8.7 pH and pKa

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

KEY WORDS acid • ph pH • base • weak acid • conjugate base

Objective

Build the skills to answer exam questions on **pH and pKa** – comparing acid strengths.

You must be able to:

- use $\mathrm{p}K_a = -\log K_a$
- rank acids by K_a or $\mathrm{p}K_a$ (smaller $\mathrm{p}K_a$ = stronger)
- relate $\mathrm{p}K_a$ to the pH where an acid is half-ionized

1 Key knowledge and 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.

pKa

$$\mathrm{p}K_a = -\log K_a.$$

A **larger** K_a (stronger acid) gives a **smaller** $\mathrm{p}K_a$.

Ranking acids

A stronger acid has a bigger K_a and a **smaller** $\mathrm{p}K_a$. So acid X ($\mathrm{p}K_a = 3$) is stronger than acid Y ($\mathrm{p}K_a = 5$).

pKa and half-ionization

At pH = $\mathrm{p}K_a$, the acid is **half-ionized** ($[\mathrm{HA}] = [\mathrm{A}^-]$). Below that pH the acid form dominates; above it, the conjugate base dominates.

A worked conversion

$K_a = 1.8 \times 10^{-5}$ gives $\mathrm{p}K_a = -\log(1.8 \times 10^{-5}) = 4.74$. Reverse: $\mathrm{p}K_a = 3$ gives $K_a = 10^{-3}$.

2 Practice

Now apply the methods above.

2.1 Find pK_a for $K_a = 1 \times 10^{-4}$. [1]

2.2 Acid A has $pK_a = 2$, acid B has $pK_a = 6$. Which is stronger? [1]

2.3 At what pH is a weak acid half-ionized? [1]

3 Exam-style questions

3.1 A stronger acid has a [1]

- ☐ **A** larger pK_a
- **B** smaller pK_a
- **C** pK_a of exactly 7
- **D** negative K_a

3.2 Three acids have K_a values 1×10^{-3}, 1×10^{-5}, and 1×10^{-9}.

(a) Find each pK_a. [2]

(b) Rank the acids from strongest to weakest. [2]

3.3 An acid has $pK_a = 4.2$. Below pH 4.2, which form (acid or conjugate base) dominates? Explain. [2]