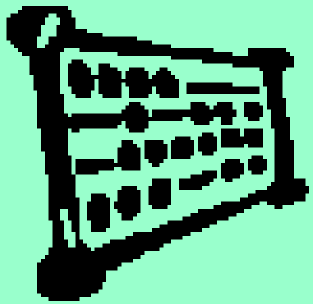
3.

Laws of Logs

$$\log_a x + \log_a y = \log_a (xy)$$

$$\log_a x - \log_a y = \log_a \left(\frac{x}{y} \right)$$

$$n \log_a x = \log_a \left(x^n \right)$$



Laws of logarithms

The following rules apply to all logs in the same base:

$$\log_a x + \log_a y = \log_a (xy)$$

$$\log_a x - \log_a y = \log_a \left(\frac{x}{y}\right)$$

$$n \log_a x = \log_a \left(x^n\right)$$

Examples of logs in action

$$\log_a x + \log_a y = \log_a (xy)$$

Example 1

NAB

Simplify

$(a)\ \log_2 16 + \log_2 4$

$= \log_2 (16 \times 4)$

$2^x = 64$

$= \log_2 (64)$

$= 6$

$(b)\ \log_3 81 - \log_3 27$

$= \log_3 \left(\frac{81}{27}\right)$

$3^x = 3$

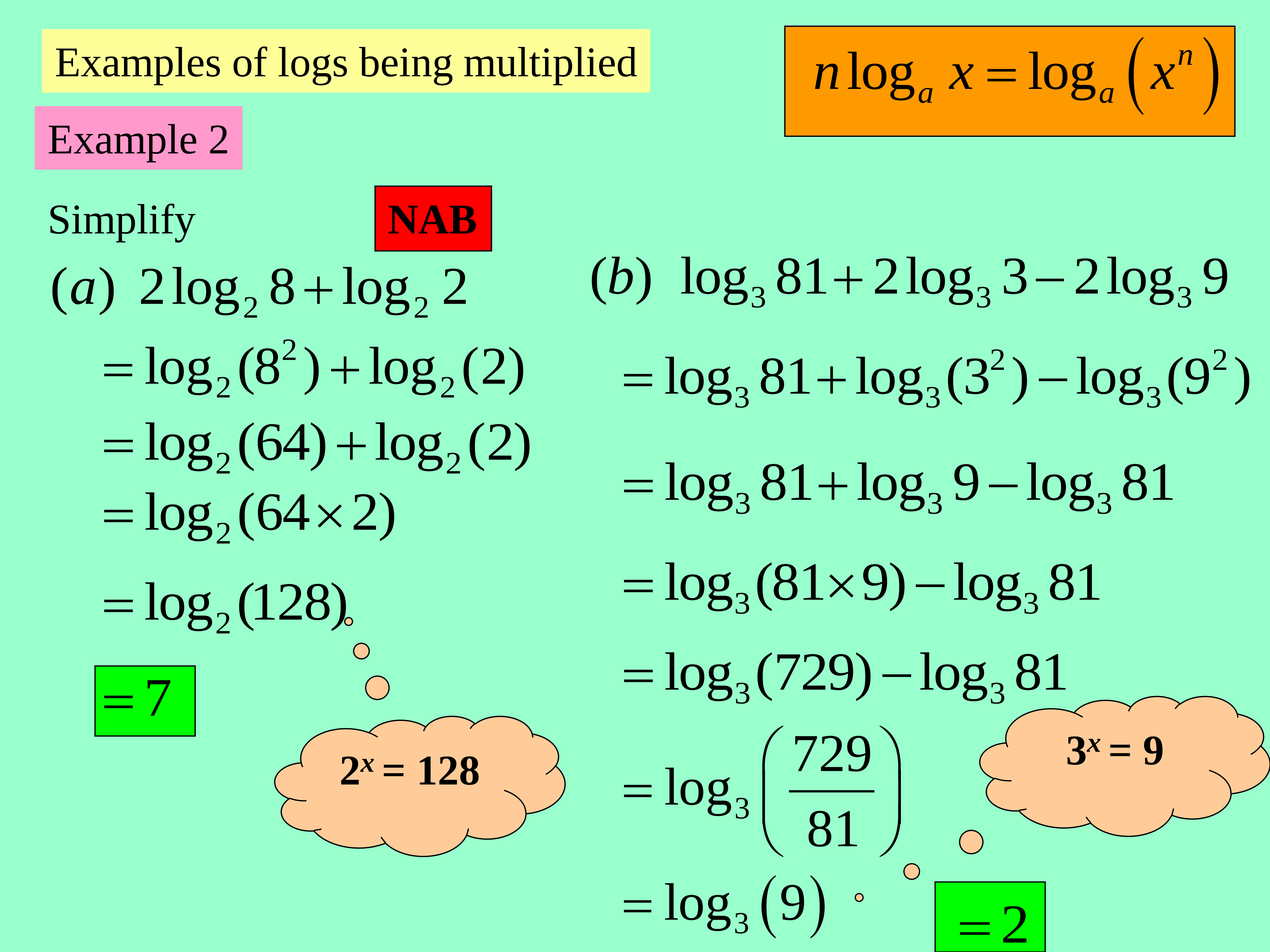
$= \log_3 (3)$

$= 1$

$$\log_a x - \log_a y = \log_a \left(\frac{x}{y}\right)$$

Heinemann, p.287, EX 15F, Q1 (a) to (d)

This is not the end


Examples of logs being multiplied
$n\log_a x = \log_a\left(x^n\right)$
Example 2
Simplify
NAB
$(a)\ 2\log_2 8 + \log_2 2$
$= \log_2(8^2) + \log_2(2)$
$= \log_2(64) + \log_2(2)$
$= \log_2(64 \times 2)$
$= \log_2(128)$
$= 7$
$2^x = 128$
$(b)\ \log_3 81 + 2\log_3 3 - 2\log_3 9$
$= \log_3 81 + \log_3(3^2) - \log_3(9^2)$
$= \log_3 81 + \log_3 9 - \log_3 81$
$= \log_3(81 \times 9) - \log_3 81$
$= \log_3(729) - \log_3 81$
$= \log_3\left(\frac{729}{81}\right)$
$= \log_3(9)$
$3^x = 9$
$= 2$

Heinemann, p.287, EX 15F, Q1 (e), (f) (m) & (n)

This is not the end

Examples of expressing y in terms of *x*

Example 3

If $\log_a y = 2\log_a 8 + 3\log_a p$ express y in terms of *p*.

Solution:

$$\log_a y = 2\log_a 8 + 3\log_a p$$

$$\log_a y = \log_a(8^2) + \log_a(p^3)$$

$$\log_a y = \log_a(8^2 \times p^3)$$

$$\log_a y = \log_a(64p^3)$$

$$y = 64p^3$$

Heinemann, p.287, EX 15F, Q5, 6 & 7