

Logarithmic Functions

Graph the function in ONE COLOR. Then graph its INVERSE in a SECOND COLOR.

ORIGINAL FUNCTION: $y = 2^x$
 Domain: \mathbb{R} Range: $y > 0$
 X-Intercepts: none
 Y-Intercepts: 1
 Increasing or Decreasing? Inc
 Equation of Asymptote: $y = 0$

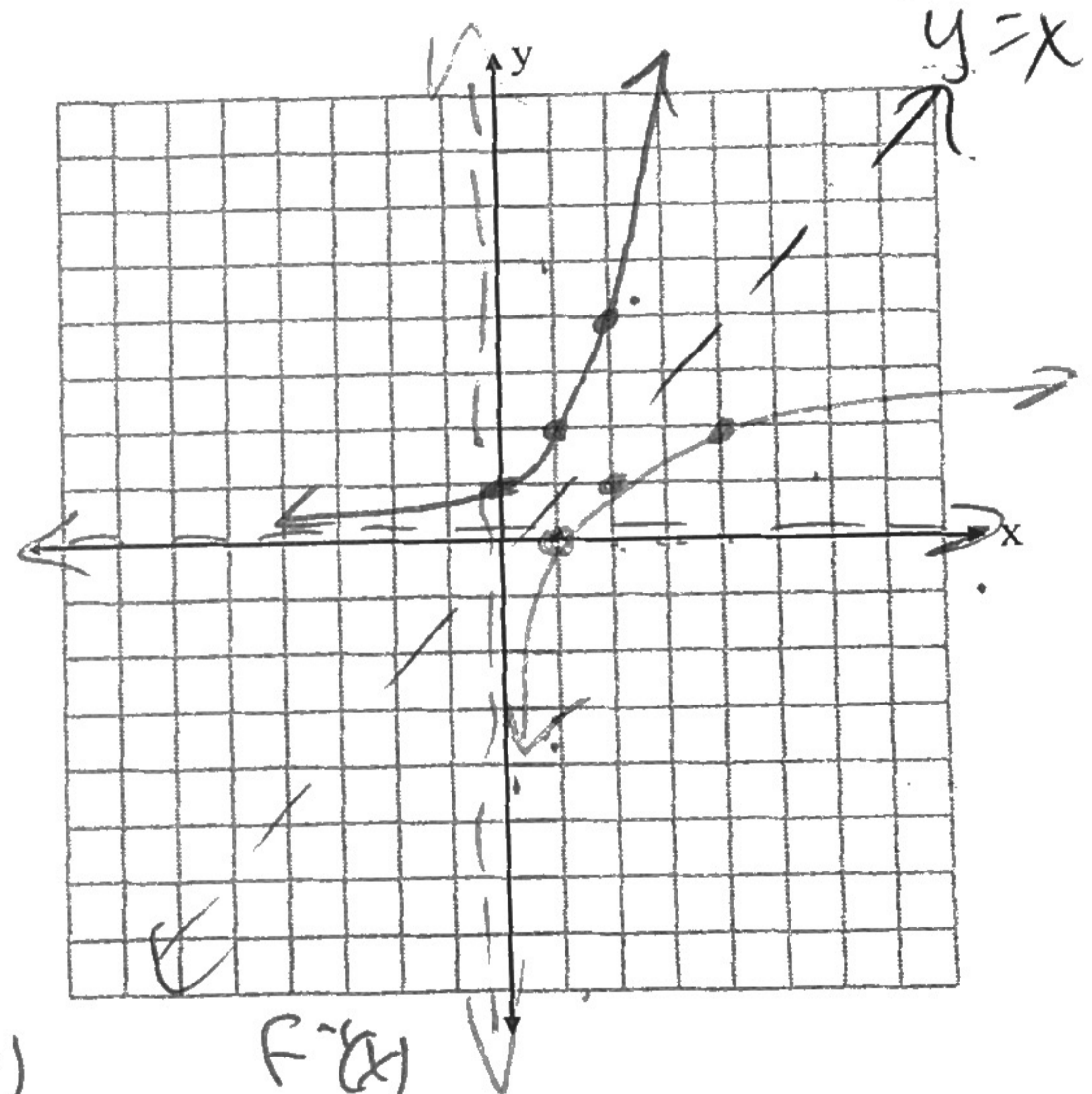
Inverse Function: Switch x + y

$$y = 2^x$$

$$x = 2^y$$

$$\log 2 = y$$

INVERSE FUNCTION:
 Domain: $x > 0$ Range: \mathbb{R}
 X-Intercepts: 1
 Y-Intercepts: none
 Increasing or Decreasing? Increasing
 Equation of Asymptote: $x = 0$



$f(x)$	$f^{-1}(x)$
0	1
1	2
2	4
4	2

Write each exponential equation in logarithmic form.

$$x = b^y$$
$$y = \log_b x$$

1. $2^6 = 64$

$$\log_2 64 = 6$$

2. $1 = 5^0$

$$\log_5 1 = 0$$

3. $5^{-2} = 0.04$

$$\log_5 0.04 = -2$$

4. $e^5 = x$

$$\log_e x = 5$$

$$\ln_e x = 5$$

5. $p = h^6$

$$\log_h p = 6$$

Write each logarithmic equation in exponential form.

6. $\log_7 49 = 2$

$$7^2 = 49$$

7. $\log_8 0.125 = -1$

$$8^{-1} = 0.125$$

8. $x = \log_6 \frac{1}{216}$

$$6^x = \frac{1}{216}$$

$$6^x = \frac{1}{6^3} \Rightarrow 6^x = 6^{-3}$$

10. $\log_{10} x = 2$

$$10^2 = x$$

11. $\ln 4 = x$

$$e^x = 4$$

Use the definition of logarithmic function to evaluate each logarithm. NO CALCULATOR!

12. $\log_2 32 = x$

$$2^x = 32$$

$$\underline{2^x} = \underline{2^5}$$

$$x = 5$$

13. $\log_3 1 = x$

$$3^x = 1$$

$$3^x = 3^0$$

$$x = 0$$

14. $\log_4 2 = x$

$$4^x = 2$$

$$(2^2)^x = 2^1$$

$$2x = 1$$

$$x = \frac{1}{2}$$

15. $\log_{10} \frac{1}{100} = x$

$$10^x = \frac{1}{100} = \frac{1}{10^2}$$

$$10^x = 10^{-2}$$

$$x = -2$$

Evaluate with the calculator. Round to 3 decimal places.

16. $\log 25$

$$1.398$$

17. $\ln 0.34$

$$-1.079$$

18. $\log_{10} x = 2.014$

$$10^{2.014} = x$$

$$x \approx 103.276$$

19. $\ln x = -4$

$$e^{-4} = x$$

$$.018$$

20. $\log x = 0$

$$10^0 = x$$

$$x = 1$$

Change of Base Property of Logs



$$\log_y x = \frac{\log x}{\log y}$$

Use Change of Base to evaluate to 3 decimal places.

$$\begin{aligned} 21. \log_2 15 &= \frac{\log 15}{\log 2} \\ &\approx 3.907 \end{aligned}$$

$$22. \log_{\frac{1}{4}} 20$$

$$-2.161$$

$$23. \log_{\sqrt{6}} 1.5$$

Product Property of Logs

Multiply Exponents

$$x^6 \cdot x^5 = x^{11}$$

$$\log x \cdot y = \log x + \log y$$

Exponents

$$\frac{x^6}{x^2} = x^4$$

Quotient Property of Logs

Divide Exponents

~~$$\frac{x^6}{x^2} = x^4$$~~

$$\log \frac{x}{y} = \log x - \log y$$

Write Each Log in EXPANDED Form.

24. $\log_3 \frac{2x}{5}$

$$\log_3 2 + \log_3 x - \log_3 5$$

25. $\log_3 \frac{2x}{3y}$

$$\log_3 2 + \log_3 x - \log_3 3 - \log_3 y$$

26. $\log_3 \frac{x}{6y}$

$$\log_3 x - \log_3 6 - \log_3 y$$

27. $\ln \frac{1}{3yz}$

$$-\ln 3 - \ln y - \ln z$$

Write Each Log in CONDENSED Form. (Write as a SINGLE log!)

28. $\log_3 2 - \log_3 10$

$$\log_3 \frac{2}{10}$$

$$\log_3 \frac{1}{5}$$

29. $\log_3 4 - \log_3 x + \log_3 z^{\frac{3}{5}}$

$$\log_3 \frac{4z^{\frac{3}{5}}}{x}$$

30. $\ln 10 - \ln x + \ln y^2 - \ln z$

$$\ln \frac{10y^2}{xz}$$

Product Property of Logs

$$\log_b x = y$$

Exponents to Exponents

$$(x^6)^4 = x^{24}$$

$$\log x^y = \underline{y \cdot \log x}$$

$$b^y = x$$

Write Each Log in EXPANDED Form.

15. $\log_3 x^4 = 4 \log_3 x$

16. $\log_3 \frac{x^3}{8y^5} = 3 \log_3 x - \log_3 8 - 5 \log_3 y$

17. $\log \frac{7^4 x^2 \sqrt{z}}{y^5}$

$4 \log 7 + 2 \log x + \frac{1}{2} \log z - 5 \log y$

18. $\ln \frac{4x^2}{y^4 z}$

Write Each Log in CONDENSED Form. (Write as a SINGLE log!)

19. $3 \log_3 2 - 2 \log_3 x + \frac{1}{3} \log_3 y$

$\log_3 \frac{8y^{\frac{1}{3}}}{x^2}$

20. $\log_3 4 - 2 \log_3 x + 5 \log_3 z^{\frac{3}{5}}$

$\log_3 \frac{4z^3}{x^2}$

21. $\ln 7 + \ln x - 2 \ln y + \frac{1}{2} \ln z$