6 Chapter Review WITH CalcChat®

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Chapter Learning Target Understand exponential and logarithmic functions.

Chapter Success Criteria
- ◆ I can determine whether a function represents exponential growth or decay.
- ◆ I can simplify exponential and logarithmic expressions.
- ■ I can solve exponential and logarithmic equations.
- ■ I can model exponential and logarithmic functions.

◆ Surface ■ Deep

SELF-ASSESSMENT 1 I do not understand. 2 I can do it with help. 3 I can do it on my own. 4 I can teach someone else.

6.1 Exponential Growth and Decay Functions *(pp. 293–300)*

WATCH

Learning Target: Write and graph exponential growth and decay functions.

Vocabulary
exponential function
exponential growth function
growth factor
asymptote
exponential decay function
decay factor

Determine whether the function represents *exponential growth* or *exponential decay*. Then graph the function.

1. $f(x) = \left(\frac{1}{3}\right)^x$
2. $y = 5^x$
3. $f(x) = (0.2)^x$
4. You deposit $1500 in an account that pays 7% annual interest. Find the balance after 2 years when the interest is compounded daily.
5. Consider two exponential decay functions f and g. Determine whether each statement is *always*, *sometimes*, or *never* true. Justify your answers.
   a. $(fg)(x)$ is an exponential decay function.
   b. $\left(\frac{f}{g}\right)(x)$ is an exponential decay function.
6. A substance decays 10% each year. Find the initial amount of the substance when there are about 5.8 grams remaining after 9 years.

6.2 The Natural Base *e* *(pp. 301–306)*

WATCH

Learning Target: Use the natural base *e* and graph natural base functions.

Vocabulary
natural base *e*

Simplify the expression.

7. $e^4 \cdot e^{11}$
8. $\frac{20e^3}{10e^6}$
9. $(-3e^{-5x})^2$

Determine whether the function represents *exponential growth* or *exponential decay*. Then graph the function.

10. $f(x) = \frac{1}{3}e^x$
11. $y = 6e^{-x}$
12. $y = 3e^{-0.75x}$
13. An account earns 3% annual interest compounded continuously. Find the principal when the balance is $100 after 10 years.

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6.3 Logarithms and Logarithmic Functions (pp. 307–314)

WATCH

Learning Target: Understand logarithms and graph logarithmic functions.

Vocabulary

AZ VOCAB

logarithm of y with base b
common logarithm
natural logarithm

Evaluate the logarithm.

14. $\log_2 8$ **15.** $\log_6 \frac{1}{36}$ **16.** $\log_5 1$

Find the inverse of the function.

17. $f(x) = 8^x$ **18.** $y = \ln(x - 4)$ **19.** $y = \log(x + 9)$

20. Graph $y = \log_{1/5} x$.

21. The Richter scale is used for measuring the magnitude of an earthquake. The Richter magnitude R is given by $R = 0.67 \ln E + 1.17$, where E is the energy (in kilowatt-hours) released by the earthquake. To the nearest tenth, what is the Richter magnitude of an earthquake that releases 23,000 kilowatt-hours of energy?

6.4 Transformations of Exponential and Logarithmic Functions (pp. 315–322)

WATCH

Learning Target: Describe and graph transformations of exponential and logarithmic functions.

Describe the transformation of f represented by g. Then graph each function.

22. $f(x) = e^{-x}$, $g(x) = e^{-5x} - 8$ **23.** $f(x) = \log_4 x$, $g(x) = \frac{1}{2}\log_4(x + 5)$

24. Find the domain and range of $f(x) = a(e^{x+h} - k)$, where $a < 0$.

Write a rule for g.

25. Let the graph of g be a vertical stretch by a factor of 3, followed by a translation 6 units left and 3 units up of the graph of $f(x) = e^x$.

26. Let the graph of g be a translation 2 units down, followed by a reflection in the y-axis of the graph of $f(x) = \log x$.

6.5 Properties of Logarithms (pp. 323–328)

WATCH

Learning Target: Use properties of logarithms.

Expand or condense the logarithmic expression.

27. $\log_8 3xy$ **28.** $\log 10x^3y$ **29.** $\ln \frac{3y}{x^5}$

30. $3 \log_7 4 + \log_7 6$ **31.** $\log_2 12 - 2 \log_2 x$ **32.** $2 \ln x + 5 \ln 2 - \ln 8$

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

33. $\log_2 10$ **34.** $\log_7 9$ **35.** $\log_{23} 42$

6.6 Solving Exponential and Logarithmic Equations *(pp. 329–336)*

WATCH

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Learning Target: Solve exponential and logarithmic equations and inequalities.

Vocabulary

AZ VOCAB

exponential equations
logarithmic equations

Solve the equation. Check your solution(s).

36. $5^x = 8$

37. $\log_3(2x - 5) = 2$

38. $\ln x + \ln(x + 2) = 3$

Solve the inequality.

39. $6^x > 12$

40. $\ln x \leq 9$

41. $e^{4x-2} \geq 16$

42. The equation $y = 0.95^x$ represents the percent chance y (in decimal form) that a player on a football team successfully kicks x extra points in a row. For what number x does the percent chance fall to 25%?

43. A scientist studying memory determines that the percent y of new information that a certain individual remembers after x minutes can be modeled by $y = \dfrac{184}{(\log x)^{1.25} + 1.84}$. After how long does the person remember 50% of new information?

6.7 Modeling with Exponential and Logarithmic Functions *(pp. 337–344)*

WATCH

Learning Target: Write exponential and logarithmic functions to model sets of data.

Write an exponential function $y = ab^x$ whose graph passes through the given points.

44. (3, 8), (5, 2)

45. (1, 3), (4, 648)

46. (−1, 16), (2, 6.75)

47. A shoe store sells a new type of basketball shoe. The table shows the pairs sold s over time t (in weeks). Use technology to find a logarithmic model of the form $s = a + b \ln t$ that represents the data. Estimate the number of pairs of shoes sold after 6 weeks.

Week, t	1	3	5	7	9
Pairs sold, s	5	32	48	58	65

Mathematical Practices

Look for and Express Regularity in Repeated Reasoning

Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts.

1. In Exercise 71 on page 314, you evaluated expressions of the form $\log_b x$, where b and x can be rewritten as powers of the same base. In general, what is the value of a logarithmic expression of this form? Justify your answer.

2. Explain how you can distinguish among data that are represented by a linear, a quadratic, or an exponential function.