Topic: Graphing log functions

Question: Will the graph of the function have a vertical asymptote or a horizontal asymptote?

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

Answer choices:

A It will have a vertical asymptote at $x = -2$

B It will have a vertical asymptote at $x = 2$

C It will have a horizontal asymptote at $y = -2$

D It will have a horizontal asymptote at $y = 2$

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Solution: A

Because $y = \log_2(x + 2)$ is a logarithmic equation, its graph will have a vertical asymptote. To find it, we'll first use the general log rule to convert the logarithmic equation $\log_2(x + 2)$ to its exponential form,

$$2^y = x + 2$$

$$x = 2^y - 2$$

We'll then plug both $y = 100$ and $y = -100$ into the equation $x = 2^y - 2$, to see what happens to the value of x as $y \to \infty$ and as $y \to -\infty$.

For $y = 100$:

$$x = 2^{100} - 2$$

$$x = \text{a very large positive number} - 2$$

$$x = \text{a very large positive number}$$

$$x = \infty$$

For $y = -100$:

$$x = 2^{-100} - 2$$

$$x = \frac{1}{2^{100}} - 2$$

$$x = \frac{1}{\text{a very large positive number}} - 2$$

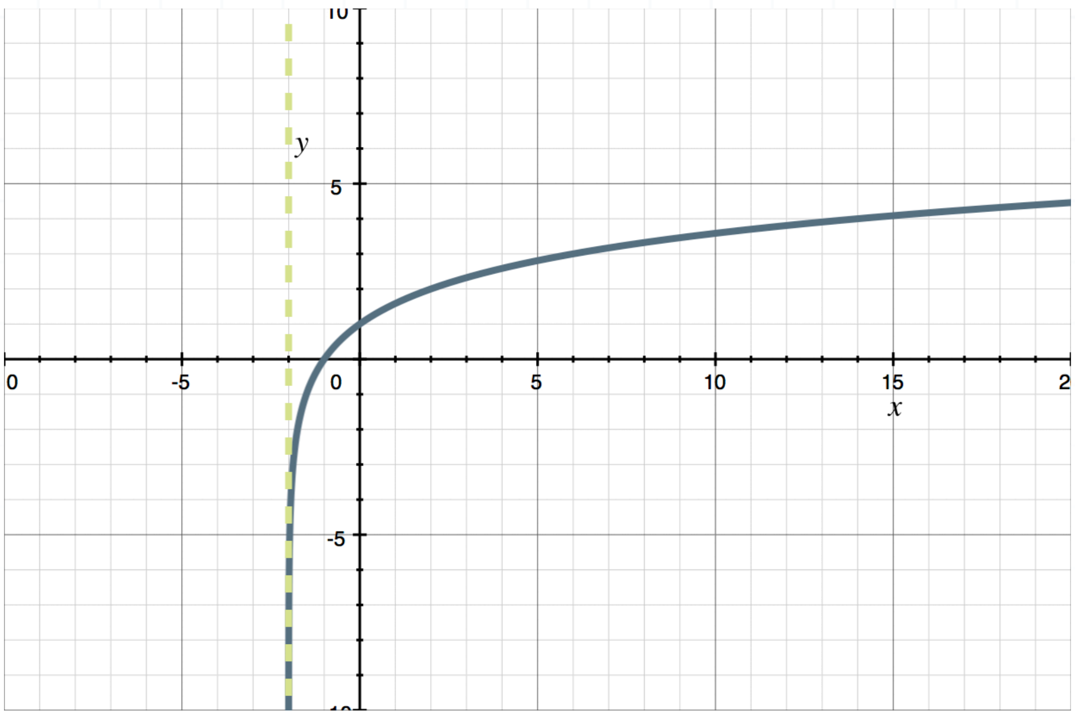
$$x = \text{a very small positive number} - 2$$

$$x = 0 - 2$$

$$x = -2$$

Plugging in $y = 100$ and $y = -100$ gives us a picture of the end behavior of the graph of the function. The results tell us that the function has a vertical asymptote at $x = -2$, and that the graph will tend toward ∞ as $x \to \infty$.

If we sketch the graph of the function, we can see this.



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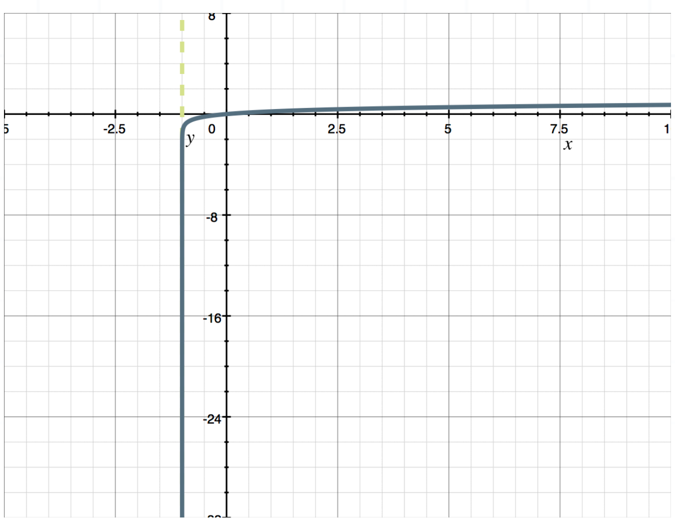
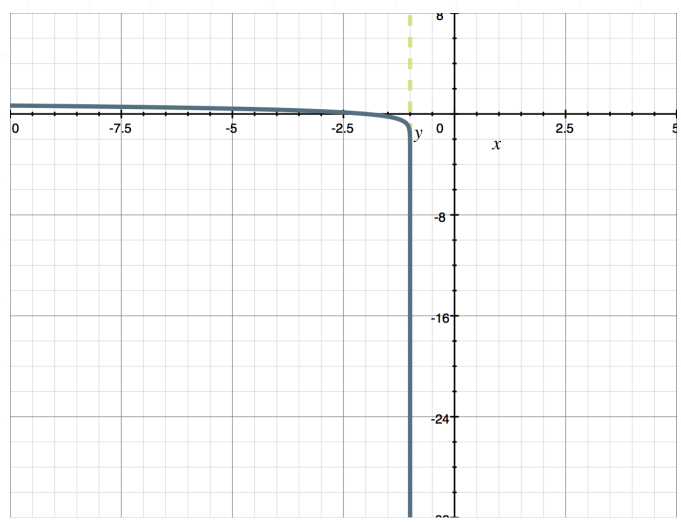
Topic: Graphing log functions

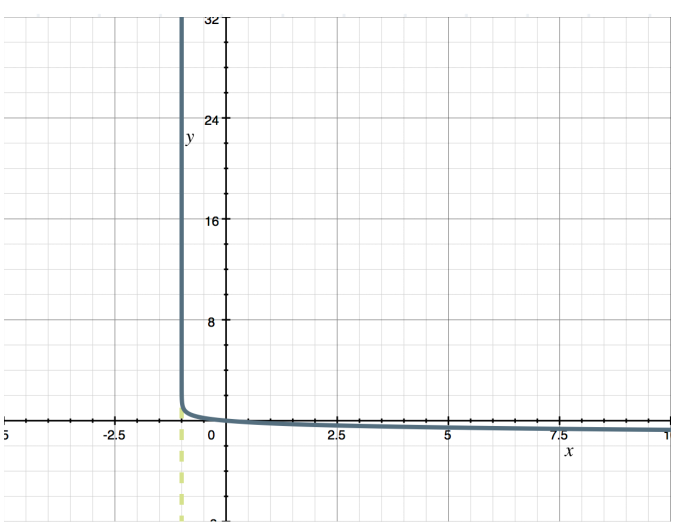
Question: Sketch the graph of the logarithmic function.

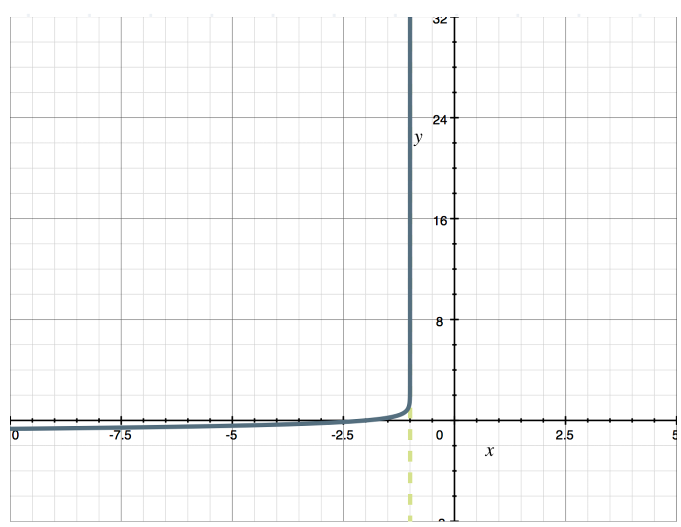
$$y = -\frac{1}{3}\log_3(x+1)$$

Answer choices:

A 

B 

C 

D 

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Solution: C

Use algebra to isolate the expression $\log_3(x+1)$.

$$y = -\frac{1}{3}\log_3(x+1)$$

$$-3y = \log_3(x+1)$$

Use the general log rule to convert this logarithmic equation to its exponential form.

$$3^{-3y} = x + 1$$

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

Plug in $y = 100$ and $y = -100$ to determine what happens to the value of x as $y \to \infty$ and as $y \to -\infty$.

For $y = 100$:

$$x = 3^{-3(100)} - 1$$

$$x = 3^{-300} - 1$$

$$x = \frac{1}{3^{300}} - 1$$

$$x = \frac{1}{\text{a very large positive number}} - 1$$

$$x = \text{a very small positive number} - 1$$

$$x = 0 - 1$$

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$$x = -1$$

For $y = -100$:

$$x = 3^{-3(-100)} - 1$$

$$x = 3^{300} - 1$$

$x =$ a very large positive number $- 1$

$x =$ a very large positive number

$$x = \infty$$

Therefore, $x = -1$ will be a vertical asymptote, and as x tends toward ∞, the function will curl down toward $-\infty$.

We'll plug in a few easy-to-calculate points, like $y = -1/3, 0, 1/3$ in order to get some points of the graph of the equation $x = 3^{-3y} - 1$ that we can plot.

For $y = 0$:

$$x = 3^{-3(0)} - 1$$

$$x = 3^0 - 1$$

$$x = 1 - 1$$

$$x = 0$$

For $y = -1/3$:

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

$$x = 3^1 - 1$$

$$x = 3 - 1$$

$$x = 2$$

For $y = 1/3$:

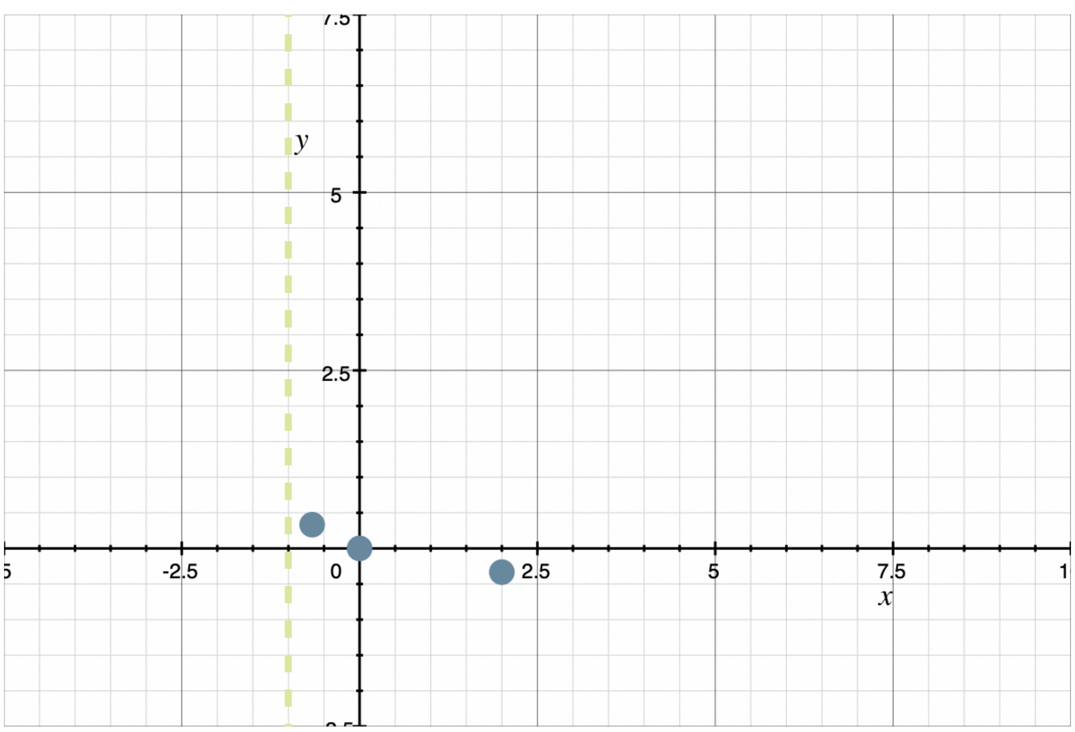
$$x = 3^{-3(1/3)} - 1$$

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

$$x = \frac{1}{3} - 1$$

$$x = -\frac{2}{3}$$

Now we have three points on the graph of the equation $x = 3^{-3y} - 1$: $(0,0)$, $(2, -1/3)$, and $(-2/3,1/3)$. If we plot these three points and draw the vertical asymptote, $x = -1$, we get



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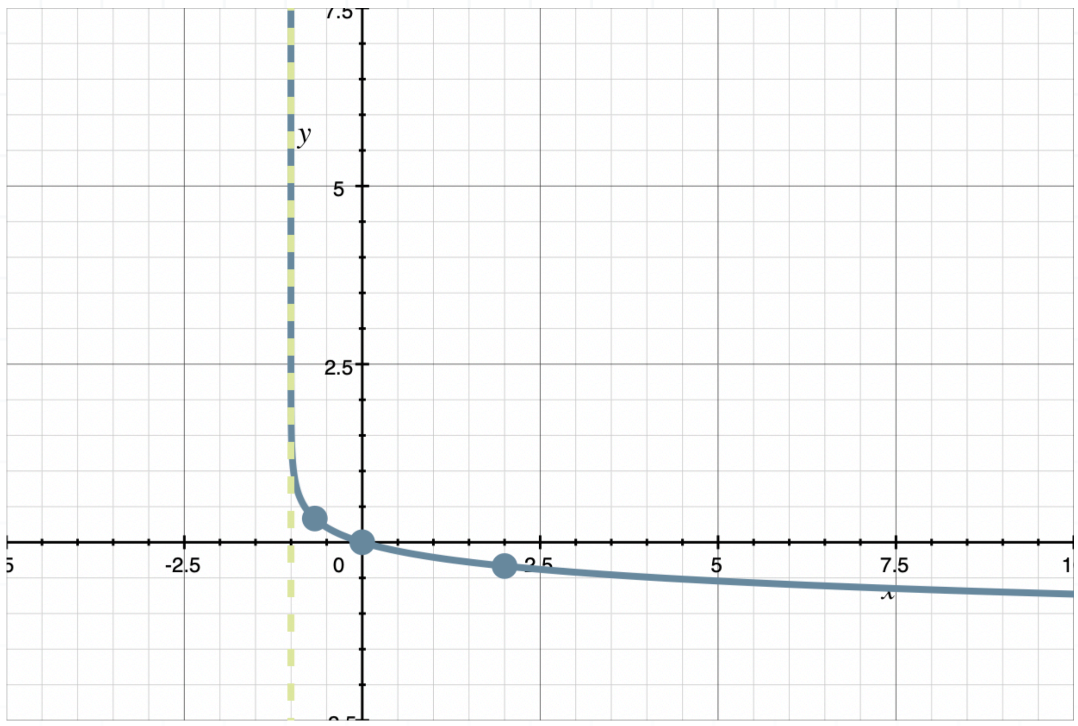
We can see, as we expected, that the exponential function will skim along the vertical asymptote $x = -1$, and then as $x \to \infty$, the function's value heads toward $-\infty$. Connecting the points on the function gives



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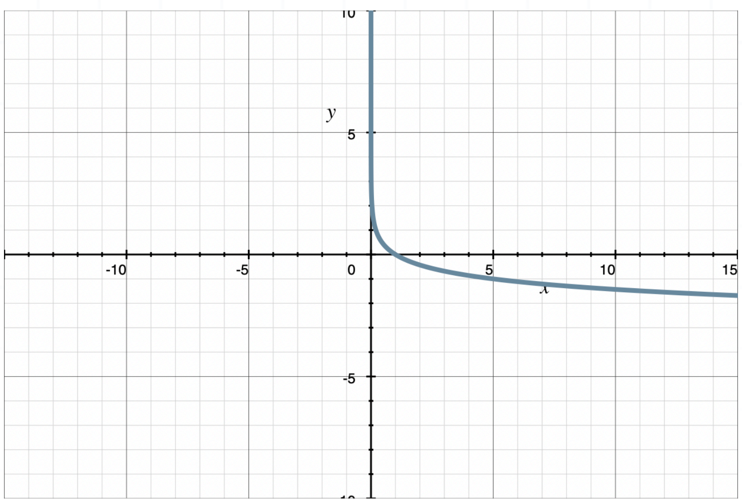
Topic: Graphing log functions

Question: Sketch the graph of the logarithmic function.

$$y = \log_5 x$$

Answer choices:

A



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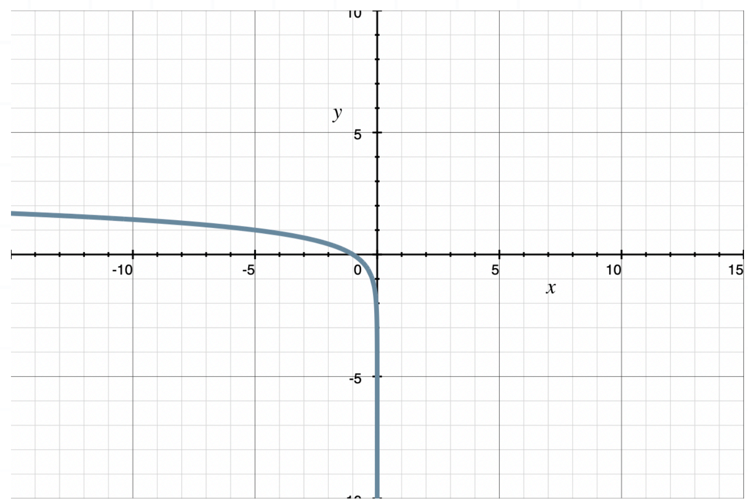

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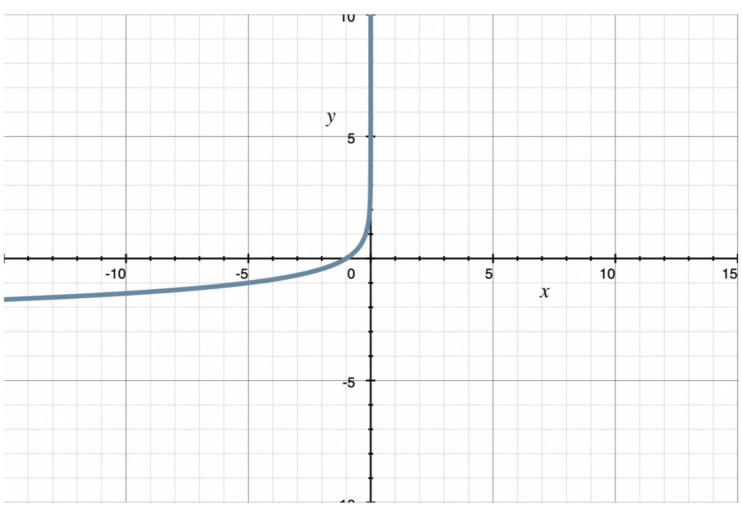

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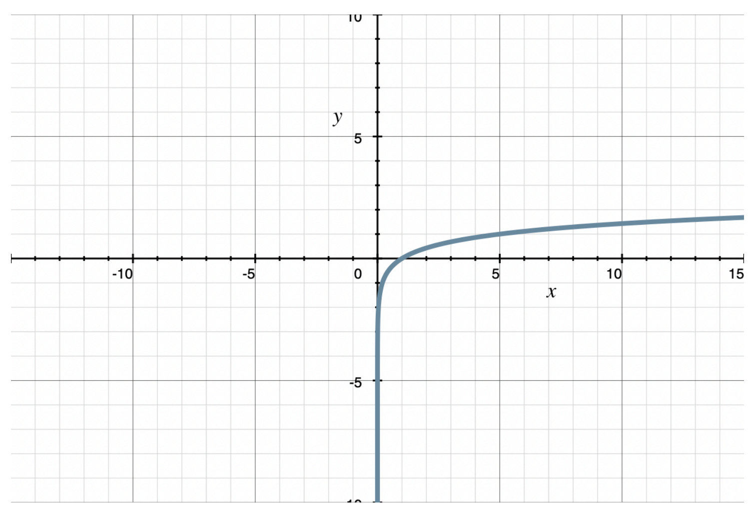

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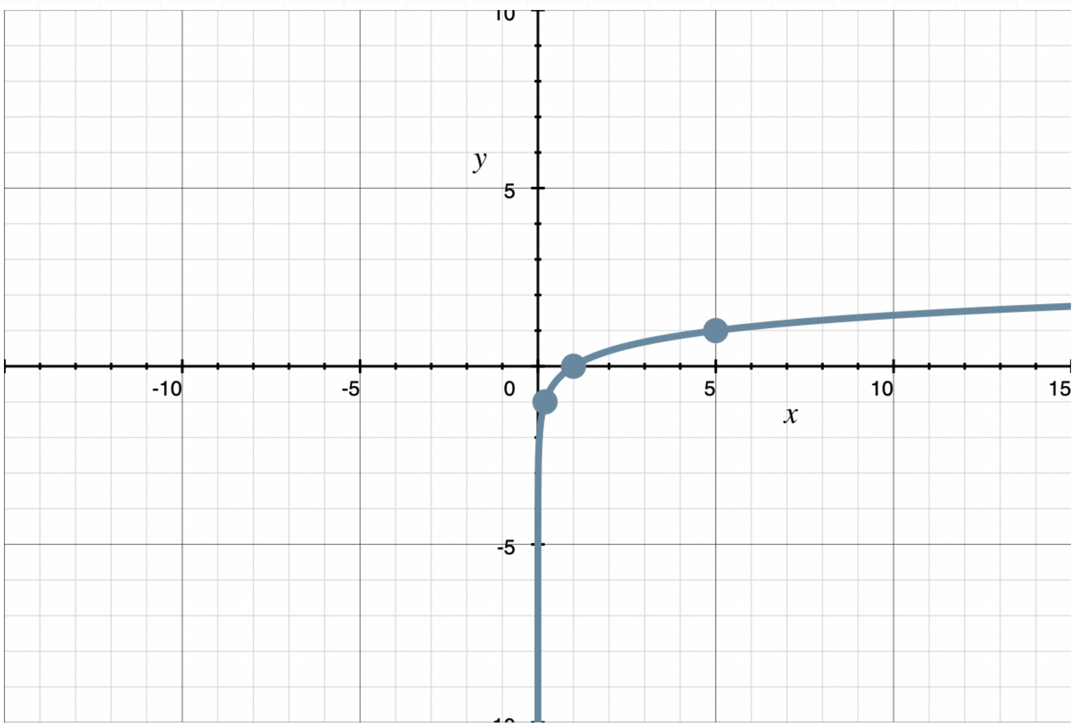
Solution: D

We know the log function will have a vertical asymptote at $x=0$ and an x-intercept at $(1,0)$.

It'll also intersect $(b,1)$ and $(1/b,-1)$. In this log function $b=5$, so we know the curve intersect $(5,1)$ and $(1/5,-1)$.

If we plot these points and the vertical asymptote and connect the points with a smooth curve, we get



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