Earthquakes and Richter Magnitude Lab

Logarithmic functions have applications, just as exponential functions do. Among the applications of logarithmic functions are earthquake intensities and magnitudes.

The **intensity** of an earthquake is a measure of the strength of an earthquake as measured by a seismograph. Earthquakes can be very small where we can hardly feel them, to very violent earthquakes which can kill thousands of people and cause widespread damage.

Earthquakes are measured using what is called its **Richter Magnitude**. The newspapers will always report the **magnitude** of an earthquake. The Richter Magnitude of an earthquake can defined to be the common logarithm (i.e. base 10 logarithm) of the intensity of the earthquake.

$$M = \log I$$

1. What is the Richter Magnitude of an earthquake with an intensity of 10,000?

2. Suppose an earthquake was twice as strong as the earthquake in Question #1. In other words, its intensity was twice the intensity of the earthquake in #1. What would be the magnitude of this earthquake?

3. Suppose an earthquake was 10 times as strong as the earthquake in Question #1. What would be the magnitude of this earthquake?

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4. The above formula can be used to find the magnitude of an earthquake if we know the intensity. It can also be used to find the intensity of an earthquake if we know the magnitude. In 1989, the Loma Prieta Earthquake hit the Bay Area during Game 3 of the World Series between the A's and the Giants. 63 people were killed and 3,700 were injured.



The Loma Prieta Earthquake had a Richter Magnitude of 6.9. What was the intensity of this earthquake?

5. In 2011, an earthquake struck off the coast of Japan killing 16,000 people, injuring 6,000 and causing the a tsunami that led to the Fukushima Daiichi nuclear disaster.



This earthquake had a Richter Magnitude of 9.0. What was the intensity of this earthquake?

6. How many times stronger was the 9.0 earthquake than the magnitude 6.9 earthquake? To get this, divide the **intensity** of the stronger earthquake by the **intensity** of the weaker one.

7. In 2004, an earthquake struck in the Indian Ocean causing a tsunami that killed 280,000 people.



This earthquake had a Richter Magnitude of 9.2. How many times stronger was this earthquake than the magnitude 9.0 earthquake?

Properties of Logarithms Calculator Exploration

- 1. Use your calculator to evaluate each of the following.
 - (a) $\log(2) + \log(3) = \log(2 \cdot 3) =$
 - (b) $\log_5(4) + \log_5(6) = \log_5(4 \cdot 6) =$
 - (c) $\log_3(7) + \log_3(2) = \log_3(7 \cdot 2) =$
- 2. What did you notice about each of your answers? Write a rule in the box below.

Product Property of Logarithms For any positive numbers b, x and y, $\log_b(x) + \log_b(y) =$

- 3. Use your calculator to evaluate each of the following.
 - (a) $\log(2) \log(3) =$ (b) $\log_5(4) - \log_5(6) =$ (c) $\log_3(7) - \log_3(2) =$ $\log_3\left(\frac{7}{2}\right) =$
- 4. What did you notice about each of your answers? Write a rule in the box below.

Quotient Property of Logarithms For any positive numbers b, x and y, $\log_b(x) - \log_b(y) =$