Calculating pH

1. What is the pH of the following solutions given their hydronium ion concentrations?
   (a) $[H_3O^+(aq)] = 5.32 \times 10^{-7}$ mol/L

   6.274

   $pH = -\log [H_3O^+]$

   (b) $[H_3O^+(aq)] = 6.1 \times 10^{-5}$ mol/L

   4.21

   (c) $[H_3O^+(aq)] = 2.679 \times 10^{-14}$ mol/L

   13.5720

   (d) $[H_3O^+(aq)] = 0.23$ mol/L

   0.64

2. Which of the above solutions would be considered acidic?

3. Fill in the following chart:

$[H_3O^+(aq)]$ (mol/L)	pH
1.37×10^{-2}	1.863
2.38×10^{-5}	4.623
2.38×10^{-6}	5.623
1.00×10^{-7}	7.000
3.45×10^{-9}	8.462
3.45×10^{-10}	9.462
3.45×10^{-11}	10.462
5.33×10^{-12}	11.273

4. Notice in the chart that the concentration of $H_3O^+(aq)$ is continually decreasing. What do you notice about the pH values?

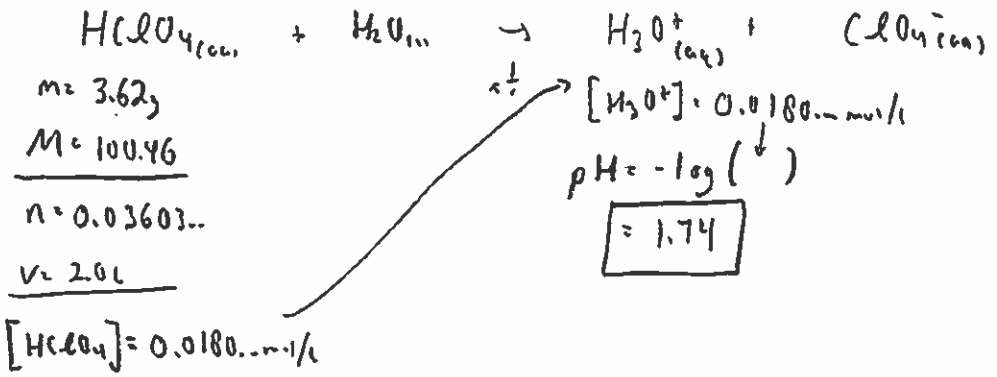
5. Generalize what happens to pH as acidity decreases.

6. What do you think happens to pH as basicity decreases?

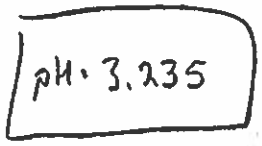
7. Find some spots on the table when the pH increases by exactly 1 pH unit. What do you notice about the change in concentration of hydronium ions at these points?

8. What is the pH of a solution made by the following methods?

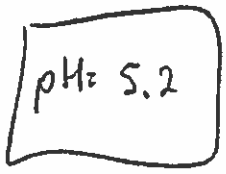
(a) Dissolving 3.62 g of pure hydrogen perchlorate, $HClO_4(aq)$ (strong acid), in 2.0 L of water.



(b) Dissolving 2.357 g of pure hydrobromic acid, HBr(aq) (strong acid), in 50.0 L of water.



(c) Dissolving 8 µg (0.000008 g) of pure nitric acid, $HNO_3(aq)$ (strong acid), in 20.0 mL of water.



pOH and pH Calculations

1. What is the pOH of the following solutions given their hydroxide ion concentrations?
   (a) $[OH^-(aq)] = 4.67 \times 10^{-3}$ mol/L

   2.328

   (b) $[OH^-(aq)] = 5.84 \times 10^{-8}$ mol/L

   7.233

   $pOH = -\log [OH^-]$

   (c) $[OH^-(aq)] = 1.478 \times 10^{-14}$ mol/L

   13.8303

   (d) $[OH^-(aq)] = 3.4 \times 10^{-2}$ mol/L

   1.47

2. Which of the above solutions are considered acidic?

   b + c

3. If given the pH of the following solution, give the pOH, or vice versa:
   (a) pH = 12.3 1.7
   (b) pOH = 5.5 8.5
   (c) pOH = 2.95 11.05
   (d) pH = 6.629 7.371
   (e) pOH = 1.1 12.9

4. Fill in the following chart:

   $pH + pOH = 14$

$[OH^-(aq)]$ mol/L	pOH	pH
1.28	-0.10	14.11
5.35×10^{-3}	2.272	11.728
8.459×10^{-5}	4.0727	9.9273
9.6×10^{-8}	7.02	6.98
1.934×10^{-15}	14.7135	-0.7135

5. What is the pOH of a 3.2 mol/L solution of lithium hydroxide, LiOH(aq)?

pOH = −0.51

6. What is the pOH of a 5.467 mol/L solution of strontium hydroxide, $Sr(OH)_2(aq)$?

pOH = −1.0388

7. What is the pH of a 3.45 mol/L solution of sodium hydroxide, NaOH(aq)?

pH = 14.538

8. What is the pOH of a solution made by dissolving 4.95 g of potassium hydroxide, KOH(aq), in 4.50 L of water?

pOH = 1.708

Calculating Concentration from pH and pOH

1. What is the concentration of hydronium ions in the following solutions given their pH values?

   (a) pH = 2.34

   (b) pH = 15.6

   (c) pH = 4.4

   (d) pH = 1.892

   (e) pH = 5.63

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

2. What is the concentration of hydroxide ions in the following solutions given the following information?

   (a) pOH = 1.45

   (b) pOH = 10.672

   (c) pOH = 7.3

   (d) pH = 2.982

   (e) pH = 4.932

   (f) pH = 10 .2

$[OH^-] = 10^{-pOH}$

$pOH = 14 - pH$

3. What is the concentration of hydrochloric acid, HCl(aq) (strong acid), that gives a solution with a pH of 3.69?

$[HCl] = 2.0 \times 10^{-4}$ mol/L

4. What is the concentration of lithium hydroxide, LiOH(aq), that gives a solution with a pOH of 4.674?

$[OH^-] = 2.12 \times 10^{-5}$ mol/L

5. What is the concentration of barium hydroxide, $Ba(OH)_2(aq)$, that gives a solution with a pH of 11.836?

$[Ba(OH)_2] = 0.00343\ mol/L$

6. What mass of hydrogen chloride gas, HCl(g) (strong acid), needs to be dissolved in 2.00 L of water to create a solution with a pH of 3.298?

$m_{HCl} = 0.0367\ g$

7. What mass of rubidium hydroxide, RbOH(s), needs to be dissolved in 1.50 L of water to create a solution with a pH of 9.35?

$m_{RbOH} = 0.0034\ g$

8. What mass of strontium hydroxide, $Sr(OH)_2(s)$, needs to be dissolved in 3.0 L of water to create a solution with a pH of 8.34?

$m_{Sr(OH)_2} = 4.0 \times 10^{-4}\ g$