

1 Express each of the following in the form  $\log_a b = c$ .

a  $10^3 = 1000$

b  $3^4 = 81$

c  $256 = 2^8$

d  $7^0 = 1$

e  $3^{-3} = \frac{1}{27}$

f  $32^{-\frac{1}{5}} = \frac{1}{2}$

g  $19^1 = 19$

h  $216 = 36^{\frac{3}{2}}$

2 Express each of the following using index notation.

a  $\log_5 125 = 3$

b  $\log_2 16 = 4$

c  $5 = \log_{10} 100\,000$

d  $\log_{23} 1 = 0$

e  $\frac{1}{2} = \log_9 3$

f  $\lg 0.01 = -2$

g  $\log_2 \frac{1}{8} = -3$

h  $\log_6 6 = 1$

3 Without using a calculator, find the exact value of

a  $\log_7 49$

b  $\log_4 64$

c  $\log_2 128$

d  $\log_3 27$

e  $\log_5 625$

f  $\log_8 8$

g  $\log_7 1$

h  $\log_{15} \frac{1}{15}$

i  $\log_3 \frac{1}{9}$

j  $\lg 0.001$

k  $\log_{16} 2$

l  $\log_4 8$

m  $\log_9 243$

n  $\log_{100} 0.001$

o  $\log_{25} 125$

p  $\log_{27} \frac{1}{9}$

4 Without using a calculator, find the exact value of  $x$  in each case.

a  $\log_5 25 = x$

b  $\log_2 x = 6$

c  $\log_x 64 = 3$

d  $\lg x = -3$

e  $\log_x 16 = \frac{2}{3}$

f  $\log_5 1 = x$

g  $\log_x 9 = 1$

h  $\lg 10^{12} = x$

i  $2 \log_x 7 = 1$

j  $\log_4 x = 1.5$

k  $\log_x 0.1 = -\frac{1}{3}$

l  $3 \log_8 x + 1 = 0$

5 Express in the form  $\log_a n$

a  $\log_a 4 + \log_a 7$

b  $\log_a 10 - \log_a 5$

c  $2 \log_a 6$

d  $\log_a 9 - \log_a \frac{1}{3}$

e  $\frac{1}{2} \log_a 25 + 2 \log_a 3$

f  $\log_a 48 - 3 \log_a 2 - \frac{1}{2} \log_a 9$

6 Express in the form  $p \log_q x$

a  $\log_q x^5$

b  $\frac{1}{2} \log_q x^{15}$

c  $\log_q \frac{1}{x}$

d  $\log_q \sqrt[3]{x}$

e  $4 \log_q \frac{1}{\sqrt{x}}$

f  $\log_q x^2 + \log_q x^5$

g  $\log_q \frac{1}{x^2} + \log_q \frac{1}{x^3}$

h  $3 \log_q x^2 - \frac{1}{2} \log_q x^4$

7 Express in the form  $\lg n$

a  $\lg 5 + \lg 4$

b  $\lg 12 - \lg 6$

c  $3 \lg 2$

d  $4 \lg 3 - \lg 9$

e  $\frac{1}{2} \lg 16 - \frac{1}{5} \lg 32$

f  $1 + \lg 11$

g  $\lg \frac{1}{50} + 2$

h  $3 - \lg 40$

8 Without using a calculator, evaluate

a  $\log_3 54 - \log_3 2$

b  $\log_5 20 + \log_5 1.25$

c  $\log_2 16 + \log_3 27$

d  $\log_6 24 + \log_6 9$

e  $\log_3 12 - \log_3 4$

f  $\log_4 18 - \log_4 9$

g  $\log_9 4 + \log_9 0.25$

h  $2 \lg 2 + \lg 25$

i  $\frac{1}{3} \log_3 8 - \log_3 18$

j  $\frac{1}{3} \log_4 64 + 2 \log_5 25$

k  $\frac{1}{2} \log_5 (1\frac{9}{16}) + 2 \log_5 10$

l  $\log_3 5 - 2 \log_3 6 - \log_3 (3\frac{3}{4})$