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?

$HNO_3 + H_2O \rightarrow H_3O^+ + NO_3^-$

0.10 M HNO_3, $[H_3O^+] = 0.10$ 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:

NH_3 ; $K_b = 1.8 \times 10^{-5}$ (p A-14, Ebbing 9th)

What is the pH?

$$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$$

$$K_b = \frac{[NH_4^+][OH^-]}{[NH_3]} = 1.8 \times 10^{-5}$$

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.

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

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

$x << 0.100$, $0.100 - x \simeq 0.100$

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

$$x = 0.001341640 8 = [OH^-]$$

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

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

Since $pH + pOH = 14.00$,

$$pH = 14.00 - 2.87$$

$$\boxed{pH = 11.13}$$

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

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

$pH_{NH_3} = 11.13$

$NaOH \rightarrow Na^+ + OH^-$

So, 0.100 M NaOH, $[OH^-] = 0.100$

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

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

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)