# Basic concepts of logarithms

So, what are logarithms or logs? Well these are just **the opposite** of exponentials, just like subtraction is the opposite of addition and division is the opposite of multiplication. In mathematical terms we say that logarithms are the **inverse** of exponentials (indices). A detail understanding of the rules of indices is required to work with logarithms. So, make sure you are familiar with the rules of indices before proceeding any further.

Here is an example of an exponential/indice:

This equation is read as, 3 raised to the power of 2 is equal to 9.

Let’s look at it in another way, we know we get to 9 when we raise 3 to some power and we want to know what that power is.

and we need to figure out what is, that is

So fundamentally that is what logs is about, that is, figuring out what power I am going to raise 3 to, to get 9.

Writing in logarithmic form it would look like this:

So,

***and*  *are equivalent statements and are interchangeable.***

So, let us look at other equivalent statements:

|  |  |  |
| --- | --- | --- |
| **Index form**  **or**  **Exponential form** |  | **Logarithmic form** |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

Observing the examples leads to the formal definition of a logarithm

**is equivalent to , for**

***Let us look at the following and without using a calculator, evaluate:***

This is always true:  for *any* base *a*, not just for .

* + But
  + so

This is always true:  for *any* base *a*, not just for .

* But what power *x* could possibly turn a *positive* 4 into a *negative* 16? This just isn't possible, so the answer is:

**No solution**

This is always true:  is undefined for *any* negative argument *a*, regardless of what the base is.

**In summary,**

* can also be written as .
* Logarithms are the inverse of exponentials.
* = 1, for any base , because
* , for any base , because .

Without using a calculator evaluate the following:

Answers on the next page.

Did you get these answers?

**Answers:**

**Well done!**

**What applications have exponential and logarithm functions?**

Both functions are used to model a wide variety of problems. For example, the loudness of sounds, the acidity of a solution (pH) and the intensity of earthquakes on the Richter scale are some examples.