Topic 6D - The pH of Aqueous Solutions

How to calculate the pH of a solution of a weak acid:

Toolbox 6D.1 - p. 473

Calculating the pH and percentage deprotonation of a weak acid:

Example 6D.1 - p. 473

Calculating the Ka and pKa of a weak acid from the pH:

Example 6D.2 - p. 474

How to calculate the pH of a solution of a weak base:

Toolbox 6D.2 - p. 475

Calculating the pH and percentage deprotonation of a weak base:

Example 6D.3 - p. 476

TABLE 6D.1 Acidic Character and K_a Values of Common Cations in Water*

Character	Examples	K_a	pK_a
Acidic			
conjugate acids of weak bases	anilinium ion, $C_6H_5NH_3^+$	2.3×10^{-5}	4.64
	pyridinium ion, $C_5H_5NH^+$	5.6×10^{-6}	5.24
	ammonium ion, NH_4^+	5.6×10^{-10}	9.25
	methylammonium ion, $CH_3NH_3^+$	2.8×10^{-11}	10.56
small, highly charged metal cations	Fe^{3+} as $Fe(H_2O)_6^{3+}$	3.5×10^{-3}	2.46
	Cr^{3+} as $Cr(H_2O)_6^{3+}$	1.3×10^{-4}	3.89
	Al^{3+} as $Al(H_2O)_6^{3+}$	1.4×10^{-5}	4.85
	Cu^{2+} as $Cu(H_2O)_6^{2+}$	3.2×10^{-8}	7.49
	Ni^{2+} as $Ni(H_2O)_6^{2+}$	9.3×10^{-10}	9.03
	Fe^{2+} as $Fe(H_2O)_6^{2+}$	8×10^{-11}	10.1
Neutral			
Group 1 and 2 cations metal cations with charge +1	Li^+, Na^+, K^+, Mg^{2+}, Ca^{2+} Ag^+		
Basic	none		

*As in Table 6C.1, the experimental pK_a values have more significant figures than shown here, and the K_a values have been calculated from these more precise data.

Table 6D.1
Atkins, *Chemical Principles: The Quest for Insight*, 7e
W. H. Freeman & Company, © 2016 by P. W. Atkins, L. L. Jones, and L. E. Laverman

TABLE 6D.2 Acidic and Basic Character of Common Anions in Water

Character	Examples
Acidic	
very few	HSO_4^-, $H_2PO_4^-$
Neutral	
conjugate bases of strong acids	Cl^-, Br^-, I^-, NO_3^-, ClO_4^-
Basic	
conjugate bases of weak acids	F^-, O^{2-}, OH^-, S^{2-}, HS^-, CN^-, CO_3^{2-}, PO_4^{3-}, NO_2^-, $CH_3CO_2^-$, other carboxylate ions

Table 6D.2
Atkins, *Chemical Principles: The Quest for Insight*, 7e
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Calculating the pH of a salt solution with an acidic cation:

Example 6D.4 - p. 479

Calculating the pH of a salt solution with a basic anion:

Example 6D.5 - p. 480