

## Logarithms

Use the power, product and quotient rules. Remember, we can't make the problems more difficult – only longer.

### Rules

$$\log_b M = x \Leftrightarrow b^x = M$$

$$\log_b MN = \log_b M + \log_b N$$

$$\log_b M/N = \log_b M - \log_b N$$

$$\log_b M^c = c \log_b M$$

**Example** Rewrite as a single logarithm  $\log A + 2\log B - 3\log C$

$$\begin{aligned} & \log A + \log B^2 - \log C^3 \\ &= \log AB^2 - \log C^3 \\ &= \log \frac{AB^2}{C^3} \end{aligned}$$

**Example** Expand the following;  $\log (c^2 d^{15})^{1/3}$

$$\begin{aligned} &= \frac{1}{3} \log (c^2 d^{15}) = \frac{1}{3} [\log c^2 + \log d^{15}] \\ &= \frac{1}{3} [2 \log c + 15 \log d] = \frac{2}{3} \log c + 5 \log d \end{aligned}$$

Expanding the following logarithmic expressions.

1.  $\log a^2 b$

2.  $\log (c/d^3)$

3.  $\log [xy^2/c^3]$

4.  $\log (a^2 b)^5$

5.  $\log \left(\frac{6y}{2}\right)$

6.  $(\ln 3x^2 y)^3$

7.  $\log (9x + 7y)$

8.  $\log (3y^2)^{-2}$

9.  $\log\left(\frac{xy}{zt}\right)$

10.  $\log(z+2)^2(3z+5)$

11.  $\log\left(\frac{5\sqrt{7}}{3}\right)$

12.  $\log\sqrt{\frac{5r^3}{z^5}}$

13.  $\log\left(\frac{x^{\frac{1}{2}}y^{\frac{1}{7}}}{w^3z}\right)$

14.  $\log(x^2y^3)$