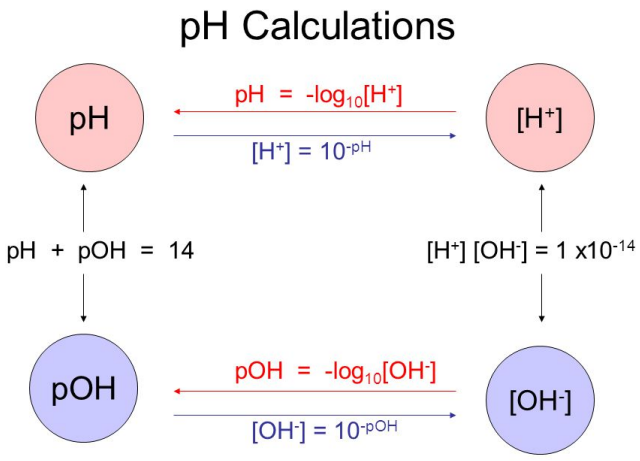
HW 15-4: -Chem Honors
pH Calculations

Name Answer Key
Period_____ **Date**_____



On reference Chart B:

$K_w = [H_3O^+]\,[OH^-] = 1.00 \times 10^{-14}$

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

$pOH = -\log [OH^-]$; $[OH^-] = 10^{-pOH}$

$pH + pOH = 14.00$

1) Fill out this chart for each of the solutions given.

Solution	$[H_3O^+]$	$[OH^-]$	pH	pOH	Acidic, Basic or Neutral
A	1.0×10^{-3} M	1.0×10^{-11} M	3.00	11.00	acidic
B	6.9×10^{-10} M	1.4×10^{-5} M	9.16	4.84	basic
C	1.0×10^{-7} M	1.0×10^{-7} M	7.00	7.00	neutral
D	5.6×10^{-3} M	1.8×10^{-12} M	2.26	11.74	acidic
E	1.0×10^{-6} M	1.0×10^{-8} M	6.00	8.00	acidic
F	3.7×10^{-10} M	2.7×10^{-5} M	9.43	4.57	basic

2) Determine the $[H_3O^+]$ and $[OH^-]$ for each of the following: *Show any needed calculations.*

a) 0.03M HCl: *strong acid dissociates 100%*

$[H_3O^+] = 0.03M = \boxed{3.0 \times 10^{-2}\ M}$ $\quad [OH^-] = \dfrac{1\times10^{-14}}{3.0\times10^{-2}} = \boxed{3.3\times10^{-13}\ M}$

b) 2.3×10^{-4} M NaOH: *strong base dissociates 100%*

$[OH^-] = \boxed{2.3 \times 10^{-4}\ M}$ $\quad [H_3O^+] = \dfrac{1\times10^{-14}}{2.3\times10^{-4}} = \boxed{4.3\times10^{-11}\ M}$

c) 0.0075 M $Mg(OH)_2$ *strong base dissociates 100%*

$[OH^-] = 2(0.0075\ M) = 0.015\ M = \boxed{1.5 \times 10^{-2}\ M}$ $\quad [H_3O^+] = \dfrac{1\times10^{-14}}{1.5\times10^{-2}} = \boxed{6.7\times10^{-13}\ M}$

On reference Chart B:

$K_w = [H_3O^+]\,[OH^-] = 1.0 \times 10^{-14}$ $\quad pH = -\log [H_3O^+];\ [H_3O^+] = 10^{-pH}$

$pH + pOH = 14.00$ $\quad pOH = -\log [OH^-];\ [OH^-] = 10^{-pOH}$

3) Determine the pH of each of the following solutions. *Show plugging into formula.*

a) $[H_3O^+] = 4.7 \times 10^{-7}$ M $\quad pH = -\log(4.7 \times 10^{-7}) = \boxed{6.33}$ *(2 sf's, so pH has 2 decimals)*

b) 0.00020 M HNO_3 *strong acid dissociates 100%*

$[H_3O^+] = 2.0 \times 10^{-4}$ M $\quad pH = -\log(2.0 \times 10^{-4}) = \boxed{3.70}$ *(2 sf's, so pH has 2 decimals)*

4) Determine the pH and pOH of each of the following solutions. *Show work.*

a) $[OH^-] = 9.2 \times 10^{-6}$ M $\quad [H_3O^+] = \dfrac{1\times10^{-14}}{9.2\times10^{-6}} = 1.1\times10^{-9}\ M$

$pH = -\log(1.1 \times 10^{-9}) = \boxed{8.96}$; $pOH = 14 - pH = \boxed{5.04}$

Alternatively, $pOH = -\log(9.2 \times 10^{-6}\ M) = 5.04$ $\quad pH + 5.04 = 14$ so $pH = 8.96$

b) 0.0067 M KOH $\quad [OH^-] = 6.7 \times 10^{-3}$ M $\quad [H_3O^+] = \dfrac{1\times10^{-14}}{6.7\times10^{-3}} = 1.5\times10^{-12}\ M$

$pH = -\log(1.5 \times 10^{-12}) = \boxed{11.83}$; $pOH = 14 - pH = \boxed{2.17}$

Alternatively, $pOH = -\log(6.7 \times 10^{-3}\ M) = 2.17$ $\quad pH + 2.17 = 14$ so $pH = 11.83$

5) Determine the $[H_3O^+]$ and $[OH^-]$ for solutions with the following pH values:

a) pH = 4.23 $\quad [H_3O^+] = 10^{-pH} = 10^{-4.23} = \boxed{5.9 \times 10^{-5}}$ $\quad [OH^-] = \dfrac{1\times10^{-14}}{5.9\times10^{-5}} = \boxed{1.7\times10^{-10}\ M}$

alternatively, $pOH = 14 - pH = 9.77$; $[OH^-] = 10^{-pOH} = 10^{-9.77} = 1.7\times10^{-10}\ M$

b) pH = 7.65 $\quad [H_3O^+] = 10^{-pH} = 10^{-7.65} = \boxed{2.2 \times 10^{-8}}$ $\quad [OH^-] = \dfrac{1\times10^{-14}}{2.2\times10^{-8}} = \boxed{4.5\times10^{-7}\ M}$

alternatively, $pOH = 14 - pH = 6.35$; $[OH^-] = 10^{-pOH} = 10^{-6.35} = 4.5\times10^{-7}\ M$

6) **Solution A has a pH of 2 and Solution B has a pH of 5.**

a) Which solution has a higher concentration of $[H_3O^+]$? A

(Hint: What is $[H_3O^+]$ in Solution A? 1×10^{-2} M What is $[H_3O^+]$ in Solution B? 1×10^{-5} M)

b) How much more acidic is solution A compared to solution B? Explain your reasoning.

Solution A is 10^3 or 1000 times more acidic than Solution B.

$(1 \times 10^{-5}\ M)(10^3) = 1 \times 10^{-2}$ M