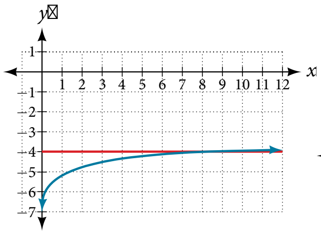
23. $x=\dfrac{\ln\left(\frac{3}{5}\right)-3}{8}$ **25.** No solution **27.** $x=\ln(3)$

29. $10^{-2}=\frac{1}{100}$ **31.** $n=49$ **33.** $k=\frac{1}{36}$ **35.** $x=\frac{9-e}{8}$

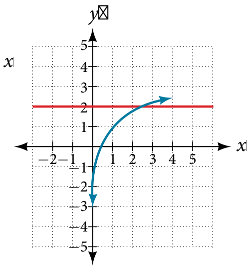
37. $n=1$ **39.** No solution **41.** No solution

43. $x=\pm\frac{10}{3}$ **45.** $x=10$ **47.** $x=0$ **49.** $x=\frac{3}{4}$

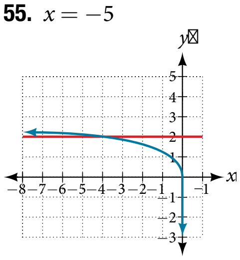
51. $x=9$



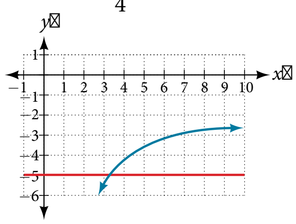
53. $x=\frac{e^2}{3}\approx 2.5$



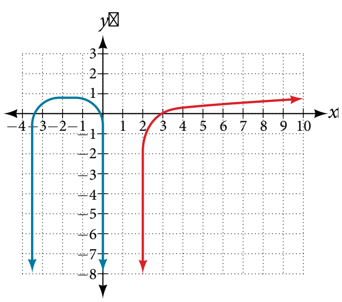
55. $x=-5$



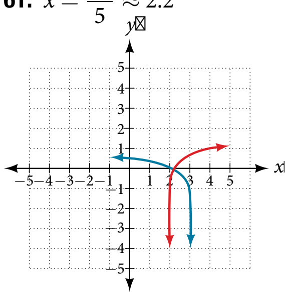
57. $x=\frac{e+10}{4}\approx 3.2$



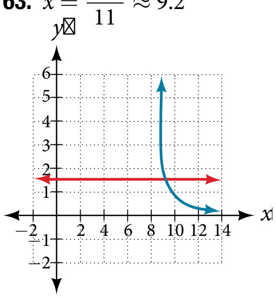
59. No solution



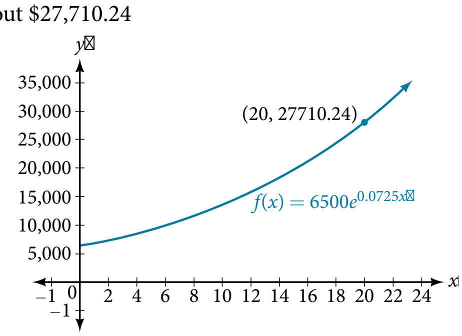
61. $x=\frac{11}{5}\approx 2.2$



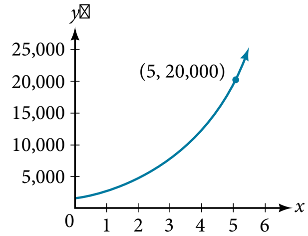
63. $x=\frac{101}{11}\approx 9.2$



65. About \$27,710.24



67. About 5 years



69. ≈ 0.567 **71.** ≈ 2.078

73. ≈ 2.2401

75. ≈ -44655.7143

77. About 5.83

79. $t=\ln\left(\left(\frac{y}{A}\right)^{\frac{1}{k}}\right)$

81. $t=\ln\left(\left(\frac{T-T_s}{T_0-T_s}\right)^{-\frac{1}{k}}\right)$

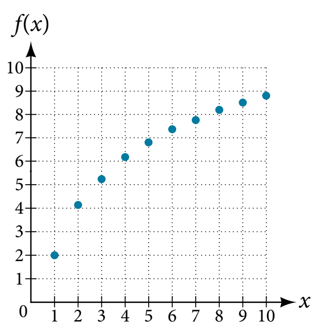
Section 4.7

1. Half-life is a measure of decay and is thus associated with exponential decay models. The half-life of a substance or quantity is the amount of time it takes for half of the initial amount of that substance or quantity to decay. **3.** Doubling time is a measure of growth and is thus associated with exponential growth models. The doubling time of a substance or quantity is the amount of time it takes for the initial amount of that substance or quantity to double in size. **5.** An order of magnitude is the nearest power of ten by which a quantity exponentially grows. It is also an approximate position on a logarithmic scale; Sample response: Orders of magnitude are useful when making comparisons between numbers that differ by a great amount. For example, the mass of Saturn is 95 times greater than the mass of Earth. This is the same as saying that the mass of Saturn is about 10^2 times, or 2 *orders of magnitude* greater, than the mass of Earth.

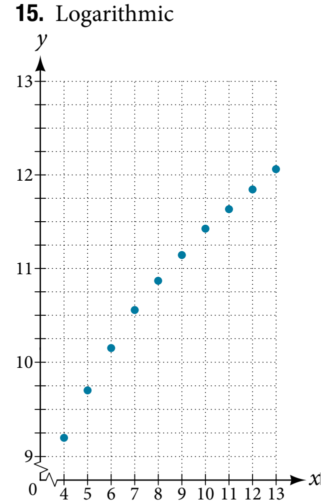
7. $f(0)\approx 16.7$; the amount initially present is about 16.7 units.

9. 150 **11.** Exponential; $f(x)=1.2^x$

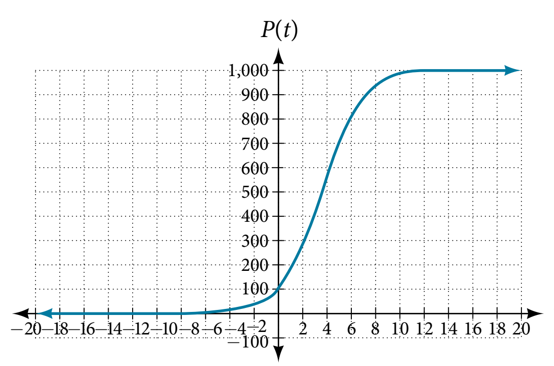
13. Logarithmic



15. Logarithmic



17.



19. About 1.4 years **21.** About 7.3 years
23. Four half-lives; 8.18 minutes
25. $M = \frac{2}{3}\log\left(\frac{S}{S_0}\right)$

$\frac{3}{2}M = \log\left(\frac{S}{S_0}\right)$

$10^{\frac{3M}{2}} = \left(\frac{S}{S_0}\right)$

$S_0 10^{\frac{3M}{2}} = S$

27. Let $y = b^x$ for some non-negative real number b such that $b \neq 1$. Then,

$\ln(y) = \ln(b^x)$

$\ln(y) = x\ln(b)$

$e^{\ln(y)} = e^{x\ln(b)}$

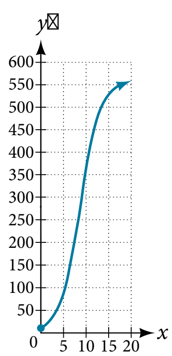
$y = e^{x\ln(b)}$

29. $A = 125e^{(-0.3567t)}$; $A \approx 43$mg **31.** About 60 days
33. $f(t) = 250e^{-0.00914t}$; half-life: about 76 minutes
35. $r \approx -0.0667$; hourly decay rate: about 6.67%
37. $f(t) = 1350\,e^{0.03465735 9t}$; after 3 hours; $P(180) \approx 691{,}200$
39. $f(t) = 256\,e^{(0.068110t)}$; doubling time: about 10 minutes
41. About 88minutes **43.** $T(t) = 90\,e^{(-0.008377t)} + 75$, where t is in minutes **45.** About 113 minutes **47.** $\log_{10}x = 1.5$; $x \approx 31.623$
49. MMS Magnitude: ≈ 5.82 **51.** $N(3) \approx 71$ **53.** C

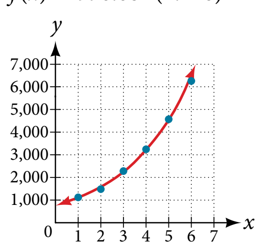
Section 4.8

1. Logistic models are best used for situations that have limited values. For example, populations cannot grow indefinitely since resources such as food, water, and space are limited, so a logistic model best describes populations. **3.** Regression analysis is the process of finding an equation that best fits a given set of data points. To perform a regression analysis on a graphing utility, first list the given points using the STAT then EDIT menu. Next graph the scatter plot using the STAT PLOT feature. The shape of the data points on the scatter graph can help determine which regression feature to use. Once this is determined, select the appropriate regression analysis command from the STAT then CALC menu.
5. The y-intercept on the graph of a logistic equation corresponds to the initial population for the population model.
7. C **9.** B **11.** $P(0) = 22$; 175
13. $p \approx 2.67$ **15.** y-intercept: (0, 15) **17.** 4 koi
19. About 6.8 months.

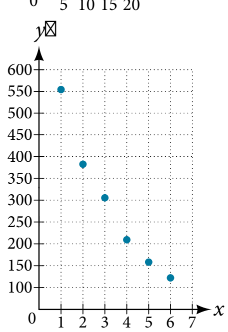
21.



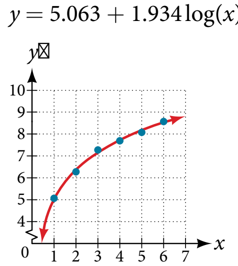
23. About 38 wolves
25. About 8.7 years
27. $f(x) = 776.682(1.426)^x$
29.



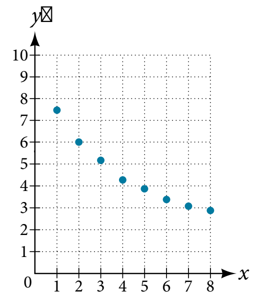
31.



33. $f(x) = 731.92e^{-0.3038x}$
35. When $f(x) = 250$, $x \approx 3.6$
37. $y = 5.063 + 1.934\log(x)$
39.

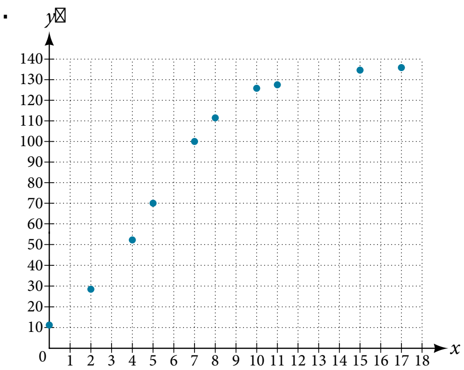


41.

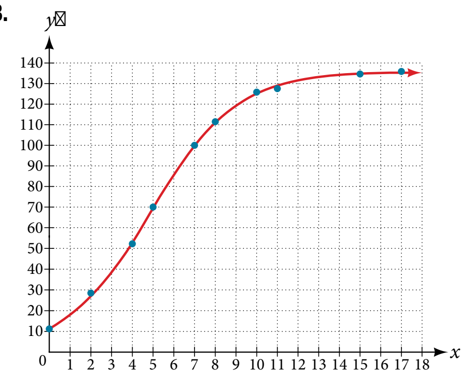


43. $f(10) \approx 2.3$
45. When $f(x) = 8$, $x \approx 0.82$
47. $f(x) = \frac{25.081}{1 + 3.182e^{-0.545x}}$
49. About 25

51.



53.



55. When $f(x) = 68$, $x \approx 4.9$ **57.** $f(x) = 1.034341(1.281204)^x$; $g(x) = 4.035510$; the regression curves are symmetrical about $y = x$, so it appears that they are inverse functions.

59. $f^{-1}(x) = \frac{\ln(a) - \ln\left(\frac{c}{x} - 1\right)}{b}$

Chapter 4 Review Exercises

1. Exponential decay; the growth factor, 0.825, is between 0 and 1.
3. $y = 0.25(3)^x$ **5.** \$42,888.18 **7.** Continuous decay; the growth rate is negative
9. Domain: all real numbers; range: all real numbers strictly greater than zero; y-intercept: (0, 3.5)