

# UNIT 4 - CHEMICAL SYSTEMS & EQUILIBRIUM

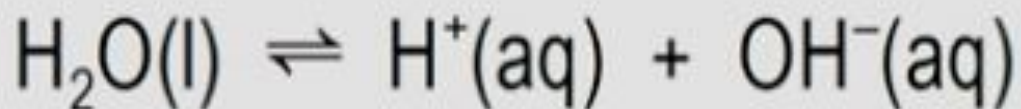
## Lesson 10

# Calculating pH of Bases

## Learning Goals

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

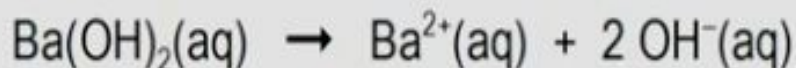
$$\text{pH} = -\log [\text{H}^+]$$



$$\begin{aligned} K_w &= [\text{H}^+][\text{OH}^-] \\ &= 1.0 \times 10^{-14} \quad (\text{at } 25^\circ\text{C}) \end{aligned}$$

### 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

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

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

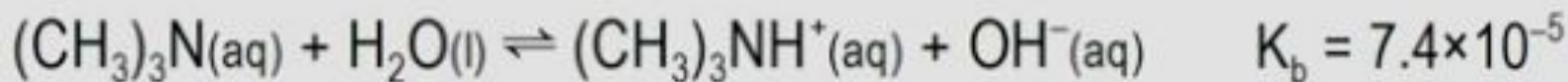
$$\begin{aligned} [\text{H}^{+}] &= \frac{K_w}{[\text{OH}^{-}]} \\ &= \frac{1.0 \times 10^{-14}}{0.16} \\ &= 6.25 \times 10^{-14} \text{ mol/L} \end{aligned}$$

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

Therefore, the pH of the solution is 13.20.

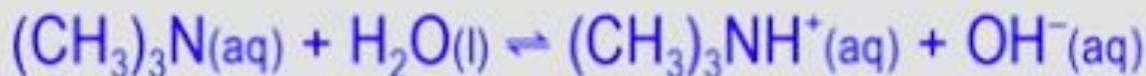
## Example 2

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

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

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

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

assume  $0.080-x = 0.080$

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

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

$$\begin{aligned} [\text{OH}^-]_{\text{eq}} &= x \text{ mol/L} \\ &= 2.4331 \times 10^{-3} \text{ mol/L} \end{aligned}$$

$$\begin{aligned} [\text{H}^+] &= \frac{K_w}{[\text{OH}^-]} \\ &= \frac{1.0 \times 10^{-14}}{2.4331 \times 10^{-3}} \\ &= 4.1099 \times 10^{-12} \text{ mol/L} \end{aligned}$$

$$\begin{aligned} \text{pH} &= -\log [\text{H}^+] \\ &= -\log (4.1099 \times 10^{-12}) \\ &= -(-11.3861 \dots) \\ &= 11.3861 \dots \end{aligned}$$

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**'