

## Bronze Outcome 1 - Solving basic equations

**RIGOUR**

**Solving Logarithmic Equations**

**Outcome 1**

**Simple equations**

Solve the following logarithmic equations...

$\log_2 x = 4$   
 $\log_3(x-5) = 2$   
 $\log_{10} x = 3$   
 $\log_4(x+7) = 3$   
 $\log_5 x = 2$   
 $\log_{10}(x-4) = \frac{1}{2}$   
 $\log_4 49 = 2$   
 $\log_8 81 = 4$   
 $\log_{25} 625 = x$   
 $\log_{16} 4 = x$

**Examples**

Solve the following equation for  $x$ .

1. Write as exponential

A logarithm is equal to the POWER you raise the BASE to get the NUMBER.

$\log_2 x = 5$        $\log_{64} 64 = 3$

$2^5 = x$        $x = 3$

base       $x = 32$        $x = \frac{1}{3} 64 = 4$

$5^3 = 125$        $x = 3$

**\*\*Find and answer\*\***

1.  $x = 32$       2.  $x = 14$   
 3.  $x = 1000$       4.  $x = 97$   
 5.  $x = 81$       6.  $x = 30$   
 7.  $x = 7$       8.  $x = 3$   
 9.  $x = 2$       10.  $x = 1/2$

⑧  $\log_{25} 625 = x$       ⑩  $\log_{16} 4 = x$

$25^x = 625$        $16^x = 4$

$x = 2$        $x = \frac{1}{2}$

(since  $25^2 = 625$ )      (since  $16^{1/2} = 4$ )

①  $\log_2 x = 4$       ④  $\log_4(x+7) = 3$

$2^4 = x$        $4^3 = x+7$

$x = 16$        $x+7 = 64$

$x = 57$       ③  $\log_9 49 = 2$

$9^2 = x$        $x^2 = 49$

$x = 9$        $x = 7$

$x = 14$       ⑤  $\log_9 x = 2$

$9^2 = x$        $9^2 = x$

$x = 81$       ⑧  $\log_x 81 = 4$

$x^4 = 81$

②  $\log_3(x-5) = 2$       ⑥  $\log_{36}(x-4) = \frac{1}{2}$

$3^2 = x-5$        $36^{1/2} = x-4$

$x-5 = 9$        $x-4 = 6$

$x = 14$        $x = 10$

$10^3 = x$        $x = 1000$

## Silver Outcome 2 - Solving standard equations

**RIGOUR**

**Solving Logarithmic Equations**

**Outcome 2**

**Standard equations**

Solve the following logarithmic equations...

$\log_6(x+4) - 3\log_6 2 = 2$   
 $\log_3 x + 2\log_3 3 = 4$   
 $\log_8(2x+1) + 4\log_8 2 = 2$   
 $\log_6 x^2 + 2\log_6 3 = 2$   
 $\log_7(x-8) - 5\log_7 2 = 1$   
 $\log_{10}(3x+1) - 2\log_{10} 4 = 3$

**Examples**

Solve the following equation for  $x$ .

1. Bring stuff up/down

2. Combine logs

3. Write as an exponential

A logarithm is equal to the POWER you raise the BASE to get the NUMBER.

$\log_6(x+4) - 2\log_6 5 = 2$

$\log_6 \left( \frac{x+4}{25} \right) = 2$

$6^2 = \frac{x+4}{25}$

$36 = \frac{x+4}{25}$

$9 = \frac{x+2}{25}$        $x+2 = 225$

$x = 223$

1.  $x = 284$       2.  $x = 9$   
 3.  $x = 3/2$       4.  $x = 2, -2$   
 5.  $x = 232$       6.  $x = 5333$

③  $\log_3(x-8) - 5\log_3 2 = 1$       ⑤  $\log_{10}(3x+1) - \log_{10} 16 = 3$

$\log_3 \left( \frac{x-8}{32} \right) = 1$        $\log_{10} \left( \frac{3x+1}{16} \right) = 3$

$3^1 = \frac{x-8}{32}$        $10^3 = \frac{3x+1}{16}$

$x-8 = 224$        $1000 = \frac{3x+1}{16}$

$x = 232$        $16000 = 3x+1$

$3x = 15999$

$x = 5333$

①  $\log_6(x+4) - \log_6 8 = 2$

$\log_6 \left( \frac{x+4}{8} \right) = 2$

$6^2 = \frac{x+4}{8}$

$36 = \frac{x+4}{8}$

$288 = x+4$

$x = 284$

②  $\log_3 x + \log_3 9 = 4$

$\log_3 9x = 4$

$3^4 = 9x$

$9x = 81$

$x = 9$

③  $\log_8(2x+1) + \log_8 16 = 2$

$\log_8 16(2x+1) = 2$

$8^2 = 16(2x+1)$

$64 = 16(2x+1)$

$4 = 2x+1$

$2x = 3$

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

④  $\log_6 x^2 + \log_6 9 = 2$

$\log_6 9x^2 = 2$

$6^2 = 9x^2$

$9x^2 = 36$

$x^2 = 4$        $x = \pm 2$

## Gold Outcome 3 - Equations with brackets

**RIGOUR**

**Solving Logarithmic Equations**

**Outcome 3**

**Equations with brackets**

Solve the following logarithmic equations...

$\log_2(x+3) + \log_2(x-5) = 2$   
 $\log_5(x-2) + \log_5(x+5) = 3$   
 $\log_2(x-5) + \log_2(x+3) = 4$   
 $\log_2(x-1) + \log_2(x+5) = 1$   
 $\log_2 x + \log_2(x+4) = 5$   
 $\log_6(x-5) + \log_6 x = 2$

**Examples**

Solve the following equation for  $x$ .

1. Combine logs

2. Write as an exponential

A logarithm is equal to the POWER you raise the BASE to get the NUMBER.

$\log_2(x-4) + \log_2(x+3) = 3$

$\log_2((x-4)(x+3)) = 3$

$2^3 = (x-4)(x+3)$

$8 = x^2 - x - 12$

$x^2 - x - 20 = 0$

$(x+4)(x-5) = 0$

$x = -4$        $x = 5$

**\*\*Set = 0 and factorise\*\***

1.  $x = -4$       2.  $x = 3$   
 3.  $x = -3, x = 7$       4.  $x = 2, x = 2$   
 5.  $x = 8, x = 4$       6.  $x = 9, x = 4$

③  $\log_2(x+3) + \log_2(x-5) = 2$       ⑤  $\log_6(x-5) + \log_6 x = 2$

$2^2 = (x+3)(x-5)$        $6^2 = x(x-5)$

$4 = x^2 - 2x - 15$        $36 = x^2 - 5x$

$x^2 - 2x - 24 = 0$        $x^2 - 5x - 36 = 0$

$(x-6)(x+4) = 0$        $(x-9)(x+4) = 0$

$x = 6$        $x = 9$        $x = -4$

①  $\log_2(x+3)(x-5) = 2$

$2^2 = (x+3)(x-5)$

$4 = x^2 - 2x - 15$

$x^2 - 2x - 24 = 0$

$(x-6)(x+4) = 0$

$x = 6$        $x = -4$

②  $\log_2(x-2)(x+5) = 3$

$2^3 = (x-2)(x+5)$

$8 = x^2 + 3x - 10$

$x^2 + 3x - 18 = 0$

$(x+6)(x-3) = 0$

$x = -6$        $x = 3$

③  $\log_2(x-5)(x+1) = 4$

$2^4 = (x-5)(x+1)$

$16 = x^2 - 4x - 5$

$x^2 - 4x - 21 = 0$

$(x-7)(x+3) = 0$

$x = 7$        $x = -3$

④  $\log_7(x-1)(x+5) = 1$

$7^1 = x^2 + 4x - 5$

$7 = x^2 + 4x - 5$

$x^2 + 4x - 12 = 0$

$(x+6)(x-2) = 0$

$x = -6$        $x = 2$