

Quiz Free Response Practice (2009B, #1, 11 points)

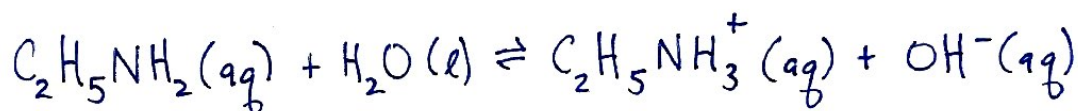
A pure 14.85 g sample of the weak base ethylamine, $C_2H_5NH_2$, is dissolved in enough distilled water to make 500. mL of solution.

- (a) Calculate the molar concentration of the $C_2H_5NH_2$ in the solution. (2 points)

$$14.85 \text{ g } C_2H_5NH_2 \times \frac{1 \text{ mol}}{45.086 \text{ g}} = 0.32937... \text{ mol } C_2H_5NH_2 \quad] \text{ 1 pt}$$

$$[C_2H_5NH_2] = \frac{0.32937 \text{ mol}}{0.500 \text{ L}} = \boxed{0.659 \text{ M}} \quad \leftarrow \text{ 1 pt}$$

- (b) Write an equation showing how the aqueous ethylamine reacts with water. (1 point)



- (c) Write the equilibrium-constant expression for the reaction between $C_2H_5NH_2(aq)$ and water. (1 point)

$$K_b = \frac{[C_2H_5NH_3^+][OH^-]}{[C_2H_5NH_2]}$$

- (d) Of $C_2H_5NH_2(aq)$ and $C_2H_5NH_3^+(aq)$, which is present in the solution at the higher concentration at equilibrium? Justify your answer. (1 point)

$$[C_2H_5NH_2]_{eq} > [C_2H_5NH_3^+]_{eq}$$

↑
Weak base, therefore $K_b < 1$, so $C_2H_5NH_2$ only partially dissociates
⇒ more weak base than conjugate acid at equilibrium

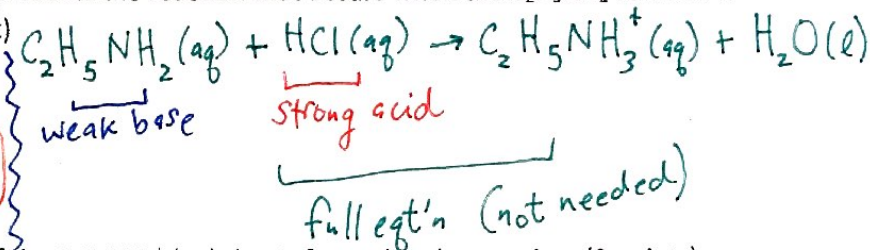
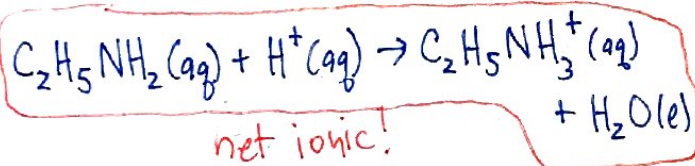
(e) A different solution is made by mixing 500. mL of 0.500 M $C_2H_5NH_2$ with 500. mL of 0.200 M HCl. Assume that volumes are additive. The pH of the resulting solution is found to be 10.93.

a. Calculate the concentration of $OH^-(aq)$ in the solution. (1 point)

$$pOH = 14 - pH = 14 - 10.93 = 3.07$$

$$[OH^-] = 10^{-pOH} = 10^{-3.07} = 8.5 \times 10^{-4} M$$

b. Write the net-ionic equation that represents the reaction that occurs when the $C_2H_5NH_2$ solution is mixed with the HCl solution. (1 point)



c. Calculate the molar concentration of the $C_2H_5NH_3^+(aq)$ that is formed in the reaction. (2 points)

not needed (yet!)
this will be more applicable
in Unit 8 (oops!)

d. Calculate the value of K_b for $C_2H_5NH_2$. (2 points)