

8.8 Properties of Buffers

Name: _____ Class: _____ Date: _____

Total: 9 marks

KEY WORDS acid 酸 • buffer 缓冲溶液 • pH 值 • base 碱 • conjugate base 共轭碱

Objective

Build the skills to answer exam questions on the **properties of buffers**.

You must be able to:

- explain why a buffer works best when $[HA] \approx [A^-]$
- state that a buffer's pH is near its pK_a
- choose an acid for a target buffer pH

1 Worked examples

Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

■ A buffer's pH is near its pK_a

A buffer's pH is set by the acid's pK_a and the ratio of base to acid. When $[A^-] = [HA]$, the ratio is 1 and $pH = pK_a$.

■ Best buffering near pK_a

A buffer resists change best when it has **plenty of both** members and they are **comparable** in amount — near a 1:1 ratio, i.e. near $pH = pK_a$.

■ Choosing the acid

To make a buffer at a target pH, pick a weak acid whose pK_a is **close to** that pH (within about ± 1). For a pH-5 buffer, choose an acid with $pK_a \approx 5$ (like acetic acid, $pK_a = 4.7$).

■ Range

A buffer is effective roughly within $pK_a \pm 1$; outside that range one component is nearly used up.

2 Practice

Now apply the methods above.

2.1 When $[HA] = [A^-]$, the pH equals what? [1]2.2 To make a buffer at pH 9, what pK_a should the acid have? [1]

2.3 Over what pH range is a buffer effective? [1]

3 Exam-style questions

3.1 A buffer works best when the acid and its conjugate base are [1]

A	B
C	D

A in very different amounts

B in comparable amounts

C both absent

D both strong

3.2 You need a buffer at pH 4.5. Available acids: formic ($pK_a = 3.7$), acetic ($pK_a = 4.7$), and hypochlorous ($pK_a = 7.5$).

(a) Which is the best choice? [1]

(b) Justify your choice. [2]

3.3 Explain why a buffer loses its effectiveness far from its pK_a . [2]