

## Section 1

1. Write the following in exponential form:

(a)  $\log_3 x = 9$

(b)  $\log_2 8 = x$

(c)  $\log_3 27 = x$

(d)  $\log_4 x = 3$

(e)  $\log_2 y = 5$

(f)  $\log_5 y = 2$

2. Write the following in logarithm form:

(a)  $y = 3^4$

(b)  $27 = 3^x$

(c)  $m = 4^2$

(d)  $y = 3^5$

(e)  $32 = x^5$

(f)  $64 = 4^x$

3. Solve the following:

(a)  $\log_3 x = 4$

(b)  $\log_m 81 = 4$

(c)  $\log_x 1000 = 3$

(d)  $\log_2 \frac{x}{2} = 5$

(e)  $\log_3 y = 5$

(f)  $\log_2 4x = 5$

## Section 2

1. Use the logarithm laws to simplify the following:

(a)  $\log_2 xy - \log_2 x^2$

(b)  $\log_2 \frac{8x^2}{y} + \log_2 2xy$

(c)  $\log_3 9xy^2 - \log_3 27xy$

(d)  $\log_4 (xy)^3 - \log_4 xy$

(e)  $\log_3 9x^4 - \log_3 (3x)^2$

2. Find  $x$  if:

(a)  $2 \log_b 4 + \log_b 5 - \log_b 10 = \log_b x$

(b)  $\log_b 30 - \log_b 5^2 = \log_b x$

(c)  $\log_b 8 + \log_b x^2 = \log_b x$

(d)  $\log_b (x + 2) - \log_b 4 = \log_b 3x$

(e)  $\log_b (x - 1) + \log_b 3 = \log_b x$

### Section 3

1. Use your calculator to find the following:

(a)  $\ln 1.4$

(b)  $\ln 0.872$

(c)  $\ln \frac{6.4 \times 3.8}{10}$

(d)  $e^{0.62}$

(e)  $e^{3.8}$

(f)  $(e^{0.24})^2$

(g)  $e^{1.4} \times e^{0.8}$

(h)  $6e^{-4.1}$

(i)  $\frac{e^{8.2}}{1068}$

(j)  $e^{-2.4} \times e^{6.1} \div (8 + \ln 2)$

2. Simplify the following

(a)  $\log x^2 - \log xy + 4 \log y$

(b)  $\ln(8x)^{\frac{1}{2}} + \ln 4x^2 - \ln(16x)^{\frac{1}{2}}$

(c)  $e^6 e^{-6}$

(d)  $12e^7 \div 6e^2$

(e)  $\ln e^2$

(f)  $\ln(e^2 \ln e^3)$

3. Find  $x$  in each of the following:

(a)  $\ln x = 2.7$

(b)  $\ln(x + 1) = 1.86$

(c)  $x = e^{9.8} \div e^{7.6}$

(d)  $6.27 = e^x$

(e)  $4.12 = e^{-2x}$

## Recap

### 1. Evaluate

(a)  $\log_{10} 1000$

(b)  $\log_4 1$

(c)  $\log_3 27$

(d)  $\log_2 \frac{1}{4}$

(e)  $\log_a a^x$

### 2. Solve for $x$

(a)  $\log_4 x = 2$

(b)  $\log_{\frac{1}{3}} x = 4$

(c)  $\log_{10}(2x + 1) = 2$

(d)  $\log_2 64 = x$

(e)  $\log_b 81 = 4$

### 3. (a) Use log laws to solve $\log_3 x = \log_3 7 + \log_3 3$ .

(b) Without tables, simplify  $2 \log_{10} 5 + \log_{10} 8 - \log_{10} 2$ .

(c) If  $\log_{10} 8 = x$  and  $\log_{10} 3 = y$ , express the following in terms of  $x$  and  $y$  only:

i.  $\log_{10} 24$

ii.  $\log_{10} \frac{9}{8}$

iii.  $\log_{10} 720$

### 4. (a) The streptococci bacteria population $N$ at time $t$ (in months) is given by $N = N_0 e^{2t}$ where $N_0$ is the initial population. If the initial population was 100, how long does it take for the population to reach one million?

(b) The formula for the amount of energy  $E$  (in joules) released by an earthquake is

$$E = 1.74 \times 10^{19} \times 10^{1.44M}$$

where  $M$  is the magnitude of the earthquake on the Richter scale.

i. The Newcastle earthquake in 1989 had a magnitude of 5 on the Richter scale. How many joules were released?

ii. In an earthquake in San Francisco in the 1900's the amount of energy released was double that of the Newcastle earthquake. What was its Richter magnitude?

## Answers

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### Section 1

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|---------------|----------------|---------------|
| (a) $x = 3^9$ | (c) $27 = 3^x$ | (e) $y = 2^5$ |
| (b) $8 = 2^x$ | (d) $x = 4^3$  | (f) $y = 5^2$ |
- |                     |                    |                     |
|---------------------|--------------------|---------------------|
| (a) $4 = \log_3 y$  | (c) $2 = \log_4 m$ | (e) $5 = \log_x 32$ |
| (b) $x = \log_3 27$ | (d) $5 = \log_3 y$ | (f) $x = \log_4 64$ |
- |        |        |         |
|--------|--------|---------|
| (a) 81 | (c) 10 | (e) 243 |
| (b) 3  | (d) 64 | (f) 8   |

### Section 2

- |                          |                    |
|--------------------------|--------------------|
| (a) $\log_2 \frac{y}{x}$ | (d) $2 \log_4(xy)$ |
| (b) $4 + 3 \log_2 x$     |                    |
| (c) $\log_3 y - 1$       | (e) 0              |
- |       |                   |                   |                    |                    |
|-------|-------------------|-------------------|--------------------|--------------------|
| (a) 8 | (b) $\frac{6}{5}$ | (c) $\frac{1}{8}$ | (d) $\frac{2}{11}$ | (e) $1\frac{1}{2}$ |
|-------|-------------------|-------------------|--------------------|--------------------|

### Section 3

- |           |          |           |          |          |
|-----------|----------|-----------|----------|----------|
| (a) 0.34  | (c) 0.89 | (e) 44.70 | (g) 9.03 | (i) 3.41 |
| (b) -0.14 | (d) 1.86 | (f) 1.62  | (h) 0.10 | (j) 4.65 |
- |                                   |            |                 |
|-----------------------------------|------------|-----------------|
| (a) $\ln xy^3$                    | (c) 1      | (e) 2           |
| (b) $\frac{1}{2} \ln 8 + 2 \ln x$ | (d) $2e^5$ | (f) $2 + \ln 3$ |
- |           |          |           |
|-----------|----------|-----------|
| (a) 14.88 | (c) 9.03 | (e) -0.71 |
| (b) 5.42  | (d) 1.84 |           |

## Recap

1. (a) 3                      (b) 0                      (c) 3                      (d)  $-2$                       (e)  $x$
2. (a) 16                      (b)  $\frac{1}{81}$                       (c) 49.5 or  $\frac{99}{2}$                       (d) 6                      (e) 3
3. (a) 21  
(b) 2  
(c) i.  $x + y$                       ii.  $2y - x$                       iii.  $2y + x + 1$
4. (a) 4.6054 months  
(b) i.  $2.76 \times 10^{26}$  Joules                      ii. 5.2 on the Richter scale.