

## 6.5 - pH and pOH Scale.notebook

### 6.5 - pH and pOH Scale Assignment

1. Calculate the pH of a solution of nitric acid that:  $\text{HNO}_3 \rightarrow \text{H}^+ + \text{NO}_3^-$

a. has a concentrations of  $1.0 \times 10^{-4} \text{ M}$   $\leftarrow$  strong  $\therefore$  complete.

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

$$\text{pH} = -\log(1.0 \times 10^{-4} \text{ M})$$

$$\text{pH} = 4$$

- b. consists of 6.3 g of solute dissolved in 1.00 L of solution?

$$M = \frac{\text{wt}}{\text{mm} \cdot V} = \frac{6.3 \text{ g}}{(63.02 \frac{\text{g}}{\text{mol}})(1 \text{ L})} = 0.09996 \text{ M}$$

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

$$= -\log(0.09996 \text{ M})$$

$$\text{pH} = 1.00$$

2. Calculate the pH of a solution that consists of 5.0 g of HCl in 250 mL of solution.

$$M = \frac{\text{wt}}{\text{mm} \cdot V} = \frac{5.0 \text{ g}}{(36.46 \frac{\text{g}}{\text{mol}})(0.25 \text{ L})} = 0.50 \text{ M}$$

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

$$= -\log[0.50]$$

$$\text{pH} = 0.30$$

3. What is the  $[\text{H}^+]$  of a solution with a pH of 10.0 at  $25^\circ\text{C}$ ? What is the pOH?

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

$$10.0 = -\log[\text{H}^+]$$

$$[\text{H}^+] = \text{antilog}(-10)$$

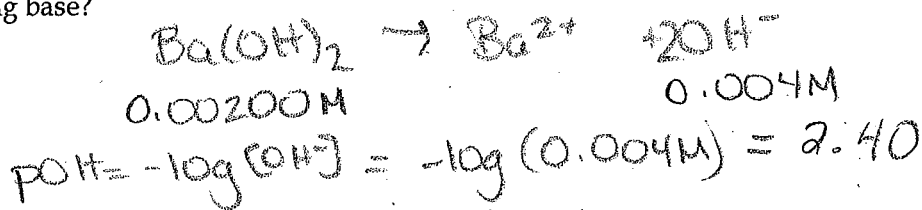
$$[\text{H}^+] = 1.0 \times 10^{-10}$$

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

$$\text{pOH} = 14 - 10 = 4$$

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4. What is the pH of an aqueous solution containing 0.00200 M barium hydroxide,  $\text{Ba}(\text{OH})_2$ , a strong base?



$$\begin{aligned} \text{pOH} + \text{pH} &= 14 \\ \text{pH} &= 14 - \text{pOH} = 14 - 2.40 = \boxed{11.6} \end{aligned}$$

5. Determine the  $K_b$  for the benzoate ion,  $\text{C}_6\text{H}_5\text{COO}^-$ .

$$K_a = 6.6 \times 10^{-5}$$

$$K_a \times K_b = 1.0 \times 10^{-14}$$

$$6.6 \times 10^{-5} \times K_b = 1.0 \times 10^{-14}$$

$$\therefore K_b = 1.5 \times 10^{-10}$$

6. Calculate the pOH of a 0.100 M solution of acetic acid.

$$K_a = \frac{[\text{H}_3\text{O}^+][\text{CH}_3\text{COO}^-]}{[\text{CH}_3\text{COOH}]}$$

$$1.8 \times 10^{-5} = \frac{x^2}{0.10\text{M}}$$

$$\therefore x^2 = 1.8 \times 10^{-6}\text{M}$$

$$x = 1.34 \times 10^{-3}\text{M}$$

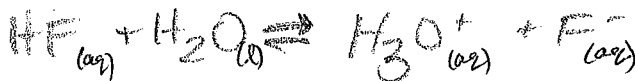


$$\begin{aligned} \text{pH} &= -\log[\text{H}^+] \\ &= -\log(1.34 \times 10^{-3}\text{M}) \end{aligned}$$

$$\text{pH} = 2.87$$

$$\begin{aligned} \text{pOH} &= 14 - \text{pH} \\ &= 14 - 2.87 = \boxed{11.1} \end{aligned}$$

7. A 2.67 g sample of hydrogen fluoride gas (HF) is dissolved in sufficient water to make 1.05 L of solution at 25°C to form an acidic solution. Hydrogen fluoride is a weak acid with  $K_a = 6.6 \times 10^{-4}$ .



Calculate the pOH of this solution.

$$M = \frac{\text{wt}}{\text{mm.v}} = \frac{2.67\text{g}}{(60.0\text{g/mol})(1.05\text{L})} = 0.127\text{M} = [\text{HF}]$$

$$K_a = \frac{[\text{H}_3\text{O}^+][\text{F}^-]}{[\text{HF}]}$$

$$6.6 \times 10^{-4} = \frac{x^2}{0.127\text{M}}$$

$$\therefore x^2 = 8.38 \times 10^{-5}\text{M}$$

$$x = 9.15 \times 10^{-3}\text{M}$$

$$\begin{aligned} \text{pH} &= -\log[\text{H}^+] \\ &= -\log(9.15 \times 10^{-3}\text{M}) \end{aligned}$$

$$\text{pH} = 2.04$$

$$\begin{aligned} \text{pOH} &= 14 - \text{pH} \\ &= 14 - 2.04 \end{aligned}$$

$$\boxed{\text{pOH} = 11.96 = 12}$$

8. A 0.20M solution.  
What is  $K_a$ ?

$$pH = -\log [H^+]$$

$$1.67 = -\log [H^+]$$

$$[H^+] = \text{antilog}(-1.67)$$

$$[H^+] = 0.021379 \text{ M}$$



$$K_a = \frac{[A^-][H^+]}{[AH]} = \frac{(2.13 \times 10^{-2})^2}{(0.20M)} = \boxed{2.2 \times 10^{-3}}$$

