## pH Calculations QUESTION 1. (4 steps excellence)

**Question:** Calculate the pH of a 0.109 mol L\(^{-1}\) solution of ethanamine.

- \(pK_a(CH_3CH_2NH_3^+) = 10.6\)
- \(K_w = 1.00 \times 10^{-14}\)

**Answer**

1. **determine if the solution is acid or base (will it accept or donate H\(^+\)) – strong or weak**
   - Ethanolamine is a weak base
   - \(c(\text{ethanolamine}) = 0.109 \text{ mol L}^{-1}\)
   - \(pK_a(CH_3CH_2NH_3^+) = 10.6\)
   - \(K_w = 1.00 \times 10^{-14}\)

2. **convert \(pK_a\) to \(K_a\)**
   - \(K_a = 10^{-pK_a}\)
   - \(K_a = 10^{-10.6}\)
   - \(K_a = 2.51 \times 10^{-11}\)

3. **calculate \([H_3O^+]\)**
   - \([H_3O^+] = \sqrt{K_a \times K_w}\)  
   - \([H_3O^+] = \sqrt{2.51 \times 10^{-11} \times 1.00 \times 10^{-14}}\)
   - \([H_3O^+] = 1.52 \times 10^{-12}\) mol L\(^{-1}\)

4. **calculate pH**
   - \(pH = -\log [H_3O^+]\)
   - \(pH = -\log [1.52 \times 10^{-12}\) mol L\(^{-1}\]
   - \(pH = 11.8\)

**Double check answer against expected pH for your solution**

\((pH\ range\ for\ weak\ base\ is\ 8-12)\ \text{yes}\)

## pH Calculations QUESTION 2. (3 steps Merit)

**Question:** Calculate the pH of 0.0152 mol L\(^{-1}\) \(CH_3NH_3Cl\) solution.

- \(K_a(CH_3NH_3^+) = 2.29 \times 10^{-11}\)

**Answer**

1. **determine if the solution is acid or base (will it accept or donate H\(^+\)) – strong or weak**
   - \(CH_3NH_3Cl\) is a weak acid (salt)
   - \(c(\text{CH}_3\text{NH}_3\text{Cl}) = 0.0152\) mol L\(^{-1}\)
   - \(K_a(CH_3NH_3^+) = 2.29 \times 10^{-11}\)

2. **calculate \([H_3O^+]\)**
   - \([H_3O^+] = \sqrt{K_a \times c(\text{HA})}\)
   - \([H_3O^+] = \sqrt{2.29 \times 10^{-11} \times 0.0152}\) mol L\(^{-1}\)
   - \([H_3O^+] = 5.90 \times 10^{-7}\) mol L\(^{-1}\)

3. **calculate pH**
   - \(pH = -\log [H_3O^+]\)
   - \(pH = -\log [5.90 \times 10^{-7}\) mol L\(^{-1}\]
   - \(pH = 6.23\)

**Double check answer against expected pH for your solution**

\((pH\ range\ for\ weak\ acid\ is\ 3-6.9)\ \text{yes}\)

**NOTE:** The white column is how your answer would appear on your test paper so make sure you write out complete sentences. The grey area is just to help you structure your answer and would not appear in the question.