- What is the pH of a 0.010 M solution of $Ca(OH)_2$?

Marks 2

$Ca(OH)_2$ is a strong base and dissociates completely according to the equation:

$Ca(OH)_2(aq) \rightarrow Ca^{2+}(aq) + 2OH^-(aq)$

A 0.010 M solution therefore has $[OH^-(aq)] = 0.020$ M and

$pOH = -\log_{10}([OH^-(aq)]) = -\log_{10}(0.020) = 1.70$

As pH + pOH = 14.00, pH = (14.00 – 1.70) = 12.30

pH = **12.30**

- What is the pH of a 0.010 M solution of HNO_2? The pK_a of HNO_2 is 3.15.

2

Nitrous acid is a weak acid so $[H_3O^+]$ must again be calculated:

	$HNO_2(aq)$	$H_2O(l)$	$\rightleftharpoons$	$H_3O^+(aq)$	$NO_2^-(aq)$
initial	**0.010**	**large**		**0**	**0**
change	**$-x$**	**negligible**		**$+x$**	**$+x$**
final	**$0.010 - x$**	**large**		**x**	**x**

The equilibrium constant K_a is given by:

$$K_a = \frac{[H_3O^+][NO_2^-]}{[HNO_2]} = \frac{x^2}{0.010 - x}$$

As $K_a = 10^{-3.15}$ is very small, $0.010 - x \sim 0.010$ and hence:

$x^2 = 0.010 \times 10^{-3.15}$ or $x = 2.66 \times 10^{-3}$ M $= [H_3O^+(aq)]$

Hence, the pH is given by:

$pH = -\log_{10}[H_3O^+(aq)] = -\log_{10}[(2.66 \times 10^{-3})] = 2.58$

pH = **2.58**

ANSWER CONTINUES ON THE NEXT PAGE

- What is the pH of a solution that is 0.020 M in CH_3COOH and 0.010 M in $CH_3CO_2^-$? The K_a of CH_3COOH is 1.8×10^{-5} M. **2**

The solution contains a mixture of a weak acid (CH_3COOH) and its conjugate base (CH_3COO^-) so acts as a buffer and the Henderson-Hasselbalch equation can be used:

$$\mathbf{pH = pK_a + \log_{10}\left(\frac{[base]}{[acid]}\right)}$$

with [base] = [CH_3COO^-(aq)] and [acid] = [CH_3COOH(aq)].

As $K_a = 1.8 \times 10^{-5}$, $pK_a = -\log_{10}K_a = -\log_{10}(1.8 \times 10^{-5}) = 4.74$.

Hence:

$$\mathbf{pH = 4.74 + \log_{10}\left(\frac{[0.010]}{[0.020]}\right) = 4.44}$$

pH = **4.44**