

CHEM 131
Quiz 7 – October 30, 2019

Name _____

Complete the following problems. Write your final answers in the blanks provided. You must show your work to receive full credit. Show your answers to the correct number of significant figures with the correct units.

1. Calculate the pH and pOH of an aqueous solution that is 0.0100 M HNO₃, 0.0150 M HCl and 0.0125 M H₂SO₄. Assume all of the solutes are strong acids. (8 points)

We have three sources of H⁺ in solution, so the total [H⁺] must be the sum of the contributions from all three sources: [H⁺]_{total} = [H⁺]_{HNO₃} + [H⁺]_{HCl} + [H⁺]_{H₂SO₄}

These are all strong acids, so each of the dissociation reaction goes to completion. Given that:

$$[\text{H}^+]_{\text{HNO}_3} = \frac{0.0100 \text{ mol HNO}_3}{1 \text{ L}} \times \frac{1 \text{ mol H}^+}{1 \text{ mol HNO}_3} = 0.0100 \text{ M}$$

$$[\text{H}^+]_{\text{HCl}} = \frac{0.0150 \text{ mol HCl}}{1 \text{ L}} \times \frac{1 \text{ mol H}^+}{1 \text{ mol HCl}} = 0.0150 \text{ M}$$

$$[\text{H}^+]_{\text{H}_2\text{SO}_4} = \frac{0.0125 \text{ mol H}_2\text{SO}_4}{1 \text{ L}} \times \frac{2 \text{ mol H}^+}{1 \text{ mol H}_2\text{SO}_4} = 0.0250 \text{ M}$$

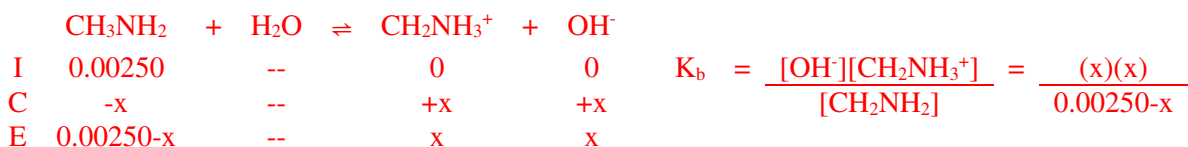
$$[\text{H}^+]_{\text{total}} = 0.0100 \text{ M} + 0.0150 \text{ M} + 0.0250 \text{ M} = 0.0500 \text{ M}$$

$$\text{pH} = -\log[\text{H}^+]_{\text{total}} = -\log(0.0500 \text{ M}) = 1.30$$

$$\text{pOH} = 14 - \text{pH} = 12.70$$

Answer _____ **pH = 1.30 pOH = 12.70** _____

2. Methylamine (CH₃NH₂), is a monobasic weak base, which can accept a proton from water to form the methylammonium ion (CH₂NH₃⁺) and hydroxide. If the pH of a 0.00250 M solution of methylamine is 10.92, what is the K_b for methylamine? (8 points)



Since we are given pH, we can calculate the [OH⁻], which is x in our K_b expression:

$$\text{pOH} = 14 - \text{pH} = 3.08$$

$$[\text{OH}^-] = 10^{-\text{pOH}} = 10^{-3.08} = 8.318 \times 10^{-4} \text{ M} = x$$

Inserting this for x in our K_b expression gives

$$K_b = \frac{[\text{OH}^-][\text{CH}_2\text{NH}_3^+]}{[\text{CH}_2\text{NH}_2]} = \frac{(8.318 \times 10^{-4})^2}{0.00250 - 8.318 \times 10^{-4}} = 4.15 \times 10^{-4}$$

Answer _____ **K_b = 4.15 x 10⁻⁴** _____

