

LESSON
7.6

Practice B
For use with pages 515–522

Assignment 5-44 (odd),
46-49 (all)

Solve the exponential equation. Check for extraneous solutions. Round the result to three decimal places if necessary.

Write tips on back page

- | | | |
|----------------------------------|------------------------------------|---|
| 1. $e^x = 1$ | 2. $e^x = 4$ | 3. $e^x + 1 = 7$ |
| 4. $5^x = 12$ | 5. $4^x - 6 = 4$ | 6. $3^{4x} = 27$ |
| 7. $e^{2x} = 4$ | 8. $3e^{3x} = 12$ | 9. $10^{2x-3} + 3 = 19$ |
| 10. $3e^x + 7 = 9$ | 11. $10^{x+2} - 12 = 22$ | 12. $10^{-x+4} + 7 = 5$ |
| 13. $3^{-3x+1} = 3^{x-9}$ | 14. $8^{2x} = 8^{x+7}$ | 15. $7^{2x-3} - 4 = 14$ |
| 16. $4e^{3x} = 1$ | 17. $e^{5x+2} = e^{3x+12}$ | 18. $3e^{3-x} = 15$ |
| 19. $9^{2x} = 3^{2x+4}$ | 20. $25^{x-4} = 5^{3x+1}$ | 21. $8^{x-1} = \left(\frac{1}{2}\right)^{2x-1}$ |
| 22. $3(2^{x+6}) = 17$ | 23. $5^{0.5x} + 12 = 21$ | 24. $-5e^x - 3 = 24$ |
| 25. $\frac{3}{4}e^{3x} - 8 = -6$ | 26. $\frac{2}{3}(4^{3x}) - 5 = -2$ | 27. $10^{2x+1} + 2 = 2$ |

Solve the logarithmic equation. Check for extraneous solutions. Round the result to three decimal places if necessary.

- | | | |
|-----------------------------------|----------------------------|--------------------------------|
| 28. $\log x = 3$ | 29. $\ln x = 4$ | 30. $\log_3 x = 5$ |
| 31. $\log_7(2-x) = \log_7 5x$ | 32. $\ln(3x-3) = \ln(x-6)$ | 33. $\ln(5-2x) = \ln(5x+3)$ |
| 34. $\log_4 3x = 6$ | 35. $\log_2(3x-1) = 8$ | 36. $7 - \log_3 8x = 2$ |
| 37. $2 \log_7(1-2x) = 12$ | 38. $3 \ln x - 7 = 4$ | 39. $\ln(1-3x) + 3 = 9$ |
| 40. $\log 7x + 4 = 5$ | 41. $4 + \log_9(3x-7) = 6$ | 42. $\log_2 2x + \log_2 x = 5$ |
| 43. $\log_6(2x-6) + \log_6 x = 2$ | 44. $\ln 3x - \ln 2 = 4$ | 45. $\ln(-5x+3) = \ln 2x+2$ |
46. **Multiple Choice** You deposit \$500 in an account that pays 3.25% annual interest compounded monthly. About how long does it take for the balance to quadruple?
 A. 36.3 years B. 42.7 years C. 45.1 years

In Exercises 47–49, use the following information.

Compounding Interest You deposit \$700 in an account that pays 2.75% annual interest. How long does it take the balance to reach the following amounts?

47. \$1000 when interest is compounded quarterly
 48. \$1500 when interest is compounded yearly
 49. \$2000 when interest is compounded continuously

50. **Rocket Velocity** Disregarding the force of gravity, the maximum velocity v of a rocket is given by $v = t \ln M$ where t is the velocity of the exhaust and M is the ratio of the mass of the rocket with fuel to its mass without fuel. A solid propellant rocket has an exhaust velocity of 2.3 kilometers per second. Its maximum velocity is 7.2 kilometers per second. Find its mass ratio M .

TIPS for solving exponential equations.

* If you have an exponential on both sides (ex: $9^{2x} = 3^{2x+4}$):

- 1) Get the same base on both sides
- 2) set the powers equal to each other
- 3) solve

(ex: 13, 17, 19, 20, 21, ...)

* If you have an exponential on only one side (ex: $4e^{3x} = 1$)

- 1) Get what's raised to the power by itself.
- 2) Switch to log form.
- 3) solve

(ex: 1, 2, 3, 4, 5, 6, 7, 8, ...)

TIPS for solving logarithmic equations.

* If you have logs with the same base on both sides (ex: $\log_4(2x-7) = \log_4(x+8)$):

- 1) Set what's inside the logs equal to each other.

2) solve

(ex: 31, 32, 33, 45, ...)

* If you have $\log(s)$ only on one side ($\ln 3x - \ln 2 = 4$):

- 1) condense down to one log if necessary / get log by itself.

2) switch to exponential form.

3) solve

(ex: 29, 36, 43, 44, ...)

(odd solutions)

Section 7.6 Practice B

①

$$e^x = 1$$

$$\ln 1 = x$$

$$0 = x$$

⑪

$$10^{x+2} - 12 = 22$$

$$10^{x+2} = 34$$

$$\log_{10} 34 = x+2$$

③

$$e^x + 1 = 7$$

$$e^x = 6$$

A

$$\ln 6 = x$$

$$1.79 = x$$

$$\log_{10}(34) - 2 = x$$

$$-0.47 = x$$

⑤

$$4^x - 6 = 4$$

$$4^x = 10$$

$$\log_4 10 = x$$

$$1.66 = x$$

⑬

$$8^{-3x+1} = 8^{x-9}$$

$$-3x+1 = x-9$$

$$-4x = -10$$

$$x = 10/4 = 5/2$$

⑦

$$e^{2x} = 4$$

$$\ln 4 = 2x$$

$$\frac{\ln 4}{2} = x$$

$$0.69 = x$$

~~⑭~~

$$7^{2x-3} = 4 = 14$$

$$7^{2x-3} = 18$$

$$\log_7 18 = 2x-3$$

$$\frac{\log_7(18)+3}{2} = x$$

⑨

$$10^{2x-3} + 3 = 19$$

$$10^{2x-3} = 16$$

$$\log 16 = 2x-3$$

$$\frac{\log(16)+3}{2} = x$$

$$2.10 = x$$

$$2.24 = x$$

~~⑮~~

$$e^{5x+2} = e^{3x+12}$$

$$5x+2 = 3x+12$$

$$2x = 10$$

$$x = 5$$

$$\begin{aligned} (19) \quad 9^{2x} &= 3^{2x+4} \\ (3^2)^{2x} &= 3^{2x+4} \\ 3^{4x} &= 3^{2x+4} \\ 4x &= 2x+4 \\ 2x &= 4 \\ x &= 2 \end{aligned}$$

$$\begin{aligned} (27) \quad 10^{2x+1} + 2 &= 2 \\ 10^{2x+1} &= 0 \\ \log 0 &= 2x+1 \\ \frac{\log(0) - 1}{2} &= x \\ \text{Und} &= x \end{aligned}$$

$$\begin{aligned} (21) \quad 8^{x-1} &= \left(\frac{1}{2}\right)^{2x-1} \\ 2^{3(x-1)} &= 2^{-1(2x-1)} \\ 2^{3x-3} &= 2^{-2x+1} \\ 3x-3 &= -2x+1 \\ 5x &= 4 \\ x &= 4/5 \end{aligned}$$

$$\begin{aligned} (29) \quad \ln x &= 4 \\ e^4 &= x \\ 54.60 &= x \end{aligned}$$

$\emptyset \in \text{NO Solution}$

$$\begin{aligned} (23) \quad 5^{0.5x} + 12 &= 21 \\ 5^{0.5x} &= 9 \\ \log_5 9 &= 0.5x \\ \frac{\log_5 9}{0.5} &= x \end{aligned}$$

$$\begin{aligned} (31) \quad \log_7(2-x) &= \log_7 5x \\ 2-x &= 5x \\ 2 &= 6x \\ 1/3 &= x \end{aligned}$$

$$2.73 = x$$

$$\begin{aligned} (33) \quad \ln(5-2x) &= \ln(5x+3) \\ 5-2x &= 5x+3 \\ -7x &= -2 \\ x &= 2/7 \end{aligned}$$

$$\begin{aligned} (25) \quad \frac{3}{4}e^{3x} - 8 &= -6 \\ \frac{3}{4}e^{3x} &= 2 \\ e^{3x} &= \frac{8}{3} \end{aligned}$$

$$\ln 8/3 = 3x \rightarrow x = \frac{\ln(8/3)}{3} = 0.33$$

(35)

$$\log_2(3x-1) = 8$$

$$2^8 = 3x-1$$

$$256 = 3x-1$$

$$257 = 3x$$

$$85.\bar{6} = x$$

(41)

$$4 + \log_9(3x-7) = 6$$

$$\log_9(3x-7) = 2$$

$$9^2 = 3x-7$$

$$81 = 3x-7$$

(37)

$$2 \log_7(1-2x) = 12$$

$$\log_7(1-2x) = 6$$

$$7^6 = 1-2x$$

$$117,649 = 1-2x$$

$$117,648 = -2x$$

$$-58,824 = x$$

$$\frac{81+7}{3} = x$$

$$29.\bar{3} = x$$

(39)

$$\ln(1-3x) + 3 = 9$$

$$\ln(1-3x) = 6$$

$$e^6 = 1-3x$$

$$e^6 - 1 = -3x$$

$$\frac{e^6 - 1}{-3} = x$$

$$-131.14 = x$$

$$(46) \quad 2000 = 500 \left(1 + \frac{0.0325}{12} \right)^{12t}$$

$$4 = \left(\frac{4813}{4800} \right)^{12t}$$

$$\log_{\left(\frac{4813}{4800} \right)} 4 = 12t$$

$$\frac{\log_{\left(\frac{4813}{4800} \right)} 4}{12} = t$$

$$42.7 = t$$

(13)

$$(47) \quad 1000 = 700 \left(1 + \frac{0.0275}{4} \right)^{4t}$$

$$\frac{10}{7} = (1.006875)^{4t}$$

$$\log_{1.006875} \left(\frac{10}{7} \right) = 4t$$

$$\frac{\log_{1.006875} \left(\frac{10}{7} \right)}{4} = t$$

$$13.0 = t$$

years

$$(48) \quad 1500 = 700 \left(1 + \frac{0.0275}{1} \right)^t$$

$$\frac{15}{7} = (1.0275)^t$$

$$\log_{1.0275} \left(\frac{15}{7} \right) = t$$

$$28.09 = t$$

years

(49)

$$2000 = 700 e^{0.0275t}$$

$$\frac{20}{7} = e^{0.0275t}$$

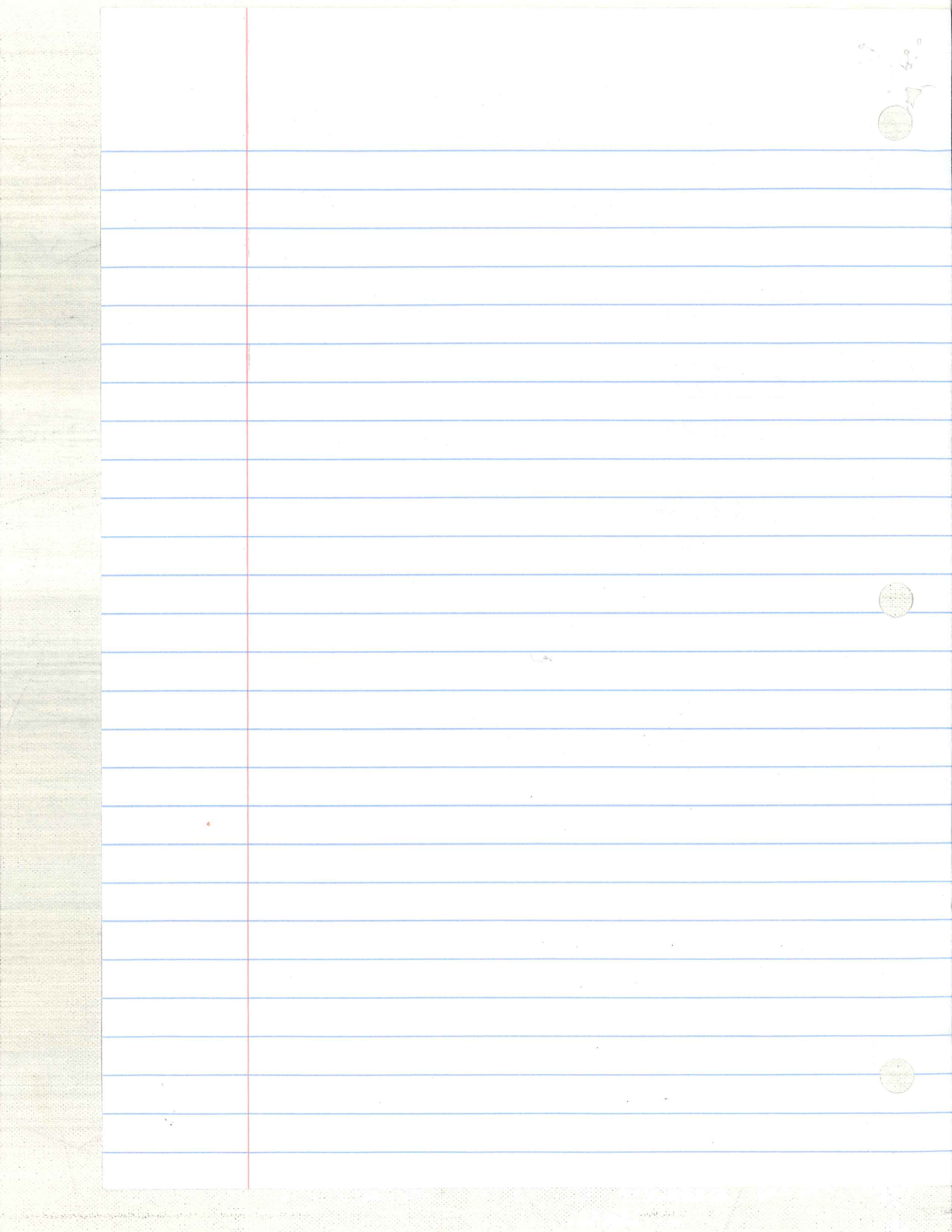
$$\ln\left(\frac{20}{7}\right) = 0.0275t$$

$$\frac{\ln\left(\frac{20}{7}\right)}{0.0275} = t$$

$$38.2 = t$$

$$38.2 = t$$

years



7.6 practice B (evens)

$$(2) \quad e^x = 4$$

$$\ln 4 = x$$

$$1.39 = x$$

$$(4) \quad 5^x = 12$$

$$\log_5 12 = x$$

$$1.54 = x$$

$$(6) \quad 3^{4x} = 27$$

$$\log_3 27 = 4x$$

$$\frac{\log_3 27}{4} = x$$

$$0.75 = x$$

$$(8) \quad \frac{3e^{3x}}{3} = \frac{12}{3}$$

$$e^{3x} = 4$$

$$\ln 4 = 3x$$

$$\frac{\ln 4}{3} = x$$

$$0.46 = x$$

(10)

$$3e^x + 7 = 9$$

$$\frac{3e^x}{3} = \frac{2}{3}$$

$$e^x = \frac{2}{3}$$

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

$$-0.41 = x$$

(12)

$$10^{-x+4} + 7 = 5$$

$$10^{-x+4} = -2$$

$$\log(-2) = -x+4$$

Log are only defined for positive inputs!

No solution

(14)

$$8^{2x} = 8^{x+7}$$

$$2x = x+7$$

$$x = 7$$

(16)

$$4e^{3x} = \frac{1}{4}$$

$$e^{3x} = \frac{1}{4}$$

$$\ln\left(\frac{1}{4}\right) = 3x$$

$$\frac{\ln\left(\frac{1}{4}\right)}{3} = x$$

$$-0.46 = x$$

(18)

$$3e^{3-x} = 15$$

$$e^{3-x} = \frac{15}{3}$$

$$e^{3-x} = 5$$

$$\ln 5 = 3-x$$

$$\ln(5) - 3 = -x$$

$$\frac{\ln(5) - 3}{-1} = x$$

$$x = 1.39$$

(20)

$$25^{x-4} = 5^{3x+1}$$

$$5^{2(x-4)} = 5^{3x+1}$$

$$\begin{array}{r} 2x - 8 = 3x + 1 \\ -3x + 8 \quad -3x + 8 \end{array}$$

$$-x = 9$$

$$x = \frac{9}{-1}$$

$$x = -9$$

(22)

$$3(2^{x+6}) = 17$$

$$2^{x+6} = \frac{17}{3}$$

$$\log_2\left(\frac{17}{3}\right) = x+6$$

$$\log_2\left(\frac{17}{3}\right) - 6 = x$$

$$-3.50 = x$$

$$\textcircled{24} \quad -5e^x - 3 = 24$$

$$+3 \quad +3$$

$$-5e^x = 27$$

$$e^x = -\frac{27}{5}$$

$$\ln\left(-\frac{27}{5}\right) = x$$

$$= x$$

No solution

$$\textcircled{26} \quad \frac{2}{3}(4^{3x}) - 8 = -2$$

$$\frac{2}{3} \cdot \frac{2}{3}(4^{3x}) = 3 \cdot \frac{2}{3}$$

$$4^{3x} = \frac{9}{2}$$

$$\log_4\left(\frac{9}{2}\right) = \frac{3x}{3}$$

$$\frac{\log_4\left(\frac{9}{2}\right)}{3} = x$$

$$0.36 = x$$

$$\begin{aligned} \textcircled{28} \quad \log x &= 3 \\ 10^3 &= x \\ 1,000 &= x \end{aligned}$$

$$\begin{aligned} \textcircled{30} \quad \log_3 x &= 5 \\ 3^5 &= x \\ 243 &= x \end{aligned}$$

$$\begin{aligned} \textcircled{32} \quad \ln(3x-3) &= \ln(x-6) \\ \frac{3x-3}{-x+3} &= \frac{x-6}{-x+3} \\ 2x &= -3 \\ x &= -\frac{3}{2} \\ \text{No solution} \end{aligned}$$

$$\begin{aligned} \textcircled{34} \quad \log_4 3x &= 6 \\ 4^6 &= 3x \\ 4,096 &= 3x \\ \frac{4,096}{3} &= x \\ 1,365.\bar{3} &= x \end{aligned}$$

$$\textcircled{36} \quad \frac{7}{-7} - \log_3 8X = \frac{2}{-7}$$

$$\frac{+ \log_3 8X = -5}{-1} \quad -1$$

$$\log_3 8X = 5$$

$$3^5 = 8X$$

$$\frac{243}{8} = \frac{8X}{8}$$

$$30.375 = X$$

$$\textcircled{38} \quad \frac{3 \ln X - 7}{+7} = \frac{4}{+7}$$

$$\frac{3 \ln X}{3} = \frac{11}{3}$$

$$\ln X = \frac{11}{3}$$

$$e^{11/3} = X$$

$$39.12 = X$$

$$\textcircled{40} \quad \text{Log } 7x + 4 = 5$$

$-4 \quad -4$

$$\text{Log } 7x = 1$$

$$\frac{10^1}{7} = \frac{7x}{7}$$

$$\frac{10}{7} = x$$

$$\textcircled{45} \quad \text{Log}_2 2x + \text{Log}_2 x = 5$$

$$\text{Log}_2 2x \cdot x = 5 \quad (\text{Product Property})$$

$$\text{Log}_2 2x^2 = 5$$

$$2^5 = 2x^2$$

$$32 = 2x^2$$

$-32 \quad -32$

$$0 = 2x^2 - 32$$

$$0 = 2(x^2 - 16)$$

$$0 = 2(x+4)(x-4)$$

$$x = -4, 4$$

(44)

$$\ln 3x - \ln 2 = 4$$

$$\ln \frac{3x}{2} = 4$$

$$e^4 = \frac{3x}{2}$$

$$2e^4 = 3x$$

$$\frac{2e^4}{3} = x$$

$$36.40 = x$$

