Problem 2: A recent earthquake measured 6.8 on the Richter scale. How many times more intense was this earthquake than an earthquake that measured 4.3 on the Richter scale?

Answer: 316

Solution: Let I_1 refer to the earthquake that measured 6.8 on the Richter scale, and I_2 refer to the earthquake that measured 4.3 on the Richter scale.

$$\begin{aligned} 6.8 &= \log \frac{I_1}{S} \\ 4.3 &= \log \frac{I_2}{S} \end{aligned}$$

Solve for: $\dfrac{I_2}{I_1}$

$$\begin{aligned} 6.8 - 4.3 &= \log \frac{I_1}{S} - \log \frac{I_2}{S} \\ 6.8 - 4.3 &= \left(\log \frac{I_1}{S}\right) - \left(\log \frac{I_2}{S}\right) \\ 2.5 &= (\log I_1 - \log S) - (\log I_2 - \log S) \\ 2.5 &= \log I_1 - \log S - \log I_2 + \log S \\ 2.5 &= \log I_1 - \log I_2 \\ 2.5 &= \log \frac{I_1}{I_2} \\ 10^{2.5} &= \frac{I_1}{I_2} \\ 316.227766017 &= \frac{I_1}{I_2} \\ \frac{I_1}{I_2} &\approx 316 \\ I_1 &\approx 316 I_2 \end{aligned}$$

The intensity of the larger earthquake was earthquake as 316 times as intense as the smaller earthquake.

Let's check our answer.

$$4.3 = \log \frac{I_2}{S} = \log I_2 - \log S$$

$$M_1 = \log \frac{I_1}{S} = \log I_1 - \log S$$

$$M_1 = \log 316 I_2 - \log S$$

$$M_1 = \log 316 + \log I_2 - \log S$$

$$M_1 = \log 316 + \log \frac{I_2}{S}$$

$$M_1 = \log 316 + M_2$$

$$M_1 = \log 316 + 4.3$$

$$M_1 = 2.49968708262 + 4.3 = 6.79968708262$$

$$M_1 \approx 6.8$$