

## 8.3 Laws of Logs

- Already know:
- ①  $\log_a a = 1$
  - ②  $\log_a (a^m) = m$
  - ③  $a^{\log_a x} = x$

$$C^x = y \leftrightarrow \log_c y = x$$

Evaluate  $\log_2 8 + \log_2 32 \rightarrow \log_2 256$   
 $3 + 5 = 8$   $\leftarrow$   $2^8 = 256$

④  $\log_c a + \log_c b = \log_c (a \cdot b)$  Notice  $8 \times 32 = 256$

Evaluate  $\log_3 243 - \log_3 9 = \log_3 27$   
 $5 - 2 = 3$   $\leftarrow$  Notice  $243 \div 9 = 27$

⑤  $\log_c a - \log_c b = \log_c (a \div b)$  or  $\log_c (a/b)$

Evaluate  $1 \log_5 25 + 1 \log_5 25 + 1 \log_5 25 = \log_5 (25 \times 25 \times 25)$   
 $3 \log_5 25 \rightarrow = \log_5 (25^3)$

~~$(\log_5 25)^3$~~

⑥  $a \log_c b = \log_c (b^a)$

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 Alternate  
 proofs

$$\text{Expand: a) } \log_5 \left( \frac{xy}{z} \right) = \log_5 x + \log_5 y - \log_5 z$$

$$\text{b) } \log_7 (\sqrt[3]{x}) = \log_7 x^{1/3} = \frac{1}{3} \log_7 x = \frac{\log_7 x}{3}$$

$$\text{c) } \log_6 \left( \frac{1}{x^2} \right) = \log_6 x^{-2} = -2 \log_6 x$$

$$\log_6 \left( \frac{1}{x \cdot x} \right) = \log_6 1 - (\log_6 x + \log_6 x)$$

$$\text{d) } \log \left( \frac{x^3}{y\sqrt{z}} \right) = \log x^3 - (\log y + \log z^{1/2})$$

$$= 3 \log x - \log y - \frac{1}{2} \log z$$

Simplify : ①  $\log_6 8 + \log_6 9 - \log_6 2$   
 (then evaluate)

$$\log_6 \left( \frac{8 \times 9}{2} \right)$$

$$\log_6 36$$

$$2.0$$

②  $\log_7 (7 \cdot \sqrt{7}) = \log_7 (7 \cdot 7^{1/2})$

$$\log_7 7 + \log_7 7^{1/2} = \log_7 (7^{3/2})$$

$$1 + \frac{1}{2}$$

$$\frac{3}{2}$$

$$= \frac{3}{2}$$

③  $2 \log_2 12 - (\log_2 6 + \frac{1}{3} \log_2 27)$   $\downarrow$   
 $\log_2 12^2 - \log_2 6 - \log_2 27^{1/3}$  ( $\log_2 18$ )

$$\log_2 \left( \frac{144}{6 \times 3} \right)$$

$$\log_2 8 = \textcircled{3}$$

Simplify:  $\log_7 x^2 + \log_7 x - \frac{5 \log_7 x}{2}$

restrictions on  $x$ ?  
 $x > 0$

$$= \log_7 \left( \frac{x^2 \cdot x}{x^{5/2}} \right)$$

$$= \log_7 (x^{1/2})$$

$$= \frac{\log_7 x}{2}$$

$3 - \frac{5}{2}$   
 $\frac{6}{2} - \frac{5}{2} = \frac{1}{2}$

$\log_7 x^{5/2}$

Simplify  $\log_5(2x-2) - \log_5(x^2+2x-3)$

Restrictions?

$$2x-2 > 0$$

$$+2 \quad +2$$

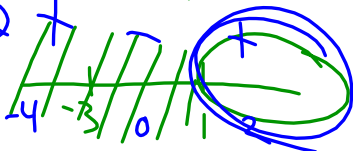
$$\frac{2x}{2} > \frac{2}{2}$$

$$x > 1$$

$$x^2+2x-3 > 0$$

$$(x+3)(x-1) > 0$$

$$x = -3 \quad x = 1$$



$$\log_5 \left( \frac{2x-2}{x^2+2x-3} \right)$$

$$\log_5 \left( \frac{2(x-1)}{(x+3)(x-1)} \right)$$

$$\log_5 \left( \frac{2}{x+3} \right)$$

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#1-3, 5-12, 18, C2, C3