

Royal Bicarbonate Pains

(The show, *Royal Pains*, is currently available on Peacock or IMDb for free, or Amazon Prime for subscribers)

The K_h for the reaction of water and carbon dioxide at $37^\circ\text{C} = 3.00 \times 10^{-3}$

The K_a for carbonic acid (H_2CO_3) at $37^\circ\text{C} = 2.7 \times 10^{-4}$

Use these values to derive one equation for all of the equilibria. Use that equation to do the following problems that involve *Royal Pains* patients.



- A. While on a routine visit to check on a patient's elbow before her big tennis match, Dr. Hank Lawson discovers the patient's father lying unconscious in the foyer. (The butler was out polishing the Lambergini.) This 67 year old, 70 kg male was then rushed to the ER and Dr. Lawson orders blood gases and blood pH. The results of the tests indicate that the patient has metabolic acidosis and will most probably miss his daughter's tennis match.

Normal values

pH = 7.4 $\text{CO}_2 = 1.2 \text{ mM}$ $\text{HCO}_3^- = 24 \text{ mM}$

Patient

$\text{CO}_2 = 1.1 \text{ mM}$ pH = 6.8

Dr. Lawson can not remember a thing from his Biochemistry class, so now you need to help him save his patient!

1. Determine the amount of bicarbonate in the patient's blood.
2. How much bicarbonate (it is packaged in 50 mL ampules that contain 1 mEq/mL) should be given to this pt (pt = patient) to restore his bicarbonate levels? (The total blood volume of a 70 kg male is 5.6L.)
3. Why is bicarbonate so important?

B. It's a busy day in the ER, and Dr. Lawson is needed to help out, so he is detained from attending the tennis match as well. The next patient was a 21 year old, 65kg male in a coma who was breathing very slowly with episodes of apnea. His friends ditched him at the door and then sped off in a cobalt blue Maserati, Their erratic behavior was noted by the door guard. All signs pointed to a narcotic overdose. Dr. Lawson ordered CO_2 levels and blood pH. The results indicate that the pt has respiratory acidosis.

Pt values: pH = 7.22 $\text{CO}_2 = 2.0 \text{ mM}$

Dr. Lawson was about give the order to inject the pt with bicarbonate when Dr. Divya Katdare popped in to save the day.

1. What is the pt's HCO_3^- level?
2. What would be a better treatment for this patient?