

196: 28-32, 39-42, 62-64, 72-74

$$28. \quad 6^x = 28$$

$$\log 6^x = \log 28$$

$$x \log 6 = \log 28$$

$$x = \frac{\log 28}{\log 6} \approx 1.86$$

$$29. \quad 1.8^x = 9.6$$

$$\log 1.8^x = \log 9.6$$

$$x \log 1.8 = \log 9.6$$

$$x = \frac{\log 9.6}{\log 1.8} \approx 3.85$$

$$30. \quad 3e^{4x} = 45$$

$$e^{4x} = 15$$

$$\ln e^{4x} = \ln 15$$

$$4x = \ln 15$$

$$x = \frac{\ln 15}{4} \approx 0.68$$

$$31. \quad e^{3x+1} = 51$$

$$\ln e^{3x+1} = \ln 51$$

$$3x+1 = \ln 51$$

$$3x = (\ln 51) - 1$$

$$x = \frac{(\ln 51) - 1}{3} \approx 0.98$$

$$32. \quad 8^x - 1 = 3.4$$

$$8^x = 4.4$$

$$\log 8^x = \log 4.4$$

$$x \log 8 = \log 4.4$$

$$x = \frac{\log 4.4}{\log 8} \approx 0.71$$

$$39. \quad 7^{2x+1} = 3^{x+3}$$

$$\log 7^{2x+1} = \log 3^{x+3}$$

$$(2x+1) \log 7 = (x+3) \log 3$$

$$2x \log 7 + \log 7 = x \log 3 + 3 \log 3$$

$$2x \log 7 - x \log 3 = 3 \log 3 - \log 7$$

$$x(2 \log 7 - \log 3) = 3 \log 3 - \log 7$$

$$x(\log 7^2 - \log 3) = \log 3^3 - \log 7$$

$$x(\log \frac{7^2}{3}) = \log \frac{3^3}{7}$$

$$x = \frac{\log \frac{27}{7}}{\log \frac{49}{3}} \approx 0.48$$

$$40. \quad 11^{x+1} = 7^{x-1}$$

$$\ln 11^{x+1} = \ln 7^{x-1}$$

$$(x+1) \ln 11 = (x-1) \ln 7$$

$$x \ln 11 + \ln 11 = x \ln 7 - \ln 7$$

$$x \ln 11 - x \ln 7 = -\ln 7 - \ln 11$$

$$x(\ln 11 - \ln 7) = \ln 7^{-1} - \ln 11$$

$$x(\ln \frac{11}{7}) = \ln \frac{1}{7 \cdot 11}$$

$$x = \frac{\ln \frac{1}{77}}{\ln \frac{11}{7}} \approx -9.61$$

$$41. \quad 9^{x+2} = 2^{5x-4}$$

$$\ln 9^{x+2} = \ln 2^{5x-4}$$

$$(x+2) \ln 9 = (5x-4) \ln 2$$

$$x \ln 9 + 2 \ln 9 = 5x \ln 2 - 4 \ln 2$$

$$x \ln 9 - 5x \ln 2 = -2 \ln 9 - 4 \ln 2$$

$$x(\ln 9 - 5 \ln 2) = \ln 9^{-2} + \ln 2^{-4}$$

$$x(\ln \frac{9}{2^5}) = \ln \frac{1}{9^2 \cdot 2^4}$$

$$x = \frac{\ln \frac{1}{1296}}{\ln \frac{1}{28125}} \approx 5.65$$

$$\begin{aligned}
 42. \quad 4^{x-3} &= 6^{2x-1} \\
 \ln 4^{x-3} &= \ln 6^{2x-1} \\
 (x-3)\ln 4 &= (2x-1)\ln 6 \\
 x\ln 4 - 3\ln 4 &= 2x\ln 6 - \ln 6 \\
 x\ln 4 - 2x\ln 6 &= 3\ln 4 - \ln 6 \\
 x(\ln 4 - 2\ln 6) &= \ln 4^3 - \ln 6 \\
 x &= \frac{\ln \frac{64}{6}}{\ln \frac{4}{36}} \approx -1.08
 \end{aligned}$$

$$\begin{aligned}
 43. \quad 3^{4x+3} &= 8^{-x+2} \\
 \ln 3^{4x+3} &= \ln 8^{-x+2} \\
 (4x+3)\ln 3 &= (-x+2)\ln 8 \\
 4x\ln 3 + 3\ln 3 &= -x\ln 8 + 2\ln 8 \\
 4x\ln 3 + x\ln 8 &= -3\ln 3 + 2\ln 8 \\
 x(\ln 3^4 \cdot 8) &= \ln \frac{64}{27} \\
 x &= \frac{\ln 2.37}{\ln 648} \approx 0.13
 \end{aligned}$$

$$\begin{aligned}
 64. \quad \log(5x^2+4) &= 2\log 3x^2 - \log(2x^2-1) \\
 \log(5x^2+4) &= \frac{\log 9x^4}{2x^2-1}
 \end{aligned}$$

$$\begin{aligned}
 5x^2+4 &= \frac{9x^4}{2x^2-1} \\
 (10x^4+3x^2+4) &= 9x^4 \\
 x^4+3x^2-4 &= 0 \\
 (x^2+4)(x^2-1) &= 0 \\
 x^2+4=0 & \text{ no sol} \\
 x^2-1=0 & \boxed{x = \pm 1}
 \end{aligned}$$

$$67. \quad \ln(3x+1) + \ln(2x-3) = \ln 10$$

$$\ln((3x+1)(2x-3)) = \ln 10$$

$$\begin{aligned}
 \ln(6x^2 - 7x + 3) &= \ln 10 \\
 6x^2 - 7x + 3 &= 10
 \end{aligned}$$

$$\text{Check: } \boxed{\frac{13}{6} \text{ or } -1}$$

$$-1 \ln(-2) \quad \times$$

$$\begin{aligned}
 & \frac{+7 \pm \sqrt{49 - 4(6)(-7)}}{12} \\
 & \frac{7+19}{12} \quad \frac{7-19}{12} \\
 & \frac{26}{12} \quad -1 \\
 & \frac{13}{6}
 \end{aligned}$$

$$63. \ln(x-3) + \ln(2x+3) = \ln(-4x^2)$$

$$\ln(x-3)(2x+3) = \ln(-4x^2)$$

$$\ln(2x^2 - 3x - 9) = \ln(-4x^2)$$

$$2x^2 - 3x - 9 = -4x^2$$

$$6x^2 - 3x - 9 = 0$$

↑ always negative
no solution

$$\frac{(6x-9)(6x+6)}{3 \cdot 3} \quad \frac{54}{9}$$

$$(2x-3)(3x+3) = 0$$

$$x = \frac{3}{2} \quad x = -1 \text{ NO}$$

$$\ln\left(\frac{3}{2} - 3\right)$$

↑
neg no

$$72. \log x = 1 - \log(x-3)$$

$$\log x + \log(x-3) = 1$$

$$\log x(x-3) = 1$$

$$10^{\log(x^2-3x)} = 10^1$$

$$x^2 - 3x = 10$$

$$x^2 - 3x - 10 = 0$$

$$(x+2)(x-5) = 0$$

$$x = -2 \quad x = 5$$

$$\begin{matrix} \times & \checkmark \\ x & \end{matrix}$$

$$73. \log 50x = 2 + \log(2x-3)$$

$$\log 50 - \log(2x-3) = 2$$

$$\log \frac{50x}{2x-3} = 2$$

$$\frac{50x}{2x-3} = 100$$

$$\cancel{50}x = \cancel{20}x - 300$$

$$-x = 4x - 6$$

$$-6 = 3x$$

$$-x = 2$$

$$74. \log(x-10) = 3 + \log(x-3)$$

$$\log(x-10) - \log(x-3) = 3$$

$$\log \frac{(x-10)}{(x-3)} = 3$$

$$\frac{x-10}{x-3} = 10^3$$

$$x-10 = 10^3(x-3)$$

$$-7 = 999x$$

$$\frac{-7}{999} = x \text{ no solution}$$