

Compare:

- Weak acid HNO_2 : pH of 0.10 M solution = 2.17

Let's compare the pH of the weak nitrous acid with the pH of a strong acid like nitric acid:

0.10 M HNO_3 , what is pH?



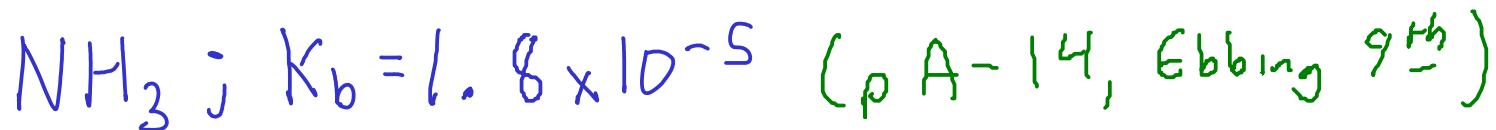
0.10 M HNO_3 , $[\text{H}_3\text{O}^+] = 0.10 \text{ M}$

pH = 1.00

The stronger the acid:

- the lower the pH of a solution of given concentration will be
- the higher the concentration of hydronium ion (when compared to the nominal acid concentration)

Consider an 0.100 M solution of the weak base ammonia:



What is the pH?



$$K_b = \frac{[\text{NH}_4^+][\text{OH}^-]}{[\text{NH}_3]} = 1.8 \times 10^{-5}$$

We want to solve for HYDROXIDE ION concentration. since it's the only species in the equilibrium that is related to hydronium ion concentration (and therefore, pH)

Species	[Initial]	Δ	[Equilibrium]
NH_4^+	0	+X	X
OH^-	0	+X	X
NH_3	0.100	-X	0.100 - X

$$\frac{(x)(x)}{(0.100 - x)} = 1.8 \times 10^{-5}$$

Solve for 'x'. This will give us the hydroxide ion concentration.

$$\frac{(x)(x)}{(0.100-x)} = 1.8 \times 10^{-5}$$

$$\frac{x^2}{0.100-x} = 1.8 \times 10^{-5}$$

$$\downarrow x \ll 0.100, \quad 0.100-x \approx 0.100$$

$$\frac{x^2}{0.100} = 1.8 \times 10^{-5}$$

$$x = 0.0013416408 = [\text{OH}^-]$$

$$\text{pOH} = -\log_{10}(0.0013416408) = 2.87$$

$$\text{Since } \text{pH} + \text{pOH} = 14.00,$$

$$\text{pH} = 14.00 - 2.87$$

$$\boxed{\text{pH} = 11.13}$$

Be careful here! We have calculated the HYDROXIDE ION concentration. Since pH is related to HYDRONIUM ION concentration, we can't just take the negative log and call it the answer

* If you'd solved this with the quadratic equation, you would have found $\text{pH} = 11.13$... same as we got here.

Compare pH to the pH of an 0.100 M solution of the strong base NaOH:

$$\text{pH}_{\text{NH}_3} \approx 11.13$$



$$\text{So, } 0.100 \text{ M NaOH, } [\text{OH}^-] = 0.100$$

$$\text{pOH} = -\log_{10}(0.100) = 1.00$$

$$\text{pH} = 14.00 - 1.00 = \boxed{13.00}$$

The stronger the base:

- the higher the pH will be for a solution of given concentration
- the higher the HYDROXIDE concentration (compared to the nominal base concentration)