Dissociation of a weak acid

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Solution:

Molecule	HF	F^-	H^+
Initial	0.1	0	0
Difference	-x	x	x
Equilibrium	0.1 - x	x	x

We can substitute these values into K_a,

$$K_a = \frac{x^2}{0.1 - x}$$

Where $K_a = 10^{-pKa} = 10^{-3.14} = 7.244 \times 10^{-4}$

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We can be confident that x << 0.1 so we can make the approximation

$$K_a \approx \frac{x^2}{0.1}$$

Thus,

$$x \approx \sqrt{CK_a}$$

$$x \approx \sqrt{7.244\ x\ 10^{-5}}$$

$$x = 0.00815$$

Finally, the pH is calculated from x, since x = $[H^+]$,

$$pH = -log_{10}(0.00815) = 2.1$$