

This is BCE#25.

I recommend you print out this page and bring it to class. [Click here](#) to show a set of five BCE25 student responses randomly selected from all of the student responses thus far in a new window.

John , here are [your responses](#) to the BCE and the [Expert's response](#).

1. Calculate the pH of a 500 mL solution containing 0.250 M NH_3 and 0.300 M NH_4NO_3 . K_b for NH_3 is 1.8×10^{-5} .

9.18 56%

12% pH = 4.8

	$\text{NH}_3(\text{aq})$ +	$\text{H}_2\text{O}(\text{l})$	\rightleftharpoons	$\text{NH}_4^+(\text{aq})$ +	$\text{OH}^-(\text{aq})$
I	0.250			0.300	~0
C	-x			+x	+x
E	$0.250 - x$			$0.300 + x$	+x

$$K_b = [\text{NH}_4^+][\text{OH}^-]/[\text{NH}_3]$$

$$1.75 \times 10^{-5} = [0.300 + x][x]/[0.250 - x]$$

$$\text{assume } 0.250 - x = 0.250$$

$$1.75 \times 10^{-5} = [0.300][x]/[0.250]$$

$$1.46 \times 10^{-5} = [x] = [\text{OH}^-]$$

The pOH of the solution is 4.84, so the pH is $14 - 4.84 = 9.16$.

b) Calculate the moles of NH_3 and NH_4^+ in the solution.

moles of $\text{NH}_3 = 0.125$ moles 75%

$0.500 \text{ L} (0.250 \text{ mole } \text{NH}_3/1\text{L}) = 0.125 \text{ mole } \text{NH}_3$

moles of $\text{NH}_4^+ = 0.15$ moles 75%

$0.500 \text{ L} (0.300 \text{ mole } \text{NH}_3/1\text{L}) = 0.150 \text{ mole } \text{NH}_4^+$

c) 0.00500 moles of HCl are added to the solution in Q1. After the addition, calculate the moles of NH_3 and NH_4^+ in the solution.

moles of $\text{NH}_3 = 0.12$ moles 62%

Since HCl reacts with NH_3 according to the reaction.

	$\text{NH}_3(\text{aq}) +$	$\text{H}^+(\text{aq})$	\rightleftharpoons	$\text{NH}_4^+(\text{aq}) +$
I	0.125 moles	0.005 moles		0.150 moles
C	-0.005 moles	-0.005 moles		+0.005 moles
E	0.120 moles	0 moles		0.155 moles

0.120 mole NH_3 after addition of the HCl

moles of $\text{NH}_4^+ = 0.155$ moles 62%

0.155 mole NH_4^+ after addition of the HCl

d) Calculate the pH of the solution after the addition of the 0.00500 moles of HCl .

$\text{pH} = 9.14$ 44%

$0.120 \text{ mole } \text{NH}_3/0.500 \text{ L} = 0.240 \text{ M } \text{NH}_3$

$$0.155 \text{ mole NH}_4^+ / 0.500 \text{ L} = 0.310 \text{ M NH}_4^+$$

	$\text{NH}_3(\text{aq})$ +	$\text{H}_2\text{O}(\text{l})$	\rightleftharpoons	$\text{NH}_4^+(\text{aq})$ +	$\text{OH}^-(\text{aq})$
I	0.240			0.310	~0
C	-x			+x	+x
E	0.240 - x			0.310 + x	+x

$$K_b = [\text{NH}_4^+][\text{OH}^-]/[\text{NH}_3]$$

$$1.75 \times 10^{-5} = [0.310 + x][x]/[0.240 - x]$$

$$\text{assume } 0.240 - x = 0.240$$

$$1.75 \times 10^{-5} = [0.310][x]/[0.240]$$

$$1.35 \times 10^{-5} = [x] = [\text{OH}^-]$$

The pOH of the solution is 4.87, so the pH is $14 - 4.87 = 9.13$.

e) Calculate the pH after adding 0.125 moles of HCl to the solution in Q1.

$$\text{pH} = 4.76 \quad 31\%$$

	$\text{NH}_3(\text{aq})$ +	$\text{H}^+(\text{aq})$	\rightleftharpoons	$\text{NH}_4^+(\text{aq})$ +
I	0.125 moles	0.125 moles		0.150 moles
C	-0.125 moles	-0.125 moles		+0.125 moles
E	0 moles	0 moles		0.275 moles

$$0.275 \text{ mole NH}_4^+ / 0.500 \text{ L} = 0.550 \text{ M NH}_4^+$$

	$\text{NH}_4^+(\text{aq})$	\rightleftharpoons	$\text{NH}_3(\text{aq}) +$	$\text{H}^+(\text{aq})$
I	0.550		0	~0
C	-x		+x	+x
E	0.550 - x		+ x	+x

$$K_a = K_w/K_b = 1.0 \times 10^{-14} / 1.75 \times 10^{-5} = [\text{NH}_3][\text{H}^+] / [\text{NH}_4^+]$$

$$5.71 \times 10^{-10} = [x][x] / [0.550 - x]$$

$$\text{assume } 0.550 - x = 0.550$$

$$5.71 \times 10^{-10} = [x][x] / [0.550]$$

$$3.14 \times 10^{-10} = x^2 = [\text{H}^+]$$

$$1.77 \times 10^{-5} \text{ M} = x = [\text{H}^+]$$

The pH of the solution is 4.75.

2. Is there anything about the questions that you feel you do not understand? List your concerns/questions.

nothing

3. If there is one question you would like to have answered in lecture, what would that question be?

nothing