

Answer on Question ##67090, Chemistry / General Chemistry

In a 1985 study of Little Rock Lake in Wisconsin, 400 gallons of 18M sulfuric acid were added to the lake over six years. The initial pH of the lake was 6.1 and the final pH was 4.7. If none of the acid was consumed in chemical reactions, estimate the volume of the lake

Solution:

$$pH = -\lg[H^+] \Rightarrow [H^+] = 10^{-pH}$$

1. Concentration before addition of acid was:

$$[H^+]_1 = 10^{-6.1} = 7.9 * 10^{-7} \text{ mol/l}$$

2. Concentration after addition of acid has become:

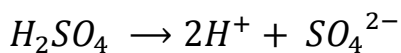
$$[H^+]_2 = 10^{-4.7} = 2.0 * 10^{-5} \text{ mol/l}$$

3. Volume of acid is:

$$V(l) = V(g) * 3.785$$

$$V(l) = 400 * 3.785 = 1514.164 \text{ (l)}$$

4. Concentration of H⁺-ions:



$$[H^+] = 2 * [H_2SO_4]$$

$$[H^+]_3 = 2 * 1514.164 * 18 = 54509.9 \text{ (mol)}$$

$$\Delta[H^+] = [H^+]_2 - [H^+]_1$$

$$\Delta[H^+] = 2.0 * 10^{-5} - 7.9 * 10^{-7} = 1.9 * 10^{-5} \left(\frac{\text{mol}}{\text{l}}\right)$$

$$\Delta[H^+] = \frac{[H^+]_3}{V_{lake} + V_{acid}} \Rightarrow V_{lake} = \frac{[H^+]_3}{\Delta[H^+]} - V_{acid}$$

$$V_{lake} = \frac{54509.9}{1.9 * 10^{-5}} - 1514.164 = 2845236240 \text{ (l)}$$
$$= 2845236.24 \text{ (m}^3\text{)}$$

Answer: 2845236.24 m³.