Key for Buffers and pH

What is the pH of a buffer that is 0.55 M in formic acid, HCOOH, and 0.63 M in sodium formate, NaHCOO?

The K_a for formic acid is 1.8×10^{-4}, which corresponds to a pK_a of 3.75. The pH of the solution is

$$\mathrm{pH} = \mathrm{p}K_a + \log \frac{[\mathrm{HCOO^-}]}{[\mathrm{HCOOH}]} = 3.75 + \log \frac{0.63}{0.55} = 3.81$$

What is the ratio of hypobromite, BrO^-, to hypobromous acid, HBrO, in a buffer with a pH of 7.88?

The K_a for hypobromous acid is 2.4×10^{-9}, which corresponds to a pK_a of 8.62. The pH of the solution is

$$\mathrm{pH} = \mathrm{p}K_a + \log \frac{[\mathrm{OBr^-}]}{[\mathrm{HOBr}]} = 8.62 + \log \frac{[\mathrm{OBr^-}]}{[\mathrm{HOBr}]} = 7.88$$

Solving for the ratio of the conjugate weak acid to the conjugate weak base gives

$$-0.74 = \log \frac{[\mathrm{OBr^-}]}{[\mathrm{HOBr}]}$$

$$\frac{[\mathrm{OBr^-}]}{[\mathrm{HOBr}]} = 0.18$$

Human blood contains two buffer systems, one based on phosphate species and one on carbonate species. If blood has a normal pH of 7.4, what are the principle phosphate and carbonate species present? What is the ratio between the two phosphate species? At the temperature of human blood, the K_a values for phosphoric acid are 1.3×10^{-2}, 2.3×10^{-7}, 6×10^{-12}, respectively. The K_a values for carbonic acid are 8×10^{-7} and 1.6×10^{-10}.

At the temperature of human blood, the pK_a values for the phosphate species are 1.89, 6.64, and 11.22, and the pK_a values for the carbonic acid species are 6.10 and 9.80. A pH of 7.40 falls within ± 1 pH unit of phosphate's pK_{a2} of 6.64; thus, we expect that there are significant amounts of both $H_2PO_4^-$ and HPO_4^{2-} present, and that there is little H_3PO_4 or PO_4^{3-} present. The relative abundance of these two species is

$$7.4 = 6.44 + \log \frac{[\mathrm{HPO_4^{2-}}]}{[\mathrm{H_2PO_4^-}]}$$

$$\frac{[\mathrm{HPO_4^{2-}}]}{[\mathrm{H_2PO_4^-}]} = 5.8$$

A pH of 7.40 is more than 1 pH unit above carbonic acid's pK_{a1} of 6.10 and more than 1 pH unit below its pK_{a2} of 9.80; thus, the only important form of carbonic acid is HCO_3^-.