Acid-Base Equilibrium
BUFFERS

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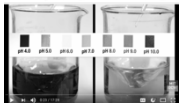
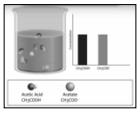
BUFFERS
Weak Acid-Weak Base Systems
Example:

$H_2CO_3(aq)$ / $HCO_3^{-1}(aq)$ / $CO_3^{-2}(aq)$

$CO_2(g) + H_2O\ (l) \leftrightarrows HCO_3^{-1}(aq) + H^{+1}(aq) \leftrightarrows CO_3^{-2}(aq) + H^{+1}(aq)$



https://www.youtube.com/watch?v=XR_0k8JIawY



https://www.youtube.com/watch?v=ZLKEjXbCU30

QUESTION

In the following equilibrium:

$HCO_3^-(aq) + H_2O\ (l) \leftrightarrows H_2CO_3\ (aq) + OH^-(aq)$

A) HCO_3^- is an acid and H_2CO_3 is its conjugate base.
B) H_2O is an acid and OH^- is its conjugate base.
C) HCO_3^- is an acid and OH^- is its conjugate base.
D) H_2O is an acid and H_2CO_3 is its conjugate base.
E) H_2O is an acid and HCO_3^- is its conjugate base.

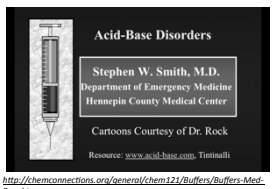
$H_2CO_3(aq)$ / $HCO_3^{-1}(aq)$ / $CO_3^{-2}(aq)$

Two VERY IMPORTANT Buffer Systems
"Bicarbonate"

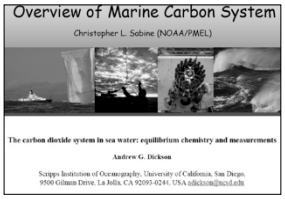
$CO_2(g) + H_2O\ (l) \leftrightarrows HCO_3^{-1}(aq) + H^{+1}(aq) \leftrightarrows CO_3^{-2}(aq) + H^{+1}(aq)$

1. ***Blood:*** *a human's blood serum volume is relatively small, 4-6 Liters with a narrow pH range, pH = 7.35 – 7.45; pH is maintained through buffering (homeostasis)*
   Have you ever had respiratory alkalosis during an exam?
2. ***Oceans:*** *an extraordinarily large volume of a "salt water" solution with a pH ~ 8.1; maintained through buffering*

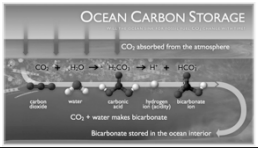
Human & Oceanic Bicarbonate Buffer Systems



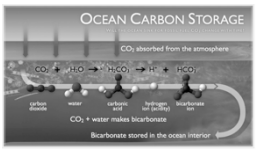
http://chemconnections.org/general/chem121/Buffers/Buffers-Med-Pres.htm



http://chemconnections.org/general/chem121/Buffers/Buffers-CO2-Oceans-2011.htm



EQUILIBRIUM
CO_2 & Oceanic Bicarbonate Buffering



$CO_2(g) + H_2O\ (l) \leftrightarrows HCO_3^{-1}(aq) + H^{+1}(aq) \leftrightarrows CO_3^{-2}(aq) + H^{+1}(aq)$

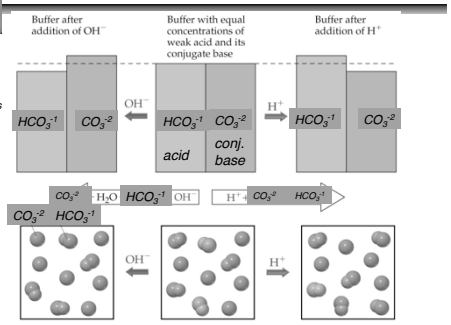
Oceans: *pH ~ 8.1 and falling*
http://www.tos.org/oceanography/issues/issue_archive/22_4.html
Increasing CO_2 is decreasing ocean pH; long term effects?
http://sos.noaa.gov/datasets/Ocean/ocean_acidification.html

Bicarbonate Buffer Systems

Which is the buffer?

One is bicarbonate buffer to pH ≈ 8 - 9.
One is water plus sodium hydroxide, pH ≈ 8 - 9.

Volunteers to experiment and find out which is which?



Energy → *Global Warming*

(Carbon) ***(CO_2)***

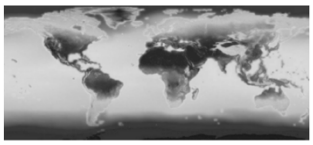
(Carbon) ***(CO_2)***

Economy (Jobs)

Your Future?

Global Warming & Your Carbon Footprint

http://chemconnections.org/general/chem108/Global%20Warming%20Bonus.html



The United Nations' Nobel Prize winning International Panel on Climate Change (IPCC: http://www.ipcc.ch/) of more than 1,000 scientists have concluded that "Human influence on the climate system is clear, and recent anthropogenic (man made) emissions of greenhouse gases are the highest in history, The atmospheric concentration of key greenhouse gases — carbon dioxide, methane, and nitrous oxide — is unprecedented in at least the last 800,000 years, and our fossil-fuel driven economies and (mankind's) ever-increasing population are to blame."