7.6 – Solve Exponential and Logarithmic Equations

Exponential Equations $b^x = b^y$ if and only if $x = y$

For example, if $3^x = 3^5$, then $x = 5$

Example 1 Solve by equating exponents

Solve $4^x = \left(\frac{1}{2}\right)^{x-3}$

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

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

$2x = -x+3$

$3x = 3$

$x = 1$

Example 2 Take a logarithm of each side

Solve $4^x = 11$

$\log_4 4^x = \log_4 11$

$x = \log_4 11$

$x = \frac{\log 11}{\log 4}$

$x = 1.73$

Logarithmic Equations $\log_b x = \log_b y$, if and only if $x = y$

For example, if $\log_2 x = \log_2 7$, then $x = 7$

Example 4 Solve a Logarithmic Equation

Solve $\log_3(4x - 7) = \log_3(x + 5)$ $\Rightarrow$ $4x-7 = x+5$

$3x-7 = 5$

$3x = 12$

$x = 4$

Example 5 Exponentiate each side of an equation

Solve $\log_4(5x - 1) = 3$

$4^{\log_4(5x-1)} = 4^3$

$5x - 1 = 64$

$5x = 65$

$x = 13$

HW: (4-36 even)

EXAMPLE 1
on p. 515
for Exs. 3–11

SOLVING EXPONENTIAL EQUATIONS **Solve the equation.**

3. $5^{x-4} = 25^{x-6}$
4. $7^{3x+4} = 49^{2x+1}$
5. $8^{x-1} = 32^{3x-2}$
6. $27^{4x-1} = 9^{3x+8}$
7. $4^{2x-5} = 64^{3x}$
8. $3^{3x-7} = 81^{12-3x}$
9. $36^{5x+2} = \left(\frac{1}{6}\right)^{11-x}$
10. $10^{3x-10} = \left(\frac{1}{100}\right)^{6x-1}$
11. $25^{10x+8} = \left(\frac{1}{125}\right)^{4-2x}$

EXAMPLE 2
on p. 516
for Exs. 12–23

SOLVING EXPONENTIAL EQUATIONS **Solve the equation.**

12. $8^x = 20$
13. $e^{-x} = 5$
14. $7^{3x} = 18$
15. $11^{5x} = 33$
16. $7^{6x} = 12$
17. $4e^{-2x} = 17$
18. $10^{3x} + 4 = 9$
19. $-3e^{2x} + 16 = 5$
20. $0.5^x - 0.25 = 4$
21. $\frac{1}{3}(6)^{-4x} + 1 = 6$
22. $2^{0.1x} - 5 = 7$
23. $\frac{3}{4}e^{2x} + \frac{7}{2} = 4$

EXAMPLE 4
on p. 517
for Exs. 24–31

SOLVING LOGARITHMIC EQUATIONS **Solve the equation. Check for extraneous solutions.**

24. $\log_5 (5x + 9) = \log_5 6x$
25. $\ln (4x - 7) = \ln (x + 11)$
26. $\ln (x + 19) = \ln (7x - 8)$
27. $\log_5 (2x - 7) = \log_5 (3x - 9)$
28. $\log (12x - 11) = \log (3x + 13)$
29. $\log_3 (18x + 7) = \log_3 (3x + 38)$
30. $\log_6 (3x - 10) = \log_6 (14 - 5x)$
31. $\log_8 (5 - 12x) = \log_8 (6x - 1)$

EXAMPLES 5 and 6
on pp. 517–518
for Exs. 32–44

EXPONENTIATING TO SOLVE EQUATIONS **Solve the equation. Check for extraneous solutions.**

32. $\log_4 x = -1$
33. $5 \ln x = 35$
34. $\frac{1}{3} \log_5 12x = 2$
35. $5.2 \log_4 2x = 16$
36. $\log_2 (x - 4) = 6$
37. $\log_2 x + \log_2 (x - 2) = 3$
38. $\log_4 (-x) + \log_4 (x + 10) = 2$
39. $\ln (x + 3) + \ln x = 1$
40. $4 \ln (-x) + 3 = 21$
41. $\log_5 (x + 4) + \log_5 (x + 1) = 2$
42. $\log_6 3x + \log_6 (x - 1) = 3$
43. $\log_3 (x - 9) + \log_3 (x - 3) = 2$