

Outside the pH scale (below 0 and above 14)

What is the pH of 1.00M HCl?

$$pH = -\log [H_3O^+] \therefore pH = -\log(1.00M) = 0.000$$

1.00×10^0 \uparrow exponent = pH

Therefore, what would the pH be if [HCl] > 1.00M?

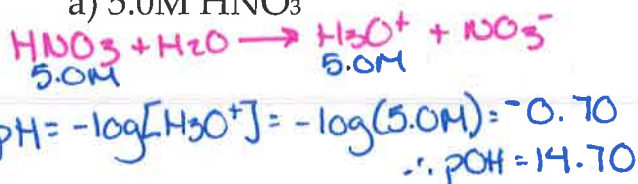
The pH would be a negative number.

* Very concentrated acidic solutions (solutions that have $[H_3O^+] > 1.0$ M) have pH values less than 0. (i.e. extremely acidic)

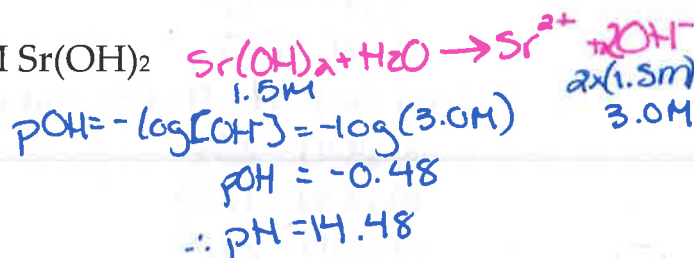
* Very concentrated basic solutions (solutions that have $[OH^-] > 1.0$ M; $[H_3O^+] < 1.0 \times 10^{-14}$ M) have pH values greater than 14. (extremely basic)

Example: Find the pH and pOH of:

a) 5.0M HNO₃

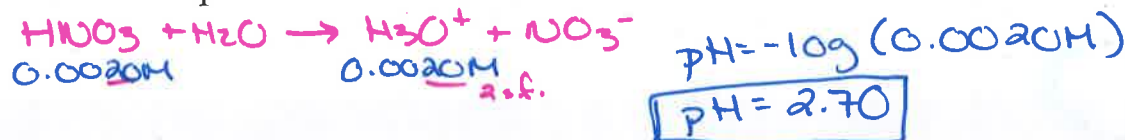


b) 1.5M Sr(OH)₂



Practice Questions:

1. Find the pH of a 0.0020M solution of HNO₃.



2. Calculate the pH of a 0.010M NaOH solution.



3. If the pH is decreased from 5 to 2, what happens to the $[H_3O^+]$ and $[OH^-]$? *every change in pH unit by 1 = 10 times Δ in [conc.]*

$pH \Delta 5 \rightarrow 2$ (3 units = $10 \times 10 \times 10 = 1000$)

$\therefore [H_3O^+] \uparrow$ by 1000 (b/c pH \downarrow)

$\therefore [OH^-] \downarrow$ by 1000 (b/c pH \downarrow)

4. If pH is increased from 7.2 to 8.9, what happens to the $[H_3O^+]$?

$pH \Delta 7.2 \rightarrow 8.9 = 1.7$ difference. \therefore because pH is \uparrow (more basic) the $[H_3O^+]$ will decrease by 50x

$\therefore 10^{1.7} = 50$

5. Calculate the pH of the final solution if 100.0mL of a strong acid at pH =

4.500 is diluted by adding 50.0mL of water.

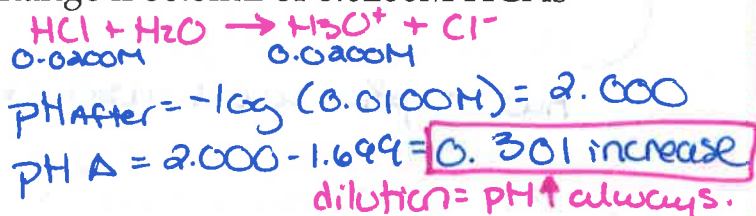
Before dilution:
 $[H_3O^+] = 10^{-(4.500)}$
 $= 3.16 \times 10^{-5} M$

After Dilution:
 $M_1 V_1 = M_2 V_2$
 $(3.16 \times 10^{-5})(0.1000) = (0.1500) M_2$
 $\therefore M_2 = 2.1081 \times 10^{-5} M$
 $pH = -\log(2.1081 \times 10^{-5} M) = \boxed{4.676}$

6. By how many pH units does the pH change if 80.0mL of 0.0200M HCl is diluted to a final volume of 160.0mL?

$[H_3O^+] = 0.0200 M$
 $\therefore pH = -\log(0.0200 M)$
 $pH_{\text{before}} = 1.699$

$M_1 V_1 = M_2 V_2$
 $M_2 = \frac{(0.0200)(0.0800)}{(0.1600)}$
 $M_2 = 0.0100 M$



- 7a) Using your acid/base table for assistance, which has lower pH, a 0.01M solution of HF or a 0.01M solution of CH₃COOH? Why?

HF is a stronger, weak acid \therefore it reacts to a greater extent to produce more $[H_3O^+]$

\therefore HF will have a lower pH than CH₃COOH.

- b) Which of the solutions above will conduct better? Why? 0.01M HF because it dissociates into ions to a greater extent $\therefore \uparrow [ion] = \uparrow \text{conductivity}$.

Assignment 9:

1. Hebden p. 139 #49deh, 50ef
2. Calculate the pH, pOH and $[OH^-]$ of a 0.00100M solution of HNO₃.
3. Calculate the pOH, pH, and $[H_3O^+]$ of a $2.34 \times 10^{-4} M$ solution of Ca(OH)₂.
4. If the pH is increased from 1 to 6, how do the $[H_3O^+]$ and $[OH^-]$ change?
5. If the pH decreases from 9.3 to 6.5, how does $[H_3O^+]$ change?
6. What is the pH of the final solution if 35.00mL of a strong acid at pH 3.56 is diluted by adding 100.0mL of water?
7. You have 50.00mL of a 0.00345M solution of HClO₄. How does the pH change if you dilute the solution to a final volume of 175.0mL?
8. Hebden p.139 #53 & p. 141 #57
9. You dissolve 0.4g of Ca(OH)₂ in 500mL of solution. What is the pH?