MATHEMATICS · GRADES 10-12

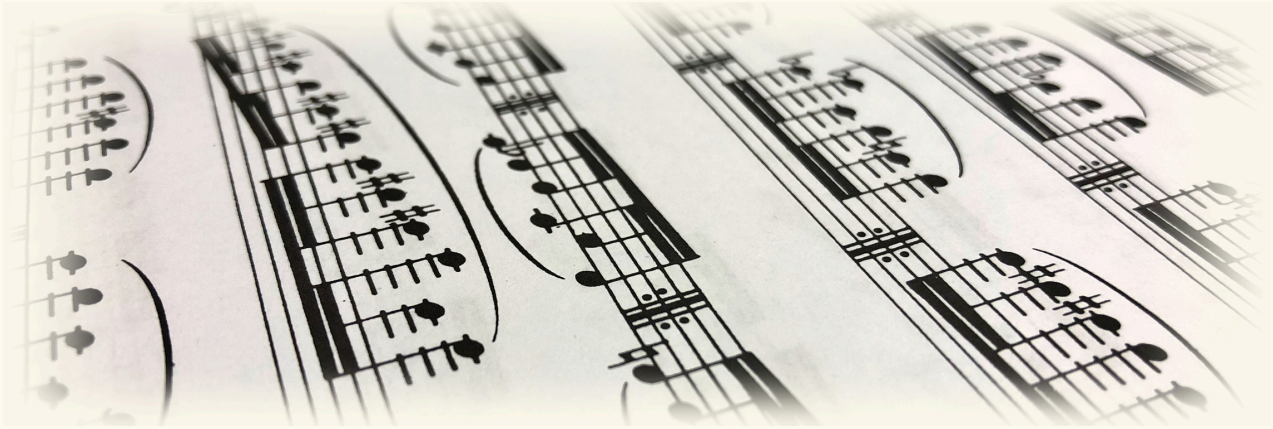
Graphing logarithmic functions

Difficulty level: Advanced

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Overview of the concept

This is how you picture a quantity that grows slowly and levels off, like the loudness of sound or the strength of an earthquake on a scale. Some things grow fast at first and then slow right down, and a logarithmic graph shows that shape clearly. It is how scientists show earthquake strength, sound levels, and the acidity of a solution, where a small step on the scale can mean a huge change in reality.

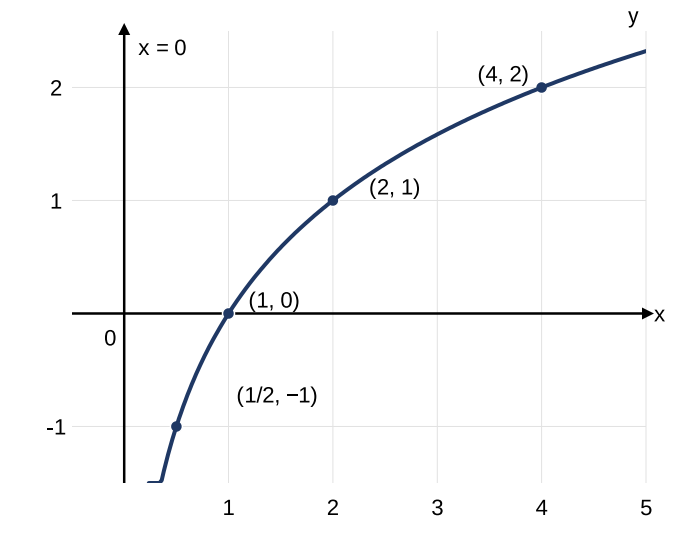


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Worked examples

EXAMPLE 1

Q Graph $y = \log_2(x)$



SOLUTION

Find points: (1, 0), (2, 1), (4, 2), $(\frac{1}{2}, -1)$

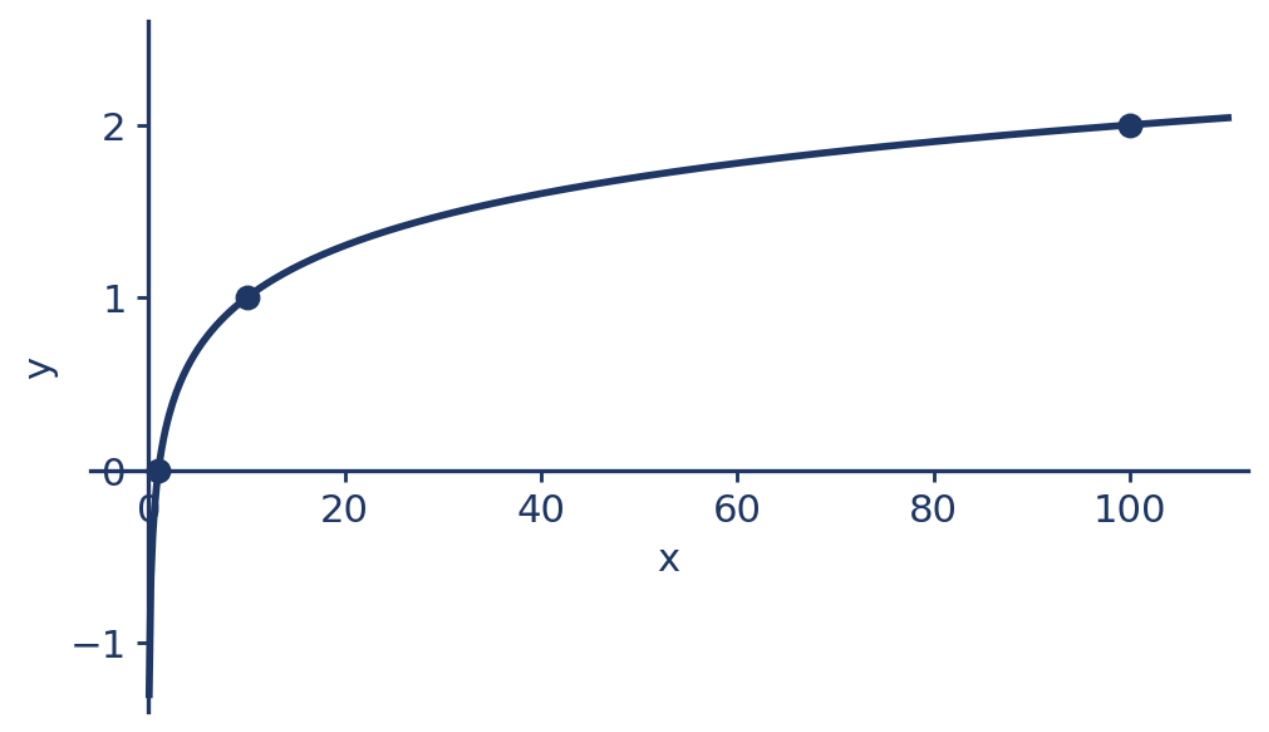
Note the vertical asymptote: $x = 0$, since logarithms are not defined for zero or negative numbers.

Plot the points and draw a smooth curve that rises slowly to the right and approaches $x = 0$ from the right.

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EXAMPLE 2

Q Graph $y = \log_{10}(x)$



SOLUTION

Find points: (1, 0), (10, 1), (100, 2)

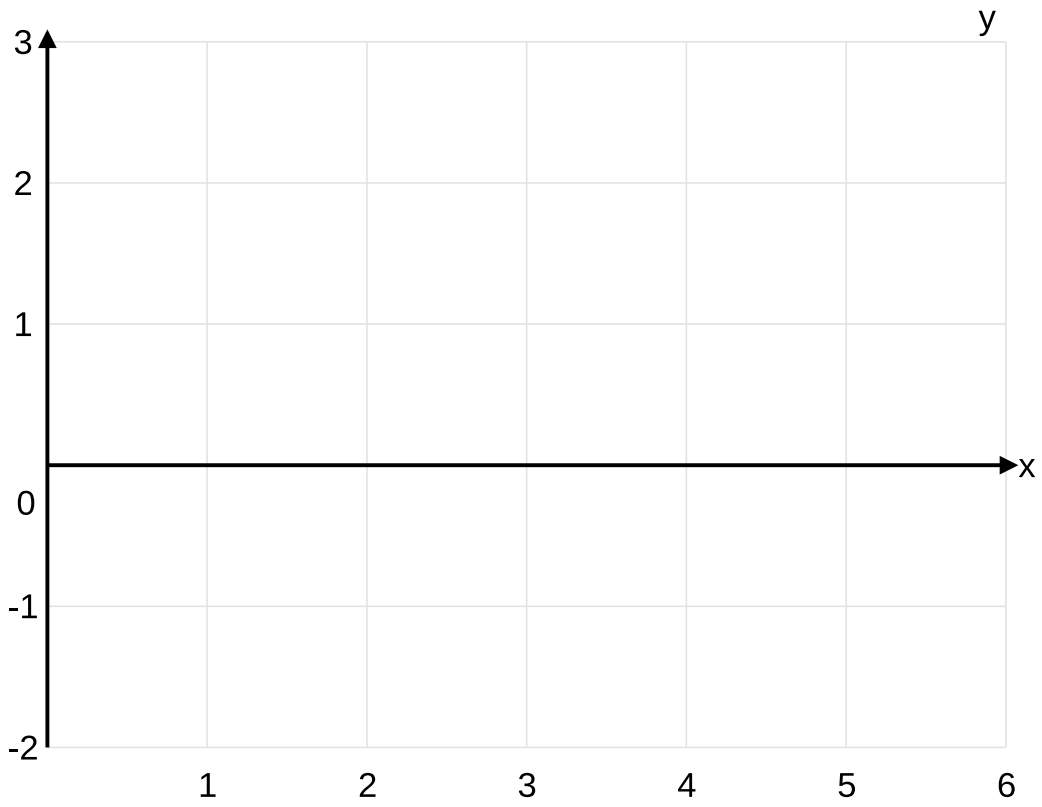
Note the vertical asymptote: $x = 0$

Plot the points and draw a smooth rising curve approaching $x = 0$.

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Practice questions

1 **Graph $y = \log_2(x) - 1$, giving the points you use and the vertical asymptote.**



A Points $(1, -1)$, $(2, 0)$, $(4, 1)$, $(\frac{1}{2}, -2)$; vertical asymptote $x = 0$; smooth curve rising slowly to the right

B Points $(1, 0)$, $(10, 1)$, $(100, 2)$; vertical asymptote $x = 0$; smooth rising curve

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C

Points $(1, -1)$, $(2, 0)$, $(4, 1)$, $(\frac{1}{2}, -2)$; vertical asymptote $y = 0$; smooth curve rising slowly to the right

D

Points $(1, -1)$, $(2, 0)$, $(4, 1)$, $(\frac{1}{2}, -2)$; horizontal asymptote $y = -1$; smooth curve rising slowly to the right

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2 The table gives the x values for $y = \log_5(x)$. Complete the y values and graph the function.

x	1	5	25
y			

A Points (1, 0), (5, 1), (25, 2); vertical asymptote x = 0; smooth rising curve

B Points (1, 0), (5, 2), (25, 3); vertical asymptote x = 0; smooth rising curve

C Points (1, 0), (5, 1), (25, 2); vertical asymptote y = 0; smooth rising curve

D Points (0, 1), (1, 5), (2, 25); vertical asymptote x = 0; smooth rising curve

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3 **Graph $y = \log_3(x)$, giving the points you use and the vertical asymptote.**

A Points (1, 0), (2, 1), (4, 2), $(\frac{1}{2}, -1)$; vertical asymptote x = 0; smooth curve rising slowly to the right

B Points (1, 0), (3, 1), (9, 2), $(\frac{1}{3}, -1)$; vertical asymptote x = 0; smooth curve rising slowly to the right

C Points (1, 0), (10, 1), (100, 2); vertical asymptote x = 0; smooth rising curve

D Points (1, 0), (3, 1), (9, 2), $(\frac{1}{3}, -1)$; vertical asymptote y = 0; smooth curve rising slowly to the right

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4

What is the domain of $y = \ln(x)$?

A $x > 0$

B $x \geq 0$

C All real numbers

D $y > 0$

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5

What is $\log_{10}(1000)$?

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6 State the vertical asymptote of $y = \log_2(x)$.

- **A** $x = 0$
- **B** $y = 0$
- **C** $x = 1$
- **D** $y = 1$

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7 For $y = \log_3(x)$, find x when $y = 2$.

- **A** 9
- **B** 6
- **C** 27
- **D** 3

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8

What is ln(e)?

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9

Where does the graph of $y = \log_2(x)$ cross the x-axis?

A (0, 1)

B (1, 0)

C (0, 0)

D (1, 1)

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10 Which point lies on the graph of $y = \log_2(x)$?

A (2, 1)

B (4, 1)

C (1, 2)

D (8, 2)

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ANSWER KEY

1. Points $(1, -1)$, $(2, 0)$, $(4, 1)$, $(\frac{1}{2}, -2)$; vertical asymptote $x = 0$; smooth curve rising slowly to the right

2. Points $(1, 0)$, $(5, 1)$, $(25, 2)$; vertical asymptote $x = 0$; smooth rising curve

3. Points $(1, 0)$, $(3, 1)$, $(9, 2)$, $(\frac{1}{3}, -1)$; vertical asymptote $x = 0$; smooth curve rising slowly to the right

4. $x > 0$

5. 3

6. $x = 0$

7. 9

8. 1

9. $(1, 0)$

10. $(2, 1)$

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