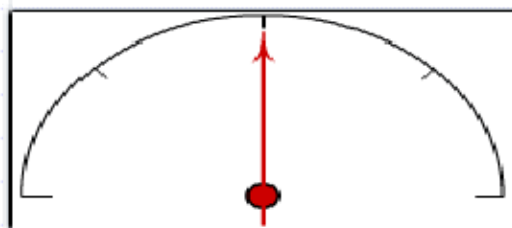


17.2 Buffers

What Constitutes a Buffer and why are they Special

Buffer Solutions

See Class Web Site



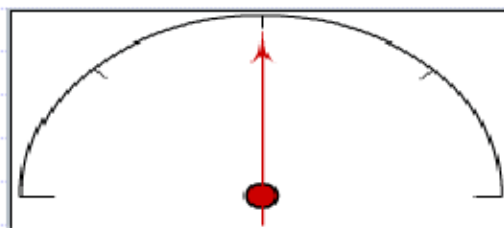
7.00



HCl

NaOH

100 mL
H₂O



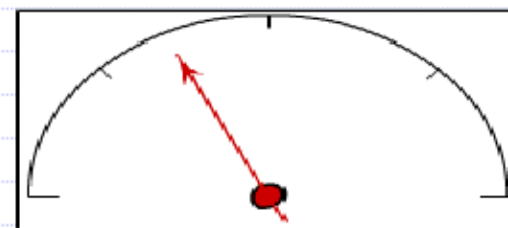
7.00



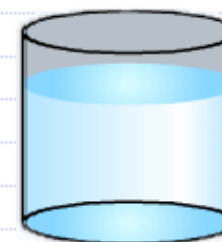
HCl

NaOH

100 mL
1.0 M NaCl



4.74



HCl

NaOH

100 mL
1.0 M CH₃CO₂H(aq)
1.0 M NaCH₃CO₂(aq)

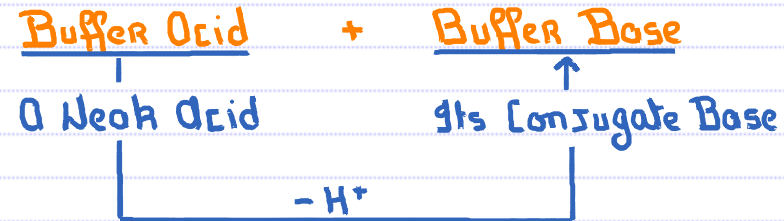
Weak acid (-H⁺)
Its conjugate base

17.2

Buffers

How do they Resist Drastic pH Change – A Summary

1. BUFFER :



2. How does a buffer resist drastic pH changes when it comes in contact with H_3O^+ or OH^-



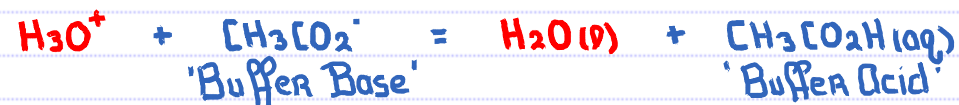
17.2

Buffers

How do they Resist Drastic pH Change

Buffer: 1M $\text{CH}_3\text{CO}_2\text{H}$ / 1M CH_3CO_2^-
Addition of Strong Acid – H_3O^+

$\text{CH}_3\text{CO}_2\text{H}$ / CH_3CO_2^-
Weak Acid / Conjugate Base
'Buffer Acid' / 'Buffer Base'



OVERALL CHANGES:

$[\text{CH}_3\text{CO}_2^-]$: ↓ ... Reacts with the added H_3O^+

$[\text{CH}_3\text{CO}_2\text{H}]$: ↑ ... Product of the reaction that removes the H_3O^+

$[\text{H}_3\text{O}^+]$: ↑ ... Slight increase ... the result of the ['Buffer Acid'] ↑

pH: ↓ ... from the slight increase in $[\text{H}_3\text{O}^+]$

17.2 Buffers

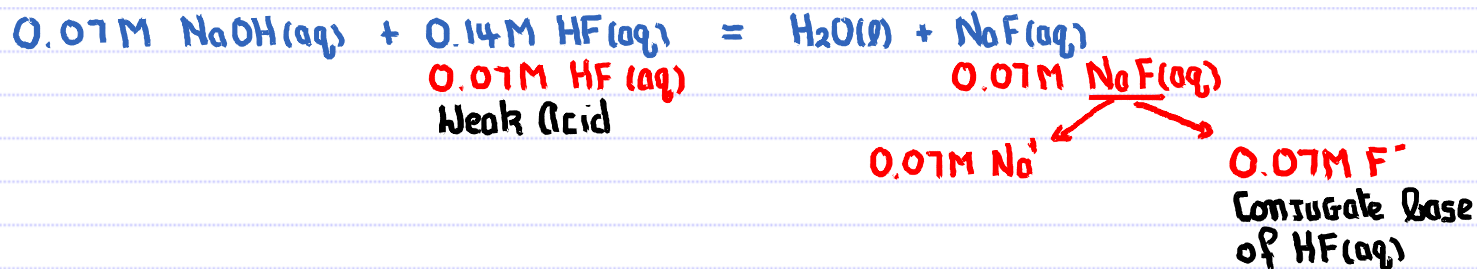
Identifying Buffers

Which of the following aqueous solutions are good buffer systems?

- 0.34 M ammonium bromide + 0.36 M ammonia
 NH_4^+ NH_3
- 0.22 M nitric acid + 0.16 M potassium nitrate
 Strong acid
- 0.32 M nitrous acid + 0.21 M potassium nitrite
 HNO_2 NO_2^-
- 0.18 M barium hydroxide + 0.21 M barium bromide
 Strong base
- 0.14 M hydrofluoric acid + 0.20 M sodium fluoride
 HF F^-

2 To Look Out For:

1.) Strong Acid + Weak Base	} When the concentration of the Strong is < concentration of the Weak.
2.) Weak Acid + Strong Base	



17.2 Buffers

Buffer pH – ICE

Calculate the pH of a buffer solution made from 1.00 L of a 0.133 M hydrofluoric acid and 0.243 mol of sodium fluoride.
 $K_a \text{ HF} = 7.2 \times 10^{-4}$

Shortest way to approach this is from the Buffer Acid equilibrium as this directly determines pH.

	HF(aq)	+ H ₂ O(l)	⇌	H ₃ O ⁺	+ F ⁻
I	0.133			0	0.243
C	-x			x	x
E	0.133 - x			x	0.243 + x

$$[\text{HF}]_i > 100(7.2 \times 10^{-4}), \quad 0.133 - x \approx 0.133$$

$$[\text{F}^-]_i > 100(7.2 \times 10^{-4}), \quad 0.243 + x \approx 0.243$$

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

$$7.2 \times 10^{-4} = \frac{x(0.243)}{0.133}$$

$$0.243x = 0.133(7.2 \times 10^{-4})$$

$$x = \frac{0.133(7.2 \times 10^{-4})}{0.243} = 3.94 \times 10^{-4} = [\text{H}_3\text{O}^+]$$

$$\text{pH} = -\log_{10}(3.94 \times 10^{-4}) = 3.40$$

