Acid and Base

مقیاس pH نشان دهنده غلظت های [H+] و [OH-] است.

$$pH = \log \frac{1}{[H^+]} = -\log [H^+]$$

TABLE 2-6 The pH Scale

$[H^+]$ (M)	pH	$[OH^-]$ (M)	pOH*
10^0 (1)	0	10^{-14}	14
10^{-1}	1	10^{-13}	13
10^{-2}	2	10^{-12}	12
10^{-3}	3	10^{-11}	11
10^{-4}	4	10^{-10}	10
10^{-5}	5	10^{-9}	9
10^{-6}	6	10^{-8}	8
10^{-7}	7	10^{-7}	7
10^{-8}	8	10^{-6}	6
10^{-9}	9	10^{-5}	5
10^{-10}	10	10^{-4}	4
10^{-11}	11	10^{-3}	3
10^{-12}	12	10^{-2}	2
10^{-13}	13	10^{-1}	1
10^{-14}	14	10^0 (1)	0

*The expression pOH is sometimes used to describe the basicity, or OH^- concentration, of a solution; pOH is defined by the expression pOH = $-\log [OH^-]$, which is analogous to the expression for pH. Note that in all cases, pH + pOH = 14.

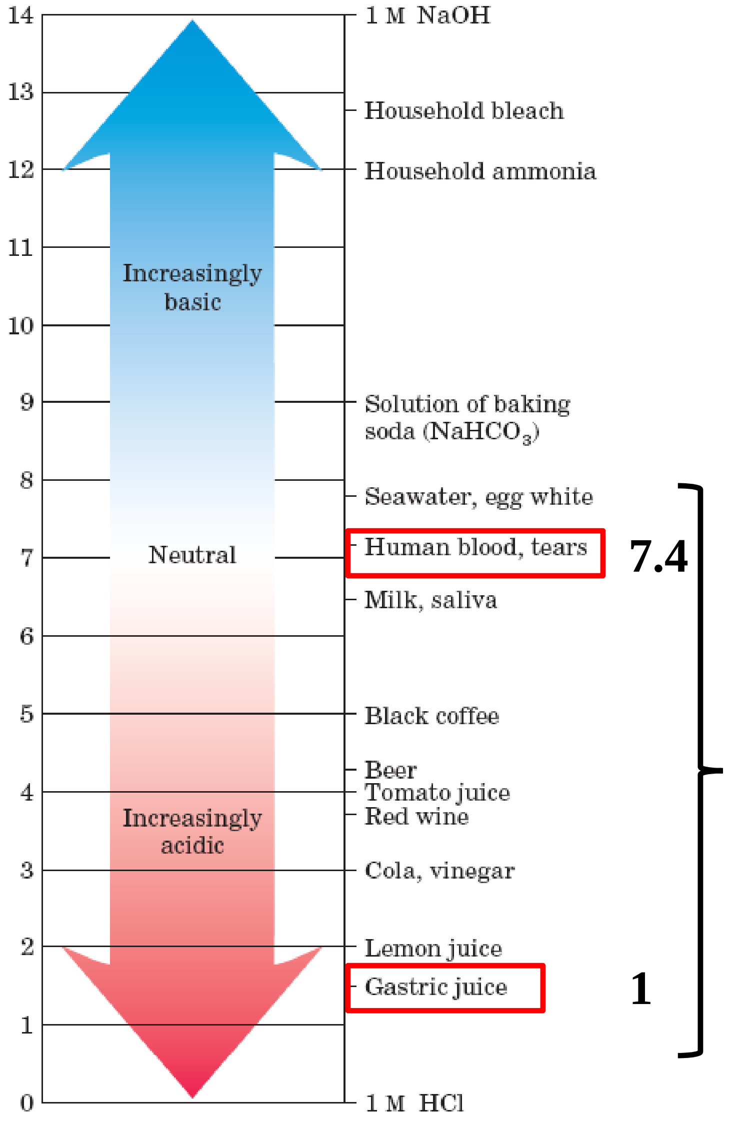


FIGURE 2-15 The pH of some aqueous fluids.

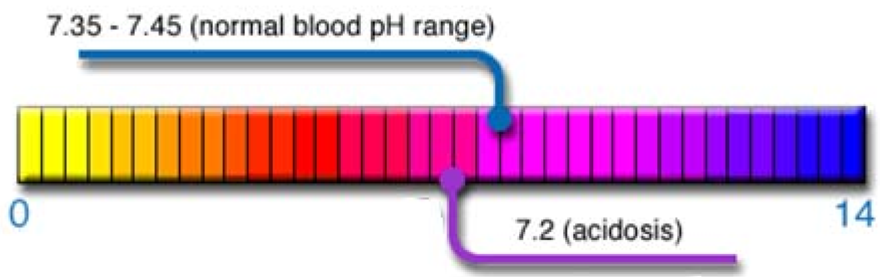
Why the pH of the body should be normal?

Measurements of the pH of blood and urine are commonly used in medical diagnoses.

❑ The pH of the blood plasma below the normal value of 7.4, the condition of **acidosis**.

❑The pH of the blood plasma above the normal value of 7.4, the condition of **alkalosis**.

❑ If blood pH moves to much below 6.8 or above 7.8, cells stop functioning and the patient dies.



دو محلول از نظر pH به اندازه یک واحد با یکدیگر اختلاف دارند، از نظر غلظت [H+] چقدر با یکدیگر اختلاف دارند؟

دو محلول از نظر pH به اندازه یک واحد با یکدیگر اختلاف دارند، از نظر غلظت [H+] چقدر با یکدیگر اختلاف دارند؟

A) pH 1 $\rightarrow$ $-\log [H^+] = 1 \rightarrow$ $[H^+] = 10^{-1} = 0.1$

B) pH 2 $\rightarrow$ $-\log [H^+] = 2 \rightarrow$ $[H^+] = 10^{-2} = 0.01$

$A/B = 0.1/0.01 = 10$

- ❑ **تعریف اسید و باز (Lowry & Bronsted)**
- ❑ **اسید و باز قوی**
- ❑ **اسید و باز ضعیف**

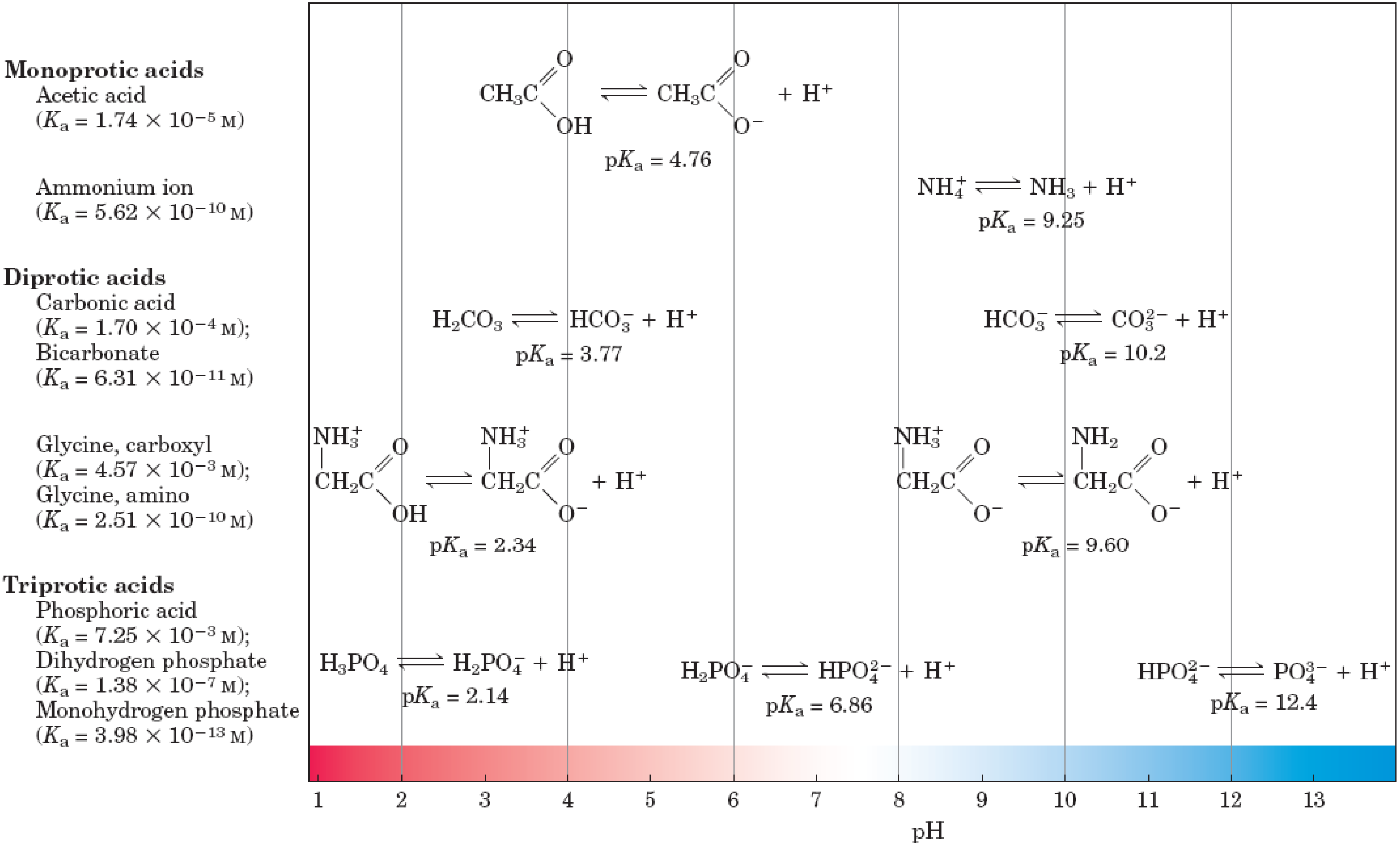
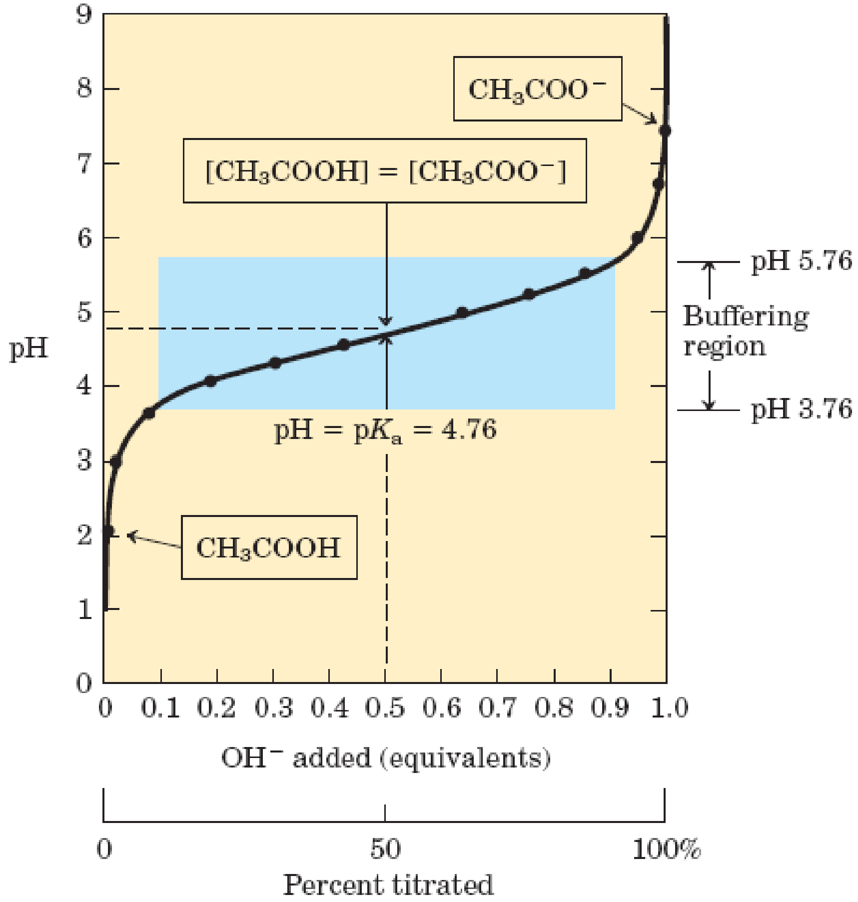


FIGURE 2–16 Conjugate acid-base pairs consist of a proton donor and a proton acceptor. Some compounds, such as acetic acid and ammonium ion, are monoprotic; they can give up only one proton. Others are diprotic (H_2CO_3 (carbonic acid) and glycine) or triprotic (H_3PO_4 (phosphoric acid)). The dissociation reactions for each pair are shown where they occur along a pH gradient. The equilibrium or dissociation constant (K_a) and its negative logarithm, the pK_a, are shown for each reaction.



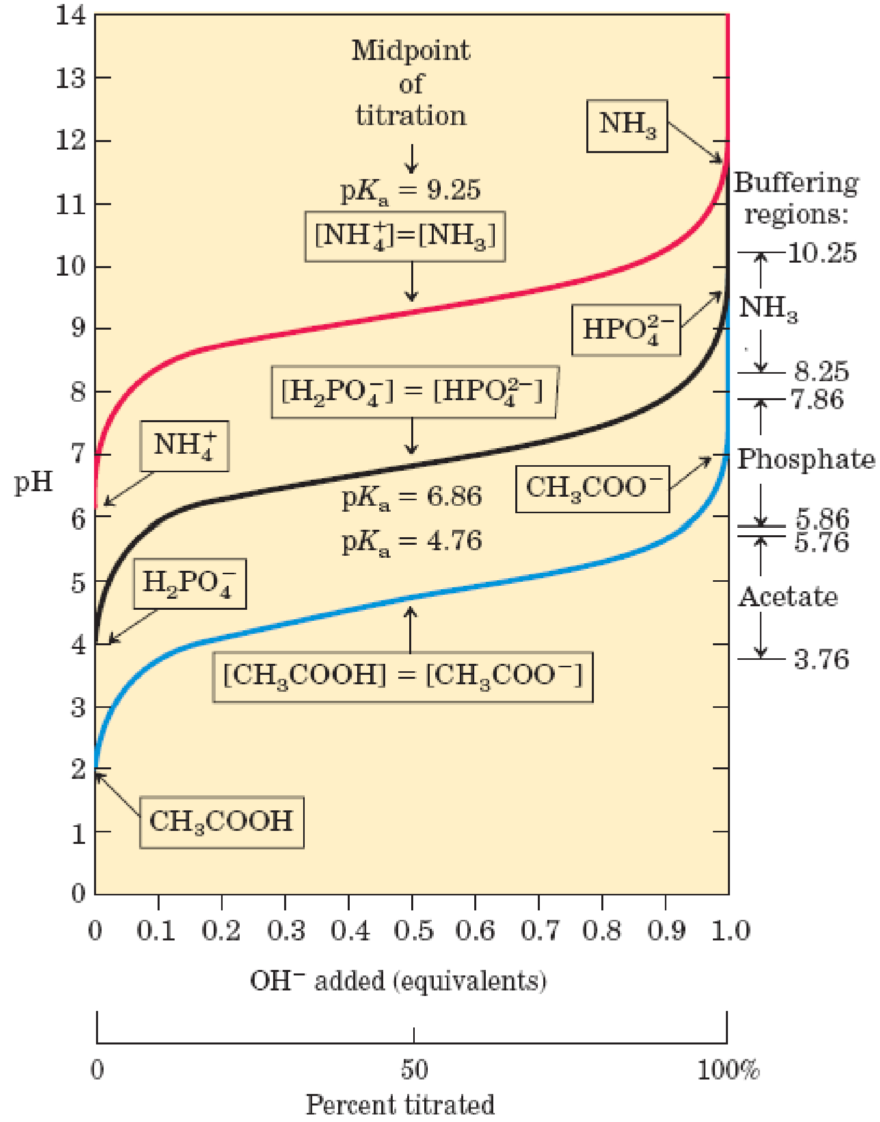
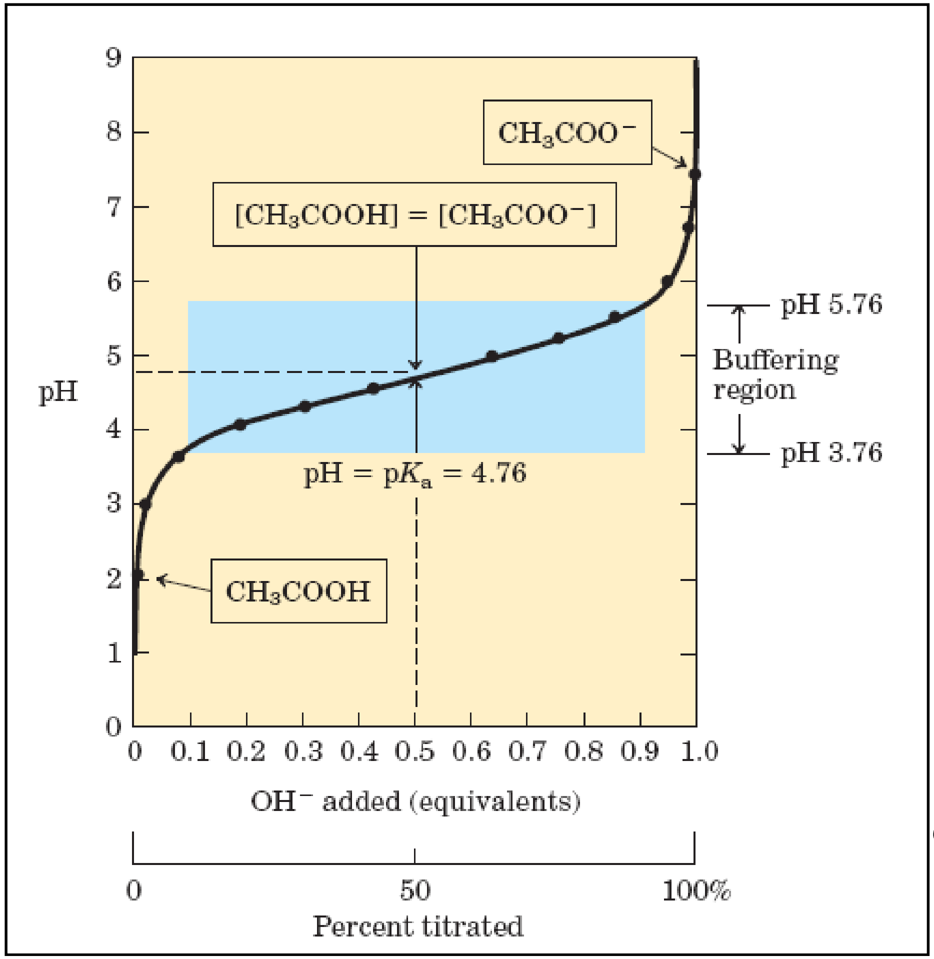
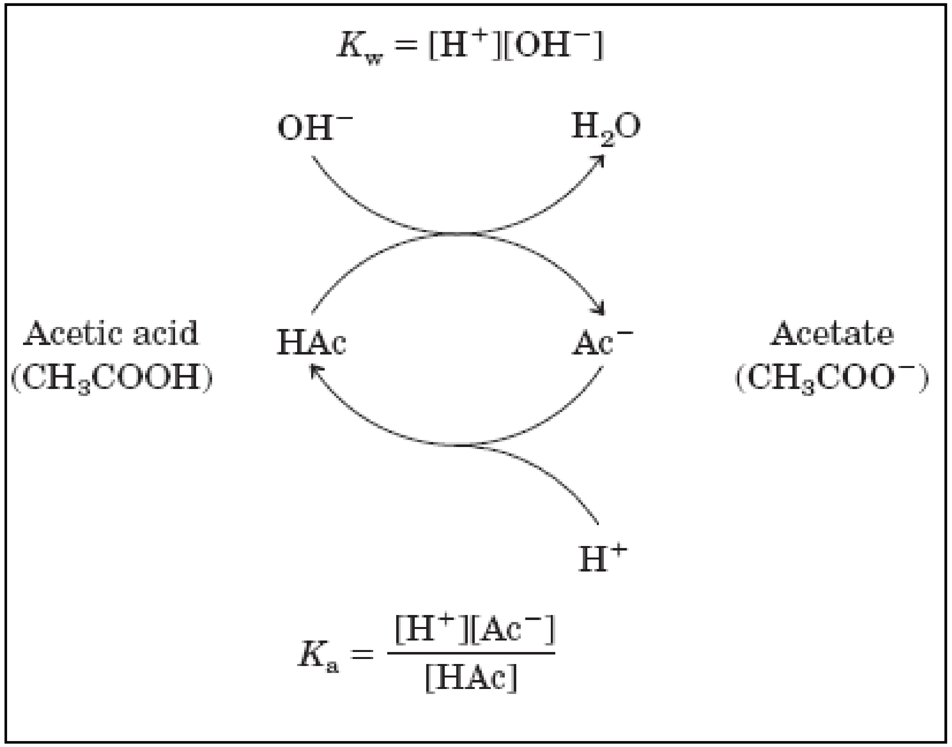


FIGURE 2–18 Comparison of the titration curves of three weak acids. Shown here are the titration curves for CH_3COOH, $H_2PO_4^-$, and NH_4^+. The predominant ionic forms at designated points in the titration are given in boxes. The regions of buffering capacity are indicated at the right. Conjugate acid-base pairs are effective buffers between approximately 10% and 90% neutralization of the proton-donor species.

بافرها

- ❑ سیستم های آبی که تمایل دارند در برابر تغییرات pH مقاومت کنند.
- ❑ مخلوطی از **اسیدهای ضعیف** و **بازهای کونژوگه** آنها هستند.





جفت اسید استیک – استات به عنوان سیستم بافری

Pka ± 1

محدوده بافری

دو بافر بیولوژیک مهم:

- سیستم فسفات (در سیتوپلاسم)

$$H_2PO_4^- \rightleftharpoons H^+ + HPO_4^{2-}$$

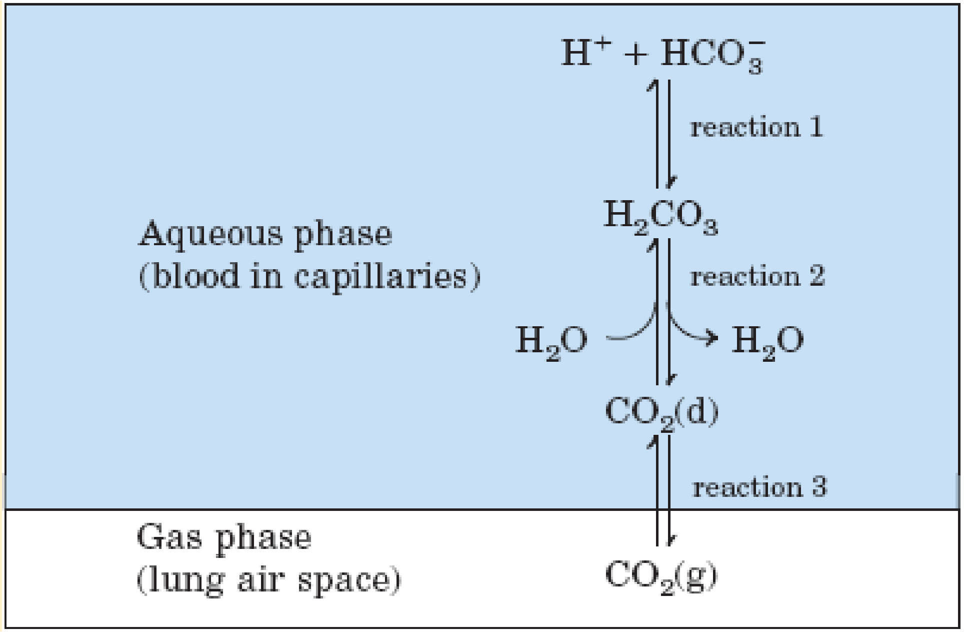
pKa = 6.86

محدوده بافری: 5.86 -7.86

- سیستم بیکربنات (پلاسمای خون)

$$H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$$

pKa = 3.77   ?????



$$H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$$ pK1 = 3.57

$$pH = 7.4 = 3.57 + \log_{10} \frac{[HCO_3^-]}{[H_2CO_3]}$$

$$\frac{[HCO_3^-]}{[H_2CO_3]} = 6761$$

$$CO_2(g) \rightleftharpoons CO_2(d)$$
$$CO_2(d) + H_2O \rightleftharpoons H_2CO_3$$
$$H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$$

$$CO_2(d) + H_2O \overset{K_h}{\rightleftharpoons} H_2CO_3$$

$$H_2CO_3 \overset{K_1}{\rightleftharpoons} H^+ + HCO_3^-$$

$$K_h = \frac{[H_2CO_3]}{[CO_2(d)]}$$

$$[H_2CO_3] = K_h[CO_2(d)]$$

$$K_1 = \frac{[H^+][HCO_3^-]}{[H_2CO_3]} = \frac{[H^+][HCO_3^-]}{K_h[CO_2(d)]}$$

$$K_1K_h = \frac{[H^+][HCO_3^-]}{[CO_2(d)]}$$

$$K_{overall} = (0.000269)(0.003) = 8.07 \times 10^{-7}$$
$$pK_{overall} = 6.1$$

$$pH = pK_{overall} + \log_{10} \frac{[HCO_3^-]}{[CO_2(d)]}$$

pH 7.4
[CO2] = 1.2 mM
[HCO3-] = 24 mM