

# Natural Logarithms

$$e \approx 2.71828$$

$\log_b x$

In other bases

In base e

$\log_2 x = 3$ $2^3 = x$ $5^x = 7$ $\log_5 7 = x$	$\ln x = 3$ $e^3 = x$ $e^x = 7$ $\ln 7 = x$
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Ex: Write in exponential form

Ex: Write in logarithmic form

1)  $\ln 8 = 2.08$

2)  $\ln \frac{1}{3} = -1.10$

3)  $e^7 = 1097$

4)  $e^{\frac{1}{2}} = 1.65$

$$e^{2.08} = 8$$

$$e^{-1.10} = \frac{1}{3}$$

$$\ln 1097 = 7$$

$$\ln 1.65 = \frac{1}{2}$$

Ex: Evaluate each expression to the nearest thousandth. If the expression is undefined, write *undefined*.

5)  $\ln 12$

6)  $\ln(-4.3)$

7)  $e^4$

8)  $e^{-2}$

$$\approx 2.484$$

$$\text{Undefined}$$

$$\approx 54.598$$

$$\approx 0.135$$

Think about it!!

$\log_2 2 = 1$

$\log_5 5 = 1$

$\log_p p = 1$

$\ln_e e = 1$

In other bases:

$\log_2 2^4 = 4$

In base e:

$\ln e^3 = 3$

$4 \log_4 6$

Ex: Simplify:

9)  $\ln e^5$

$$5$$

10)  $\ln \sqrt{e}$

$$\ln e^{\frac{1}{2}}$$

$$\frac{1}{2}$$

11)  $\ln \frac{1}{e^2}$

$$\ln e^{-2}$$

$$-2$$

12)  $e^{\ln 3}$

$$e^{\ln 3}$$

$$3$$

13)  $e^{3 \ln 4}$

$$e^{\ln 4^3}$$

$$e^{\ln e^64}$$

$$64$$

Ex: Solve

14)  $e^x = 18$

$$\ln 18 = x$$

$$2.89 \approx x$$

15)  $e^{2x} = 10$

$$\ln 10 = 2x$$

$$\frac{2.30 \approx 2x}{2}$$

$$1.15 \approx x$$

16)  $e^{x+1} = 30$

$$\ln 30 = x+1$$

$$\frac{3.40 \approx x+1}{-1}$$

$$2.40 \approx x$$

17)  $e^{\frac{1}{2}x} = 9$

$$\ln 9 = \frac{1}{2}x$$

$$2(2.20) \approx (\frac{1}{2}x)^2$$

$$4.39 \approx x$$