

Question 2

A scientist is studying the pH level of a solution, which is defined by the formula:

$$\text{pH} = -\log_{10}[H^+]$$

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

- (a) If a solution has a hydrogen ion concentration of $[H^+] = 3.2 \times 10^{-5}$, find its pH.
- (b) If another solution has a pH of 4.6, what is its hydrogen ion concentration?
- (c) Which solution is more acidic, and by how many times is it more acidic?

Question 2 - Solution

(a) **Compute pH:**

$$\begin{aligned}\text{pH} &= -\log_{10}(3.2 \times 10^{-5}) = -[\log_{10}(3.2) + \log_{10}(10^{-5})] \\ &= -[\log_{10}(3.2) - 5] \approx -[0.5051 - 5] = -(-4.4949) = \boxed{4.49}\end{aligned}$$

(b) **Compute hydrogen ion concentration from pH:**

$$\text{pH} = -\log_{10}[H^+] \Rightarrow \log_{10}[H^+] = -4.6 \Rightarrow [H^+] = 10^{-4.6} \approx \boxed{2.51 \times 10^{-5}}$$

(c) **Compare acidity:**

Recall: lower pH = more acidic.

The first solution has pH ≈ 4.49 , second has pH 4.6, so first solution is more acidic.

To find how many times more acidic:

$$\frac{[H^+]_{\text{first}}}{[H^+]_{\text{second}}} = \frac{3.2 \times 10^{-5}}{2.51 \times 10^{-5}} \approx \boxed{1.27 \text{ times more acidic}}$$