

AP[®] CHEMISTRY
2009 SCORING GUIDELINES (Form B)

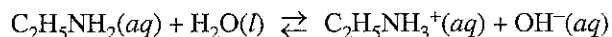
Question 1 (10 points)

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.

$n_{C_2H_5NH_2} = 14.85 \text{ g } C_2H_5NH_2 \times \frac{1 \text{ mol } C_2H_5NH_2}{45.09 \text{ g } C_2H_5NH_2}$ $= 0.3293 \text{ mol } C_2H_5NH_2$ $M_{C_2H_5NH_2} = \frac{0.3293 \text{ mol } C_2H_5NH_2}{0.500 \text{ L}} = \mathbf{0.659 \text{ M}}$	<p>One point is earned for the correct number of moles.</p> <p>One point is earned for the correct concentration.</p>
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The aqueous ethylamine reacts with water according to the equation below.



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

$K_b = \frac{[C_2H_5NH_3^+][OH^-]}{[C_2H_5NH_2]}$	<p>One point is earned for the correct expression.</p>
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- (c) 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.

<p>$C_2H_5NH_2$ is present in the solution at the higher concentration at equilibrium. Ethylamine is a weak base, and thus it has a small K_b value. Therefore only partial dissociation of $C_2H_5NH_2$ occurs in water, and $[C_2H_5NH_3^+]$ is thus less than $[C_2H_5NH_2]$.</p>	<p>One point is earned for the correct answer with justification.</p>
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Question 1 (continued)

(iv) Calculate the value of K_b for $C_2H_5NH_2$.

$$[C_2H_5NH_2] = \frac{0.150 \text{ mol } C_2H_5NH_2}{1.00 \text{ L}} = 0.150 \text{ M}$$

$$K_b = \frac{[C_2H_5NH_3^+][OH^-]}{[C_2H_5NH_2]} = \frac{(0.100)(8.5 \times 10^{-4})}{0.150} = 5.67 \times 10^{-4}$$

One point is earned for the correct calculation of the molarity of $C_2H_5NH_2$ after neutralization.

One point is earned for the correct value.