Marks
3

- Above what concentration of H_3O^+ is a solution considered to be acidic at 25 °C?

Neutral at 25 °C corresponds to $[H_3O^+(aq)] = 10^{-7}$ M and pH = 7.0. Acidic solutions have pH < 7.0 and $[H_3O^+(aq)] > 10^{-7}$ M

Answer: **10^{-7} M**

At 95 °C the auto ionisation constant of water, K_w, is 45.7×10^{-14}. What is the pH of a neutral solution at 95 °C?

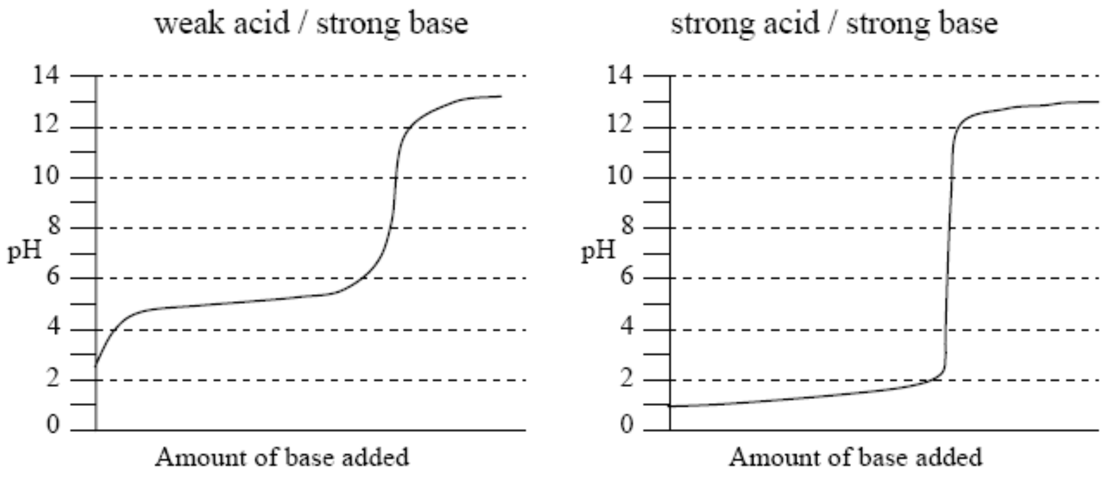
K_w refers to the auto ionisation reaction, $2H_2O(l) \rightleftharpoons H_3O^+(aq) + OH^-(aq)$ so that $K_w = [H_3O^+(aq)][OH^-(aq)]$. As the solution is neutral, $[H_3O^+(aq)] = [OH^-(aq)]$. Hence:

$$K_w = [H_3O^+(aq)][OH^-(aq)] = [H_3O^+(aq)]^2 = 45.7 \times 10^{-14}$$
$$[H_3O^+(aq)] = 6.76 \times 10^{-7} \text{ M}$$
$$\text{pH} = -\log_{10}[H_3O^+(aq)] = -\log_{10}(6.76 \times 10^{-7}) = 6.17$$

pH = **6.17**

Marks 7

- The titration curves for a titration of a weak acid with a strong base and for a strong acid with a strong base are distinctly different. Draw a diagram for each case.



List the main differences.

(i) **The initial starting pH is higher for the weak acid than for the strong acid.**

(ii) **The equivalence point, where the moles of added base is the same as the initial moles of acid, is at pH = 7 for the strong acid/strong base case but it is at pH >7 for the weak acid/strong base.**

(iii) **The weak acid/strong base curve has an inflexion point at the half equivalence point. No such point is seen on the strong base/strong acid curve.**

Explain these differences.

(i) **This is because the strong acid dissociates completely but the weak acid dissociates only to a small extent. Thus, assuming equal concentrations of strong and weak acid, $[H_3O(aq)]^+$ is thus larger for the strong acid and the pH is lower.**

(ii) **At the equivalence point, the conjugate base of the acid is present. For the strong acid, the conjugate base is an extremely weak base and the solution is neutral. For the weak acid, the conjugate base is a weak base and the solution thus has pH > 7.**

(iii) **At the half-equivalence point, the weak acid and its conjugate base have equal concentrations and the pH is equal to pK_a. as given by the Henderson-Hasselbalch equation. This is the point of maximum buffering so that addition of extra base has limited effect on the pH.**

ANSWER CONTINUES ON THE NEXT PAGE

- What is the difference between the 'end point' and the 'equivalence point' in a titration. 2

The end point is the first permanent change of the indicator – it is when you see that the reaction has finished.

The equivalence point is when the stoichiometrically correct amount of reactant has been added.