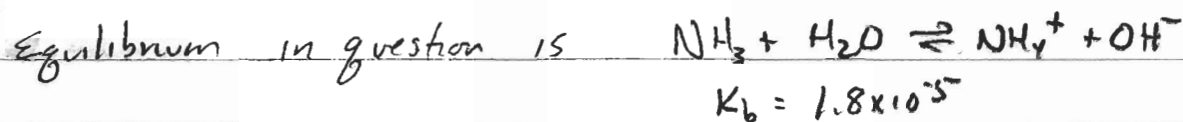


Bonus Calculation

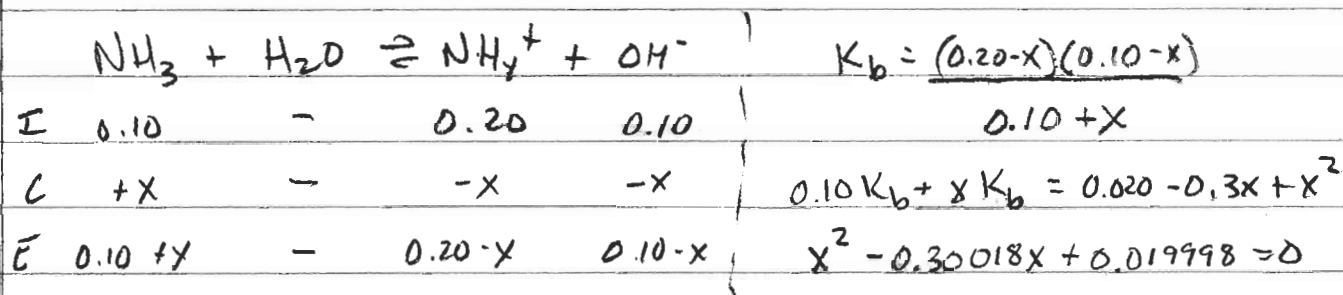
What are the equilibrium concentrations of a solution whose initial concentrations are $[\text{NH}_3] = 0.10 \text{ M}$, $[\text{NH}_4^+] = 0.20 \text{ M}$ and $[\text{OH}^-] = 0.10 \text{ M}$?



① are we at equilibrium?

$$Q = \frac{[\text{NH}_4^+][\text{OH}^-]}{[\text{NH}_3]} = \frac{(0.20)(0.10)}{(0.10)} = 0.2 > K_b, \text{ so too product heavy.}$$

② what happens as we go to equilibrium?



Solving for x: $x = 0.2004, 0.0998$

if $x = 0.2004$, $[\text{NH}_4^+] + [\text{OH}^-]$ at equilibrium would be negative, which cannot be, so

$x = 0.0998$ must be valid answer and

$$[\text{NH}_3] = 0.10 + x = 0.1998 = \underline{0.20 \text{ M}}$$

$$[\text{NH}_4^+] = 0.20 - x = 0.1002 = \underline{0.10 \text{ M}}$$

$$[\text{OH}^-] = 0.10 - x = 0.000199 = \underline{0.00020 \text{ M}}$$