

Exercise walk-through

4.4.2

Buffers, neutralisation and indicator choice

Pearson Edexcel · International A-Level · Chemistry

Find the temperature boundary

Your turn

$\Delta H = +36.0 \text{ kJ mol}^{-1}$; $\Delta S(\text{system}) = +120 \text{ J mol}^{-1} \text{ K}^{-1}$. Which condition gives positive total entropy?

- A. T below 300 K
- B. T above 300 K
- C. Every temperature
- D. No temperature

Buffer after neutralisation

Your turn

0.0100 mol HA receives 0.00400 mol OH^- . Which HA:A⁻ ratio enters the buffer expression?

- A. 10:4
- B. 6:4
- C. 4:6
- D. 10:6

Independent structural identification

Your turn

$\text{C}_3\text{H}_6\text{O}$ has two carbon-13 signals, gives iodoform and no Tollens' silver. Which structure fits?

- A. Propanal
- B. Propanone
- C. Propan-1-ol
- D. Ethanoic acid

Exercises 2.1·2.3

2.1 Write equations showing how an ethanoic acid/ethanoate buffer consumes added H^+ and OH^- . [2]

2.2 For $K_a = 2.00 \times 10^{-5}$, $[\text{HA}] = 0.100$ and $[\text{A}^-] = 0.200 \text{ mol dm}^{-3}$, calculate buffer pH. [3]

2.3 A titration has a steep region from pH 8.0 to 10.5. Indicator X changes at 3.1–4.4 and Y at 8.2–10.0. Select and justify. [2]

3 Exam-style questions

Exercises 2.1·2.3

2.1 Write equations showing how an ethanoic acid/ethanoate buffer consumes added H^+ and OH^- . [2]



2.2 For $K_a = 2.00 \times 10^{-5}$, $[\text{HA}] = 0.100$ and $[\text{A}^-] = 0.200 \text{ mol dm}^{-3}$, calculate buffer pH. [3]

2.2 $[\text{H}^+] = 2.00 \times 10^{-5}(0.100/0.200) = 1.00 \times 10^{-5} \text{ mol dm}^{-3}$; $\text{pH} = 5.00$.

2.3 A titration has a steep region from pH 8.0 to 10.5. Indicator X changes at 3.1–4.4 and Y at 8.2–10.0. Select and justify. [2]

3 Exam-style questions

2.3 Y; its transition lies within the steep region so a small titrant addition produces the endpoint colour change.

Exercises 3.1·3.3

3.1 0.0200 mol HA is mixed with 0.00500 mol NaOH. $K_a = 1.00 \times 10^{-5}$. Calculate the resulting buffer pH and explain the error in using initial moles of HA. [4]

3.2 25.0 cm³ of 0.100 mol dm⁻³ monoprotic HA receives 30.0 cm³ of 0.100 mol dm⁻³ NaOH at 298 K. Calculate pH using $K_w = 10^{-14}$. Explain why the buffer expression fails. [5]

3.3 Prepare 100.0 cm³ of a buffer with pH 5.00 using only 0.200 mol dm⁻³ HA and 0.200

Exercises 3.1-3.3

3.1 0.0200 mol HA is mixed with 0.00500 mol NaOH. $K_a = 1.00 \times 10^{-5}$. Calculate the resulting buffer pH and explain the error in using initial moles of HA. [4]

3.1 After reaction HA = 0.0150 mol and $A^- = 0.00500$ mol. $[H^+] = 10^{-5}(0.0150/0.00500) = 3.00 \times 10^{-5} \text{ mol dm}^{-3}$; pH = 4.52. OH^- has consumed HA and formed A^- , so initial acid moles are no longer the buffer numerator.

3.2 25.0 cm³ of 0.100 mol dm⁻³ monoprotic HA receives 30.0 cm³ of 0.100 mol dm⁻³ NaOH at 298 K. Calculate pH using $K_w = 10^{-14}$. Explain why the buffer expression fails. [5]

3.2 Acid 0.00250 mol, OH^- added 0.00300 mol; excess 0.000500 mol. $[OH^-] = 0.000500/0.00909 \text{ mol dm}^{-3}$. pOH = 2.04, pH = 11.96. HA is exhausted; an HA/ A^- buffer no longer exists.

3.3 Prepare 100.0 cm³ of a buffer with pH 5.00 using only 0.200 mol dm⁻³ HA and 0.200

3.3 $[H^+] = 10^{-5.00} = 1.00 \times 10^{-5} \text{ mol dm}^{-3}$. $[A^-]/[HA] = K_a/[H^+] = 1.80$. Equal stock