Name: Key
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CHEMISTRY 12
ACID BASES UNIT
Lesson #11
pH and pOH

Important Formula's:

memorize these!

$pH = -\log[H_3O^+]$	$[H_3O^+] = \text{antilog}(-pH)$
$pOH = -\log[OH^-]$	$[OH^-] = \text{antilog}(-pOH)$

NOTE: In Chem 12 all log's will be to a base of 10 !!!!

Example 1. What is the log of 0.01?

$\log(0.01) = -2.0$

Example 2. What is the log of 10^{-7} ?

$\log(10^{-7}) = -7.0$

Example 3. What is the antilog of 4?

$\text{antilog}(4) = 1 \times 10^4$

→ always express "antilogs" in scientific notation.

Example 4. If $[H_3O^+] = 3.94 \times 10^{-4}$ M , what is the pH?

$pH = -\log[H_3O^+] \longrightarrow -\log(3.94 \times 10^{-4}) = 3.405$

NOTE: Significant Figures in LOG VALUES only the decimal place of a log value is significant

∴ pH = 3.405 = (3) pOH = 10.4 = (1)

Example 5. If $[OH^-] = 9.5 \times 10^{-12}$ M, what is the pOH?

$pOH = -\log[OH^-] \longrightarrow -\log(9.5 \times 10^{-12}) = 11.02$

Example 6. If pH = 3.405, what is the [H_3O^+] ?

$[H_3O^+] = \text{antilog}(-pH) \longrightarrow \text{antilog}(-3.405)$

$[H_3O^+] = \boxed{3.94 \times 10^{-4}}$

Example 7. If pOH = 11.02, what is the [OH^-] ?

$[OH^-] = \text{antilog}(-pOH) \longrightarrow \text{antilog}(-11.02)$

$[OH^-] = \boxed{9.5 \times 10^{-12}}$

LOG LAW: **Log (A x B) = log (A) + Log (B)**

Recall: Kw--> 1.00 x 10^{-14} = [H_3O^+] [OH^-]

Therefore: $\log(1.00 \times 10^{-14}) = \log([H_3O^+][OH^-])$

$(-14.000 = \log[H_3O^+] + \log[OH^-])\ *-1$

$14.000 = -\log[H_3O^+] + -\log[OH^-]$

$\longrightarrow 14.000 = pH + pOH$ or $pKw = pH + pOH$

Example 8. If pH = 9.355, what is the pOH?

$14.000 = pH + pOH \longrightarrow pOH = 14.000 - 9.355$

$\boxed{pOH = 4.645}$

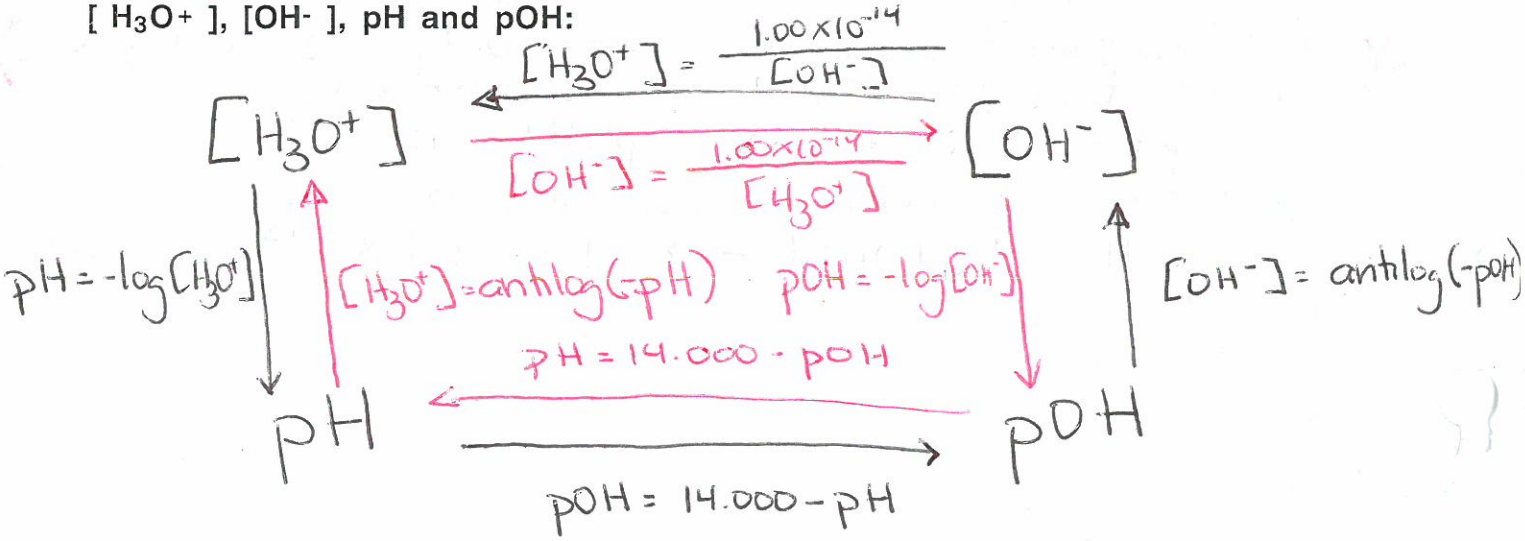
Example 9. If pOH = 2.35, what is the pH?

$14.000 = pH + pOH \longrightarrow pH = 14.000 - pOH$

$= 14.000 - 2.35$

$\boxed{pH = 11.65}$

Use the following diagram to work back and forth between [H_3O^+], [OH^-], pH and pOH:



Example 10. If pH = 6.330, what is the [OH⁻]?

Route #1: pH → pOH → $[OH^-]$

$pOH = 14.000 - 6.330 = 7.670$

$[OH^-] = \text{antilog}(-pOH) \rightarrow \text{antilog}(-7.670) = \boxed{2.14 \times 10^{-8}\ M}$

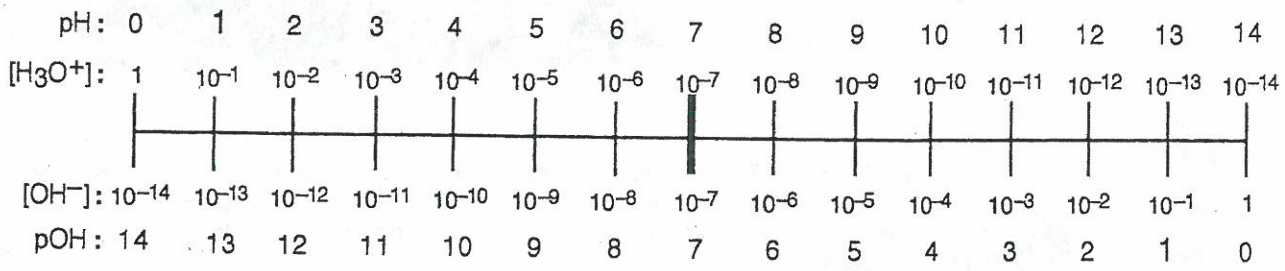
Route #2: pH → $[H_3O^+]$ → $[OH^-]$

$[H_3O^+] = \text{antilog}(-6.330) \approx 4.68 \times 10^{-7}\ M$

$[OH^-] = \dfrac{1.00 \times 10^{-14}}{4.68 \times 10^{-7}} = \boxed{2.14 \times 10^{-8}\ M}$

The pH SCALE :

The relationships between $[H_3O^+]$, $[OH^-]$, pH and pOH are shown on the following diagram.



You should note the following about the diagram.

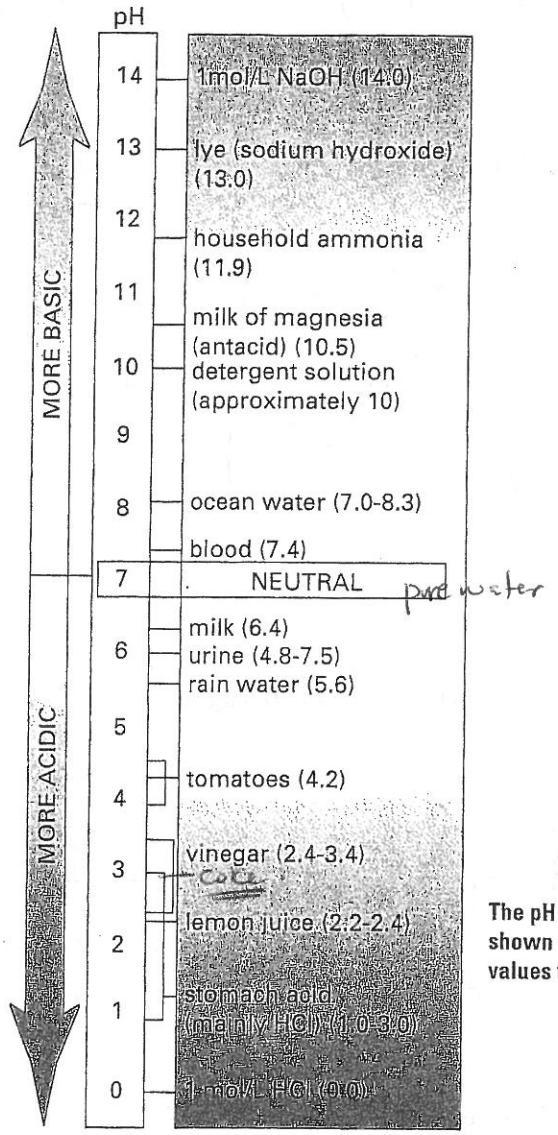
a) The pH scale INCREASES as the pOH scale DECREASES.

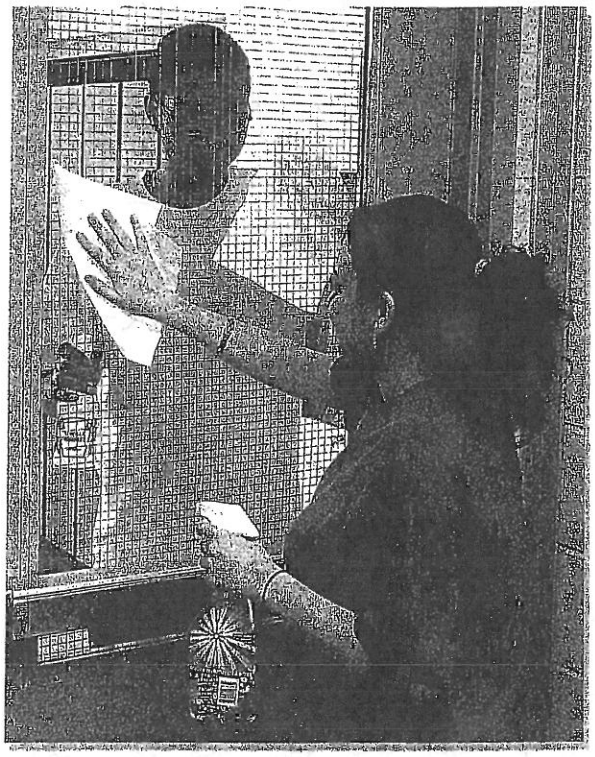
b) A solution is ACIDIC when its pH is LESS THAN 7; a solution is BASIC when its pOH is LESS THAN 7. Conversely, a solution is BASIC when its pH is GREATER THAN 7; a solution is ACIDIC when its pOH is GREATER THAN 7. A NEUTRAL solution has pH = pOH = 7.

c) At any point along the horizontal scale it is found, as expected, that $pH + pOH = 14$ and $[H_3O^+][OH^-] = 10^{-14}$.

d) While it is possible for pH to have a value of –1 or 15, say, the pH scale is meant for use in the range 0 to 14. A pH of –1.00 is better handled in terms of its molar concentration: $[H_3O^+] = 10\ M$.

The pH Scale with Common Household Substances





The pH values of many common solutions fall within a range from 0 to 14, as shown on this pH scale. The table above the pH scale relates the positive pH values to their hydronium ion concentrations and their logarithms.

Seatwork/Homework: Exercises 47-57 in Hebden
PLO's: L8-L12