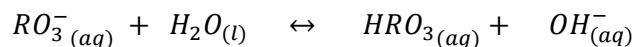


# CHEM 209 WRAP UP ASSIGNMENT

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## CHOSEN SCENARIO : SCENARIO 2

1. A) Where did the student go wrong in their calculations? Why is this considered incorrect?



Q:  $3.0 \times 10^{-2}$  mols of  $RO_3^-(aq)$  is added to 1.5L of water and reacts according to the reaction above. The pKb of  $RO_3^-(aq)$  is 5.9. Calculate the concentration of  $OH^-(aq)$  in the solution.

	$RO_3^-(aq)$	$H_2O(l)$	$HRO_3(aq)$	$OH^-(aq)$
I	$3.0 \times 10^{-2}$	1.5	0	0
C	-X	-X	+X	+X
E	$3.0 \times 10^{-2} - X$	$1.5 - X$	X	X

$$K = \frac{[P]}{[R]}$$

$$5.9 = \frac{[X][X]}{[3.0 \times 10^{-2} - X][1.5 - X]}$$

$$5.9x^2 - 9.027x + 0.2655 = x^2$$

$$4.9x^2 - 9.027x + 0.2655 = 0$$

$$x = 3.0 \times 10^{-2} \text{ mol/L and } x = 1.8 \text{ mol/L}$$

$\therefore x = 3.0 \times 10^{-2}$  Because if it was equal to 1.8, we would have a negative equilibrium concentration on  $RO_3^-(aq)$

$$[OH^-] = x = 3.0 \times 10^{-2} \text{ mol/L}$$

B) Calculate the correct  $[OH^-]$  and Kb values in the problem above. Use these corrected values to find the pH and pOH of the solution.

C) Create a Lewis Structure Diagram of each molecule in the reaction (reactants and products) to show how the molecules changed throughout the reaction.

SOLUTIONS:

A) The student made three big errors in their calculations. The student was told that  $3.0 \times 10^{-2} \text{ mol RO}_3^-$  was added to 1.5L of water for this reaction. The student used this to create an incorrect ICE table. This ICE table is wrong because the student used  $\text{H}_2\text{O}_{(l)}$  in their calculations. Liquid water cannot be used as there is no way of a liquid having a concentration. Another mistake was using the 1.5L of  $\text{H}_2\text{O}_{(l)}$  as a concentration rather than using it to calculate the true concentration of  $\text{RO}_3^-$ . This was incorrect as 1.5L is not a concentration and not finding the concentration of  $\text{RO}_3^-$  correctly causes an incorrect "x" value. The final mistake was using the  $\text{pK}_b$  value in their calculation rather than the  $\text{K}_b$  value. The  $\text{pK}_b$  is used to represent the strength of a base while the  $\text{K}_b$  value is the dissociation constant used for the calculations. The student needed to make the conversion from  $\text{pK}_b$  to  $\text{K}_b$  before their calculations.

B)  $\frac{3.0 \times 10^{-2} \text{ mol}}{1.5 \text{ L}} = 2.0 \times 10^{-2} \text{ mol/L}$   $\text{K}_b = 10^{-5.9} = 1.2589 \times 10^{-6}$

	$\text{RO}_3^-(\text{aq})$	+	$\text{H}_2\text{O}_{(l)}$	$\rightleftharpoons$	$\text{HRO}_3(\text{aq})$	+	$\text{OH}^-(\text{aq})$
I	$2.0 \times 10^{-2}$				0		0
C	-x				+x		+x
E	$2.0 \times 10^{-2} - x$				x		x

Small x approx:  $\frac{2.0 \times 10^{-2}}{1.2589 \times 10^{-6}} > 1000$   
 $\therefore 2.0 \times 10^{-2} - x = 2.0 \times 10^{-2}$

$$1.2589 \times 10^{-6} = \frac{x^2}{2.0 \times 10^{-2} - x}$$

$$1.2589 \times 10^{-6} = \frac{x^2}{2.0 \times 10^{-2}} \rightarrow 2.5178 \times 10^{-4} = x^2$$

$x = 0.01586$   
 $x = 0.016$

$[\text{OH}^-] = x = 0.016 \text{ M}$   $\text{pOH} = -\log[\text{OH}^-] = 1.80$   
 $\text{pH} = 14 - \text{pOH} = 12.20$

