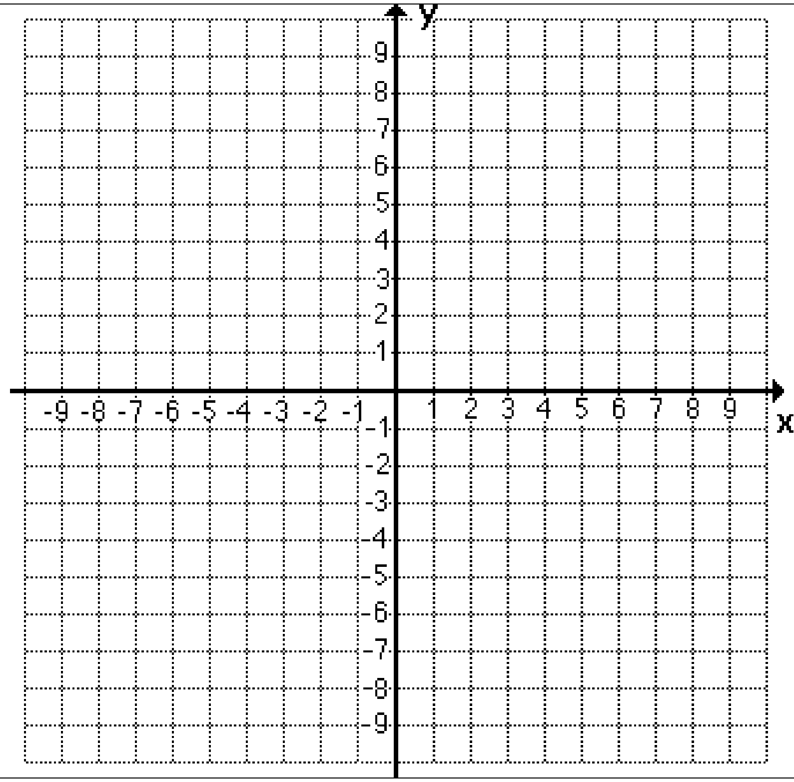
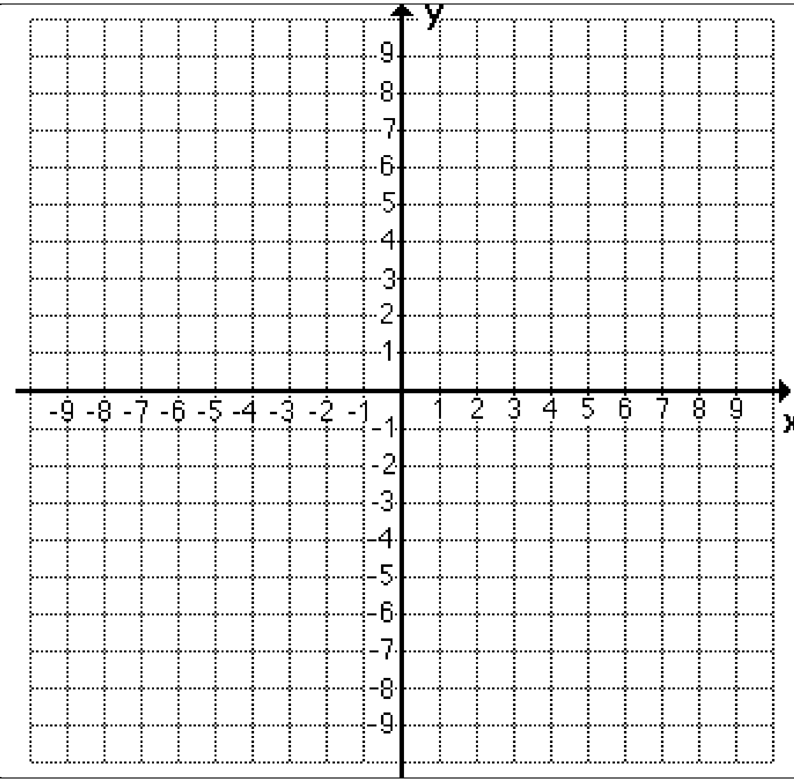
Horizontal line of reference:

Movement

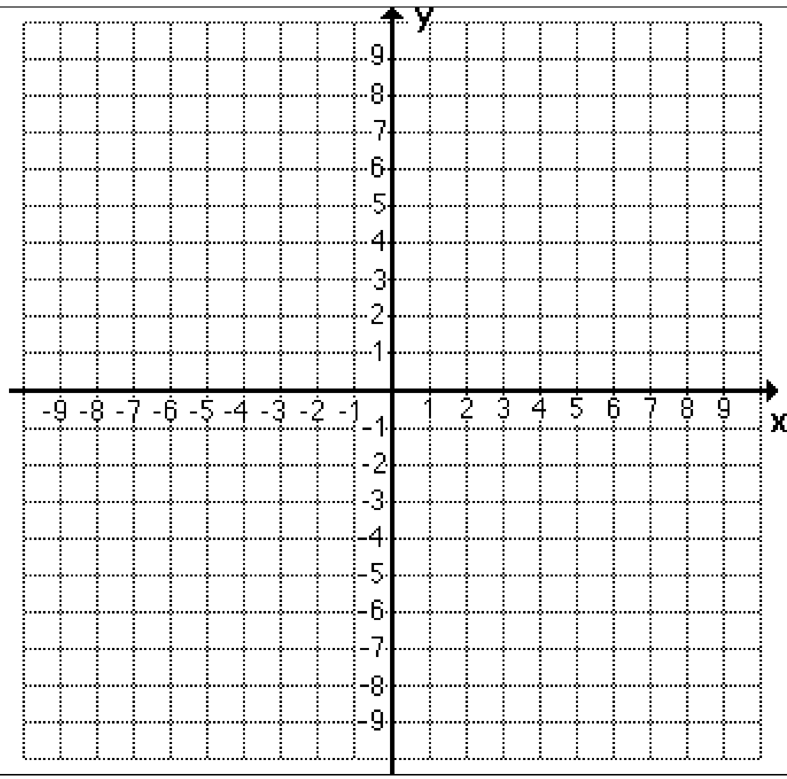
- **Over 1, up 0(3).**
- **Over 2, up 1(3).**
- **Over 4, up 2(3).**
- **Over 8, up 3(3).**
- **Over 16, up 4(3).**

…etc



A) $f(x)=\log_2(x+2)$	B) $f(x)=\log_3(x-1)+2$
	
Key point: **Vertical Asymptote:** **Y-intercept:** **X-intercepts:** **Domain:** **Range:**	**Key point:** **Vertical Asymptote:** **Y-intercept:** **X-intercepts:** **Domain:** **Range:**

C) $f\left(x\right)=\log_2\left(x+4\right)+6$



Key point:

Vertical Asymptote:

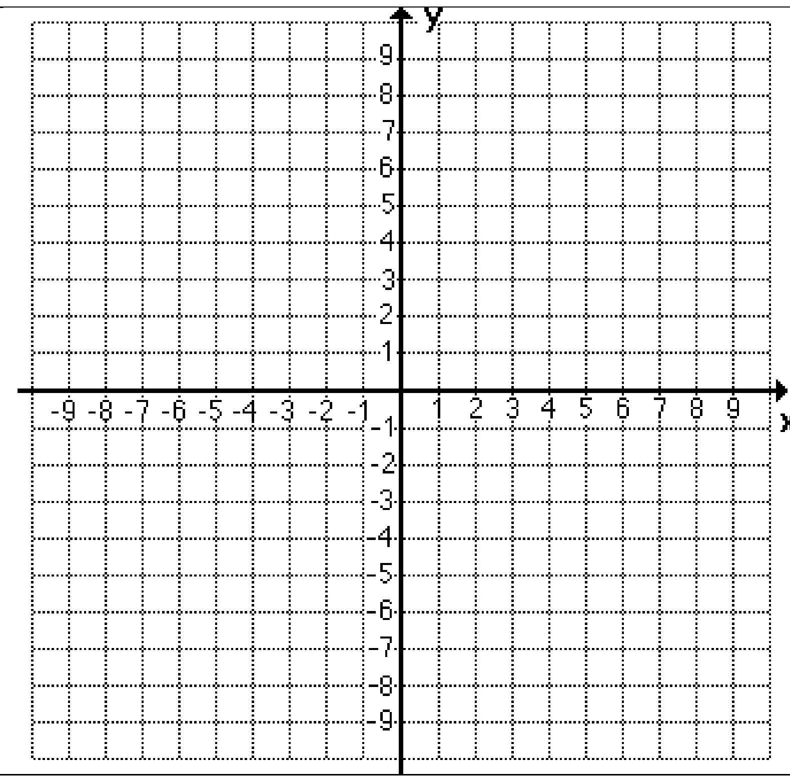
Y-intercept:

X-intercepts:

Domain:

Range:

D) $f\left(x\right)=2\log_4\left(x+7\right)-5$



Key point:

Vertical Asymptote:

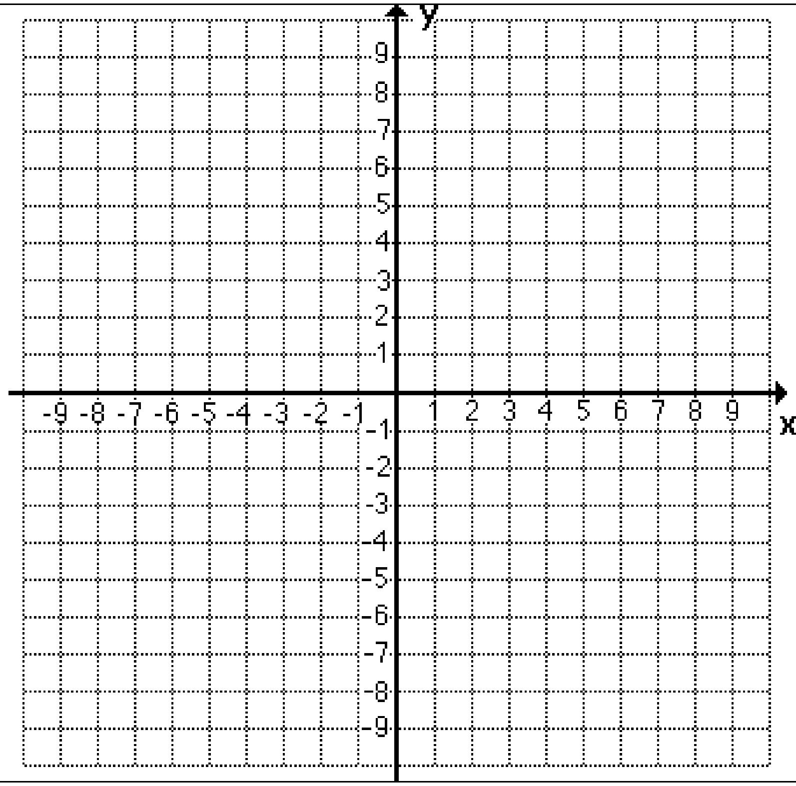
Y-intercept:

X-intercepts:

Domain:

Range:

E) $f(x) = -\ln(x-1) - 2$



Key point:

Vertical Asymptote:

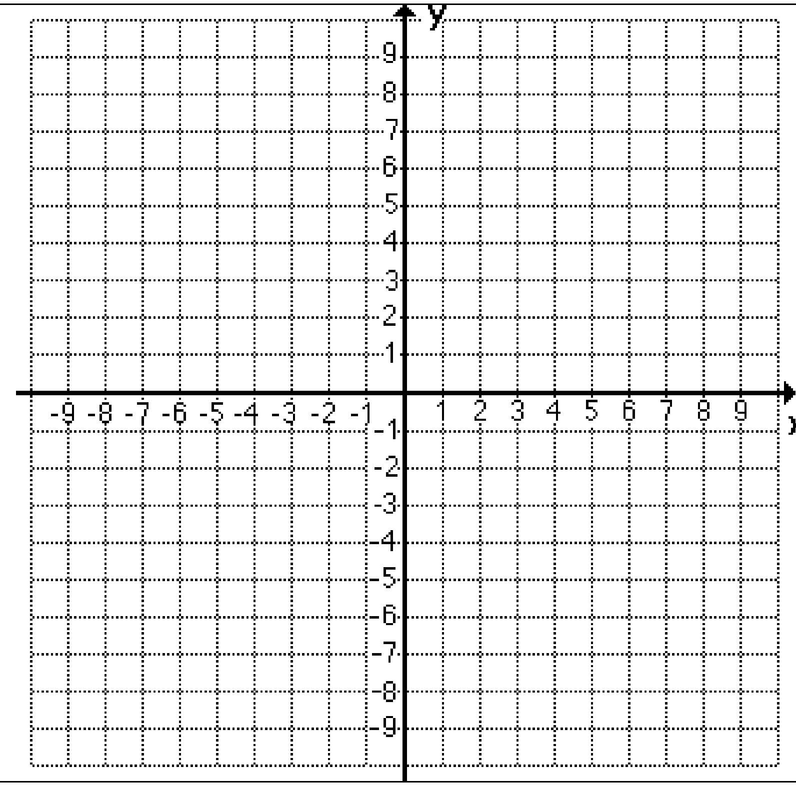
Y-intercept:

X-intercepts:

Domain:

Range:

F) $f(x) = 4 - \ln x$



Key point:

Vertical Asymptote:

Y-intercept:

X-intercepts:

Domain:

Range: