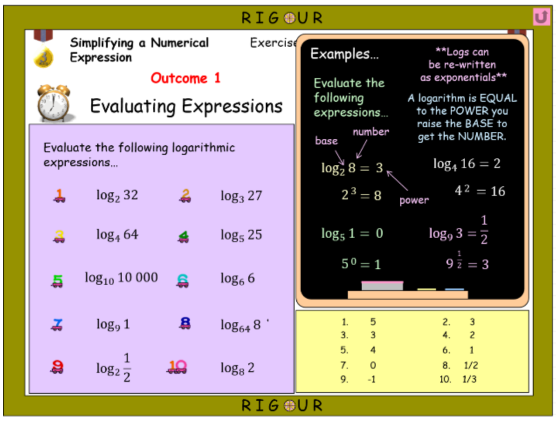
# Bronze Outcome 1 – Evaluating expressions




① $\log_2 32 = 5$ (since $2^5 = 32$)

② $\log_3 27 = 3$ (since $3^3 = 27$)

③ $\log_4 64 = 3$ (since $4^3 = 64$)

④ $\log_5 25 = 2$ (since $5^2 = 25$)

⑤ $\log_{10} 10\,000 = 4$ (since $10^4 = 10\,000$)

⑥ $\log_6 6 = 1$ (since $6^1 = 6$)

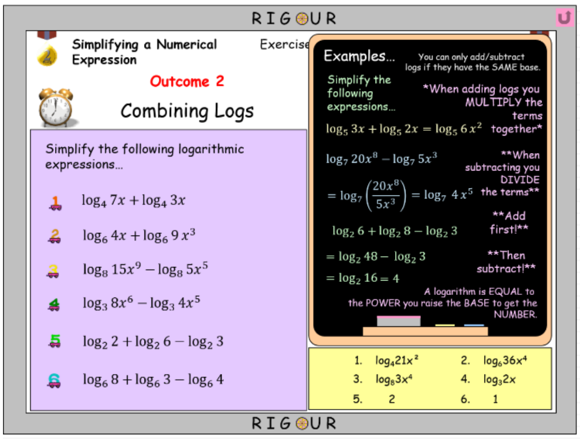
⑦ $\log_9 1 = 0$ (since $9^0 = 1$)

⑧ $\log_{64} 8 = \frac{1}{2}$ (since $64^{1/2} = \sqrt{64} = 8$)

⑨ $\log_2 \frac{1}{2} = -1$ (since $2^{-1} = \frac{1}{2}$)

⑩ $\log_8 2 = \frac{1}{3}$ (since $8^{1/3} = \sqrt[3]{8} = 2$)

# Silver Outcome 2 – Combining logs




① $\log_4 7x + \log_4 3x$
$= \log_4 21x^2$ (since $7x \times 3x = 21x^2$)

② $\log_6 4x + \log_6 9x^3$
$= \log_6 36x^4$ (since $4x^1 \times 9x^3 = 36x^4$) Subtract the powers

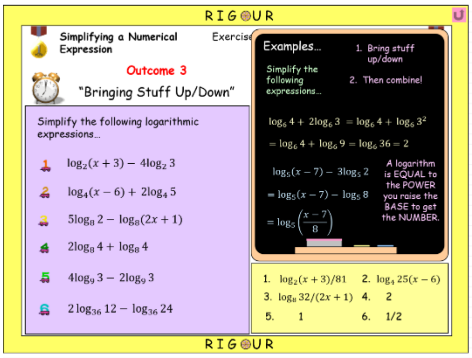
③ $\log_8 15x^9 - \log_8 5x^5$ $\left(\frac{15x^{9 \div 3}}{5x^5 \div 5} = \frac{3x^9}{x^5} = 3x^4\right)$
$= \log_8 3x^4$

④ $\log_3 8x^6 - \log_3 4x^5$ $\left(\frac{8x^6 \div 4}{4x^5 \div 4} = \frac{2x^6}{x^5} = 2x^1 = 2x\right)$ $6-5=1$
$= \log_3 2x$

⑤ $\log_2 2 + \log_2 6 - \log_2 3$ (since $2^2 = 4$)
$= \log_2 12 - \log_2 3 = \log_2 4 = 2$

⑥ $\log_6 8 + \log_6 3 - \log_6 4$ (since $6^1 = 6$)
$= \log_6 24 - \log_6 4 = \log_6 6 = 1$

# Gold Outcome 3 – Bringing stuff "up/down"




① $\log_2(x+3) - \log_2 81$
$= \log_2\left(\frac{x+3}{81}\right)$

② $\log_4(x-6) + \log_4 25$
$= \log_4 25(x-6)$

③ $\log_8 32 - \log_8(2x+1)$
$= \log_8\left(\frac{32}{2x+1}\right)$

④ $\log_8 16 + \log_8 4$
$= \log_8 64 = 2$ (since $8^2 = 64$)

⑤ $\log_9 81 - \log_9 9 = \log_9 9 = 1$ (since $9^1 = 9$)

⑥ $\log_{36} 144 - \log_{36} 24$
$= \log_{36} 6$ ($144 \div 24 = 6$)
$= \frac{1}{2}$ (since $36^{1/2} = 6$)