

Monoprotic acid of concentration C

1. Strong acid – assume $K_a = 1000$
2. $K_a/C < 0.01$? Yes \rightarrow 5, No \rightarrow 3
3. $K_a/C > 20$? Yes \rightarrow 4, No \rightarrow 6
4. $pH = -\log(C) \rightarrow 7$
5. $pH = -\log(\sqrt{CK_a}) \rightarrow 7$
6. $pH = -\log\left(\frac{\sqrt{K_a(K_a+4C)} - K_a}{2}\right) \rightarrow 7$
7. $pH \leq 6.30$? Yes \rightarrow End, No \rightarrow 8
8. $K_a/C > 20$? Yes \rightarrow 9, No \rightarrow 10
9. $pH = -\log\left(\frac{C + \sqrt{C^2 + 4K_w}}{2}\right) \rightarrow$ End
10. $C \leq 10^{-8}$? Yes \rightarrow 11, No \rightarrow use BATE
11. $pH = 7.00 \rightarrow$ End

Weak monoprotic acid salt of concentration C

1. $pK_b = 14 - pK_a$
2. Continue as for monoprotic base.

Monoprotic base of concentration C

1. Strong base – assume $K_b = 1000$
2. $K_b/C < 0.01$? Yes \rightarrow 5, No \rightarrow 3
3. $K_b/C > 20$? Yes \rightarrow 4, No \rightarrow 6
4. $pH = 14 - \log(C) \rightarrow 7$
5. $pH = 14 - \log(\sqrt{CK_b}) \rightarrow 7$
6. $pH = 14 - \log\left(\frac{\sqrt{K_b(K_b+4C)} - K_b}{2}\right) \rightarrow 7$
7. $pH \geq 7.70$? Yes \rightarrow End, No \rightarrow 8
8. $K_b/C > 20$? Yes \rightarrow 9, No \rightarrow 10
9. $pH = 14 - \log\left(\frac{C + \sqrt{C^2 + 4K_w}}{2}\right) \rightarrow$ End
10. $C \leq 10^{-8}$? Yes \rightarrow 11, No \rightarrow use BATE
11. $pH = 7.00 \rightarrow$ End

Weak monoprotic base salt of concentration C

1. $pK_a = 14 - pK_b$
2. Continue as for monoprotic acid.

pH & pOH definition

$$pH = -\log([H^+])$$

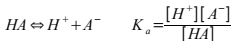
$$pOH = -\log([OH^-])$$

water ionization constant

$$K_w = [OH^-][H^+] = 10^{-14}$$

$$pH + pOH = pK_w = 14$$

acid dissociation constant



base dissociation constant



$$pK_a + pK_b = 14$$

Dissociation percentage

$$f_p = [A^-]/C$$

Henderson-Hasselbalch equation

$$pH = pK_a + \log\left(\frac{[A^-]}{[HA]}\right)$$

$$pOH = pK_b + \log\left(\frac{[B^+]}{[BOH]}\right)$$

Strong acids

HCl, HBr, HI, HClO₄,
H₂SO₄ (first proton only), HNO₃

Strong bases

KOH, NaOH, RbOH, CsOH

Weak acids/bases

	pK _{ax}		pK _{ax}
acetic C ₂ H ₄ O ₂	4.75	H ₂ SO ₄	-3
HF	3.45		1.99
H ₂ CO ₃	6.37	oxalic C ₂ O ₄ H ₂	1.25
	10.25		4.27
citric C ₆ H ₈ O ₇	3.13		
	4.76		pK _b
	6.40	NH ₄ OH	9.25
H ₃ PO ₄	2.15	aniline C ₆ H ₇ N	9.4
	7.20		
	12.35		

BATE – pH calculator

Program for fast, easy and accurate calculation of pH of solutions containing mixtures of strong/weak acid/bases up to four dissociation steps.