(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) $10^{-10.50} = [H_3O^+]$ $\quad$ $([H_3O^+] = 10^{-pH})$

$[H_3O^+] = 3.16227766 \times 10^{-11}\ M \approx$ **$3.2 \times 10^{-11}\ M\ H_3O^+$**

(B) $(3.16227766 \times 10^{-11})[OH^-] = 1.0 \times 10^{-14}$ $\quad$ $([H_3O^+][OH^-] = 1.0 \times 10^{-14})$

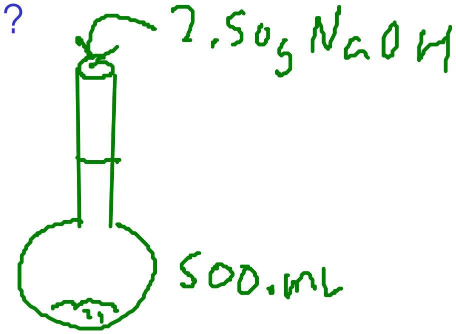
$[OH^-] = 0.000316228\ M =$ **$3.2 \times 10^{-4}\ M\ OH^-$**

(C) $NaOH \rightarrow Na^+ + OH^-$

So $[NaOH]_{nominal} =$ **$3.2 \times 10^{-4}\ M\ NaOH$**

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



First, we need to find the concentration of the sodium hydroxide solution.

Find moles NaOH

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

Find molarity

$$M = \frac{mol\ NaOH}{L\ solution} = \frac{0.0625\ mol\ NaOH}{0.500\,L} = 0.125\ M\ NaOH$$

The HYDROXIDE ion concentration equals the nominal NaOH concentration...

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

$$pOH = -\log_{10}(0.125) = 0.90 \qquad (pOH = -\log_{10}[OH^-])$$

$$pH + 0.90 = 14.00 \qquad (pH + pOH = 14.00)$$

$$\boxed{pH = 13.10}$$

For a WEAK ACID, equilibrium does not lie far to the right. The ionization equilibrium of the acid itself is important!

$$HA + H_2O \rightleftharpoons H_3O^+ + A^-$$

$$K_a = \frac{[H_3O^+][A^-]}{[HA]}$$

acid ionization constant

Again, water's concentration will not change significantly, so it is folded into the ionization constant

(HA) = concentration of undissociated acid

For a WEAK BASE, equilibrium does not lie far to the right. The ionization equilibrium of the base itself is important!

$$B + H_2O \rightleftharpoons BH^+ + OH^-$$

$$K_b = \frac{[BH^+][OH^-]}{[B]}$$

base ionization constant

Values for Ka and Kb can often be found in data books / tables / or on the web.

In OpenStax, these constants are in Appendix H and Appendix I!