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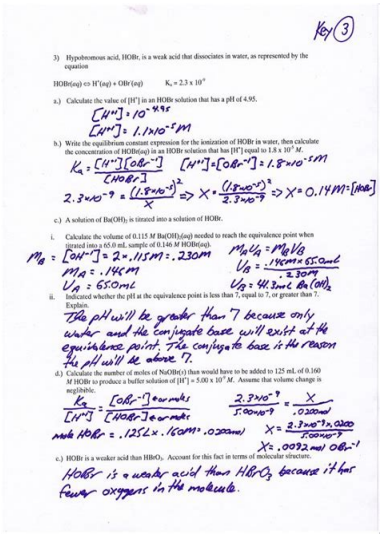

Key (3)

3) Hypobromous acid, HOBr, is a weak acid that dissociates in water, as represented by the equation

$HOBr(aq) \leftrightarrows H^+(aq) + OBr^-(aq)$ $K_a = 2.3 \times 10^{-9}$

a.) Calculate the value of $[H^+]$ in an HOBr solution that has a pH of 4.95.

$[H^+] = 10^{-4.95}$

$[H^+] = 1.1 \times 10^{-5} M$

b.) Write the equilibrium constant expression for the ionization of HOBr in water, then calculate the concentration of HOBr(aq) in an HOBr solution that has $[H^+]$ equal to $1.8 \times 10^{-5} M$.

$K_a = \frac{[H^+][OBr^-]}{[HOBr]}$ $[H^+] = [OBr^-] = 1.8 \times 10^{-5} M$

$2.3 \times 10^{-9} = \frac{(1.8 \times 10^{-5})^2}{X} \Rightarrow X = \frac{(1.8 \times 10^{-5})^2}{2.3 \times 10^{-9}} \Rightarrow X = 0.14 M = [HOBr]$

c.) A solution of $Ba(OH)_2$ is titrated into a solution of HOBr.

i. Calculate the volume of 0.115 *M* $Ba(OH)_2$(aq) needed to reach the equivalence point when titrated into a 65.0 mL sample of 0.146 *M* HOBr(aq).

$M_B = [OH^-] = 2 \times .115 M = .230 M$

$M_A = .14 cM$

$V_A = 65.0 mL$

$M_A V_A = M_B V_B$

$V_B = \frac{.14 cM \times 65.0 mL}{.230 M}$

$V_B = 41.3 mL\ Ba(OH)_2$

ii. Indicated whether the pH at the equivalence point is less than 7, equal to 7, or greater than 7. Explain.

The pH will be greater than 7 because only water and the conjugate base will exist at the equivalence point. The conjugate base is the reason the pH will be above 7.

d.) Calculate the number of moles of NaOBr(s) that would have to be added to 125 mL of 0.160 *M* HOBr to produce a buffer solution of $[H^+] = 5.00 \times 10^{-9} M$. Assume that volume change is negligible.

$K_a = \frac{[OBr^-]_{eq}\ moles}{[H^+] \quad [HOBr]_{eq}\ moles}$ $\frac{2.3 \times 10^{-9}}{5.00 \times 10^{-9}} = \frac{X}{.020 mol}$

$mole\ HOBr = .125 L \times .160 M = .020 mol$ $X = \frac{2.3 \times 10^{-9} \times .020}{5.00 \times 10^{-9}}$

$X = .0092 mol\ OBr^-$

e.) HOBr is a weaker acid than $HBrO_3$. Account for this fact in terms of molecular structure.

HOBr is a weaker acid than $HBrO_3$ because it has fewer oxygens in the molecule.

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