PRACTICE & PROBLEM SOLVING

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Practice Tutorial

Additional Exercises Available Online

UNDERSTAND

10. Use Structure Would you use the natural log or the common log when solving the equation $10^{x+2} = 78$? Is it possible to use either the natural log or common log? Explain.

11. Make Sense and Persevere Explain why logarithms are necessary to solve the equation $3^{x+2} = 8$, but are not necessary to solve the equation $3^{x+2} = 27^{4x}$.

12. Reason Tristen solved the equation $\log_3 (x + 1) - \log_3 (x - 6) = \log_3 (2x + 2)$. Justify each step of solving the equation in Tristen's work. Are both numbers solutions to the equation? Explain.

$$\log_3(x + 1) - \log_3(x - 6) = \log_3(2x + 2)$$
$$\log_3(x + 1) = \log_3(2x + 2) + \log_3(x - 6)$$
$$\log_3(x + 1) = \log_3(2x + 2)(x - 6)$$
$$(x + 1) = (2x + 2)(x - 6)$$
$$x + 1 = 2x^2 - 10x - 12$$
$$0 = 2x^2 - 11x - 13$$
$$x = 6.5 \text{ or } x = -1$$

13. Error Analysis The number of milligrams of medicine in a person's system after t hours is given by the function $A = 20e^{-0.40t}$. Thomas sets $A = 0$ to find the number of hours it takes for all of the medicine to be removed from a person's system. What mistake did Thomas make? Explain.

14. Mathematical Connections Explain the importance of the Power Property of Logarithms when solving exponential equations.

15. Error Analysis Find the student error in the solution of the logarithmic equation.

$$\log (x + 3) + \log x = 1$$
$$\log x (x + 3) = 1$$
$$x(x + 3) = 10^1$$
$$x^2 + 3x - 10 = 0$$
$$(x - 2)(x + 5) = 0$$
$$x = 2, -5$$

✗

PRACTICE

Find all solutions of the equation. Round answers to the nearest ten-thousandth. SEE EXAMPLE 1

16. $3^{2-3x} = 3^{5x-6}$

17. $7^{3x} = 54$

18. $25^{x^2} = 125^{x+3}$

19. $4^{3x-1} = \left(\frac{1}{2}\right)^{x+5}$

20. $4^{2x+1} = 4^{3x-5}$

21. $6^{x-2} = 216$

Find all solutions of the equation. Round answers to the nearest ten-thousandth. SEE EXAMPLES 2 AND 3

22. $2^{3x-2} = 5$

23. $4 + 5^{6-x} = 15$

24. $6^{3x+1} = 9^x$

25. $-3 = \left(\frac{1}{2}\right)^x - 12$

26. $3^{2x-3} = 4^x$

27. $4^{x+2} = 8^{x-1}$

28. Dale has $1,000 to invest. He has a goal to have $2,500 in this investment in 10 years. At what annual rate compounded continuously will Dale reach his goal? Round to the nearest hundredth. SEE EXAMPLE 4

Find all solutions of the equation. Round answers to the nearest thousandth. SEE EXAMPLE 5

29. $\log_2 (4x + 5) = \log_2 x^2$

30. $2\ln (3x - 2) = \ln (5x + 6)$

31. $\log_4 (x^2 - 2x) = \log_4 (3x + 8)$

32. $\ln (5x - 2) = \ln (x - 1)$

33. $\ln (2x^2 + 5x) = \ln (2x + 7)$

34. $2\log (x + 1) = \log (x + 1)$

35. $\log_2 x + \log_2 (x - 3) = 2$

36. $\log_2 (3x - 2) = \log_2 (x - 1) + 4$

37. $\log_6 (x^2 - 2x) = \log_6 (2x - 3) + \log_6 (x + 1)$

Solve by graphing. Round answers to the nearest thousandth. SEE EXAMPLE 6

38. $\log(5x - 3)^2 = x - 4$

39. $\ln(2x) = 3x - 5$

40. $\log(4x) = x + \log x$

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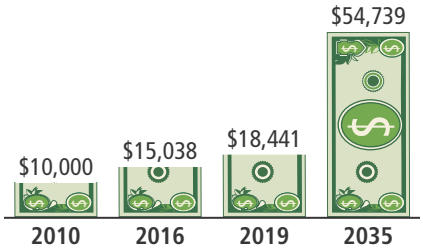
Mixed Review Available Online

APPLY

41. Model With Mathematics The population of a city is modeled by the function $P = 250{,}000e^{0.013t}$, where t is the number of years since 2000. In what year, to the nearest year, will the population reach 450,000?

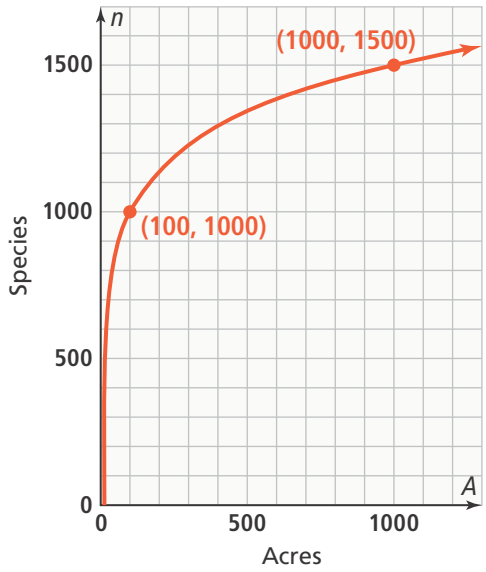
42. Use Structure Felix invested $10,000 into a retirement account in 2010. He then projected the amount of money that would be in the account for several years assuming that interest would compound continuously at an annual rate. Later, when he looked back the data, he could not recall the annual rate that he used for the projections. Use the data below to determine the annual rate.



43. Higher Order Thinking A biologist is using the logarithmic model $n = k\log(A)$ to determine the number of a species n, that can live on a land mass of area A. The constant k varies according to the species.

a. Use the graph to determine the constant k for the species that the scientist is studying.

b. Determine the land mass in acres that is needed to support 3,000 of the species.



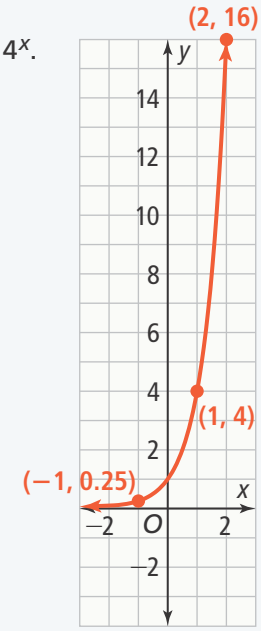
ASSESSMENT PRACTICE

44. Which of the following have the same solution? Select all that apply.

Ⓐ $\log_8 (x^2 - 15) = \log_8 (2x)$
Ⓑ $\ln (12x + 2) = \ln (2x - 3)$
Ⓒ $\log_2 x + \log_2 (x + 4) = 5$
Ⓓ $\log_3 (15x + 6)^2 = 8$
Ⓔ $\log_4 (3x - 5) = 2$

45. SAT/ACT The graph shows the function $y = 4^x$. Determine when the function shown in the graph is greater than the function $y = 2^{3x-1}$.

Ⓐ $x > 1$
Ⓑ $x < 1$
Ⓒ $x > -1$
Ⓓ $x < -1$



46. Performance Task A professor conducted an experiment to find the relationship between time and memory. The professor determined the model $f(t) = t_0 - 15\log(t + 1.1)$ gives the memory score after t months when a student had an initial memory score of t_0.

Part A Write a model for a student with the given initial memory score.

Part B After about how many years will the student have a memory score of 65?