

Answer on the question #67152, Chemistry / Physical Chemistry

Question:

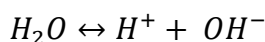
An acid solution with pH=6 at 25°C is diluted by 10^2 times. The pH of solution will be?

Solution:

When you have an acid in such a dilute solution, you should account for the dissociation of water. This means, we should take into account initial concentration of hydrogen ions of 10^{-7} mol/L. Let's calculate the initial concentration of hydrogen ions in the solution when we add some hypothetical acid HX:

$$[H^+] = 10^{-6} \cdot 10^{-2} + 10^{-7} = 1.1 \cdot 10^{-7} \text{ mol L}^{-1}$$

Let's consider the equilibrium in water:



	H_2O	H^+	OH^-
Initial concentration	-	$1.1 \cdot 10^{-7}$	10^{-7}
Change	-	$-x$	$-x$
Equilibrium	-	$1.1 \cdot 10^{-7} - x$	$10^{-7} - x$

$$K_w = 10^{-14} = [H^+][OH^-]$$

$$10^{-14} = (1.1 \cdot 10^{-7} - x)(10^{-7} - x)$$

$$10^{-14} = 1.1 \cdot 10^{-14} - 1.1 \cdot 10^{-7} \cdot x - 10^{-7} \cdot x + x^2$$

$$0 = 0.1 \cdot 10^{-14} - 2.1 \cdot 10^{-7} \cdot x + x^2$$

$$x = 4.88 \cdot 10^{-9}$$

So, the concentration of hydrogen ions is $1.1 \cdot 10^{-7} - 4.88 \cdot 10^{-9} = 1.05 \cdot 10^{-7}$ mol/L.
Let's find pH of the solution:

$$pH = -\log[H^+] = -\log(1.05 \cdot 10^{-7}) = 6.97$$

Answer: The pH of the solution is 6.97. Upon dilution, pH becomes closer to neutral, or 7.