# Exercise 15.1a

## *p*H & *p*OH

Name: _____

Date: _____ Per: _____

In any aqueous solution the water present will self-ionize to form hydronium ($H_3O^+$) and hydroxide ($OH^-$) ions according to the equation below. In pure water these concentrations must be equal due to the mole ratio in which they form during ionization. The amounts produced of each ion in pure water at 25°C are listed below the ionization equation. As the concentration of either ion changes, the concentration of the other changes to maintain equilibrium. *p*H and *p*OH are based on these concentrations. As *p*H increases, *p*OH decreases and vice versa.

$$H_2O(l) + H_2O(l) \rightleftarrows H_3O^+(aq) + OH^-(aq)$$

$1.0 \times 10^{-7}\ M$ $1.0 \times 10^{-7}\ M$ ☜ *Concentration in pure water*

*In this chapter and those that follow, the symbols [ ] placed around a formula or number mean "the molar concentration of".*

***DIRECTIONS: Complete the following in the spaces provided:***

1. $K_w = [H_3O^+][OH^-] =$ [ ] [ ] = ____

2. Complete the formulas for calculating the following from $[OH^-]$ & $[H_3O^+]$ concentrations:

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

3. What type of relationship exists between the $[H_3O^+]$ and $[OH^-]$ in an aqueous solution? _____.

4. If the concentration of $[H_3O^+]$ in an aqueous solution doubles the $[OH^-]$ _____.

5. Complete the formulas for calculating the following from $[H_3O^+]$ & $[OH^-]$ concentrations:

*p*H = ____ *p*OH = ____

6. Without using a calculator, find the:

| | $[H_3O^+] = 1.0 \times 10^{-5}\ M$ | $[OH^-] = 1.0 \times 10^{-3}\ M$ | $[OH^-] = 1.0 \times 10^{-11}\ M$ | $[H_3O^+] = 1.0 \times 10^{-8}\ M$ |
|---|---|---|---|---|
| *p*H of a solution with: | | | | |
| *p*OH of a solution with: | | | | |
| *This solution is:* | acid base | acid base | acid base | acid base |

7. Without using a calculator, find the:

| | *p*H = 4 | *p*OH =12 | *p*H = 1 | *p*OH = −1 |
|---|---|---|---|---|
| $[H_3O^+]$ in a solution with: | | | | |
| $[OH^-]$ in a solution with: | | | | |
| *This solution is:* | acid base | acid base | acid base | acid base |

8. Complete the formulas for calculating the following from *p*H & *p*OH:

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

9. Complete the formulas for calculating the following from pOH & pH:

*p*H = ____ *p*OH = ____

*(OVER)*



Answers: 18) $1.34 \times 10^{-4}$ 19) $1.6 \times 10^{-6}$

# Exercise 15.1a

## *p*H & *p*OH

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***DIRECTIONS: Using the logarithm/antilog functions of a calculator, complete the following:***

| | **$[H^+]$** | ***p*H** | **$[OH^-]$** | ***p*OH** | **Acid/Base** |
|---|---|---|---|---|---|
| 10. | $3.50 \times 10^{-3}$ *M* | | | | |
| 11. | | 5.30 | | | |
| 12. | | | $6.70 \times 10^{-3}$ *M* | | |
| 13. | | | | 9.70 | |
| 14. | $4.50 \times 10^{-9}$ *M* | | | | |
| 15. | | 11.2 | | | |
| 16. | | | $9.10 \times 10^{-11}$ *M* | | |
| 17. | | | | 1.40 | |

***DIRECTIONS: Using the logarithm/antilog functions of a calculator, complete the following:***

18. Uric acid is a chemical created when the body breaks down substances called purines. A 0.128 *M* solution of uric acid ($HC_5H_3N_4O_3$) has a *p*H of 2.39. Calculate the $K_a$ of uric acid.

19. Codeine ($C_{18}H_{21}NO_3$) is a weak organic base. A $5.0 \times 10^{-3}$ M solution of codeine has a *p*H of 9.95. Calculate the value of $K_b$ for this substance.



Answers: 18) $1.34 \times 10^{-4}$ 19) $1.6 \times 10^{-6}$