Calculating pH when given either $[H_3O^+]$ or $[HO^-]$

If hydronium ion concentration is given, simply use calculator and take the negative log of $[H_3O^+]$

$[H_3O+] = 3.5 \times 10^{-3}\ M$

$-\log(3.5 \times 10^{-3})$

pH = 2.5

If hydroxide ion concentration is given, First use Kw expression to calculate $[H_3O^+]$ and then take the negative log of $[H_3O^+]$ Given: $[HO^-] = 3.5 \times 10^{-3}\ M$ First use Kw expression to determine $[H_3O^+]$ $Kw = [H_3O+]\,[HO^-]$ $1.0 \times 10^{-14} = [H_3O+]\,[HO^-]$ $1.0 \times 10^{-14} = [H_3O+]\,(3.5 \times 10^{-3})$ Now rearrange and solve for $[H_3O^+]$ $\frac{1.0 \times 10^{-14}}{(3.5 \times 10^{-3})} = [H_3O+] = 2.9 \times 10^{-12}$ Finally, take –log of $[H_3O^+]$ $-\log(2.9 \times 10^{-12})$ pH = 11.5	There is a faster method: Take the –log of $[HO^-]$, this is called the pOH Use the Kw expression in log form and rearrange: $pOH = -\log(3.5 \times 10^{-3}\ M) = 2.5$ pOH = 2.5 $Kw = [H_3O+]\,[HO^-]$ pKw = pH + pOH 14 = pH + 2.5 pH = 14 - 2.5 = 11.5

Calculating pH when strong acid or strong base concentration is given.

Remember, strong electrolytes completely dissociate, thus the concentration of H_3O^+ or OH^- is equal to the starting concentration given in the problem.

Example: 0.15 *M* HCl gives H_3O^+ concentration of 0.15 *M*
Take the –log to get pH: -log (0.15) = 0.8
pH = 0.8

Example: 0.25 *M* KOH gives HO^- concentration of 0.25 *M*
Take the –log to get pOH: -log (0.25) = 0.6
pOH = 0.6
pH = 14 – pOH
pH = 13.4