## EXAMPLE 2 Evaluate logarithms

**Evaluate the logarithm.**

**a.** $\log_4 64$ **b.** $\log_5 0.2$ **c.** $\log_{1/5} 125$ **d.** $\log_{36} 6$

### Solution

To help you find the value of $\log_b y$, ask yourself what power of $b$ gives you $y$.

**a.** 4 to what power gives 64? $4^3 = 64$, so $\log_4 64 = \mathbf{3}$.

**b.** 5 to what power gives 0.2? $5^{-1} = 0.2$, so $\log_5 0.2 = \mathbf{-1}$.

**c.** $\frac{1}{5}$ to what power gives 125? $\left(\frac{1}{5}\right)^{-3} = 125$, so $\log_{1/5} 125 = \mathbf{-3}$.

**d.** 36 to what power gives 6? $36^{1/2} = 6$, so $\log_{36} 6 = \mathbf{\frac{1}{2}}$.

**SPECIAL LOGARITHMS** A **common logarithm** is a logarithm with base 10. It is denoted by $\log_{10}$ or simply by log. A is a logarithm with base $e$. It can be denoted by $\log_e$, but is more often denoted by ln.

| Common Logarithm | Natural Logarithm |
|---|---|
| $\log_{10} x = \log x$ | $\log_e x = \ln x$ |

Most calculators have keys for evaluating common and natural logarithms.

## EXAMPLE 3 Evaluate common and natural logarithms

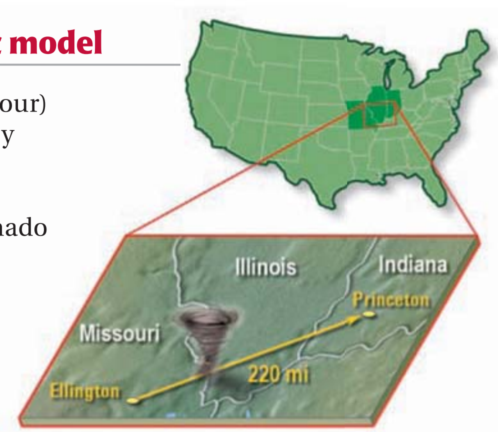
| Expression | Keystrokes | Display | Check |
|---|---|---|---|
| **a.** log 8 | LOG 8 ) ENTER | 0.903089987 | $10^{0.903} \approx 8$ ✓ |
| **b.** ln 0.3 | LN .3 ) ENTER | −1.203972804 | $e^{-1.204} \approx 0.3$ ✓ |

## EXAMPLE 4 Evaluate a logarithmic model

**TORNADOES** The wind speed $s$ (in miles per hour) near the center of a tornado can be modeled by

$$s = 93 \log d + 65$$

where $d$ is the distance (in miles) that the tornado travels. In 1925, a tornado traveled 220 miles through three states. Estimate the wind speed near the tornado's center.




*Not drawn to scale*

### Solution

$s = 93 \log d + 65$ **Write function.**

$= 93 \log 220 + 65$ **Substitute 220 for *d*.**

$\approx 93(2.342) + 65$ **Use a calculator.**

$= 282.806$ **Simplify.**

▶ The wind speed near the tornado's center was about 283 miles per hour.