

9-5 Study Guide and Intervention *(continued)***Base e and Natural Logarithms**

Equations and Inequalities with e and \ln All properties of logarithms from earlier lessons can be used to solve equations and inequalities with natural logarithms.

Example

Solve each equation or inequality.

a. $3e^{2x} + 2 = 10$

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Original equation

$3e^{2x} = 8$

Subtract 2 from each side.

$e^{2x} = \frac{8}{3}$

Divide each side by 3.

$\ln e^{2x} = \ln \frac{8}{3}$

Property of Equality for Logarithms

$2x = \ln \frac{8}{3}$

Inverse Property of Exponents and Logarithms

$x = \frac{1}{2} \ln \frac{8}{3}$

Multiply each side by $\frac{1}{2}$.

$x \approx 0.4904$

Use a calculator.

b. $\ln(4x - 1) < 2$

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Original inequality

$e^{\ln(4x - 1)} < e^2$

Write each side using exponents and base e .

$0 < 4x - 1 < e^2$

Inverse Property of Exponents and Logarithms

$1 < 4x < e^2 + 1$

Addition Property of Inequalities

$\frac{1}{4} < x < \frac{1}{4}(e^2 + 1)$

Multiplication Property of Inequalities

$0.25 < x < 2.0973$

Use a calculator.

Exercises

Solve each equation or inequality.

1. $e^{4x} = 120$

2. $e^x \leq 25$

3. $e^{x-2} + 4 = 21$

4. $\ln 6x \geq 4$

5. $\ln(x + 3) - 5 = -2$

6. $e^{-8x} \leq 50$

7. $e^{4x-1} - 3 = 12$

8. $\ln(5x + 3) = 3.6$

9. $2e^{3x} + 5 = 2$

10. $6 + 3e^{x+1} = 21$

11. $\ln(2x - 5) = 8$

12. $\ln 5x + \ln 3x > 9$