

# Logarithms in Practice<sub>take 2</sub>

While working in a group make sure you:

- Expect to make mistakes but be sure to reflect/learn from them!
- Are civil and are aware of your impact on others.
- Assume and engage with the strongest argument while assuming best intent.

*pH Scales:* Let  $[H^+]$  be the concentration of hydrogen ions in solution  $X$  measured in moles per liter (denoted  $M$ ). Then

$$\text{pH level of solution } X = -\log[H^+]$$

1. What is the pH level of battery acid if the concentration of hydrogen ions in battery acid is about 0.1M?
2. What is the  $[H^+]$  of stomach acid if the pH value of stomach acid is 2.3?
3. How many more times concentrated is the battery acid  $[H^+]$  to vinegar's concentration where vinegar commonly has a pH value of 3?

*Richter Scale:* Let  $I$  be the intensity of an earthquake  $X$  and  $S$  be the intensity of a ‘standard’ earthquake. Then the measurement of an earthquake  $X$  as measured on the Richter Scale is:

$$\log \left( \frac{I}{S} \right)$$

4. In March of 2011 Japan’s earthquake was 9.0 on the Richter Scale. February 2001 Tacoma had an earthquake measuring 6.8 on the Richter Scale. How many more times more intense was Japan’s earthquake to the one in Tacoma?

*Decibels:* The loudness of a sound is measured in decibels and is related to the intensity  $I$  by

$$10 \log \left( \frac{I}{S} \right)$$

where  $S = 10^{-12} \text{ W/m}^2$

5. France passed a law limiting iPods and other MP3 players to a maximum possible volume of 100 decibels. Find the maximum intensity (in  $\text{W/m}^2$ ) an iPod is legally allowed to output in France.
6. Normal conversation has a sound level of about 65 decibels. How many more times intense than normal conversation is the sound an iPod operating at the French maximum of 100 decibels?