

Evaluate the logarithm without using a calculator.

1. $\log_4 16$ $4^x = 16$
 $x = 2$

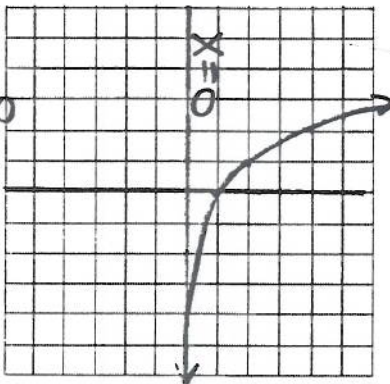
2. $\log_5 1$ $5^x = 1$
 $x = 0$

3. $\log_3 8$ $3^x = 8$
 $x = 1$

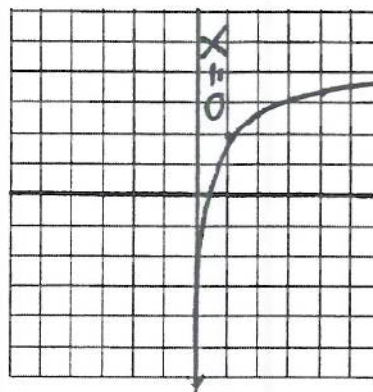
4. $\log_{1/2} 32$ $(\frac{1}{2})^x = 32$
 $x = -5$

Graph the function, identify the asymptote, and state the domain and range.

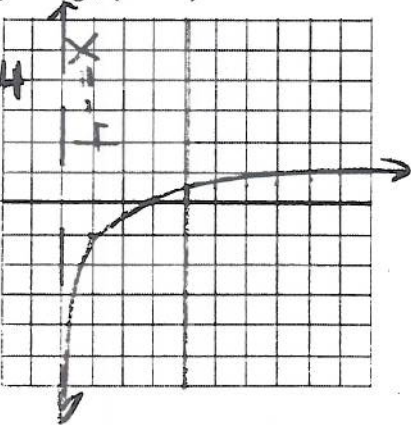
5. $y = \log_2 x$

domain: $x > 0$
range: \mathbb{R} 

6. $y = \ln x + 2$

domain: $x > 0$
range: \mathbb{R} 

7. $y = \log_3(x + 4) - 1$

domain: $x > -4$
range: \mathbb{R} 

Expand the expression.

8. $\log_2 5x$
 $= \log_2 5 + \log_2 x$

9. $\log_5 x^7$
 $= 7 \log_5 x$

10. $\ln 5xy^3$
 $= \ln 5 + \ln x + 3 \ln y$

11. $\log_3 \frac{6y^4}{x^8}$
 $= \log_3 6 + 4 \log_3 y - 8 \log_3 x$

Condense the expression.

12. $\log_3 5 - \log_3 20$

$$= \log_3 \frac{1}{4}$$

13. $\ln 6 + \ln 4x$

$$= \ln 24x$$

14. $\log_6 5 + 3 \log_6 2$

$$= \log_6 5 \cdot 2^3$$

$$= \log_6 40$$

15. $4 \ln x - 5 \ln x$

$$= \ln \frac{x^4}{x^5} = \ln \frac{1}{x}$$

Use the change-of-base formula to evaluate the logarithm.

16. $\log_3 10$

$$= \frac{\log_{10} 10}{\log_{10} 3} \approx 2.096$$

17. $\log_7 14$

$$= \frac{\log_{10} 14}{\log_{10} 7} \approx 1.356$$

18. $\log_5 24$

$$= \frac{\log_{10} 24}{\log_{10} 5} \approx 1.975$$

19. $\log_8 40$

$$= \frac{\log_{10} 40}{\log_{10} 8} \approx 1.774$$

Solve the equation.

20. $2^{x+1} = 16^{x+2}$

$$2^{x+1} = 2^{4(x+2)}$$

$$x+1 = 4x+8$$

$$-7 = 3x$$

$$x = -7/3$$

22. $3^{2x} + 5 = 13$

$$3^{2x} = 8$$

$$\log_3 8 = 2x$$

$$x = \frac{\log_3 8}{2} \approx 0.946$$

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

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

$$-x = \ln 4$$

$$x = -\ln 4$$

$$x \approx -1.386$$

23. $3^{x+1} - 5 = 10$

$$3^{x+1} = 15$$

$$\log_3 15 = x+1$$

$$x = \log_3 15 - 1$$

$$x \approx 1.465$$

24. $\log_4 (4x+7) = \log_4 (11x)$

$$4x+7 = 11x$$

$$7x = 7$$

$$x = 1$$

25. $\ln (3x-2) = \ln (6x)$

$$3x-2 = 6x$$

$$3x = -2$$

$$x = -2/3$$

no solution

26. $6 \ln x = 30$

$$\ln x^6 = 30$$

$$e^{\ln x^6} = e^{30}$$

$$x^6 = e^{30}$$

$$x = \sqrt[6]{e^{30}} \approx 148.413$$

27. $\log_2 (x+4) = 5$

$$2^5 = x+4$$

$$x = 2^5 - 4$$

$$x = 28$$