(A) What is the concentration of hydronium ion in an aqueous solution whose pH is 10.50? (B) What is the hydroxide ion concentration? (C) What molar concentration of sodium hydroxide solution would provide this pH?

A) $pH = 10.50 \quad [H_3O^+] = ?$

$pH = -\log_{10}[H_3O^+] \longrightarrow [H_3O^+] = 10^{-pH}$

$[H_3O^+] = 10^{-10.50} = \boxed{3.2 \times 10^{-11}\ \underline{M}\ H_3O^+}$

B) $pH + pOH = 14.00$

$pOH = 14.00 - 10.50 = 3.50$

$[OH^-] = 10^{-pOH} = 10^{-3.50} = 3.2 \times 10^{-4}\ \underline{M}\ OH^-$

OR $[H_3O^+][OH^-] = K_w = 1.0 \times 10^{-14}$

$(3.2 \times 10^{-11})[OH^-] = 1.0 \times 10^{-14}$

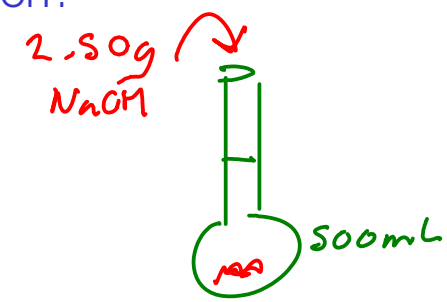
$[OH^-] = 3.2 \times 10^{-4}\ M$

( ) Sodium hydroxide (NaOH) is a STRONG BASE

$NaOH \longrightarrow Na^+ + OH^-$ | 1:1 ratio, so $3.2 \times 10^{-4}\ \underline{M}$ NaOH

What is the pH of a sodium hydroxide solution made from dissolving 2.50 g of sodium hydroxide in enough water to make 500.0 mL of solution?

NaOH: 40.00 g/mol



Find molarity of the NaOH

$$M = \frac{\text{moles NaOH}}{L \leftarrow 0.5000\,L}$$

$$2.50\ g\ NaOH \times \frac{mol\ NaOH}{40.00\ g\ NaOH} = 0.0625\ mol\ NaOH$$

$$\underline{M} = \frac{0.0625\ mol\ NaOH}{0.5000\,L} = 0.125\ \underline{M}\ NaOH$$

Sodium hydroxide is a strong base, so we expect it to completely ionize. The hydroxide concentration equals the NaOH concentration.

$NaOH \rightarrow Na^+ + OH^-$ (1:1)

$[OH^-] = [NaOH] = 0.125\ M$

$[H_3O^+][OH^-] = 1.0 \times 10^{-14}$

$[H_3O^+](0.125) = 1.0 \times 10^{-14}$

$[H_3O^+] = 8.0 \times 10^{-14}$

pH = 13.10

OR, use

$pOH = -\log_{10}(0.125) = 0.90$

$pH + pOH = 14.00$

$pH = 14.00 - 0.90$

pH = 13.10