

Chem 106: Class/ Lab

Week 13

Pick a vial

Using the vial number, sign-in on the Lab roster

TODAY:

- 1) Fluid Exchange
- 2) Acid-Base Equilibrium Experiment
- 3) Global Warming Capstone Writing Assignment (INTRODUCTION)

Turn in Completed Global Warming Scantron









Chem 106: Class/ Lab

Week 12

Follow Instructions

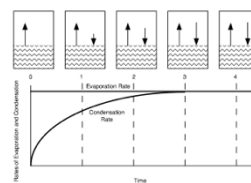
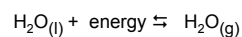
<http://chemconnections.org/general/chem120/fluid-ex.106.html>

Acid-Base Indicators

| | pH range for color change | | | | | | | | | | | | | |
|-------------------|---------------------------|---|-----|---|--------|---|---|---|------|------|--|--|--|--|
| | 0 | 2 | 4 | 6 | 8 | 10 | 12 | 14 | | | | | | |
| Methyl violet | Yellow |  | | Violet | | | | | | | | | | |
| Thymol blue | Red |  | | Yellow | | Yellow | |  | | Blue | | | | |
| Methyl orange | | | Red |  | | Yellow | | | | | | | | |
| Methyl red | | | Red |  | | Yellow | | | | | | | | |
| Bromthymol blue | | | | | Yellow |  | | Blue | | | | | | |
| Phenolphthalein | | | | | | Colorless |  | | Pink | | | | | |
| Alizarin yellow R | | | | | | | Yellow |  | | Red | | | | |

What is equilibrium?

Water evaporates, and Water is an Acid & a Base



Equilibrium & Currency Exchange Rates



The US \$ is the current common global currency

The cost of a McDonald's Big Mac in US \$, country by country, provides a basis for the relative global market equilibrium value of the local currency

The "Big Mac Index" was introduced by the Economist magazine in September 1986 by Pam Woodall and is published annually

Currently, US \$20 would only buy 3 Big Macs in Geneva, Switzerland, but 9 in Moscow, Russia

Geneva \rightleftharpoons US \rightleftharpoons Moscow

Water is neutral

It is an Acid and a Base



What is equilibrium?

Reactants \rightleftharpoons Products

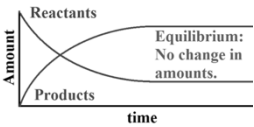
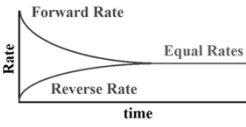
| EXPERIMENT #1 | | | | EXPERIMENT #2 | | | |
|---------------|-----------------|----------------|--|---------------|-----------------|----------------|--|
| TIME | Amount Reactant | Amount Product | | TIME | Amount Reactant | Amount Product | |
| 1 | 100 | 0 | | 1 | 100 | 0 | |
| 2 | 75 | 25 | | 2 | 10 | 90 | |
| 3 | 59 | 41 | | 3 | 16 | 84 | |
| 4 | 48 | 52 | | 4 | 20 | 80 | |
| 5 | 41 | 59 | | 5 | 22 | 78 | |
| 6 | 37 | 63 | | 6 | 24 | 76 | |
| 7 | 34 | 66 | | 7 | 25 | 75 | |
| 8 | 32 | 68 | | 8 | 26 | 74 | |
| 9 | 31 | 69 | | 9 | 27 | 73 | |
| 10 | 30 | 70 | | 10 | 28 | 72 | |
| 11 | 29 | 71 | | 11 | 29 | 71 | |
| 12 | 29 | 71 | | 12 | 29 | 71 | |
| 13 | 29 | 71 | | 13 | 29 | 71 | |

Water is neutral
It is an Acid and a Base

$$\text{H}_2\text{O}(l) + \text{H}_2\text{O}(l) \rightleftharpoons \text{H}_3\text{O}^+(aq) + \text{OH}^-(aq)$$

What is equilibrium?

Reactants \rightleftharpoons Products

("Equilibrium Constant") $K = [\text{Products}] / [\text{Reactants}]$

Water is neutral
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("Equilibrium Constant") $K = [\text{Products}] / [\text{Reactants}]$

Reactants \rightleftharpoons Products

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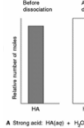
$K = [71][29] / K = 2.4$

Water is neutral
It is an Acid and a Base

$$\text{H}_2\text{O}(l) + \text{H}_2\text{O}(l) \rightleftharpoons \text{H}_3\text{O}^+(aq) + \text{OH}^-(aq)$$

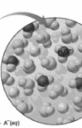
What is equilibrium?

Before dissociation



1.0 M HCl solution
 $K = [\text{Products}] / [\text{Reactants}]$
 $K = 1.0 \div 0 = \infty$

After dissociation



1.0 M HOAc (vinegar) solution
 $K = [\text{Products}] / [\text{Reactants}]$
 $K \approx 10^{-5}$

A Strong acid: $\text{HCl}(aq) + \text{H}_2\text{O}(l) \rightarrow \text{H}_3\text{O}^+(aq) + \text{Cl}^-(aq)$
B Weak acid: $\text{HOAc}(aq) + \text{H}_2\text{O}(l) \rightleftharpoons \text{H}_3\text{O}^+(aq) + \text{Ac}^-(aq)$

Water is neutral
It is an Acid and a Base

$$\text{H}_2\text{O}(l) + \text{H}_2\text{O}(l) \rightleftharpoons \text{H}_3\text{O}^+(aq) + \text{OH}^-(aq)$$

What is equilibrium?

$\text{H}_2\text{O} + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{OH}^-$
 conj conj
 acid 1 base 2 acid 2 base 1

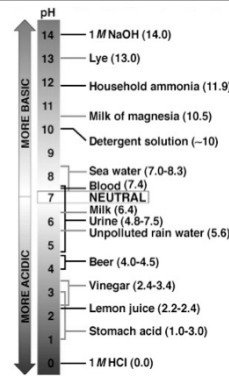
$K_w = 1 \times 10^{-14}$ at 25°C

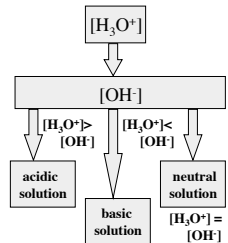
$K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = [1 \times 10^{-7}\text{M}][1 \times 10^{-7}\text{M}]$

The Relations Among $[\text{H}_3\text{O}^+]$, pH, $[\text{OH}^-]$, and pOH

| | $[\text{H}_3\text{O}^+]$ | pH | $[\text{OH}^-]$ | pOH |
|---------|--------------------------|-------|-----------------------|-------|
| BASIC | 1.0×10^{-15} | 15.00 | 1.0×10^1 | -1.00 |
| | 1.0×10^{-14} | 14.00 | 1.0×10^0 | 0.00 |
| | 1.0×10^{-13} | 13.00 | 1.0×10^{-1} | 1.00 |
| | 1.0×10^{-12} | 12.00 | 1.0×10^{-2} | 2.00 |
| | 1.0×10^{-11} | 11.00 | 1.0×10^{-3} | 3.00 |
| | 1.0×10^{-10} | 10.00 | 1.0×10^{-4} | 4.00 |
| | 1.0×10^{-9} | 9.00 | 1.0×10^{-5} | 5.00 |
| NEUTRAL | 1.0×10^{-8} | 8.00 | 1.0×10^{-6} | 6.00 |
| | 1.0×10^{-7} | 7.00 | 1.0×10^{-7} | 7.00 |
| ACIDIC | 1.0×10^{-6} | 6.00 | 1.0×10^{-8} | 8.00 |
| | 1.0×10^{-5} | 5.00 | 1.0×10^{-9} | 9.00 |
| | 1.0×10^{-4} | 4.00 | 1.0×10^{-10} | 10.00 |
| | 1.0×10^{-3} | 3.00 | 1.0×10^{-11} | 11.00 |
| | 1.0×10^{-2} | 2.00 | 1.0×10^{-12} | 12.00 |
| | 1.0×10^{-1} | 1.00 | 1.0×10^{-13} | 13.00 |
| | 1.0×10^0 | 0.00 | 1.0×10^{-14} | 14.00 |
| | 1.0×10^1 | -1.00 | 1.0×10^{-15} | 15.00 |

The pH Values of Some Familiar Aqueous Solutions
(TODAY'S LAB EXPERIMENT)

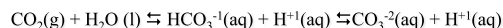




Chem 106: Class Week 12

Today's experiment
Acids-Bases Experiment
(Course/ Lab Manual pp. 79-82)
Due & stamped Today

$\text{H}_2\text{CO}_3(\text{aq}) / \text{HCO}_3^{-1}(\text{aq}) / \text{CO}_3^{-2}(\text{aq})$ Two VERY IMPORTANT Complex Acid-Base: Bicarbonate Buffer Systems



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

Acid-Base Disorders

Stephen W. Smith, M.D.
Department of Emergency Medicine
Hennepin County Medical Center

Cartoons Courtesy of Dr. Rock

Resource: www.acid-base.com/Tintinalli

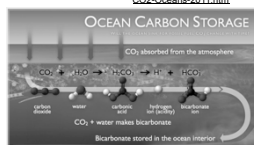
Overview of Marine Carbon System
Christopher L. Sabine (NOAA/PMEL)

The carbon dioxide system in sea water: equilibrium chemistry and measurements

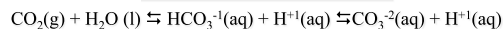
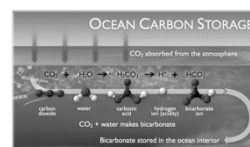
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<http://chemconnections.org/general/chem121/Buffers/Buffer/Wed-Press.htm>

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



EQUILIBRIUM CO₂ & Oceanic Bicarbonate Buffering

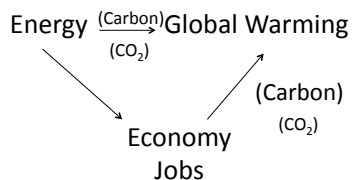


Oceans: pH ~ 8.1 and falling

http://www.tos.org/oceanography/issues/issue_archive/22_4.html

Increasing CO₂ is decreasing ocean pH; long term effects?

http://sos.noaa.gov/datasets/Ocean/ocean_acidification.html



<https://www.co2.earth/>

Global Warming, Your Carbon Footprint & Your Future

SEE:

<http://chemconnections.org/IFTVET-2016/IFVET-Global%20Warming.htm>

<http://chemconnections.org/IFTVET-2016/IFVET-Global%20Warming.htm>

IFTVET
6th International Cooperation Summit Forum
October 21-24, 2016

中国现代职业教育国际合作联合会
International Federation of Technical and Vocational Education & Training

Globalization / Global Warming

Dr. Ron Rusay
罗纳德·卢塞 教授
Diablo Valley College, California USA
美国岱伯洛谷学院
加利福尼亚·美国

Viewing/ Reading / Doing

Student Research & Writing Assignment

<http://chemconnections.org/Global%20Warming/Global%20warming%20&%20Carbon%20Footprint.pdf>

Global Warming, Your Carbon Footprint & Your Future



<http://chemconnections.org/Global%20Warming/>

Sign today's Roster with designation (M1.... etc.) if you are forming an ARC Help Group

Chem 106: Class

Week 13

Turn in Today

1. Titration of Vinegar: Completed Course/ Lab Manual pg. 86) Due Today
2. Post Lab Questions: Aqueous Solutions (Complete Course/ Lab Manual pg. 87) DUE Today
3. Ideal Gas Worksheet (Course/ Lab Manual pg. 60) DUE Today

Acids-Bases Experiment
(Course/ Lab Manual pp. 79-82)
Due & signed Today