Problems of Acid–base equilibria: Buffer solutions

1) We prepare 128 mL of buffer solution 0.3 mol/L in acetic acid and 0.36 mol/L in sodium acetate.
a) Calculate the pH.
b) Calculate the pH and the pH change if 32 mL of 0.23 mol/L of sodium hydroxide solution is added to the buffer solution.
c) Calculate the pH and the pH change if the sodium hydroxide solution is added to 128 mL of pure water.
Data: $K_a = 1.80\times10^{-5}$.

2) We have 100 mL of buffer solution 0.07 mol/L in ammonia and 0.07 mol/L in ammonium chloride.
a) Calculate the pH.
b) Calculate the pH and the pH change when 25 mL of 0.04 mol/L of hydrochloric acid solution is added to the buffer solution.
c) Find out the pH and the pH change if the hydrochloric acid solution is added to 100 mL of pure water.
Data: $K_b = 1.80\times10^{-5}$.

3) A buffer solution has a concentration 0.26 mol/L in acetic acid and 0.24 mol/L in sodium acetate.
a) Calculate its pH.
b) Find out the pH and the pH change when 8 mL of 0.11 mol/L solution of sodium hydroxide is added to 32 mL of buffer solution.
Data: $K_a = 1.80\times10^{-5}$.

4) We have a buffer solution with a concentration 0.1 mol/L in ammonia and 0.1 mol/L in ammonium chloride.
a) Calculate the pH.
b) Calculate the pH and the pH change if 20 mL of 0.16 mol/L solution of hydrochloric acid is added to 115 mL of buffer solution.
Data: $K_b = 1.80\times10^{-5}$.

5) A buffer solution is 0.57 mol/L in acetic acid and 0.57 mol/L in sodium acetate.
a) Find out the pH.
b) Calculate the pH and the pH change if 19 mL of 0.24 mol/L solution of hydrochloric acid is added to 76 mL of buffer solution.
Data: $K_a = 1.80\times10^{-5}$.

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6) We have a buffer solution with a concentration 0.39 mol/L in ammonia and 0.41 mol/L in ammonium chloride.
a) Calculate the pH.
b) Find out the pH and the pH change when 22 mL of 0.39 mol/L solution of sodium hydroxide is added to 88 mL of buffer solution.
Data: $K_b = 1.80\times10^{-5}$.

7) We prepare 124 mL of buffer solution 0.68 mol/L in acetic acid and 0.66 mol/L in sodium acetate.
a) Find out the pH.
b) Calculate the pH and the pH change if 31 mL of 0.24 mol/L of sodium hydroxide solution is added to the buffer solution.
c) Find out the pH and the pH change if the sodium hydroxide solution is added to 124 mL of pure water.
Data: $K_a = 1.80\times10^{-5}$.

8) We prepare 116 mL of buffer solution 0.53 mol/L in ammonia and 0.53 mol/L in ammonium chloride.
a) Calculate the pH.
b) Find out the pH and the pH change when 29 mL of 0.26 mol/L of hydrochloric acid solution is added to the buffer solution.
c) Calculate the pH and the pH change if the hydrochloric acid solution is added to 116 mL of pure water.
Data: $K_b = 1.80\times10^{-5}$.

Answers:

1) **a)** pH = 4.824 **b)** pH = 4.981 ΔpH = 0.157 **c)** pH = 12.663 ΔpH = 5.663
2) **a)** pH = 9.255 **b)** pH = 9.13 ΔpH = –0.125 **c)** pH = 2.097 ΔpH = –4.903
3) **a)** pH = 4.71 **b)** pH = 4.806 ΔpH = 0.096
4) **a)** pH = 9.255 **b)** pH = 9.007 ΔpH = –0.248
5) **a)** pH = 4.745 **b)** pH = 4.653 ΔpH = –0.092
6) **a)** pH = 9.234 **b)** pH = 9.448 ΔpH = 0.215
7) **a)** pH = 4.732 **b)** pH = 4.81 ΔpH = 0.078 **c)** pH = 12.681 ΔpH = 5.681
8) **a)** pH = 9.255 **b)** pH = 9.148 ΔpH = –0.107 **c)** pH = 1.284 ΔpH = –5.716