

I am slightly confused about one certain task. There are 4 different solutions (NH₃, HCl, NaOH, CH₃COOH), their concentration is the same (c=1 mol/l). The question is which solution has pH that is higher than 7, but lower than 14. It is obvious that HCl and organic acid cannot have such concentration of hydrogen ions. Both ammonia and sodium hydroxide have base properties. NH₃ is a weaker base though. I am not sure how to find the concentration of hydroxide in NH₃ and NaOH properly. Thank you for the explanation.

pH 1M NaOH

Solution

$$c_{\text{NaOH}} = 1\text{M}$$



$$[\text{OH}^-] = 1\text{M}$$

$$\text{pOH} = -\log[\text{OH}^-]$$

$$\text{pOH} = -\log [1]$$

$$\log 1 = 0$$

$$\text{pOH} = 0$$

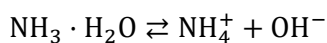
$$\text{pH} = 14 - \text{pOH}$$

$$\text{pH} = 14 - 0 = 14$$

Answer: pH = 14

pH 1M ammonia aqueous solution (NH₃ · H₂O)

Solution:



$$K_b = \frac{[\text{NH}_4^+][\text{OH}^-]}{[\text{NH}_3 \cdot \text{H}_2\text{O}]} = 1.8 \cdot 10^{-5}$$

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

$$[\text{NH}_3 \cdot \text{H}_2\text{O}] \approx c_{\text{NH}_3 \cdot \text{H}_2\text{O}}$$

$$K = \frac{[\text{OH}]^2}{[\text{NH}_3 \cdot \text{H}_2\text{O}]}$$

$$[\text{OH}^-] = \sqrt{K_b \cdot c_{\text{NH}_3 \cdot \text{H}_2\text{O}}} = \sqrt{1.8 \times 10^{-5} \cdot 1} = 0.0042426$$

$$\text{pOH} = -\log[\text{OH}^-] = -\log[0.0042426] = -2.37$$

$$\text{pH} = 14 - 2.37 = 11.63$$

Answer: pH = 11.63