Show that the hydroxide-ion concentration in an aqueous solution is 1x10^-4 M when the hydronium-ion concentration is 1x10^-10 M. Recall that 10^a x 10^b x =10^(a+B)

Solution

Water molecules auto-dissociate into hydronium and hydroxide ions in the following equilibrium:

$$2H_2O \leftrightarrow H_3O^+ + OH^-;$$

The concentration product of hydronium and hydroxide ions in water solution is constant:

$$[H_3O^+] \cdot [OH^-] = 1 \cdot 10^{-14} \text{ M}^2;$$

So, if the hydronium-ion concentration is$[H_3O^+] = 1 \cdot 10^{-10}$ M, then hydroxide-ion concentration is:

$$[OH^-] = 1 \cdot \frac{10^{-14}}{[H_3O^+]} = 1 \cdot \frac{10^{-14}}{10^{-10}} = 1 \cdot 10^{-4} \text{ M};$$

Answer: in this case the hydroxide-ion concentration in an aqueous solution is 10^{-4}M when the hydronium-ion concentration is 10^{-10} M, because the concentration product of hydronium and hydroxide ions in water solution is constant ($1 \cdot 10^{-14}$ M^2).