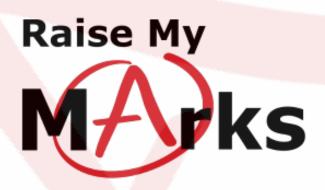
Properties of Logarithms 7



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(1)

# Properties of logarithm

Let's consider some properties of the logarithmic function,

$$y = f(x) = \log_b x$$

1. b > 0

- 2. x-intercept = 1
- 3. y-axis is a vertical asymptote
- 4. Domain=  $\{x \in \mathbb{R} | x > 0\}$
- 5. Range =  $\{y | y \in \mathbb{R}\}$
- 6. If b > 1 then the logarithmic function is increasing.
- 7. If 0 < b < 1 then the logarithm function is decreasing.

Notes, the most common base used is 10 for the logarithm function. This logarithm is writtedn as  $\log x$  rather than  $\log_{10} x$ . The value of the base *b* can be omitted when b = 10.

#### Some basic properties of logarithms

1. 
$$\log_b 1 = 0$$

- 2.  $\log_b b = 1$
- 3.  $\log_b b^x = x$
- 4.  $b^{\log_b x} = x$

More properties of logarithms when x > 0, w > 0 and  $r \in \mathbb{R}$  is a real number.

5.

$$\log_a(xw) = \log_a x + \log_a w$$

6.

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

7.

$$\log_a x^r = r \log_a x$$

Let's use some of these properties to solve logarithmic equation.



Properties of Logarithms 7 - Exercises

#### Example

Solve  $\log_6 x = 2$ .

**Solution:**  $\log_6 x = 2$  means  $x = 6^2 = 36$ .

### Example

Solve  $\log_6 x + \log_6(x+1) = 1$ 

# Solution:

$\log_6 x + \log(x+1)$	=	1, multiplicative property
$\log_6[(x(x+1))]$	=	1 equivalence to exponential
$6^{1}$	=	x(x+1)
0	=	$x^2 + x - 6$
0	=	(x+3)(x-2)

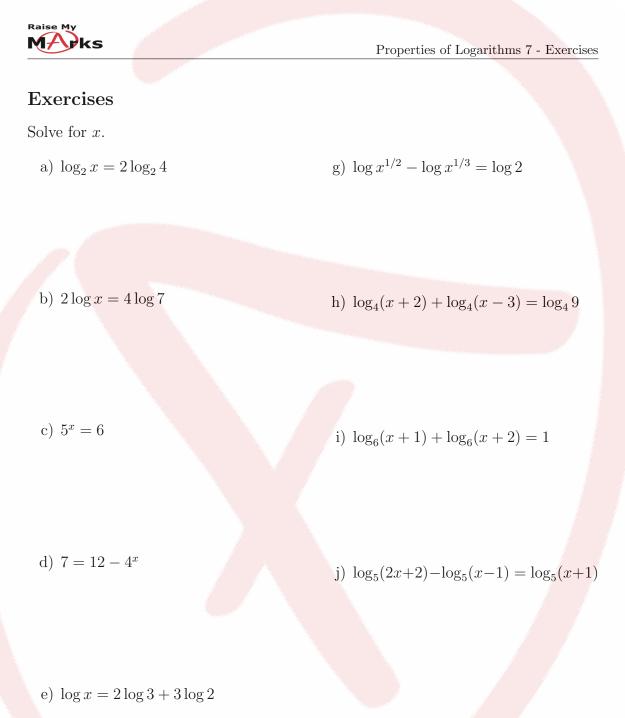
Therefore, x = -3 or 2.

## Example

Solve  $3^x = 23$ .

#### Solution:

$3^x$	=	23, Tal	<mark>ke log b</mark> ase 10 on both sides
$\log 3^x$	_	$\log 23,$	power property
$x \log 3$	=	$\log 23$ ,	solve for x
x	=	$\frac{\log 23}{\log 3}$	



k)  $\log_2(\log_3 a) = 2$ 

f)  $\log \sqrt{x} = \log 1 - 2 \log 3$ 



Properties of Logarithms 7 - Exercises

l)  $\log_{2n}(1944) = \log_n(486\sqrt{2})$  find  $n^6$ .