

UNIT 4 - CHEMICAL SYSTEMS & EQUILIBRIUM

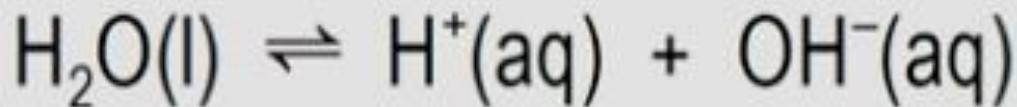
Lesson 10

Calculating pH of Bases

Learning Goals

- I will be able to calculate the pH of solutions of bases.

$$\text{pH} = -\log [\text{H}^+]$$

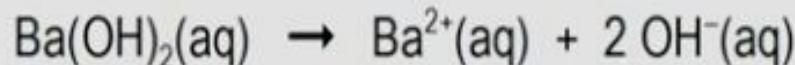


$$K_w = [\text{H}^+][\text{OH}^-]$$

$$= 1.0 \times 10^{-14} \quad (\text{at } 25^\circ\text{C})$$

Example 1

Calculate the pH of a 0.080 mol/L barium hydroxide solution.



$$c_{\text{Ba(OH)}_2} = 0.080 \text{ mol/L}$$

strong base; 100% dissociated

$$\begin{aligned} [\text{OH}^-] &= 2(0.080 \text{ mol/L}) \\ &= 0.16 \text{ mol/L} \end{aligned}$$

$$K_w = [\text{H}^+][\text{OH}^-]$$

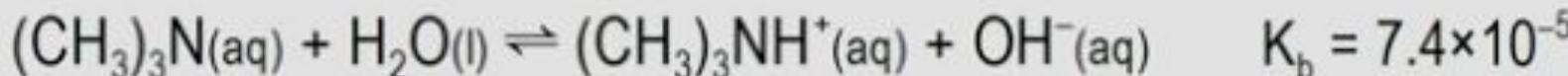
$$\begin{aligned} [\text{H}^+] &= \frac{K_w}{[\text{OH}^-]} \\ &= \frac{1.0 \times 10^{-14}}{0.16} \\ &= 6.25 \times 10^{-14} \text{ mol/L} \end{aligned}$$

$$\begin{aligned} \text{pH} &= -\log [\text{H}^+] \\ &= -\log (6.25 \times 10^{-14}) \\ &= -(-13.2041\dots) \\ &= 13.2041\dots \end{aligned}$$

Therefore, the pH of the solution is 13.20.

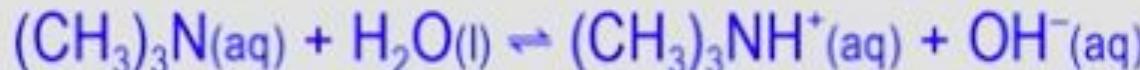
Example 2

Calculate the pH of a 0.080 mol/L trimethylamine solution.



$$c_{(\text{CH}_3)_3\text{N}} = 0.080 \text{ mol/L}$$

weak base; equilibrium



INITIAL CONCENTRATION	0.080	—	0	~0
CHANGE IN CONCENTRATION	$-x$	—	$+x$	$+x$
EQUILIBRIUM CONCENTRATION	$0.080 - x$	—	x	x

EQUILIBRIUM
CONCENTRATION

$$0.080-x \quad x \quad x$$

$$K_b = \frac{[(\text{CH}_3)_3\text{NH}^+][\text{OH}^-]}{[(\text{CH}_3)_3\text{N}]}$$

$$7.4 \times 10^{-5} = \frac{(x)(x)}{0.080-x}$$

$$7.4 \times 10^{-5} = \frac{x^2}{0.080-x}$$

$$7.4 \times 10^{-5} = \frac{x^2}{0.080}$$

assume $0.080-x = 0.080$

$$\sqrt{(7.4 \times 10^{-5})(0.080)} = x$$

$$2.4331 \dots \times 10^{-3} = x$$

$$[\text{OH}^-]_{\text{eq}} = x \text{ mol/L}$$

$$= 2.4331 \dots \times 10^{-3} \text{ mol/L}$$

$$[\text{H}^+] = \frac{K_w}{[\text{OH}^-]}$$

$$= \frac{1.0 \times 10^{-14}}{2.4331 \dots \times 10^{-3}}$$

$$= 4.1099 \dots \times 10^{-12} \text{ mol/L}$$

$$\text{pH} = -\log [\text{H}^+]$$

$$= -\log (4.1099 \dots \times 10^{-12})$$

$$= -(-11.3861 \dots)$$

$$= 11.3861 \dots$$

Therefore, the pH of the solution is 11.39.

Success Criteria

- ❑ I can calculate the pH of solutions of bases.

PRACTICE:

- Worksheet: 'PRACTICE: CALCULATING pH OF BASES'