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Rewrite in terms of
2 and 3

$$1. \ln 6 = \ln(2 \cdot 3) = \ln 2 + \ln 3$$

$$\text{ex } \ln 2 \approx .6931 \quad \ln 3 \approx 1.0986$$

$$\text{find } \ln \frac{2}{27} = \ln 2 - \ln 27$$

$$\begin{aligned} \ln 2 - \ln 3^3 &= \ln 2 - 3 \ln 3 \\ &\approx .6931 - 3(1.0986) \\ &\approx -2.6027 \end{aligned}$$





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3.3 Properties of Logarithms

$$\log_{10} 25$$

calc

$$10^? = 25$$

$$\boxed{\log} 25 \approx 1.3979$$

$$10^{1.3979} \approx 25$$

$$\log_4 25$$

Since most calculators have only base 10 $\boxed{\log}$ and base e $\boxed{\ln}$, must change base to solve other bases.





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Change of base formula

Base b	Base 10	Base e
$\log_a X = \frac{\log_b X}{\log_b a}$	$\log_a X = \frac{\log X}{\log a}$	$\log_a X = \frac{\ln X}{\ln a}$
ex $\log_4 25 = \frac{\log_2 25}{\log_2 4}$ $= \frac{\log_2 25}{2}$	ex $\log_4 25 = \frac{\log 25}{\log 4}$ ≈ 2.3219	ex $\log_4 25 = \frac{\ln 25}{\ln 4}$ ≈ 2.3219





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Practice

$$\textcircled{1} \log_7 4$$
$$\frac{\ln 4}{\ln 7} \approx .7124$$

$$\textcircled{2} \log_{1/8} 64$$
$$= -2$$

$$\textcircled{3} \log_{20} 135$$
$$\approx 1.637$$

$$\textcircled{4} \log_7 2401$$
$$= 4$$





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Bases other than 10 and e

$$\log_4 32 = \frac{\log_2 32}{\log_2 4} = \frac{5}{2}$$

$$4^{5/2} = 32$$

1.

$$\log_8 32$$

$$\frac{\log_2 32}{\log_2 8} = \frac{5}{3}$$

2.

$$\log_9 27$$

$$\frac{\log_3 27}{\log_3 9} = \frac{3}{2}$$

3.

$$\log_8 2$$

$$\frac{\log_2 2}{\log_2 8} = \frac{1}{3}$$





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Properties of Logarithms

Base b

$$\log_b(uv) = \log_b u + \log_b v$$

$$\log_b\left(\frac{u}{v}\right) = \log_b u - \log_b v$$

$$\log_b u^n = n \log_b u$$

!! ex

$$\log_2 4^3 = 3 \log_2 4$$

Natural Log

$$\ln(uv) = \ln u + \ln v$$

$$\ln\left(\frac{u}{v}\right) = \ln u - \ln v$$

$$\ln u^n = n \ln u$$

!!

