

## Logarithms

Laws of logarithms:

1. if  $\log_a(a^x) = y$  then  $a^y = x$ ,  $y = \frac{\ln x}{\ln a}$
2.  $\log_a x = \frac{\ln x}{\ln a}$ ,  $\log_e x = \ln x$
3.  $\ln(e^x) = x$ ,  $\ln e = 1$
4. if  $\ln x = y$ , then  $e^y = x$
5.  $\log_a(xy) = \log_a x + \log_a y$
6.  $\log_a\left(\frac{x}{y}\right) = \log_a x - \log_a y$
7.  $\log_a x^r = r \log_a x$

1. Using the laws of logarithms, what are the following equivalent to?

a.  $\log_b(x) - \log_b(y) =$       b.  $\log_b(u) + \log_b(v) =$

c.  $\log_a y^2 + \log_a x^3 =$       d.  $\log_a y^3 + \log_a x^4 =$

e.  $\ln(e) =$       f.  $\ln a + \frac{1}{2} \ln b =$

g.  $2 \ln 4 - \ln 2 =$       h.  $\ln x + a \ln y - b \ln z =$

2. Solve the following for x using known logarithm properties.

a.  $\ln x = 2$       b.  $\ln x = -1$

c.  $\ln x = 5$       d.  $13^x = 6$

e.  $7 = 2^x$       f.  $9^x = 4$

$$g. \ e^{5-3x} = 10$$

$$h. \ (2-\ln x)\ln x = 0$$

$$i. \ 2\ln x = 1$$

$$j. \ e^{-x} = 5$$

$$k. \ e^{2x+3} - 7 = 0$$

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

$$m. \ 2^{x-5} = 3$$

$$n. \ \ln x + \ln(x-1) = 1$$

3. Find the value of each expression.

$$a. \ \log_2 64 =$$

$$b. \ \log_6 \frac{1}{36} =$$

$$c. \ \log_8 2 =$$

$$d. \ \ln e^{\sqrt{2}} =$$

$$e. \ \log_{10} 1.25 + \log_{10} 80 =$$

$$f. \ \log_5 10 + \log_5 20 - 3\log_5 2 =$$

$$g. \ 2^{(\log_2 3 + \log_2 5)} =$$

$$h. \ e^{3\ln 2} =$$