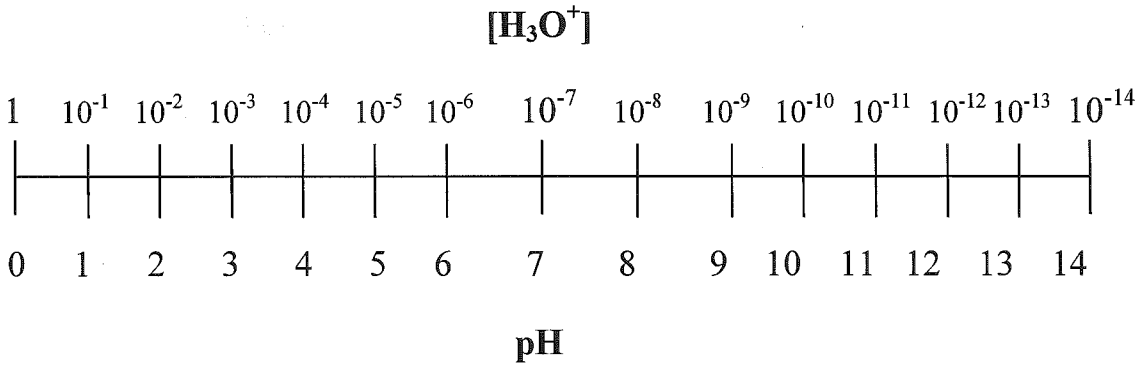
8. pH, pOH and pK Values

a) The pH Scale

i) A logarithmic scale showing strength of acids and bases.



ii) Every decrease in pH of 1 = Increase in $[H_3O^+]$ by 10

b) What is pH?

i) Measure of $[H_3O^+]$ present in a solution

ii) Solution is acidic when pH less than 7

iii) **$pH = -\log[H_3O^+]$**

iv) What is pH when the $[H_3O^+] = 1.2 \times 10^{-3}$ M?

$pH = -\log(1.2 \times 10^{-3}) =$ **2.92**

v) What is pH when the $[H_3O^+] = 4.8 \times 10^{-8}$ M?

$pH = -\log(4.8 \times 10^{-8}) =$ **7.32**

vi) What is the $[H_3O^+]$ when the pH is 2.55?

$[H_3O^+] = 10^{-2.55}$ *or* $[H_3O^+] = \text{antilog}(-2.55) =$ **2.8×10^{-3} M**

vii) What is the $[H_3O^+]$ when the pH is 9.70?

$[H_3O^+] = 10^{-9.70} =$ **2.0×10^{-10} M**

c) What is pOH?

i) Measure of $[OH^-]$ present in a solution

ii) Solution is basic when pOH less than 7 *(pH greater than 7)*

iii) **$pOH = -\log[OH^-]$**

iv) What is pOH when the $[OH^-] = 1.5 \times 10^{-1}$ M?

$pOH = -\log(1.5 \times 10^{-1}) = 0.82$

v) What is pOH when the $[OH^-] = 4.4 \times 10^{-4}$ M?

$pOH = -\log(4.4 \times 10^{-4}) = 3.36$

vi) What is the $[OH^-]$ when the pOH is 12.65?

$[OH^-] = 10^{-12.65} = 2.2 \times 10^{-13}$ M

vii) What is the $[OH^-]$ when the pOH is 1.70?

$[OH^-] = 10^{-1.70} = 2.0 \times 10^{-2}$ M

d) Relationship Between pH and pOH

i) **$pH + pOH = 14$**

ii) What is the pH of a solution if the pOH is 10.2?

$pH = 14 - 10.2 =$ **3.8**

iii) What is the $[OH^-]$ if the pH is 3.25?

$pOH = 14 - 3.25 = 10.75$ $\quad [OH^-] = 10^{-10.75} =$ **1.8×10^{-11} M**

iv) What is the pOH if the $[H_3O^+] = 1.7 \times 10^{-4}$ M?

$pH = -\log(1.7 \times 10^{-4}) = 3.78$ $\quad pOH = 14 - 3.78 =$ **10.22**

v) What is the $[H_3O^+]$ if the $[OH^-] = 3.50 \times 10^{-5}$ M

$pOH = -\log(3.50 \times 10^{-5}) = 4.456$

$pH = 14 - 4.456 = 9.544$

$[H_3O^+] = 10^{-9.544} =$ **2.86×10^{-10} M**

or

$[H_3O^+][OH^-] = Kw$

$$[H_3O^+] = \frac{1.00 \times 10^{-14}}{3.50 \times 10^{-5}} =$$ **2.86×10^{-10} M**

e) pK Values

i) pK values are just for convenience!

ii) Observe the Pattern!

$pH = -\log[H_3O^+]$ $\quad 6 = -\log[1.00 \times 10^{-6}]$

$pKw = -\log[Kw]$ $\quad 14 = -\log[1.00 \times 10^{-14}]$

ii) **$pKw = 14$** *($pH + pOH = 14$ or $pH + pOH = pKw$)*

iii) Observe the Pattern!

$pKa = -\log[Ka]$ $\quad 2.12 = -\log[7.5 \times 10^{-3}]$

$pKb = -\log[Kb]$ $\quad 4.74 = -\log[1.8 \times 10^{-5}]$

iv) **$pKa + pKb = pKw$**

f) Significant Figures

i) In a pH (or pOH) value, only the numbers after the decimal are significant

ii) Example:

pH = 2.465 has 3 sig. figs. The "2" give the power of 10….not significant.

iii) Example:

pH = 10.25 has 2 sig. figs.

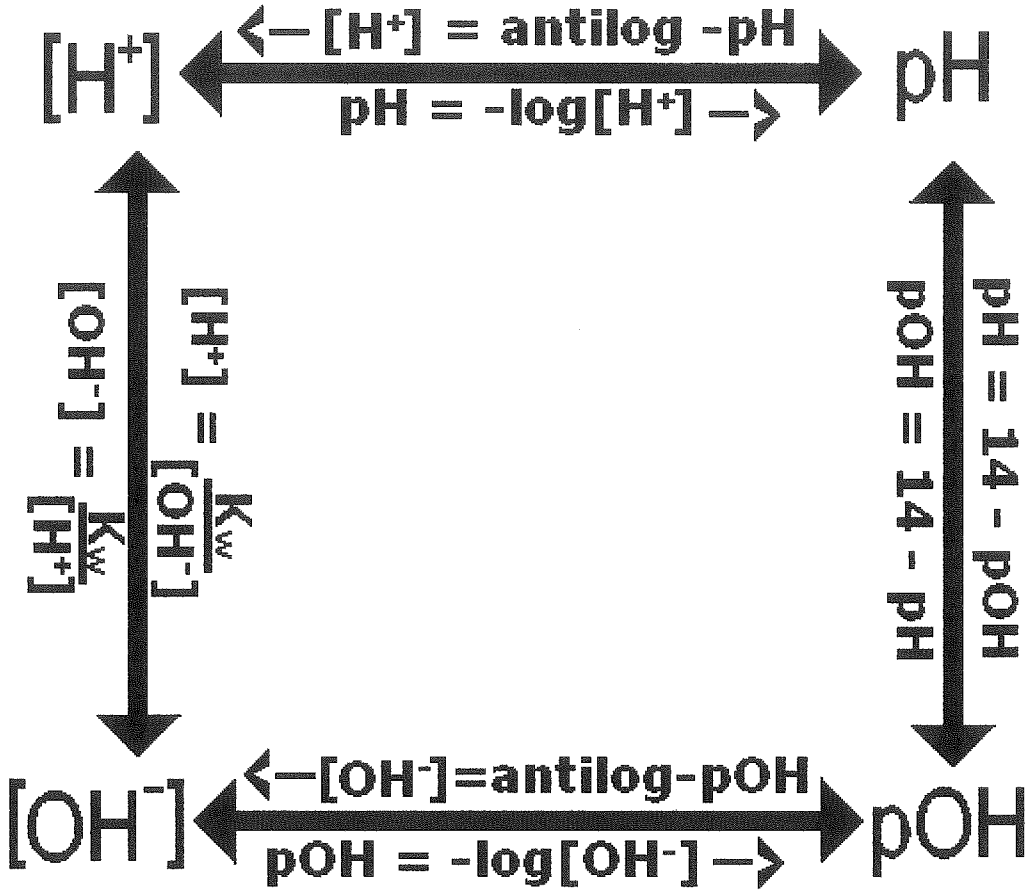
iv) Example: $[H_3O^+] = 1.24 \times 10^{-3}$ M. What is pH?

$pH = -\log(1.24 \times 10^{-3}) = 2.907$

v) Example: $[H_3O^+] = 1.762 \times 10^{-6}$ M. What is pH?

$pH = -\log(1.762 \times 10^{-6}) = 5.7540$

Do Questions: #47 page 134; #48 page 135; #49-57 page 139-141


[H+]
pH
← [H+] = antilog -pH
pH = -log[H+] →
[OH-] = Kw / [H+]
[H+] = Kw / [OH-]
pH = 14 - pOH
pOH = 14 - pH
[OH-]
pOH
←[OH-]=antilog-pOH
pOH = -log[OH-] →