Chemistry 12

Acid-Base Equilibrium III

Name:
Date:
Block:

1. pH and pOH

pH and pOH

Complete the following table:

Solution	**$[H_3O^+]$**	**$[OH^-]$**
1.0 M NaOH		
1.0 M HCl		

- Concentration of acids and bases can range from extremely high to extremely low.
- It is easier to express these concentrations as **logarithms.**

Logarithms

- "Power of 10" way to specify the concentration of hydronium or hydroxide ions in a solution
- The logarithm of a number is the power to which 10 must be raised to obtain that number.

$$10^y = x \Leftrightarrow \log_{10} x = y$$

Practice. Take the log of the following numbers.

log (1.0×10^{-9}) =	log (1.0×10^{-7}) =	log (1.0×10^{-5}) =	log (1.0×10^{-3}) =
log (5.0×10^{-9}) =	log (2.4×10^{-7}) =	log (1.6×10^{-5}) =	log (7.9×10^{-3}) =

We want to avoid negative numbers so we **multiply by –1**. This is called taking the **"negative log".**

$$-\log(7.9\times10^{-3}) = \_\_\_\_\_\_\_$$

Practice. Take the NEGATIVE log of the following numbers.

–log (1.0×10^{-8}) =	–log (1.0×10^{-6}) =	–log (1.0×10^{-4}) =	–log (1.0×10^{-2}) =
–log (5.0×10^{-8}) =	–log (2.4×10^{-6}) =	–log (1.6×10^{-4}) =	–log (7.9×10^{-2}) =

- The reverse of "taking the log" is to "take the antilog" → EXPONENTIAL FORM
- It just simply means to write the number as a power of 10.

Antilog (2.0) = $10^{2.0}$ = 100 Antilog (-2.0) = $10^{-2.0}$ = 0.01

Practice. Calculate the following.

$10^{-4.23}$ =	$10^{-0.34}$ =	$10^{-6.89}$ =	$10^{-5.790}$ =
$10^{-2.1}$ =	$10^{-6.71}$ =	$10^{-5.33}$ =	$10^{-1.1}$ =

Significant Figures for Logs:

- Only the digits after the decimal place of a log value is significant:

  Ex: –log (**5.28** x 10^{-5}) = [–log (**5.28**)] + [–log (10^{-5})]

  = **–0.723** + (5)

  = 4.**277**

  *Molarity: **5.28** x 10^{-5} M (3 SF)* *pH = 4.**277** (3 SF)*

Practice. Which solutions have the correct number of significant figures? For the incorrect solutions, write the correct answer below.

–log (5.61x10^{-8}) = 7.25	–log (8.9x10^{-5}) = 4.051	–log (3.0912x10^{-2}) = 1.509872895	–log (1.0x10^{-10}) = 10.00
$10^{-4.52}$ = 3.02 x 10^{-5}	$10^{-3.1}$ = 8 x 10^{-4}	$10^{-1.11}$ = 0.078	$10^{-0.96}$ = 0.1096

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

Take the negative log…

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

Results in…

$$pK_w = pH + pOH$$

Which means:

$$pH = -\log [H_3O^+] \quad \textit{and} \quad pOH = -\log [OH^-]$$

and

$$[H_3O^+] = 10^{-pH} \text{ and } [OH^-] = 10^{-pOH}$$

Practice:

1. What is the pH of a 0.010 M nitric acid solution?
2. What is the pH of a solution with $[H_3O^+] = 3.2 \times 10^{-4}$ M?
3. What is $[H_3O^+]$ of a solution with pH = 2.31?
4. What is the pOH of a 0.05M NaOH solution?
5. What is the pOH of a solution with [OH-] = 2.08×10^{-12}?
6. What is the pH of a solution with a pOH = 11.022?

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

Take the negative log…

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

Results in…

$$pK_w = pH + pOH = 0 + 14$$

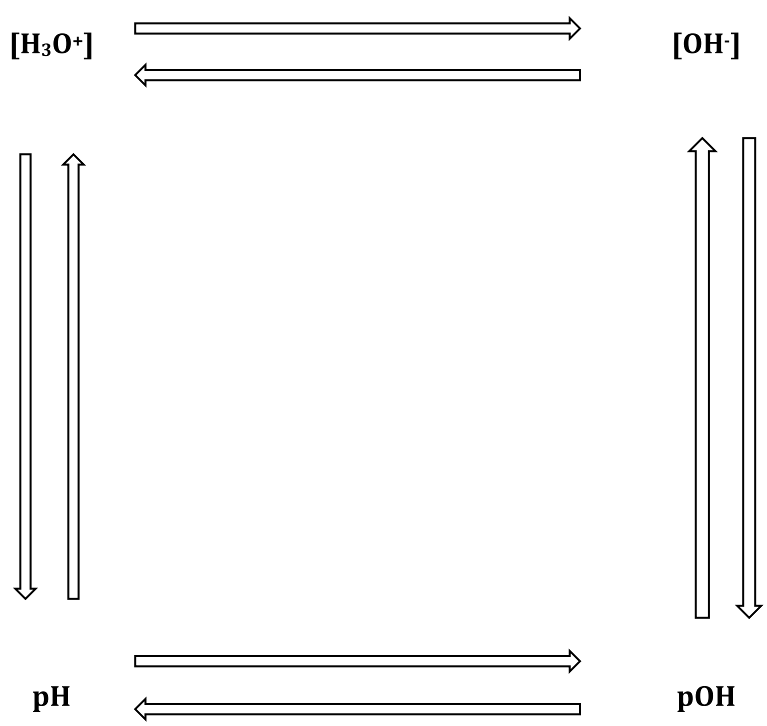
Which means:

$$pH + pOH = 14$$

Practice:

1. If pH = 0.355, what is pOH?

2. If pH = 6.330, what is $[OH^-]$?



<u>Hebden Workbook: Pg. 139 #49-53, Pg. 141 #55 - 56:</u>

Determine the pH of the solution that results when 50.0 mL of 0.200 M H_2SO_4 is mixed with 100.0 mL of 0.400 M NaOH.

A student adds 35.0 mL of an HCl solution with a pH of 2.00 to 15.0 mL of NaOH solution with a pH of 12.00. Calculate the pH of the final solution.

What mass of NaOH must be added to 500.0 mL of a solution of 0.020 M HI to obtain a solution with a pH of 2.50?

<u>Hebden Workbook Pg. 143 #58 - 68</u>