LESSON MAKER PRO

Log Graph Detective

Solve logarithmic models and read their key features.

HIGH SCHOOL · MA.912.AR.5.9

MA.912.AR.5.9 "Solve and graph mathematical and real-world problems that are modeled with logarithmic functions. Interpret key features and determine constraints in terms of the context."

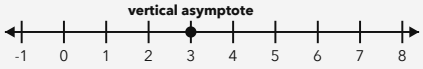
NAME _____ DATE _____

GRAPHING LOGARITHMS

For $y = \log_b(x - h) + k$, the input must make $x - h$ positive, so the domain is $x > h$ and the graph has a vertical asymptote at $x = h$. To solve a logarithmic equation, isolate the logarithm and rewrite it as an exponential equation.

WORKED EXAMPLE

The number line marks the vertical asymptote of $y = \log_4(x - 3) + 1$. State the domain and find the x-intercept.



1. The marked asymptote is $x = 3$, so the domain is $x > 3$.
2. For the x-intercept, set $y = 0$: $\log_4(x - 3) + 1 = 0$.
3. Rewrite: $\log_4(x - 3) = -1$, so $x - 3 = 4^{-1} = 1/4$.
4. Add 3: $x = 13/4$.

Answer: Domain: $x > 3$. x-intercept: $(13/4, 0)$.

PRACTICE 6 problems

1 Solve $\log_3(x) = 2$.

ANSWER _____

2 Solve $\log_5(x + 4) = 1$.

ANSWER _____

3 Solve $\log_7(2x - 1) = 1$.

ANSWER _____

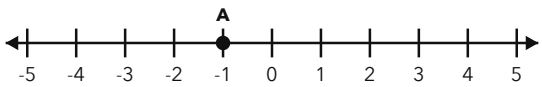
4 For $y = \log_3(x + 2) - 1$, state the vertical asymptote and the domain.

ANSWER _____

5 Find the x-intercept of $y = \log_2(x) + 3$.

ANSWER _____

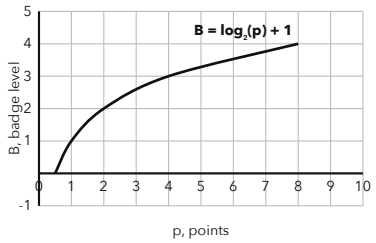
6 Point A marks the vertical-asymptote boundary for $y = \log_6(x + 1)$. State the domain and the vertical asymptote.



ANSWER _____

APPLY IT Show your work

1 A gaming app models a player's badge level B from points p by $B = \log_2(p) + 1$. Use the graph to find the number of points needed for badge level 3. Then state the constraint on p in this model.



ANSWER _____

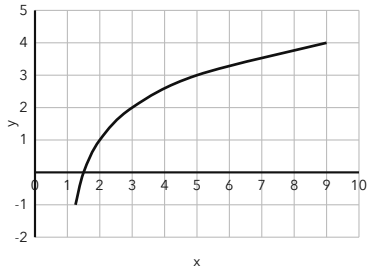
2 At a concert, a sound-level increase L is modeled by $L = 10\log_{10}(r)$, where r is the ratio of the sound intensity to a reference intensity. If L = 30, find r and state its constraint.

WORK SPACE

ANSWER _____

CHALLENGE One step up

The graph represents $y = \log_b(x - h) + k$, where b is a whole number greater than 1. Determine the equation. Then explain how the graph shows the domain.



WORK SPACE AND ANSWER

ANSWER KEY

Log Graph Detective

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PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Solve $\log_3(x) = 2$.	**x = 9**
2	Solve $\log_5(x + 4) = 1$.	**x = 1**
3	Solve $\log_7(2x - 1) = 1$.	**x = 4**
4	For $y = \log_3(x + 2) - 1$, state the vertical asymptote and the domain.	**Vertical asymptote: x = -2. Domain: x > -2.**
5	Find the x-intercept of $y = \log_2(x) + 3$.	**(1/8, 0)**
6	Point A marks the vertical-asymptote boundary for $y = \log_6(x + 1)$. State the domain and the vertical asymptote.	**Domain: x > -1. Vertical asymptote: x = -1.**

PART 2 · APPLY IT

1. **p = 4 points. The constraint is p > 0.** Read B = 3 on the graph, which matches p = 4. A logarithm requires a positive input, so p must be greater than 0.
2. **r = 1000. The constraint is r > 0.** Divide by 10 to get $\log_{10}(r) = 3$, then rewrite as $r = 10^3$. The intensity ratio must be positive.

CHALLENGE

$y = \log_2(x - 1) + 1$. The curve approaches but never reaches x = 1, so x = 1 is the vertical asymptote and the domain is x > 1.

Accept equivalent exponential reasoning and equivalent domain wording, such as all real x greater than the asymptote value. For graph-based responses, accept the exact values shown by the plotted logarithmic points.