

Acid-Base Math Problems

NORMAL VALUES:

pH: 7.40

apparent pK_a for carbonic acid-bicarbonate buffer): 6.10

a for CO_2 at body temperature: $\frac{0.03 \text{ mmols}}{L * \text{ torr}}$

P_{CO_2} (in systemic arterial plasma): 40 mmHg

1. What must be the ratio of bicarbonate to dissolved CO_2 at the regulated pH value of 7.4?
2. What is the [bicarbonate] at normal pH and acid-base balance?
3. Exercise – hold P_{CO_2} constant and vary [bicarbonate] to calculate pH for an isopleth. This is most easily done on an excel worksheet. Give it a try – if you are good at excel it won't take more than a minute or so.

Also be able to ID various acid base disturbances and compensation pathways as we discussed them in class.

ANS:

1. $pH = pK_a + \log [\text{bicarbonate}]/\text{dissolved } \text{CO}_2)$

let $x = [\text{bicarbonate}]/\text{dissolved } \text{CO}_2$

$$7.4 = 6.1 + \log x$$

$$\log x = 1.3$$

$$10^{\log x} = 10^{1.3}$$

$$x = 19.95 \approx 20:1$$

2. Proceeding by substitution from the previous result:

$$x = [\text{bicarbonate}]/\text{dissolved } \text{CO}_2 = 19.95$$

$$[\text{bicarbonate}]/(40 \text{ torr} * \frac{0.03 \text{ mmols}}{L * \text{ torr}}) = 19.95$$

$$[\text{bicarbonate}] = 19.95 * 40 * 0.03 \text{ mols} * L^{-1} = 23.94 = 24 \text{ mM}$$