3.5 Applications of Logarithms Part II

Ex. 1

A population of Tribbles multiplies five fold every 6 days. By how much does the population grow between the 4th and 20th day?

We can express 'growth' as a ratio.
→ Input initial conditions, output final conditions.

$P = P_0 (x)^{\frac{t_2 - t_1}{n}}$

$\frac{P}{P_0} = 5^{\frac{20-4}{6}}$

≈ 73 times

$\frac{P}{\text{original}} = 73$

$P = (\text{original})73$

Ex. 2 Richter Scale $\left(I = I_0 \times 10^{(R)}\right)$ -- Where R is the Richter Number

Mr. Epp has a temper tantrum; it caused a magnitude 3.2 earthquake. Five days later he blew up at his D block class and it caused a magnitude 5.7 earthquake. How much stronger was the 2nd earthquake as compared to the 1st earthquake?

$\left(I = I_0 \times 10^{(R_2 - R_1)}\right)$

$\frac{I}{I_0} = 10^{5.7 - 3.2}$

$\frac{I}{I_0} \approx 316$ times as big

Ex. 3.

In Vancouver there was a magnitude 4.6 earthquake, five days later an aftershock occurred, it was 1/40 the magnitude of the 1st earthquake. What is the Richter number of this earthquake?

$\left(I = I_0 \times 10^{R_2 - R_1}\right)$

$\frac{I}{I_0} = \frac{1}{40} = 10^{R_2 - 4.6}$

$\frac{1}{40} = \frac{10^{R_2}}{10^{4.6}}$

$\frac{10^{4.6}}{40} = 10^{R_2}$

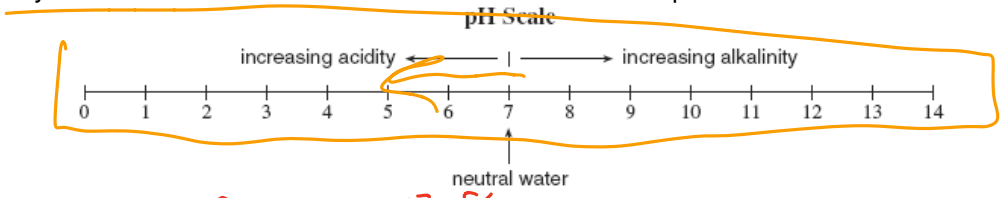
$\log\left(\frac{10^{4.6}}{40}\right) = \log\left(10^{R_2}\right)$

$\frac{\log\left(\frac{10^{4.6}}{40}\right)}{\log(10)} = R_2$

$R_2 \approx 3$

Ex 4.

The pH scale measures acidity (0-7) or alkalinity (7-14) of a solution. It is a logarithmic scale in base 10. Thus, a pH of 12 is 10 times more alkaline than a pH of 11. If bleach has a pH of 13, how many more times more alkaline is it than blood which as a pH of 8?



$\left(P = P_0 \times 10^{pH_2 - pH_1}\right)$

$\frac{P}{P_0} = 10^{13-8}$

$\frac{P}{P_0} = 10^5$

hint $\frac{P}{P_0} = 10^5$

Ex. 5. If the pH of acetic acid is 5, what is the pH of hydrochloric acid if it is 200 times more acidic?

$\left(P = P_0 \times 10^{pH_2 - pH_1}\right)$

$\frac{P}{P_0} = \frac{1}{200} = 10^{pH_2 - 5}$

$\frac{1}{200} = \frac{10^{pH_2}}{10^5}$

$\frac{10^5}{200} = 10^{pH_2}$

$\log\left(\frac{10^5}{200}\right) = pH_2$

Hint $pH_2 \approx 2.7$