17.2 Buffers

How do they Resist Drastic pH Change – A Summary

1. Buffer : Buffer Acid + Buffer Base

Buffer Acid: a Weak Acid

Buffer Base: its Conjugate Base

$-H^+$

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

a) H_3O^+ : $H_3O^+ + \text{Buffer Base} = H_2O(l) + \text{Buffer Acid}$.

b) OH^- : $OH^- + \text{Buffer Acid} = H_2O(l) + \text{Buffer Base}$.

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How do they Resist Drastic pH Change

Buffer: 1M CH_3CO_2H / 1M $CH_3CO_2^-$
Addition of Strong Acid – H_3O^+

CH_3CO_2H / $CH_3CO_2^-$
Weak Acid — Conjugate Base
'Buff Acid' — 'Buffer Base'

$H_3O^+ + CH_3CO_2^- = H_2O(l) + CH_3CO_2H(aq)$
'Buffer Base' — 'Buffer Acid'

Overall Changes:

$[CH_3CO_2^-]$: ↓ ... Reacts with the added H_3O^+

$[CH_3CO_2H]$: ↑ ... Product of the reaction that removes the H_3O^+

$[H_3O^+]$: ↑ ... Slight increase ... the result of the ['Buffer Acid'] ↑

pH: ↓ ... From the slight increase in $[H_3O^+]$

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How do they Resist Drastic pH Change

Buffer: 1M CH_3CO_2H / 1M $CH_3CO_2^-$
Addition of Strong Base – OH^-

CH_3CO_2H / $CH_3CO_2^-$
Weak Acid — Conjugate Base
'Buffer Acid' — 'Buffer Base'

$OH^- + CH_3CO_2H(aq) = H_2O(l) + CH_3CO_2^-$
'Buffer Acid' — 'Buffer Base'

OVERALL CHANGES

$[CH_3CO_2H]$: ↓ ... Reacts with the added OH^-.

$[CH_3CO_2^-]$: ↑ ... Product of the reaction that removed OH^-

$[OH^-]$: ↑ ... Slight increase ... a result of the [Buffer Base] ↑

pH : ↑ ... From the slight increase in $[OH^-]$

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do they Resist Drastic pH Change

A buffer solution made from **HF** and **KF** has a pH = 2.84.
Addition of OH^- will cause –

a) Increase or Decrease significantly
b) Increase slightly
c) Decrease slightly
d) Increase
e) Decrease

a) pH  b) ✓ ... adding a base

b) [HF]  e) ✓ ... used in the removal of OH^-

$OH^- + HF(aq) = H_2O(l) + F^-$

'Buffer acid' 'Buffer base'

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Identifying Buffers

Which of the following aqueous solutions are good buffer systems?

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

2 To Look Out For:

1.) Strong Acid + Weak Base
2.) Weak Acid + Strong Base

} When the concentration of the Strong is < concentration of the Weak.

$$0.07\,M\ NaOH(aq) + 0.14\,M\ HF(aq) = H_2O(l) + NaF(aq)$$

0.07 M HF (aq) — Weak Acid

0.07 M NaF(aq) → 0.07 M Na^+ + 0.07 M F^- (Conjugate Base of HF(aq))