8.6 Exercises

In Exercises 1-10, use a calculator to evaluate the function at the given value \( p \). Round your answer to the nearest hundredth.

1. \( f(x) = \log_4(x); \ p = 57.60 \).
2. \( f(x) = \log_4(x); \ p = 11.22 \).
3. \( f(x) = \log_7(x); \ p = 2.98 \).
4. \( f(x) = \log_3(x); \ p = 2.27 \).
5. \( f(x) = \log_6(x); \ p = 2.56 \).
6. \( f(x) = \log_8(x); \ p = 289.27 \).
7. \( f(x) = \log_8(x); \ p = 302.67 \).
8. \( f(x) = \log_5(x); \ p = 15.70 \).
9. \( f(x) = \log_8(x); \ p = 46.13 \).
10. \( f(x) = \log_4(x); \ p = 15.59 \).

In Exercises 11-18, perform each of the following tasks.

a) Approximate the solution of the given equation using your graphing calculator. Load each side of the equation into the Y= menu of your calculator. Adjust the WINDOW parameters so that the point of intersection of the graphs is visible in the viewing window. Use the intersect utility in the CALC menu of your calculator to determine the x-coordinate of the point of intersection. Then make an accurate copy of the image in your viewing window on your homework paper.

b) Solve the given equation algebraically, and round your answer to the nearest hundredth.

11. \( 20 = 3(1.2)^x \)
12. \( 15 = 2(1.8)^x \)
13. \( 14 = 1.4^{5x} \)
14. \( 16 = 1.8^{4x} \)
15. \( -4 = 0.2^x - 9 \)
16. \( 12 = 2.9^x + 2 \)
17. \( 13 = 0.1^{x+1} \)
18. \( 19 = 1.2^{x-6} \)

In Exercises 19-34, solve the given equation algebraically, and round your answer to the nearest hundredth.

19. \( 20 = e^{x-3} \)
20. \( -4 = e^x - 9 \)
21. \( 23 = 0.9^x + 9 \)
22. \( 10 = e^x + 7 \)
23. \( 19 = e^x + 5 \)
24. \( 4 = 7(2.3)^x \)
25. \( 18 = e^{x+4} \)
26. \( 15 = e^{x+6} \)
27. \( 8 = 2.7^{3x} \)

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28. $7 = e^{x+1}$
29. $7 = 1.1^{8x}$
30. $6 = 0.2^{x-8}$
31. $-7 = 1.3^x - 9$
32. $11 = 3(0.7)^x$
33. $23 = e^x + 9$
34. $20 = 3.2^{x+1}$

35. Suppose that you invest $17,000 at 6% interest compounded daily. How many years will it take for your investment to double? Round your answer to the nearest hundredth.

36. Suppose that you invest $6,000 at 9% interest compounded continuously. How many years will it take for your investment to double? Round your answer to the nearest hundredth.

37. Suppose that you invest $16,000 at 6% interest compounded daily. How many years will it take for your investment to reach $26,000? Round your answer to the nearest hundredth.

38. Suppose that you invest $15,000 at 5% interest compounded monthly. How many years will it take for your investment to double? Round your answer to the nearest hundredth.

39. Suppose that you invest $18,000 at 3% interest compounded monthly. How many years will it take for your investment to double? Round your answer to the nearest hundredth.

40. Suppose that you invest $7,000 at 5% interest compounded daily. How many years will it take for your investment to reach $13,000? Round your answer to the nearest hundredth.

41. Suppose that you invest $16,000 at 9% interest compounded continuously. How many years will it take for your investment to double? Round your answer to the nearest hundredth.

42. Suppose that you invest $16,000 at 2% interest compounded continuously. How many years will it take for your investment to reach $25,000? Round your answer to the nearest hundredth.

43. Suppose that you invest $2,000 at 5% interest compounded continuously. How many years will it take for your investment to reach $10,000? Round your answer to the nearest hundredth.

44. Suppose that you invest $4,000 at 6% interest compounded continuously. How many years will it take for your investment to reach $10,000? Round your answer to the nearest hundredth.

45. Suppose that you invest $4,000 at 3% interest compounded daily. How many years will it take for your investment to reach $14,000? Round your answer to the nearest hundredth.

46. Suppose that you invest $13,000 at 2% interest compounded monthly. How many years will it take for your investment to reach $20,000? Round your answer to the nearest hundredth.

47. Suppose that you invest $20,000 at 7% interest compounded continuously. How many years will it take for your investment to reach $30,000? Round your answer to the nearest hundredth.
48. Suppose that you invest $16,000 at 4% interest compounded continuously. How many years will it take for your investment to double? Round your answer to the nearest hundredth.

49. Suppose that you invest $8,000 at 8% interest compounded continuously. How many years will it take for your investment to double? Round your answer to the nearest hundredth.

50. Suppose that you invest $3,000 at 3% interest compounded daily. How many years will it take for your investment to double? Round your answer to the nearest hundredth.
8.6 Solutions

1. Using a calculator,
   \[ f(57.60) = \log_4(57.60) = \frac{\log(57.60)}{\log 4} \approx 2.92399845327748 \]

3. Using a calculator,
   \[ f(2.98) = \log_7(2.98) = \frac{\log(2.98)}{\log 7} \approx 0.561137574130754 \]

5. Using a calculator,
   \[ f(2.56) = \log_6(2.56) = \frac{\log(2.56)}{\log 6} \approx 0.524628039999395 \]

7. Using a calculator,
   \[ f(302.67) = \log_8(302.67) = \frac{\log(302.67)}{\log 8} \approx 2.74720062506472 \]

9. Using a calculator,
   \[ f(46.13) = \log_8(46.13) = \frac{\log(46.13)}{\log 8} \approx 1.8425446243031 \]

11. a) The graphical solution is shown below.

   ![Graphical Solution Image]

b) Here is an algebraic solution:
   \[
   20 = 3(1.2)^x \quad \Rightarrow \quad \frac{20}{3} = 1.2^x \\
   \Rightarrow \quad \log \left( \frac{20}{3} \right) = \log(1.2^x) \\
   \Rightarrow \quad \log \left( \frac{20}{3} \right) = x \cdot \log(1.2) \\
   \Rightarrow \quad x = \frac{\log \left( \frac{20}{3} \right)}{\log(1.2)} \approx 10.4053520507718
   \]

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13. a) The graphical solution is shown below.

b) Here is an algebraic solution:

\[ 14 = 1.4^{5x} \implies \log(14) = \log(1.4^{5x}) \]
\[ \implies \log(14) = 5x \cdot \log(1.4) \]
\[ \implies x = \frac{\log(14)}{5 \log(1.4)} \approx 1.5686627557246 \]

15. a) The graphical solution is shown below.

b) Here is an algebraic solution:

\[ -4 = 0.2^x - 9 \implies 5 = 0.2^x \]
\[ \implies \log(5) = \log(0.2^x) \]
\[ \implies \log(5) = x \cdot \log(0.2) \]
\[ \implies x = \frac{\log(5)}{\log(0.2)} \approx -1.00 \]

17. a) The graphical solution is shown below.
b) Here is an algebraic solution:

\[ 13 = 0.1^{x+1} \implies \log(13) = \log(0.1^{x+1}) \]
\[ \implies \log(13) = (x + 1)\log(0.1) \]
\[ \implies \frac{\log(13)}{\log(0.1)} = x + 1 \]
\[ \implies x = \frac{\log(13)}{\log(0.1)} - 1 \approx -2.11394335230684 \]

19.

\[ 20 = e^{x-3} \implies \ln(20) = \ln(e^{x-3}) \]
\[ \implies \ln(20) = x - 3 \]
\[ \implies x = \ln(20) + 3 \approx 5.9957327355399 \]

21.

\[ 23 = 0.9^x + 9 \implies 14 = 0.9^x \]
\[ \implies \log(14) = \log(0.9^x) \]
\[ \implies \log(14) = x \cdot \log(0.9) \]
\[ \implies x = \frac{\log(14)}{\log(0.9)} \approx -25.0478778804195 \]

23.

\[ 19 = e^x + 5 \implies 14 = e^x \]
\[ \implies \ln(14) = \ln(e^x) \]
\[ \implies \ln(14) = x \]
\[ \implies x = \ln(14) \approx 2.63905732961526 \]

25.

\[ 18 = e^{x+4} \implies \ln(18) = \ln(e^{x+4}) \]
\[ \implies \ln(18) = x + 4 \]
\[ \implies x = \ln(18) - 4 \approx -1.10962824210384 \]
27. 

\[ 8 = 2.7^{3x} \implies \log(8) = \log(2.7^{3x}) \]
\[ \implies \log(8) = 3x \cdot \log(2.7) \]
\[ \implies x = \frac{\log(8)}{3 \log(2.7)} \approx 0.697856474455816 \]

29. 

\[ 7 = 1.1^{8x} \implies \log(7) = \log(1.1^{8x}) \]
\[ \implies \log(7) = 8x \cdot \log(1.1) \]
\[ \implies x = \frac{\log(7)}{8 \log(1.1)} \approx 2.55207543550219 \]

31. 

\[ -7 = 1.3^{x} - 9 \implies 2 = 1.3^{x} \]
\[ \implies \log(2) = \log(1.3^{x}) \]
\[ \implies \log(2) = x \cdot \log(1.3) \]
\[ \implies x = \frac{\log(2)}{\log(1.3)} \approx 2.64192679581114 \]

33. 

\[ 23 = e^{x} + 9 \implies 14 = e^{x} \]
\[ \implies \ln(14) = \ln(e^{x}) \]
\[ \implies \ln(14) = x \]
\[ \implies x = \ln(14) \approx 2.63905732961526 \]

35. \[ P(t) = 17000 \left(1 + \frac{0.06}{365}\right)^{365t} \]. Therefore,

\[ 34000 = 17000 \left(1 + \frac{0.06}{365}\right)^{365t} \implies 2 = \left(1 + \frac{0.06}{365}\right)^{365t} \]
\[ \implies \log(2) = \log \left(1 + \frac{0.06}{365}\right)^{365t} \]
\[ \implies \log(2) = 365t \log \left(1 + \frac{0.06}{365}\right) \]
\[ \implies t = \frac{\log(2)}{365 \log \left(1 + \frac{0.06}{365}\right)} \approx 11.5534025000063 \]
37. \( P(t) = 16000 \left( 1 + \frac{0.06}{365} \right)^{365t} \). Therefore,
\[
26000 = 16000 \left( 1 + \frac{0.06}{365} \right)^{365t} \quad \Rightarrow \quad \frac{13}{8} = \left( 1 + \frac{0.06}{365} \right)^{365t}
\]
\[
\Rightarrow \log \left( \frac{13}{8} \right) = \log \left( 1 + \frac{0.06}{365} \right)^{365t}
\]
\[
\Rightarrow \log \left( \frac{13}{8} \right) = 365t \log \left( 1 + \frac{0.06}{365} \right)
\]
\[
\Rightarrow t = \frac{\log \left( \frac{13}{8} \right)}{365 \log \left( 1 + \frac{0.06}{365} \right)} \approx 8.09246199067501
\]

39. \( P(t) = 18000 \left( 1 + \frac{0.03}{12} \right)^{12t} \). Therefore,
\[
36000 = 18000 \left( 1 + \frac{0.03}{12} \right)^{12t} \quad \Rightarrow \quad 2 = \left( 1 + \frac{0.03}{12} \right)^{12t}
\]
\[
\Rightarrow \log(2) = \log \left( 1 + \frac{0.03}{12} \right)^{12t}
\]
\[
\Rightarrow \log(2) = 12t \log \left( 1 + \frac{0.03}{12} \right)
\]
\[
\Rightarrow t = \frac{\log(2)}{12 \log \left( 1 + \frac{0.03}{12} \right)} \approx 23.1337751324019
\]

41. \( P(t) = 16000e^{0.09t} \). Therefore,
\[
32000 = 16000e^{0.09t} \quad \Rightarrow \quad 2 = e^{0.09t}
\]
\[
\Rightarrow \ln(2) = 0.09t
\]
\[
\Rightarrow t = \frac{\ln(2)}{0.09} \approx 7.70163533955495
\]

43. \( P(t) = 2000e^{0.05t} \). Therefore,
\[
10000 = 2000e^{0.05t} \quad \Rightarrow \quad 5 = e^{0.05t}
\]
\[
\Rightarrow \ln(5) = 0.05t
\]
\[
\Rightarrow t = \frac{\ln(5)}{0.05} \approx 32.188758248682
\]
45. \( P(t) = 4000 \left(1 + \frac{0.03}{365}\right)^{365t} \). Therefore,

\[
14000 = 4000 \left(1 + \frac{0.03}{365}\right)^{365t} \quad \Rightarrow \quad \frac{7}{2} = \left(1 + \frac{0.03}{365}\right)^{365t}
\]

\[
\Rightarrow \log\left(\frac{7}{2}\right) = \log\left(1 + \frac{0.03}{365}\right)^{365t}
\]

\[
\Rightarrow \log\left(\frac{7}{2}\right) = 365t \log\left(1 + \frac{0.03}{365}\right)
\]

\[
\Rightarrow t = \frac{\log\left(\frac{7}{2}\right)}{365 \log\left(1 + \frac{0.03}{365}\right)} \approx 41.7604817066046
\]

47. \( P(t) = 20000 e^{0.07t} \). Therefore,

\[
30000 = 20000 e^{0.07t} \quad \Rightarrow \quad \frac{3}{2} = e^{0.07t}
\]

\[
\Rightarrow \ln\left(\frac{3}{2}\right) = 0.07t
\]

\[
\Rightarrow t = \frac{\ln\left(\frac{3}{2}\right)}{0.07} \approx 5.79235868725949
\]

49. \( P(t) = 8000 e^{0.08t} \). Therefore,

\[
16000 = 8000 e^{0.08t} \quad \Rightarrow \quad 2 = e^{0.08t}
\]

\[
\Rightarrow \ln(2) = 0.08t
\]

\[
\Rightarrow t = \frac{\ln(2)}{0.08} \approx 8.66433975699932
\]