

L6 – 6.5 – Applications of Logarithms in Physical Sciences

MHF4U

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Part 1: Review of Solving Logarithmic Equations

Example 1: Solve for x in the following equation

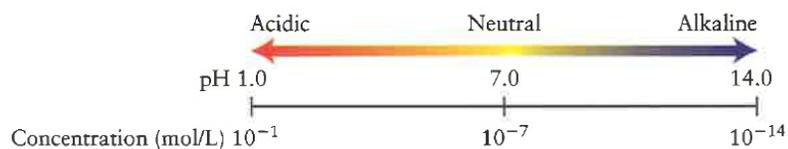
$$\log_2(x - 6) = 4 - \log_2 x$$

Part 2: pH Scale

The pH scale is used to measure the acidity or alkalinity of a chemical solution. It is defined as:

$$pH = -\log[H^+]$$

where $[H^+]$ is the concentration of hydronium ions, measured in moles per liter.



pH = 0	battery acid, strong hydrofluoric acid
pH = 1	hydrochloric acid secreted by stomach lining
pH = 2	lemon juice, gastric acid, vinegar
pH = 3	grapefruit, orange juice, soda
pH = 4	tomato juice, acid rain
pH = 5	soft drinking water, black coffee
pH = 6	urine, saliva
pH = 7	"pure" water
pH = 8	seawater
pH = 9	baking soda
pH = 10	Great Salt Lake, milk of magnesia
pH = 11	ammonia solution
pH = 12	soapy water
pH = 13	bleaches, oven cleaner
pH = 14	liquid drain cleaner

Example 2: Answer the following pH scale questions

a) Tomato juice has a hydronium ion concentration of approximately 0.0001 mol/L. What is its pH?

b) Blood has a hydronium ion concentration of approximately 4×10^{-7} mol/L. Is blood acidic or alkaline?

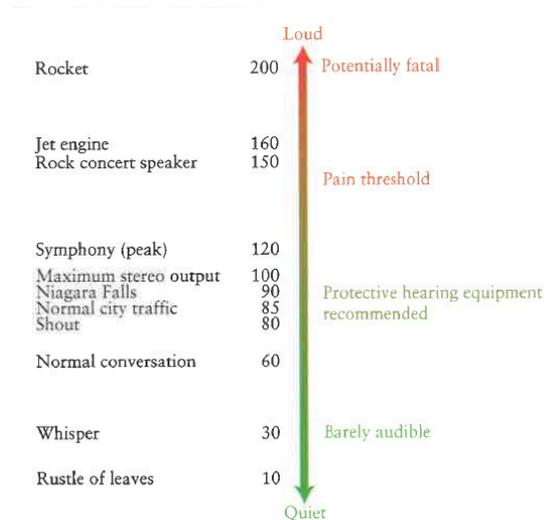
c) Orange juice has a pH of approximately 3. What is the concentration of hydronium ions in orange juice?

Part 3: Decibel Scale

Some common sound levels are indicated on the decibel scale shown. The difference in sound levels, in decibels, can be found using the equation:

$$\beta_2 - \beta_1 = 10 \log \left(\frac{I_2}{I_1} \right)$$

where, $\beta_2 - \beta_1$ is the difference in sound levels, in decibels, and $\frac{I_2}{I_1}$ is the ratio of their sound intensities, where I is measured in watts per square meter (W/m^2)



Example 3: Answer the following questions about decibels

a) How many times as intense as a whisper is the sound of a normal conversation

b) The sound level in normal city traffic is approximately 85 dB. The sound level while riding a snowmobile is about 32 times as intense. What is the sound level while riding a snowmobile, in decibels?

Part 4: Richter Scale

The magnitude, M , of an earthquake is measured using the Richter scale, which is defined as:

$$M = \log\left(\frac{I}{I_0}\right)$$

where I is the intensity of the earthquake being measured and I_0 is the intensity of a standard, low-level earthquake.

Example 4: Answer the following questions about the Richter Scale

a) How many times as intense as a standard earthquake is an earthquake measuring 2.4 on the Richter scale?

b) What is the magnitude of an earthquake 1000 times as intense as a standard earthquake?