Review Questions: pH and pOH

1. Calculate the pH and pOH of lake water which was found to have $[H^+] = 3.2 \times 10^{-5}$ mol/L

    Ans   pH = 4.49, & pOH = 9.51

2. The pH of a soil sample is 8.3. What is the $[H^+]$ and $[OH^+]$ of the sample?

    Ans $[H^+] = 5.0 \times 10^{-9}$ mol/L

    $[OH^-] = 2.0 \times 10^{-6}$ mol/L

3. What is the pH of a sodium hydroxide, a strong base, solution that has a concentration of 0.0026 mol/L?

    Ans   pH =11

4. Calculate $[H^+]$, and $[OH^-]$ for the following:
    a) pOH = 9.561

    Ans $[H^+] = 3.64 \times 10^{-5}$ mol/L
    Ans $[OH^-] = 2.75 \times 10^{-10}$ mol/L

    b) pH = 3.176

    Ans $[H^+] = 6.67 \times 10^{-4}$ mol/L
    Ans $[OH^-] = 1.50 \times 10^{-11}$ mol/L

1. Calculate pH and pOH for the follwing:
    a) $[H^+] = 8.52 \times 10$ mol/L

    Ans pH = 9.07, & pOH = 4.93

    b) $[OH^-] = 9.50 \times 10$ mol/L

    Ans pH = 10.9, & pOH = 3.10

K_w, $[H^+]$, and $[OH^-]$ Questions

1. Calculate $[H^+]$, and $[OH^-]$ for each of the following solutions:
    a) 0.001 mol/L HCl, a strong acid

    Ans $[H^+] = 1.0 \times 10^{-3}$ mol/L
    $[OH^-] = 1.0 \times 10^{-11}$ mol/L

    b) 4.0 mol/L NaOH, a strong base

    Ans $[H^+] = 2.5 \times 10^{-15}$ mol/L
    $[OH^-] = 4.0$ mol/L

    c) 6.00×10^{-3} mol/L $Ca(OH)_2$, a strong base

    Ans $[H^+] = 8.3 \times 10^{-13}$ mol/L
    $[OH^-] = 1.2 \times 10^{-2}$ mol/L

    d) 2.5×10^{-4} mol/L HNO_3, a strong acid

    Ans $[H^+] = 2.5 \times 10^{-4}$ mol/L
    $[OH^-] = 4.0 \times 10^{-11}$ mol/L

K_a & K_b Questions

1. The value of Ka for $H_2S <\!==\!> H^+ + HS^-$ is 1.0 x 10^{-7}. What is the value of $[H^+]$ in a 0.050 mol/L solution of HS is a weak acid.

   Ans $[H^+]$ = 7.1 x 10^{-5} mol/L

2. The value of Ka for $H_2O_2 <\!==\!> H^+ = HO_2^-$ is 2.4 x10^{-12}. What is the pH of a 0.20 mol/L solution of H_2O_2? H_2O_2 is a weak acid.

   Ans   pH = 6.2

3. Kb for NH_3, a weak base, is 1.8 x10^{-5}. Calculate the $[H^+]$, $[OH^-]$, pH, and pOH of a 0.0200 mol/L solution.

   Ans $[H^+]$ = 1.67 x 10^{-11} mol/L
   $[OH^-]$ = 6.00 x 10^{-4}mol/L
   pH = 10.8
   pOH = 3.22

4. Ka for HNO_2, a weak aci, is 5.1 x 10^{-4}. What is the $[H^+]$, $[OH^-]$, pH, and pOH of a 0.400 mol/L HNO_2 solution?

   Ans $[H^+]$ = 1.43 x10^{-2} mol/L
   $[OH^-]$ = 6.99 x 10^{-13} mol/L
   pH = 1.84
   pOH = 12.2

5. Calculate Ka for a 0.100 mol/L solution of formic acid, $HCHO_2$, a weak acid, if the pH is 2.38

   Ans   Ka = 1.8 x 10^{-4}

6. When butter turns rancid, its foul odour is mostly butyric acid, a weak acid. A 0.0100 mol/L solution of butyric acid has a pH of 3.40. Using Hbu and Bu⁻, claculate the Ka of Butyric acid.

   Ans   Ka = 1.7 x 10^{-5}

7. Nicotinic acid, $HC_2H_4NO_2$, is a B vitamin. It is also a weak acid with Ka = 1.4 x 10^{-5}. What is the $[H^+]$ and the pH of a 0.100 mol/L solution?

   Ans $[H^+]$ = 1.8 x 10^{-3} mol/L
   pH = 2.9

Conjugate Acid and Base Pairs

1. Write the conjugate acid for each of the following: **Ans**
   a) NO_2 HNO_2
   b) HCO_3^- H_2CO_3
   c) HPO_4^{-2} $H_2PO_4^-$
   d) OH^- H_2O
   e) H_2SO_4 $H_3SO_4^+$
   f) CH_3NH_2 $CH_3NH_3^+$

2. Write the conjugate base for each of the following: **Ans**
   a) HF F^-
   b) HCO_3^- CO_3^{-2}
   c) NH_3 NH_2^-
   d) $N_2H_5^+$ N_2H_4
   e) HPO_4^{-2} PO_4^{-3}
   f) $(CH_3)_2NH_2^+$ $(CH_3)_2NH$