

Buffers, titration curves and indicators

AP Chemistry · Test

Name: _____ Date: _____ Class: _____ Mark: ____ / 20

Answer all questions. Show your working. A calculator is allowed. Use $K_w = 1.0 \times 10^{-14}$ and $pK_a(\text{CH}_3\text{COOH}) = 4.74$ unless the question gives other data.

Level: AP Chemistry · **Curriculum:** AP Chem Unit 8

Time: 45 minutes · 8 questions · Total: 20 marks · Calculator allowed

Question 1 Defining a buffer (2 marks)

Define a buffer solution and give one example of a suitable pair of substances. (2 marks)

Question 2 Buffer pH (3 marks)

A buffer contains 0.15 mol/dm^3 HF and 0.25 mol/dm^3 NaF. pK_a of HF = 3.17. Calculate its pH. (3 marks)

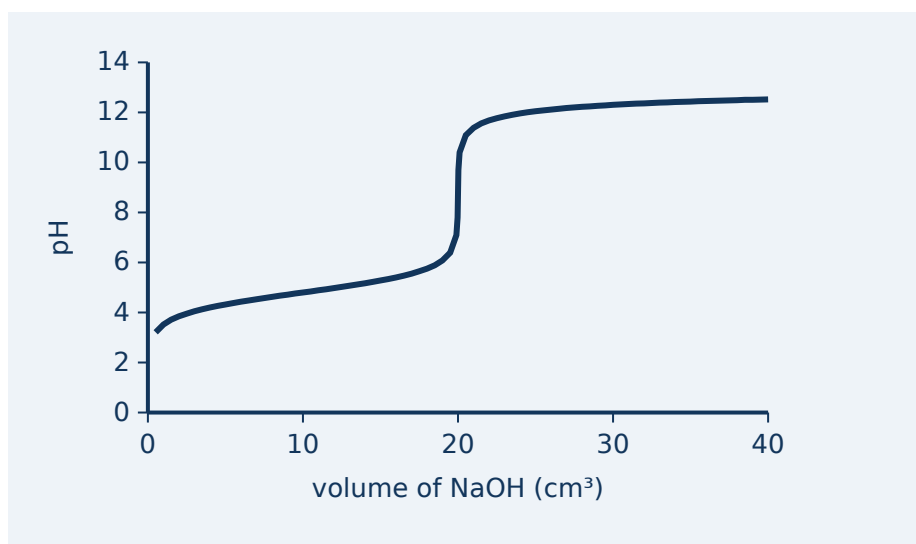
Question 3 Adding acid (3 marks)

A 500 cm^3 buffer contains 0.15 mol NH_3 and 0.20 mol NH_4Cl (pK_a of $\text{NH}_4^+ = 9.25$). Calculate the pH after 0.020 mol HCl is added. (3 marks)

Question 4 Effective range (2 marks)

Explain why a buffer works best when pH is within one unit of pK_a . (2 marks)

Question 5 Reading a titration curve (3 marks)



Titration curve of a weak monoprotic acid with NaOH.

The curve shows 20 cm³ of a weak acid titrated with NaOH.

- State the equivalence volume. (1 mark)
- Use the curve to state pK_a. (1 mark)
- Choose from methyl orange (3.1–4.4), bromothymol blue (6.0–7.6) and phenolphthalein (8.3–10.0) the best indicator. (1 mark)

Question 6 Strong acid titration (2 marks)

Calculate the volume of 0.100 mol/dm³ NaOH needed to neutralise 20.0 cm³ of 0.150 mol/dm³ HCl. (2 marks)

Question 7 Equivalence pH of HCN (3 marks)

25.0 cm³ of 0.200 mol/dm³ HCN ($K_a = 4.9 \times 10^{-10}$) is titrated with 0.200 mol/dm³ NaOH. Calculate the pH at equivalence and explain why it is above 7. (3 marks)

Question 8 Not a buffer (2 marks)

Explain why a mixture of HCl and NaCl cannot act as a buffer. (2 marks)