



$$K_b = \frac{[\text{NH}_4^+][\text{OH}^-]}{[\text{NH}_3]}$$



$$K_b = \frac{[\text{C}_5\text{H}_5\text{NH}^+][\text{OH}^-]}{[\text{C}_5\text{H}_5\text{N}]}$$

82) HNO_3 - strong acid = terrible base
 • conjugate base of strong acid
 has no base strength

H_2O $K_b = K_w = 1.0 \times 10^{-14}$ NH_3 $K_b = 1.8 \times 10^{-5}$

$\text{C}_5\text{H}_5\text{N}$ $K_b = 1.7 \times 10^{-9}$





$$[\text{NaOH}] = [\text{OH}^-]$$

$$a) [\text{OH}^-] = 0.10 \text{ M} \quad \text{pOH} = -\log(0.10) = 1.00$$

$$\text{pH} = 14 - 1.00 = 13.00$$

$$b) [\text{OH}^-] = 1.0 \times 10^{-10} \text{ M} \quad \text{pOH} = -\log(1.0 \times 10^{-10}) = 10.00$$

$$\text{pH} = 14 - 10.00 = 4.00$$

$$* \text{ water } [\text{OH}^-] = 1.0 \times 10^{-7}$$

$$\text{pH} = 7.00$$

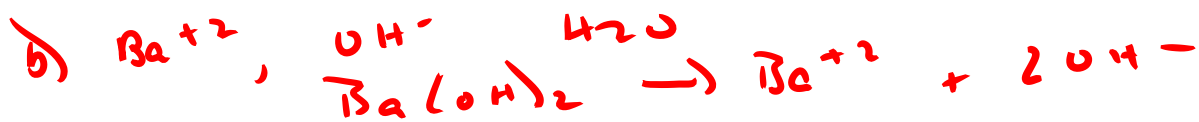
$$c) [\text{OH}^-] = 2.0 \text{ M} \quad \text{pOH} = -\log(2.0) = -0.30$$

$$\text{pH} = 14.00 - (-0.30) = 14.30$$



$$[\text{OH}^-] = 0.015 \text{ M} \quad \text{pOH} = -\log(0.015) = 1.82$$

$$\text{pH} = 14.00 - 1.82 = 12.18$$



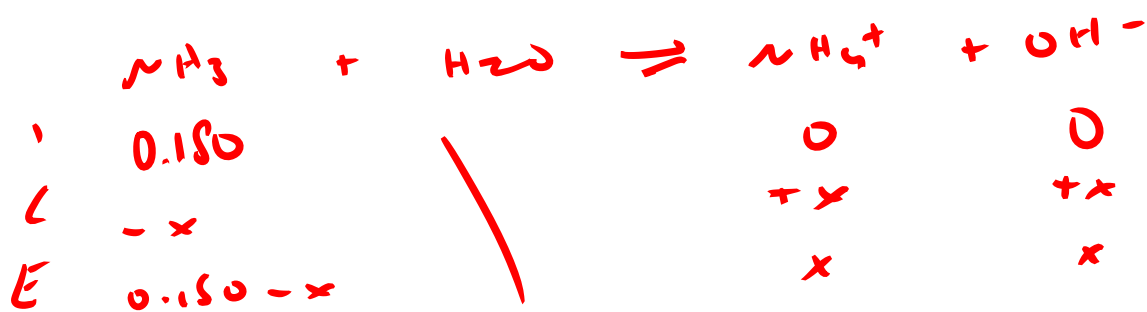
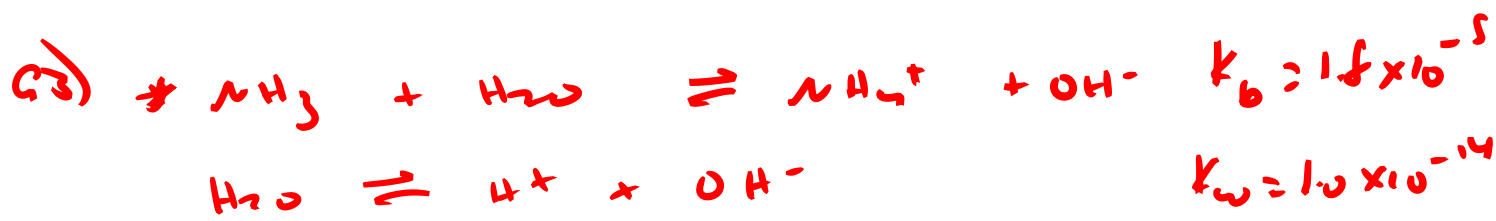
$$[\text{OH}^-] = 2(0.015 \text{ M}) = 0.030 \text{ M}$$

$$\text{pOH} = -\log(0.030) = 1.52$$

$$\text{pH} = 14.00 - 1.52 = 12.48$$

9.) $\text{pOH} = 14.00 - 11.56 = 2.44$
 $[\text{OH}^-] = [\text{KOH}] = 10^{-2.44} = 3.6 \times 10^{-3} \text{ M}$

$0.8000 \text{ L} \frac{3.6 \times 10^{-3} \text{ mol}}{\text{L}} \left| \frac{56.11 \text{ g KOH}}{1 \text{ mol KOH}} \right. = 0.16 \text{ g KOH}$



$K_b = \frac{[\text{NH}_4^+][\text{OH}^-]}{[\text{NH}_3]} = 1.8 \times 10^{-5} = \frac{x^2}{0.150 - x}$ insignificant

$x = [\text{OH}^-] = 1.6 \times 10^{-3} \text{ M}$

$\% = \frac{1.6 \times 10^{-3}}{0.150} \times 100 = 1.1\%$ ✓

$\text{pOH} = -\log(1.6 \times 10^{-3}) = 2.80$

$\text{pH} = 14.00 - 2.80 = 11.20$



$$K_b = 4.0 \times 10^{-4}$$

b)



$$K_w = 1.0 \times 10^{-14}$$



$$I \quad 0.20$$

$$0$$

$$0$$

$$C \quad -x$$

$$+x$$

$$+x$$

$$x$$

$$x$$

$$E \quad 0.20 - x$$

$$K_b = \frac{[(C_2H_5)_3NH^+][OH^-]}{[(C_2H_5)_3N]} = 4.0 \times 10^{-4} = \frac{x^2}{0.20 - x}$$

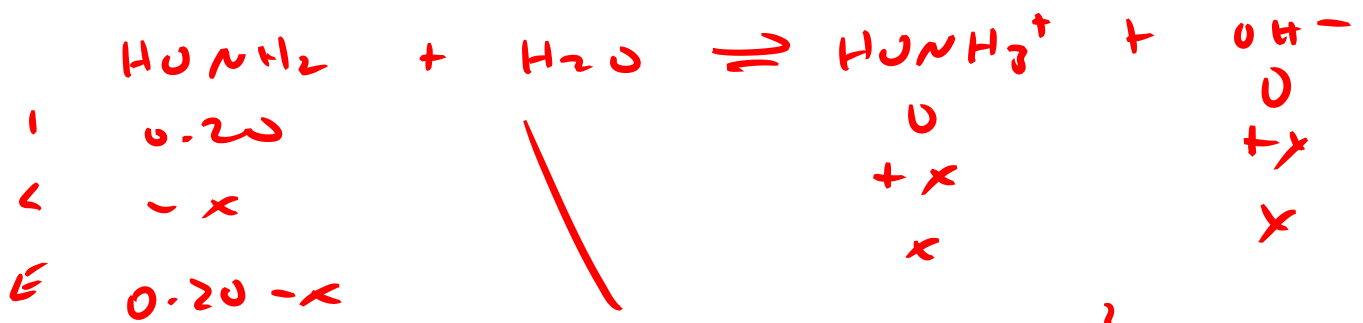
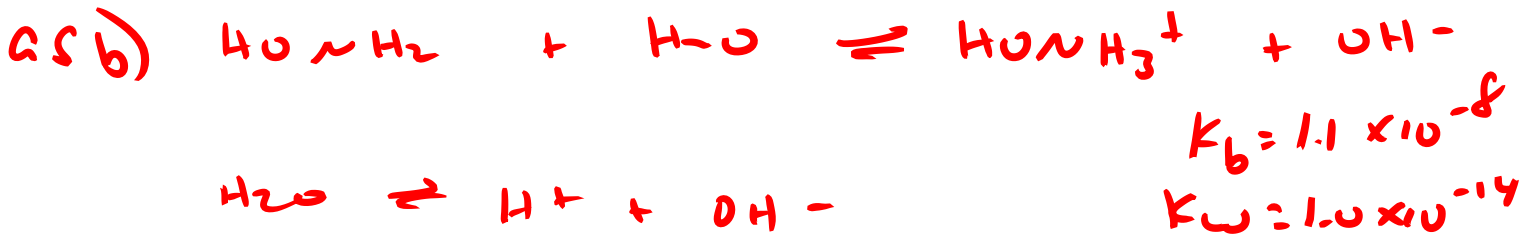
insignificant

$$x = [OH^-] = 8.9 \times 10^{-3} M$$

$$\frac{570}{100} \frac{8.9 \times 10^{-3}}{0.20} \times 100 = 4.570 \checkmark$$

$$[H^+] = \frac{1.0 \times 10^{-14}}{8.9 \times 10^{-3}} = 1.1 \times 10^{-12} M$$

$$pH = -\log(1.1 \times 10^{-12}) = 11.96$$



$$K_b = \frac{[\text{HONH}_3^+][\text{OH}^-]}{[\text{HONH}_2]} = 1.1 \times 10^{-8} = \frac{x^2}{0.20 - x}$$

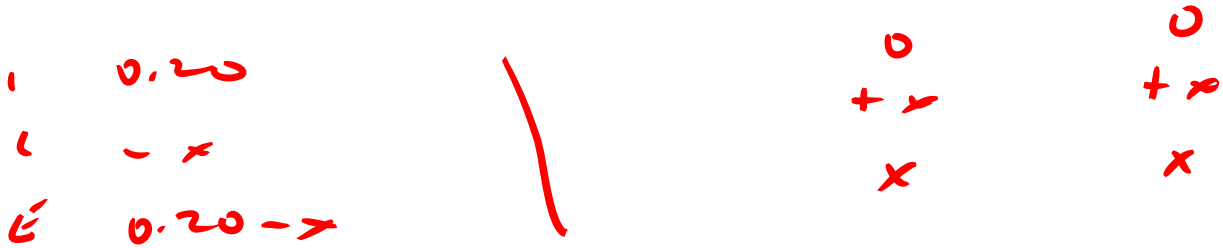
insignificant

$$x = [\text{OH}^-] = 4.7 \times 10^{-5} \text{ M}$$

$$\frac{5.5}{100} = \frac{1.1 \times 10^{-8} \times 1.00}{0.20} = 5.5 \times 10^{-6} \quad \checkmark$$

$$[\text{H}^+] = \frac{1.0 \times 10^{-14}}{4.7 \times 10^{-5}} = 2.1 \times 10^{-10} \text{ M}$$

$$\text{pH} = -\log(2.1 \times 10^{-10}) = 9.68$$



$$K_b = \frac{[\text{C}_2\text{H}_5\text{NH}_3^+][\text{OH}^-]}{[\text{C}_2\text{H}_5\text{NH}_2]} = 5.6 \times 10^{-4} = \frac{x^2}{(0.20 - x)}$$

insignif. fract

$$x = [\text{OH}^-] = 1.1 \times 10^{-2} \text{ M}$$

$$\frac{5.6}{100} = \frac{1.1 \times 10^{-2}}{0.20} \times 100 = 5.5 \frac{5.6}{100} \approx$$

$$\frac{x^2}{0.20 - x} = 5.6 \times 10^{-4}$$

$$x^2 = 1.12 \times 10^{-4} - 5.6 \times 10^{-4} x$$

$$x^2 + 5.6 \times 10^{-4} x - 1.12 \times 10^{-4} = 0$$

$$x = 1.0 \times 10^{-2} \text{ M} = [\text{OH}^-]$$

$$[\text{H}^+] = \frac{1.0 \times 10^{-14}}{1.0 \times 10^{-2}} = 1.0 \times 10^{-12}$$

$$\text{pH} = -\log(1.0 \times 10^{-12}) = 12$$

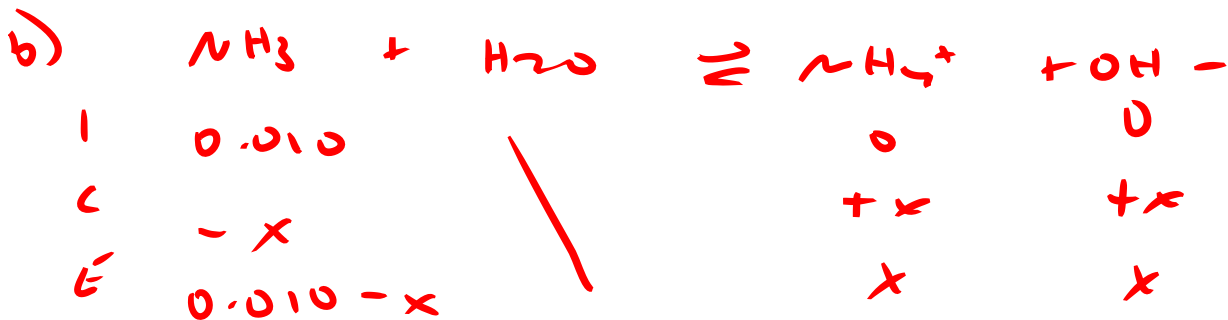


$$K_b = \frac{[\text{NH}_4^+][\text{OH}^-]}{[\text{NH}_3]} = 1.8 \times 10^{-5} = \frac{x^2}{0.10 - x}$$

insign.

$$x = [\text{OH}^-] = 1.3 \times 10^{-3}$$

$$\% \text{ (\% ionization)} = \frac{1.3 \times 10^{-3}}{0.10} \times 100 = 1.3\%$$

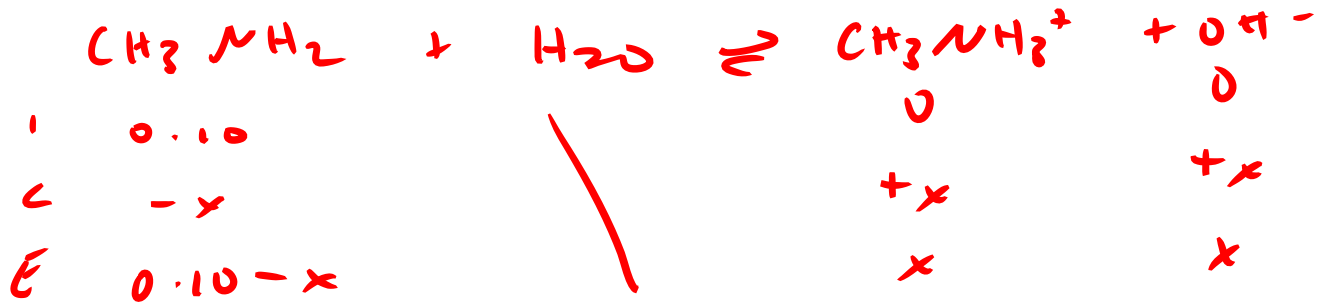


$$K_b = \frac{(x)^2}{0.010 - x} = 1.8 \times 10^{-5}$$

insignificant

$$x = [\text{OH}^-] = 4.2 \times 10^{-4} \text{ M}$$

$$\% \text{ : } \frac{4.2 \times 10^{-4}}{0.010} \times 100 = 4.2\%$$



$$K_b = \frac{[\text{CH}_3\text{NH}_3^+][\text{OH}^-]}{[\text{CH}_3\text{NH}_2]} = 4.38 \times 10^{-4} = \frac{x^2}{0.10 - x}$$

insign.

$$x = 6.6 \times 10^{-3} \text{ M} = [\text{OH}^-]$$

$$\% = \frac{6.6 \times 10^{-3}}{0.10} \times 100 = 6.6\%$$

$$\frac{x^2}{0.10 - x} = 4.38 \times 10^{-4}$$

$$x^2 = 4.38 \times 10^{-5} - 4.38 \times 10^{-4} x$$

$$x^2 + 4.38 \times 10^{-4} x - 4.38 \times 10^{-5} = 0$$

$$x = 6.4 \times 10^{-3} \text{ M} = [\text{OH}^-]$$

$$\% (\% \text{ ionization}) = \frac{6.4 \times 10^{-3}}{0.10} \times 100 = 6.4\%$$

101) PT = p-toluidine ($\text{CH}_3\text{C}_6\text{H}_4\text{NH}_2$)



$$K_b = \frac{[\text{PTH}^+][\text{OH}^-]}{[\text{PT}]} = \frac{x^2}{0.016 - x}$$

$$\text{pH} = 8.60 \quad \text{pOH} = 14.00 - 8.60 = 5.40$$

$$[\text{OH}^-] = 10^{-5.40} = 4.0 \times 10^{-6} \text{ M}$$

$$K_b = \frac{(4.0 \times 10^{-6})^2}{0.016 - (4.0 \times 10^{-6})} = 1.0 \times 10^{-9}$$