A solution will be made by dissolving 3.08 g of NH_4Cl in 50.0 mL of 0.20 M NH_3. Assume 50 mL of solution.

Determine the concentration of NH_4^+ in this mixture:

$$3.08 \text{ g } NH_4Cl \left(\frac{1 \text{ mole}}{53.5 \text{ g}}\right) = 0.058 \text{ mol } NH_4^+ \qquad [NH_4^+] = \left(\frac{0.058 \text{ mol}}{0.050 \text{ L}}\right) = 1.15 \text{ M}$$

Determine the pH of this solution using one of two different methods:

Consider the dissociation of NH_4^+ in the presence of some NH_3 (common ion effect)

	$NH_4^+(aq)$ + $H_2O(l)$	à	$NH_3(aq)$	+	$H_3O^+(aq)$
I	1.15		0.20		~0
C	-x		+x		+x
E	1.15 -x		0.20+x		x

$$K_a = 5.6x10^{-10} = \frac{[NH_3][H_3O^+]}{[NH_4^+]} = \frac{(0.20+x)(x)}{1.15-x}$$

x is likely to be small relative to 1.15 and to 0.20 because 1. NH_4^+ is a weak acid and 2. the common ion effect

$$K_a = 5.6x10^{-10} = \frac{(0.20+x)(x)}{1.15-x} \sim \frac{(0.20)(x)}{1.15}$$

$x = [H_3O^+] \sim 3.22x10^{-9}$ M , pH = 8.5

Consider the dissociation of NH_3 in the presence of some NH_4^+ (common ion effect)

	$NH_3(aq)$ + $H_2O(l)$	à	$NH_4^+(aq)$	+	$OH^-(aq)$
I	0.20		1.15		~0
C	-z		+z		+z
E	0.20-z		1.15+z		z

$$K_b = 1.8x10^{-5} = \frac{[NH_4^+][OH^-]}{[NH_3]} = \frac{(1.15+z)(z)}{0.20-z}$$

z is likely to be small relative to 1.15 and to 0.20 because 1. NH_3 is a weak base and 2. the common ion effect

$$K_b = 1.8x10^{-5} = \frac{(1.15+z)(z)}{0.20-z} \sim \frac{(1.15)(z)}{0.20}$$

$z = [OH^-] \sim 3.13x10^{-6}$ M , pOH = 5.5, pH = 8.5