Marks

- Tris(hydroxymethyl)aminomethane is commonly used to make buffer solutions. It has a base ionisation constant of 1.26×10^{-6}. What is the pH of a 0.05 M aqueous solution of this compound? **3**

The base ionization constant refers to the reaction below for which the reaction table is:

	tris	+ H_2O	$\rightleftharpoons$	trisH$^+$	OH$^-$
Initial	**0.05**			**0**	**0**
Change	**-x**			**+x**	**+x**
Equilibrium	**0.05 - x**			**x**	**x**

As pK_b = -log$_{10}K_b$, at equilibrium,

$$K_b = \frac{[\text{trisH}^+][\text{OH}^-]}{[\text{tris}]} = \frac{(x)(x)}{(0.05-x)} = \frac{x^2}{(0.05-x)} = 1.26 \times 10^{-6}$$

As K_b is so small, x will be tiny and 0.05 – x ~ 0.05 and so

$x^2 = 1.26 \times 10^{-6} \times 0.05$ or $x = [OH^-] = 2.5 \times 10^{-4}$ M

Hence, pOH = -log$_{10}[OH^-]$ = -log$_{10}(2.5 \times 10^{-4})$ = 3.60 and so:

pH = 14.00 – pOH = 10.4

Answer: **10.4**

- The ionisation constant of water, K_w, at 37 °C is 2.42×10^{-14}. What is the pH for a neutral solution at 37 °C? **1**

By definition, $K_w = [H^+(aq)][OH^-(aq)]$. Water ionizes to produce equal amounts of H^+(aq) and OH^-(aq). Let $[H^+(aq)] = [OH^-(aq)] = y$:

$K_w = (y)(y) = y^2 = 2.42 \times 10^{-14}$

$y = 1.56 \times 10^{-7}$ M = $[H^+(aq)]$

pH = -log$_{10}[H^+(aq)]$ = -log$_{10}(1.56 \times 10^{-7})$ = 6.81

Answer: **6.81**