L6 – 6.5 – Applications of Logarithms in Physical Sciences

MHF4U

Jensen

Part 1: Review of Solving Logarithmic Equations

Example 1: Solve for x in the following equation

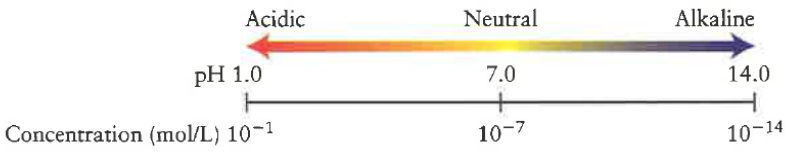
$\log_2(x-6) = 4 - \log_2 x$

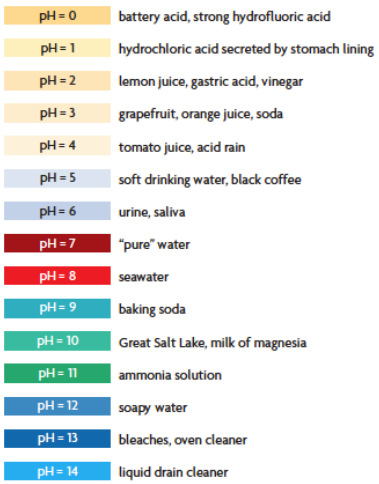
Part 2: pH Scale

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

$$\boldsymbol{pH = -\log[H^+]}$$

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





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?

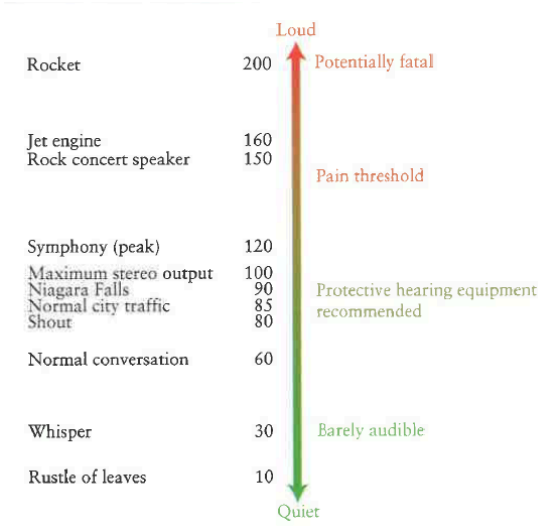
c) Orange juice has a pH of approximately 3. What is the concentration of hydronium ions in orange juice?

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:

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

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:

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

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?