

Excellent!

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The Richter magnitude scale assigns a number to the amount of energy released by an earthquake. Mathematically it is described as the logarithm of the movement of the needle in micrometers (μm), minus the compensation for distances from the center of the earthquake. Written, it appears:

$$M = \log_{10}(x) - (.15 - 1.6\log_{10}(\Delta\text{Km})) \quad \text{When } \Delta\text{Km} < 100$$

$$M = \log_{10}(x) - (3.38 - 3\log_{10}(\Delta\text{Km})) \quad \text{When } 200 < \Delta\text{Km} < 600$$

When the magnitude of earthquakes are reported, the distance correction has already been compensated for so we are left with the equation:

$$M = \log_{10}(x)$$

Using the definition on a logarithm we can derive:

$$10^M = x$$

Using the new equation we can now easily compare the difference in magnitude between the 1964 Anchorage earthquake, which measured 9.2 on the Richter scale, and the 1994 Northridge earthquake, which measured 6.7 on the Richter scale.

For the Anchorage earthquake:

$$10^M = x$$

$$10^{9.2} = x$$

$$x = 1,584,893,192$$

For the Northridge earthquake:

$$10^M = x$$

$$10^{6.7} = x$$

$$x = 5,011,827$$

So while the difference in magnitude for the earthquakes was 2.5, the Anchorage earthquake was over 300 times more powerful.



On December 22, 2003 an earthquake originating from 7 miles NE of San Simeon register as 6.5 on the Richter scale. 40 buildings were destroyed and 2 people were killed.

- 1) Using the equation $M = \log_{10}(x) - (3.38 - 3\log_{10}(\Delta Km))$, find the movement of the needle in μm (x) when a magnitude of 4.7 is measured from 217 km away

$$M = \log_{10}(x) - (3.38 - 3\log_{10}(\Delta Km))$$

$$4.7 = \log_{10}(x) - (3.38 - 3\log_{10}(217))$$

$$4.7 = \log_{10}(x) - (-3.6294)$$

$$4.7 = \log_{10}(x) + 3.6294$$

$$1.0706 = \log_{10}(x)$$

$$10^{1.0706} = x$$

$$x = 11.7652 \mu m$$

- 2) Startled by a large bug, a scientist accidentally drops his inhaler directly onto the seismometer and causes the needle to jump 405 μm . Using the equation $M = \log_{10}(x)$, find the magnitude of this accident.

$$M = \log_{10}(x)$$

$$M = \log_{10}(405)$$

$$M = 2.6074$$