# Announcements

Wednesday, May 06, 2009

**Exam 3** is graded but not ready to be handed back. Scores are in D2L. You can pick up your exam after 4pm in the lab today, otherwise it will be returned on Monday. An answer key will be posted by the end of the week.

**Discussion assignment 2** phase 3 post due this Friday, May 8, at noon. Replies due before final exam.

**Ch 14** MC assignment is now available, due before class next Wednesday.

**Extra credit labs**: experiments 11 and 12 in your packet. Do them at home and bring the completed worksheets to the final exam. They are worth up to 5 extra credit points each.

**Comprehensive final exam** is next Wednesday, May 13 from **10 am to noon**. The exam is 50 3-point multiple choice questions. (150 points total).

You are allowed **one handwritten 3x5" note card** (both sides) for the final exam.

Review sessions next Monday at 3pm, Tuesday at 1pm and Wednesday at 8am.

## Acids:



- Sour taste
- Turn litmus **red**
- Normally have H written first in formula (HCl, $HNO_3$, etc.)
- Treated like an ionic compound with $H^+$ / anion$^-$

**Binary acids**: H and one other element

$H^+ / Cl^-$ = HCl — hydrochloric acid

HBr

HI

$H_2S$

(chloride) → hydrochloric acid

**Oxyacids**: H and an oxyanion

$H^+ / NO_3^-$ (nitrate) → $HNO_3$ nitric acid

$H^+ / NO_2^-$ (nitrite) → $HNO_2$ nitrous acid

## Bases:

- Bitter taste
- Turn litmus **blue**

Ionic hydroxides: NaOH, $Ca(OH)_2$, KOH, etc

~~$CH_3OH$~~ alcohol

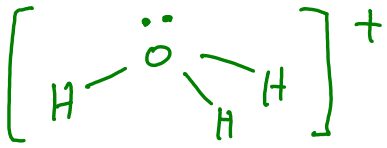
Carbonates: ($CO_3^{2-}$) $Na_2CO_3$, $NaHCO_3$ Sodium bicarbonate (baking soda)

N-containing molecules:

$NH_3$ ammonia

**Acids** create $H_3O^+$ (hydronium) ion in water

hydronium ion structure:



1. Dissociation:

pure molecules $HCl(g) \xrightarrow{H_2O} H^+(aq) + Cl^-(aq)$

H—Cl hydrogen chloride

2. Hydronium ion formation:

$H^+(aq) + H_2O(l) \rightarrow H_3O^+(aq)$ hydronium ion

**Overall**: $HCl + H_2O \rightarrow H_3O^+ + Cl^-$

Every acid produces hydronium ions in water by a similar process:

$HNO_3 + H_2O \rightarrow H_3O^+ + NO_3^-$

$H_2SO_4 + H_2O \rightarrow H_3O^+ + HSO_4^-$

$HSO_4^- + H_2O \rightarrow H_3O^+ + SO_4^{2-}$

**Bases** create $OH^-$ (hydroxide) ion in water:

$NaOH(s) \xrightarrow{H_2O} Na^+(aq) + OH^-(aq)$

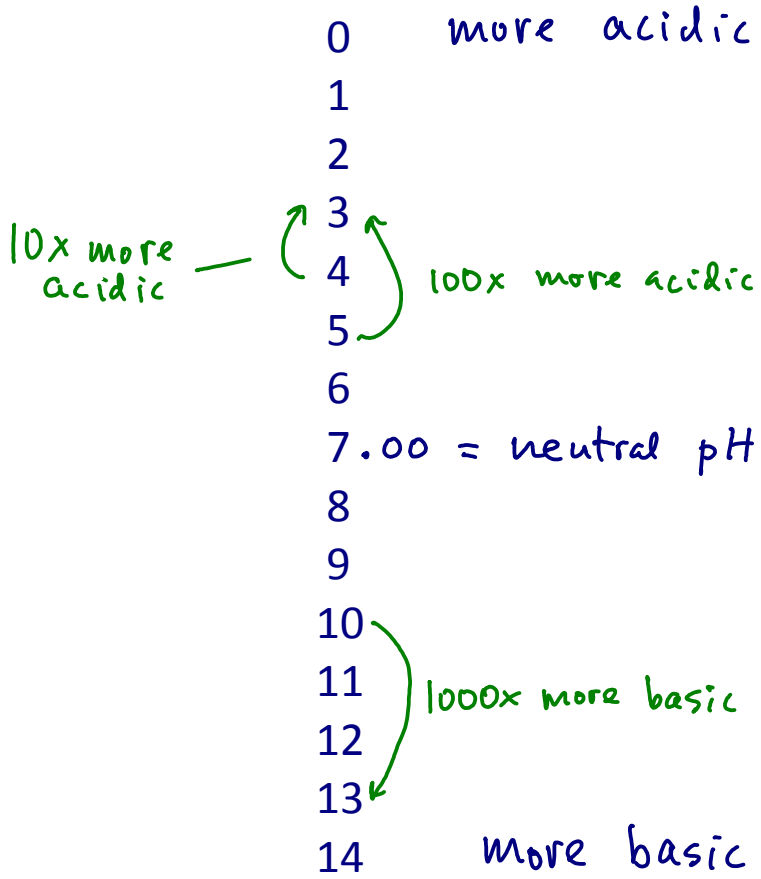
A **strongly acidic** solution has a relatively high concentration of $H_3O^+$.

A **strongly basic** (alkaline) solution has a relatively high concentration of $OH^-$.

A **neutral** solution has equal conc's of $H_3O^+$ and $OH^-$.

A basic solution still has some $H_3O^+$ ions,
but $[OH^-] > [H_3O^+]$ and vice-versa for acidic solutions.
[ ] = molar concentration

The **pH scale** is a 0-14 scale which measures the acidity or basicity of solution.



pH values and calculations

pH = 2 means $[H_3O^+] = 10^{-2}$ *M*

pH = 3 means $[H_3O^+] =$ $10^{-3}$ M

$10^0 = 1$

$10^{-1} = \frac{1}{10} = .1$

$10^{-2} = \frac{1}{100} = .01$

$10^{-3} = \frac{1}{1000} = .001$

Which is **more acidic**, pH = 2 or pH = 3?

$[H_3O^+]$ = .01 M .001 M

If $[H_3O^+] = 10^{-9}$ *M*, then pH = 9

0
1 $[H_3O^+]$
2 → $10^{-2}$ M
3 → $10^{-3}$ M
4
5
6
(neut) 7 → $10^{-7}$ M
8
9 → $10^{-9}$ M
10
11
12
13
14

Logarithms:

log $10^9$ = 9

log $10^2$ = 2

log $10^{-9}$ = −9

-log $10^{-9}$ = 9

.007
.008
.009
.01

$pH = -\log [H_3O^+]$

If $[H_3O^+] = 10^{-6}$ *M*, then pH = -log $10^{-6}$ = 6 (exact)

If $[H_3O^+] = 1.0 \times 10^{-12}$ *M*, pH = 12.00 (2 sf, 2 dp)

Sig figs in concentrations become decimal places in pH

If $[H_3O^+] = 4.2 \times 10^{-12}$ *M*, pH = $-\log(4.2 \times 10^{-12}) \approx 11.38$

Text calculator: (-) LOG 4.2 E (-) 12 = (EE, EXP)

Numerical calculator: 4.2 E 12 +/- LOG +/-

pH calculations

$pH = -\log [H_3O^+]$

If $[H_3O^+] = 2.87 \times 10^{-3}$ *M*, what is pH?

$pH = -\log(2.87 \times 10^{-3}) = 2.542$

(in pH values, the sig figs are after the decimal point)

If pH = 8, $[H_3O^+] =$ $10^{-8}$ M

$[H_3O^+] = 10^{-pH}$

need exact power of 10

If pH = 2.87 (2 dp), $[H_3O^+] = 10^{-2.87} =$ .00135 (2 s.f.) → .0013 M

$= 1.3 \times 10^{-3}$ M

text calculator: shift LOG $10^x$ (-) 2.87 =

numerical calculator: 2.87 +/- shift LOG $10^x$

If pH = 6.43, $[H_3O^+] = 10^{-6.43} =$ $3.7 \times 10^{-7}$ M

(Use MODE or SCI if your calculator gives you 0.00000...)

[$OH^-$] and pOH calculations

If [$OH^-$] = $10^{-4}$ *M*, pOH = 4

pOH = -log [$OH^-$]

[$OH^-$] = $10^{-pOH}$

pH + pOH = 14

pH = 12.23

pOH = 14 − pH

= 1.77

| pH | | pOH |
|---|---|---|
| 0 | acidic | 14 |
| 1 | | 13 |
| 2 | | 12 |
| 3 | | 11 |
| 4 | | 10 |
| 5 | | 9 |
| 6 | | 8 |
| 7 | neut. | 7 |
| 8 | | 6 |
| 9 | | 5 |
| 10 | | 4 |
| 11 | | 3 |
| 12 | | 2 |
| 13 | | 1 |
| 14 | basic | 0 |

[$H_3O^+$] ⇄ pH ⇄ pOH ⇄ [$OH^-$]

If [$OH^-$] = 0.0230 *M*, pOH =

pH =

[$H_3O^+$] =

pH shows this solution is: acidic / basic / neutral