



NAME

Study Guide

Natural Logarithms

Logarithms with base *e* are called **natural logarithms** and are usually written **In** *x*. Logarithms with a base other than *e* can be converted to natural logarithms using the change of base formula. The antilogarithm of a natural logarithm is written antiln x. You can use the properties of logarithms and antilogarithms to simplify and solve exponential and logarithmic equations or inequalities with natural logarithms.

Example 1 Convert $\log_{4} 381$ to a natural logarithm and evaluate.

 $\log_a n = \frac{\log_b n}{\log_b a}$ $\log_{4} 381 = \frac{\log_{e} a}{\log_{e} 4} \qquad a = 4, b = e, n = 381$ $= \frac{\ln 381}{\ln 4} \qquad \log_{e} x = \ln x$ ≈ 4.2868 Use a calculator.

So, $\log_4 381$ is about 4.2868.

Example 2 Solve $3.75 = -7.5 \ln x$.

$3.75 = -7.5 \ln x$	
$-0.5 = \ln x$	Divide each side by -7.5
antiln $(-0.5) = x$	Take the antilogarithm of each side.
0.6065 pprox x	Use a calculator.

The solution is about 0.6065.

Example 3 Solve each equation or inequality by using natural logarithms.

a. $4^{3x} = 6^{x+1}$ $4^{3x} = 6^{x+1}$ $\ln 4^{3x} = \ln 6^{x+1}$ Take the natural logarithm of each side. $3x \ln 4 = (x + 1) \ln 6$ $ln a^n = n ln a$ 3x(1.3863) = (x + 1)(1.7918)Use a calculator. 4.1589x = 1.7918x + 1.79182.3671x = 1.7918 $x \approx 0.7570$ b. $25 > e^{0.2t}$ $25 > e^{0.2t}$ $\ln 25 > \ln e^{0.2t}$ Take the natural logarithm of each side. $\ln 25 > 0.2t \ln e$ $\ln a^n = n \ln a$ 3.2189 > 0.2tUse a calculator. 16.0945 > tThus, *t* < 16.0945

11-6- Natural	NAME Practic Logarithm	e ns	DATE	PERIOD
Evaluate eac 1. ln 71	ch expression. 2.	ln 8.76	3. ln 0.532	
4. antiln –0	0.256 5 .	antiln 4.62	6. antiln –1.62	2

Convert each logarithm to a natural logarithm and evaluate.

7. log ₇ 94	8. $\log_5 256$	9. $\log_9 0.712$
-------------------------------	------------------------	--------------------------

Use natural logarithms to solve each equation or inequality.

10. $6^x = 42$ **11.** $7^x = 4^{x+3}$ **12.** $1249 = 175e^{-0.04t}$

- **13.** $10^{x+1} > 3^x$ **14.** $12 < e^{0.048y}$ **15.** $8.4 < e^{t-2}$
- 16. Banking Ms. Cubbatz invested a sum of money in a certificate of deposit that earns 8% interest compounded continuously. The formula for calculating interest that is compounded continuously is $A = Pe^{rt}$. If Ms. Cubbatz made the investment on January 1, 1995, and the account was worth \$12,000 on January 1, 1999, what was the original amount in the account?