REVIEW

Solve for x

$$80e^{0.045x} = 240$$

÷80 ÷80

$\ln e^{0.045x} = 3$

$\frac{.045x}{.045} = \frac{\ln 3}{.045}$

$x \approx 24.41$

$e^x = \ln x$

$10^x = \log x$

$3^x = \log_3 x$

$b^x = \log_b x$

Logarithmic Scales are used in many important applications in your (yes, your) life.

Decibel Scale -

Richter Scale -

Octave Scale -

F-Scale in Photography

pH Scale -

Brightness of Stars -

Ban and Deciban -

Palermo Technical Impact Hazard Scale

Comparing Earthquake intensities:

$$R = \log \frac{a}{T} + B$$

R = magnitude
a = amplitude
T = period
B = distance from center (weakens at distance)

How many times more severe is a 7.4 quake than a 5.5 quake?

$7.4 = \log \frac{a_1}{T} + B \qquad 5.5 = \log \frac{a_2}{T} + B$

$7.4 - 5.5 = \left[\log \frac{a_1}{T} + B\right] - \left[\log \frac{a_2}{T} + B\right]$

$1.9 = \log \frac{a_1}{T} + B - \log \frac{a_2}{T} - B$

$1.9 = \log \frac{a_1}{T} - \log \frac{a_2}{T}$

$1.9 = \log \frac{a_1}{a_2}$

$\frac{a_1}{T} \div \frac{a_2}{T}$

$\frac{a_1}{T} \times \frac{T}{a_2}$

$10^{1.9} = \frac{a_1}{a_2}$

$\frac{a_1}{a_2}$

≈ 79.98 80 X greater

How many times more severe was the 1978 Mexico city earthquake (R = 7.9) than the 1994 Los Angles earthquake (R =6.6)?

$1.3 = \log \frac{a_1}{a_2}$

$10^{1.3} = a_1/a_2$

≈ 19.95

20x greater

Comparing acidity: $pH = -\log\left[H^+\right]$

H^+ hydrogen-ion concentration

Sour Vinegar has a pH of 2.4 and a box of Leg and Sickle baking soda has a pH of 8.4.

a) what are their hydrogen-ion concentrations

b) how many times greater is the H+ of vinegar than baking soda?

c) By how many order of magnitude do they differ?

SV:

$-2.4 = +\log[H^+]$

$10^{-2.4} = H^+$

3.98×10^{-3}

BS

$-8.4 = +\log[H^+]$

$10^{-8.4} = H^+$

3.98×10^{-9}

b) $\frac{H^+ \text{ vinegar}}{H^+ \text{ soda}}$

$\frac{3.98 \times 10^{-3}}{3.98 \times 10^{-9}}$

$\frac{10^{-3}}{10^{-9}} = 10^{-3+9} = 10^6$

6 orders

Carbonated water has a pH of 3.9 and household ammonia has a pH of 11.9.

a) what are their hydrogen-ion concentrations

b) how many times greater is the H+ of vinegar than baking soda?

c) By how many order of magnitude do they differ?

water ammonia

$3.9 = -\log[H^+]$

$10^{-3.9} = H^+$

1.25×10^{-4}

$10^{-11.9} = H^+$

1.25×10^{-12}

b) $\frac{1.25 \times 10^{-4}}{1.25 \times 10^{-12}} = 10^8$

c) 8 orders

Newton's Law of Cooling

Temp. After time t | Temp. of surrounding medium | Initial Temp | constant | Time

$$T(t) = T_m + (T_0 - T_m)e^{-kt}$$

A cup of cocoa has cooled from 95° to 50° after 13 minutes in a room at 25°. How long will it take for the cup to cool to 30°?

T_0 = 95°, T_m = 25°

$50 = 25 + (95-25)e^{-13k}$

$50 = 25 + 70e^{-13k}$

$-25 \quad -25$

$\frac{25}{70} = \frac{70e^{-13k}}{70}$

$\frac{25}{70} = e^{-13k}$

$\frac{\ln(25/70)}{-13} = \frac{-13k}{-13}$

$k \approx .079$

$30 = 25 + 70e^{-.079t}$

$5 = 70e^{-.079t}$

$\frac{5}{70} = e^{-.079t}$

$\frac{\ln(5/70)}{-.079} = \frac{-.079t}{-.079}$

$t \approx 33$ minutes