

2 Express each logarithmic form in exponential form.

(a) $\log_3 27 = 3$ (b) $\log_{10} 1000 = 3$ (c) $\log_2 128 = 7$

(d) $\log_x y = z$ (e) $\log_5 1 = 0$ (f) $\log_{27} 3 = \frac{1}{3}$

(g) $\log_2 \left(\frac{1}{8}\right) = -3$ (h) $\log_{49} 7 = \frac{1}{2}$ (i) $\log_{10} 0.001 = -3$

3 Express each of the following in an equivalent form, either exponential or logarithmic.

(a) $\log_2 16 = 4$ (b) $\log_6 6 = 1$ (c) $2^{-3} = \frac{1}{8}$

(d) $49^{\frac{1}{2}} = 7$ (e) $\log_{27} 3 = \frac{1}{3}$ (f) $\log_2 64 = 6$

(g) $12^0 = 1$ (h) $10^{-4} = 0.0001$ (i) $\log_7 1 = 0$

4 Find the value of each of the following.

(a) $\log_3 3^5$ (b) $\log_2 2^7$ (c) $\log_{10} 10^4$ (d) $\log_x x^3$

(e) $\log_x x^5$ (f) $\log_x x^{\frac{2}{3}}$ (g) $\log_x x^{\sqrt{3}}$ (h) $\log_x x^{-3}$

5 Calculate.

(a) $\log_{10} 10$ (b) $\log_{10} 100$ (c) $\log_{10} 1$ (d) $\log_{10} 1000$

(e) $\log_{10} 1.36$ (f) $\log_{10} 40.8$ (g) $\log_{10} 146$ (h) $\log_{10} 0.0302$

6 Properties of logarithms are examined in (a) and (b).

(a) Find the value of each of the following.

$$\log_2 2 \quad \log_{10} 10 \quad \log_4 4 \quad \log_8 2^3 \quad \log_6 (36)^{\frac{1}{2}}$$

Use the results. What is the value of $\log_a a$ for $a \in R$, $a > 0$?

(b) Find the value of each of the following.

$$\log_2 2^3 \quad \log_{10} 10^2 \quad \log_2 2^{-1} \quad \log_{10} 10^{-3} \quad \log_5 5^2$$

Use the above results. What is the value for all $a \in R$, of $\log_a a^x$, $a > 0$?

B To work with logarithms, you must understand the vocabulary and meaning of symbols: exponential form, logarithmic form, $\log_a x$, and so on. Where needed, round to 1 decimal place.

7 Find the value of each logarithm.

(a) $\log_2 8$ (b) $\log_5 625$ (c) $\log_2 32$ (d) $\log_{10} \frac{1}{1000}$

(e) $\log_2 \left(\frac{1}{32}\right)$ (f) $\log_{10} 1$ (g) $\log_5 \sqrt{5}$ (h) $\log_2 64$

(i) $\log_{27} 3$ (j) $\log_m m^x$ (k) $\log_a a$ (l) $\log_a 1$

Solve for x .

(a) $\log_2 x = 3$ (b) $\log_2 32 = x$ (c) $\log_x 27 = 3$

(d) $\log_3 \left(\frac{1}{27}\right) = x$ (e) $\log_5 x = -3$ (f) $\log_x 20 = 1$

(g) $\log_x \frac{1}{8} = -3$ (h) $\log_x x^5 = 5$ (i) $x = \log_2 8\sqrt{2}$

9 You can use your calculator to solve for x to 4 decimal places. The first question is done for you. (Refer to your manual.)

(a) $\log_{10} x = 4$

Think:
calculator steps

	INPUT	OUTPUT
Press	$\boxed{\text{CE/C}}$ 4 $\boxed{\text{INV}}$ $\boxed{\text{LOG}}$	10 000
		↑ Thus $x = 10\,000$

Check

Press	$\boxed{\text{CE/C}}$ 10 000 $\boxed{\text{LOG}}$ 4	← Thus, $\log_{10} 10\,000 = 4$
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(b) $\log_{10} x = 3$ (c) $\log_{10} x = 2.5$ (d) $\log_{10} x = 0.8$
(e) $\log_{10} x = 3.61$ (f) $\log_{10} x = 0.542$ (g) $\log_{10} x = 0.0856$

10 Which of the following equations are equivalent? (Solve for the variable.)

(a) $\log_{32} y = \frac{2}{5}$ (b) $\log_{16} 2 = y$ (c) $\log_y 81 = \frac{4}{3}$ (d) $\log_8 y = \frac{2}{3}$

11 (a) Find the value of $\log_2 64$. (b) Find the value of $\log_2 128$.
(c) What is the value of $\log_2 64 + \log_2 128$?

12 Find the value of each of the following.

(a) $\log_3 81 + \log_3 27$ (b) $\log_{10} 1000 - \log_{10} 0.01$
(c) $\log_3 \sqrt[4]{3} + \log_3 \sqrt[5]{81}$ (d) $\log_2 (4 \times \sqrt[5]{4}) - \log_2 (8^{\frac{1}{3}})$

13 Find the value of each of the following.

(a) $2^{\log_2 4}$ (b) $10^{\log_{10} 100}$ (c) $5^{\log_5 25}$ (d) $3^{\log_3 (\frac{1}{27})}$ (e) $4^{\log_4 (4^3)}$
(f) Use the above results. What is the value for all $a \in R$, or $a^{\log_a m}$, $a > 0$?

14 Find the value of each expression. Use the results from the previous question.

(a) $\log_{27} 3$ (b) $\log_6 (\log_2 64)$ (c) $3^{\log_3 27}$
(d) $27^{\log_3 9}$ (e) $2^{\log_2 8 + \log_2 64}$ (f) $5^{(\log_3 8 - \log_3 2)}$

15 Simplify.

(a) $3^{\log_3 27} + 10^{\log_{10} 1000}$ (b) $5^{\log_5 8} - 3^{\log_3 5 + \log_3 7}$

imately the same. g)B 5.a)7.6 b)48.4 6.a)7.9, 50.2
 imately the same. c)A 7.a)5.4 b)28.5 c)5.0.

rcise, page 375

6 b)6.067 c)6.152 d)4.102 e)1.778 f)1.782

h)1.945 2.a)10^{0.650} b)10^{0.191} c)10^{0.949}

e)10^{0.254} f)10^{0.704} g)10^{0.491} h)10^{0.406}

7375 b)10^{0.5674} c)10^{0.2062} d)10^{0.4579} e)10^{0.3528}

7 g)10^{0.8895} h)10^{0.9876} 4.a)10^{1.676} b)10^{2.3862}

96 d)10^{1.926} e)10^{2.499} f)10^{-0.203} g)10^{1.802}

5.a)30.4 b)490.9 c)668.1 d)1.11 e)1.17

58 b)8.59 c)30.37 d)55.72 e)666.8 f)5480.4

23 b)4.276 c)13.76 d)1.0193 8.a)38.55

c)3.603 d)158.2 e)120.0 f)29.04

3 b)0.895 c)339.0 10.a)\$1.56 b)\$3.28

3.72 12.B is better by \$110.46.

ercise, page 378

48 b)128.000 c)10.882 d)0.479 e)0.227

k)274 g)0.949 h)16.809 i)1.071 j)0.245

1 b)3.0 c)2.0 d)4.0 e)9.0 f)15.9 g)512.0

3.a)5.76 b)1.78 c)9.58 d)725.43 e)0.62

g)1.50 h)708.22 i)0.20 j)0.00 k)6.16 l)1.55

19 b)0.49 c)0.23 d)-1.00 e)-0.69 5.a)1.28

c)2.59 d)2.98 e)15.80 f)2.30 6.a)38.04

6 c)0.28 d)1.47 e)0.19 f)160 720.91

cm/h 8.502 377 286 9.\$192.54 10.4.80 × 10⁻¹³

ercise, page 380

0 b)200 c)3200 d)102 400 2.a)3200

00 c)200(2ⁿ) 3.a)2500 b)160 000 4. $\frac{1}{2}$ h

000 b)2 048 000 c)500(2²ⁿ) 6.12 min

1 000 b)2 560 000 8.a)16 000 b)64 000

4 000 9.179 200 10.6400% 11.a)\$986.91

59.52 c)\$1853.13 12.a)\$2585.03 b)\$1085.03

i)1665.56 b)\$865.56 c)\$144.26

ercise, page 384

mg 2. 5 d 3.a)280 d b)980 d 4. 62.5 mg 5. 138 d

d 7. 5.0 km/h 8. 32.0 km/h 9. 11 500 years

500 years 11. 17 300 years 12. 8600 years

) 200 years

PTER 10

Exercise, page 391

es d)x = 10^y, y = log₁₀x 2.c)y = log₂x.

log₃x 4.a)0.30 b)0.70 c)0.90 d)1.00 5.a)0.60 b)0.85

3 d)0.54 6.a)1.0 b)10.0 c)5.0 d)2.5 e)4.5 f)2.2

Exercise, page 394

og₂8 = 3 b)log₃81 = 4 c)log₅125 = 3

7;343 = 3 e)log_mp = n f)log₁₀1 = 0

16⁴ = $\frac{1}{2}$ h)log₈₁27 = $\frac{3}{4}$ 2.a)3³ = 27

b)10³ = 1000 c)2⁷ = 128 d)x^z = y e)5⁰ = 1
 f)27 $\frac{1}{3}$ = 3 g)2⁻³ = $\frac{1}{8}$ h)49 $\frac{1}{2}$ = 7 i)10⁻³ = 0.001

3.a)2⁴ = 16 b)6¹ = 6 c)log₂ $\frac{1}{8}$ = -3 d)log₄₉7

e)27 $\frac{1}{3}$ = 3 f)2⁶ = 64 g)log₁₂₁11 = 0

h)log₁₀0.0001 = -4 i)7⁰ = 1 4.a)5 b)7 c)4

f) $\frac{2}{3}$ g) $\sqrt{3}$ h)-3 5.a)1 b)2 c)0 d)3 e)0.134 f)1

g)2.164 h)-1.520 6.a)All equal to 1 b)3, 2,

-3, 2; x 7.a)3 b)4 c)5 d)-3 e)-5 f)0 g) $\frac{1}{2}$

j)x k)1 l)0 8.a)8 b)5 c)3 d)-3 e) $\frac{1}{125}$ f)20

h)x > 0, x ≠ 1 i) $\frac{7}{2}$ 9.b)1000 c)316.2278 d)1000

e)4073.8028 f)3.4834 g)1.2179 10.a)4 b) $\frac{1}{4}$ c)

d)4 11.a)6 b)7 c)13 12.a)7 b)5 c) $\frac{21}{20}$ d) $\frac{7}{5}$ 13.

b)100 c)25 d) $\frac{1}{27}$ e)64 f)m 14.a) $\frac{1}{3}$ b)1 c)27

e)512 f)4 15.a)1027 b)-27 16.a)1000 b)398

17.10 000 18.4 19.40 20.16

10.3 Exercise, page 398

1.a)A : 1, B : 1.58 b)2.58 c)2.58 d)approxima

same e)2 × 3 = 6 2.a)A : 2, B : 1.4 b)0.7 c)0.

d)9 ÷ 4.5 = 2 3.a)A : 0.30, B : 0.90 b)0.90 c)

d)8 e)0.90 f)same 4.a)(i)0.9 (ii)0.6 b)0.6 c)

e)same f)yes

10.4 Exercise, page 401

1.a)log₃13 + log₃47 b)log₂3.2 + log₂78

c)log₁₀15.2 + log₁₀33.8 d)log_xp + log_xg

e)log₂x + log₂y f)log₂m + log₂n 2.a)log₇(13

b)log₂(28 × 36) c)log₇(43 × 81)

d)log₁₀(22.7 × 36.3) e)log_a(mn) f)log_a(a³b³)

3.a)log₃ $\left(\frac{37}{22}\right)$ b)log₂ $\left(\frac{85}{74}\right)$ c)log₁₀ $\left(\frac{222}{75}\right)$ d)

e)log_b $\left(\frac{33}{11}\right)$ f)log_a $\left(\frac{x^2y}{sy}\right)$ 4.a)log₂72 - log₂3

b)log₇352 - log₇19.3 c)log₁₀751 - log₁₀82

d)log_aa - log_ab e)log₅52.5 - log₅131

f)log_a741 - log_a337 g)log_b842 - log_b61.3

h)log₇73.2 - log₇13.7 5.a)log₄7 + log₄6

b)log₆0.28 + log₆536 c)log₇421 - log₇237

d)log₂22.3 - log₂481 e)log₁₀7 + log₁₀27 +

f)log₂p + log₂q - log₂m - log₂n 6.a)2 b)2

7.a)5 b)3 c)4 d)3 8.a)7 b)2 c)3 d)1 e)6 f)

10.(a) $\frac{1}{7}$, (c) 11.a) $\frac{3}{2}$ b)9 c) $\frac{14}{3}$ d) $-\frac{1}{2}$ 12.a)log

b)log₃ $\left(\frac{xy^2}{a^2}\right)$ c)log₃ $\left(\frac{x^2 - y^2}{xy}\right)$

10.5 Exercise, page 405

1.a)2 log₇15 b)8 log₆57 c)4 log_xa d)-2 log