Solve the exponential equation. Express the solution set in terms of natural logarithms.

1) \(5^x + 7 = 3\)
   Objective: (3.4) Use Logarithms to Solve Exponential Equations

2) \(e^{4x} = 7\)
   Objective: (3.4) Use Logarithms to Solve Exponential Equations

Solve the exponential equation. Use a calculator to obtain a decimal approximation, correct to two decimal places, for the solution.

3) \(e^x = 4.2\)
   Objective: (3.4) Use Logarithms to Solve Exponential Equations

4) \(3^x = 11\)
   Objective: (3.4) Use Logarithms to Solve Exponential Equations

5) \(3e^x = 29\)
   Objective: (3.4) Use Logarithms to Solve Exponential Equations

For the given functions \(f\) and \(g\), find the requested composite function value.

6) \(f(x) = 2x + 2, \quad g(x) = 2x^2 + 1; \quad \text{Find } (g \circ f)(2).\)
   Objective: (5.1) Form a Composite Function
7) \( f(x) = 2x + 7, \ g(x) = -\frac{2}{x}; \) Find \((g \circ f)(3).\)

Objective: (5.1) Form a Composite Function

8) \( f(t) = \sqrt{t^4 + 30t^2 + 225}, \ g(t) = \frac{t + \frac{3}{5}}{3}; \) Find \((f \circ g)(15).\)

Objective: (5.1) Form a Composite Function

For the given functions \( f \) and \( g, \) find the requested composite function.

9) \( f(x) = 7x + 6, \ g(x) = 5x - 1; \) Find \((f \circ g)(x).\)

Objective: (5.1) Form a Composite Function

10) \( f(x) = \frac{3}{x - 1}, \ g(x) = \frac{8}{3x}; \) Find \((f \circ g)(x).\)

Objective: (5.1) Form a Composite Function

Decide whether the composite functions, \( f \circ g \) and \( g \circ f, \) are equal to \( x.\)

11) \( f(x) = \frac{x + 2}{3}, \ g(x) = 3x - 2 \)

Objective: (5.1) Form a Composite Function

12) \( f(x) = \sqrt{x + 1}, \ g(x) = x^2 \)

Objective: (5.1) Form a Composite Function
Solve the problem.

13) An oil well off the Gulf Coast is leaking, with the leak spreading oil over the surface of the gulf as a circle. At any time \( t \), in minutes, after the beginning of the leak, the radius of the oil slick on the surface is \( r(t) = 3t \) ft. Find the area \( A \) of the oil slick as a function of time.

Objective: (5.1) Form a Composite Function

14) An airline charter service charges a fare per person of $500 plus $30 for each unsold seat. The airplane holds 25 passengers. Let \( x \) represent the number of unsold seats and write an expression for the total revenue \( R \) for a charter flight.

Objective: (5.1) Form a Composite Function

Find the domain of the composite function \( f \circ g \).

15) \( f(x) = \frac{10}{x + 10}; \quad g(x) = x + 6 \)

Objective: (5.1) Find the Domain of a Composite Function

16) \( f(x) = x + 6; \quad g(x) = \frac{9}{x + 2} \)

Objective: (5.1) Find the Domain of a Composite Function

17) \( f(x) = \frac{1}{x - 7}; \quad g(x) = \frac{-49}{x} \)

Objective: (5.1) Find the Domain of a Composite Function

18) \( f(x) = \frac{1}{x - 7}; \quad g(x) = \sqrt{x - 1} \)

Objective: (5.1) Find the Domain of a Composite Function
Indicate whether the function is one-to-one.

19) \{(-2, -19), (-3, 14), (19, 17)\}
   Objective: (5.2) Determine Whether a Function Is One-to-One

20) \{(7, 4), (-8, 4), (-20, 7)\}
   Objective: (5.2) Determine Whether a Function Is One-to-One

Use the horizontal line test to determine whether the function is one-to-one.

21)

Objective: (5.2) Determine Whether a Function Is One-to-One

22)

Objective: (5.2) Determine Whether a Function Is One-to-One
Find the inverse of the function and state its domain and range.

23) \{((8, 1), (-1, -8), (-6, 5), (6, -5))\}

Objective: (5.2) Determine the Inverse of a Function Defined by a Map or a Set of Ordered Pairs

Decide whether or not the functions are inverses of each other.

24) \(f(x) = 3x + 9, \ g(x) = \frac{1}{3}x - 3\)

Objective: (5.2) Find the Inverse of a Function Defined by an Equation

25) \(f(x) = (x - 6)^2, \ x \geq 6; \ g(x) = \sqrt{x} + 6\)

Objective: (5.2) Find the Inverse of a Function Defined by an Equation

26) \(f(x) = (x - 2)^2, \ x \geq 2; \ g(x) = \sqrt{x} + 2\)

Objective: (5.2) Find the Inverse of a Function Defined by an Equation

The function \(f\) is one-to-one. Find its inverse.

27) \(f(x) = 3x - 6\)

Objective: (5.2) Find the Inverse of a Function Defined by an Equation

28) \(f(x) = 5x^2 - 8, \ x \geq 0\)

Objective: (5.2) Find the Inverse of a Function Defined by an Equation

29) \(f(x) = \frac{5}{3x + 7}\)

Objective: (5.2) Find the Inverse of a Function Defined by an Equation
30) \( f(x) = \frac{4}{x + 4} \)

Objective: (5.2) Find the Inverse of a Function Defined by an Equation

31) \( f(x) = \sqrt[3]{x + 7} \)

Objective: (5.2) Find the Inverse of a Function Defined by an Equation

Find a formula for the inverse of the function described below.

32) A size 56 dress in Country C is size 20 in Country D. A function that converts dress sizes in Country C to those in Country D is \( f(x) = \frac{x}{2} - 8 \).

Objective: (5.2) Find the Inverse of a Function Defined by an Equation

Approximate the value using a calculator. Express answer rounded to three decimal places.

33) \( 2 \sqrt{6} \)

Objective: (5.3) Evaluate Exponential Functions

34) \( e^{-1.4} \)

Objective: (5.3) Evaluate Exponential Functions

Solve the problem.

35) The function \( D(h) = 6e^{-0.4h} \) can be used to determine the milligrams \( D \) of a certain drug in a patient’s bloodstream \( h \) hours after the drug has been given. How many milligrams (to two decimals) will be present after 10 hours?

Objective: (5.3) Evaluate Exponential Functions
36) A rumor is spread at an elementary school with 1200 students according to the model

\[ N = 1200(1 - e^{-0.16d}) \]

where \( N \) is the number of students who have heard the rumor and \( d \) is the number of days that have elapsed since the rumor began. How many students will have heard the rumor after 5 days?

**Objective:** (5.3) Evaluate Exponential Functions

Use transformations to graph the function. Determine the domain, range, and horizontal asymptote of the function.

37) \( f(x) = 5(x - 3) \)

**Objective:** (5.3) Graph Exponential Functions

38) \( f(x) = 2^{-x} + 5 \)

**Objective:** (5.3) Graph Exponential Functions
Graph the function.

39) \( f(x) = \left( \frac{1}{3} \right)^x \)

Solve the equation.

40) \( 4^{-x} = \frac{1}{16} \)

41) \( 2(3x - 7) = 4 \)

42) \( 2x^2 - 3 = 64 \)

43) \( 92x \cdot 27(3 - x) = \frac{1}{9} \)

Objective: (5.3) Graph Exponential Functions

Objective: (5.3) Solve Exponential Equations
44) \(64x - 4 = 16^{3x}\)

Objective: (5.3) Solve Exponential Equations

Solve the problem.

45) Suppose that \(f(x) = 5^x + 6\). If \(f(x) = 1/131\), what is \(x\)?:

Objective: (5.3) Solve Exponential Equations

Change the exponential expression to an equivalent expression involving a logarithm.

46) \(7^3 = 343\)

Objective: (5.4) Change Exponential Statements to Logarithmic Statements & Logarithmic Statements to Exponential Statements

47) \(5^2 = x\)

Objective: (5.4) Change Exponential Statements to Logarithmic Statements & Logarithmic Statements to Exponential Statements

48) \(32^{1/5} = 2\)

Objective: (5.4) Change Exponential Statements to Logarithmic Statements & Logarithmic Statements to Exponential Statements

Change the logarithmic expression to an equivalent expression involving an exponent.

49) \(\log_{1/5} 625 = -4\)

Objective: (5.4) Change Exponential Statements to Logarithmic Statements & Logarithmic Statements to Exponential Statements
50) \( \log_3 9 = 2 \)

Objective: (5.4) Change Exponential Statements to Logarithmic Statements & Logarithmic Statements to Exponential Statements

51) \( \log_5 25 = x \)

Objective: (5.4) Change Exponential Statements to Logarithmic Statements & Logarithmic Statements to Exponential Statements

52) \( \ln x = 4 \)

Objective: (5.4) Change Exponential Statements to Logarithmic Statements & Logarithmic Statements to Exponential Statements

53) \( \ln \left( \frac{1}{e^5} \right) = -5 \)

Objective: (5.4) Change Exponential Statements to Logarithmic Statements & Logarithmic Statements to Exponential Statements

Find the exact value of the logarithmic expression.

54) \( \log_4 \frac{1}{64} \)

Objective: (5.4) Evaluate Logarithmic Expressions

55) \( \log_{1/5} 25 \)

Objective: (5.4) Evaluate Logarithmic Expressions
56) \( \log_5 \sqrt{5} \)

Objective: (5.4) Evaluate Logarithmic Expressions

57) \( \ln e^3 \)

Objective: (5.4) Evaluate Logarithmic Expressions

Use a calculator to evaluate the expression. Round your answer to three decimal places

58) \[
\frac{\ln \frac{7}{5}}{0.94}
\]

Objective: (5.4) Evaluate Logarithmic Expressions

59) \[
\frac{\log 7 \cdot \log 2}{\ln 2 - \ln 5}
\]

Objective: (5.4) Evaluate Logarithmic Expressions

Solve the problem.

60) The pH of a chemical solution is given by the formula

\[ \text{pH} = -\log_{10}[H^+] \]

where \([H^+]\) is the concentration of hydrogen ions in moles per liter.

Find the pH if the \([H^+] = 8.4 \times 10^{-13} \).

Objective: (5.4) Evaluate Logarithmic Expressions

Solve the equation.

61) \( \log_5 x^2 = 4 \)

Objective: (5.4) Solve Logarithmic Equations
62) \( \log_3 (x^2 - 2x) = 1 \)

Objective: (5.4) Solve Logarithmic Equations

63) \( 7 + 9 \ln x = 4 \)

Objective: (5.4) Solve Logarithmic Equations

64) \( \ln \sqrt{x} + 5 = 3 \)

Objective: (5.4) Solve Logarithmic Equations

The Richter scale converts seismographic readings into numbers for measuring the magnitude of an earthquake according to this function \( M(x) = \log \left( \frac{x}{x_0} \right) \), where \( x_0 = 10^{-3} \).

65) What is the magnitude of an earthquake whose seismographic reading is 6.8 millimeters at a distance of 100 kilometers from its epicenter? Round the answer to the nearest tenth.

Objective: (5.4) Solve Logarithmic Equations

Solve the problem.

66) \( \text{pH} = -\log_{10}[H^+] \) Find the \([H^+]\) if the pH = 2.4.

Objective: (5.4) Solve Logarithmic Equations

Use the properties of logarithms to find the exact value of the expression. Do not use a calculator.

67) \( \ln e^{\sqrt{6}} \)

Objective: (5.5) Work with the Properties of Logarithms
68) \( \log_2 32 - \log_2 16 \)

Objective: (5.5) Work with the Properties of Logarithms

69) \( \log_2 27 \cdot \log_2 8 \)

Objective: (5.5) Work with the Properties of Logarithms

70) \( e^{\ln 13} \)

Objective: (5.5) Work with the Properties of Logarithms

Write as the sum and/or difference of logarithms. Express powers as factors.

71) \( \log_4 \left( \frac{x^3}{y^8} \right) \)

Objective: (5.5) Write a Logarithmic Expression as a Sum or Difference of Logarithms

72) \( \ln \sqrt[3]{ey} \)

Objective: (5.5) Write a Logarithmic Expression as a Sum or Difference of Logarithms

73) \( \log_3 \frac{\sqrt[7]{16}}{q^2p} \)

Objective: (5.5) Write a Logarithmic Expression as a Sum or Difference of Logarithms
74) \( \log \left( 1 - \frac{1}{x^3} \right) \)

Objective: (5.5) Write a Logarithmic Expression as a Sum or Difference of Logarithms

Express as a single logarithm.

75) \((\log_a x - \log_a y) + 2 \log_a z\)

Objective: (5.5) Write a Logarithmic Expression as a Single Logarithm

76) \(2 \log_b m - \frac{3}{5} \log_b n + \frac{1}{3} \log_b j - 3 \log_b k\)

Objective: (5.5) Write a Logarithmic Expression as a Single Logarithm

77) \(3 \log_a (2x + 1) - 2 \log_a (2x - 1) + 2\)

Objective: (5.5) Write a Logarithmic Expression as a Single Logarithm

Solve the problem.

78) Find the value of \(\log_3 4 \cdot \log_4 5 \cdot \log_5 6 \cdot \log_6 7 \cdot \log_7 8 \cdot \log_8 9\)

Objective: (5.5) Evaluate Logarithms Whose Base Is Neither 10 Nor e

Solve the equation.

79) \(\log_5 (x + 3) = 1\)

Objective: (5.6) Solve Logarithmic Equations

80) \(\log (3 + x) - \log (x - 5) = \log 3\)

Objective: (5.6) Solve Logarithmic Equations
81) \[ \log_3 x + \log_3(x - 24) = 4 \]

Objective: (5.6) Solve Logarithmic Equations

82) \[ \log_2(3x - 2) - \log_2(x - 5) = 4 \]

Objective: (5.6) Solve Logarithmic Equations

83) \[ 3 \cdot 5^2t - 1 = 75 \]

Objective: (5.6) Solve Exponential Equations

Solve the problem.

84) The formula \( A = 283e^{0.028t} \) models the population of a particular city, in thousands, \( t \) years after 1998. When will the population of the city reach 335 thousand?

Objective: (5.6) Solve Exponential Equations

Find the present value. Round to the nearest cent.

85) To get $5600 after 2 years at 7% compounded annually

Objective: (5.7) Determine the Present Value of a Lump Sum of Money

86) To get $25,000 after 12 years at 6% compounded semiannually

Objective: (5.7) Determine the Present Value of a Lump Sum of Money

Solve the problem.

87) What principal invested at 8% compounded continuously for 4 years will yield $1190?

Round the answer to two decimal places.

Objective: (5.7) Determine the Present Value of a Lump Sum of Money
Answer Key
Testname: 13SPR_CH5_MATH1_HW_3

1) \[ \left\{ \frac{\ln 3}{\ln 5} - 7 \right\} \]
2) \[ \left\{ \frac{\ln 7}{4} \right\} \]
3) 1.44
4) 2.18
5) 2.27
6) 163
7) \(-\frac{2}{13}\)
8) 51
9) 35x - 1
10) \(\frac{9x}{8 - 3x}\)
11) Yes, yes
12) No, no
13) \(A(r(t)) = 9\pi t^2\)
14) \(R(x) = (25 - x)(500 + 30x)\) or \(12,500 + 250x - 30x^2\)
15) \(\{x \mid x \neq -16\}\)
16) \(\{x \mid x \neq -2\}\)
17) \(\{x \mid x \neq 0, x \neq -7\}\)
18) \(\{x \mid x \geq 1, x \neq 50\}\)
19) Yes
20) No
21) Yes
22) No
23) \((1, 8), (-8, -1), (5, -6), (-5, 6)\) \(D = \{1, -8, 5, -5\} ; R = \{8, -1, -6, 6\}\)
24) Yes
25) Yes
26) No
27) \(f^{-1}(x) = \frac{x + 6}{3}\)
28) \(f^{-1}(x) = \sqrt{\frac{x + 8}{5}}\)
29) \(f^{-1}(x) = \frac{5 - 7x}{3x}\)
30) \(f^{-1}(x) = \frac{-4x + 4}{x}\)
31) \(f^{-1}(x) = x^3 - 7\)
32) \(f^{-1}(x) = 2(x + 8)\)
33) 5.462
34) 0.247
35) 0.11 mg
36) 661 students
37) domain of $f$: $(-\infty, \infty)$; range of $f$: $(0, \infty)$
   horizontal asymptote: $y = 0$

38) domain of $f$: $(-\infty, \infty)$; range of $f$: $(5, \infty)$
   horizontal asymptote: $y = 5$

40) $\{2\}$
41) $\{3\}$
42) $\{3, -3\}$
43) $(-11)$
44) $(-4)$
45) $-3$
46) $\log_7 343 = 3$
47) $\log_5 x = 2$
48) \( \log_{32} 2 = \frac{1}{5} \)

49) \( \left( \frac{1}{5} \right)^{-4} = 625 \)

50) 3\(^2\) = 9

51) 5\(^x\) = 25

52) \( e^4 = x \)

53) \( e^{-5} = \frac{1}{e^5} \)

54) -3

55) -2

56) \( \frac{1}{2} \)

57) 3

58) 0.358

59) -1.251

60) 12.08

61) [25, -25]

62) [3, -1]

63) [\( e^{-1/3} \)]

64) [\( e^6 - 5 \)]

65) 3.8

66) 3.98 \times 10^{-3}

67) \( \sqrt[3]{6} \)

68) 1

69) 3

70) 13

71) 3\( \log_4 x - 8 \log_4 y \)

72) \( \frac{1}{3} \ln y + \frac{1}{3} \)

73) \( \frac{1}{7} \log_3 16 - 2 \log_3 q - \log_3 p \)

74) \( \log(x - 1) + \log(x^2 + x + 1) - 3 \log x \)

75) \( \log_a \frac{xz^2}{y} \)

76) \( \log_b \frac{m^2}{n^{3/5} k^3} \)

77) \( \log_a \frac{a^2(2x + 1)^3}{(2x - 1)^2} \)

78) 2

79) [2]

80) [9]

81) [27]

82) [6]
Answer Key
Testname: 13SPR_CH5_MATH1_HW_3

83) $\left\{ \frac{3}{2} \right\}$
84) 2004
85) $4891.26$
86) $12,298.34$
87) $864.12$