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AP[®] CHEMISTRY
2009 SCORING GUIDELINES (Form B)
Question 1 (continued)

(d) 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.

(i) Calculate the concentration of OH^- (aq) in the solution.

$pH = -\log[OH^-]$ $[OH^-] = 10^{-10.93} = 1.17 \times 10^{-11}$ $[OH^-] = \frac{K_w}{[H^+]} = \frac{1.00 \times 10^{-14}}{1.17 \times 10^{-11}} = 8.5 \times 10^{-4} M$ OR: $pOH = 14 - pH = 14 - 10.93 = 3.07$ $[OH^-] = -\log[OH^-]$ $[OH^-] = 10^{-3.07} = 8.5 \times 10^{-4} M$	One point is earned for the correct concentration.
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(ii) Write the net-ionic equation that represents the reaction that occurs when the $C_2H_5NH_2$ solution is mixed with the HCl solution.

$C_2H_5NH_2 + H_3O^+ \rightarrow C_2H_5NH_3^+ + H_2O$	One point is earned for the correct equation.
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(iii) Calculate the molar concentration of the $C_2H_5NH_3^+$ (aq) that is formed in the reaction.

moles of $C_2H_5NH_2 = 0.500 L \times \frac{0.500 mol}{1.00 L} = 0.250 mol$ moles of $H_3O^+ = 0.500 L \times \frac{0.200 mol}{1.00 L} = 0.100 mol$	One point is earned for the correct number of moles of $C_2H_5NH_2$ and H_3O^+ .
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	$[C_2H_5NH_2]$	$[H_3O^+]$	$[C_2H_5NH_3^+]$
initial value	0.250	0.100	0
change	-0.100	-0.100	+0.100
final value	0.150	0	0.100

$[C_2H_5NH_3^+] = \frac{0.100 mol C_2H_5NH_3^+}{1.00 L} = 0.100 M$

One point is earned for the correct concentration.