Class Announcements

8.10 What Are Buffers? – Identifying Buffer Solutions

How many of the following aqueous solutions are buffers? 3!

a) 0.24 M HI + 0.18 M NaI ✗ ... HI is a strong acid

d) 0.10 M CH_3COOH + 0.18 M CH_3COOK ✓ ... Weak acid and its conjugate base

c) 0.27 M NH_4Br + 0.31 M NH_3 ✓ ... Weak acid and its conjugate base

b) 0.34 M NH_4NO_3 + 0.39 M $NaNO_3$ ✗ ... NO_3^- is not the conjugate base of NH_4^+

d) 0.10 M HCl + 0.21 M NaF ✓!

SA + WB = 100%

$H_3O^+ + F^- \rightarrow H_2O(l) + HF(aq)$

0.1M 0.21M → 0.11M 0.1M

After Reaction 0.1M HF and 0.11M F^- Remain!

8.10 What Are Buffers? – How Do They Resist Drastic pH Changes

(d)

A 1L solution contains 0.25 mol of NaCN and 0.15 mol of HCN.

1. Increase significantly
2. Increase slightly
3. Decrease significantly
4. Decrease slightly
5. Increase
6. Decrease

a) Addition of 0.1 mol of HCl will case the [HCN] to –

5. $H_3O^+ + CN^- = HCN(aq) + H_2O(l)$

b) Addition of 0.1 mol of HCl will case the pOH to –

2. pH ↓ slightly with the addion of H_3O^+ ... pH + pOH = 14 ... pOH ↑ slightly

c) Addition of 0.1 mol of NaOH will case the [HCN] to –

6. $OH^- + HCN(aq) = H_2O(l) + CN^-$

d) Addition of 0.2 mol of NaOH will case the pH to –

1. Buffer capacity exceeded ... pH will increase significantly.

8.11 How do We Calculate the pH of a Buffer?

$$HA_{(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+ + A^-$$

$$K_a = \frac{[H_3O^+][A^-]}{[HA]}$$

$$pH = -\log_{10}[H_3O^+]$$

$$[H_3O^+] = K_a\left([HA]/[A^-]\right)$$

$$\log_{10}[H_3O^+] = \log_{10}K_a + \log_{10}[HA]/[A^-]$$

$$-\log_{10}[H_3O^+] = -\log_{10}K_a - \log_{10}[HA]/[A^-]$$

$$pH = pK_a \left(-\log_{10}[HA]/[A^-]\right)$$

Math Magic!

$$pH = pK_a + \log_{10}[A^-]/[HA]$$

HA = weak acid, A^- is HA's conjugate base

Buffer pH: $pH = pK_a + \log_{10}\frac{[\text{Buffer base}]}{[\text{Buffer acid}]}$

↳ HENDERSON-HASSELBACK EQUATION

8.11 How do We Calculate the pH of a Buffer?

MAIN QUESTION

Question

A solution contains the following components

0.208 M HCO_2H ... Acid

0.376 M $NaHCO_2$ ... Base

What is the pH of the solution?

Ka HCO_2H = 1.8×10^{-4}

Answer

Enter a response, then Submit.

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$$pH = pK_a + \log_{10} \frac{[\text{Buffer base}]}{[\text{Buffer acid}]}$$

$$pH = -\log_{10}(1.8 \times 10^{-4}) + \log_{10} \frac{[HCO_2^-]}{[HCO_2H]}$$

$$pH = 3.745 + \log_{10}\left(\frac{0.376}{0.208}\right)$$

$$= 3.745 + \log_{10}(1.807)$$

$$= 3.745 + 0.257$$

$$= 4.002$$

8.11 How do We Calculate the pH of a Buffer?

Acid Base

A buffer solution made from HF and KF has a pH of 2.84. If the pKa for HF is 3.14, what is the $[F^-]/[HF]$ in the buffer?

$$\frac{[F^-]}{[HF]} = 0.5$$

$$pH = pKa + \log_{10}\frac{[\text{Buffer base}]}{[\text{Buffer acid}]}$$

$$2.84 = 3.14 + \log_{10}\frac{[F^-]}{[HF]}$$

$$2.84 - 3.14 = \log_{10}\frac{[F^-]}{[HF]}$$

$$-0.3 = \log_{10}\frac{[F^-]}{[HF]}$$

$$[F^-]/[HF] = 10^{-0.3} = 0.501$$