

Name: _____ Period: _____ Date: _____

Ms. Randall A & P

Case study: Blood pH

Based on “The Case of the Mortified Mom: Acids, pH and Buffers” by Terry Platt (National Center for Case Study Teaching in Science)

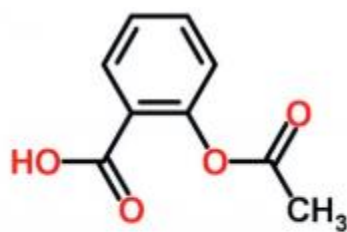
The Patient:

Paramedics were called to the home of the Mathews family because their 3-year old daughter, Molly, had gotten into the medicine cabinet and consumed a large number of aspirin tablets. She didn't know how many tablets of aspirin Molly had consumed, but had recently read that a fatal dose for a child could be as little as 3 gm (10 300-mg tablets). When the paramedics arrived Molly had vomited several times, with bits of undissolved tablets visible, but seemed sleepy, almost lethargic. She was rushed to the nearest Emergency Room. When she reached the hospital she was unarousable and was breathing rapidly and deeply. She was examined and lab samples were obtained. They revealed a pH of 6.8 and a plasma salicylate level of 100 mg/dL, together with a number of other electrolyte abnormalities. He hadn't seen a pH that low for some time. It certainly explained Molly's rapid and deep respiration.

The nurse started to administer activated charcoal through a nasogastric tube to absorb any residual aspirin in Molly's stomach and prevent its entry into the bloodstream.

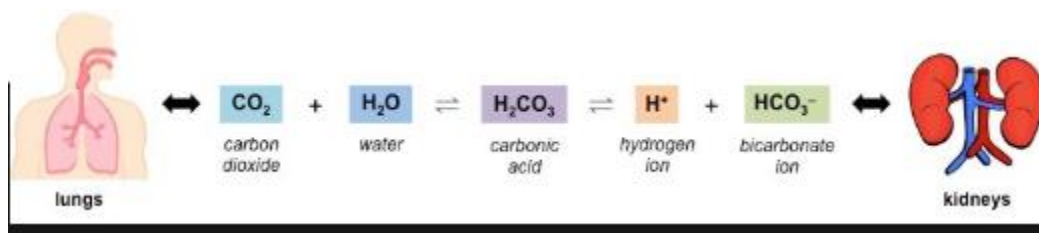
The physician on duty, Dr. Pedro Martinez, intubated Molly's trachea for airway protection and carried out hyperventilation, which he said was “to avoid hypoventilation and a worsening of her metabolic acidosis.”

Aspirin was originally a trademark for acetosalicylic acid, which can inhibit a pathway, leading to inflammation, but it is also a weak organic acid. That means at high levels it can lower the pH of your blood from its normal value of about 7.4—and any level below about 7 begins to be dangerous.



Aspirin
Molecular Formula: $C_9H_8O_4$
Average mass: 180.157 g/mol
Chemical name: 2-(acetyloxy) benzoic acid

Blood pH is maintained by the carbonic acid/bicarbonate system, which utilizes the following formula:



Questions:

1. Under normal conditions the carbonic acid/bicarbonate system functions to:
 - a) Maintain blood pH near physiological pH.
 - b) Remove excessive H^+ generated during metabolism.
 - c) Transport CO_2 from the tissues to the lungs for exhalation.
 - d) All of the above.
2. Why is Molly breathing so rapidly and deeply when she arrives at the Emergency Room, despite being nearly comatose?
 - a) aspirin has inhibited her ability to use oxygen effectively.
 - b) Her body is trying to rid itself of CO_2 .
 - c) She is out of breath from all she has been through.
 - d) Her hemoglobin can't deliver oxygen at low pH.

3. The physician intubated Molly's trachea and carried out hyperventilation, which he explained to the family was "to avoid hypoventilation and a worsening of her metabolic acidosis." They also administered activated charcoal through a nasogastric tube and IV bicarbonate.

What is the purpose of the activated charcoal?

- a) Absorb the residual aspirin to prevent it from entering her bloodstream.
 - b) Increase the rate of absorption of the aspirin to shorten the duration of the overdose.
 - c) Increase the pH of the stomach.
 - d) Settle her stomach after the vomiting.
4. What effect would the IV bicarbonate have on the carbonic acid/bicarbonate reaction above?
 - a) Shift it to the left and increase the pH
 - b) Shift it to the right and decrease the pH
 - c) Settle it closer to equilibrium.
 - d) No effect.
5. A few hours later Molly was breathing more regularly and her blood pH was returning to normal. What would be the consequence(s) of lower than normal blood pH?
 - a) Cause proteins to denature
 - b) Decrease in enzyme activities
 - c) Limit hemoglobin's ability to transport oxygen
 - d) All of the above