14. Hydrazine, H_2NNH_2, has a K_b of 9.50×10^{-7}. If you have 10.0 g of N_2H_4 in enough H_2O to make 250 mL of solution, what is the pH?

15. If you have a 1.00 M solution of iodic acid, HIO_3, whose pH is 0.474, what is the K_a?

16. A 2.00 M solution of boric acid, H_3BO_3, has what equilibrium concentrations of H_3BO_3, $H_2BO_3^{2-}$, BO_3^{3-}, H^{1+}, OH^{1-}, and pH? $K_{a1} = 5.81 \times 10^{-10}$, $K_{a2} = 1.80 \times 10^{-13}$, $K_{a3} = 1.60 \times 10^{-14}$

14. $10\,g\,N_2H_4 \times \frac{1\,mol}{32.06\,g} \times \frac{1}{0.250\,L} = 1.25\,M$

	$[N_2H_4]$	+ H_2O ⇌	$[N_2H_5^{1+}]$	+ $[OH^{1-}]$
i	1.25		0	0
Δ	$-x$		$+x$	$+x$
eq	$1.25 - x$		x	x

$$K_b = \frac{[N_2H_5^{1+}][OH^{1-}]}{[N_2H_4]} = 9.5 \times 10^{-7} = \frac{[x][x]}{[1.25 - x]}$$

$x = 0.00109$

5% test: $\frac{0.00109}{1.25} \times 100 = 0.0872\%$ … good assumption

$[OH^{1-}] = 0.00109$ … $pOH = -\log[0.00109] = 2.96$

$pH = 14 - 2.96 = 11.0$

15. $[H^{1+}] = 10^{-0.474} = 0.336$

	$[HIO_3]$	⇌ $[H^{1+}]$	+ $[IO_3^{1-}]$
i	1.00	0	0
Δ	-0.336	$+0.336$	$+0.336$
eq	0.664	0.336	0.336

$$K_a = \frac{[H^{1+}][IO_3^{1-}]}{[HIO_3]} = \frac{[0.336][0.336]}{[0.664]} = 0.170$$

16. $[H_3BO_3] \rightleftharpoons [H^{1+}] + [H_2BO_3^{1-}]$

	H_3BO_3	H^{1+}	$H_2BO_3^{1-}$
i	2	0	0
Δ	$-x$	$+x$	$+x$
eq	$2-x$	x	x

$$K_{a_1} = \frac{[H^{1+}][H_2BO_3^{1-}]}{[H_3BO_3]} = 5.81\times10^{-10} = \frac{[x][x]}{[2-x]}$$

$x = 3.41\times10^{-5} = [H^{1+}] = [H_2BO_3^{1-}]$

5% test: $\frac{3.41\times10^{-5}}{2}\times100 = 0.00170\%$ … good assumption

$[H_2BO_3^{1-}] \rightleftharpoons [H^{1+}] + [HBO_3^{2-}]$

	$H_2BO_3^{1-}$	H^{1+}	HBO_3^{2-}
i	3.41×10^{-5}	3.41×10^{-5}	0
Δ	$-x$	$+x$	$+x$
eq	$3.41\times10^{-5}-x$	$3.41\times10^{-5}+x$	x

$$K_{a_2} = \frac{[H^{1+}][HBO_3^{2-}]}{[H_2BO_3^{1-}]} = 1.8\times10^{-13} = \frac{[3.41\times10^{-5}+x][x]}{[3.41\times10^{-5}-x]}$$

$x = 1.80\times10^{-13} = [HBO_3^{2-}]$

5% test: $\frac{1.80\times10^{-13}}{3.41\times10^{-5}}\times100 = 5.23\times10^{-7}\%$ … good

$[HBO_3^{2-}] \rightleftharpoons [H^{1+}] + [BO_3^{3-}]$

	HBO_3^{2-}	H^{1+}	BO_3^{3-}
i	1.80×10^{-13}	3.41×10^{-5}	0
Δ	$-x$	$+x$	$+x$
eq	$1.80\times10^{-13}-x$	$3.41\times10^{-5}+x$	x

$$K_{a_3} = \frac{[H^{1+}][BO_3^{3-}]}{[HBO_3^{2-}]} = 1.6\times10^{-14} = \frac{[3.41\times10^{-5}+x][x]}{[1.8\times10^{-13}-x]}$$

$x = 8.45\times10^{-23}$ ☺ good!

$[H_3BO_3]_{eq} = 2.00$

$[H_2BO_3^{1-}]_{eq} = 3.41\times10^{-5}$

$[HBO_3^{2-}]_{eq} = 1.80\times10^{-13}$

$[BO_3^{3-}]_{eq} = 8.45\times10^{-23}$

$[H^{1+}]_{eq} = 3.41\times10^{-5}$

$[OH^{1-}]_{eq} = 2.93\times10^{-10}$

$pH = 4.47$