1) What is the pH of a 0.0235 M HCl solution?

2) What is the pOH of a 0.0235 M HCl solution?

3) What is the pH of a $6.50 \times 10^{-3}$ M KOH solution? (Hint: this is a basic solution – concentration is of OH$^-$)

4) A solution is created by measuring $3.60 \times 10^{-3}$ moles of NaOH and $5.95 \times 10^{-4}$ moles of HCl into a container and then water is added until the final volume is 1.00 L. What is the pH of this solution?

5) What is the pH of a $6.2 \times 10^{-5}$ M NaOH solution? (Hint: this is a basic solution – concentration is of OH$^-$)

6) A solution with a H$^+$ concentration of $1.00 \times 10^{-7}$ M is said to be neutral. Why?
Solutions

Note: The significant figures in the concentration of \([H^+]\) or \([OH^-]\) is equal to the number of decimal places in the \(pH\) or \(pOH\) and vice versa.

1) What is the \(pH\) of a 0.0235 M HCl solution?
\[ pH = -\log[H^+] = -\log(0.0235) = 1.629 \]

2) What is the \(pOH\) of a 0.0235 M HCl solution?
\[ pH = -\log[H^+] = -\log(0.0235) = 1.629 \]
\[ pOH = 14.000 - pH = 14.000 - 1.629 = 12.371 \]

3) What is the \(pH\) of a \(6.50 \times 10^{-3}\) M KOH solution?
\[ pOH = -\log[OH^-] = -\log(6.50 \times 10^{-3}) = 2.187 \]
\[ pH = 14.000 - pOH = 14.000 - 2.187 = 11.813 \]

4) A solution is created by measuring 3.60 \(\times\) \(10^{-3}\) moles of NaOH and 5.95 \(\times\) \(10^{-4}\) moles of HCl into a container and then water is added until the final volume is 1.00 L. What is the \(pH\) of this solution?

Since there is both acid and base we will assume a 1 mole acid:1 mole base ratio of neutralization. There is more base than acid so the leftover base is what will affect the \(pH\) of the solution.

\[ 3.60 \times 10^{-3} \text{ moles} - 5.95 \times 10^{-4} \text{ moles} = 3.01 \times 10^{-3} \text{ moles NaOH} \]
\[ \frac{3.01 \times 10^{-3} \text{ moles NaOH}}{1.00 \text{ L soln}} \]
\[ pOH = -\log[OH^-] = -\log(3.01 \times 10^{-3}) = 2.521 \]
\[ pH = 14.000 - pOH = 14.000 - 2.521 = 11.479 \]

5) What is the \(pH\) of a \(6.2 \times 10^{-5}\) M NaOH solution?
\[ pOH = -\log[OH^-] = -\log(6.2 \times 10^{-5}) = 4.21 \]
\[ pH = 14.00 - pOH = 14.00 - 4.21 = 9.79 \]

6) A solution with a \(H^+\) concentration of \(1.00 \times 10^{-7}\) M is said to be neutral. Why?
\[ pH = -\log[H^+] = -\log(1.00 \times 10^{-7}) = 7.000 \]
\[ pOH = 14.000 - pH = 14.000 - 7.000 = 7.000 \]
\[ pOH = -\log[OH^-] = -\log(OH^-) = 7.000 \] we can use this to find the \(OH^-\) concentration
\[ -\log[OH^-] = 7.000 \]
\[ \log[OH^-] = 7.000 \]
\[ 10^{\log[OH^-]} = 10^{7.000} \]
\[ [OH^-] = 10^{7.000} \]
\[ [OH^-] = 1.00 \times 10^{-7} \text{ M} \]

The concentrations of \(H^+\) and \(OH^-\) are equal, as are the \(pH\) and \(pOH\), so the solution must be neutral.