

## Common Logarithms 50

Any positive number can be used as a base for logarithms, however, the base ten is very useful because we are familiar with the decimal number system which has a base of ten. Logarithms with a base of ten are called common logarithms. We write  $y = \log_{10}x$  as  $y = \log x$ .

examples:

$$\log 10 = 1, \quad \log 1000 = 3 \quad \log 0.01 = -2 \quad \log 50 = 1.7$$

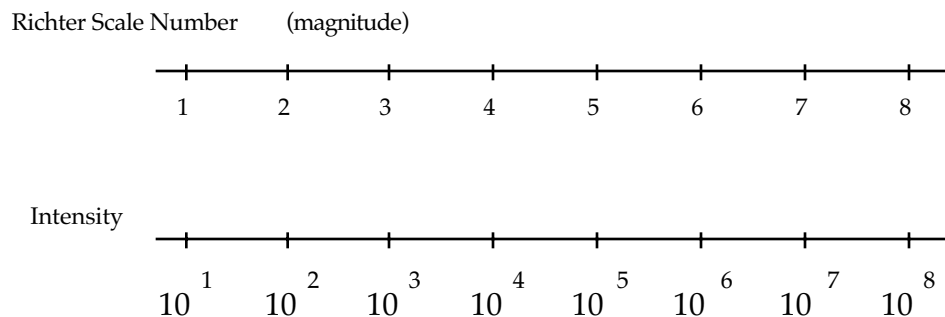
The above logarithms can be found using a calculator.

The exponential form for each of the above logarithms is given below.

$$10^1 = 10 \quad 10^3 = 1000 \quad 10^{-2} = 0.01 \quad 10^{1.7} = 50$$

example:

The Richter scale for earthquakes is an example of a logarithmic scale.



On this scale, an earthquake of magnitude 5, has an intensity of  $10^5$ . This earthquake is ten times as intense as one of magnitude 4.

example:

Find the intensity of a magnitude 6.6 earthquake. It is  $10^{6.6} = 4.0 \times 10^6$ .

example:

If the intensity of an earthquake is 2500, what is the Richter magnitude? It is  $\log 2500 = 3.4$ .

example:

Suppose that two earthquakes occur. One is magnitude 7.2, and the other magnitude 4.8. How much more intense is the first earthquake?

$I_1/I_2 = 10^{7.2}/10^{4.8} = 10^{2.4} = 251$ . The first earthquake is 251 times more intense.

Problems:

1) Evaluate:

- a)  $10^5$                       b)  $10^{-3}$                       c)  $10^{4.2}$                       d)  $10^{-1.6}$

2) Evaluate:

- a)  $\log 100$                       b)  $\log 10^{-7}$                       c)  $\log 80$                       d)  $\log 800$

3)a) Find the intensity of a magnitude 7.0 earthquake.

b) Find the magnitude of an earthquake with an intensity of 1000.

4)a) Find the intensity of a magnitude 4.8 earthquake.

b) Find the magnitude of an earthquake with an intensity of 150.

5)a) How many more times more intense is a magnitude 8 earthquake than a magnitude 7 earthquake?

b) How many more times more intense is a magnitude 5 earthquake than a magnitude 2 earthquake?

c) How many more times more intense is a magnitude 6.5 earthquake than a magnitude 3.9 earthquake?

Answers: 1)a) 100,000, b) 0.001, c)  $1.6 \times 10^4$ , d) 0.025, 2)a) 2, b) -7, c) 1.9, d) 2.9, 3)a) 10,000,000, b) 3, 4)a) 63,000, b) 2.2, 5)a) 10, b) 1000, c) 398 times.