**Applications of Logarithmic Functions**

Logarithmic functions are used to describe scenarios where an exponential change in one quantity corresponds with a linear change in another. Some examples of real-world applications of logarithmic functions include:

* The Richter scale for measuring earthquake intensities.
* The Decibel scale to represent the loudness of sounds.
* The pH scale used in chemistry to measure the acidity of a solution.

**Example 1**

The amplitude detected from the vibrations of an earthquake increases by a factor of 10 for each increase of 1 on the Richter scale. In other words, an earthquake that measures 7 on the Richter scale has an amplitude that is 10 times larger than one with a measure of 6 on the Richter scale. An earthquake with a reading of 8 on the Richter scale has an amplitude that is 100 times larger than one with a measure of 6 on the Richter scale.

How many times more intense is an earthquake with magnitude of 6.8 on the Richter scale compared to one that has a measure of 4.3?

**Example 2**

The loudness of sound is measured in Decibels. For every linear increase of 10 Decibels, the sound intensity increases by a factor of 10. For example, sound that has a loudness of 90 dB is 100 times more intense than sound that has a loudness of 70 dB.

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How many times more intense is the sound of a rock concert (at 120 dB) compared to normal conversation (at 60 dB)?

**Example 3**

The pH of a solution is a measure of the inverse hydrogen ion [H+] concentration in units of mol/L. As the pH increases, the amount of hydrogen ions in the solution decreases exponentially. For example, a solution with a pH of 6 is 100 times more acidic than a solution with a pH of 8. Pure distilled water has a pH of 7.

pH = -log[H+] where  is the concentration of H+

a) Determine the pH of hydrochloric acid that is secreted by the stomach lining and has a concentration of 0.03 mol/L.

b) Apple juice has a pH of 3. Determine the concentration of hydrogen ions in this solution.

c) If vinegar is 200 times more acidic than tomatoes which has a pH of 4.5, what is the pH of vinegar?

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