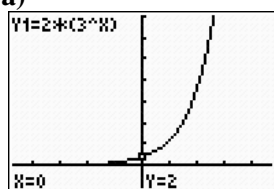


## Prerequisite Skills

1. a)

b)  $\{x \in \mathbb{R}\}, \{y \in \mathbb{R}, y > 0\}, y = 0$ 

2. a) \$23 000

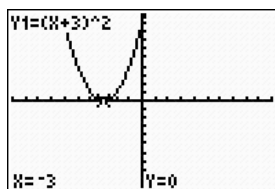
b) \$11 776

3. a)  $p$ b)  $n^2$ c)  $3x^4$ d)  $\frac{4m^6}{n^2}$ 

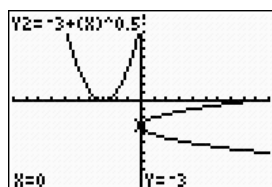
4. a) 9

b)  $\frac{5}{2}$ c)  $-\frac{9}{7}$ 

5. a)

b)  $\{x \in \mathbb{R}\}, \{y \in \mathbb{R}, y \geq 0\}$ 

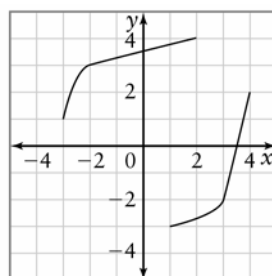
c)

d)  $\{x \in \mathbb{R}, x \geq 0\}, \{y \in \mathbb{R}\}$ 

e) No, the original function is not 1 to 1, so the inverse is not a function

6. b)  $\{x \in \mathbb{R}, -3 \leq x \leq 2\}, \{y \in \mathbb{R}, 1 \leq y \leq 4\}$ 

c)

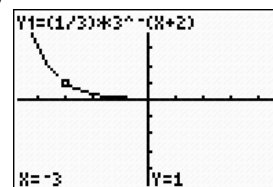
d)  $\{x \in \mathbb{R}, 1 \leq x \leq 4\}, \{y \in \mathbb{R}, -3 \leq y \leq 2\}$ 

e) Yes, the original function is 1:1, so the inverse is a function

7. a) vertical stretch factor 2, translation left 3 units and down 4 units

b) reflection in  $x$ -axis, vertical stretch factor 2, translation right 2 units8. a) vertical compression factor  $\frac{1}{3}$ ,reflection in  $y$ -axis, translation left 2 units

b)



## 6.1 The Exponential Function and Its Inverse

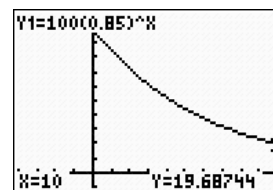
1. a) Data set b) is exponential. Successive terms have constant ratios.

b)  $y = 5^x$ 2. a) iii,  $y = 3^x$ b) i,  $y = 5^x$ c) ii,  $y = \left(\frac{1}{3}\right)^x$ 

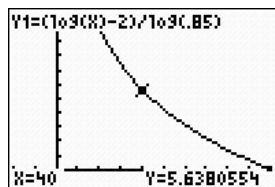
3.

	$f(x) = \left(\frac{1}{2}\right)^x$	Inverse of $f$
Domain	$\{x \in \mathbb{R}\}$	$\{x \in \mathbb{R}, x > 0\}$
Range	$\{y \in \mathbb{R}, y > 0\}$	$\{y \in \mathbb{R}\}$
$x$ -intercept	none	1
$y$ -intercept	1	none
Intervals for which $f(x)$ is positive	$(-\infty, +\infty)$	$(0, 1)$
Intervals for which $f(x)$ is increasing	none	none
Equation of asymptote	$y = 0$	$x = 0$

4. a)



b)



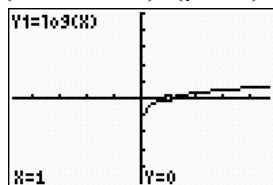
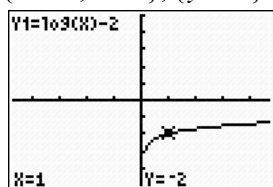
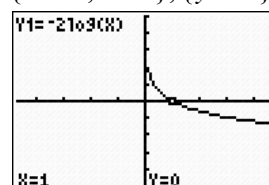
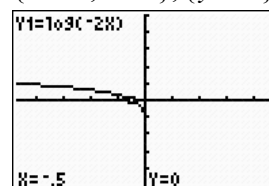
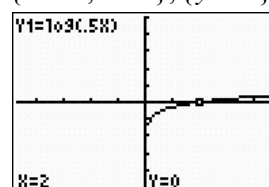
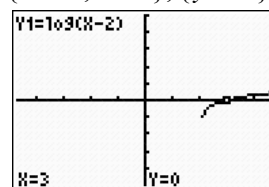
- c) 4.3 m      d) -11.13%/m  
 e) -7.21 %/m; greater, magnitude of slope is increasing as  $d$  increases  
 5. a) increases      b) 1.44

## 6.2 Logarithms

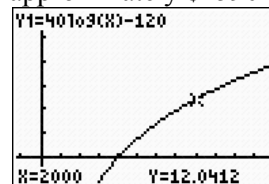
1. a)  $\log_3 243 = 5$       b)  $\log_6 \frac{1}{216} = -3$   
 2. a)  $4^3 = 64$       b)  $10^y = 30$   
 3. a) 2      b) -6      c) 2      d) -2.6  
 4. a) 2.3      b) 1.6  
 5. a) 1.68      b) -0.32  
 6. a) 2374 years      b) 19 000 years  
 c)  $R = 10^{-\frac{A}{19\,000}}$       d) 99%  
 7. Answers may vary.  
 8. a) 2.6      b)  $C = 10^{-pH}$       c)  $10^{-7}$  mol/L  
 9. a) 0.50, 1.00, 1.50, 2.00,  $\log(3.16^k) = \frac{k}{2}$   
     b) 5.00, 1.25      c) 100, 25, 1.5  
 10. a) 0.6, 1.3, 1.9,  
      $\log m + \log n = \log(m+n)$   
     b) 2.5, 3.2      c) 8, 2.5

## 6.3 Transformations of Logarithmic Functions

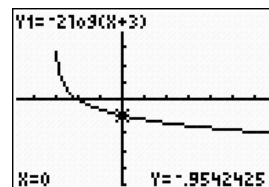
1. a)  $y = 2\log(x)$       b)  $y = \log(x+2)$   
 c)  $y = \log(x) + 2$       d)  $y = \log(2x)$   
 2. a)  $\{x \in \mathbb{R}, x > 0\}, \{y \in \mathbb{R}\}$

b)  $\{x \in \mathbb{R}, x > 0\}, \{y \in \mathbb{R}\}$ c)  $\{x \in \mathbb{R}, x > 0\}, \{y \in \mathbb{R}\}$ d)  $\{x \in \mathbb{R}, x < 0\}, \{y \in \mathbb{R}\}$ e)  $\{x \in \mathbb{R}, x > 0\}, \{y \in \mathbb{R}\}$ f)  $\{x \in \mathbb{R}, x > 2\}, \{y \in \mathbb{R}\}$ 

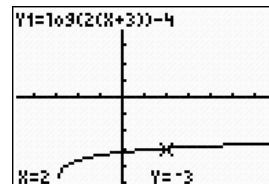
3. a) i) 12 years      ii) 19 years  
 b) approximately \$1590

c)  $A \geq 1000$  because  $n \geq 0$ 4. a)  $y = \log(x) + 3$ b)  $y = -2\log(x+5)$ 

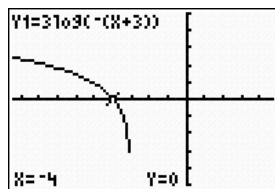
5. a)



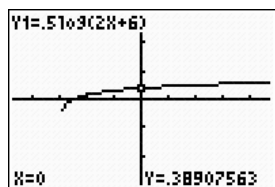
b)



c)



d)

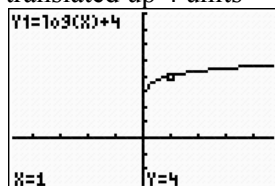


6. a) compress horizontally by a factor of  $\frac{1}{2}$ , translate left 3 units, reflect in the  $x$ -axis

b) reflect in the  $y$ -axis, stretch vertically by a factor of 3, translate up 4 units

7. The function  $y = -\log(-x)$  can be obtained by reflecting  $y = \log x$  in the  $y$ -axis and reflecting in the  $x$ -axis, so a point  $(a, b)$  is transformed to  $(-a, -b)$ . Reflection of the function  $y = \log x$  in the line  $y = x$  has the exact same effect, so the two log functions are inverses.

8. a) each pair of graphs is identical  
b) translated up 4 units



#### 6.4 Power Law of Logarithms

1. a) 21      b) -10      c)  $\frac{2}{3}$       d)  $\frac{1}{6}$   
 2. a) 1.756      b) 31.495  
 3. a) 1.4 m      b) 10  
 4. a) 1.1      b) -2.9  
 5. a)  $\log_4 16, 2$       b)  $\log_{\frac{2}{3}} \frac{8}{27}, 3$   
 6. a) 11.63      b) 9.51  
 7. b) 2030  
 8. a) 800 years      b) 96.6%  
 9. a)  $1^x = 5; b \neq 1$  because  $1 \neq 5$   
 b)  $\frac{\log 5}{\log 1}; b \neq 1$  because of division by 0

10. a) vertical compression

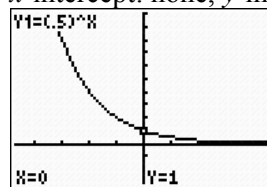
b)  $y = \frac{\log x}{\log a}; \frac{1}{\log a}$  acts as a vertical compression factor, therefore as  $a$  increases,  $\frac{1}{\log a}$  decreases

#### 6.5 Making Connections: Logarithmic Scales in the Physical Sciences

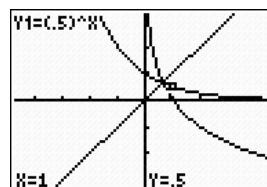
1. a) 3.5      b) 8.1  
 2. a)  $6.31 \times 10^{-3}$  mol/L      b)  $2.51 \times 10^{-12}$  mol/L  
 3. a) 1000      b) 3.2  
 4. 30 dB  
 5. 39.8  
 6. 6.8  
 7. a) 50119      b) star B  
 8. a)  $10^{-6}$  W/m<sup>2</sup>      b) 0.5 W/m<sup>2</sup>  
 9. a) 31      b) 6.0      c) 5351

#### Chapter 6 Review

1. a)  $\{x \in \square\}, \{y \in \square, y > 0\}$ , function is always positive and decreasing,  $y = 0$ ,  $x$ -intercept: none,  $y$ -intercept: 1



b)

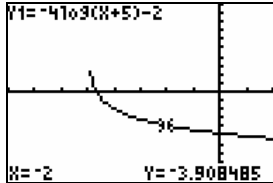


- c)  $\{x \in \square, x > 0\}, \{y \in \square\}$ , function positive when  $x \in (0, 1)$ , negative when  $x \in (1, +\infty)$ , function always decreasing,  $x = 0$ ,  $x$ -intercept: 1,  $y$ -intercept: none  
 2. a)  $\log_5 625 = 4$       b)  $\log_4 12 = x$   
 c)  $\log_{12} y = 3$   
 3. a)  $8 = 10^x$       b)  $x = 5^4$       c)  $200 = b^7$   
 4. a) -3      b) 3      c) -2      d) 8  
 5. a) 6      b)  $x > 0, x \neq 1$

6. a)  $y = -\log\left[\frac{1}{2}(x+5)\right] - 3$

b)  $y = -\log\left(\frac{1}{2}x + 5\right) - 3$

7.



8.  $y = 5\log(x+1)$

9. a)  $\frac{5}{2}$       b)  $-\frac{2}{5}$

10. a) 2.32    b) 2.26    c) 1.43    d) 0.09

11. a) 0.65 mV    b) 11.3 s    c) 3.54 mV

12. a) 251      b) 7.9

13. a)  $6.3 \times 10^{-5}$  mol/L

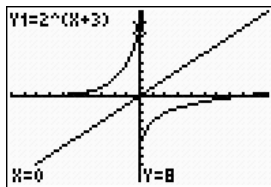
b) no, pH is 3.8

### Chapter 6 Test

1. a)  $\{x \in \square\}, \{y \in \square, y > 0\}$ , y-intercept 8,

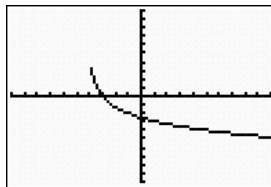
no x-intercept, function always  
positive and increasing, horizontal  
asymptote:  $y = 0$

b)



c)  $y = \log_2 x - 3$

2. a)



b)  $\{x \in \square, x > -4\}, \{y \in \square\}, x = -4$

3.  $y = -\log(x+5)$

4. a) 3    b) 4    c)  $\frac{3}{4}$     d)  $\frac{3}{2}$

5. a) 2.551      b) 2.661

c) 1.760      d) -1.576

6. 9.1%

7. a)  $10^{-7}$  W/m<sup>2</sup>

c) 86 dB

8. 11.3 cm

9. a) 398

b) 3162

b) -0.4