

Logarithm laws

1 Rewrite the following as the sum or difference of logarithms without any powers or surds:

a $\log_8 xy$

b $\log_3 \left(\frac{7}{11} \right)$

c $\log \left(\frac{pq}{r} \right)$

d $\log \left(\frac{1}{xy} \right)$

e $\log \left((7x)^6 \right)$

f $\log (7x^4)$

g $\log \left((2x)^{-1} \right)$

h $\log \left(\frac{7}{2} \right)$

i $\log (5x^{-1})$

j $\log \left((3x)^{-7} \right)$

k $\log (7x^{-6})$

l $\log \left(5x^{\frac{2}{3}} \right)$

m $\log \left((14x)^{\frac{2}{3}} \right)$

n $\log \left(\sqrt{\frac{c^4}{d}} \right)$

o $\log (v^2)$

2 Rewrite the following expressions without any powers or surds:

a $\log_4 y^7$

b $\log_8 (x^6)$

c $\log (x^4)$

d $\log \left((x+7)^6 \right)$

e $\log \left((2x+5)^6 \right)$

f $\log_a B^{-5}$

g $\log \left((2x+3)^{-1} \right)$

h $\log \left((4x+3)^{-8} \right)$

i $\log \left(x^{\frac{1}{5}} \right)$

j $\log_5 \sqrt{y}$

k $\log \left((5x+9)^{\frac{1}{3}} \right)$

3 Write each of the following expressions as a single logarithmic term:

a $\log 7 + \log 12$

b $\log_{10} 11 + \log_{10} 5 + \log_{10} 3$

c $\log_{10} 12 - (\log_{10} 2 + \log_{10} 3)$

d $\log_{10} 42 - \log_{10} 7$

e $\log_{10} 8 - \log_{10} 32$

f $\log_{10} 2 + \log_{10} 3 - \log_{10} 7$

g $5(\log_{10} 3 + \log_{10} 6)$

h $3(\log_{10} 6 - \log_{10} 3)$

i $3\log_{10} 22 - 3\log_{10} 11$

j $7\log_{10} 5 - 21\log_{10} 25$

4 Write each of the following expressions as a single logarithmic term:

a $3\log x^5 - 2\log x^4$

b $6\log x + 5\log y$

c $8\log x - \frac{1}{2}\log y$

d $5\log x - \log \left(\frac{1}{x} \right) - \log y$

e $\log x^4 + \log x^2$

f $\log 2x + \log 50y$

5 Rewrite each of the following equations in index notation:

a $\log_{10} 1000 = 3$

b $\log_{10} (\sqrt{10}) = \frac{1}{2}$

c $\log_{10} \left(\frac{1}{1000} \right) = -3$

d $\log_{10} \left(\frac{1}{\sqrt{10}} \right) = -\frac{1}{2}$

6 Rewrite each of the following equations in logarithmic notation:

a $10^4 = 10\,000$

b $10^{-3} = \frac{1}{1000}$

c $10^{\frac{1}{2}} = \sqrt{10}$

d $10^{-\frac{1}{2}} = \frac{1}{\sqrt{10}}$

7 Simplify each of the following expressions:

a $\log_{10} 10 + \frac{\log_{10} (12^8)}{\log_{10} (12^2)}$

b $\frac{8 \log_{10} (\sqrt{10})}{\log_{10} (100)}$

c $\log_{10} (10) + \log_{10} (10)$

d $\frac{\log_{10} 125}{\log_{10} 5}$

e $\frac{\log_4 49}{\log_4 7}$

8 Simplify each of the following expressions:

a $\frac{5 \log m^2}{6 \log \sqrt[3]{m}}$

b $\frac{\log a^4}{\log a^2}$

c $\frac{\log a^3}{\log \sqrt[3]{a}}$

d $\frac{\log \left(\frac{1}{x^2} \right)}{\log x}$

9 Write $\log \left(\frac{2u}{3v} \right)$ in terms of $\log 2$, $\log u$, $\log 3$ and $\log v$.

10 Rewrite the following in terms of $\log u$ and $\log v$ without any powers or surds:

a $\log (u^3 v^5)$

b $\log \left(\frac{\sqrt[3]{v}}{\sqrt{u}} \right)$